Chapter VI: Impact of Flood Hazard

6.1 Introduction

Bank failure, river shifting and river depositions, associated with flash floods, are primarily nature's way of adjusting fluvial dynamics along the Himalayan margin. Such an adjustment has been deleteriously disturbed by the human interferences. Implementation of various development schemes, construction of human settlement and road to cater the ever-increasing population, exploitation of forest produce to generate work potential, boosting of agricultural growth, tourism, mining and quarrying, on the Himalayan immature geology have triggered the huge and complex disasters (Basu S.R., Ghatowar L., 1988; Dutt G.N., 1966; Sarkar, S. 2007; Starkel L et. al., 2000).

The situation was not so desperate even 50 years back. The hills were densely forested with very thin population and the harmonic relation between the upper and lower catchments were well preserved. Extensive heedless deforestation, haphazard construction of roads and settlements, unscientific and illegal mining activities, inadequate drainage, in other words - unscientific and unplanned usage of land, has led to the establishment of vicious cycle of degradation. During heavy and concentrated rainfall, catastrophic soil erosion and innumerable landslides are caused to transport huge amount of sediments from the upper part of the catchments in the Darjeeling, Sikkim and Bhutan Himalayas to the river (Sarkar, S., 1991, 1996 & 2004). The river like Mahananda, Tista, Lish, Gish, Chel, Jaldhaka, Daina, Rethi, Torsa, Pana, Jainti, Dima, Kaljani, Sankosh, Raidak, Bala, Pagla, Gabarbasra etc. are incapable of transporting the load efficiently under the existing hydrological conditions, especially along their lower reaches (Froehlich, W. Soja, R. & Sarkar, S. 2000). The riverbeds are thus elevating at many places at an alarming rate resulting in lessening of cross sectional areas. The reduced cross sections being incapable of arresting the unusual monsoon discharge caused devastating flood, causing heavy damage to the land and properties. It also endangered the priceless forest lands vis-a-vis wild life, tea gardens, arable lands, settlements and the vital line of communications (Sanyal, 1969; 1970).

Although, flash flood has not been an uncommon phenomenon in the foothill area of Jalpaiguri, the frequency and magnitude of such events has increased many fold during the recent past. Two such catastrophic events during the last decade (1993 and 1998) demonstrate the enormity of damage and ever-increasing threat to the biosphere of the sub-Himalayan West Bengal (NBFCC, 165; WAPSOS, 2003). Some observations and measurements made on the effect of flood are represented below:

6.2 Flood characteristics

The dangers of flood waters are associated with a number of different criteria, not necessarily independent of each other but creating different types of clearly recognizable hazards. A summary of the criteria and related hazards is given below.

a) *Depth of water* often effects building stability against flotation and foundation failures, flood proofing, and vegetation survival have different degrees of tolerance to inundation. In each case these can usually be identified and the depth of hazard be established.

b) *Duration of inundation* is of utmost importance since damage or degree of damage is often related to it. This applies to structural safety, the effect of interruption in communications, industrial activity and public services, and the life of plants including agriculture.

c) *Velocity of flood water* causes high erosive forces and hydro-dynamic pressures. These features often result in complete or partial failure of structures by creating instability or destroying foundation support. Dangerously high velocities can occur on the flood plains as well as in the main river channel that might cause large scale death of animal and human lives.

d) *Rate of rise of river level* and discharge is important in its relation to the time available for giving flood warnings or making arrangements for evacuation and flood fighting arrangements. Rate of rise can therefore, influence planning permission for flood plain occupation and its zoning.

e) *Frequency of occurrence* is related to the overall damage cause by flood. Potential damage in a flood plain relates to the cumulative effect of depth, duration and velocity hazards measured over a long period of time. This will very often, but not exclusively, influence decisions on planning permission, especially if the hazard can be measured in quantitative terms. Cumulative frequency of occurrence of the various hazards is a consideration that farming communities throughout the world have always taken into account, usually on the basis of experience and intuitive reasoning, as they decide the type and intensity of agricultural or livestock farming to employ in regions susceptible to floods.

f) *Seasonality of flood* vis-à-vis inundation of land during a growing season can have a completely destructive effect on agricultural production. Seasonality in large floods is therefore an important influence on severity of flood hazard.

