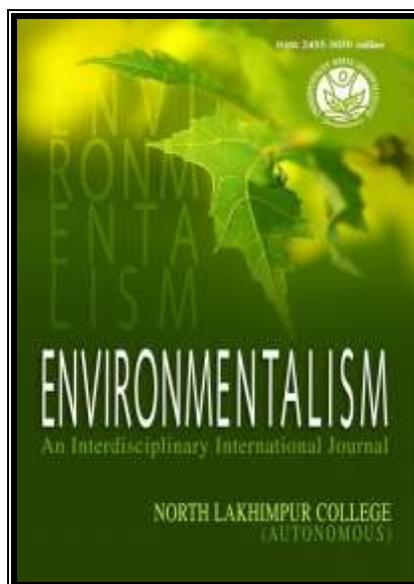


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## **FLOOD ADAPTATION TECHNIQUES AND ITS APPLICABILITY IN JIADHAL RIVER BASIN, DHEMAJI, ASSAM, INDIA**

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### **Abstract**

**Flood is a chronic problem of Assam. It occurs during every monsoonal months of the year and creates havoc among the riverine people of the state. Because of the fertile soil and high agricultural potentiality, people also continue to live in these regions and developed many ways of adaptation to live with flood. The concept of flood management has changed now. It turns towards the idea of ‘living with flood’. Although, flood management can be achieved through several alternative procedures, attempts are now directed to non-structural measures. This paper tries to enlighten the modern and traditional flood adaptation techniques and rural development program of Jiadhhal basin of Dhemaji, Assam, India.**

**Key words:** Flood adaptation, Jiadhhal River Basin.

### **1 Introduction**

Flood is the inundation of normally dry land resulting from the rising and overflowing of a water body. It is the most destructive natural disaster on a global scale and the damages caused by it is increasing year after year. In monsoonal India, where average annual rainfall is more than 2000 millimeters, flood is a normal seasonal feature. It occurs because of natural cause like heavy rainfall, cloudburst, snowmelt, removal of vegetation and man made or artificial cause like dam failure and paving and construction (Ayog *et al.* 2006).

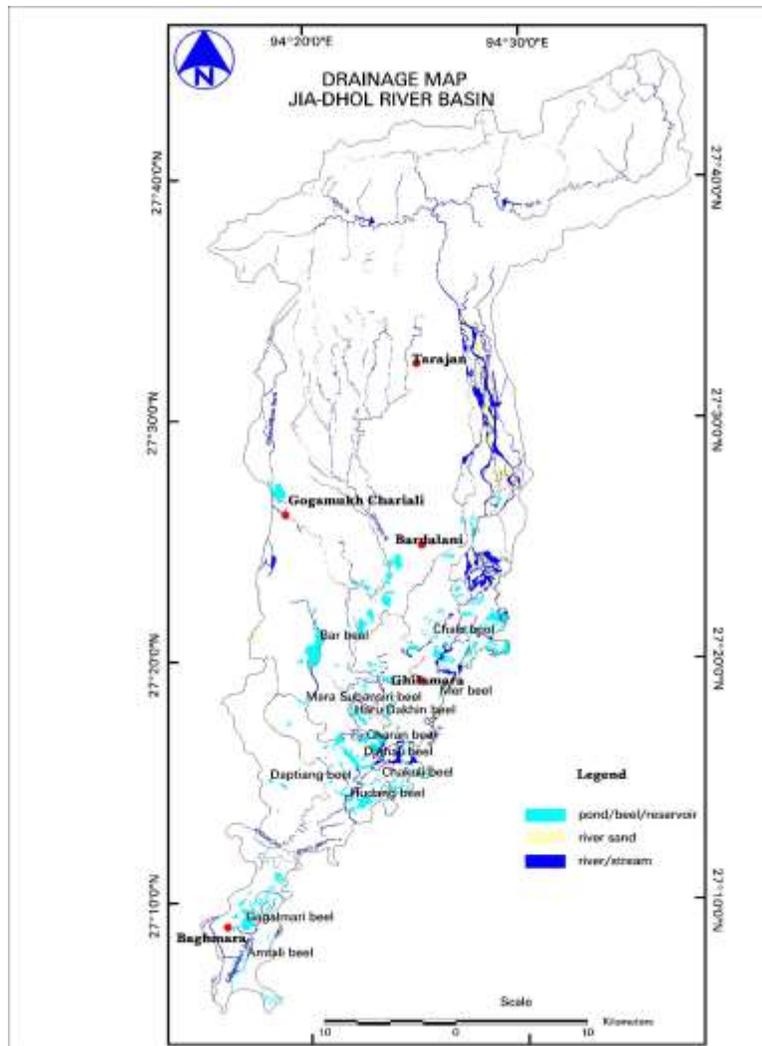
Assam is the severest flood affected state of Brahmaputra basin, which is highly dependent on agriculture. Large magnitude, high frequency and extensive devastation are the important characteristics of the flood of Assam. Every year almost three million people are affected by the floods in Assam and the annual loss, due to flood damage cross the limits of 650 crores (Source: National Flood Commission).

