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UNDERSTANDING THE DYNAMICS AND SEVERITY OF FLOOD IN MORIGAON DISTRICT, ASSAM

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Abstract
Floods are acknowledged as one of the utmost catastrophic events that possess the capability to cause widespread destruction. India is consistently ranked among the countries most severely impacted by flooding. It bears a significant burden of flood-related disasters, experiencing frequent and extensive flooding events. Among the North Eastern states of India, Assam has been facing adverse impacts due to floods every year. Amid the districts that are significantly prone to flooding, Morigaon district holds a prominent position unparalleled by any other. Between 2015 and 2020, the Disaster Management Department of Morigaon reported that a total of 2,483 families lost their homes due to flooding. Additionally, an estimated area of approximately 24,719 bighas of privately owned land and 8,470 bighas of government-owned land were submerged in the Brahmaputra River. These affected areas were previously part of the Laharighat, Mayong, and Bhuragaon revenue circles. Keeping this point in view, an attempt has been made here to study the dynamics and severity of flood in Morigaon district and its mitigation measures using different primary and secondary data with the help of geospatial tools.

Keywords: Flood, Catastrophic Events, Disaster Management, Mitigation Measures

Introduction
Floods are a fluvio-geomorphic problem that is characterized by the overflow of water onto normally dry land (Shumie, 2019). Floods are a common and recurring natural phenomenon that can have significant impacts on the environment and human populations (Echogdali et al., 2018). They can cause damage to infrastructure, destroy crops and livestock, contaminate water sources, displace communities, and even result in loss of lives(Amoo et al., 2018). The impact of flood is not confined only the developing countries but also expand its devastating effects to developed nations. For instance, countries like China, the United States, France, Bangladesh, Nepal, Bhutan and Sri Lanka have all experienced significant economic losses due to the increasing frequency and intensity of floods(Aryal et al., 2020). In Indian context, according to the Central Water Commission Report 2022, there has been a significant increase in flood-related fatalities over the years. The report states that the number of deaths caused by floods rose from 37 in 1953 to as high as 1,815 in 2020.The CWC data indicated that a total of approximately 4.1 million hectares of land were affected by floods. The states majorly impacted include Assam, Bihar, Uttar Pradesh, and West Bengal. The entire Brahmaputra valley falls under the monsoon regime of South East Asia (Goswami, 1985). During the 2020 monsoon, the Assam State Disaster Management Agency revealed that approximately 5.69 million individuals were impacted and 5,378 villages across 30 out of the total of 33 districts in Assam state endured severe consequences.

This work has been developed to determine the flood dynamics, magnitude, intensity and severity of flood in Morigaon district. The main objective of this study is to assess the extent of flood damage in Morigaon district, analyze the fluvio-geomorphic factors that contribute to the occurrence and

severity of floods in the area and find out the mitigation measures of flood. This study incorporated various sources of data, including primary and secondary data, to analyze the flood situation in the district. The analysis of flood in Morigaon district is important for understanding the fluvio-geomorphic factors that contribute to its occurrence and severity. Additionally, it can provide valuable insights for the development of effective flood mitigation strategies and early warning systems.

Study Area

Morigaon district is located in the middle part of the Brahmaputra valley (Fig.2.1). It was created in the 1989 with an area of 1450.02 Km^2. The district is extended from $26^0 15^/$ to $26^0 5^/$ North latitude and $92^0\ 0^/$ East to $95^0 5^/$ East longitude in the North-Eastern region of India. It has total area of the district is 1502.69 km^2 and in terms of area it has secured 23^{th} position among the other districts of Assam and 540^{th} in India. It has comprised of 5 revenue circles, 7 blocks, 85 Panchayats, 632 villages, 1 statutory town, 3 urban areas and 5 census town with total 9,57,853 population of different community according to 2011 census. It is the second smallest district of Assam. The district surrounded by the mighty Brahmaputra in the north, Karbi Anglong in the south, Nagaon district in the east and the District of Kamrup in the west. It has mainly 3 physiographic divisions. These are north-western low-lying plains, central and eastern built up plain, central western plain interspersed with hillocks. The district encompasses extensive plain and dispersed low hills. It has average elevation ranges from 60 m to 360 m above the mean sea level (MSL).

