The 1998 Flood and Gumti River Bank Erosion

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ABSTRACT.

The catchment area of the river Gumti is in India's hilly Tripura state. The area of the catchment area is 4,900 kilometers. And, the recorded rainfall is 2,800 millimeter.

Gumti was the only one outlet of the catchment area. To reduce the pressure on the Gumti river, the Government of Pakistan made the men made 'Salda' river about 30 kilometer north of the Comilla district from the eastern border of Pakistan (now Bangladesh) in 1960. It was somewhat helpful, but due to the increasing amount of monsoon rainfall in the upper catchment area had caused the erosion of the southern embankment in 1998 and caused heavy damages to the crops and fish culturing ponds.

The author surveyed the flooding area in 1998 and found that Government's negligence was one of the main causes of southern bank erosion. The erosion could have been protected by the authority should a proper step would have been taken before the erosion in Parura village, 15 kilometer west of Comilla city.

KEY WORDS

Catchment area; Back water; Kinetic Energy; Normal flood; Abnormal flood.

1. INTRODUCTION.

Bangladesh is a land of monsoon rains and mighty rivers. The greater part of the landscape of the country is dominated by the alluvial plains with numerous and unstable stream channels. The three major rivers, namely the Brahmaputra also known as the Jamuna, the Ganges-Padma, and the Meghna, have greatly contributed to the shaping of the landforms, topography and structural pattern of the Bengal basin. (Fig.1. Major river and Flood affected area of 1998 in Bangladesh)

The river Gumti is the only one river of the Tripura state of British India. Though the river is not comparable with the great three rivers but it puts a great role in controlling this State's mainly agro based economy. Before the independence, the king of the Tripura State undertook a project for repairing the Gumti river embankments. The king executed an agreement to this effect on 26th July 1878 (Hanif, 2002). The total length of the river is 320 kilometer, but the distance in a direct line from the point where it enters Comilla district in Bangladesh borderline in "Bibirbazar," east of the Comilla city, does not exceed 64 kilometer. After the liberation of India and Pakistan in 1947, the state had been divided, under the control of Pakistan. Later the western part of the Triputa State was named