### **Background of the Study area:**

The study is confined to the Jiadhhal river basin of Assam. The basin covers an area of 1122 km<sup>2</sup> having latitudinal and longitudinal extensions of 27°08' N to 27°45' N and 94°15' E to 94°38' E respectively, Figure 1. Out of its total area, Arunachal Pradesh claims 397.94 km<sup>2</sup> i.e. 35.47 percent and rest 724.06 km<sup>2</sup> i.e. 64.53 percent belongs to

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Assam. The basin is bounded by Moridhal river basin in the east and Subansiri river basin in the west. Rising from the West Siang district of Arunachal Himalaya at an elevation of 1247 m. Jiadhah traverses a distance of 65 km through mountains and hills and after passing through a narrow gorge in Arunachal Pradesh river enters the plains of Assam in Dhemaji district where it flows a braided pattern. After receiving Kumotiya, Jiadhah is known as Kumotiya River, but from the railway line to Gogamukh- Ghilamara, it is known as the river Sampara. Jiadhah traverses 122 km through plains and finally debouches into the Kherkatia Suti of the River Brahmaputra near Kathonigaon (90m from MSL). But after construction of the embankment over the Kherkatia



**Figure 1. Drainage Map of the Jiadhah River Basin.**

Suti (1965-66), the river falls into the Subansiri River system. The whole basin experiences heavy rainfall (average annual rainfall is 3,500mm. as recorded). Jiadhah carries heavy silt load from the hilly catchment area during the flood season and deposits on its bed in the plains. Due to this fact, the riverbed has risen up considerably and the river follows a braided pattern with its width is more than 3 km in some of the reaches. Large scale sedimentation has made large areas of land sand casts and unfit for agriculture. Several villages have been completely eroded

away leaving no trace of their existence, while many other villages are completely buried under the sediments. It hampered the agrarian economy of the basin very dangerously and affects the rural development. Acute shortage of food and occurrence of diseases are often grim in this region during flood (Gogoi *et al.* 2013). The river has a tendency to shift its course towards its left bank. The total length of the river is 187 km.



**Figure 2: Photographs of the Agricultural land affected by Sand/Silt Deposition**

**Anthropo-genetically** Jiadhal basin has a unique position in Assam due to transitional metamorphosis of different ethnic groups. The demographic identity of the area is vividly significant for its schedule tribe and schedule caste population. These populations have different mode of attachment to the rivers and other natural resources. The prominent groups are Mishing, Sonowal, Deori, Hajong, Lalung, Kachari, Namasudra, Koibatra etc. Each of these ethnic groups has their own cultural, social, structural and religious features.

## 2 Database and Methodology

The Maps are drawn by using Survey of India's Topographical Maps( No. 83 I/6, 83 I/7, 83 I/8 and 83 I/10 on 1:50,000 scale) and has been verified by satellite imagery (IRS-1C,LISS-III). Data (from1973-2003) are collected from the concerned departments of Govt. of Assam (Water Resource Development Department and Brahmaputra Board) and Central Govt. offices (Geological Survey of India etc.). A village survey is conducted to identify various crop types, production and land-use characteristics. A map is prepared showing existing and potential flood hazard zone.