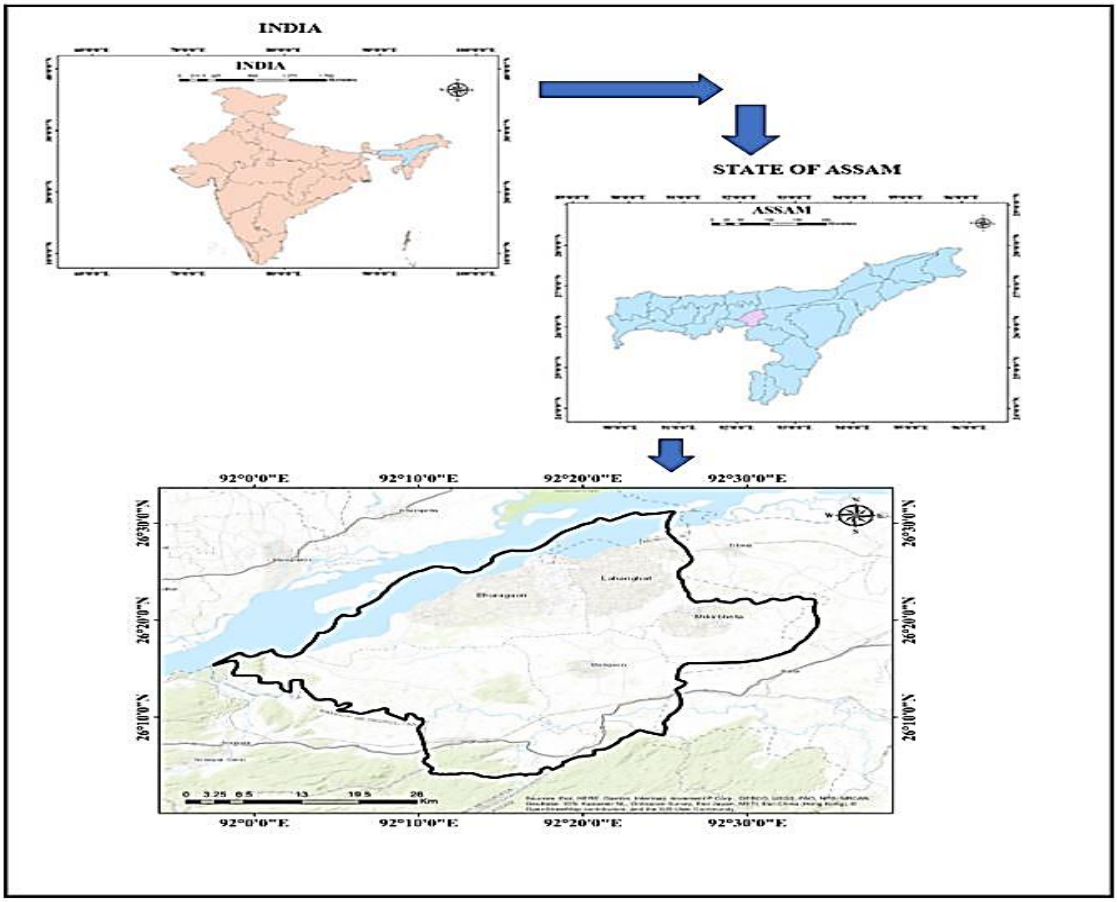

Fig. 1: Location Map of Study Area

Objectives of the Study

- To study the nature and intensity of flood in the study area
- To analyse the causes of flood in the study area
- To find out the mitigation measures of flood

Methodology

To study the extension and intensity of flood in the Morigaon district, both primary and secondary data have been used. In primary step the data collected through household survey and the ground reality has been assessed through field observation. For secondary data, topographical map of 1972, various governmental and non-governmental reports, remote sensing data, internet blogs and historical records were analysed. To analyse the extension of flood, different multispectral satellite images were used, including from sources such as Landsat 5 & Landsat 7 by using computer-based GIS software like ArcView and ERDAS.

