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RIVERBANK EROSION AND ASSESSMENT OF ECONOMIC LIVES OF ENVIRONMENTAL REFUGEES: A CASE STUDY OF GANGETIC RIVERINE TRACT IN MALDA DISTRICT OF WEST BENGAL, INDIA

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Abstract

The Ganges River exhibits dynamic channel shifting, characterised by relentless bank erosion, particularly along its Left Bank (LB), in the Malda district of West Bengal, over the past few decades. This has led to large-scale land loss, the displacement of riverine communities, and the socio-economic challenges they face. The present study focuses on the Left Bank shifting of the Ganges in the district and investigates the economic impacts on internally displaced persons (IDPs), referred to as Environmental Refugees. The research uses a mixed-method approach, blending quantitative and qualitative methods. Primary data are collected using the Household Survey Method, which involves administering a questionnaire, along with Key Informant Interviews and Focus Group Discussions. Satellite images are analysed to estimate the extent of shifting of the LB of the Ganges and the resulting human displacement. Descriptive statistics, Karl Pearson's correlation coefficient, scatter diagrams, and cartographic techniques have been applied to identify how Ganges Left Bank erosion and the resulting shifting are intricately linked to the economic conditions of the displaced population, rendering them economically marginalised and vulnerable to natural disasters. The findings of the research reveal that the continuous eastward shifting of the Ganges has swallowed thousands of acres of highly fertile and productive land, hundreds of inhabited villages, and has compelled the displacement of lakhs of people in the study area. The loss of highly productive agricultural land, jobs, and business establishments has made the lives of IDPs uncertain and their livelihoods highly vulnerable. The study highlights that recurrent riverbank erosion exacerbates socio-economic vulnerability in the riverine tract of Malda district. IDPs are facing multi-dimensional socio-economic challenges that lead to deprivation, destitution, delicacy, and entrenched poverty. Urgent development and deployment of sustainable rehabilitation initiatives and riverbank erosion control strategies are needed to mitigate further human displacement and socio-economic marginalisation.

Keywords: Riverbank, Vulnerability, Environmental Refugees, Resettlement, Migration

1. Introduction

Considering the gravity of displacement due to natural hazards at the global level, the United Nations High Commission for Refugees (2010) provided the definition and conceptual framework of 'Refugee', but did not mention the term 'Environmental or Ecological Refugee' as such. Though the term 'Environmental Refugee' (ER) was first used by Lester Brown of the World Watch Institute in the 1970s, Hinnawi first provided a formal definition of the term 'Environmental Refugee' (Morrissey, 2009). El-Hinnawi (1985) first defined the term Environmental as “those people who have been forced to leave their traditional habitat, temporarily or permanently, because of a marked environmental disruption (natural and/or triggered by people) that jeopardised their existence and/or seriously affected the quality of their life”. ‘Environmental disruption’ in this definition means any physical, chemical and/or biological changes in the ecosystem (or the resource base) that render it, temporarily or permanently, unsuitable to support human life”. The natural, socio-economic, and cultural environmental degradation are a serious issues for the ERs in the affected areas. The quality of life of the refugees gets affected, and they also affect the life of the native dwellers of the concerned receiving areas (El-Hinnawi, 1985).

According to Myers (1997), most of the ERs belong to environmentally hostile regions for human habitation. The ERs have become a global problem in recent years. Many environmental factors and natural disasters in the form of soil erosion, drought, deforestation, desertification, water shortages, climate change, floods, cyclones, storms, and surges may cause the homelessness of many people and resultant ER. It was estimated by Myers (1997, 2001) that worldwide there would be around 50 million ERs in 2010, and he further estimated that there would be approximately 200 million ERs by 2050. Natural, anthropogenic, and human-induced disasters produced a huge number of ERs at the global level. The phenomena of ERs may involve temporary or permanent displacement of people from their own habitats (Bates, 2002). The environmental disaster-induced human displacement is a growing global phenomenon. Environmentally induced hazards such as cyclones, hurricanes, tornadoes, and floods made the land inhospitable for human habitation, and people are very often forced to leave their own habitats (Peters, 2011). As stated by the Global Report on Internal Displacement, published by the Internal Displacement Monitoring Centre (2023), at the end of 2022, there were 71.1 million internally displaced persons (IDPs) at the global level due to conflicts and disasters. The Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6, 2022) confirms that climate-induced fluvial hazards, including riverbank erosion, are one of the leading drivers of internal displacement in South Asian countries, where India and Bangladesh are identified as critical hotspots. The average rate of climate-induced migration and displacement is more than 20 million people each year globally (IPCC et al., 2022). Thousands of people become victims because of riverbank erosion, and the riverine people lose their fertile agricultural land and habitats. Ultimately, they become landless as well as homeless. Thousands of people have been displaced in the Brahmaputra-Jamuna floodplain of Bangladesh due to riverbank erosion (Zaman, 1991). Natural and man-made environmental disruptions may cause the displacement of people throughout the world.

Hence, there may be a number of reasons behind the occurrence of ERs. Paul (2005) mentioned that North-Central Bangladesh was extremely affected by the Tornado of 2004 which took a heavy toll of lives and destroyed businesses, standing crops, livestock etc., but simultaneously he tried to show that all disasters do not create ERs if the authorities provide appropriate aid on an emergency basis and take proper steps to mitigate the problems of disaster affected areas. As projected by the Groundswell Report, Part II, on internal climate migration, the number of climate-induced migrants in the world could reach 216.1 million by 2050, with 40.5 million primarily in the riverine tracts and deltaic regions in South Asia (Clement et al., 2021). Riverbank erosion has become a serious natural hazard, particularly for those who reside close to riverbanks, which are vulnerable to erosion nearly every year. It has been seen that a large number of people are displaced due to riverbank erosion throughout India and face different types of socio-economic problems (Das et al., 2014). From the pertinent existing literature, it is observed that millions of people have been displaced and become ERs throughout the world due to various man-made and natural hazards, including riverbank erosion. In the last few decades, the Malda district of West Bengal has witnessed the problems of ERs due to the massive LBE of the Ganges. The riverbank erosion-induced ERs are facing severe socio-economic problems and are becoming vulnerable to further environmental disasters. Thakur et al. (2012) studied the bank erosion hazards of the Ganges upstream of the Farakka Barrage up to the Rajmahal Hill, i.e., the riverine tract of the Ganges of Malda district and traced the socio-economic effects of it. Thus, it is observed that several researchers have attempted to study the severity of bank erosion of the Ganges and the resultant effects, but no one has raised the issues of ERs, which are exclusively produced by the LBE of the Ganges in Malda District. Most of the studies regarding the bank erosion in the study area are date back. But this erosion has again revived since 2018, and it has become severe in some areas in the study area. Thus, the main objective of this paper is to highlight the shifting of the LB of the Ganges and the resultant socio-economic hardships of the displaced people in the study area.