## 3 Traditional Techniques of Flood Adaptation:

Adaptation to extreme environment including flood is inherently a human survival trait. Hence, over centuries, communities living on floodplains have evolved many techniques of adaptations and have learnt to respond positively towards flood hazard reduction. The floodplain settlers of the Jiadhal basin also have their own traditional and cultural believes to cope with the changing scenario of flood. Because of their diverse socio-economic and cultural factors the impact on different communities varies and thus the vulnerability also has different dimensions. The most unique adaptation that has evolved in response to flood disasters is the *stilt houses*. Over the centuries the Mishing and Deori tribal group of the area have developed the elevated "saang ghar", a raised platform bamboo house as their shelter. These houses were generally not submerged in normal floods. Another best practice which has

been traditionally developed and adopted by the community is *raised granary* system which ensuring security of food grains and hay for animals, from high flood. They use some *wooden raised grinder* during flood. Another important system of adaptation is boats. Every household has their own *wooden boat* as a chief mode of transportation during the flood. Some people make *rafts from banana* tree trunks at the time of need. With this cheap mode of transportation they collect drinking water and fodders for animals etc. from distant places.

Regarding agriculture, in these rural villages, especially where paddy farming is the main occupation, floods cause extensive crop damage. Four distinct types of paddy grown in this area are: Sali (winter paddy), Ahu (autumn paddy), Boro (summer paddy) and Bao dhan (deep water paddy). They grow the tall, bold-grained, indigenous rice varieties, which don't require much care. Flood generally affects Ahu during the maturity and Sali in its early and late periods of growth. They prefer flood resisting rice variety like gaya and high yielding variety with short span of cropping seasons, now-a-days. Crop diversification and mixed cropping is one of the critical mechanisms adopted by the farmers to guard against heavy losses. Farmers cultivate a number of crops in different landholdings. Mixed cropping of Ahu and Bao rice is a common strategy in the low-lying areas. If the weather is favorable the Ahu crop is ready before the flood. Even, if there is early flood damage to the Ahu farmers are able to harvest sections of the Bao crop. No doubt, farmers cultivate varieties of vegetables like pulses, mustard, potato etc. in winter for their economic development. Flood dwellers do not have the idea of orchard. They do not have definite household area with distinct boundary. They live together in a particular locality with some public resources.

#### **4 Modern Techniques of flood Adaptation:**

The various measures adopted for flood management may be categorized into two groups, viz., structural like construction of embankments, reservoirs, channel improvements, town protection etc. and non-structural like flood forecasting, flood plain zoning etc. etc.

#### **5 Embankment System:**

After the countrywide disastrous flood in 1954, the choice of construction of embankment had been taken due the following reasons:

- i. They are easy means of preventing the overflowing the banks.
- ii. Initial cost of construction is less and can be constructed quickly
- iii. Maintenance is easy
- iv. Increases the storage capacity of river
- v. May be used as shelter during flood period

So, in Jiadhah basin also embankment is the highest used method of flood control. The important ones are:

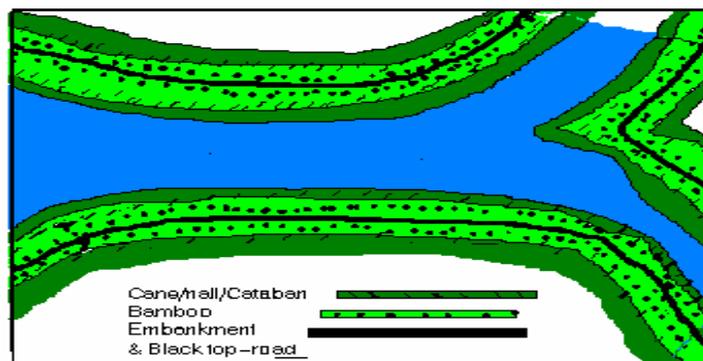
- i. Major Embankment (M.E.) along left bank of Jiadhah from Tinigharia to Rly. Line of length 6.05 km. (constructed in 1956-57).
- ii. Flood prevention dyke of Jiadhah basin with a length of 5 km. (constructed in 1976- 77).
- ii. Extension of Jiadhah dyke from Basin to Tinigharia of length 5 km. (constructed in 1987-88).

