

## **CHAPTER 3**

### **GEOGRAPHY AND THE HISTORY OF FLOODING IN BANGLADESH**

Throughout its history, floods in Bangladesh have caused havoc, loss of life and damage to property, so that on the global stage, the name Bangladesh is conspicuously associated with the phenomenon of flooding. Accordingly, this chapter tries to portray the historical pattern(s) of flooding that have occurred in the geographical area which is now called Bangladesh. At first, I will give an account of the types of flooding that have occurred there over time, after which I will provide a short overview of the three major river systems associated with flooding in Bangladesh. After that, I describe the past flooding events that have occurred in this geographical area, covering two sections. In the first section, I will illustrate the flooding events that took place before the liberation of Bangladesh in 1971, covering the causes, types and impacts of each event; thereafter, in the latter section, I will cover the flooding events that have occurred since 1971.

#### **3.1 Types of Floods in Bangladesh**

People in Bangladesh generally experience four main types of floods: flash floods, riverine floods, rain floods and storm-surge floods, but the type and intensity of flooding varies across all regions, with different regions facing different types or intensities of flooding. This section discusses these four main types of flood with a view to providing an understanding of their nature, geography and damage patterns. The common periods when these four types of floods tend to occur are shown in Figure 3.1:

##### **3.1.1 Flash Floods**

The flooding season in Bangladesh generally begins with flash floods which occur as early as early April and late May. These types of flood are characterized by a sharp rise in the water level and a high flow velocity resulting from exceptionally heavy precipitation occurring over neighboring hills and mountains (the Khashia, Jaintia, Garo and Tripura hills). Such floods rise and fall rapidly, usually within a few

hours or days, and they occur mostly in the eastern and northern rivers, along the borders of Bangladesh.

### 3.1.2 Riverine Floods

With the onset of the monsoon in May, all the major rivers begin to swell - bringing flood waters from upstream. As over 70% of the water annually generated in the combined Ganga-Brahmaputra-Meghna catchment area flows during the few monsoon months (May to August), the rivers are not able to drain all the waters and the water level begins to rise sharply, particularly during the peak flow periods. When rising water levels breach river banks, spillage occurs. Such events are common every year in Bangladesh; however, if certain conditions arise, riverine overbank spillages trigger the most devastating floods in the country. High intensity riverine floods may continue for months, as happened in the disastrous floods of 1988 and 1998. River floods cause most crop damage when they occur early (in late May and June) or late (after mid-August), when crops may be uprooted or fields waterlogged, with those same fields buried under thick alluvial deposits and with riverbank land eroded.

| Types of Flood     | Period of Occurrence | March       | April | May | June       | July | August | Sept.      | Oct. |
|--------------------|----------------------|-------------|-------|-----|------------|------|--------|------------|------|
|                    |                      | Early Flood |       |     | Peak Flood |      |        | Late Flood |      |
| Flash Floods       | Early                | ■           | ■     | ■   |            |      |        |            |      |
|                    | Mid                  |             |       |     | ■          | ■    | ■      |            |      |
|                    | Late                 |             |       |     |            |      |        | ■          | ■    |
| Riverine Floods    | Early                |             |       |     |            |      |        |            |      |
|                    | Mid                  |             |       |     | ■          | ■    | ■      |            |      |
|                    | Late                 |             |       |     |            |      |        | ■          | ■    |
| Rain Floods        | Mid                  |             |       |     | ■          | ■    | ■      |            |      |
|                    | Late                 |             |       |     |            |      |        | ■          | ■    |
| Storm-Surge Floods | Early                | ■           | ■     | ■   |            |      |        |            |      |
|                    | Late                 |             |       |     |            |      |        | ■          | ■    |

Figure 3.1 Types and duration of floods in Bangladesh

### **3.1.3 Rainfall-induced Flooding**

Rain floods are often caused by heavy rainfall either within the sub-basin or in upper catchment areas. Bangladesh receives, on average, some 2200 mm. of rainfall annually, and so local, excessive rainfall often generates high volumes of runoff in the rivers and canals - in excess of their drainage capacity. Thus the degree and depth of these rain floods varies within the wet season and from year to year based on the volume of rainfall and subsequent water-levels in the canals and major rivers, those which control the drainage of water from the land. Rain induced floods do not deposit any silt on the land, but rather remove top-soil materials from the ridges to the adjoining lowlands. Past records suggest that excessive rain causes floods in the peak and late flooding seasons (July to October).

