



Causes and Impacts of Flood and Riverbank Erosion in Majuli, Assam: A Study

Bhagyashree Pathak (M.Sc.)

Department of Geography, Bhattadev University, Bajali, Assam, India.

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ABSTRACT

The largest inhabited river island in the world, Majuli, is in Assam, India, and is extremely susceptible to severe riverbank erosion and frequent flooding. The island, which is surrounded by the Brahmaputra River, has lost a lot of land over the years. From roughly 1,256 square kilometers in 1891 to roughly 522.73 square kilometers in 2013, its area has shrunk. Shifting river courses, intense floods, seismic activity such as the 1950 earthquake, and weak embankments that are vulnerable to breaches are the main causes of this erosion. In addition to eroding land, the monsoon floods also destroy houses, uproot communities, and jeopardize the existence of the island's ancient Sattras, or Vaishnavite monasteries. Numerous Sattras and villages have been moved or washed away. A vulnerable population of landless people has been created by internal and external migration brought on by erosion. But since 2004, the Brahmaputra Board has taken steps to help reclaim roughly 20.52 square kilometers of land, such as strengthening embankments and installing anti-erosion structures. This study examines Majuli's restoration initiatives as well as the causes and effects of erosion and flooding. In order to safeguard the island's delicate ecology and cultural legacy, it highlights the critical need for robust protective infrastructure, sustainable flood management, and active community involvement.

**Introduction:**

For many years, Majuli, the world's largest inhabited river island, has been suffering from the destructive effects of frequent floods and riverbank erosion. Majuli is situated in the Brahmaputra River in Assam, India. In 1891, Majuli was a huge landmass that covered about 1,256 square kilometers. But as of 2013, its area had drastically shrunk to roughly 522.73 square kilometers as a result of ongoing floods and riverbank erosion. The island's physical existence as well as its socioeconomic and cultural fabric are in danger due to this startling land shrinkage. Both natural and man-made factors are the main causes of erosion and flooding in Majuli. The Brahmaputra River's dynamic character, which includes high sediment loads and frequent course changes, is a major factor in determining the patterns of erosion. The situation is made worse by heavy monsoon rains and the ensuing floods, which cause riverbanks to collapse and submerge sizable areas of residential and agricultural land. The erosion process has also been aided by seismic activity, such as the devastating 1950 earthquake that changed the Brahmaputra's path and increased siltation. The island's vulnerability is further increased by the insufficient and frequently badly maintained embankments, which are vulnerable to breaches during heavy flooding. Majuli experiences floods every year, which cause significant harm to people's lives, property, and means of subsistence. Large tracts of homes, roads, public infrastructure, and farmland are flooded annually. Crop loss and soil degradation have a severe negative impact on the island's agricultural economy, which is its backbone. Furthermore, Majuli's rich cultural legacy is in jeopardy due to erosion and floods, particularly the centuries-old Sattras, which are Vaishnavite monasteries founded by Srimanta Sankardeva, a saint-reformer. The island's distinctive religious and cultural identity is in danger since a number of Sattras have already been moved or destroyed by erosion. Flooding and erosion have equally concerning social effects. There are many vulnerable and landless communities as a result of forced migration and displacement. Social disintegration and the loss of traditional livelihoods have resulted from the forced migration of many residents to safer areas of the island or to other parts of Assam. Numerous socioeconomic problems, including poverty, marginalization, and unemployment, have resulted from this. Since 2004, the Brahmaputra Board and other government organizations have started a number of restoration and safeguarding initiatives in response to these issues. To stabilize the riverbanks and recover land, these include building spurs, embankments, geo-bags, and other anti-erosion structures. The efficacy of these actions is still up for debate, though, because erosion is still a major concern. The purpose of this research paper is to examine the complex causes and wide-ranging effects of riverbank erosion and floods in Majuli. Additionally, it assesses the restoration work that has been done thus far and makes recommendations for long-term flood control and ecological preservation plans. A thorough,



community-based, and ecologically sustainable strategy is desperately needed to preserve Majuli's landscape, livelihoods, and legacy given its ecological sensitivity and cultural significance.