Earlier researchers (Thakur et al., 2012; Rudra, 2009) have mostly described the geomorphic dynamics and the extent of LBE of the Ganges upstream of the Farakka Barrage, but these works are largely dated back and focus more on physical processes rather than on the specific economic challenges and other human dimensions of the repeated displacement.

Moreover, the study area has faced large-scale displacement due to renewed LBE and the accelerated eastward shifting of the Ganges, which is not officially documented. Existing studies seldom address the economic trajectories of IDP-households, how displaced people rebuild lives and livelihoods, and cope with repeated relocation. Hence, this study fills a critical gap by focusing on the economic challenges of these displaced people living in one of the most erosion-prone districts of India.

This study is conceptualised on the basic premise that riverbank erosion is a dynamic geomorphological process that triggers multiple socio-economic vulnerabilities

among stable riverine populations. In the riverine tract of the Ganges in Malda district, repeatedly severe left bank erosion (LBE) occurs due to a host of hydro-geomorphologic factors such as high monsoonal discharge, heavy deposition of sediment, channel shifting, and human interventions (notably construction of Farakka Barrage), resulting in eastward migration of the Ganges.

The outcomes of this physical process are the direct loss of productive assets, including fertile agricultural land, orchards, infrastructure, business establishments, common property resources, and, above all, homesteads. Riverbank erosion-induced loss of movable and immovable properties leads to forced displacement, often internal displacement, multiple times. Affected communities are compelled to resettle mostly on fragile lands such as char lands, retired embankments, PWD lands and roadsides, or other insecure places, without legal land tenure. The internally displaced persons (IDPs) become ERs who suddenly lose their livelihoods, economic viability, and social security, and become environmentally vulnerable within their own homeland. These IDPs experience rising unemployment, declining income, and increasing dependence towards informal, insecure, and precarious migration-driven occupations. Most of the workforce is bound to migrate to distant, unknown, and insecure places. These migrant workers are low-paid, and sometimes even unpaid. This substantial transformation of occupational type and structures increases exposure to physical exploitation, socio-economic marginalisation, and health risks.

The prolonged economic crisis produces multi-dimensional socio-economic fragilities, such as poverty, indebtedness, food insecurity, malnutrition, poor housing and infrastructures, limited access to health and educational facilities, and reduced adaptability. Thus, this framework conceptualises riverbank erosion as a very pivotal and continuous process, in which river dynamics interact with administrative failures and socio-economic fragility to reshape the livelihoods of ERs. The framework also demonstrates that without effective and successful erosion control measures, an inclusive policy of rehabilitation, and effective livelihood restoration, the displaced people remain trapped in a vicious cycle of economic insecurity and environmental risk **(Figure 1).**

The objectives of this study to examine the impacts of the continuous LBE of the Ganges on the socio-economic and livelihood of IDP households, referred to as Environmental Refugees (ERs). Identify and address the existing research gap on the severe LBE of the Ganges in Malda district and try to understand why and how this erosion makes the riverine people long–term economically vulnerable communities despite decades of the government's interventions.

2. Study Area

Malda district, the connecting district between North Bengal and South Bengal of India, has been selected as the study area for the present study. With a geographical area of 3733 km^2 (1,441.6 sq. miles) and a population of 3988845, the district ranked 12th

position in terms of area and 11th position in terms of population size in the state (Census of India, 2011). Because of physiographic diversity, the district has three distinctive physiographic divisions, i.e. *Tal*, *Barind* and *Diara*. The northern portion of the district, bounded by the Mahananda and Kalindri River, is known as the *Tal* region, while the eastern part of the district, i.e., the eastern margin of the Mahananda River, is called the *Barind* region. This is basically the upland zone of the district. The south-western part, transitional zone between the marshy *Tal* tract and the *Barind* upland, is known as *Diara*, which is made of highly fertile alluvial soil formed by the Ganges and its tributaries and distributaries. Of the three regions, Diara is bestowed with highly fertile alluvial soil.

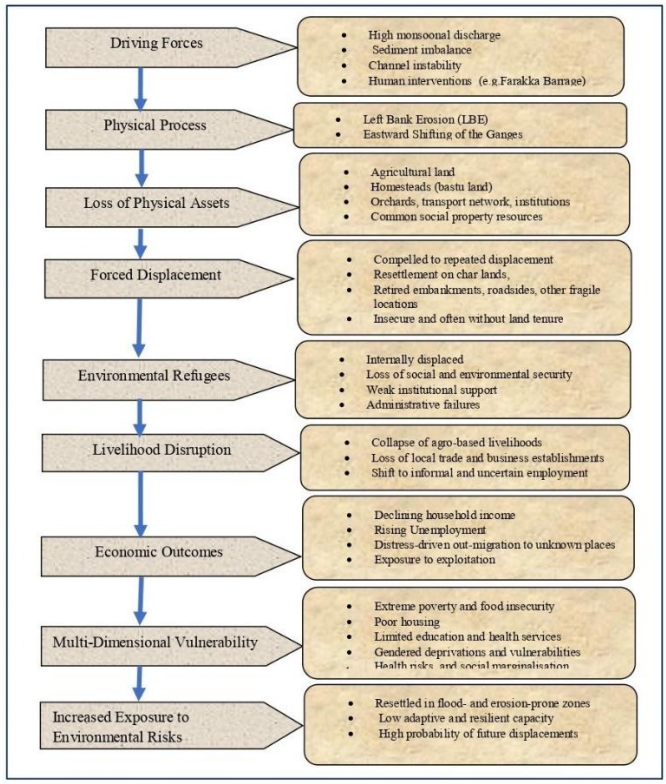


Figure 1: Conceptual Framework of Riverbank Erosion-Induced Impacts on the Economic Lives of the Environmental Refugees

This region is agriculturally prosperous, and most of the working people are engaged in agricultural activities. Opportunities for prosperous agricultural activities and other livelihood opportunities make this region thickly populated. But unfortunately, this region is facing a severe recurring environmental disaster in the form of severe floods and riverbank erosion, which is caused mainly by the river Ganges. This erosion of the Ganges poses a serious problem to the riverine people in the district, mainly Manikchak and Kaliachak-II C.D. Block, and hence these two Blocks have been selected as the study area **(Figure 2)**. A large population has been displaced, and many of them have become

refugees in their own homeland due to this disaster. In fact, both the authors of this paper are native people of this disaster-affected area and have even gone through the sufferings with these refugees. Hence, as co-inhabitants and co-sufferers, this particular aspect of research has been considered to bring the attention of all policymakers to mitigate the sufferings of these refugees.

