Flood Management in Assam, INDIA: A review of Brahmaputra Floods, 2012

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Abstract- Brahmaputra is an important river for irrigation and transportation in the state of Assam, India. About 2,900 km long and with an average depth of 38 m mighty river is prone to catastrophic flooding in spring when the Himalayan snows melt. The average discharge of the river is about 19,300 cubic metres per second and floods can reach over 100,000 cubic metres per second. It is a classic example of a braided river and is highly susceptible to channel migration and avulsion. It is also one of the few rivers in the world that exhibit a tidal bore. The river drains the Himalaya east of the Indo-Nepal border, southern-central portion of the Tibetan plateau above the Ganges basin, south-eastern portion of Tibet, the Patkai-Bum hills, the northern slopes of the Meghalaya hills, the Assam plains and the northern portion of Bangladesh. The basin, especially south of Tibet is characterized by high level of rainfall.

Present study is an account of the devastation caused by the flooding in the Brahmaputra during 2012 and a case of Barpeta district Assam with an emphasis to the mitigation and management done by the district administration. The challenges faced by the district officials during flood are one of the prime aspects covered in the study. The study also depicts the probable mitigation measures could be beneficial for the region and henceforth for the flood prone states.

Index Terms- Brahmaputra, Disaster Management, Flood, Hazard, Vulnerability.

I. INTRODUCTION

By virtue of geo-climatic conditions about 60 percent of the landmass of India is prone to flood and it is the most common of all environmental hazards. Flood regularly claims over 20,000 lives per year and adversely affects around 75 million people worldwide (Smith, 1996). The reason lies in the widespread geographical and geomorphological distribution of the tracks of rivers and floodplains and low-lying coasts, together with their longstanding attractions for human settlement. Death and destruction due to flooding continue to be all too common phenomena throughout the world today, affecting millions of people annually. Floods cause about one third of all deaths, one third of all injuries and one third of all damage from natural disasters (Akew, 1999).

Among all natural disasters, floods are the most frequent to be faced by India. Floods in the eastern and northeastern part of India (Orissa, Bengal, Andhra Pradesh, Bihar and Assam) in the recent past, are striking examples. The annual precipitation, in India, including snowfall is estimated at 4,000 Billion Cubic Meter (BCM). Out of this, the seasonal rainfall in monsoon is of the order of 3,000 BCM (Report by Central Water Commission (CWC)). The rest includes sparse rainfall, lower depression and rain due to cloud bursts.

The records of the last century show a trend of widening of the Brahmaputra in Assam. The Brahmaputra occupied around 4000 sq. km in the 1920s and now the Brahmaputra occupies about 6000 sq. km (WRD, 2008). Based on the satellite image estimation of area eroded in the Brahmaputra for the recent years of 1997 to 2007-08 (WRD, 2008), the total land loss per year (excluding avulsion) is reported to be from 72.5 to 80 Sq. km/year. Bank erosion has been continually wiping out more than 2500 villages and 18 towns including sites of cultural heritage and tea gardens affecting lives of nearly 500,000 people. In north India numerous streams and rivulets rise in the Himalayan foothills and sub-mountain region from Kashmir in the west to Assam in the east. These streams are subject to flood due to the incidence of heavy rainfall in their respective catchment areas during monsoon. The instant rainfall over the steep terrain causes sharp rise in the water level of streams resulting flood in the sub-mountain region downstream. The rainfall in India shows great temporal and spatial variations, unequal seasonal distribution and geographical distribution and frequent departures from the normal. As reported by Central Water Commission (CWC) under Ministry of Water Resources, government of India, the annual average area affected by floods is 7.563 million ha. This observation was based on data for the period 1953 to 2000, with variability ranging from 1.46 million ha in 1965 to 17.5 million ha in 1978. On an average, floods have affected about 33 million person between 1953 and 2000. There is every possibility that this figure may increase due to population growth. The National Flood Commission (1980) has reported that the total flood prone area of India was 34 million ha. It has also mentioned that an area of 10 million ha has been protected, but the effective protection may be available to only 6 million ha. Main problems in India with respect to floods are inundation, drainage congestion due to urbanization and bank erosion. The river system, topography of the place and flow phenomenon are the different contributing factors responsible for flooding. Being a vast country, the flood problems in India may be visualized on regional basis.