### **3.1.4 Storm Surge Floods**

Tropical cyclones commonly generate storm surge floods in the coastal areas of Bangladesh which contain large estuarine channels, extensive tidal flats and low-lying islands. According to Mirza, Bangladesh experienced a total of 35 cyclones during the period 1960 to 1992 (Mirza, 1997), and among these, seventeen were reported to be deadly, causing havoc and the loss of human life. These storm surge floods are most likely to occur during the pre- and post-monsoon periods (April to May and October to November), but there have been instances of this type of flood coinciding with the monsoon peak floods.

## **3.2 Physical Characteristics of the Three Major River Basins**

Of the different types of floods, riverine floods are the most pervasive and have the most prolonged impacts in terms of land use, the economy and development strategies for Bangladesh; thus, it is changes in river-induced flooding that may be felt most strongly in Bangladesh in the future. Riverine flooding is largely fed by cross-border flows and is highly influenced by the physical characteristics of the river basins lying outside the country's borders. The Ganges, the Brahmaputra and the Meghna river basins are different from each other with regard to their physical characteristics, and this plays a significant role in generation of floods.

The Ganges, the Brahmaputra and the Meghna river systems cover about 1.75 million sq. km of the Himalayan region and support more than 500 million people (Verghese and Iyer, 1993). These Himalayan river systems are unique in the world with respect to their water and sediment supply, channel processes and instability, and are characterized by high flows during the monsoon periods and low flows in the dry season. The high flows often cause floods in many parts of the river basins, particularly in Bangladesh at the downstream end; whereas, the low flows are inadequate to meet the dry season water demands across large parts of each basin. A brief description of the principal characteristics of each river basin is given below.

### **3.2.1 The Ganges Basin**

The Ganges basin is distributed over China, India, Nepal and Bangladesh. Of the total basin area of 109.5 million ha, India has the largest share at 79%, Nepal ranks second with 14% while 4% of the entire basin is in Bangladesh - comprising 37% of the country's area. China shares the remaining 3% of the basin (Verghese and Iyer, 1993). The river divides itself into two channels about four kilometers from Farakka, where India built a barrage in 1976, and the main left arm enters Bangladesh about eighteen kilometers below Farakka. According to a report, about 54 rivers flow into Bangladesh from India and of these, about 40% of the cross-border flows come through the Ganges (Abbas, 1987).

### **3.2.2 The Brahmaputra Basin**

The Brahmaputra is one of the world's largest braided river systems in terms of discharge, sediment transport and channel processes (The Jamuna Multipurpose Bridge Authority, 1989). The river system has been contributing significantly towards the development of the Bengal Delta at its lower reaches for many centuries (Barua, 1994), and its basin is distributed over Tibet (China), India, Bhutan and Bangladesh, of which more than 50% is in Tibet, 34% in India and only 8% is in Bangladesh. It enters Bangladesh from the north, and of the total flows into Bangladesh represents more than half (54%).

### 3.2.3 The Meghna Basin

The basin area of the Meghna/Barak is 80,200 sq. km, of which 44,000 sq. km is in India and the rest (36,200 sq. km) lies in Bangladesh (Rogers, 1989). It is much smaller than the basins of either the Ganges or the Brahmaputra. The river enters Bangladesh from the east near the India-Bangladesh border. The Barak bifurcates into two rivers: the Surma and the Kushiya. The Surma receives a number of tributaries from Kashia and the Goro Hills, while the Kushiya receives tributaries from the Tripura Hills. The Surma and Kushiya join again at Ajmiriganj in Bangladesh and flow towards the south as the Kalni River. Near Kuliarchar, upstream of Bharabbazar, the Kalni takes the name 'Meghna', which flows south-west to meet the Padma (the combined flow of the Ganges and the Brahmaputra) at Chandpur. The three rivers combined then move south to flow into the Bay of Bengal. The river networks in Bangladesh, including the river basins of the three major rivers, are shown in Figure 3.2.