6.3 Environmental impact

It is well understood that the flood problem in sub-Himalayan Jalpaiguri district is a natural process that cannot be stopped. Contemporary flood disaster of Jalpaiguri is essentially man induced. The following processes are in fact responsible for increasing frequency and magnitude of flood disaster (figure 6.1):

- Degradation in catchment area
- Construction of unplanned and wanton embankments
- Filling up of wetlands/depression for the extension of agriculture &settlement
- Encroachment of river valley
- Converting dormant/seasonal/paleo-channel into arable and/or settled area

Flood, like many other natural processes have many beneficial effects on the economy and environment. The traditional flood protective measure (embankment) deprived North Bengal to receive beneficial effects at the one end and accelerates the darker side of flood (aggradations, bank failure, avulsions) at the other end.

The detrimental effect of embankment in controlling flood hazard has been demonstrated globally and it is proved to be counter productive. In North Bengal the NBFCC

constructed 747 km long embankments in Jalpaiguri, Darjeeling and Koch Bihar districts in the name of flood protection. It could protect 870 sq. km area at the cost of 5400 sq. km area brought under threat of flood hazard in Jalpaiguri, Koch Bihar and Darjeeling district.

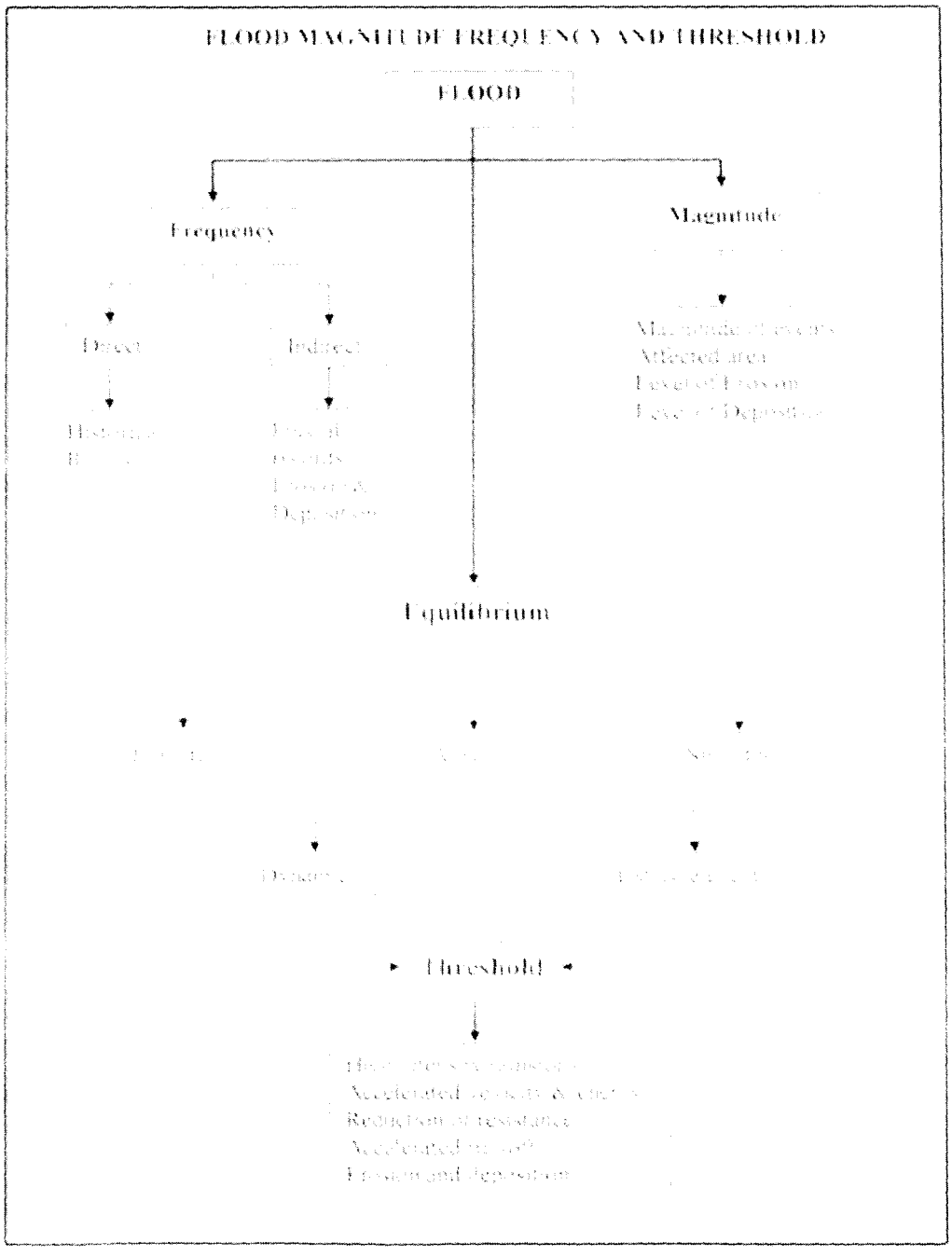

Figure 6.1 Increasing flood frequency and magnitude

Following are the major effect of embankment on the fluvial dynamics of sub-Himalayan rivers:

- Aggradation vis-à-vis rising of riverbed at an alarming rate and in many cases river bed are now higher than the ground level inducing avulsion.