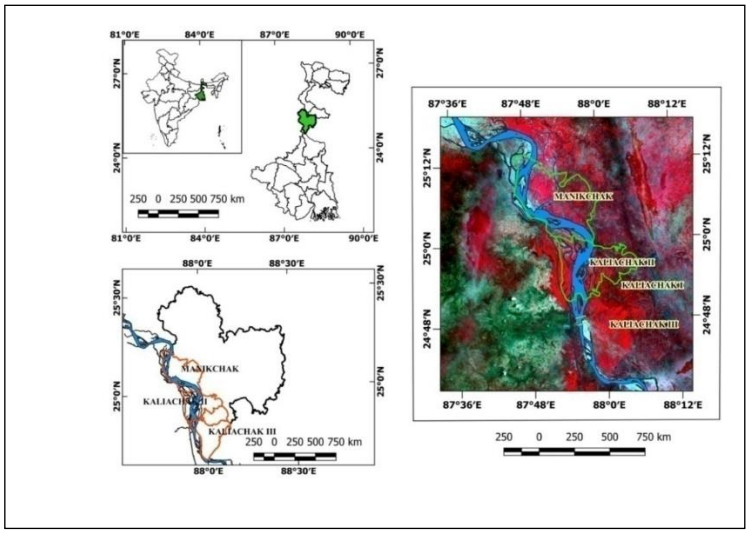


Figure 2: Study area location in Malda district, West Bengal, India.

3. Materials and Methods

3.1 Database

The study is empirical in nature, which is based on both primary and secondary sources of data. The primary data have been collected through field surveys using structured and pre-tested survey questionnaires, KII and FGDs. The secondary data have been obtained from different published and unpublished sources such as the District Census Handbook, District Human Development Report, national and international reputed journals, project reports, and PhD theses, etc. The satellite images have been used for assessing the shifting courses of the Ganges from 1973 to 2023 **(Table 1).** The Mouza (revenue villages) maps and Google Earth images have been analysed for a better understanding of the present location of the riverine tract of the Ganges in the study area.

3.2 Sampling Techniques, Sample Size and Data Collection Procedures

As such, Manikchak, English Bazar, Kaliachak-I, Kaliachak-II and Kaliachak-III C.D. blocks comprise riverine tracts of the Ganges in Malda district. Through analysing satellite images, it becomes evident that Manikchak and Kaliachak-II are the most flood-induced riverbank erosion-affected areas by the Ganges. Hence, samples for the present study are drawn from these two severely affected blocks by riverine erosion and shifting of the river

course of the Ganges. In this study, 'ERs' are defined as people who have been displaced (at least once during 1973-2023) and resettled along the LB and *charlands* of the Ganges as a consequence of having lost their homes and agricultural lands due to riverbank erosion. Stratified random sampling (SRS) technique has been adopted for carrying out this research work. For the Household Survey (HHS), Internally Displaced Household (IDH) is divided into three groups based on the distance between the present LB of the Ganges and resettled households, which are as follows:

Group I: Households resettled within 500 metres of the riverbank,

Group II: Households resettled between 500 metres and 1 km from the riverbank, and

Group III: Households resettled more than 1 km from the riverbank.

Table 1. Particulars of the satellite images used

Date	Satellite and Sensor	Spatial Resolution (m)	Source
1973	Landsat-MSS	57	USGS
1977	Landsat-MSS	57	USGS
1980	Landsat-MSS	57	USGS
1987	Landsat-TM	30	USGS
1992	Landsat-TM	30	USGS
2000	Landsat-TM	30	USGS
2015	Landsat-OLI/TIRS	30	USGS
2023	Landsat-OLI/TIRS	30	USGS

A well-structured survey schedule comprising both closed and open-ended questions has been used for carrying out door-to-door household survey for the collection of first-hand information from the sampled households. Before finalisation of the survey schedule, a pilot survey was conducted in the study area to remove unwanted errors. Taking an equal number of samples from each selected C.D. block (50 from each block), as many as 100 households were surveyed in the month of October-November 2022 and 2023 (post-monsoon situation). The heads of the households were interviewed, of which 70 % male and 30% female, aged 45 years and above, formed the respondents**.** Only those households were selected as sample households which were displaced at least once during 1973 to 2023 due to the LBE of the Ganges and at present do not have legal ownership of their residential land. Out of 100 surveyed households, 50 % were from Group I, 25 % from both Group II and Group III each, but all were IDH. Besides the HH Survey, Observation method, FGD, and KII methods have been applied to gather quantitative and qualitative information to perceive the ground reality of the riverine people of the study area.

Although more than 80,000 households have been displaced due to the erosion in the study area, a total of 100 IDP households have been selected for detailed socio-economic investigation. The drawn sample size is considered sufficient and statistically reliable for several reasons.

First, the decision to select 100 displaced households as the sample size for the present study was guided by methodological considerations. The sample has been drawn by applying a stratified random sampling only from the erosion-induced IDP households belonging to diverse economic and social groups, ranging from small to large farmers, landless labourers, small traders, government employees, fishermen, migrant labourers, etc., from multiple pockets of the affected regions to ensure the representativeness of the sample households. For the determination of sample size, Cochran's (1977) sampling techniques have been followed.

$$n_0 = \frac{Z^2.\mathrm{p.q}}{e^2}$$ (Applicable for the unknown or large population size)

where,

n_0 denotes the initial sample size, z denotes the z-score (based on the level of confidence), p denotes the estimated proportion of the population with attributes, q=1-p is the proportion without the attribute, while e denotes the desired margin of error

Here, the exact displaced population is unknown

z=1.96 at 95% level of confidence

p=0.5 → q=0.5 (used in case of unknown population)

e= .10 (selected precision level)

Substitute the values in the formula, i.e.