Data Source for Flood Inundation Mapping

Table 1: Data Sources

Image	Year	Path/ Row	Spatial Resolution	Source
Landsat 5– TM	23/ 09/ 1988	136/42	30 m	USGS
Landsat 5 – TM	30/ 06/ 1992	136/42	30 m	USGS
Landsat 5 – TM	10/08//2001	136/42	30 m	USGS
Landsat 7 ETM	29/ 06/ 2012	136/42	30 m	USGS

Discussion

Nature and Extend of Flood

Since the early times, floods have been of major aspects of man's interactions. The occurrences of floods in flood prone river basins have been a rule rather than an exception. The Morigaon district is also not exception in this regard. The district is situated in the state of Assam, India, and is known for its vulnerability to frequent fluvially associated floods. Fluvial floods are a major concern in Morigaon district, as they caused extensive damaged to settlement, infrastructure, agriculture set up, and livelihoods. Furthermore, fluvial floods have significant impacts on the population and economy of the entire district.

As per the departmental record of District Disaster Management Department, Morigaon in the year 2014, the total crop area affected in the district is 18,900 hectare of agricultural land and in this year total 262 numbers of villages were affected. In terms of population total 282114 numbers were affected in the intensive flood occurred in 2014. In the corresponding year, a total of eight fatalities were recorded amongst the human population. As per of data 2015, the total crop area affected in the district is 10701.47 hector of agricultural land and total 283 numbers of villages were affected. In terms of population, total 310159 numbers were affected in the intensive flood occurred in 2015. During the same year, there were a total of twelve deaths reported among the human population. In 2016, the district experienced a tremendous adverse impact on agricultural land, with a total crop area of43602.28 hectares. Additionally, there were reports of wide-ranging damage in a considerable number of villages, with a total count of 341 affected areas. In terms of population, an alarming figure revealed that as many as 365142 individuals suffered from the severe flooding event that occurred in 2016. Tragically, this catastrophic incident resulted in the loss of eleven precious lives within the impacted human community during the same year. In the year 2017, the region encountered a noteworthy negative influence on cultivated land, with a combined arable land area of 36605.79 hectares impacted. Furthermore, there were reports of substantial devastation in numerous villages, comprising a total count of 395 areas affected. Concerning the population statistics, an

alarming figure indicated that as many as 530279 individuals endured the severe flooding incident that transpired in 2017. Unfortunately, and in a tragic time of events, this disastrous incident resulted in the unfortunate loss of 31 precious human lives within the impacted community during that particular year. In 2018, there were no substantial occurrences of flooding within the district. Consequently, minimal detrimental results have been observed as a result of this absence of significant flood events.

In the year 2019, once again, the district experienced a severe flood that had a tremendous negative impact. The region encountered a noteworthy negative influence on cultivated land, with a combined arable land area of 61051 hectares impacted. Furthermore, there were reports of substantial devastation in numerous villages, comprising a total count of 435 areas affected. Concerning the population statistics, an alarming figure indicated that as many as 761225 individuals endured the severe flooding incident that transpired in 2019.

