CHAPTER 6

FLOOD AND EROSIONAL PROBLEM

6.1. INTRODUCTION

The riverine areas of Assam measures only 27 per cent of the total area of the state, while the 73 per cent of its area is covered by hills. This adverse topographical feature coupled with heavy rainfall, ranging from 1780 mm in some places of the Brahmaputra valley, and 6350 mm or more in the north-eastern hills mostly concentrate during 4 or 5 monsoon months, is responsible for the frequent damaging floods in Assam. The problem of floods in the valley is not new. It was widely prevalent during the 18th and the early 19th centuries.

It is well known that typical alluvial rivers like the rivers in Assam plains cannot normally maintain channels which are capable of carrying flood discharge within their formed banks. This is particularly true where the rainfall is concentrated during monsoon months and the maximum flood discharge compared to the dominant discharge during the rain is high. Spilling of banks during a high flood by the Brahmaputra and most of its tributaries is therefore a normal phenomenon.
6.2. FLOOD DURING THE EARLIER PERIOD

6.2.1. Lakhimpur and Dibrugarh Districts

The river Brahmaputra and its tributaries changed their courses in some degree every year. The sand bars were formed by the Brahmaputra, Dehang, Dihing and Subansiri. These sand bars were submerged during the flood. The banks were either abrupt or abrupt on one side only where the current set in and cut away the banks and shelving on the other. The bank of the Brahmaputra in these districts was higher and covered with forests. Between the main banks there was a wide stretch in which the river oscillates from side to side throwing out here and there divergent channels which after a time rejoined the parent stream. The water of the river was heavily charged with suspended matter, and the smallest obstruction in its course gave rise to a sand bar.

During the 18th century the flood in the south bank did little damage. The Dihing occasionally submerged large areas. But the land in the north bank was more exposed to flood. All the tributaries, viz. Sissi, Gai, Gantang, Subansiri, Ranganadi and Dikrong were over flowed. The Brahmaputra also inundated a vast area on its north bank. The Ahom rulers constructed a few embankments along some tributaries namely Dihing and Khowang. These embankments were occasionally maintained by the preceding British
rulers. A few new embankments were constructed by them. But for want of fund these were not further maintained. The population of the north bank was so sparse that no necessity arose for attempting to occupy the inundated areas. Yet, between 1900 and 1905, a considerable benefit was derived by constructing a few more bunds along Ranganadi, Dekrong and their tributaries. Steps were taken in the same period to restore permanent cultivation along Dihing and Khowang by repairing those bunds.

6.2.2. Sibsagar and Jorhat districts

In 1570, the flood throughout Assam was so severe that almost all the crops were damaged causing famine. There was another heavy flood in 1642 which caused extensive damage. The people was enabled to control moderate flood by constructing embankments along the Brahmaputra, Desang, Dikhow, Dihing and Darika. The construction of embankments was mainly centred around Sibsagar. Uptil 1840, these embankments were greatly neglected by the then Government. As a result the rivers constantly caused flood during rains. By 1870, almost all the rivers namely Dikhow, Disang, Jhaji, Disai, Kakadonga, Dhansiri and a part of the Brahmaputra were embanked but owing to the numerous streams and water courses, these embankments were of no use at high stages.
In the following river bank, embankment was constructed by the Ahom ruler: Dikhow, Disang, Jhaji, Disai, Kakodonga and Dhansiri. A large bund also constructed along south bank of the Brahmaputra in Sibsagar district.

6.2.3. Darrang and Sonitpur districts

The Darrang and Sonitpur Districts were subjected to severe floods in the past. The Brahmaputra and its tributaries like Bharali, Ghiladhari, Jia-Dhansiri, Nonoi and Barnadi occasionally caused flood by overflowing their banks. But the people were well known to these flood prone areas and the cultivators did not attempt to cultivate anything more than summer rice or cold weather crops. As the population density in 1901 were as low as 38 per square kilometre, it was not felt necessary to bring the submerged tracts under permanent cultivation and hence no embankment was constructed at that time.

