



Received: 08-02-2024  
Accepted: 18-03-2024

ISSN: 2583-049X

## **River Bank Erosion; Causes and Impact on human Life: A Case Study of Samserganj Block, Murshidabad, West Bengal**

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### **Abstract**

The Ganga is India's most important and iconic river. The lifeline of India is the Ganges River. It flows between India and Bangladesh. The Ganga River originates from the Gangotri Glacier in Uttarkashi District, Uttarakhand. After entering West Bengal, the Ganga divides into two parts near Mithipur in Murshidabad district known as Bhagirathi and Hooghly in West Bengal and Padda and Meghna in Bangladesh. Murshidabad district lies on the left bank of river Ganges which is a flood plain region of West Bengal. River bank erosion is the most effective environmental disaster in Murshidabad district. My study area is Samserganj block which is located in the northern part of Murshidabad district. River bank erosion is a major problem

in the Samserganj block Murshidabad, causing significant damage to infrastructure and displacing local communities. This abstract presents a comprehensive analysis of the factors contributing to river bank erosion in the area and proposes potential solutions to mitigate its impact. The study utilizes satellite imagery, field surveys, and interviews with local residents to assess the extent of erosion and identify vulnerable areas. Again, I have shown through this research work, what are the reasons, what time of the year is more river bank erosion and what is the human activity in this river erosion? And as a result of this bank erosion, I have analysed what problems people are facing and what effect it has on the economy and society.

**Keywords:** Erosion, Sedimentation, Bank Stability, Channel Migration, Poor Maintained of Embankments, Loss of Land, Flood Risk, Infrastructure Damage, Displacement of Communities

### **1. Introduction**

The Ganga is India's most important and iconic river. The lifeline of India is the Ganges River. It flows between India and Bangladesh. The Ganga River originates from the Gangotri Glacier in Uttarkashi District, Uttarakhand. Ganga is a trans boundary river in Asia. The main river Ganga commences at the conflux of Alaknanda from right and Bhagirathi from left at Devprayag in the Garhwal division of the Indian state of Uttarakhand. The total length of the river Ganga from its source to its mouth is about 2525 km. Out of the total length of river Ganga, about 520 km. is in West Bengal (Ghosh 2019) <sup>[4]</sup>. After entering West Bengal, the Ganga divides into two parts near Mithipur in Murshidabad district known as Bhagirathi and Hooghly in West Bengal and Padda and Meghna in Bangladesh. Murshidabad is one of the districts of the state of West Bengal, presently comprises five sub-divisions (Berhampore, Jangipur, Lalbagh, Kandi, and Domkol), 26 community development blocks, 254-gram panchayets, eight municipalities, and 2210 mouzas (Census of India, 2011) <sup>[9]</sup>.

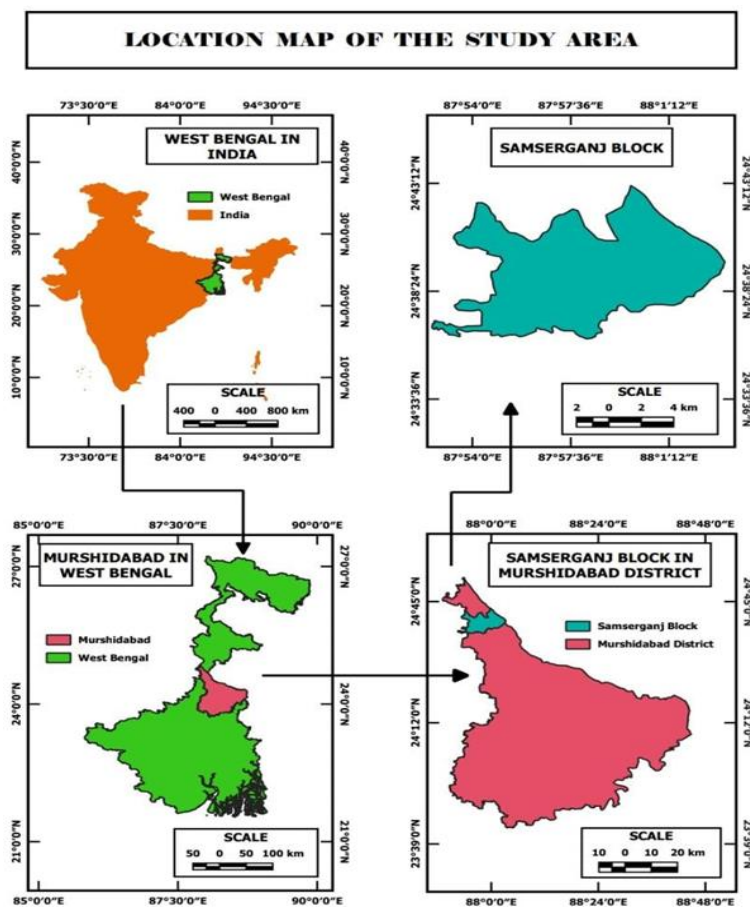
Murshidabad district lies on the left bank of river Ganges which is a flood plain region of West Bengal. River bank erosion is the most effective environmental disaster in Murshidabad district. The district is well drained by a number of river systems such as Padma, Bhagirathi, Jalangi and Bhairab (S. Ghosh 2016). Riverbank erosion along the Ganga is becoming a frequent affair in West Bengal's Murshidabad district. My study area is Samserganj block which is located in the northern part of Murshidabad district. As this region is located on the banks of river Ganges, the amount of erosion is very high. Breakdowns occur here almost every monsoon and post-monsoon. As a result, many people lost their agricultural land, houses.