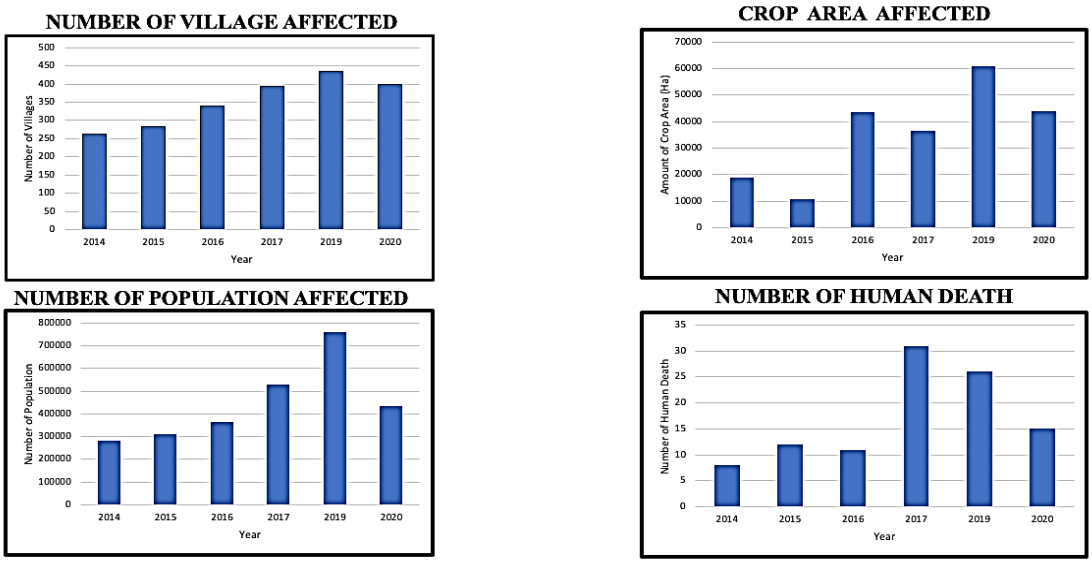

Fig. 2 : Number of Villages, Agricultural Land, Population, Human Death
Source: District Disaster Management Department, Morigaon

Unfortunately, and in a tragic turn of events, this disastrous incident resulted in the unfortunate loss of 26 precious human lives within the impacted community during that particular year.

Photo Plate 1: Photographs of Flood Inundated Area, 2022

Source: Field Survey, 2022

In the year 2020, the district once again faced a severe flood that had significant negative consequences. The impact on farmland was particularly noteworthy, with approximately 43962.06 hectares of arable land affected. Additionally, numerous villages experienced substantial devastation with a total of 398 villages being impacted by the flood

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In terms of population statistics, an alarming number of individuals - estimated to be around 433535 people - endured this catastrophic flooding incident in 2020. Tragically, this calamity resulted in the untimely demise of 15 individuals within the impacted locality during that ill-fated year.