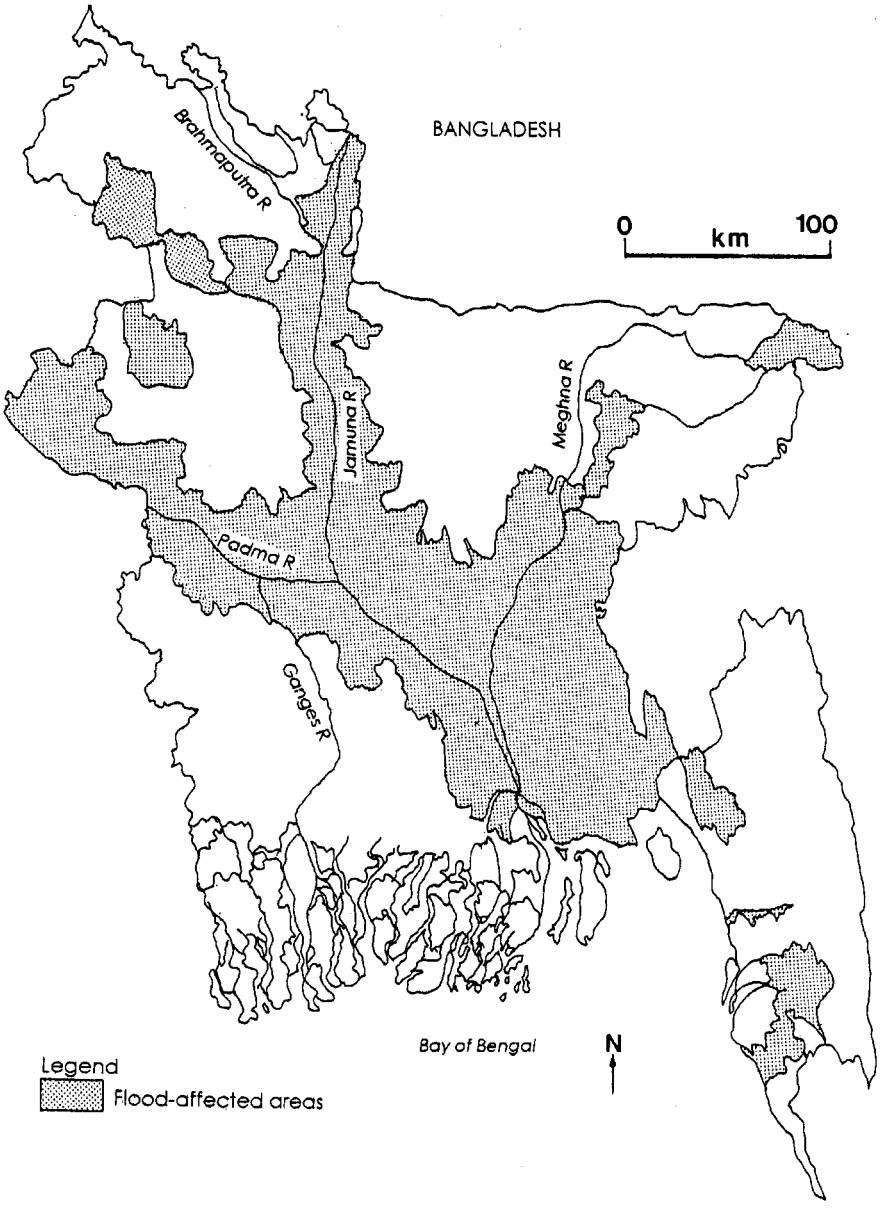

Fig.1. Major river and Flood affected area of 1998 in Bangladesh
Source: The flood forecasting and warning center (FFWC) Dhaka, Bangladesh

Comilla and the eastern part was remained under control of India.

The Comilla city is one of the oldest city in the sub-continent. The British government had named it as the city of Banks and Tanks. This ancient city was formed in the 9th century. However, the Gumti was a trouble maker in the monsoon when the heavy rainfall in the upper catchment area which is now the hilly Tripura state of India (Fig-2. showing the major river and Gumti river floodplain in Comilla. Bangladesh). This heavy rainfall in the upper catchment area had been causing trouble since centuries.