II. STUDY AREA

Barpeta district in the State of Assam was created and started functioning since 1983. The district is spread across 3245 sq.kms. It is surrounded by Bhutan Hills in the north, Nalbari and

Baksa districts in the east, Goalpara and Kamrup districts in the south and Bongaigaon and Chirang districts in the west. Total population of the district is 16,93,190 (2011 census) with a population density of 632 per sq.km. and sex ratio of 1000:951. The major rivers flowing through the district are Brahmaputra, Beki, Manas, Pahumara, Kaldia, Palla, Bhelengi and Chaulkhowa. The rivers flowing through the district are also causes annual floods and riverbank erosion particularly in the char areas (flood plane), leading to a considerable loss of life and property. Barpeta district has overall flat topography with gentle slope towards south (Figure 1). The northern part of the district is slightly elevated, while the southern part close to the northern bank of the river Brahmaputra is low lying and flood prone.

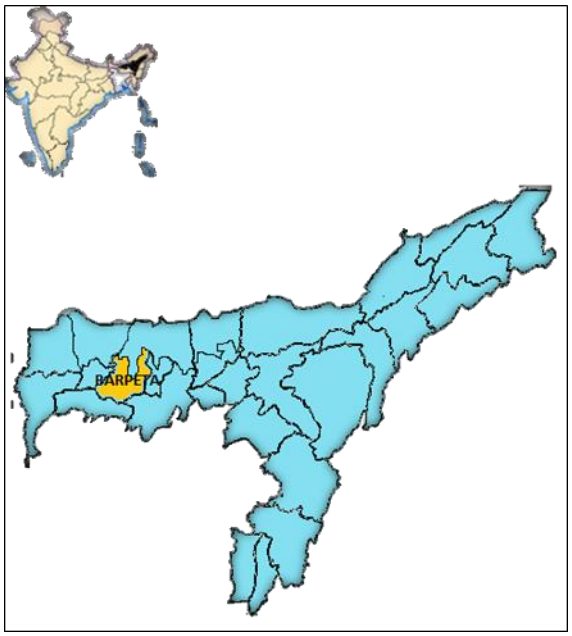

Figure 1: Schematic map of the district

III. 2012 BARPETA FLOOD INCIDENT

Berpeta district experienced three waves of flood during the year 2012. These were one of the most severe floods in the Barpeta history. The river Brahmaputra touched the highest flood level of 43.62 m in the history of last nine years. The brief impacts of the floods are as in Table 1.

Table 1: Impacts of 2012 Brahmaputra flood waves

	Duration of the flood	**Rivers Responsible for Flooding**	**Major Revenue Circles affected**
First Wave	7th to 24th June, 2012,	Pahumara, Kaldia, Bhellengi and Tihu	• Sarthebari (in continuation) • Bajali • Sarupeta • Barpeta (small part)
Second Wave	25th June to 14th August, 2012	Brahmaputra, Nakhanda, Mora Chaulkhowa and Bhellengi	• Barpeta • Sarthebari • Baghbar • Chenga • Kalgachia • Barnagar
Third wave	21st Sep to 15th Oct, 2012	Pohumara, Kaldia, Bharamputra, Nakhanda and Mora chaulkhowa.	• Barpeta • Chenga • Kalgachia • Sarthebari • Baghbar • Bajali

Three waves of flood at Barpeta affected almost entire district. A large number of people and livestock were faced the devastation of flood and large area of agricultural land inundated for a long period of time.

2012 floods of Assam had created severe economic, human and livestock losses. A total number of 686 villages were affected by the floods. Death toll of Human was raised to 36 out of which 23 were males and 13 females. About 4,25,732 livestock and poultry had also been affected.

There was hardly any circle in the district, which has not been affected during the flood period (June-Oct, 2012). Barpeta, Chenga and Baghbar circles were affected entirely and only Barnagar circle was affected least where 5 out of 97 villages were affected.

Since the district is grossly depends on the agriculture, the livelihood of the local communities shattered by the impact. A total of 1,56,480 hectares of agricultural land inundated and about 26,842 hectares of non-agricultural land was also worst affected by the flood. A significant amount of infrastructural damage was also recorded, which includes 12508 completely damaged house, 3521severely damaged house, and 28891 partially damaged house. Large number of roads, bridges, culvert had been damaged along with the losses in other sectors i.e., fishery, water resource etc. Most of the State Highway, PWD roads have been affected by the incessant rains either being inundated or waterlogged causing communication disruption and obstruction in relief and rescue operations.

IV. FLOOD MANAGEMENT BY DISTRICT ADMINISTRATION

Early Warning:

In Barpeta district early warning dissemination was quite effective to connect the last mile. Central Water Commission (CWC), the agency responsible for monitoring of all the rivers in the state, released the first early warning for 2012 flood. In case of rise in water level or any probability from the catchments area, CWC issues the warning to the SDMA/DDMA for further dissemination through EWS established by the DDMA. For each village State Government has appointed a resource person (village head man), who is responsible for the dissemination of early warning in his/her villages during flood situation. Early warning has been disseminated on time for the quick response and evacuation for all the three flood waves.