**Object of the Study:**

To show the channel instability and bank erosion in the study area.

- To identify the Spatio-temporal change in economy and livelihood especially occupational shift, livelihood crisis.

- To find out the major causes of bank erosion in this area.
- To identify the erosion affected vulnerable area along the bank of river Ganga in Samsanganj CD block.

**Background of the Study Area:**

The district Murshidabad has its own heritage and great historical back ground. The name “Murshidabad” reminds us about Murshid Kuli Khan, the great Muslim ruler. It was the capital of undivided Bengal, Bihar and Orissa during the period of Nawab Siraj-ud-dullah. The Murshidabad district of West Bengal is situated on the south of Ganga River. Latitude and longitudinal extension of the district is 23°43' N. to 24°52'N. And 87°49'E to 88°44' E. The district is situated in a flood plain region of moribund delta of West Bengal. The Bhagirathi River is almost divided the district into two equal physiographic divisions. Western part of Bhagirathi River is known as “Rarh” and the eastern part of Bhagirathi River is known as “Bagri”.

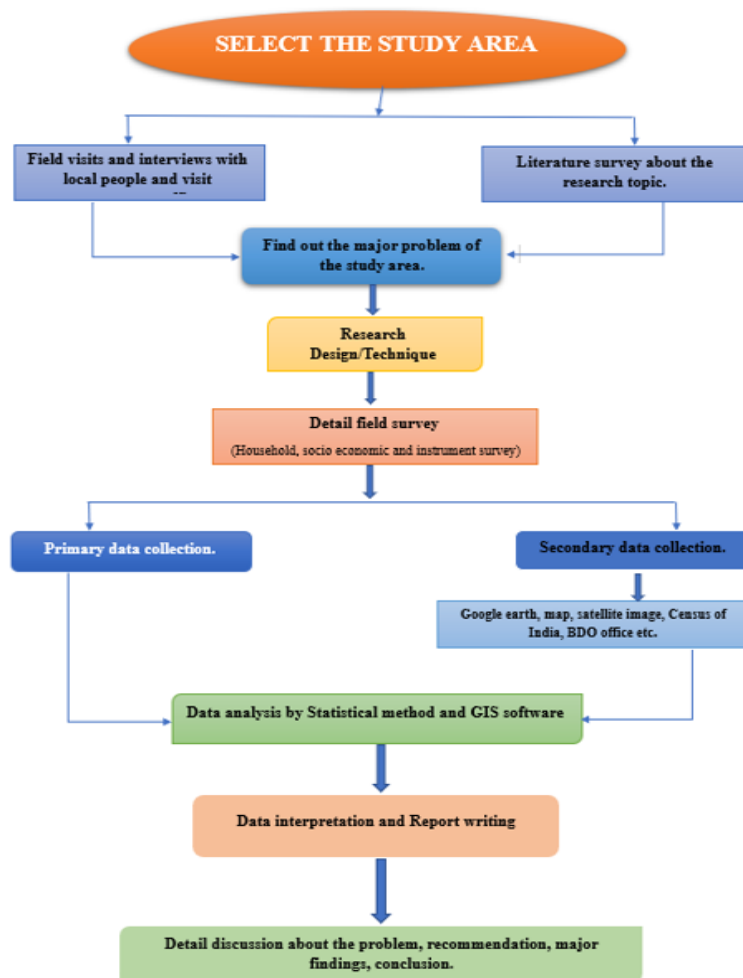
My case study area is Samsanganj CD block. The samsanganj block of west Bengal is situated on the south of murshidabad district “Rarh” region. Samsanganj CD block is bounded by Farakka CD block in the north, in the east, Suti II CD block, in the south and Pakur and Maheshpur CD block. Samsanganj CD Block is located at 24°39'02"N 87°58'12"E. Total area of this block 92.69 km<sup>2</sup>. And total population of this block is 284072, density 3100 /