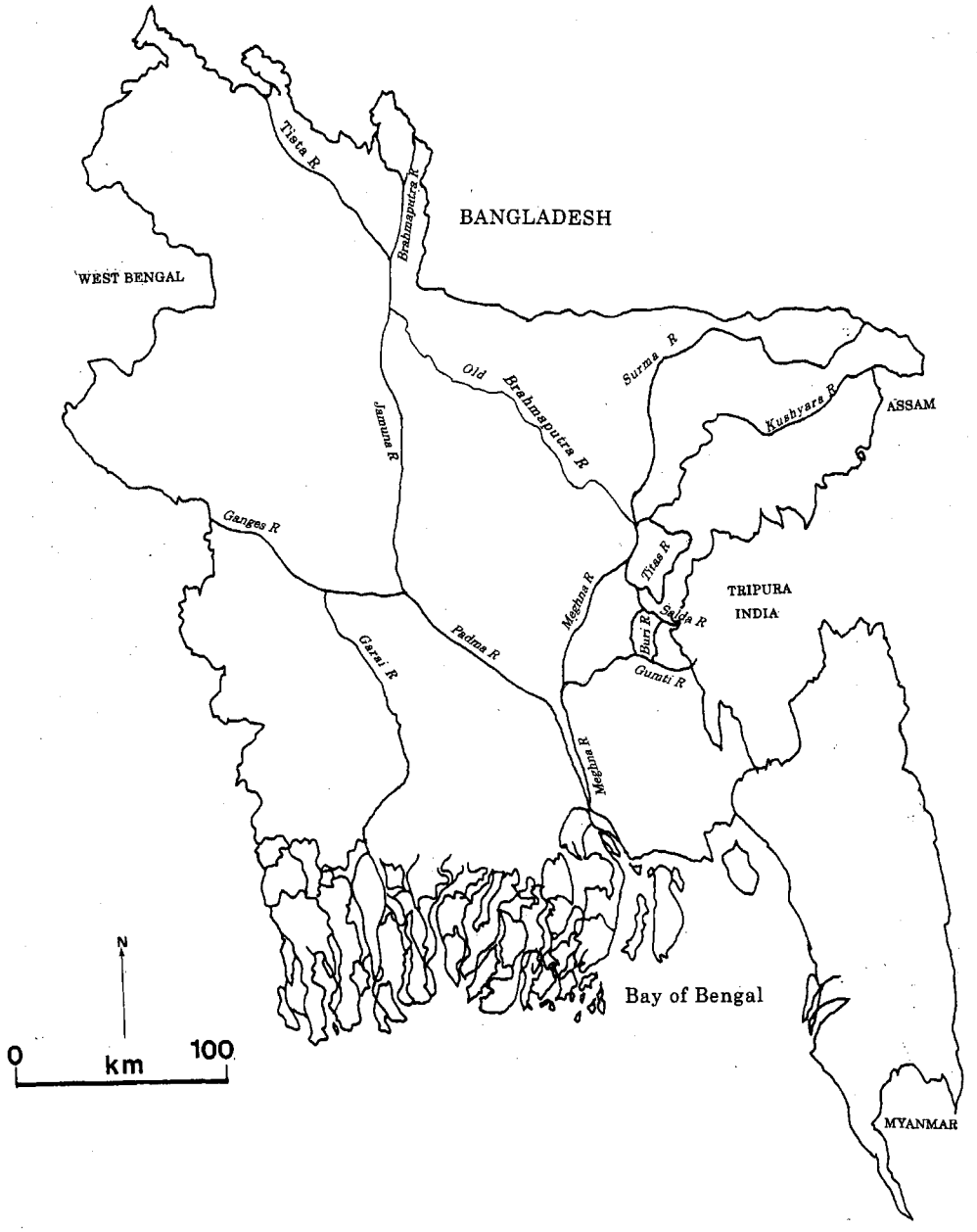

Fig.2. Map of Bangladesh showing the major river and Gumti river floodplain in Comilla. Bangladesh
Source: Bangladesh Space Research and Sensing Organization (SPPARRSO) and Bangladesh Water Development Board.

It was over flooded and destroyed crops and other resources. Probably due to this reason the hundred years old "Gumti River Embankment" was made to protect the city and the surrounding areas. However, the embankments were firmly made during Pakistan period. But after the birth of Bangladesh the Government did not give a proper look to the river banks' management.

However, this is a very old embankment existing from about 300 years back or more. The river's embankments were said to be maintained by the Government from 1669 to 1884 (Hanif, 2002.)

Due to heavy siltation the river basin had rose up and it was one of the main causes of Gumti river bank erosions. There are other causes also can be thought. In 1998, during the prolonged deadly flood in the history of Bangladesh, the southern bank of the river was suddenly eroded and had caused heavy damages to the farmers as well as to the economy of the Comilla district. The river was eroded in the village Parura of Devidwar sub-district, about 15 kilometers west of the city.

2. THE STUDY AREA AND PROCEDURE.

2.1 Selection of the Study Area.

The term normal and abnormal floods refer to the nature of a specific flood event in a given year. Although the overall depth of floodwater during a specific event is the main variable for determining whether it is a normal or an abnormal event, flood depth is also a function of topographic variations. For example, major morphologic depression, such as back swamps and oxbow lakes, are liable to deep flooding, whereas natural levees and other elevated tracts remain above normal flood levels or experience shallow floods. Major deep flood areas of Bangladesh are located along the lower Ganges, the lower Brahmaputra and the upper Meghna floodplains. Practically the author got some ideas on the Gumti river bank erosion at the Parura village of the Devidwar sub-district of Comilla. The Author had visited that area just after the erosion in 1998 and studied the damages of the flooded areas. (Fig: 3 showing the physical model of normal and abnormal floods in Bangladesh).

3. THE GUMTI RIVER FLOOD PLAIN.

The Gumti river is the most significant river in Comilla district in the eastern part of Bangladesh bordering the Tripura State of India (Fig-2. Showing the major river and Gumti river floodplain). This river is one of the tributaries of the Meghna river. The river enters in Comilla district at Bibirbazar, about 13 kilometers north east of the Comilla town. It flows westward through the district and after a long tortuous coarse the river joins to Buri river, a branch of the Meghna in Daudkandi sub-district (Fig-2.) The total length of the river is estimated at about 512 kilometers. But its distance from the "Bibirbazar" point in Bangladesh to the Meghna river is only 64 kilometers. Its breadth is 66 meters, somewhere less. During the heavy rains the river gets full from bank to bank. The width from one bank to another is about 300 meters or more near the comilla city. APB (Associate Press of Bangladesh) from Comilla had reported that the flood situation in the district was remained unchanged as the river Gumti was flowing 84 cm above the danger level (July 23, 1998. The Bangladesh Ovserver.)