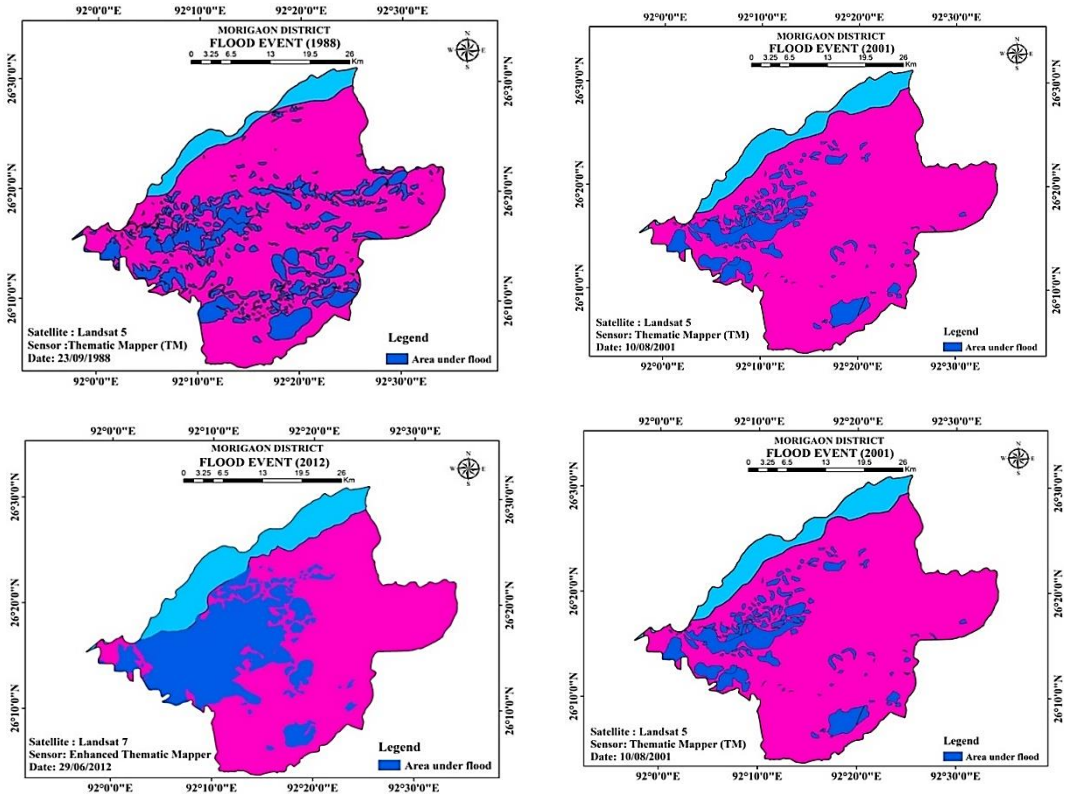

Fig. 2: Flood Event in Different Time Period
Source: USGS Earth Explorer

According to the Flood Contingency Report (2022-2023) published by the District Disaster Management Department in Morigaon, in the catalogue of villages severely impacted by flooding, within the Mayong revenue circle, there exists a subset of villages that have experienced an exceptionally profound level of devastation as a result. Amongst this group are some villages are Sildubi. 1 No. Murkata. 2 No. Murkata, Bahoitari., Raja Mayong, Hati Muria, Kasa Sila, Hatigar V.G.R., Kanjuli Pathar, Kal Sila, Pabitora P.G.R., Garumara Dalani, Khalani Beel. Nakara Habi, Buraburi, Kukuwari, Kuranibari, Loon Mati, Chengmari Gaon, Chengmari Pathar, Dhekiabari, Chanaka, Gomariguri, Karati Pam. Garjan, Gagalmari, Panikauri, Sukuti Puta Habi. In Laharighat Revenue Circle, the villages that have been significantly impacted by floods are extensively affected. The devastating consequences of these flood events have had a profound impact on the communities dwelling within these areas. The name of some of these villages are Hahsorabori, Bogolipara Gaon, Dakhin Chenimari. Kathani, Borthol Doloigaon Leruamukh, Tatikata, Bhuyanbari Pather,

Borchapori, Ulubari, Solmari, Chenimari, Bogolipara Pather. Chetuaikhaity, Bhajakhaity Pather, Titatolabori, Jengorbori, Batobori, Rajagadhua, Moirabari Gaon, Hahsoragaon, Borthol Kacharigaon.

The villages situated in Bhuragaon Revenue Circle have experienced considerable devastation due to floods, leading to widespread and severe effects. The flood events have had a profound impact on the communities residing within these areas, leaving them with enduring consequences. The name of some of these villages are Banmuri Beel, Patrabori, Pukalagi Kupatimari, Balidunga Pam, Tengaguri Kacharigaon, Borhalukanda, Hariabeel, 1 No Borpathar, Baralimari Gaon, Sunduba Tup, Barukhata Chaharigaon, Jengpari, Barukati, Darangi Gaon, Barduba Tup, 1 No Barunguri Beel, Betoni, Hindu Japori, Shalmari Pam, Banmuri Gaon, Lengerigaon.

The floods have caused significant destruction and had a profound impact on the villages located within the Morigaon Revenue Circle. Some of them are Kaliajari, 27 No Block, Shimoluguri, Chamkotabori, Da-Chikabori, Parojari, Dumbaha, Dhekifalabori, Kanfolabori. Buwalguri, Hogoltoli, Dighalbori, Bakhorbori, Udori, Lothabori.

