

Assessment of Flood Hazard and its Effects in Dolokhat village of Lakhimpur District, Assam

Azruddin Khan, Manash Jyoti Bhuyan, Debashree Borah



Abstract: Land of rivers, India annually faces the perennial problems of flood and siltation basically along the flood plain region since millennia. Situated on a tectonically active zone and transversed by the Brahmaputra and Barak river system, Assam has been recognized as the worst sufferer. Increasing magnitude and devastation of the hazard is much owed due to the great earthquake of 1950 along with both natural and human-induced factors and activities. The regions located at upper Brahmaputra valley are frequently inundated and eroded wiping away vast areas of cropland, properties, and human lives. As such, the Lakhimpur district of Assam faces similar havoc each year with massive destruction leaving many people helpless and homeless. The people living in the rural areas of the district had to struggle hard to sustain their lives and livelihoods and thus, adopted their indigenous or traditional ways and means of coping with the floods. This paper, therefore, attempts to study the causes and impacts of floods caused by the river Singri, a sub-tributary of the Brahmaputra river on the inhabitants of Dolokhat village located in Lakhimpur district. This study also takes into account the differential shifting patterns of the river for a period of 12 years from 2005 to 2017, wherein highest erosion was observed during 2017 eroding 22.60 hectares of land displacing people and livestock. The study was undertaken using both primary and secondary sources of information. Data and information collected have been processed and analyzed using Google Earth Pro, ArcGIS 10.9.2, Microsoft Word and Microsoft Excel. Such information will enable the planners, policy-makers, geomorphologists, etc. in targeted solutions and strategies to initiate measures and mitigate such problems so that the adverse effects of floods could be reduced to a certain extent.

Keywords: river, flood hazard, devastation, erosion.

I. INTRODUCTION

Floods have evoked as the most dynamic and recurrent hydrological phenomena leading to widespread destruction since millennia. In tropical monsoon environment, river floods are considered to be the most common event. Chow (1956) has defined flood as “a relatively high flow that overtops the natural or artificial banks in any reach of a stream and spreads over the plain”. Geographically, the state of Assam is located in the southern part of eastern Himalayas and thus, criss-crossed by the gigantic Brahmaputra and Barak system along with their tributaries is severely prone to flood annually.

A combination of both natural and human factors and processes has immensely contributed in making the situation worse by increasing the flood magnitude, intensity, and destruction leaving the floodplain dwellers in a pathetic condition/homeless. Floods act as both boon and hazard to the inhabitants of the valley. It is boon when it arrives with a considerable magnitude providing water and required alluvium to the fields whereas it's considered as bane or hazard when it overtops its bank causing erosion, channel migration, siltation, avulsion and swiping away human lives and properties (Hazarika, 2016). Almost entire parts of Assam witnesses the flood havoc with greater intensity (Kipgen and Pegu, 2018) on areas located in the upper Brahmaputra valley such as Dibrugarh, Sibsagar, Jorhat, Lakhimpur, riverine island Majuli, etc., as the worst-affected (Bora, 2001). Experiencing this chief natural calamity almost every year affecting largely, a small village namely, Dolokhat, which is a chronically flood-affected area in Lakhimpur district, has been taken into account. This paper tries to investigate the probable causes responsible for such high flows and the responses of the dwellers. Bankline migration for a specific period from 2005 to 2017 has also been interpreted to study the shifting of Singra river and its impact on the village.

II. STUDY AREA

The present study has been carried out in Dolokhat village located under the jurisdiction of Naobaicha revenue circle of Lakhimpur district (Fig.1). The village is located on the north bank of the river Brahmaputra within latitudes 27°11'09" N and 27°09'47" N and her longitudinal extension is from 93°58'24" E and 94°00'08" E. The rivers Singra and Mora-Singra flow through the eastern and western part of the village respectively. The village has an average elevation of about 92.80 m from the mean sea level.

However, according to the Census report of 2011, the village has a total population of 2,114 settled in its area of about 4.56 square kilometers. People of different ethnic groups inhabit the village and communities like Assamese, Bengali, Nepali, Adivasis, Goria, etc.