$z^2 = 1.96^2 = 3.8416$,

p × q = 0.5 × 0.5 = 0.25

Multiply, 3.8416 × 0.25=0.9604

Divide by $e^2 = .10^2 = 0.01$

n_0= (0.9604/0.01) =96.04 (sample size selected 100 as a round figure)

Second, the IDP households have been selected through stratified random sampling (SRS) from two of the most severely affected C.D. blocks, i.e. Manikchak and Kaliachak-II in the district, to ensure spatial diversity and true representation across six villages from three displacement-distance categories from the riverbank. This stratification allowed balanced representation of the displaced households with varying magnitudes of exposure to erosion-induced economic distress and resettlement stress.

Third, some practical constraints, such as fragmented settlements, limited accessibility to the erosion-affected villages and destruction of roads by erosion, made larger sample surveys practically very difficult. The 100-IDP sampled household, therefore,

strikes a good balance between feasibility and analytical reliability, which enables the use of descriptive statistics and correlation analysis to validate the patterns observed in the field.

Finally, the existing studies (Biswas & Anwaruzzaman, 2019 & Kaiser, 2023) focused on the riverbank erosion-induced displacement in Malda district and adjacent regions have relied on household samples ranging from 80 to 100 to draw the pattern of demographic and socio-economic consequences.

The sample respondents were brought to a common place to have a 'Focus Group Discussion' to get in-depth information on different aspects of the impacts of LBE and the resultant eastward shifting of the Ganges on the lives and livelihoods of the dwellers having various occupations in the region. Key Informants (KI) such as social activists, leaders of the *Bastuhara Committee*, *Ganga Bhangan Protirodh Action Nagorik Committee*, teachers, professors, village representatives, and other learned and well-informed people residing there are interviewed deeply to get the actual sense of loss of properties, educational institutes, medical infrastructures, business and industrial setup, and to assess the magnitude of impacts on the ecological refugees. Being native inhabitants of the LB of the Ganges, the authors are helpless witnesses to this flood-induced massive erosion almost every year and the resultant loss of properties, distressed lives, and livelihoods of the riverine people. Despite this, the authors have physically investigated erosion-affected areas multiple times to know the present location and entire course of the Ganges in the district and the whole situation of the dislocated people who are still fighting with this natural disaster for their survival.

The collected data from both primary and secondary sources have been arranged systematically, and selected descriptive statistics, Karl Pearson's Correlation Coefficient method, as well as some pertinent cartograms such as Scatter Diagram, Pie-graph, Bar Graphs, tables, and charts have been drawn using MS Excel and MS Word. QGIS and SPSS software have also been used for better quantitative, cartographic, and diagrammatic representations.

4. Results and Discussions

4.1 Shifting of the Left Bank of the Ganges in the Study Area during 1973-2023

Riverbank erosion and resultant shifting of its course is a very common fluvial geomorphologic phenomenon that shapes the riverine landscape and channel morphology of the concerned river. This section mainly focuses on the extent of bank erosion and channel shifting of the Ganges in the study area during the period 1973-2023.

According to the Key Informants of the study area, the bank line between Manikchak Ghat and upstream of Farakka Barrage was subjected to severe bank erosion from 1973 to 2020, but the rate of erosion and resultant eastward shifting in the Diara region was not uniform. During 1994-1998, Manikchak Ghat to Gopalpur, Gopalpur to Panchanandapur, and Panchanandapur to Laskarpur faced a rapid phase of bank failure.

Dharampur, Gopalpur, and Panchanandapur again underwent a rapid phase of bank failure intermittently during the period between 2002 and 2005. Up to 1990, a total of 35 inhabited villages were engulfed by the Ganges, while 18 villages were lost during 1990-2005 (Thakur et al., 2012).

Table 2. Left bank erosion (LBE) of the Ganges in Malda District

Year	Total length affected (km)	Maximum width of erosion (m)	Approx. loss of land (Hectares)
1931 to1978	-	-	14,335
1979	5	200	60
1980	7	150	105
1981	11	400	260
1982	5	150	65
1983	5	200	90
1984	7	100	70
1985	6	150	90
1986	6	200	105
1987	8	300	240
1988	7	100	70
1989	10	150	150
1990	8	200	160
1991	11	150	170
1992	9	150	130
1993	7	200	145
1994	7	1250	160
1995	8	200	145
1996	15	250	310
1997	6	100	60
1998	10	900	330

Source: Compiled by the authors based on “Erosion problems of the river Ganga in the districts of Malda and Murshidabad in West Bengal,” by P. K. Parua, 1999, *Bi-monthly Technical Journal of American Society of Civil Engineers - Indian Section, 13*(2), as cited in *A report on the impact of the Farakka Barrage on the human fabric* (p. 26), by M. Banerjee, 1999, South Asia Network on Dams, Rivers and People.

Table 2 vividly illustrates the continuous intensification of LBE of the Ganges in Malda District, revealing a pattern of episodic devastating riverbank failure and lateral shifting of the Ganges over time. The staggering loss of 14,335 hectares of land loss confirms the prolonged severity of the problem, while subsequent years indicate an intensifying variability of lateral expansion and volumetric land erosion. The mid-1990s were a critical phase of lateral shifting, and 1996 and 1998 emerged as peak disaster years with huge land losses of 310 hectares and 330 hectares, respectively. The extreme surge of

lateral erosion of 1,250 metres in 1994 indicates episodic channel aggression and large-scale riverbank retreat. Overall, the data depict that the Ganges is one of the highly dynamic and destructive river systems in India, particularly in Malda, where recurrent bank collapses have not only modified the physical landscape but also intensified the vulnerability of human settlements and agrarian livelihoods over the successive decades.