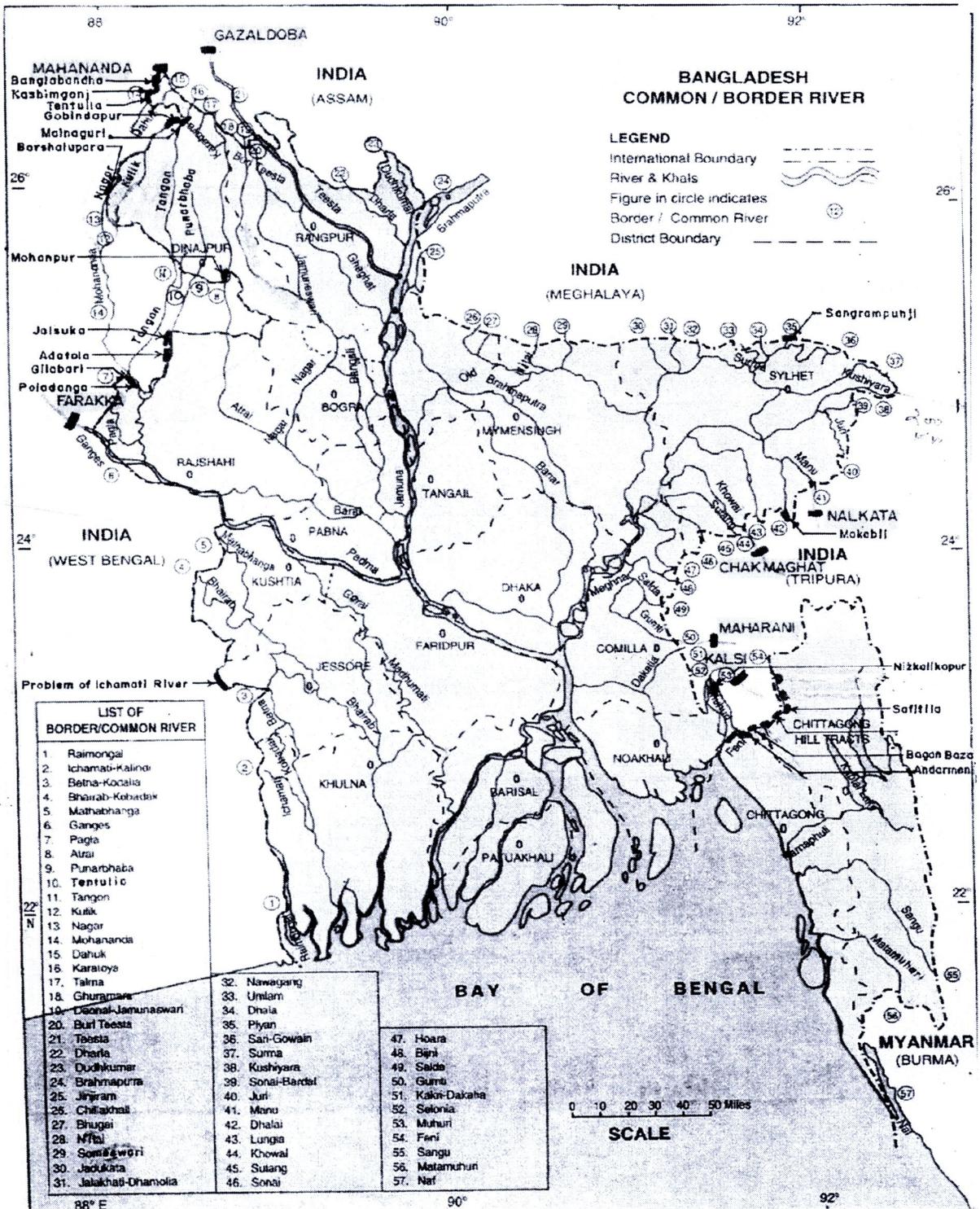


Figure 3.2 River networks in Bangladesh

Source: [www.iwra.org/congress/2008/resource/authors/abs380\\_article.doc](http://www.iwra.org/congress/2008/resource/authors/abs380_article.doc)