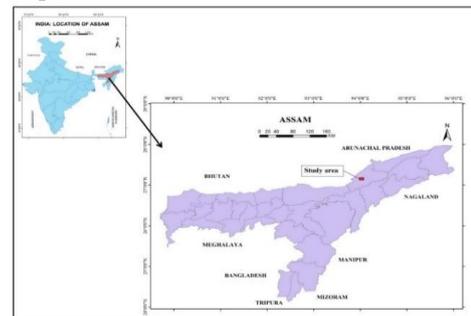


Fig. 1: Location of Dolokhat village

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III. DATABASE AND METHODOLOGY

The study was carried out using both primary and secondary data and information. Primary data were collected through intensive field visits and survey while the relevant secondary data were collected from various secondary sources, consultation of maps and relevant books and journals. The information on floods and its impact, erosion and deposition scenario, flood-affected areas, etc. were collected by surveying 127 out of 406 households of the Dolokhat village for which stratified random sampling was carried out. Besides, focus group discussions among people of different age and sex have been conducted to understand the nature of flood in the village. Again, a GPS survey was conducted to understand the slope and elevation pattern of the village. Data and information so collected have been processed and analyzed using Google Earth Pro, ArcGIS 10.9.2, Microsoft Word and Microsoft Excel.

IV. RESULTS AND DISCUSSIONS

A. Nature and dimensions of flood

Amidst all fluvio-geomorphic hazards, the emergence of floods has been common phenomena mostly in the riverine plain. River flood coupled with siltation is complex processes ravaging people along with their homesteads (Buragohain and Bhuyan, 2015). Floods are recurrent in the village occurring in the months of June, July, and August. The occurrence of floods, however, varies each year because of the variation in rainfall patterns in the upper catchment areas of the river Singra. Floods generally occur during the peak monsoon season.

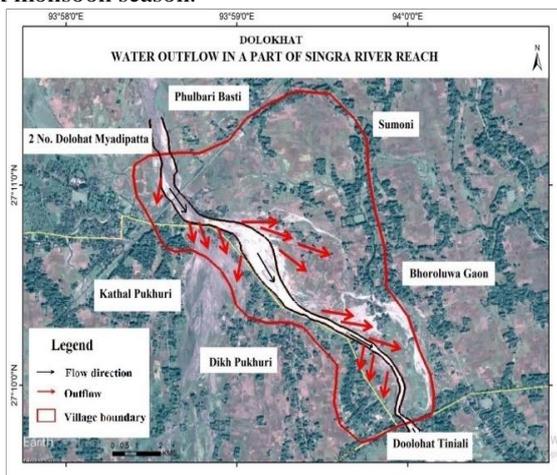


Fig. 2: Water outflow of the river during the peak monsoon period

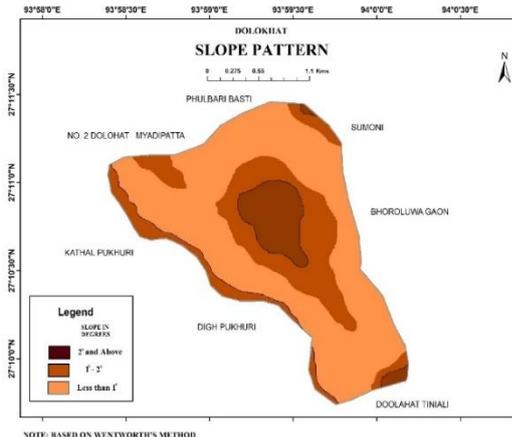


Fig. 3: Slope pattern of Dolokhat village

During the peak monsoon months, when the river water level increases it causes floods in the village. The water of the Singra river overflows its bank and thus causes floods (Fig. 2). Sometimes, the floodwater flows and joins the Mora-Singra river. The central part of the village, which is relatively lower in elevation than the other parts (Fig. 3), is frequently flooded because the river water flows following the slope and is deposited at the lower part as Singra river has a depth of above 2°. A part of the village on the western side has a slope between 1° to 2° indicating the depth of the village higher than the riverbank.

B. Pattern of bank line shifting

Flowing from source to outlet, a river leaves its imprint by changing the entire landscape it passes. A channel shifts when water overtops during floods by cutting its bunds and also due to extreme tectonic movements. Channel change is primarily attributed to the combined effects of both natural and anthropogenic activities. In the study of flow dynamics of a river, the magnitude of channel change plays a crucial role required for proper channel design, river restoration, watershed planning and management (Goswami, 2013).

Table 1: Erosion and deposition scenario in the village

Year	Erosion (in hectare)	Deposition (in Hectare)
2005	-8.12	5.76
2009	-14.08	5.32
2015	-18.5	7.06
2017	-22.6	8.01

Source: Computed by the authors.