The Gumti river's embankment existing from about 300 years back. The riverbanks were maintained by the then Government from 1669 to 1845. The Pakistani Government (from 1947 to

1970) had remodeled the Gumti river embankment under its "Flood Protection Scheme" for the river to protect the Comilla city and its largest military cantonment about 5 kilometers west from the city. This flood protection scheme somewhat reduced the sufferings of those Gumti neighborhoods in the southern side.

During the 1998 great flood, the author had studied the Gumti river bank erosion area. As mentioned above the Gumti river banks has a great role of protecting the Comilla city and its surrounding villages, industries and farmlands in the southern and the northern side of the eastern part of the district. The river's both side embankments are 15 meters in height 3 kilometers south of the city. People in the southern part of the river had experienced a few floods in the 19th century. So, farmers of this area are comparatively richer than the farmers of the northern side of the river. In contrast, the northern bank of the river was eroded many times in the flooding seasons. There were some sayings, the author heard about this matter from the aged people. (They are: 1. The authority of the city used to destroy the northern embankment to save the city and the cantonment. 2. The southern side of the river was full of farmlands. So, they thought destroying the northern embankment was better. However, it is controversial.) In the southern part, the Comilla city, the Devidwar sub-district, the southern part of the Burichong sub-district, the eastern part of the Chandina sub-district. The Gumti has joined to the Buri river which flows accross the Muradnagar sub-district. The Buri river

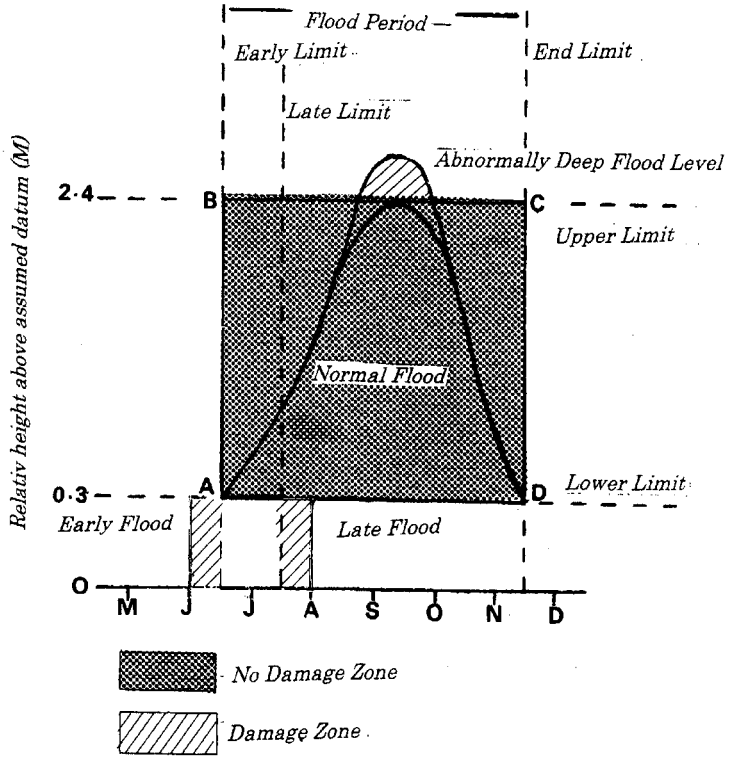

Fig.3. A physical model of normal and abnormal floods in Bangladesh.

flows from the upper part of the Meghna river in the Nabinagar sub-district in the Brahmanbaria district and again joined to the Meghna river in the Daudkandi sub-district of the Comilla district (Fig-2).

The catchment area of the river is in Tripura state and it is about 4,900 square kilometer. The maximum rainfall was recorded 2,800 millimeter. And its total outlet in the western side are two rivers, the Gumti river and the men made Salda river. About 80% of water flows through the Gumti river and the rest of the water flows through the Salda river. This two rivers meet to the Buri river (Fig-2).