During that period almost all the tributaries changed their courses, frequently. The Jia-Bharali ruined a considerable cultivable land. The Dhansiri, Nonoi, Gabharu, Barnadi and Rowta changed their courses in the past causing much damage. No protective work was felt necessary at that time.
6.2.4. Nohogong District

Much damage was annually done to the harvest of Ahu crops by the floods of the Brahmaputra, Kalong and Kapili, however, violent destruction seldom took place in this district. In 1825 an unusual inundation took place, which caused heavy damage to the crops. The second great flood occurred around 1842 when nearly the whole district was submerged. Another great flood appeared in 1937 when the level of the flood water was much above the ridges of houses.

The remains of embankments are found at Barbhajia and Juria. Upto 1905, the district was practically without any flood protection measures.

6.2.5. Kamrup and Barpeta districts

Prior to 1897 these districts seldom experienced violent and destructive floods. After 1897 earthquake, the topography of these districts changed to a great extent, and severe devastating floods, appeared frequently.

Several embankments, totalling 10 in number, were constructed prior to 1874. It is reported that the floods in these districts appeared not due to the local rainfall, but due to the rise of the level of the Brahmaputra.
6.2.6. Goalpara, Kokrajhar and Dhubri districts

The floods in these districts were an annual feature. A very high flood appeared in 1860 and 1870. The principal cause of the flood was the rise of the Brahmaputra assisted by the contribution of numerous hillstreams and heavy rainfall in the low lying tracts.

There was no sign of existence of embankments in these districts. But an ancient earthen wall at Ghurla, Jamira and Taria is in existence. But this wall did not appear to do well in keeping the floods in control.

6.3. FLOOD PROBLEM DURING THIS CENTURY

From the record, it is observed that the flood problem was intensive during this century and extensive measures were taken in Sibsagar and Jorhat Districts. In other districts only few embankments were constructed. In those days, the floods and the resulting damages were accepted as inevitable and not an unmixed evil. Population was very less and larger areas were covered by forests and beels. Habitation and cultivation were comparatively limited to high land, as a result the intensity of damage to cultivation and property was less. Though the flood problem was acute from the very beginning of this century, yet the flood protection measures on the rivers started only after 1940.
A few flood protection works were undertaken between 1940 and 1950.

To a large extent, the flood problem of Assam, can also be ascribed to the great earthquakes of 1897 and 1950. The 1897 earthquake seriously disturbed the topography and the drainage system of lower Assam, while the 1950 earthquake was responsible for spoiling the drainage system of the Upper Assam region.

The earthquake of 1897 was felt over 4.54 million Sq. Km. Large tracts of land along the Brahmaputra got depressed during this earthquake. The big depression on either side of the Brahmaputra in Barpeta and Chaygaon areas near Gauhati were partly to this earthquake. Prior to this earthquake the drainage system between North Gauhati and Manas was ultimately effected by the Manas and the Chaulkhowa rivers.

The 1950 earthquake caused widespread devastation throughout the Upper Assam region. The earthquake has severely affected the surface topography of the area. The Brahmaputra silted up extensively upto Neamati. The tributaries of the Brahmaputra were also extensively silted up at some places upto 6m. The changes in the rivers were so much that the whole topography had undergone a permanent change.

For a river basin, where the topographical features and meteorological situations are enough to create floods
even in normal conditions, large scale seismic disturbances from time to time upset the rivers of the entire region keeping the drainage system in a perpetual state of flux. It takes decades for rivers to reestablish the drainage system, once disturbed. The seismic disturbances of low magnitudes which are too frequent do not allow the rivers to stabilise their regimes and carry the flood water within their sections. The extensive silt load brought down by the rivers either reduces the channel capacity creating inundation, and forces the rivers to change their courses altogether.