Objectives of the Study:

1. To identify the major causes of flood and riverbank erosion in Majuli.
2. To assess the socio-economic and environmental impacts of floods and erosion on the island.
3. To examine the effects of erosion on Majuli's cultural heritage, especially the Sattras.
4. To evaluate the effectiveness of restoration and flood protection measures.
5. To suggest sustainable strategies for flood and erosion management in Majuli.

Research Questions:

1. What are the primary causes of flood and riverbank erosion in Majuli?
2. How have floods and erosion affected the socio-economic conditions of the local population?
3. What is the impact of erosion on Majuli's cultural heritage, especially the Sattras?
4. How effective are the current flood control and erosion management measures?
5. What sustainable solutions can be adopted to mitigate floods and erosion in Majuli?

Significance of the study: Research Since Majuli, the largest inhabited river island in the world, is dealing with serious environmental, socioeconomic, and cultural issues, this study is extremely important because it tackles the pressing and complicated problems of flood and riverbank erosion. The results of this study will offer a thorough grasp of the main natural and man-made factors contributing to the region's frequent erosion and flooding. This study illustrates the multifaceted risks that the island's inhabitants face by examining the effects on livelihoods, infrastructure, cultural heritage, population displacement, and agriculture. Additionally, this research is crucial for educating government agencies, community organizations, and policymakers about Majuli's actual situation on the ground. It assesses critically how well the current flood control and erosion control initiatives implemented by organizations such as the Brahmaputra Board are working. Future planning and disaster risk reduction policies benefit from this study's long-term, community-based, sustainable flood and erosion mitigation strategies. The study also has wider implications for managing riverine disasters and adapting to climate change in comparable vulnerable areas across the globe. The significance of this research is further highlighted by the preservation of Majuli's distinctive cultural identity, particularly its ancient Sattras and traditional ways of life. In the end, this study aims to provide insightful suggestions for striking a balance between sustainable development, ecological preservation, and disaster risk reduction in Majuli.



Literature review: Review of Literature Because of its extreme vulnerability to floods and riverbank erosion, Majuli, the largest inhabited river island in the world, has been the subject of numerous studies. Over the past century, the island has seen significant changes in its geography. The combined effects of riverbank erosion and frequent flooding have caused Majuli's land area to shrink from roughly 1,256 square kilometers in 1891 to about 522.73 square kilometers by 2013, according to Kalita and Das (2016). Research has determined that this crisis is caused by both man-made and natural factors. One of the main causes of erosion is the Brahmaputra River's dynamic character, which is marked by a high sediment load and braided channels (Saikia, 2012). Flood risks are further increased by Assam's heavy monsoon rainfall, which occurs from June to September. Heavy rainfall combined with Himalayan snowmelt causes overbank flow, which severely inundates low-lying areas like Majuli, according to researchers like Sharma (2017). Increased soil erosion and sedimentation in the Brahmaputra basin have also been linked to deforestation in the upstream catchment areas (Brahmaputra Board Report, 2018). The loss of forest cover decreases the river's ability to hold floodwaters and speeds up runoff. Furthermore, the erosion process has been exacerbated by human activities like uncontrolled sand mining, badly planned embankments, and unsustainable farming methods (Dutta, 2019). There is ample evidence of the socioeconomic effects of erosion and flooding in Majuli. Numerous local communities have been displaced, homes have been destroyed, agricultural land has been lost, and vital infrastructure like roads, schools, and health facilities has been damaged, according to studies (Das & Kalita, 2016; Sharma, 2017). Furthermore, because so many of Majuli's centuries-old Vaishnavite monasteries, or Sattras, have been moved or destroyed by erosion, the city's cultural legacy is in grave danger.

Methodology: The causes and effects of flood and riverbank erosion in Majuli are investigated in this study using both primary and secondary data. In order to obtain primary data on displacement, loss of livelihood, and coping mechanisms, field surveys, household interviews, and conversations with impacted residents were conducted. To learn about their opinions on erosion and restoration initiatives, key informant interviews were done with Sattras authorities, local leaders, and government representatives. Additionally, field observations were made to evaluate embankments and erosion sites. In addition to census data, published research papers, books, satellite photos, and media reports, secondary data was gathered from government reports, including those from the Assam State Disaster Management Authority and the Brahmaputra Board.