The catchment area of the Gumti river is 4,900 kilometer in the south western part of the Tripura state. Though the Gumti river is not so much significant like the big five rivers, but it has an important impact during the rainy season in the Comilla district. The river banks are about 50kms long from the west boarder (Bibirbazar) of the Tripura state. Its role in the 1998 big flood was very serious. The population of the Comilla district is 4,263,538, and one third of its population experienced a serious flood damage due to Gumti river's southern bank erosion at the "Parura" village which is 15 kilometer west away from the Comilla city. As mentioned above that the southern bank erosion was very unusual and that the farmers around this area did not expect such an erosion suddenly. The damages were significant. The farmers lost their boro rice crops within a day. (The crops were supposed to be harvested a couple of days later.) The flooded water had reached near the Comilla city and hundreds of mud houses were damaged. The riverbank was eroded in the last week of August in 1998.

The author thinks the dam was eroded due to the following reason. "The hydraulic efficiency of the river was decreased with the increased rate of migration. 1. A substantial amount of 'Kinetic Energy' was responsible in eroding the river bank. 2. Due to the political turmoil within the parties, the authority did not give a proper looking on the riverbanks. 3. The southern bank of the river in Parura village was almost in a point of collapse during the prolonged flood. The high current of the water had

Table.1. Estimated losses for the Comilla flood in 1998.

Area flooded (km2)	1,700	square kilometers
Average duration of floods (days)	21	days
Number of affected people	106.500	
Number of deaths	150	
Rice production lost (thousand tons)	75,000	
Number of cattle lost	500	
Roads damaged (km)	1,000	km
Embankments damaged (km)	500	km
Number of Bridges and culverts damaged	30	
Number of effected houses	5,325	
Number of schools damaged	150	
Number of displaced people	50,000	

made the bank thinner. 4. Continuous abnormal heavy rainfall of the river's upper catchment area had caused the river current faster and brought millions of tons of silt together. 5. As the channel boundaries of alluvial rivers in Bangladesh are highly mobile. This condition had significantly affected the flood condition.

However, the author learned that the southern bank erosion once happened in the first half of the 20th century. (The author, however, learned about the first erosion of the southern bank from the older farmers. They were above 70 years old.) Location of that erosion was in the Araiura village, about three kilometers west of the downtown Comilla, near the southern side of the riverbank. The 1998 southern bank erosion was happened for the second time at the "Parura village" in the Debidwar sub-district. The location of the first erosion was in the Araiura village, it is about 3 kilometers south west of the Comilla city.

Here, one more factor also can be considered. The water level of the big three rivers had risen in the danger level for the third time in last week of August. This time the water flow of the Gumti river