The study of flood data reveals that there is no regularities in the cycle of floods. A very high flood was experienced in the upper reaches of the Brahmaputra in 1931, the gauge at Dibrugarh rose to 104.63m. The flood was later exceeded to 104.66m in 1942. This was followed by a higher flood in 1946 when the gauge was recorded at 104.81m. At Gauhati, there was an unprecedented flood in 1906 when the gauge exceeded up to 51.5m. High floods were recorded at this station during 1931, 1935 and 1948.

6.4. FLOOD PROBLEM SINCE 1950

The flood problem is existing in this valley for the last two to three centuries. However, after the earthquake of 1950, the effect of flood has become more pronounced.
The intensities of flood become high. At present, the population in the riverine areas is increasing at a fast rate as the high lands are covered by the tea gardens and forests, resulting in large scale encroachment of the flood plains and the low lying areas of the Brahmaputra and its tributaries both for habitation and cultivation. With the increase of population in the riverine areas, even floods of moderate magnitudes have created acute problems.

The reaches of the Brahmaputra along the south bank and the north bank are discussed below separately from the upstream to the downstream.

6.4.1. South bank

6.4.1.1. Dibrugarh district—

The upper portion of the reach from Noadihing outfall to Betanigaon, lies along the bank of the Luhit and the remaining length along the Brahmaputra. The Brahmaputra bank in these reaches was high and hardly ever got submerged, before the earthquake of 1950. But after the earthquake, the bed of the Luhit silted up by a few metres, thereby loosing its channel capacity in a drastic way. The outfall of Dibang also shifted to the east and increased the discharge in the channel opposite Saikhowaghat. This resulted extensive spilling of the Luhit right from the Noa-Dihing outfall upto Kobo.
The present Dibru channel between Pumapathar and Dibrugarh in fact is a spill channel of the Brahmaputra. The unprecedented flood height at Maijan, Mathola and Dibrugarh in 1955 is not a true reflection of the magnitude of the discharge in the river due to the rise in the river bed resulting from the 1950 earthquake. The higher flood heights have been obtained for corresponding discharges. Also the steepening of the bed grade in these reaches has resulted from the higher velocities of flow, carrying discharge with comparatively smaller depth. Between Dibrugarh and Dehingmukh, the river bank is found high and above the flood level, but due to the silting of the channel of the Brahmaputra in these reaches after the earthquake of 1950 is now inundated with water in many places.

6.4.1.2. Sibsagar and Jorhat Districts—

In these reaches, the river spills copiously over its south bank in most areas causing damage to life, property and crop. Embankments had been constructed in these reaches in small stretches during 1905. The areas in these reaches are low. One of the lowlying areas in these reaches is Moriahola which is heavily affected by the fury of flood. On the upstream side of these reaches lies the famous Kazi-ranga Game Sanctuary. Previously the Brahmaputra bank was high and hardly any spill used to flow into this area. But
owing to the erosion of the high bank downstream of Dhan-
sirimukh at present, extensive spilling takes place inun-
dating the sanctuary which makes the life of the animals
insecured. The notable tributary rivers of the Brahmaputra
in these districts are Disang, Dikhow and Jhaji.

6.4.1.3. Nowgong District—

An outcrop of the Mikir Hills protrudes on to
the Brahmaputra bank at Silghat. The other outcrop of hills
on the west is at Hilaikhunda (Mayang Parbat), a continua-
tion of Khasi and Jaintia Hills. Between these two hills,
the bank of the Brahmaputra is submerged during floods.
There is a 24 Km wide depression. This depression is drained
by Laligang and Sonai. The main channel of the Brahmaputra
was away from the south bank in this reach. After the great
earthquake there has been a significant change in the
channel of the Brahmaputra, downstream of Silghat. The deep
channel of the Brahmaputra now hugging the south bank
opposite Tezpur has caused extensive erosion. As a result,
there is heavy spilling of the Brahmaputra into this entire
area causing extensive damages.