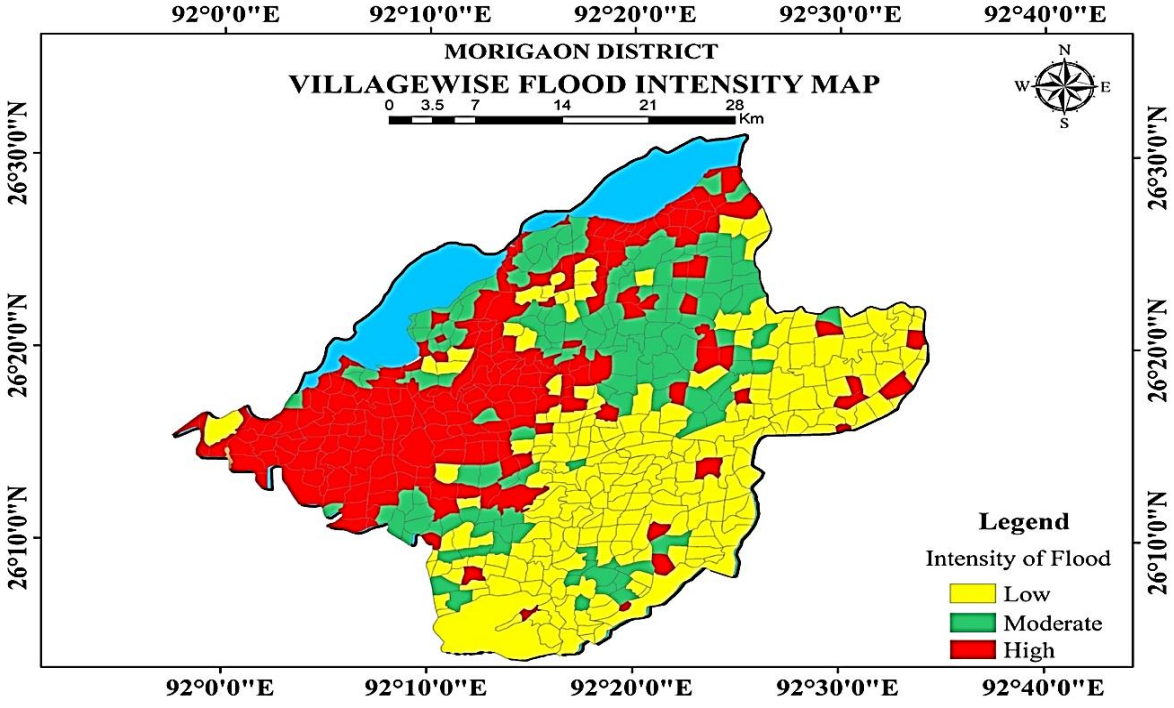

Fig. 3: Village Wise Flood Intensity Map
Source: District Disaster Management Department, Morigaon

The flooding has resulted in considerable devastation and exerted a profound influence on the villages situated within the Mikirbheta Revenue Circle as well. A number of these villages are Hatibat Simaluguri, Sukdal Borbori, Sukdal Sarubori, Kalikajari, Silpukhuri, Kujisatra, Kahua Ati, Dewrabori. The highly vulnerable nature of these villages exposes them to increased risks during periods of heavy rainfall and rising river levels. These flood-affected communities face several challenges such as loss of crops, destruction of homes, displacement of residents, disruption in transportation networks.

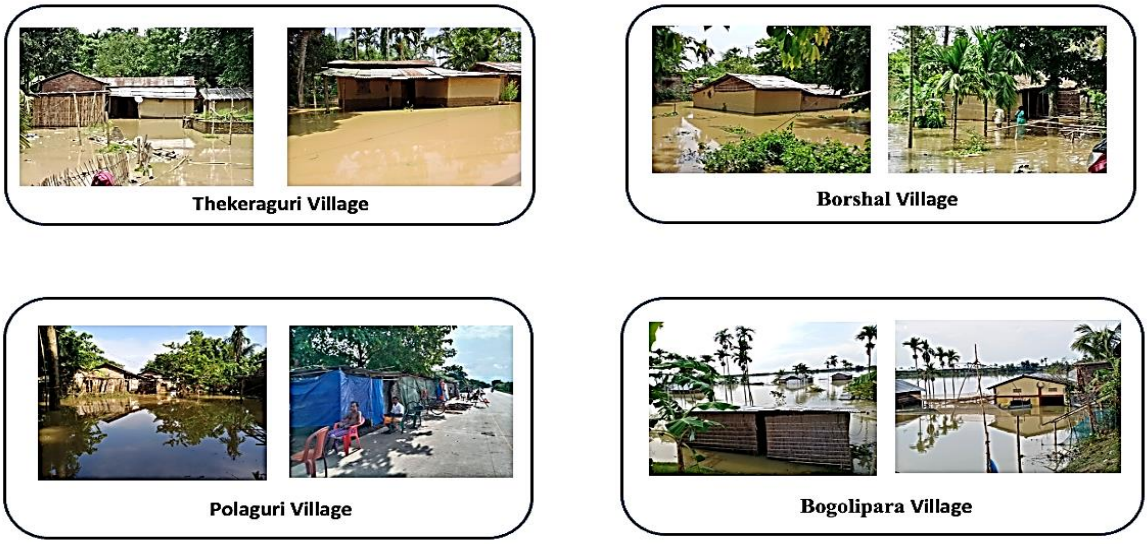

Photo Plate 2: Flood Scenario in Different Regions of the Study Area
Source: Field Survey, 2022