### 3.3 Description of Flood Events Chronologically

#### 3.3.1 Historical Account of Floods up to 1970; Before Independence in Bangladesh

Morphologically speaking, Bangladesh looks like a vast plain with a delta formed by sedimentary deposits from two of the great river systems of South Asia: the Ganges and the Brahmaputra. The Bay of Bengal lies to the south. Though in recent times it has been widely recognized as a flood-prone area, very little documentary information is available about flood events and their impacts before 1950s; however, a report on the District of Rangpur (previously Gaibandha - under Rangpur District) by Glazier (1787-88) gives a recorded description of widespread flooding that occurred in 1787. The report also states that the flood not only caused loss of human life and livestock, but also resulted in a “25-fold increase in the price of rice”. Later, another report by Mahalanabish (1927) contains a study of the recurrence of floods from 1870 to 1922. However, issues related to flood problems gained in prominence after the unprecedented floods of 1954 and 1955, when about 60% of the country’s arable land (23 million acres) went under water. Soon after these floods, the government of India and the then Pakistan agreed to investigate the problem jointly but did not, in fact, this report never materialized (EPWAPDA, 1964). Later on, the UN Technical Assistance Mission (Krug Mission) helped the formation of the East Pakistan Water and Power Development Authority (EPWAPDA) in 1959, to monitor systematically the phenomena of floods in the country. The reports by Mahalanabish and EPWAPDA (now BWDB) indicate the extent and intensity of floods during recent decades.

During the period under discussion (up to 1970) major floods occurred in 1917, 1943, 1954, 1955, 1956, 1962, 1966, 1968 and in 1970. Of these, the floods of 1917 and 1954 are considered to have been the most widespread and devastating. According to Mr. Abed Ali, popularly known as *Doctor Abed Ali*, (one of my key informants; 87 years old) the water level during the flood of 1962 was even higher than that of 1988 and had a disastrous impact on the lives and property at my research site. Doctor Ali also thinks that the havoc caused by the flood of 1962 might have led the then government to erect the Brahmaputra Right Embankment (BRE) in 1963, to

protect Gaibandha town from the inundation of flood water. However, no documentary record about the losses experienced during the flood in 1962 is available. The flood of 1970 was a storm surge flood, striking the coastal area of Bangladesh (it coincided with high tides). At the time, many thousands of poor migrants were sleeping in the fields where they had to harvest in the coastal areas, so the number of deaths was as high as 300,000 (Carter, 1987).

A number of physical and environmental factors are held responsible for the recurrence of floods, but in Bangladesh the continuum of upstream flows passing through a single constricted outlet towards the sea is the single contributing factor to the floods, though at the same time, the southwest monsoon raises the mean tide levels in the Bay of Bengal. Other important factors contributing to flooding include excessive rainfall over a part or whole of the country, as well as the flat topography and drainage capacity being reduced by siltation of canals and rivers. This inadequate drainage condition exists almost everywhere in the country except in the north and northeast hilly upland areas of the country. In the northeast and northwest and in Chittagong, regional flash floods often make the situation worse. The estimated damage caused by major floods during the period 1917 to 1970 is shown below:

Table 3.1 Estimated damage due to floods - 1917 to 1970

| Years | Areas Affected<br>(sq. km) | Crops<br>Damaged<br>(m. acres) | Population<br>Affected (m.) | Estimated Loss<br>(US\$m) |
|-------|----------------------------|--------------------------------|-----------------------------|---------------------------|
| 1954  | 36,800                     | 12.3                           | N/A                         | 40                        |
| 1955  | 50,500                     | 16.8                           | N/A                         | 42                        |
| 1956  | 35,400                     | 10.0                           | N/A                         | 27                        |
| 1962  | 37,200                     | N/A                            | N/A                         | 18                        |
| 1966  | 36,500                     | N/A                            | N/A                         | 18                        |
| 1968  | 37,200                     | N/A                            | N/A                         | 36                        |
| 1970  | 42,400                     | N/A                            | 35 (300,000)                | 35                        |

Figures in parentheses indicate the number of deaths. Sources: EPWAPDA, BWDB

### **3.3.2 Historical Account of Flood Events since the Independence of Bangladesh in 1971**

Based on the historic records, it appears that the frequency, magnitude and duration of floods have increased substantially during the last few decades. For example, all major floods covering more than 35% area of the country occurred since 1974. In order to understand the pattern and magnitude of flood events, I will now give a short description of each major flood that has hit Bangladesh since 1971.