Rescue and Response:

Since flood is a regular phenomena in the district, District Administration and all the concern departments was prepared in advance to manage the flood situations. As soon as department received the early warning from the CWC, the information has been quickly disseminated to each village in a well planned manner for the evacuation of the people and cattle living in the places have probability of inundation. National Disaster Response Force (NDRF), State Disaster Response Force (SDRF) and District Administration Officials closely administered the relief and rescue works. Major steps towards the relief and rescue explained in Table 2

Table 2: Administrative Response during 2012 Brahmaputra floods.

Step 1	On receipt of warning of the impending flood for all the three waves, part of the immediate response an early warning has been disseminated in each village to warn the people.
Step 2	Emergency Operation Centre (EOC) has been activated in the District on 24 x7 basis.
Step 3	District Administration has been disseminated early warning in the likely affected areas especially to those people who have no access to mass media.
Step 4	Immediately after inundation evacuation activities has been started from the worst affected circles on the priority basis.
Step 5	Adequate number of Disaster Management staff, rescue swimmers, boats, and equipment had been deployed to all the affected villages for quick rescue and relief operations.
Step 6	Flood affected people had been shifted to pre-identified safe places at higher elevations i.e. schools, Panchayat Ghar, embankments.
Step 7	As a key responsibility, food, safe drinking water, hygiene and sanitation facilities etc. has been provided to all the affected people by the District Administration.
Step 8	Search and Rescue activities were also carried out through out the district along with the relief work. All the injured and people needed medical attention had been administered by the medical care unit.
Step 9	Damage assessment has also been carried out for the assessment of loss due to flooding for private and public infrastructures and crops etc.
Step 10	Cost of damages has also been sent to the State Govt. for release of funds from the "Calamity Relief Fund" as per the prescribed norms.

As the 2012 floods were severe as compare to the previous years, the requirement of the boats were comparatively high. About 292 boats were deployed with the rescue teams to evacuate the people and cattle. Approximately 83,731 people were evacuated safely and a total of 105 relief camps were established with all the necessary arrangements and as many as thousands of others have taken shelter on roadsides, embankments, highlands etc. About 40 medical teams had been formed to provide medical assistance to the affected people.

Mitigation Measures by the District:

District Administration was regularly monitoring the early sign of impending flood and rising water level in the rivers on day-to-day basis. Since flood is the regular phenomena in the district so it is essential to monitor the situation in advance for better preparedness. According to the rainfall in the catchment area and prediction of IMD, there was high possibility of the flood hitting the district this year, a number of necessary arrangements / exercises have been carried out i.e. identification of potentially weak areas along embankments and river banks, capacity building, quick response, early warning etc. All the potentially weak embankments were identified as vulnerable sites and mapped by the Water Resource Department (Figure 2). After identification of such sites, repair works in advance has been completed especially for the most vulnerable sits like Pazarbhanga, Manikpur etc. As a next step towards the effective flood management the District administration was done the assessment of available resources in hand and the resources required for worst case. Immediately after the warning for severe rainfall at the catchment areas and speculation of flooding of the district, a 24x7 Emergency Control Room has been established with adequate number of supporting staffs and officers.

Figure 2: Breach and river erosion on the bank of river Bharamputra

Major Challenges Faced by the District Administration:

The 2012 flood situations at the district were significantly well managed but still there were challenges to reach the final goal of zero casualties. During the entire flood management (June-October 2012), number of issues had been identified which need to be addressed on the priority basis to deal the future

floods efficiently. Some major issues and challenges identified by the District Administration are discussed below,

Problem Concerned with People's Return to Home:

Since the embankments are on higher elevation than flood plains, people have taken immediate shelter during the floods. The flood affected victims, who have lost their homes stayed back on the embankment for a long time, some stayed back permanently. Though the people on the temporary embankment are protected physically but on the flip side the temporary embankments are highly vulnerable to erosion and breaching.

Disease Surveillance and Control:

During the entire flood period (June-Oct, 2012), no disease outbreak was reported. District Administration, Medical and Public Health Department were prepared in advance to deal with any disease outbreak situation. A total number of 40 medical teams have been deployed to the various sites for the surveillance and monitoring purpose.

Adverse Meteorological Conditions:

The northeastern part of India generally receives high precipitation primarily due to the Southwest monsoon. Average annual rainfall in the region is very high and ranges from 1750 mm in the plains to about 6400 mm in the hills, this huge volume of water rushes through the narrow bowl shaped valley of Assam to the Bay of Bengal ravaging the area through floods and land erosion. The recurring floods in the state of Assam devastate about 20% of the plain area to as high as 67 %.