During the field survey in the months of October-November 2022 and 2023, the researchers observed that the Ganges has continued severe bank erosion at Uttar Hukumat Tola of Gopalpur Mouza (revenue village) in the form of block slide and block slumping, etc. Due to the eastward shifting of the course, the Ganges engulfed thousands of acres of fertile land in the *Diara* region and took a mighty bend in its course between Manikchak Ghat and Panchanandapur **(Figure 3).**

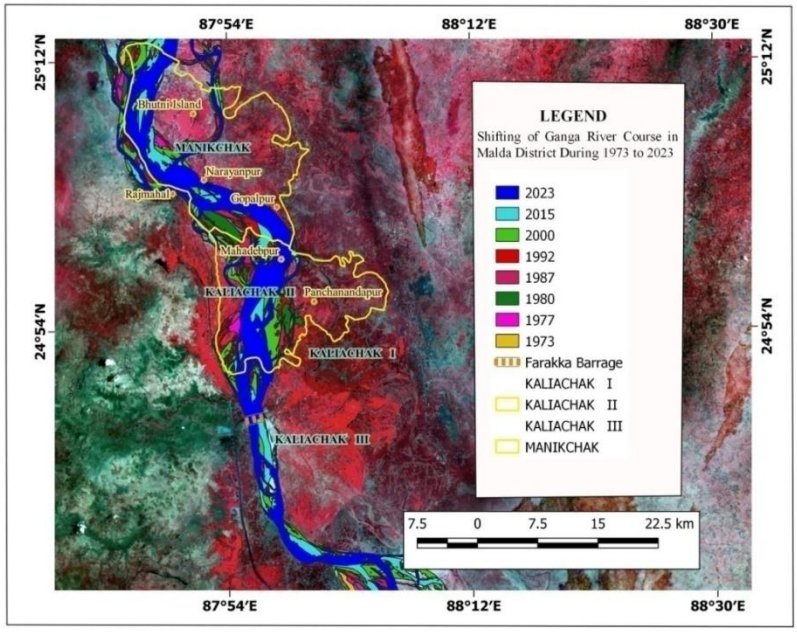


Figure 3: Visual representation of shifting of the Ganges course from 1973 to 2023 with some vulnerable sites in the study area.

Malda district is not the only region which is suffering from the problems of riverbank erosion; the adjoining regions like Bangladesh and Assam are also suffering from severe bank erosion of the Jamuna, Padma and Brahmaputra rivers. The left bank of the Jamuna has eroded a total of 1038 km^2 in Bangladesh during 1973-2019 and shifted its channel towards the east. The junction of the Jamuna River with the Padma is also very dynamic and has witnessed huge lateral migration towards the southeast (Rahman, 2022). Assam is also facing a serious challenge due to the riverbank erosion, as more than 4.27 lakh hectares of land have been eroded by the river Brahmaputra and its tributaries for the

last six decades, which is 7.40 % of the total geographical area of the state. The state is losing nearly 8000 hectares of land each year. **Table 3** discloses year-wise data on the area eroded, number of affected villages and families and the loss of properties because of riverbank erosion in Assam (Govt. of Assam, 2014). Due to bank erosion of the Brahmaputra, thousands of families have been displaced, become landless, and crores of properties were lost in Assam, particularly in Dhubri, Kamrup, Barpeta and Goalpara districts (Dekaraja &Mahanta, 2021).

Table 3. Year-wise area eroded and affected population in Assam

Year	Area Eroded in Hectare	Number of Villages Affected	Number of families affected	Value of property (including land loss) Rs in Lakh
2001	5348	227	7395	377.72
2002	6803	625	17985	2748.34
2003	12589.6	424	18202	9885.83
2004	20724	1245	62258	8337.97
2005	1984.27	274	10531	1534
2006	821.83	44	2832	106.93
2014	12579.13	N.A.	77805	N.A.

Source: Water Resource Department, Govt. of Assam, 2014

4.2 Economic Lives and Livelihoods, and Vulnerabilities of the ERs

Since the inception of the construction of the Farakka Barrage during the late 1960s, the severity of the LBE of the Ganges has increased as it has disturbed the natural dynamics of the river. The easterly flight of the Ganges engulfed as many as 64 inhabited and uninhabited Mouzas (revenue villages) covering about 267 km^2 of the geographical area of Malda district (Rudra, 2009). The riverine dwellers of the LB of the Ganges are losing their productive agricultural lands and *Bastu* (homestead) lands, including household properties and assets, every year since 1973. The actual data regarding land loss is not properly documented, neither by the Land Revenue Department nor by the Irrigation and Waterways Department (I & W) of the Government of West Bengal (GoWB). Kedar Nath Mondal (2015), an activist and leader of the (president) *Ganga Bhangan Pratirodh Action Nagorik Committee,* informed that the Ganges has laterally shifted almost 8-9 km towards east and washed away more than 22 Mouzas (revenue villages), tens of thousands of hectares of productive agricultural lands, Mango Orchards, and displaced around 80 thousand households. As stated by Banerjee (1999), as many as 4.5 lakh people became homeless due to LBE, and 22 Mouzas of Manikchak, Kaliachak-I and Kaliachak-II C.D. blocks have been washed into the river. After losing their permanent home, productive agricultural lands, occupational setups, business establishments, etc, these vulnerable people became refugees in their homeland. As per the District Human Development Report, Govt. of West Bengal (GoWB, 2007), 5343.59 Hectares (ha) and 10163.77

hectares of productive croplands of Manikchak and Kaliachak-I and II blocks, respectively, have been eroded during 1973-2006.

As per the field survey findings, 33 per cent of households lost less than 5 bighas of land, 25 per cent lost 5-10 bighas, 19 per cent lost 10-20 bighas, 14 per cent lost 20-25 bighas, whereas 9 per cent lost more than 25 bighas of agricultural land during 1990-2023 **(Figure 4).**

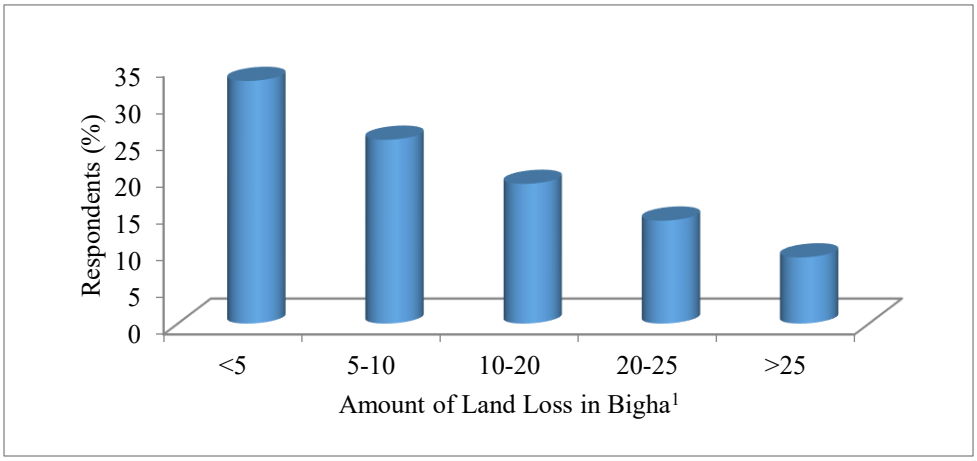


Figure 4: Amount of Land Loss of the Surveyed Households

Field Survey, October-November 2022 and 2023

Note: Bigha[1] is an Indian unit of land measurement (1 Bigha =0.25 hectare)