But because of the loose, sandy soil character of the basin embankments are easily erodible and during the high flood breaching cause heavy damage of life and property. Failure of embankment generally depends on-



- i. The prevailing slope of the embankment
- ii. Soil condition
- iii. Action of mouse to store the rice etc.
- iv. White ant treatment
- v. Human action

Embankments put limits to the river channel. The sediments which was to be deposited in a much wider area in the absence of embankments, is deposited in a limited river channel. Thus the river bed rises at an accelerated rate and consequently the flood water level rises. But by planting local cane and bamboo parallel to embankment one can protect that easily. Figure 3 indicates such an idea about long lasting embankment system.



**Figure3: Plan for a stable and permanent embankment system for unstable Jiadhal River. (Plan after Dr. M. Kar)**

This figure gives an idea regarding the construction of long lasting embankment by planting cane and bamboo with parallel to embankment. This model already practiced in many parts of Assam and greatly applicable in case of Jiadhal basin also.

**6 Flood-plain zoning (FPZ):**

Flood-plain zoning is another very effective technique of flood management. Detail map of flood-prone areas of

**Table1: Flood Hazard zonation of Jiadhal River Basin**

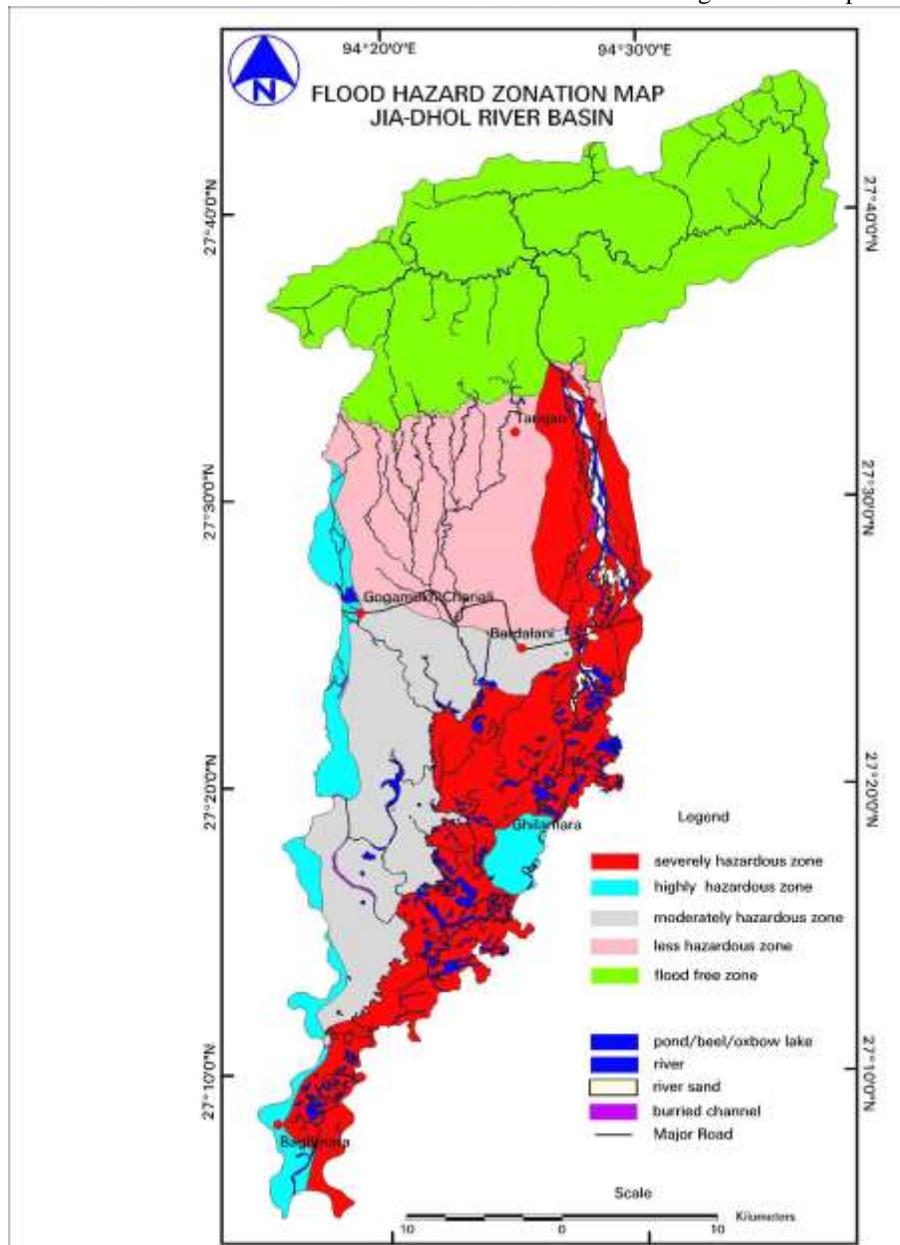
Sl. No.	Flood hazard zone	Area in Km <sup>2</sup>	Area in %
1	Severely hazardous zone	282.89	25.21
2	Highly hazardous zone	69.56	6.20
3	Moderately hazardous zone	181.61	16.19
4	Less hazardous zone	181.64	16.19
5	Flood free zone	406.30	36.21
	Total basin area	1122	100%