Factors Leading to Flooding

The primary cause of flooding in the Morigaon district of Assam is attributed to the elevation of water levels in the Brahmaputra River during the monsoon season.(Goswami and Kalita,2019). The phenomenon of deforestation coupled with shifting cultivation practices on the steep slopes and valley bottoms has undeniably played a significant role in exacerbating erosion rates in the upper reaches of the river as well as its tributaries. The removal of trees through deforestation disrupts the natural stabilizing mechanisms that vegetation provides, such as their roots helping to bind soil particles together. This disruption intensifies surface runoff during rainfall events, resulting in increased soil erosion from these vulnerable landscapes. Henceforth, it becomes evident that both deforestation and shifting cultivation have acted synergistically towards escalating erosion rates within highland regions adjacent to rivers and their tributaries (Goswami, 1985). An important factor that contributes to the increasing sedimentation in the Brahmaputra River is its impact on reducing the capacity of the river and causing overflow during monsoon seasons. This phenomenon has far-reaching consequences, as it leads to extensive flooding along the river banks, resulting in substantial infrastructure damage and posing a threat to human lives.

Moreover, land-use alterations and increased soil erosion have significantly augmented flood severity over time. In addition, human settlements in low-lying areas exacerbate this flood problem by further increasing siltation levels in river channel. Furthermore, high climatic extremes coupled with anthropogenic influences have intensified flood occurrences in recent decades.

Mitigation Measures

The government implements a variety of structural and non-structural techniques and protection measures to ensure long-term protection(Orozco & Caballero, 2018).

Structural measures

Structural measures encompass the implementation of autonomous actions aimed at mitigating or preventing potential negative consequences resulting from hazardous events. Structural measures involve employing various engineering techniques and constructing hazard-resistant structures along with protective infrastructure(Singh, 2009).

Embankments commonly known as artificial levees or guard wall (locally known as *Mathawry*) represent the predominant method employed in river control engineering. Their purpose lies in confining floodwaters within specific areas of low economic value on the floodplain(Dewan M.L. & Shai Devendra Er., 2010).The construction of embankment is one of the highly preferred mitigation measures. Through suitable embankment construction, the intensity of flood can be reduced. Secondly, by revitalizing the waterway branches and undertaking canal construction, the intensity of flood can be reduced efficiently. Thirdly, it has been mentioned that during flood drainage congestion occurs at the mouth of the tributaries. The tributaries thus cannot discharge their flow and the backwater create heavy flood (Sabhapandit, 2003). So, by deviating the channel route, the water flow can be diverted and thereby the intensity of flood can be reduced.

Non-structural Measures

Non-structural measures encompass a range of strategies and approaches that aim to mitigate the risks associated with different hazards. These measures are designed to address policies, increase public awareness, encourage learning and development, enhance public commitment and engagement, and implement effective methods and operating practices. The implementation of non-structural measures plays a vital role in mitigating risk and minimizing the adverse impacts caused by natural disasters or alternative risk (Singh, 2009). Accurate and punctual flood predictions enable authorities to implement emergency protocols that ensure the relocation of individuals and valuable assets away from potential danger (Cloke & Hannah, 2012). To mitigate the impact of floods, it is vital to avoid constructing infrastructure in areas that are prone to high flood risk. This proactive measure can significantly minimize the extent of damage caused by flooding events. By implementing this strategy and preventing development in such vulnerable zones, society can successfully minimize the adverse consequences associated with flood disasters(White et al., 2001). Residents residing in regions at risk of flooding necessitate receiving comprehensive education regarding the appropriate actions to undertake if confronted with an occurrence of a flood. This entails crafting strategies for evacuation and familiarizing themselves with proper channels through which they can promptly call upon the emergency services (Burningham & J., 2008).

Conclusion

From the above analysis, it is clear that the Morigaon district is experiencing severe recurring flood. This creates a severe adverse impact on the livelihoods and well-being of the local population. The revenue circle of the district that experiences significant flooding includes Laharighat, Mayong, and Bhuragaon. There are many causes which are responsible to trigger higher intensity of flood in this region. Therefore, the policymakers should focus on the long-term structural measures with proper management strategies and aware the flood plan dwellers regarding different facets of preventive measures to reduce their damages. Above all the government, local people a voluntary organisation should work mutually to make the area suitable for settlement.

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