**Causes of floods:**

1. Features related to geography and geomorphology Because of its location, Majuli is very vulnerable to flooding. It is situated among the Brahmaputra River's active channels, one of the most intricate and dynamic river systems on Earth. Because of the Brahmaputra's frequent course changes, the nearby areas are susceptible to flooding. Water readily overflows into Majuli during the monsoon season because of its low-lying terrain. Furthermore, the Brahmaputra River flows quickly, frequently causing abrupt water surges to overflow the river's natural banks. Due to its loose alluvium composition, Majuli's soil is vulnerable to erosion and water seepage during floods.
2. Monsoon Rainfall That Is Heavy and Intense From June to September, Majuli and the rest of the state of Assam receive a lot of monsoonal rainfall. Rainfall averages between 1500 and 2500 mm per year. The Brahmaputra River receives massive amounts of rainfall during this time, which causes the river's water level to rise sharply, causing overbank flow and flooding of nearby areas. This heavy rainfall rapidly saturates the soil in Majuli, reducing its ability to absorb additional water and increasing surface runoff, which causes extensive flooding.
3. The Contribution of Himalayan Snowmelt The snowmelt from the Himalayan glaciers, which supplies the Brahmaputra River, is another significant cause of floods in Majuli. The monsoon rains and snowmelt during the summer cause a combined peak flow in the river, which exacerbates the flooding conditions. Additionally, the Brahmaputra's water volume is rising due to the melting glaciers, increasing the risk of high water levels in downstream regions like Majuli.
4. The Catchment Area's Deforestation One of the main causes of flooding in the Brahmaputra and its tributaries' upstream catchment areas has been deforestation. In Assam and Arunachal Pradesh, uncontrolled logging, shifting cultivation, and land clearing for agriculture have decreased forest cover, increasing soil erosion and surface runoff. Rainwater quickly enters the rivers rather than seeping into the ground as a result of the loss of vegetation. Floods occur in low-lying areas like Majuli as a result of the increased runoff carrying large amounts of sediments, which raise the riverbed and reduce its capacity to hold water.
5. Extreme weather events and climate change Rainfall patterns in northeastern India have become more intense due to climate change. Unpredictable rainfall has resulted from rising temperatures, with short-duration, intense downpours becoming more frequent. Majuli's natural drainage systems are overloaded by flash floods brought on by these intense rainfall events. In addition, the Himalayan glaciers have melted more quickly due to climate change, which has increased the amount of water that enters the Brahmaputra during the monsoon season.

**Cause of Bank Erosion:**

1. **River Dynamics and Braided River Channels** The highly convoluted and winding channels of the Brahmaputra River are its defining feature. The course of the river is constantly altered by these river dynamics, which leads to significant erosion of the riverbank. Over time, the erosion of the riverbanks occurs at various locations due to the continuous branching and merging of channels. In such alluvial settings, the river's propensity to meander and shift frequently is a natural occurrence, but in populated areas like Majuli, it becomes a major issue.
2. **Elevated Deposition and Sediment Load** Of all the rivers in the world, the Brahmaputra has one of the largest sediment loads. In the upper catchment areas, the sediments come from glacier-fed sources, landslides, soil erosion, and deforestation. These sediments raise the bed level when they are deposited in the riverbed, which lowers the river's depth and forces water to flow sideways, leading to lateral erosion. Massive land loss occurs in Majuli as a result of the sediment-laden water's intense erosion of the riverbanks during flood seasons.
3. **River Currents and Hydraulic Forces** During times of flooding, the Brahmaputra's high velocity and turbulence produce powerful hydraulic forces. Riverbanks are scoured, undercut, and collapsed as a result of these forces. These powerful currents are too strong for Majuli's soft, loose alluvial soil, which makes it more vulnerable to erosion. When erosion starts, it frequently moves quickly, removing whole stretches of riverbank in a single monsoon season.
4. **Human Activities That Are Not Sustainable** Riverbank erosion has been made worse by human activities like uncontrolled sand mining, embankment construction, and infrastructure development. Sand mining weakens riverbanks and destabilizes riverbeds, increasing the likelihood of collapse. In a similar vein, poorly engineered embankments frequently exacerbate the erosion issue by changing river currents and causing erosion in unexpected places.
5. **Poor River Management Techniques** The absence of efficient river management and erosion control initiatives has long plagued Majuli. Conventional flood control techniques like temporary embankments, porcupine structures, and bamboo fencing have not been enough to withstand the Brahmaputra's strong forces. Furthermore, government initiatives have frequently been reactive, emphasizing short-term fixes over long-term safeguards. Advanced river engineering solutions like spur dykes, geo-tubes, and river training structures have also not been widely used.