- Providing false security among the local inhabitants and instrumental for large scale human settlement in the river valley e.g., between embankment and active channel.

- Responsible for making the North Bengal's river more unpredictable

6.3.1 Rising of river bed

During monsoon, high intensity rainfall induces innumerable landslides and mass movements, which transport huge amount of loads from the upper catchment to the rivers, which are incapable of transporting the load efficiently under the existing hydrological conditions. Thus, the river beds are rising at many places, resulting in the lessening of cross sectional areas, which being incapable of arresting the unusual monsoonal discharge can cause devastating floods, endangering the vital lines of communications, human habitation, firm lands, forest stands and wild life (photo 6.1 &6.2). During the period 1984 to 2006, the river beds of most of the rivers along the Himalayan margins got elevated significantly (Sarkar S., 2008). The amount of elevation at various locations of these rivers is given in table 6.1

Table 6.1 Rising of river beds(in metre) during the period 1984 – 2006*

Rivers	*Rising of bed level*	*Location of measurement*	*Period of measurement*
Torsa	0.900	NH 31 Bridge, Madarihat	1985-2005
Sankosh	0.800	NH 31 Bridge	1987-2003
Balason	1.124	Near Matigara Tea Garden	1984-2006
Mahananda	1.980	NH 31 Bridge, Champasari	1984-2006
Kaljani	1.310	Near Alipurduar	1992-2002
Lish	2.490	Bagrakot	1982-2004
Gish	1.980	Odlabari	1982-2004
Diana	2.012	NH 31 Bridge	1990-2005
Rethi	2.410	Near Chamurchi	1990-2003
Dima	1.800	Near Rajabhatkhowa	1991-2003
Bala	2.145	Near Santalabari	1991-2003
Jainti	3.050	Jainti	1991-2003
Pagli	2.540	Near Makrapara	1993-2003

** Based on Sarkar S., 2004a; 2007; 2008.*

Photo 6.1. Embankment accelerates river deposition vis-a-vis rising of river bed at the Gish valley near Odlabari.

Photo. 6.2 Embankment induced river bed rising at the Bala valley near Santalabari.

6.3.2 Bank failure and enlargement of river valley

Rising of river beds often invites devastating bank failure. Field study reveals that massive bed material deposits on the Lish, Jainti, Pagi, Bala, Rethi, Diana and Dima during the flood of 1993 and 1998 caused massive bank failure in these rivers at a distance of about 1 to 10 km from the Himalayan margin (photo 6.3 &6.4). Such bank failure often cause

addition burden of silt load to the river. The study on the 1993 flood in the river Jainti revealed that such deposit amounts over 150,000 cubic meters of materials into the river bed, within a stretch of 950 metres near Jainti.

Photo 6.3 Bank failure along the Torsa valley near Satali

Photo 6.4 Bank erosion along the Bala valley in Buxa Tiger Reserve

River valley widening is another significant manifestation of the devastating flash flood in the sub-Himalayan Jalpaiguri district. Study on the river Jainti, Dima, Bala, Pana etc. since 1993 revealed that such increase in some sections is as high as 250% during the last 8 years (Sarkar S., 2008). Comparative analysis of old Topographic maps and recent Satellite imageries show that most of the small and medium rivers in this area expanded as much as two to three times in their valley width during the last 100 years (photo 6.5 &6.6). There is every possibility to form a coalesceing mega-valley within next 50 years in the event of an extreme event like very high intensity rainstorm followed by flash flood of great magnitude.

Photo 6.5 Enlargement of valley due to massive deposition along Dima valley.

Photo 6.6 Enlargement of valley of river Titi near Totopara

6.3.3 River shifting vis-à-vis migration

Rising of riverbeds and bank failures often culminates into the shifting of rive course. Many rivers of this region demonstrate such shifting of which the Torsa, Tista, Jaldhaka, Jainti, Chel, Daikhowa, Jhumur, Daina, Rethi, Pana etc. are noteworthy during the recent past. Such shifting often cause devastation to the arable lands, forest stand, settlements and communication lines.