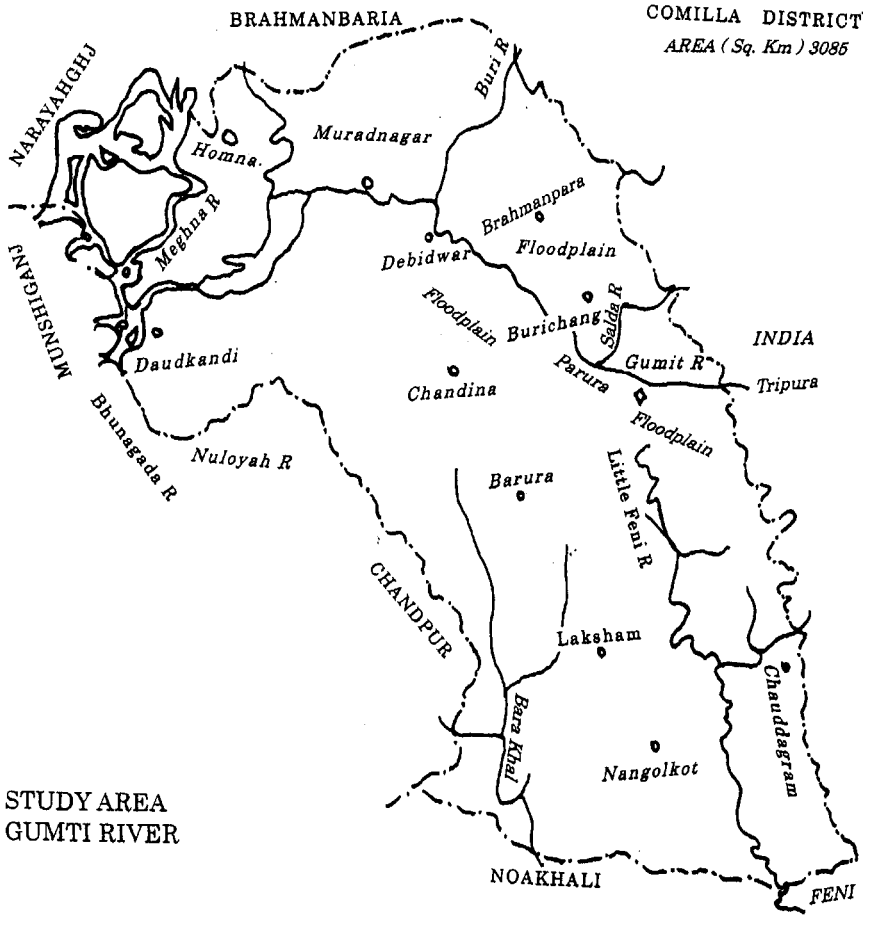

Fig. 4. Map of Comilla, showing the location of the study area in relation to the major river and floodplain.

became slower and for which 'high magnitude' in the water flow of the river put pressure to the banks of the river, so the southern bank was eroded. Here, another cause, the oceanic conditions combined with the high tide may have caused the backwater pressure from the Meghna river. (Fig: 4. Showing the location of study area in relation to the major river and floodplain).

Due to the riverbank erosion, about 500 mud houses were flashed away by the river current. The speed of the current could not be recorded. All in a sudden it was happened, the people of this area were not ready about this bank erosion. The approximate height of river current between the two banks was in danger level (about 3 meter higher than the normal level) and the villagers around the erosion area were in the 3 meter below the water level in the river water flow between the two river banks.

Due to the Gumti river bank erosion and the heavy raining in monsoon some people had to face many other additional problems. A couple of days had remained for harvesting the rice crops when the Gumti river bank eroded suddenly and washed away all the crops. For which the farmer were in panic. The quite matured crops were damaged in this densely populated country. Because they depend on their harvested crops only; otherwise many would die in hunger and diseases. They lost of their cattle, pet chicken and ducks and the cultured fishes from the ponds. Due to the heavy rains the rescue efforts were frustrating in the flooded Comilla district where nearly 70,000 people had been shifted to the shelters. And, rains which were ceased before the weekend had returned back again and half a million people were taking the brunt of the flooding after this river bank erosion.

The erosion had made 100,000 people homeless and flashed away their houses and all of their belongings. But the flood seemed an impossible task until the Gumti river water level was falling and dropped below the base level of the 3 meter high embankment in Parura. (Fig. 4. Showing the location of the study area in relation to the major river and Gumti river floodplain.)

Three people had died when their houses collapsed or were swept away by the floods in the Burichong sub-district area and two others were presumed to have drowned.

Table 2. Tenure and housing structure.

	Gumti N(%)
Number of respondents	94
Age of respondents	
21-40 years	32 (35%)
>40 years	59 (60%)
Tenure at the present address	
21-40 years	38 (37%)
>40 years	55 (53%)
Housing structure	
Earth foundation / thatched roof	77 (60%)
Earth / concrete foundation andcorrugated iron roof.	19 (40%)

This flashed flood had damaged more than 1,700km of roads and rice paddies in 120,000 acres in the Comilla district, according to official estimation.

When 70% land of a country is flooded and the water gets into the houses, the poor conditions of sanitation could be easily understandable. Ordinary latrines and sanitary latrines all of them are submerged under the flood water from hundreds of houses and polluted the water which led to many diseases. So, the poor sanitation during the flood is one of the many causes for spreading out diseases, like cholera, diarrhea, dysentery and hepatitis caused by HV virus.