River Erosion and Breaching of Embankments:

River erosion and breaching of embankments are major cause for the rapid inundation. Roads and embankments have been breached or overtopped at various places, with the worst breaches developed at places.

Management of VIP visits:

VIP visits during and after flooding have been identified as one of the major challenges for district administration. During the flood situation it is very difficult to manage the necessary arrangements (i.e., security, logistics etc.) for the VIPs as most of the resources are deployed in the rescue, relief and other important work related to flood management.

Coordination among the Agencies

Interdepartmental coordination during disaster situation is one of the important issues need to be addressed. In normal practice majority of the NGOs are trying to reach the affected sites in proximity of roads and headquarter with the similar type of relief materials. Hence, a good coordination mechanism among the NGOs is high priority need.

Boat Management:

Availability of the adequate number of boats during the relief and rescue work at the time of flood was a challenge for the administration. All the resources i.e. boats men, rescue swimmers etc. need to put in loop in terms of regular meetings and exercises especially during the non-flood period.

Relief Camp Management:

During flood managing relief camps were a major challenge for the department especially distribution of food, hygiene and sanitation at the campsite etc. Even each relief camp context presents different unique challenges, which require improvisation and quick problem solving techniques.

Damaged Roads:

Most of the roads were severely damaged including the State Highways, PWD roads due to the inundation and waterlogging caused serious communication disruption in relief and rescue operations. The district administration has planned alternative solution to combat with these situations through the deployment of adequate number of boats for the relief and rescue operations. But restoration of road connectivity is the challenge to pursue quick relief and rescue operations.

Waterlogged Agricultural Land:

In many cases, the temporary small embankments were made to stop the high flow of water inside the town. After the flood is over the same small embankments were acted as barrier to stop the backflow of trapped water. District administration faced huge challenge to drain out the trapped floodwater in the agricultural lands. Finally the administration removed the temporary embankments to help the trapped water for backflow.

Conclusions and Recommendations:

Barpeta is regularly affected by floods due to high discharge in the Brahmaputra and other river system of the district. The main causes of floods are widespread heavy rainfall in the catchment areas and inadequate capacity of the river channel to contain the flood flow within the banks of the river.

Flood hazard and potential flood risk from all sources need to be identified and considered at the initial stage in the planning process. Disaster Risk Reduction need to be mainstreamed in the developmental processes of the district and should preferentially be located in areas with little or no flood hazard thereby avoiding or minimizing the risk. Identification and mapping of all the resources, alternative routes is required in advance in view to the worst flood scenarios along with the capacity building exercises for all the stakeholders including the community. Flood awareness among the communities need improvement along with the concept of community based disaster risk management. Launching public awareness campaigns on flood safety and risk reduction and sensitizing all stakeholders to flood problems and mitigation in flood prone areas is essential.

Water Management is another major identified issue by the District Administration. Presently administration is working on the planning phase of this issue. Since the area is too big, so instead of making embankments, Administration and PWD planning to do the proper channelization of the rivers and tributary system. During the flood time, instead of creating flooding excess water will be distributed in different channels to avoid inundation. Proper channelization of water is an effective and long-term solution for the flood management. In case of embankment development, the concern is the regular increase in riverbed height, as much as big embankments we develop, it will be shorter each year due to the high quantity of sedimentation in

the riverbed. So development of embankments may not be a long-term solution for the problem.

Geographical Information System (GIS) based database need be prepared to map, analyze, plan and manage all the hazards and resources for the better management of future floods. Flooding becomes a major hazard to life and property only when people live on the floodplain. Identification of the unplanned and unauthorized construction in the riverbed areas could be mapped through GIS for planning. Flood hazard maps will be showing flood boundary based on different magnitudes of flood with specific return periods. These maps can be used to regulate developmental activities within the floodplain, so that damages could be minimized. Some of the data required for hazard mapping is difficult to obtain from ground measurements and it is time consuming; in such cases satellite imageries plays an important role. Satellites provide synoptic and frequent coverage of flood affected areas and thus become valuable for monitoring flood disaster. Thus satellite data can be directly used for deriving the flood inundation limits. If satellite data sets during flood times are available over a period of time for a floodplain, they can be conveniently used for hazard zone mapping.

A GIS based detailed mapping and modeling will be useful for flood hazard. Flood zones are geographical areas likely to be flooded in a particular range and they are also a key tool in flood risk management within the planning process as well as in flood warning and emergency planning. The basic concept of flood plain zoning is to regulate land use in the flood plains in order to restrict the damage due to floods, while deriving maximum benefits from the same.

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