6.3.4 Loss of forest resources and biodiversity

One of the most important direct loss caused by the unscientific and illegal mining activities in the Sub-Himalayan Jalpaiguri and adjacent Bhutan is the destruction of Jalpaiguri`s rich forest, the best in West Bengal. Recent study conducted by the author reveals, that in between 1993 to 1999, 850 hectares of good forest land was destroyed either by bank failure or by shifting river courses. Over 2 million trees were destroyed – the market price for which are approximately 15,000 million rupees (photo 6.7 & 6.8).

Huge dolomite dust transported by air and river water accumulates on the forest floor, and rises the pH value of the soil (pH 7.5 to 8.1 recorded near Jainti by the author). Alkalinity of the soil hinders the availability of phosphate to the plants. Non availability of phosphate along with alkalinity is found to be responsible for dying of valuable timber especially Sal around Santalabari-Jainti area.

Survey during 1999, reveals that over 5000 trees were dead around Santalabari-Jainti. In addition to this, dolomite dust is also found to be responsible for the destruction of undergrowth rich bio diversity of this area (photo 6.9 & 6.10). This also exerts detrimental effects on the wild life of this region. Shifting of river courses like Jainti, has also destroyed rich bio diversity of this region. It also affects the animal migration. Moreover calcium richness in the fodder and drinking water may cause health hazard to the wild life (Sarkar S, 2004a).

Photo 6.7 Remnants of once dense forest in Buxa Tiger Reserve near Jayanti

Photo. 6.8 Remnants of once dense forest in Reti Reserve Forest near Deklapara, Birpara

6.4 Economic impact

During monsoon, high intensity rainfall induces devastating floods in sub-Himalayan North Bengal causing large damage to the environment, society and the economy in addition to loss of animal and also human lives. Floods also endanger the vital lines of communications and installations, human habitation, firm lands, forest stands and wild life. From the point of view of economic sense the loss was huge and unimaginable and so far no attempt has been made to make an economic cost assessment of flood hazard in sub-

Himalayan Jalpaiguri district. The assessment made by the investigator has been presented in the following sections.

Photo 6.9 Dying Sal tree in Buxa Tiger Reserve, due to deposition of dolomite at Bala valley near Santalabari in 1999.

Photo 6.10 Remnant of once gregarious Sal tree in Buxa Tiger Reserve, in 1996

6.4.1 Loss of tea gardens

Tea gardens of Jalpaiguri and Darjeeling districts are also threatened by flood disaster. In between 1993 to 1999, about 75 hectares of tea garden land was lost forever due to bank failure and floods (photo 6.11). Accumulation of calcium on the tea garden soil has detrimental effects both in terms of productivity and quality. Productivity is decreasing in many tea gardens and the quality is also deteriorating. This has already posed a serious threat to the tea export market. Moreover, such contaminated tea may cause serious health hazards to the consumers. The situation is worst in Makrapara tea garden which lost its 75% of plantation area and 80% of productivity during the past 10 years.

Photo. 6.11 Massive erosion of Rajabhat Khawa Tea Garden near Kalchini

6.4.2 Impact on agriculture

Due to large scale sedimentation in the foot hill regions destroy the arable land. In the study area shifting of river causes are very normal phenomena, many rivers of the district shifted their channels several times which ultimately destroy the vast tract of arable land. Another important sector is widening of the river valleys, sometimes coalesces of the river valleys destroyed the arable land. It also degrades the soil due to unlimited release of dolomite through the air and water accumulation of calcium on the soil surface. This increase the pH value of the soil and makes the soil fertile to sterile.

The largest economic flood-related losses are in the agricultural sector. Obviously most losses to agriculture result from the drowning of crops. Susceptibility to drowning depends on the type of crop and duration of flooding. Some are quickly killed by a relatively small amount of superfluous water. Others can resist as much as a few days of submersion. Even crops that thrive on large amounts of standing water will be killed if the water stagnates as in Koch Bihar district example. Other agricultural losses occur in the submersion of crop storage facilities. Grains and other crops will quickly spoil if saturated with water, even for a short time. An additional negative impact on the agricultural sector is the erosion of topsoil by the floods. Here the impact is indeed long term, resulting in the reduced productivity of the land and possibly eventual abandonment.

Flooding, however, is not all bad. For some agricultural areas flooding is a positive and necessary event. These lands depend on the periodic silt deposits for added nutrients to the soil. Flooding also serves other advantages including the filtering or dilution of pollutants that enter the waterways, flushing of nutrients in river systems, preserving of wetlands, recharging of groundwater, and maintaining of river ecosystems by providing breeding, nesting, feeding and nursery areas for fish, shell fish, migrating waterfowl and others.