Another problem is the drinking water. All the water pumps went under water making the crisis of drinking water. People are put in shelters, but the lack of drinking water forced the people to drink contaminated flooded water then suffer from above mentioned diseases. Especially the children are the main victims, and the mortality rate of children were high. In some flood affected areas relief such as food and rice are supplied, but the supply of drinking water were not carried out.

4 . NATURE OF THE QUESTIONNAIRE.

Prion to the formal questionnaire survey, a community report was prepared for each sample village by the team leader of field assistants, based on a reconnaissance of general economic conditions of the village, its agricultural land use patterns, infrastructure facilities, such as rural roads, schools and public buildings, and existing flood control structures, such as embankments and canals. Such reports were helpful in interpreting and analyzing questionnaire responses. The respondents were selected by

Table.3. Types of indigenous adjustments to floods.

	Gumti N(%)
(a) Indigenous flood proofing measures / flood adaptations	
Raised homesteads	90
Raised floors of living quarters	87
Constructed platforms for temporary shelter	28
Took shelter in schools and other public Buildings	40
Took shelter on major roads	23
Constructed shelters for cattle and poultry	7
Used bamboo bridges between houses	2
Used country boats / rafts	38
(b) Agricultural adjustments	
Cultivated aman (in shallow and deep floods)	92
Cultivated aus (in shallow floods only)	0
Cultivated aman and aus together	1
Cultivated new rice crops following flood damage	26

using systematic sampling, proportionate to the number of house in a village. Thus, in the Gumti floodplain (study Area) 94 respondents were selected by sampling every fourth or fifth household out of a total number of 150 houses in four villages. A door-to-door interview was conducted by a team of two to three field assistants under the general supervision of the author.

At lest two type of data were obtained during the course of the interview. First, data on housing structures, such as foundation and plinth characteristics and nature of walls and roofs, were record by the interviewers based on their observation (Table 2). Second, data on indigenous adjustments were obtained by using a checklist (Table 3). Since many of these questions were technical in nature, the majority of respondents failed to provide spontaneous answers. They were then asked to respond to a set of pre- determined answers. The following data reported in this paper are of the latter type.

5. INTERPRETATION.

(A) Tenure and Housing Structure (Table 2).

Following White's (1974) working hypothesis, one of the central assumptions of the Gumti river study area was that the floodplain residents perceptions of causes of floods and their solution preferences were influenced by individual experience of the flood hazards which, in turn, were influenced by the age and tenure of the respondents and the environmental setting of their properties. Data in Table- 2. indicates that the study areas in the age distribution of the respondents and the length of property ownership. Large proportions of respondents in this study area were older then 40 years 60% in the Gumti flood plain. They were long term residents who were born and brought up in their present locations. Data on tenure reflected lack of mobility of the flood plain residents, as all respondents resided at their present address for more than 20 years and at least one half of them lived their for more than 40 years, i.e. through three historic flood (1955, 1987, and 1988). The respondents had, thus, potential for providing valuable information on the flood problems based on their long term observations and experience.

An overwhelming 60% of the houses on the Gumti floodplain (N=77) were poorer in quality with earth foundation and thatched roof. Because of shallow flooding most of the plinth levels of living quarters were low and the elevations of homesteads were often barely above the normal annual flood levels. Thus, despite shallow flooding, the Gumti homes were vulnerable to frequent flooding.

(B) Indigenous Adjustments to Floods (Table 3).

The term adjustment can be defined as a human activity intended to reduce the negative impact of a flood hazard (White, 1974). Adjustments to flood hazards in Bangladesh can be classified in different ways. Modern engineering flood control structures, such as embankment, levees, flood walls and polders, constitute structural adjustment that are intended to modify flood regimes significantly. In contrast, indigenous adjustments comprise all other measures - most of which are of the folk or pre-industrial type - that are intended to adapt to natural flood regimes. 1. Indigenous flood proofing or

flood adaptation may involve certain amounts of structural adjustments, such as raising homesteads above flood levels and the construction of animal refuges; but these activities are usually considered indigenous to contrast them with modern engineering structural measures (United Nations, 1984).

2. Agricultural adjustment refer to traditional cropping practices that have evolved for generations to adapt different crops to varied flood depths at different levels of the floodplains (Rasid and Paul, 1987).