After losing their land and other assets, they are facing a severe economic crisis because they have lost their other economic setup, such as the silk industry and business establishments, etc. As a result, they are in a state of utter financial uncertainty. Most of the displaced people became destitute as they have lost almost all immovable properties, material resources and assets and are suffering from extreme forms of poverty. After loss of financial and employment setup, they are exposed to massive unemployment, and consequently become rudderless and economically unstable. As a result, most of them are suffering from extreme financial crises. The majority of the workforce have become daily wage earners. **Table 4** shows mean monthly per capita income of the displaced households is Rs. 2354.76, while both the median and modal income are Rs. 2000.00, which is very low when compared to the monthly per capita Gross National Income (GNI) of the country (Rs. 17748.42) as per the financial year 2023-24 (Government of India, 2025).

As they have lost their occupational establishments, many of them have changed their usual and familiar work and are bound to adopt some uncommon jobs as their profession. **Figure 5** shows that before becoming ERs, the people of the study area were mainly dependent on agriculture, in which about 60 per cent of households were

economically dependent on cultivation in the form of crop cultivation, mango, mulberry and other fruit cultivation.

Table 4. Descriptive statistics of per capita monthly income of the households

	N	Minimum	Maximum	Mean	Median	Mode	Std. Deviation	Range
Per Capita Monthly Income of Households (Rs.)	100	1000.00	6333.33	2354.76	2000.00	2000.00	961.21	5333.33
Valid N (list-wise)	100							

Source: Field Survey, October-November 2022 and 2023

Basically, the landless people managed their livelihood as daily wage earners by engaging themselves in different types of informal jobs, while 6 per cent of households had business as their main source of income.

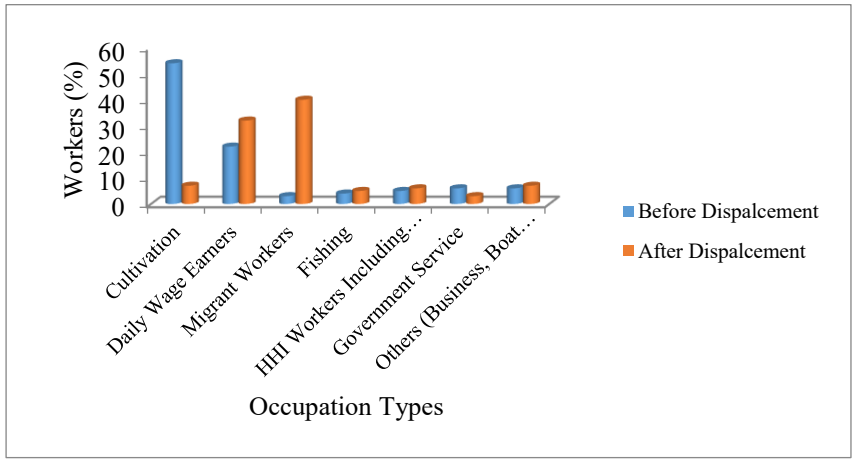


Figure 5: Main Occupation of the Surveyed Households, *HHI denotes Household Industry

Source: Field Survey, October-November 2022 and 2023

A majority of the young male workforce became migrant labour. They are used to going to even far-flung states such as Jammu and Kashmir, Assam, Meghalaya, Mizoram, Gujarat, Delhi, Maharashtra, Kerala, Karnataka, Tamil Nadu, Andhra Pradesh, Telangana, etc., in search of jobs. These workplaces are completely unknown to the migrant workers; they face unpredictable problems due to their unfamiliarity with the new environment. Such out migrant workers are unskilled in nature; hence, they engage themselves as rickshaw

pullers and porters in the market, labourers engage in earthwork, sand mining, construction workers, labourers also engage in construction and cleaning of sewer lines, construction of bridges, power transmission and mobile tower construction labourers, and fruit sellers, etc.

The bank erosion of the Ganges helps the district to gain the identity as 'the Supply Source of Cheap Labour' of the country. The duration and availability of jobs for these out-migrant labourers are highly uncertain. In some cases, they become marginal workers as they get jobs for less than six months a year. The respondents informed that these migrant labourers are facing several difficulties and problems at their workplace, such as extreme shortage of liveable space; consuming unsafe drinking water, malnutrition, unfamiliar language and culture, unhealthy living conditions, and lack of medical facilities, as they are compelled to stay together in an unsafe small tent or room at their workplace. As a result, they lead extremely sub-human lives. Many migrant labourers died due to fatal accidents such as building collapse, falling from towers and buildings, various uncommon and infectious diseases, etc. From the FGD, it was found that 9 migrant labourers who are ERs of the Manikchak C. D. block of the riverine tract of the Ganges were killed due to a multi-storied building collapse at Byculla region of Mumbai on the 31st August 2017. In fact, the Byculla region of Mumbai has become a big colony of the migrant labourers, the displaced people of Malda district. In many cases, they come back to their home carrying difficult-to-treat diseases. Besides these, sexually transmitted diseases are also common among them. On the other hand, their spouses and siblings also lead a sub-standard type of life in their fragile residences because of the absence of guardians. Very often, they have been cheated by the *Thikadar* (labour contractors), private companies, occupants, *Dofadar* (labour gang leader), *Munshi* (Labour supervisor), etc., and they are harassed by local people at their workplace, suspecting them of being Bangladeshis as the majority of them are Muslims, and they speak Bengali. Despite these severe problems, they are compelled to work as migrant labourers throughout the country in search of a livelihood to support their families. **Figure 6** depicts the types of occupation of migrant workers. The majority of the migrant workers (51 per cent) are engaged in electric and mobile tower construction (E.M.T.C.), whereas in building and bridge construction, the share is 20 per cent and 9 per cent, respectively. Thus, the migrant workers primarily become construction workers.

Table 5 exhibits the minimum and maximum average monthly income of the migrant workers at the tune of Rs. 6000 and Rs. 20000, respectively, whereas the average monthly income is Rs. 9780. This small amount is highly insufficient to meet the basic needs of their families.