6.4.3 Loss of land and property

Floods of Jalpaiguri district are very erratic in nature where heavy rainfall of short duration in the upper catchment and the lower catchment of the rivers causes huge discharge of the water in the rivers. Which ultimately breached the protection structures like embankment and spurs etc. and inundate the forests, arable land and thickly populated areas suddenly, this sudden floods create huge loss for agricultural land, tea garden, houses, livestock and property.

6.4.4 Impact on health

In floods, deaths usually exceed injuries. Surgical needs are low and are generally only during the first 72 hours. Floods may create conditions that promote secondary threats of water borne and vector borne diseases. A slight increase in deaths from venomous snake bites has been reported but not fully substantiated.

In sub-Himalayan Jalpaiguri district dolomite dust and its accumulation through flood water in the foothill area is causing serious health hazard to the local people through the contamination in water, air and food. Study reveals that the incidence of kidney stone is found two times more among the people residing in Jainti-Rajabhatkhawa-Chamurchi-Birpara-Makrapara-Lankapara area.

6.4.5 Deterioration of surface and sub-surface water quality

Flood water also carry large amount of dolomite dust dissolving calcium to the river water and thereby deteriorating water quality of these rivers. This has destroyed the aquatic

diversity of these rivers. Deforestation also alters the soil water relationship dramatically. It reduces the `lag time` significantly and increases surface run-off and thereby the probability of floods. Dissolved calcium also moves through the subsurface through the soil pores and thereby deteriorates the quality of sub-surface water.

6.4.6 Deterioration of soil quality

Unlimited release of dolomite through the air and water cause accumulation of calcium on the soil surface. This increases the pH value, which have detrimental effects to many traditional crops, especially tea. In some extreme cases calcium crust may also develop and thereby, once fertile soil may turn sterile.

6.4.7 Impact on built-up area

The following are the major identifiable impact of flood disaster on built-up areas including housing or other small buildings in rural settlements in sub-Himalayan Jalpaiguri district:

i) Houses washed away due to the impact of the water under high stream velocity. The houses are commonly destroyed or dislocated so severely that their reconstruction is not feasible.

ii) Flotation of houses caused by rising waters. This occurs when light-weight, typically wood houses are not securely anchored. They can be removed too far from their foundations for relocation and repair.

iii) Damage caused by inundation of house. The house may remain intact and on its foundation, but the water damage to materials may be severe. Repair is often feasible but may require special procedures to dry out properly.

iv) Undercutting of house. The velocity of the water may scour and erode the house's foundation or the earth under the foundation. This may result in the collapse of the house or require substantial repair.

v) Damage caused by debris. Massive floating objects such as trees and other houses may impact on standing houses and cause significant damage.

Photo 6.12 Destroyed Jainti bridge during 1993 Alipurduar flood

Photo 6.13 Large scale destruction caused by floods of 1998 in Alipurduar

6.4.5 Impact on development

Increased magnitude and frequency of flood occurrences in sub-Himalayan North Bengal have had significant effect on the long-term economic growth of the affected region. Indirect and secondary effects on the local and national economy include reduction in family income, decline in the quality and quantity of tea production, unemployment, increase in income disparities, and decline in income. In addition, relief and reconstruction efforts often compete with development programs for available funds (photo 6.12 & 6.13).

The loss of crops and the need to find alternate sources of income have often caused small-scale migrations of farmers and skilled workers from the area to different states of India. Small marginal farms usually cannot survive economically following a major flood. Farmers are often forced to sell their land because they cannot afford to rehabilitate it. This may result in a substantial increase in the number of people migrating to urban areas, and thus a related housing shortage.

6.5 Conclusion

During monsoon, high intensity rainfall induces devastating floods in sub-Himalayan North Bengal causing large damage to the environment, society and the economy in addition to loss of animal and also human lives. Floods also endanger the vital lines of communications and installations, human habitation, firm lands, forest stands and wild life.

Foothill region of this district is traversed by numerous small streams which may be characterized by a common phenomenon, called avulsion i.e. changing river course. Huge sediment load carried by these streams gets deposited in this zone causing deterioration of channels day by day. The area being very rich in forest land, tea garden etc. suffers heavy losses every year due to these sand and chemical deposits from flood water.

Flood situation of the blocks of Alipurduar-I, Alipurduar-II, Kumargram, Nagrakata, Dhupguri, Madarihat, Falakata, Kalchini lying to the left of the river Jaldhaka is very acute. The rivers Kaljani, Torsa, Raidak etc. cause flood through numerous streams descending from Bhutan hills which are very much flashy in nature. National Highway and Railway

bridge opening of waterways are also not adequate enough to cater to such flood discharges. The area needs to be given special emphasis since it is very rich in natural resources of forest and tea gardens.

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