6.4.1.4. Kamrup District—

In the reach the hills run more or less paralle-
ling the bank of the Brahmaputra from the border of Nowgong
district to Palasbari through Pandu. Between Pandu and Palasbari, the Brahmaputra bank is high. However, from Palasbari to Mormoi, a length of 86 Km there is extensive spilling and erosion during the floods. This area is drained by Kulsi, Boko, Singara and other channels. Some flushing from the Brahmaputra through the outfall of these channels also takes place.

6.4.1.5. Goalpara District—

In this reach, the Brahmaputra bank is high and protected by hillocks but for a small gap of about 5 Km between Goalpara and Pancharatna. Between Kharmauza and South Salmara, the flood spill of the Brahmaputra causes very extensive damage. From South Salmara to Mancachar, the reach flanks the Garo Hills where the effect of flood spills of the Brahmaputra is very damaging. The topography in these reaches is rather peculiar. The cultivated land lies in a narrow strip along the foot hills with spill channels from the Brahmaputra into the Jinjiram, cutting across at places.

6.4.2. North Bank
6.4.2.1. Lakhimpur District—

The reach between Dijmur and Silamukh spills very copiously into a large inhabited area, east of the Subansiri river. This area is drained by Tongani, Sissi, Moridhol,
Jiadhol, Kumotia and other rivers. There are extensive low lying areas in this reach which are water logged by the accumulation of flood water. The situation has been aggravated by the earthquake of 1950, after which there has been increasing spill from the Brahmaputra. This has caused deterioration of the drainage channel. The reach between Silamukh and Badoti lies along the bank of Luhit. Outfalls of Sila, Subansiri, Ghagor, Ranganadi, Pabo, Gerelli and Dikrong rivers lie in this area. The area along the Luhit bank is water-logged in many places, and partly covered with forest. The reach between Badoti and Gamirighat partly lies on the bank of the Luhit and the Brahmaputra. The flooding extends upto Gamirighat on the west, beyond which the Brahmaputra bank is high.

6.4.2.2. Sonitpur and Darrang districts—

A stretch of high land extends like a plateau along the bank of the Brahmaputra from Gamirighat to north of Bishanath where tea gardens are situated almost upto the river bank. There is a depression, south of this plateau, which is subjected to inundation. But the reach between Bishanath and Tezpur, the bank gets inundated by the spill of the Brahmaputra. The inundation is caused directly by an old spill channel taking off from the river at Bishanath and joining back at the outfall of the Bharali. Between this
spill channel and the main river, a wide and high sand bar has been in existence for quite a long time. The Brahmaputra bank at Tezpur and for a few kilometre on either side is high and dotted with hillocks. West of Tezpur, the other hills appear on the Brahmaputra bank at a distance of 30 Km at Singri. In between, the bank is low enough to get inundated water during flood. The bank line for the rest reaches in these districts is comparatively high, well above the Brahmaputra flood level.

6.4.2.3. Kamrup District—

Between Rangamati and North Gauhati, there is an extensive spilling. Between North Gauhati and Hatimura, there is a continuous chain of hillocks along the bank except for a small gap between Amingaon and Sualkuchi. The area, west of Sualkuchi and upto Goalpara district, is lowlying and waterlogged. The area had sunk as a result of 1897 earthquake.

6.4.2.4. Goalpara and Dhubri districts—

The Brahmaputra bank in these districts is interspersed with hillocks and lakes which receives spills through Champamati, also. The area west of Dhubri receives copious spilling from Gangadhar also making it flood prone.
6.5. EROSIONAL PROBLEM

A considerable bank erosion of the Brahmaputra can be attributed to the instability of the river coupled with the silt and sand strata of its bank. It appears that a number of factors are interrelated to one another. The main factors are excessive sediment charge, its age old tendency to shift southward and traversing its valley in a series of deep and narrow throats followed by broad and shallow aggrading reaches (Ahmed and Maswood, 1984, p. 83).