Table 5. Descriptive statistics of monthly income of the migrant workers

	N	Minimum	Maximum	Mean	Std. Deviation
Average Monthly Income of Migrant Workers (Rs.)	100	6000	20000	9780.00	2736.140
Valid N (list-wise)	100				

Source: Field Survey, October-November 2022 and 2023

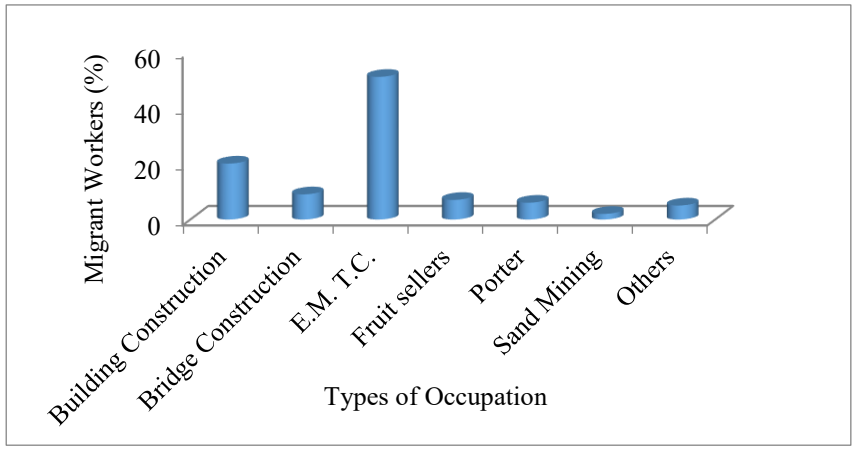


Figure 6: Types of Occupation of Migrant Workers

Source: Field Survey, October-November 2022 and 2023

The scatter diagram **(Figure 7)** discloses the negative linear relation between the 'size of the households' and 'monthly per capita income' (Rs.) of the displaced people. It shows a moderate negative correlation between the variables, which is statistically significant at the 0.01 significance level (2-tailed). It comprehensively indicates that the bigger the household size, the lower the monthly per capita income. As these riparian people are poverty-stricken due to riverbank failure and the recurrence of floods for decades, large families are considered by them an asset. They usually think that more hands mean more income, as most of them believe in hand-to-mouth living, and these misconceptions put them in a vicious cycle.

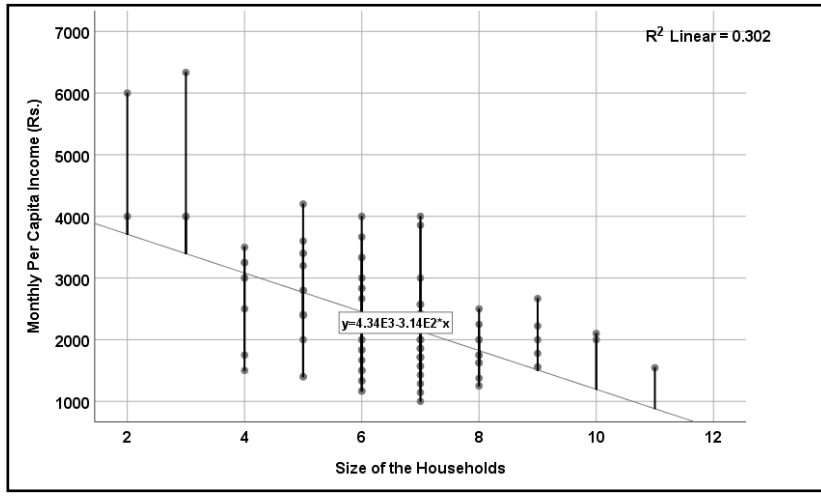


Figure 7: Graphical Representation of the Linear Correlation between the Household Size and Monthly Per Capita Income (Rs.)

Source: Field Survey, October-November 2022 and 2023

The ERs become destitute by losing productive agricultural land, jobs, business establishments, and even their permanent shelter, and they are forced to adapt to new jobs for survival, new places for residence, etc.

Table 6. Distribution of economic indicators adopted by environmental refugees (% of sample)

Daily Per Capita Income of the Household (Rs)	Less than 100	100-200	Above 200
% of Respondents	21	66	13
Income Satisfaction	Satisfied	Dissatisfied	Highly Dissatisfied
% of Respondents	13	39	48
Job Satisfaction	Satisfied	Dissatisfied	Highly Dissatisfied
% of Respondents	26	42	32
Employment opportunity	Very Low	Low	Moderate
% of Respondents	64	22	14
Loan Opportunities	Very Low	Low	Moderate
% of Respondents	55	33	12
Living Conditions	Satisfied	Dissatisfied	Highly Dissatisfied
% of Respondents	7	29	64

Source: Field survey during October – November 2022 and 2023

Table 6 illustrates the economic struggles and their level of satisfaction, in which 87 per cent of respondents reported low income, 87 per cent of them expressed either dissatisfied or highly dissatisfied with their present livelihood and income, while 74 per cent expressed either dissatisfaction or highly dissatisfied with their present jobs. They also reported that they have limited employment and institutional credit facilities, and are highly dissatisfied with their present living conditions.

5. Policy Recommendations and Implications

5.1 Summary of Findings

This study depicts how the LBE of the Ganges in Malda district has transformed a once agriculturally prosperous region into an area marked by widespread displacement and economic distress. Continuous eastward shifting of the Ganges has engulfed thousands of acres of highly productive farmlands, hundreds of inhabited villages, uprooting more than 80000 households and compelling them to relocate multiple times. The IDP people have lost their homesteads, firms and livelihood bases and become Environmental Refugees within their own homeland.

The economic consequences are extremely critical as it has destroyed agricultural livelihoods and diminished employment opportunities. They are facing absolute poverty and are trapped in vicious cycles. After losing their movable and immovable properties and assets, a large section of the working force became migrant manual labourers working in

unknown and distant places under precarious conditions. They are living in remotely located and isolated places, which are highly vulnerable to natural disasters like floods, cyclones, bank erosion, etc. and leading substandard lives with uncertain livelihoods.

5.2 Reasons for Failure of Previous Interventions

The persistence of severe LBE in Malda despite decades of the state's interventions demonstrates that the previous measures have largely failed to mitigate the problem due to certain reasons-

As per the insights of FGDs and KIIs, multiple government departments and agencies, such as the Department of Land Reforms, Irrigation & Waterways, and Disaster Management authorities, have worked independently, often without proper coordination, which has resulted in overlapping and conflicting mandates, bureaucratic delays and inconsistent implementation.