(Note: negative sign denotes erosion and positive sign denotes deposition)

Similarly, channel change over spatial and temporal dimension is accompanied by both vertical and horizontal movement of the channel. As such, Singri river is too related to horizontal expansion causing bank line migration, bank widening, cut-off, etc. (Table 1). A comparative assessment of bank lines is prepared based on differential periods from 2005-2017 (Fig. 4). During the year 2005, the rate of erosion was 8.12 while deposition as 5.76 that was minimal with lesser destruction (table). In 2009, rate of erosion (14.08%) accelerated than deposition (5.32) while the massive flooding occurred during 2018 with 22.60% area under erosion drowning number of villages, croplands, properties, human lives, etc. The chronically flood-affected areas of Dolokhat village have been shown in Fig. 5. Pre-monsoonal shower causes the river to overflow at Naoboicha and due to breaching of the embankment; heavy losses were witnessed by the dwellers.





Fig. 4: Bank line shifting (2009-2017)

Noteworthy that, the river has been shifting its course towards the east due to which erosion has been a very common phenomenon.

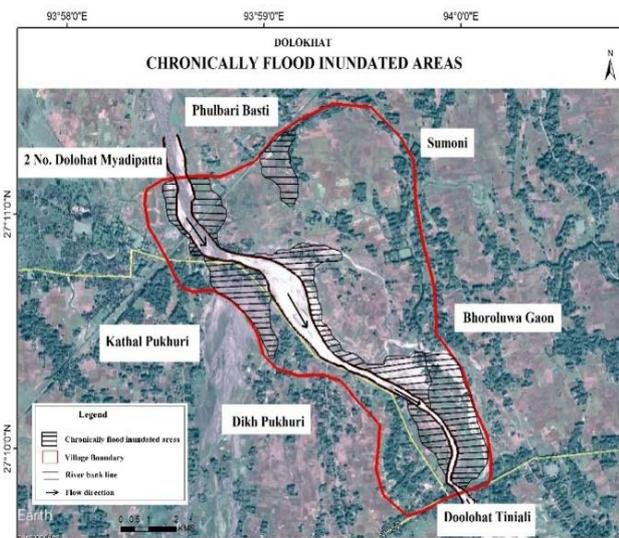


Fig. 5: Chronically flood inundated areas in Dolokhat village, 2018

C. Flood hazard and its causes

The complex river system coupled with differential factors has caused widespread devastation to the entire region. Of this, the effects of monsoonal rhythm are considered as the main driving force responsible for such a disaster. Situated in the tectonically active zone, the Brahmaputra valley experiences high frequency floods especially after the major earthquake of 1950 that led to the rise of river bed from 2.5 to 3 meters near Dibrugarh (Bora, 2003).

Apart from naturally induced factors, anthropogenic causes have also contributed substantially increasing the quantum of inundation and flood damages. Encroachment of floodplain dwellers and unplanned settlements in the study area have led to severe flooding problems. Another significant factor is the construction of embankments that hinders the free flow of river water, thus breaching occurs flooding the nearby areas for a prolonged period. Another significant factor for the drowning of the village is due to the Ranganadi or Red river in the upper catchment area of Arunachal Pradesh (ASDMA, 2017).

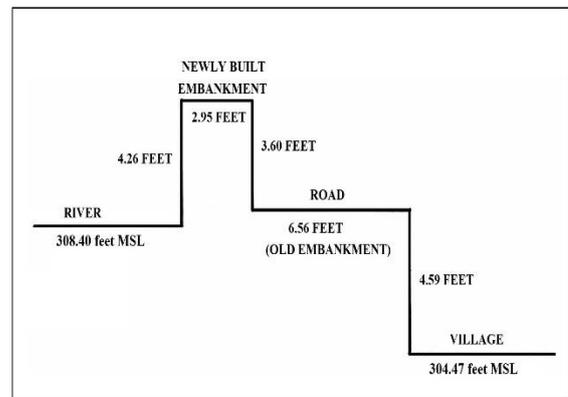


Fig. 6: A schematic diagram showing the differential altitudinal positions of the riverbed, newly constructed embankment, road, and the village.

As such due to heavy downpour in the upper catchment areas of the river Singra, the Dolokhat village and its surrounding areas are acutely inundated. The river Singra entering the plains from the foothills causes floods in the plains as the immediate downstream areas are also having similar elevations. Therefore, excess river water does not flow immediately and takes time to flow downstream. Hence, the river water overflows its banks thereby causing floods. However, it is interesting to note that the riverbed is located at an elevation of about 94 m, while the village is located at an elevation of about 92.80 m. Thus, the village is located 1.10 m lower than the riverbed (Fig. 6). Noteworthy that the newly built embankment was constructed with sands (Fig. 7), therefore it is easily breached by the river water during the peak monsoon season. Sandy soils are more prone to erosion from rainwater and runoff (Thorne and Tovey, 1981) because they are loose and thus are eroded easily. Again, as water always flows from the higher altitudinal to lower altitudinal areas, the river water then flows over the old embankment, which acts as the road, and finally, the river water enters the village causing severe problems to the people.