#### **Floods of 1974**

After the independence of Bangladesh in 1971, the first severe flood occurred in 1974; a black time for Bangladesh as that year's flooding coincided with the only famine in the short history of Bangladesh. According to reports, it was a rain-induced flood as there was heavy rainfall between April and July and subsequently a series of devastating floods hit Bangladesh along the Brahmaputra River. About 35% of the area of the country was affected and 28,000 people died. There is controversy over the role floods had in bringing about this particular famine, but all agree that floods played a significant role in its intensity.

#### **Floods of 1984**

Three series of floods hit Bangladesh in quick succession in 1984. In some areas flooding occurred on each of the three occasions, but in other areas flood impacts were separate and distinct. The first phase of flooding was rain-induced, as widespread heavy rains during the two weeks from May 6<sup>th</sup> to 19<sup>th</sup> caused severe flooding in eastern Bangladesh, covering the districts of Comilla, Feni, Kishorganj and Sylhet. A rapid onrush of water flowing down from the Indian hills also contributed to this early flash flooding event. The second phase of flooding which occurred in June to July was caused by a combination of rainfall and river flooding, affecting mainly areas near the banks of the Jamuna-Padma (Brahmaputra-Ganges), such as Faridpur, Jessore, Barisal, Rangpur, Tangail and Jamalpur. The last flooding event of 1984 occurred in early and mid-September and hit many parts of the country, including Rangpur, Kurigram, Rajshahi, Dhaka, Tangail, Kustia and Sylhet. About 91

people lost their lives and many crops were damaged, causing a food crisis in the country (Montgomery, 1985).

### **Floods of 1987**

The flood event of 1987 in Bangladesh was one of the most devastating floods of the twentieth century, and that year Bangladesh also experienced a series of other floods. The first flood occurred in June in the northeastern region, with water coming from the hill streams, causing flash floods. This flooding was then intensified by excessive rainfall which started in July all over the country, with the heaviest falling in greater Rangpur District (my research site Gaibandha District is under Ranpur). The rivers of this area, particularly the Ghagot, Karotoya, Bangali and a few others crossed the danger level that year and caused widespread flooding in the greater districts of Rangpur, Dinajpur and Bogra. Later on, the water levels of all three major rivers rose simultaneously, and during August heavy rainfall continued throughout the country. The rivers in the northwest (Rajshahi and lower Dinajpur) caused serious flood in northwestern districts, and the total flow of excess water during late July and early August into the Chalan *bil* area caused severe damage in the districts of Rajshahi, Bogra, Pabna and Tangail. During this period, the Brahmaputra crossed the danger level on July 27<sup>th</sup> in the north, the Ganges surpassed its danger level on July 30<sup>th</sup> in the middle of August and the Meghna crossed the danger level in the southeast region of the country. Again, a depression in the Bay of Bengal during the last week of August caused storm surges in the southern Chittagong/Cox's Bazaar areas and caused severe local floods in this coastal area (Matin, 1987). Thus, from mid-July to late August (early September in some parts), the major rivers remained at a high flood level.

The rain-induced floods in greater Rangpur during July were followed by a flash flood in August in all the northern rivers, and this coincided with the Ganges and the Brahmaputra also crossing the danger level due to heavy rainfall. The drainage of the northeastern area through Chalan *bil* was seriously impeded and floods in the area lasted a long time; moreover, a depression in the Bay of Bengal at the end of August caused torrential rains for several days in the whole basin area, extending from Assam (the eastern side in India) to the Bengal lower delta. This caused flash floods in the

southeaster parts of Bangladesh while the storm surge in the coastal areas retarded drainage from the mid-central districts of Bangladesh, and as a result, many parts of Bangladesh experienced stagnant water for about two weeks on average - during July and August.