Jiadhal basin is prepared after a thorough study of flood cycle. After observation it is cleared that the whole hazardous situation is a result of the intensive human intervention on the upper reaches of the river. In addition to

this construction of bridges and roads aggravate the situation. The huge extraction and mining of boulders from the upper reaches of the river has increased the current manifold leading to intensive erosion on both the upper reaches as well as on the bank line on the plains. The NH 52 which connects Dhemaji town with rest of the country through roadways often breaches at two points in Samarajan locality causing great threat to the area. Five flood hazard zones are identified and demarcated as shown in the table 1.

### 6.1 Severely hazardous zone

The severely hazardous zone is confined within the embankments. It includes large number of ponds, beels, oxbow



**Figure 4: Flood hazard zonation Map**

lakes, buried channels etc and the active flood plain zone of the basin. In order to protect the flooded area on its left bank, the embankments have been constructed. In the year 1992, serious erosion occurred on the left bank and the



river avulsed causing breach of the dyke near Kekuri Village on 22.06.92. The river avulsed through this breach and started flowing almost parallel to the railway line towards the west. This breach has not been closed so far and the present length of the breach is 1.335 km. Another breach occurred in this embankment due to erosion near Dihiri Village on 05.07.98. This breach has also not been closed so far and the present length of the breach is 800m. After the occurrence of the breach of the embankment near Kekuri village, the railway line was working as an embankment for the avulsed course of the river Jiadhah. Gradually the avulsed course started affecting the Railway embankment. Finally, during the flood season of 1998, the railway track near Samarajan was breached. The places like Bardoloni, Samarajan, Batgharia, Naruathan, Ghuguha, Sampara, Batamari Kekuri etc. are under this zone which covers (25.21%) an area of 282.89 Km<sup>2</sup>.

### **6.2 Highly Hazardous Zone**

Because of the protection of present embankment, the area within Ghilamara and its adjoining area including Dighali gaon etc are found to be a highly hazardous zone. This zone covers 6.20% of area, which is 69.56 Km<sup>2</sup> of the basin.

### **6.3 Moderately Hazardous Zone**

The localities viz. Gogamukh, Bordoi bam (including Bordoi bam tea estate), Beelmukh, Bagvia etc. are under this zone. This zone includes (16.19%) a vast area of 181.61 Km<sup>2</sup>.

### **6.4 Less Hazardous Zone**

Entire foot hill region, piedmont plain and area including Tarajan, Uriyamguri, Gobindpur, Okhamati, Sonapur etc of upper alluvial plain, are included in this zone. This zone covers an area of (16.19%) 181.64 Km<sup>2</sup>.

### **6.5 Flood Free Zone**

It is the largest zone including the entire area covering Arunachal Pradesh (36.21% or 406.30 Km<sup>2</sup>) of the river basin. Though the region has a dense network of streams but because of its high slope there is not any possibility of flood in this zone. So, it is delineated as Flood free zone (Hazarika 2007).