Erosive factors and increasing silting in the river initiate change that takes place in river migration following flood problems. The river bank erosion is maximum during the falling flood stages (Sen, 1968, p. 211). The excessive sediment load is due to the frequent seismic disturbances of low magnitude in addition to the earthquakes of disastrous nature (p. 45-47). The tendency of the Brahmaputra to shift southward can be observed clearly by shifting of the mouth of numerous south bank tributaries to the east. These tributaries normally flow parallel to the Brahmaputra before joining it. (Ahmed, et al., 1983, p. 36). The lower portion of these tributaries merges with the main river thus shifting the outfall of these tributaries upstream (Ahmed and Maswood, 1984, p. 87). The Brahmaputra had claimed the tails of Dibru, Disai, Dhansiri, Mora-Diphu and Kulsi rivers, in its encroachment of the south bank.
Numerous tributaries of the north bank with excessive silt load joining the Brahmaputra form subaqueous deltas, may be one of the causes for its southward shift (Ahmed, et al., 1983, p. 36). Large scale shifting of the main river had occurred even in the 17th century when it left the channel of Kherkutia suti and lower reaches of Subansiri north of Majuli island and took its present course south of Majuli Island comprising of an area of 900 Sq. Km. In the Brahmaputra valley, this southward shift is more pronounced in the upper reaches. In the lower reach, from Gauhati to Goalpara, the river is confined in between the rocks of the basement complex. In this region, northerly migration of the Brahmaputra is causing erosion to a number of villages. But downstream of Goalpara, the river is again shifting towards south causing erosion (Ahmed and Maswood, 1984, p. 87).

The width of the Brahmaputra is constricted at a number of places in the valley compared to the width of river both upstream and downstream. The Nodal points (Table 23) and their subsequent effect on the river scour depth maintain a constant value along the entire length of the braided river. It appears that at narrow of constricted reaches the scour occurs with increasing flow and fill with diminishing flow. In wide reaches both upstream and downstream the fill generally occurs during the low flow. Thus the nodal points are areas of deep scour depth and a tendency to fill. While the
Constrictions in the lower reaches are due to the inselbergs of Garo-Khasi Massif scattered on both the banks of the Brahmaputra confining the main channel between the nodal points, in upper reaches the constriction appears to be due to the occurrences of more resistant strata or the Brahmaputra channel configuration, itself. As a result of these nodal points, the river scour depth does not maintain a constant value along the entire length of the braided river.

The bank of the Brahmaputra is predominantly composed of sand and silt with a low percentage of clay below 7. Therefore the banks of the Brahmaputra are susceptible to erosion even at the slight increase in velocity of water owing to the sudden changes in the cross channels, by the formations of shoals. Practically no reach of the Brahmaputra bank except where rock outcrops are visible, can be considered as firm bank (Ahmed and Maswood, 1984, p. 86-87).

In a braided river of the magnitude of the Brahmaputra, a short-term channel migration is quite drastic. The rate of rise and fall of the river, the number and position of major channels active during the floods, the formation and movement of large bed forms, cohesion and composition of bank material and intensity of bank slumping are some of the factors for controlling the bank line movement.
The shifting cultivation is practised by most of the tribal people living in the hills of Assam. The evil effects of shifting cultivation is immense on soil erosion. There are two aspects of this soil loss from watersheds of the floods. Firstly, by loosing the soil, the capacity of soil to store water where it falls is lost. Secondly, the huge quantity of silt, sediment and debris brought down decrease the capacity of the rivers where the discharge has increased due to the increase of run off in the upper catchment.