km<sup>2</sup>. River erosion prone area in this block is new shibpur, dhusharipara, kamalpur, hiranandapur, dhangora etc.

**Soil of the Study Area:**

According to the report of the district statistical hand book, Murshidabad (2010 to 2011), characteristics of the soil in the Samsanganj blocks are more or less similar to the district of Murshidabad. The river Bhagirathi separated the Murshidabad district into two broad geographical regions. These regions are almost equal in area. The two regions are: The Rarh area and the Bagri area. Rarh area is composed by lateritic clay and nodular ghuting (Ghosh 2019) [4]. The soil of this area is greyish and reddish by colour. And, the soil is rich in lime and iron-oxide. The eastern tract or the Bagri area is observed on the eastern portion of the river Bhagirathi. This area is formed by Gangetic alluvial deposits. Deposition of fresh silt almost every year makes Bagri very much fertile (District Census hand book, Murshidabad, 2011).

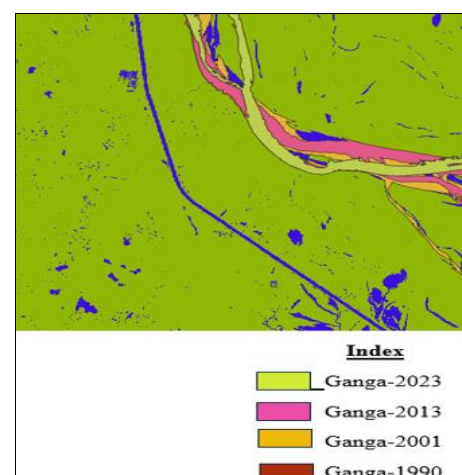
**2. Materials and Methods**



Methodological design refers to the entire process of planning to carry out a research work. With this in mind I created my research design. My research work starts with selection the research problem and the study area. I have shown my research design through a table. **Identify the area of concern:** The first step in any river bank erosion study is to identify the area of concern. This can be done by analysing historical data and conducting site visits to assess the extent of the erosion. **Collect data:** Collecting data is a crucial step in any river bank erosion study. I have divided the data collection into two parts, one is primary and one is secondary. The primary data collection can include household surveys, face to face interview, contact with local people, visit local administrative office, and the secondary data collect from review past work, journal, thesis paper, google, newspaper reading etc. Afterall collect all information that can help me to understanding the causes of River bank erosion in my study area. **Analyse data:** After the data is collected, it needs to be analysed to determine the causes of erosion. This can be done using various tools such as GIS (Geographic Information System), and remote sensing techniques. I have used QGIS, ARCGIS, EXEL etc. **Develop a plan:** Based on the analysis of the data, a plan needs to be developed to address the causes of erosion. This plan should include measures to prevent further erosion and restore the damaged areas. Once the plan is developed, it needs to be implemented. This may involve construction of protective structures such as retaining walls or planting vegetation to stabilize the bank.

### 3. Results and Discussion: Causes of river bank erosion The shifting of Ganga River:

This section will present the shifting courses of the river Ganga from the year 1990 to 2023 in the study area. The changing course of the Ganga River has been continuously reshaping the boundary of Murshidabad District. Rivers transfer millions of tons of sediment with their flow. These sediments accumulate in the plains every year, creating many problems such as decreased river width and depth due to siltation. When the amount of discharge increases, bank erosion is initiated, causing floods and river-bank erosion (Thakur, 2011).



Due to the construction of the Farakka barrage (between 1962 and 1971) across the Ganga River, the whole river course has been altered, and gradual meander formation has started between the Rajmahal hills and Farakka (Mukherjee, 2011). The above fig of Samsanganj shows that the river is constantly shifting to the left side. The river is coming directly and hitting the left side in the areas of Dhusaripara, Shibpur, Kamalpur, Dhangora, so the erosion is more in these areas. Basically, channel shifting is the main cause of river erosion in this region.