## **7 Agro-Research for Greenery and agriculture over the sand deposits:**

After the destruction of natural forest in Samarajan area due to high sand deposits the entire region converts in to a semi desert zone. But some local grass varieties are to be seen gradually. Among them the important ones are Keyabon (*Kyllinga brevifolia*), Bon-rohor (*Desmodium sps.*), Lajukibon / the sensitive plant (*Mimosa pudica*), Panic grass (*Penicum sps.*), Jetulipoka / Wild raspberry (*Rubus sps.*), Duboribon / Bermuda grass (*Cynodon dactylon*), Kohua / Kans grass (*Saccharum spontaneum*) etc. Regarding agriculture Agri-Scientist innovate some new varieties of rice like Bali Sali, Juai Khowa, Kekowa for the sand casts agricultural field of the basin. Sand covered area with P<sup>H</sup> value 5.7, are potential for certain crops and vegetables like potato, beat, frenchbean, Garlic, linseed, carrot, cabbage, Brinjal, pumpkin, Sweet potato, water melon and sugarcane.

## **8 Other Techniques:**

An **advance warning** and **flood forecasting** system needs to be developed through coordinated action among Arunachal and Assam for timely warning and controlling the losses in the basin. **Flood Insurance Scheme** for the dwellers of flood prone area can be introduced as an effective measure for providing relief to people. A substantial increase in **rural credit for farmers** including small and marginal should be introduced to enhance the agricultural

growth which will lead economic progress, opportunities for a healthy and productive life to rural families. A **large scale plantation programs** in river catchment should be introduced to reduce soil erosion. A **modified new cropping calendar and patterns** should be implemented on the basis of their local agro-climatic environment to minimize crop loss (Nguyen 2003). Activities of **self-help groups and rural credit and thrift society** also can support to develop the rural riverine economy of the basin. Government and NGOs can **organize workshop etc to train the people-‘how to live with flood in a better way.’** They can supply the seedling for agriculture just after the flood for transplantation, which must be grown in a high platform or a distant place.

### 9 Conclusion:

Jiadhal is special in many ways. **First**, it has a very large catchment area in its upper course. The area receives very high amount (5000mm) of rainfall which supply a huge amount of water to its 1630 numbers of first order tributaries, particularly in rainy season. When continuous heavy rainfall occurs in its upper catchment area, this shallow river becomes beyond control. It creates flash flood affecting the railway line and National Highway No 52. As a result Dhemaji becomes isolated from rest of the country in every year. **Second**, as the river flows through Dhemaji District of Assam, the distance between its foothill and confluence is very short. The slope of the area is also almost plain. So, in that very low gradient Jiadhal river frequently changes its course. **Third**, the river is originating from the loose and fragile Himalayan sedimentary terrain as a result the down-cutting capacity of the tributaries is very high. The developmental activities of Arunachal portion e.g. construction of road, emerging new urban centre etc. affect the permanent vegetal cover of the region. It leads to generate huge volume of sediments in its hilly part. But in plain because of very low Gradient, river deposits a huge amount of sediments in the channel. Because of this, the river bed becomes higher than the adjacent agricultural fields. In every monsoon season, river changes its course affecting the surrounding agricultural fields and settlement. And **last one**, the absence of channel continuity i.e. the absence of a permanent channel (due to shifting of the river channel) is also one of the most important causes of devastation activities of the Jiadhal river. Although it's hilly course is very distinct but in plain the river often vanish from its channel and merge with nearby swamps and beels, again it reappears. So, the channel is not sufficient to carry the huge amount of water as well as sediments during the monsoon. The wideness of the river valley is also not uniform in the plain course. In Somorajan part (the devastating part of National Highway 52) its wideness varies from 5 to 7 km. In the lower part of the river, NH 52 and NF Railway are perpendicular to this river. Two bridges (Road and Railway) resist the carrying capacity of the river. So, by considering these above mention causes, instead of flood control adaptation is the best practice for the flood plain dwellers of the Jiadhal Basin.

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