During the 1998 catastrophic prolonged flood events, when the ground levels of a large number of houses were inundated, the residents were forced to take shelter on different types of platforms. Most often temporary platforms were constructed inside the houses (in some places out side the houses where the houses were completely submerged in the lower plains) for cooking, resting and sleeping.

Agricultural adjustments in the sample villages were limited principally to adaptation of two popular varieties of- aus and aman-to varied flood depths and regimes. Aus was the pre-monsoon rice crop of shallow flood area, i.e relatively high lands. Following the aus harvest in July and August, high lands might be utilized for transplanting aman in shallow floods. On the other hand, a special variety of floating broadcast aman, that has adapted admirably well to rising flood levels, was also common in deep flood areas. In shallow flood zones of the Gumti floodplain partially regulated flood levels (by the Gumti embankment) have assured the success of transplant aman. Intercropping was a type of agricultural adaptation to floods, which was designed to secure flood-tolerant aman in case of failure of flood-vulnerable aus (Paul, 1984).

In the Gumti shallow flood area cultivation of new transplant aman following flood damage was reported by 28 respondents.

6. DISCUSSIONS, RESULTS AND CONCLUSION:

Global warming, deforestation in the upper riparian regions and human interventions in the natural functioning of the ecosystem for increasing productivity leading to economic growth, will only cause more frequent natural disasters such as floods. As the population grows and urbanization takes place at an enhanced rate, flood damages will increase and more and more people will become more intensely vulnerable.

Here, the author explained nature of the flood problems. It is essential to differentiate between the three different categories of inundation i.e. those caused by (a) The three major rivers, (b) The role of the minor rivers in the rainy season; and (c) The accumulation of local rainfall due to poor drainage conditions and due to the back water effect of high river levels from the big three rivers.

Another point should be noted that high percentage of the water flow of the rivers in Bangladesh rivers comes from outside of the country. The Gumti river also an international cross boundary river.

From a technical point of view, flood control law and regulation could rationally be achieved by a combination of the technical measures outside and inside the nation's borders. The agreement between India and Bangladesh in this regard for the inclusion of Nepal in this programme which is relating to the development of water resources is a step in the right direction. This does not mean that programme of water control in the country must await co-operation agreements between the three countries. Schemes must be formulated which would fit into the country's later developments with storage facilities outside the country.

The recommendations have been divided into five main groups:

1. Hydrology 2. River bank erosions control, 3. Planning in the non-tidal regions, 4. Relief and rehabilitation measures.

The study area of the Gumti river floodplain is a significant for Comilla district in the eastern part of the Bangladesh bordering the Tripura state of India.

Regarding erosion of Gumti river bank in 1998, was caused due to the following reasons:

Negligence of the authority in observing the water fluctuation, siltation, dredging, detection of the weaker points, where the embankments were slowly eroding due to the prolonged flood period near the Devidwar Sub-District area.

The Prura village is situated in this sub-district. This erosion could be protected easily if the authority would give proper attention when the water current was flowing above the danger level, the local people said to the author.

Conclusion: Flood in the Comilla district can be protected if a master plan is undertaken. About two third of the area could be protected from flood, and irrigation method to the farmlands can be modernized.

The author visited different rice farming areas of Japan. Learning from unique irrigation systems, here the anything flood in the Comilla district can be protected by constructing big dam and embankments in Brammanpara sub-district, Muradnagar and Daudkandi sub-districts. But it will cost millions of dollars.

And to protect the erosion of the Gumti river banks, thousands of cement blocks should be placed beneath the two banks. One more think should be done, i.e., from Devidwar to Muradnagar. The Gumti river banks should be developed properly. The banks should be more higher and wider and dredging in rainy season could reduce the water pressure to the banks.

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Note.

1. Aman, Aus, and Boro crops : Local names of the Bangladeshi rice. Aman rice is cultivated from March to April, and its harvesting is October to November.
2. Aus : It is a pre-monsoon rain crops and the sowing period is March to May and the harvesting period is July and August.
3. Boro : Boro is a winter crops. Its first sowing period is January to February, and harvesting period is April to May.
4. Kinetic Energy : The energy that occurs from the motion of the river water and the product of mass and square of its velocity. The movement energy is called kinetic energy.
5. Taka : Taka is the name of Bangladesh currency. One Dollar is equivalent to 59 Taka.

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