Table 3.2 Damage caused by the 1987 flood in Bangladesh

| <b>Nature of Damage</b>  | <b>Amount/Extent</b> |
|--------------------------|----------------------|
| Affected districts       | 50                   |
| Affected <i>upazilas</i> | 347                  |
| Affected areas           | 57,270 sq. kms       |
| Population affected      | 29.52 million        |
| Crops damaged            | 3.14 million acres   |
| Loss of life             | 1657                 |
| Loss of livestock        | 64,170               |
| Roads damaged            | 16,630 kms           |
| Bridges/culverts damaged | 1,102                |
| BWDB embankment damaged  | 1,179 kms            |

Source: BWDB, 1987

### **Floods of 1988**

While the flood of 1987 is called the 70-years flood, the floods of 1988 in Bangladesh are referred to as the 100-year floods, and they are considered to have been the worst in the modern history of Bangladesh (Chowdhury, 1989). These floods devastated the economy and, according to some estimates, submerged 75% of the country. The 1988 floods in Bangladesh were mainly riverine floods, and the synchronization of flood peaks for the major three rivers took place over a period of two weeks, causing a sudden increase in the water level in virtually all areas of the country (GOB and UNDP, 1989; Brammer, 1990).

Though floods are a normal part of the ecology in Bangladesh, the 1988 floods were unusual for both their severity and duration. Unlike the normal floods which

cover large parts of the country for several days or weeks during July and August, the floods of 1988 lasted until October in many areas. The sudden rise in water levels and the serious flooding within the city of Dhaka caused a high number of deaths and destroyed roads, houses, crops and other assets.

### **Floods of 1998**

“The nation is faced with a disaster of [the] highest order. All signs, as they become more and more visible, lead to one conclusion: We are faced with a disaster with catastrophic dimensions. It is not just another flood; it is THE FLOOD which all Bangladeshis will remember for generations to come. This will be the reference point for many of our national events. This will set the standard of our capability or incapability”.

These statements appeared in Professor Muhammad Yunus’ article in The Daily Star on September 11<sup>th</sup> 1998, a major English-language newspaper printed in Dhaka, in the midst of what has been called “the flood of the century” (cited in Ninno et al. 2001: 21) – yet another 100-year flood in the recent history of Bangladesh. The 1998 floods began in early July in the southern part of Bangladesh and continued over the next three months in various parts of the country, inundating 68% of the total area at various times. Initially, the flooding (caused by heavy rainfall) was mainly confined to the southern hilly regions and the Meghna Basin in the northeast of Bangladesh. During the third week of July, a heavy on-rush of water in the Brahmaputra, which flows into Bangladesh from the north, added to rising water levels in the Ganges (Padma) basin in the western part of the country and by July 28<sup>th</sup>, 30% of the total area was inundated. After two weeks the water levels in the Padma River started rising sharply, in conjunction with the water levels of other rivers. Consequently, by August 30<sup>th</sup>, 41% of the total area was submerged. The flood situation reached its peak, in terms of the number of monitoring stations reporting flows above the danger levels, on September 7<sup>th</sup> 1998, when 51% of the total area was inundated (Ninn et al., 2001).

In terms of peak water levels at various monitoring stations, the 1988 and 1998 floods in Bangladesh were almost identical; as they both averaged 11.45 meters above danger level. The major difference between these two floods was in the

duration of the flooding. Water at the major river monitoring stations was above danger level for an average of 34 days in 1988, compared with 59 days in 1998.

As the floods of 1988 and that of 1998 were almost identical, the estimated damage of these two floods is shown below, together.

Table 3.3 Estimates of damage caused by the floods of 1988 and 1998

| Types of Damage                         | Floods of 1988 | Floods of 1998 |
|-----------------------------------------|----------------|----------------|
| Area flooded (km)                       | 89,970         | 100,250        |
| Average duration of floods (days)       | 34             | 59             |
| Number of people affected               | 45,000,000     | 30,916,351     |
| Loss of human life                      | 2379           | 918            |
| Rice production lost (million tons)     | 2.00           | 2.04           |
| Number of cattle lost (including goats) | 172,000        | 26,564         |
| Roads damaged (km)                      | 13,000         | 15,927         |
| Embankments damaged (km)                | 1990           | 4528           |
| Number of bridges and culverts damaged  | 1160           | 6890           |
| Number of houses affected               | 7,200,000      | 9,800,571      |
| Number of schools damaged               | 19,000         | 1760           |