D. Undergoing problems and human adaptation/responses

The people in the villages of the Brahmaputra valley have long been facing a large number of problems caused by the floods and thus, adapt themselves accordingly with the flooding situation (Nayak and Panda, 2016). People belonging to different castes and communities have their own ways of coping up with the flooding environment. Similarly, the Dolokhat village has been undergoing severe problems because of the recurrent floods. The floods of the Singra river has eroded the agricultural lands of many people due to which they had to engage themselves as daily wage workers. Thus, agricultural production in the village has been affected by floods. It should be mentioned here that during 2018, 4.23 hectares of land has been eroded during floods. Besides, destruction of roads, houses, and other infrastructures, loss of property and domesticated animals, etc. have added to the list of their problems. Noteworthy that, the effect of floods in some areas was so intense that people have abandoned their houses and started settling away from the river (Fig. 8 & 9).



On the other hand, the loss of grazing lands on either bank of the river Singra has posed as another problem for the villagers. Since the grazing lands have been eroded by the river during the peak flood period, therefore, it has now become a problem for the villagers to graze their animals. The farmers of the village usually plough their fields with the help of oxen and such lack of fodder for the domesticated animals has become a serious problem.



Fig 7: Embankment built by sands



Fig. 8: An abandoned house in the village



Fig. 9: A house damaged by floods



Fig 10: Protective measures adopted by the villagers

The people of Dolokhat village also has its own ways of adapting to the wraths of floods. The people of the village try to mitigate the floods by giving obstruction to erode and breach its banks. Bamboos and bags filled with sand are used to prevent the banks from erosion (Fig. 10). Again, banana tree rafts are used during floods as transport for carrying humans as well as their properties. On the other hand, during floods, temporary settlements of tarpaulin (locally called as *tirpal*) are made in the uplands to protect and save themselves from floods.

E. Mitigation strategies and recommendations

As riverbank erosion, floods are the most vulnerable events, thus it is convenient to develop the approach of “living with floods” as such hazards cannot be eliminated completely. Management strategies should be addressed based on the entire river system at the cost of sustainability concerning water resource management. Moreover, people’s active participation is the most appropriate way of dealing with such problems. The laws and policies implemented by the government also have to be checked and reviewed at regular intervals. Advancement of GIS and Remote Sensing techniques have paved the way in many aspects such as in preparing maps on flood-prone areas and assess floodplain zone risks more precisely, monitoring, flood forecasting, etc.

Both structural and non-structural measures are taken under consideration to reduce flood effects. Raising of the embankment with the provision of pipe culverts in order to minimize drainage problems, construction of mini dams or reservoirs to store the excess water, watershed planning and management, etc. (Hazarika, 2016) Moreover, the inhabitants of the sampled village practice few resistant crops that needs to be encouraged by providing subsidies from the government. Nevertheless, due to uneven torrential rainfall, the existing crop calendar should be modified to lessen the effects on crop productivity (Bora, 2003). Additionally, another non-structural measure involves contour ploughing, bamboo plantation, terracing, strip cropping, flood insurance, proofing, etc.

V. CONCLUSION

The above study reveals that the annual floods in the Dolokhat village have immensely affected the lives and livelihoods of the local people creating damages to their properties and infrastructure. The village, because of its peculiar locational and elevation characteristics, has been suffering from the ravages of floods and is inevitable. The high flow in the Singra river occurs during the peak monsoon period from May to August wherein the faulty sand-based construction of embankments easily gets breached swiping the rural poor. In fact, the lateral shifting of the river towards the eastern side has eroded many of their agricultural as well as grazing lands which have destabilized the rural economy and structure. However, the villagers mostly had to rely on the production, based on rabi crops during winter instead of the kharif crops grown in summer. Thus, the locals have long been coping up with the floods and concentrated on cultivating rabi crops. Noteworthy that, the magnitude of floods increases as unscientific and faulty mitigation strategies adopted by the locals. Therefore, proper plans should be executed so that the effects of floods can be minimized to the maximum possible extent.



However, the positive effects of floods, from depositing fertile alluvium on the agricultural fields to restoring groundwater and aquatic ecology should be kept in mind while framing the plans and actions.

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