### Soil Structure:



The type of soil plays a crucial role in River Bank erosion. The type of soil, its texture, structure, and composition can all affect erosion rates. The Murshidabad District belongs into the zone of alluvial soil. The characteristics of the soil also have great impact on the extent of erosion. The banks adjacent to Samsanganj block have been formed by alternate layers of silt, clay and sand. Different soil types have different levels of permeability and resistance to erosion. Sandy soils are more prone to erosion than clay soils. The river bank here is composed of sandy soil, which is highly permeable and prone to erosion. Soil that is too dry or too wet can be more prone to erosion. When soil is dry, it becomes more compacted and less able to hold together. When soil is too wet, it becomes more saturated and less able to support vegetation. One example of the impact of soil on river bank erosion can be seen in the Samsanganj area of West Bengal. The river bank here is composed of sandy soil, which is highly permeable and prone to erosion. In addition, the soil structure is poor, with little organic matter to hold it together. This makes the river bank vulnerable to erosion, especially during periods of heavy rainfall or flooding.

### Flood and River Bank erosion:

Flood is the most crucial reason of river bank erosion. The chances of flood increase in the rainy season. During flood the huge amount of water flow with higher velocity brings enough energy to tear away the top layers of soil or even

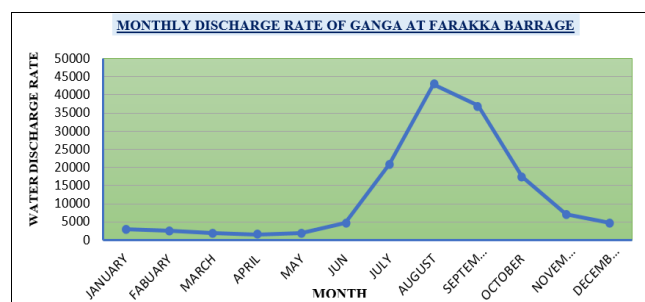
causes mass failure. This section will present the impact of floods and river-bank erosion on the livelihoods of the inhabitants. The floods and river-bank erosion in the study area are quite severe, and these hazards have a wide range of negative impacts on people who reside there. The inhabitants are constantly under the threat of losing their agricultural lands, horticulture farmlands, their lives, houses, and livestock. They frequently have to displace their households to other places, leaving behind their homeland, which creates social instabilities and leaves them reeling under psychological distress. Due to the loss of land and resources, their income and employment opportunities are also reduced. Displaced people are compelled to resettle in open spaces, embankments, or other parts of the emerging chars or river-banks, making their lives and livelihood more vulnerable.

### River bank erosion for farakka barrage:

Before the construction of the Farakka barrage, the Ganges River used to carry a large amount of sediment downstream, which helped to maintain the stability of the river banks. However, after the construction of the barrage, the flow of water in the Ganges River has been significantly reduced, which has resulted in a decrease in sediment transport downstream. As a result, river bank erosion has increased significantly in my study area.

The reduction in sediment transport downstream has also resulted in the deposition of sediment upstream of the barrage, which has led to an increase in flood risk in the region. The reduction in water flow downstream of the barrage has also affected the aquatic ecosystem, as it has led to a decrease in fish populations and other aquatic life. Due to the construction of Farakka Dam, the Bhagirathi River required an uninterrupted flow of 40 thousand cusecs of water. But due to various reasons, it was not possible to get that amount of water in the dry season except the rainy season. As a result, even after four decades, the problem of navigability of Kolkata and Haldia ports has not been resolved. Instead, about 2000 million cubic meters of silt piled up in the mouth of the Hooghly River due to low flow of water. Of course, river erosion is natural. His course is normal. But, if the normal flow of the river is blocked for any reason, there are various adverse reactions.

In conclusion, the construction of the Farakka barrage has had significant impacts on river bank erosion, flood risk, and the aquatic ecosystem in Samsanganj Block.