Source: Ninno et al, 2001: 5; Ahmed, 1999: 151

### **Floods of 2004**

The flooding event of 2004 also started in April and destroyed over 80% of the rice crop in certain areas of Bangladesh. A second phase of flooding in July wiped out food stocks and other sources of nutrition and income such as livestock and agricultural day laboring. This was a riverine flood with a normal pattern of a slow rise in the water levels of the major rivers. Torrential downpours in September again led to localized flooding; thus, flood-water remained standing for up to three months in some areas. In total, 39 out of 64 districts of the country were affected, including Dhaka. More than 30 million people were affected directly; about four million houses were damaged and the total death toll was 747. Though the flood of 2004 was not as devastating as those of 1988 or 1998, the total damage from this flood was estimated to be of the order of US\$2.2 billion.

### **Floods of 2007**

The 2007 floods in Bangladesh were unusual in character. The mountain torrents and monsoon downpours caused three major rivers – the Padma, the Meghna and the Jamuna – to swell and overspill their banks across the country. That year's flood came in two waves; the first wave commenced around July 24<sup>th</sup> and initially affected Nilfamari, Lalmonirhat, Kurigram, Sherpur, Jamalpur, Sylhet and Sunamganj districts. In the following days, Rangpur, Gaibandha, Bogra, Sirajganj districts and subsequently the other districts were inundated, up to August 6<sup>th</sup> 2007. This represented an area impacted of 39 districts. The second wave started on September 5<sup>th</sup> and continued up until 15th September when some new districts apart from the previous 39 districts were flooded. A total of 46 districts were affected in varying degrees during both flood waves.

The 2007 flood inundated about 32,000 sq. km, including the *char* area of 6,000 sq. km, affecting almost sixteen million people in around three million households. Thousands of people were affected by flood related health hazards; 85,000 houses were completely damaged while almost one million suffered partial damage. In total, 649 people were reported to have perished, either as a direct result of the floods or through flood-related causes including bridges collapsing or boats capsizing. A number of children drowned as a result of swimming in the flooded

areas, while an unidentified number was reported to have died as result of diseases caused by contaminated water and poor sanitation.

### 3.4 Summary

Flooding has strong historical roots in Bangladesh, with the first floods reported to have occurred in 1787.

Mainly, four types of floods occur in Bangladesh – flash floods, riverine floods, rainfall-induced floods and storm surge floods. Flash floods are characterized by a quick rise and fall and occur as early and/or late floods. Riverine floods are most common in Bangladesh, and are characterized by the overflowing of river banks. Riverine floods may continue for months and cause havoc and significant damage to life and property. Rainfall-induced floods are caused by excessive monsoon rainfall in the sub-basin or in upstream catchments; they often occur during the peak and late (June to October) flooding season. Storm surge floods are brought about by tropical cyclones and happen mostly in the early and/or late flooding season, and are dangerous in terms of their destructive power.

Three major river basins in the country, those of the Ganges, Brahmaputra and Meghna rivers, play a vital role in the generation of floods. The Ganges basin is linked with China, India, Nepal and Bangladesh, the Brahmaputra basin is connected with China, Bhutan, India and Bangladesh, and the Meghna basin is linked with India. These three river basins actually cover almost the whole of the country – the Ganges enters Bangladesh through the west, the Brahmaputra from the north and the Meghna from the east; then these three rivers together flow south towards the Bay of Bengal.

Before Bangladesh became independent, major floods occurred in 1917, 1954, 1962 and in 1970, and among these the flood of 1970 was of the storm surge variety, causing about 30,000 deaths plus significant damage.

Large floods, those covering more than 35% of the country, have occurred since 1974 and major floods took place in 1974, 1984, 1987, 1988, 1991, 1998, 2004 and 2007. Among these, the flood of 1991 was of the cyclonic type. The floods of 1987, 1988 and 1998 are considered to have been the most disastrous floods as they covered more than 65% of the country and have been termed ‘100-year floods’.

The continuum of upstream flows flowing down through a single constricted basin towards the sea in Bangladesh is held as the main contributory factor towards flooding in the country. Any blockage in the drainage system, blocking the path of the rivers' flows, as well as excessive monsoon rain, are the other auxiliary causes of the recurrent flooding that takes place in Bangladesh.