Most of the interventions, such as the construction of kaccha (earthen) embankments, sporadic boulder dumping, bamboo piling, sandbags, etc., were temporary and implemented only during severe erosion, which was washed by the strong current of the Ganges. A combination of central-state, inter-state and intra-state political turmoil, administrative neglect, delayed allocation or discontinuation of funds has also led to an uncoordinated and inconsistent response to the crisis that has destroyed lives and livelihoods and displaced thousands of households. Previous policies didn't focus on the complete socio-economic rehabilitation of the internally displaced households. Most of the displaced households relocated to the fragile, retired embankments and unsafe flood-prone zones without stable lives and livelihoods, education and healthcare facilities.

Moreover, affected local people, the primary stakeholders, in planning and decision-making is a critical factor in the failure of previous states' interventions of mitigation measures. This top-down approach often neglects the vital indigenous knowledge that has led to local community mistrust and mismatched solutions.

5.3 Realistic and Inclusive Policy Recommendations

The policy measures are recommended to address LBE of the Ganges and its impacts on the lives and livelihoods of the IDPs. The LB of the Ganges between Rajmal and the Farakka Barrage is the oscillation zone, which experiences severe bank erosion almost every year during the monsoon and post-monsoon seasons. To address this problem, the government may take preventive measures, such as bank protection and cleaning of alluvial deposits through regular dredging, mainly from the upstream of the Farakka Barrage, to maintain the river’s navigability and discharge of excess water during the rainy season, which is the need of the hour. Though dredging is widely recommended, it’s not a completely risk-free and long-term solution. If these are not scientifically planned and designed or properly executed and maintained, they can alter river dynamics significantly, accelerate sedimentation, and intensify downstream flood and erosion events.

Moreover, the regular dredging may not be budget-friendly as its cost is very high, approximately Rs 1.2 crore per km as seen from the Inland Waterways Authority of India (IWAI) for the works stretching Sultanganj–Mahendrapur and Mahendrapur–Barh in Bihar (Dredge Wire, 2024).

Alternatively, riparian forestations, vegetative bio-engineering, and flood plains restoration are effective measures for the stabilisation of riverbanks naturally and improving ecological health resilience. But Bioengineering works too are quite expensive, and it may cost roughly Rs. 2.2 crore (including coir + geotextile blanket + vetiver grass plantation) per km of river bank as found in the case of Vishwamitra Project, Gujarat (The Times of India, 2025). 'Soft Bank Protection' - Soft bio-engineered bank protection and revegetation costs may cost even ₹4 – 8 crore/km (World Bank, 2021).

A complete rehabilitation package must be implemented for the IDP households, including proper distribution of *Khasland* (vested lands) of the river bed through the administration, basic health infrastructure and services, distribution of subsidised foods through fair price shops (PDS), etc. Financial incentives and easy access to banking and other institutional credit can be very supportive of micro-scale entrepreneurship, as most IDPs are facing an economic crisis and need support to boost their livelihoods. Malda district, specifically the erosion affected region, is well-known for Mango cultivation. Vegetables (Tomato, Cabbage, Cauliflower), Sugarcane and Maize are also widely cultivated in the fertile riverine tract of the Ganges, but the cultivators are not getting the desired benefits due to mismanagement of these agricultural products. The state and the central government should establish agro-based industries, such as the food processing industry at Manikchak and Kaliachak-II C.D. blocks, to generate employment, particularly for the IDPs, which can arrest the migration of these ecosystem people. As the road connectivity and transportation system have been almost destroyed due to this erosion, and the displaced communities become isolated, the road must be rebuilt, and means of transportation such as buses, autos, etc., must be provided to restore the transportation system of the affected area. The restored and reconnected transportation can play a vital role in reviving the economy of this region.

Additionally, a few more steps may be taken to solve some problems of the erosion victims in the region. Immediate initiation of a joint survey by the Bengal and Jharkhand administrations, moderated and supervised by the central representative, to solve the problem of border dispute between West Bengal and Jharkhand is needed. To fix the boundary between the states permanently, it may be defined in terms of coordinates (latitude and longitude). Geospatial technology components such as GPS and satellite imagery may be employed in surveying and demarcating the boundary. The boundary as depicted in the Toposheet No. 72 P/13 (1:63360), published in 1924 by the Survey of India (British-India Government), may be considered as the basis of settling the border dispute. The Government of West Bengal must consider re-establishing the previously abolished Gram Panchayats of K. B. Jhaubona and Paranpur, as Hamidpur Gram Panchayat has already been re-established. Building a road running from Farakka to Barharwa to Piarpur,

or the Farakka-Taltala-Piarpur road are essential for the fast movement of vehicles to access services from mainland Bengal. The road may be built jointly by the Jharkhand and Bengal governments, as the road will be useful to the residents of both states. Similarly, the Government of West Bengal should initiate to supply electricity and may arrive at an agreement with the Jharkhand Government to supply electricity in the erosion-affected char area through Jharkhand. Establishing a police outpost at Piarpur will be very effective to rebuild the dismantled law and order condition, and also to root out the menace of antisocial activities. Jal Police with proper equipment is essential to achieve the goal of re-establishing the rule of law. It is necessary to convert the already existing (Hindi medium) schools into Bengali medium immediately, through recruitment of teachers by the Bengal Govt. in consultation with the Jharkhand government, which is the need of the hour to arrest dropouts substantially (Anwaruzzaman & Khatoon, 2012).The NGOs and district administration should make arrangements for counseling the IDPs to come out of social isolation, loss of identity and mental trauma resulting from repeated displacement. Besides this counseling, the government should provide vocational training such as basic computer courses, tailoring, boutique works, etc., which enables the youths to get various types of blue and white-collar jobs in their own state.

There are limitations of this study as it was carried out solely in the severely affected two C.D. blocks of Malda district. The data were collected through sampled HHS, FGD and KII, which cannot encompass all the dimensions of the bank erosion-induced problems. Hence, the findings may not always be generalised, and all policy measures cannot be recommended to other erosion-prone areas of the states or the country. Temporal and spatial variation in erosion intensity and resultant displacement, land and economic loss at the micro-level, gender issues, and educational crisis could not be fully assessed due to unrecorded and a lack of official data. This study recommends that there is a huge scope for further comparative analysis in multiple erosion-prone areas of West Bengal, India and neighbouring countries, focusing on the displacement of households and socio-economic challenges, the differential impact of erosion on women, children and elderly people, to provide a more comprehensive socio-economic model of riverbank erosion-induced displacement dynamics.

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