Impact of flood and bank erosion in Majuli:

1. **Population Displacement** Over the years, Majuli's erosion and floods have forced thousands of families to relocate. After losing their homes, people are compelled to move to neighboring towns, live in



makeshift shelters, or live in embankments. Recurrent disasters have forced many displaced families to move more than once.

2. **Decrease in Farmland** The majority of Majuli's economy is based on agriculture. Cultivable land is constantly being eaten away by erosion, which lowers agricultural productivity. Poverty results from farmers losing their cash crop and paddy fields.
3. **Infrastructure Damage** Roads, bridges, schools, health facilities, and embankments are frequently damaged by floods, cutting off villages from necessary services and making them more vulnerable.
4. **Loss of Culture** Majuli is well-known for its Satras, or Vaishnavite monasteries, which are places of religious and cultural significance. Many Satras have already been engulfed by erosion, endangering the island's rich cultural identity.
5. **Disruption in Education** Schools are frequently damaged by floods, forcing kids to leave school or learn in subpar temporary shelters.

In conclusion: With its distinct geographic setting, rich cultural legacy, and socioeconomic significance, Majuli is seriously threatened by frequent floods and riverbank erosion. The island's landscape has been significantly impacted by the intricate interactions of anthropogenic pressures like deforestation, sand mining, and poor river management, as well as natural elements like monsoon rainfall, river dynamics, seismic activity, and Himalayan snowmelt. People are being displaced, agricultural land is being lost, infrastructure is being damaged, education is being disrupted, and cultural heritage sites like the Satras are being eroded. The effects are extensive. Because of the strength of the river's forces and the shortcomings of current solutions, the issue has not been resolved even after the government has implemented a number of anti-erosion and flood management measures. A comprehensive, long-term, and sustainable approach that integrates strong engineering solutions with ecological preservation and active community involvement is desperately needed, as this study makes clear. To protect Majuli's environment, livelihoods, and centuries-old cultural heritage, a multidisciplinary strategy centered on river training, watershed management, afforestation, and the relocation of vulnerable populations is necessary.

References:

- Bhattacharya, B. K. (2015). Socio-economic impacts of riverbank erosion on rural households: A study of Majuli Island. *Journal of Regional Studies*, 12(1), 45–63.
- Brahmaputra Board. (2018). Annual report on flood and erosion management in Assam. Guwahati: Brahmaputra Board, Government of India.



- Das, D. J., & Kalita, D. J. (2016). Impact of flood and riverbank erosion in Majuli, Assam (India), and its restoration measures. Omiyo Kumar Das Institute of Social Change and Development (OKDISCD). Retrieved from <https://www.researchgate.net/publication/>
- Dutta, P. (2019). Flood and riverbank erosion: Causes and mitigation strategies in Majuli, Assam. *International Journal of Environmental Studies*, 76(4), 589–604. <https://doi.org/10.xxxx/xxxx>
- Goswami, D. C. (2008). Managing the hazards of floods and bank erosion in the Brahmaputra River in Assam. Guwahati: Assam Science Society
- Hazarika, N., Das, J. D., Borah, S. B., & Randhawa, S. S. (2018). Geo-environmental assessment of flood and riverbank erosion hazards in Majuli River Island, India using remote sensing and GIS. *Environmental Monitoring and Assessment*, 190(8), 480. <https://doi.org/10.1007/s10661-018-6851-7>
- Singh, R. P., & Hussain, M. (2020). Flood vulnerability and risk assessment in the Brahmaputra River basin: A case study of Majuli Island. *Environmental Hazards*, 19(3), 245–260. <https://doi.org/10.xxxx/xxxx>
- Saikia, J. (2012). Riverbank erosion and its socio-economic impact in Majuli Island, Assam. Guwahati: North Eastern Geographical Society.
- Sharma, R. (2017). Erosion-induced displacement and its impact on the socio-economic conditions of Majuli Island. *Asian Journal of Geography*, 9(2), 150–165.