Data source: World runoff data

Monthly water discharge rate of Ganga at Farakka barrage

### Poor maintained of Embankments:

Regular inspection and maintenance of river embankments can help to prevent erosion. This includes removing debris, repairing any damage, and reinforcing weak spots in the

embankment. Proper drainage is important to prevent erosion. Drainage systems should be installed to prevent water from pooling on the embankment and causing erosion. Sediment load of the river water also plays important role in bank erosion. Fine sediment in river water will increase the viscosity of flow, increase the tractive force, decrease the bed irregularities and bed form roughness and thus enhance the instability of river bank and bank (S Ghosh 2015) [1] Land use practices can contribute to erosion. Controlling land use practices such as farming, logging, and construction can help to prevent erosion. Using erosion-resistant materials such as concrete or stone can help to prevent erosion. These materials are less likely to be affected by flowing water and are more durable than other materials.

**Anthropogenic activities:**

Along bank side such as digging of the land for preparation of brick, furrowing of land for cultivation, construction for habitation etc. also accelerate the process of river bank erosion. Brick field are concentrated in different parts of Murshidabad district along the bank side of the Padma and Bhagirathi River.

Digging of land on the river bank at Samserganj, Dhulia and Maya and other places by land mafia. (Ghosh 2015) [1] long Farakka which was built across the river during 1962-1971, bank revetment with boulders, construction of the spurs to deflect the impinging current, the flood control embankment, excessive withdrawal of ground water is all combine causes for river bank failure.

**Sedimentation:**

Sedimentation and river bank erosion are two interconnected processes that occur naturally in rivers and streams. Sedimentation is the process by which sediment, such as sand, silt, and clay, is deposited on the riverbed and banks. This can happen when the flow of water slows down, allowing particles to settle out of the water column. Sedimentation can also occur when the river carries more sediment than it can transport, causing the excess sediment to settle out of the water.

Actually, the sediment accumulates in the river and the water holding capacity of the river decreases, resulting in the failure of the river bank due to this flood.

**Housing near River bank:**

When building houses near a river, it is important to consider the potential for river bank erosion. The natural processes of sedimentation and erosion can be accelerated by human activities, such as construction and land use changes. This can lead to increased erosion and sedimentation, which can threaten the stability of river banks and nearby structures houses are built along the banks of rivers, especially concrete houses, the silt-clay soil on the river bank is subjected to pressure and water seeps in during the monsoons, softening the soil and causing erosion. People in rural areas make their home near the bank which adds compressive force to the soil beyond its capacity and thus cause erosion.

**Heavy Rainfall:**

During periods of heavy rainfall, the risk of river bank erosion increases. This is because the increased water flow can cause more sediment to be carried away from the river banks, leading to erosion. In addition, heavy rainfall can also cause landslides and other types of erosion that can further destabilize the river banks. Excess rainfall loosens the soil layer and the soil loses its stability and breaks down.

**Strong Current of Rivers:**

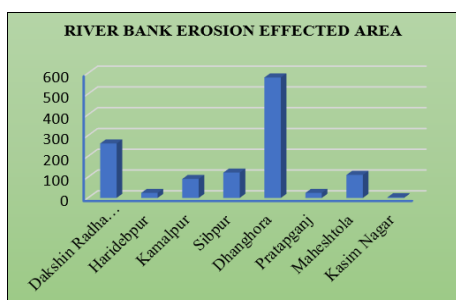
Strong current generates because of the volume of water flowing or the steep stream gradient. Where the river currents are very much high, river bank erosion can occur. In case of cohesion less bed materials, these strong currents create a cantilever overhang of cohesive materials by wearing away non cohesive materials. So, at the toe of the bank shear stress exceeds the critical shear and erosion occurs.

**Deforestation:**

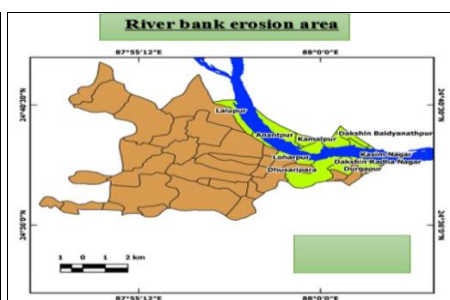
We observe that river erosion is more due to forest cutting and changes in river behaviour. Vegetation or forest can hold the soil of the river bank with the help of its roots. As a result, erosion is reduced. But currently, due to the unscientific activities of people, the vegetation of the river bank is facing destruction.

**Garret Ranking Method: Reasons of River bank erosion in Samserganj Block**

S. No	Reason of river bank erosion	Average score	Rank
1	Soil structure	41.24	v
2	Channel shifting	61.32	ii
3	Poor embankments	63.41	I
4	Farakka barrage	56.21	iii
5	Human activities	50.34	iv
6	Deforestation	30.71	vii
7	Flood	32.37	vi

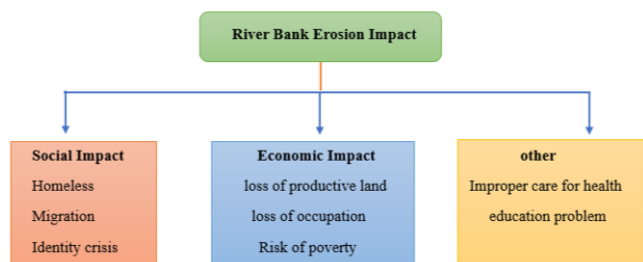


Data source: Census 2011



**Impact of River Bank Erosion:**

River bank erosion can have several negative impacts on the environment and human settlements. Some of these impacts include:



**Increased flood risk:**

River bank erosion can have significant impact on flooding. River bank erosion can increase the risk of flooding, as it can alter the course of the river and reduce its capacity to hold water. Flood is the most effective impact of river bank erosion. When river banks erode, sediment is carried downstream and can accumulate in areas where the river widens or slows down. This can lead to the formation of sandbars, which can alter the flow of the river and cause it to flood in unexpected ways. As the households of the study area mainly depend on agriculture for a living, changes in land size significantly impact the households' food security. After the loss of their lands, they not only become homeless but also jobless. It becomes very challenging for them to get a job, which has a direct negative impact on their lives. Therefore, most people migrate to other metropolitan cities to work as wage labourers. They suffer from food shortages and homelessness. Thus, the impacts of floods and river-bank erosion on human life and livelihood are of different kinds: Social, economic, education, health-related, and at times political. In the study area, economic and social impacts are particularly severe.

**Agriculture land loss:**

The impact of river bank erosion on agricultural land in Samsanganj can be significant and have far-reaching consequences for local communities and the economy. When river banks erode, agricultural lands located near the river are at risk of being washed away or inundated by water, leading to loss of crops, soil fertility, and livelihoods for farmers. River bank erosion can result in the loss of valuable agricultural land that is essential for food production and livelihoods. Farmers may lose access to fertile soil and irrigation sources, affecting their ability to grow crops and sustain their livelihoods. Erosion-induced land loss can force farmers to abandon their homes and agricultural fields, leading to displacement and loss of community ties. This can have social and economic impacts on affected families, who may struggle to find alternative sources of income and housing. Erosion-damaged agricultural land may suffer from reduced soil fertility, increased salinity, and waterlogging, which can negatively impact crop yields and quality. Farmers may face challenges in restoring productivity to eroded lands, further exacerbating food insecurity and economic hardship.

**The damage to infrastructure and homes:**



Caused by river bank erosion in Samsanganj can have significant social, economic, and environmental impacts on local communities. When river banks erode, infrastructure such as roads, bridges, buildings, and utilities located near the river are at risk of being damaged or destroyed. River bank erosion can damage roads, bridges, and transportation networks, making it difficult for residents to access essential services, markets, and emergency assistance. Disrupted transportation routes can isolate communities and hinder economic activities, leading to increased transportation costs and delays. Erosion-induced land loss can result in the destruction of homes, buildings, and property located near the river bank. Residents may be forced to evacuate their homes due to safety concerns, leading to displacement and loss of shelter. The loss of homes can have emotional, financial, and social impacts on affected families.

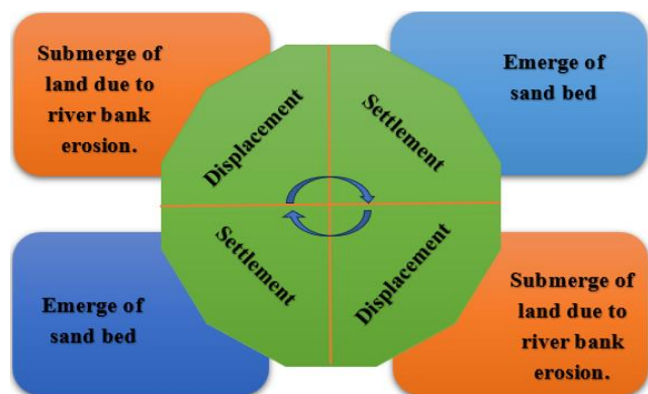
**Impact on Transport:**



Source: Google earth

The Basic problem of the affected region of riverbank is transport. It is frequently found that after a flood the road way communication become so much hampered that the area become paused due to lack of proper commination system. Many roads have been washed away which can still be seen on google earth but do not exist in reality. Shown in the picture below. Erosion can also damage infrastructure such as bridges, roads, and other structures built near the river.

### Migration:



Migration is the main problem in the region due to river erosion. Every year as a result of river erosion, many people's houses, farmlands, and valuables are washed away by the river and they are shifted to different places. As most of the people in this region are engaged in agriculture. But due to the erosion of the river, most of the people moved to other states in search of work. (Egg - Kerala, Bangalore, Chennai, Mumbai, Gujarat) Every year, many people move from one place to another for work or residence important to implement measures to mitigate its effects. Overall, river bank erosion can have significant economic, social, and environmental impacts, and it is.

### Impact on settlement:

River bank erosion can have a significant impact on settlements located near the river. River bank erosion can cause loss of property for people living near the river. The erosion can cause the river to shift its course, leading to the destruction of homes and other structures. People living near the river may be forced to relocate due to the erosion. This can lead to social and economic disruptions for the affected communities.

### Water pollution:

The erosion of river banks in Samsanganj can have significant impacts on water pollution, which can further exacerbate environmental degradation and pose risks to human health and aquatic ecosystems. River bank erosion can result in the release of large amounts of sediment into the water, leading to sedimentation in rivers, streams, and other water bodies. Excessive sedimentation can cloud the water, reduce water clarity, and disrupt aquatic habitats. Sediment can also carry pollutants such as heavy metals, pesticides, and nutrients, which can contaminate water sources and harm aquatic organisms. Erosion-induced sedimentation and pollution can degrade aquatic habitats, including riverbeds, wetlands, and riparian zones. Sediment deposition can smother aquatic vegetation, alter stream channels, and reduce habitat complexity for fish and wildlife. Habitat degradation can impact biodiversity, reduce ecosystem resilience, and compromise the ecological functions of rivers and water bodies.

### Identity Crisis:

Identity crisis due to river erosion is an important issue. There are many families in my study area who lost their identity proof (Voter Card, Aadhaar Card, Ration Card, Birth Certificate, Land Deed) due to sudden collapse.

### 4. Findings

1. Bank line shifting increases the risk of river bank erosion in vulnerable areas across the river. As a result of constant river erosion, the villages along the river are completely washed away. River erosion in Samsanganj is more frequent during monsoon and post-monsoon.
2. Bank line shifting of river Ganga is the main cause of river erosion. Now the bank line shifting of river Ganga is more towards left side than right side as a result river erosion is being observed remarkably in left side.
3. Every year, the amount of sediment that is removed from the river bed is more and more sediment is stored in the river bed, thus the water holding capacity of the river decreases and the people living on the bank line are in danger.
4. Continue river bank erosion and migration are important factors in changing the natural features of this area, vegetation, agriculture land, water body, marshy land.
5. Due to the loss of agricultural land or productive land, most of the people in this area lose their jobs, which has a negative impact on their income. And shifts to other places due to work demands.
6. River erosion has a very important impact on education. Deprived of education in erosion area, many child labourers are observed here who are mostly involved in Beddi rolling work.

### 5. Conclusion

After the discussion in previous chapter related to river bank erosion causes and impact in Samsanganj block of Murshidabad District. River bank erosion is a natural phenomenon that can cause significant damage to settlements and infrastructure near rivers. It is caused by a variety of factors, including human activities and natural processes. The impacts of river bank erosion can be severe, including loss of property and infrastructure, displacement of communities, and environmental degradation. However, by taking measures to mitigate the effects of erosion, such as building protective structures and implementing sustainable land use practices, we can minimize its impact and protect people, infrastructure, and the environment. It is essential for governments and communities to work together to address river bank erosion and ensure the long-term sustainability of settlements near rivers.

### 6. Acknowledgements

I would like to acknowledge and give my warmest thanks to my sir 'Dr. Sanatan Ghosh' who made this work possible. His guidance and advice carried me through all the stages of writing my paper. I would also like to thank Mr. Subham Roy brilliant comments and suggestions, thanks to you. And also, I like to thanks the local people of my study area for giving me exact data.

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