6.5.1. Maijan and Mathola

After the remarkable earthquake of 1950, Dibrugarh and its suburbs lying to the south bank of the Brahmaputra river have been subjected to the fury of the flood in each monsoonal season causing acute erosion. A vast area of about 15 Km around Maijan and Mathola (Plate 33, 34, 35, 36) including a portion of Dibrugarh town, has been encroached by the river since 1950 (Ahmed, et al., 1983, p. 31). But after taking town protection measures at Dibrugarh by constructing dykes and spurs in 1956 the erosion was almost arrested for a stretch of about 9.6 Km around Dibrugarh. The dyke has resulted extensive erosion at Maijan and Mathola on the adjacent eastern margin of the town by deflected current. Since 1953 in this reach the river migrated for a distance of about 6 Km.
It appears that Dibru Island situated at about 9.5 km upstream of Maijan spur plays a significant role in controlling the flow pattern of the Brahmaputra River. The flow from the central channel swings towards the south bank beyond the nose of the island and thereafter hugs the south bank of Maijan and Mathola upto Dibrugarh. It again takes a swing away from the southern bank to join the central channel (Ahmed, et al., 1983, p. 31). Prior to 1969 floods, the main channel of the river was towards the south of the Dibru Island and then further turned towards south opposite Maijan. The main current meets the bank at Maijan and Mathola. At present, the main channel of the river is towards the north of Dibru Island and a small channel still remains on the south side. The main channel swings towards the south about 600m upstream of Maijan bridge and is also met by the small channel before meeting the left bank. Along with these changes in the channel configuration the point of attack on the bank also has shifted from downstream of Maijan spur to about 1,200m upstream of Maijan spur.

During 1967, the flood eroded the bank upstream of Maijan spur. The erosion continued during the flood season of 1968 when the maximum flood level was noted at 105.30m. The shoal formed at the upstream of Maijan spur after the flood of 1968 was gradually washed away, subjecting the south bank to severe river action (Ahmed, et al., 1983, p. 31).
The Dibrugarh, Rangagora, Tinsukia (D.R.T.) road runs almost along the ground level in many reaches. In the vicinity of the Maijan bridge where the erosion seems to be severe, the road is only about 1m higher than the river bank (Plate 37). The average bank level at this site of erosion varies from 103.60 to 105.10m. During the flood, the water spills over the bank and the D.R.T. road also at number of points. The water thus spilling over the road flows to the Maijan and Mathola Beels on the rear side and then overflow the Tea Garden road, running parallel to the D.R.T. road. At the back side of the road there is a beel from a distance of 300m downstream of Maijan bridge which continues for quite some distance upstream. When further erosion occurs at this site and the road is eroded (Plate 38), a large flow enters the beel. Some portion of this bed is deep up to 8m when the flood enters directly the Maijan Beel.

The bank line recession in the Maijan and Mathola area clearly indicates instability of the bank (Plate 39, 40). From 1953 to 1980 the Maijan and Mathola Tea Estates respectively got eroded 15.66 and 419.58 hectares of tea plantation by the Brahmaputra River. The annual rate of erosion at Maijan and Mathola is 33.05 hectares (Map No. 6 and 7).

6.6. DAMAGE DUE TO EROSION

Since the earthquake of 1950, the southward shift-
ing of the Brahmaputra river is causing severe erosion at number of places (Ahmed and Maswood, 1984, p. 83). The Sadiya town at the confluence of the Dibang and Luhit disappeared in 1953. A major part of Palasbari disappeared in 1954. The erosion is still pronounced and serious at Bishanath, Singri, Sualkuchi, Mukalmua, and Bahari on the north bank of the Brahmaputra, and Oakland, Maijan, Mathola, Mohanaghat, Desangmukh, Majuli, Neamati, Dhansirimukh, Mariahola, Hatimura and Goalpara on the south bank. It has been observed that when the river attack is in full fury, it can carry away as much as 30m of land in a single day and thereby 1.5 Km width of land disappear in a season. The maximum erosion takes place during the falling stage of the flood.

Upto 1982 the erosion had taken place over a length of 395 Km on the south bank and 240 Km on the north bank. During the period of 1954 to 1982, a total of 2,25,606.27 hectare of land was eroded. Thus an average of 8,057.36 hectare per year is eroded by the Brahmaputra.
TABLE 23 : Width of the Nodal Points at different reaches.

<table>
<thead>
<tr>
<th>Site</th>
<th>Width at the nodal point in Km</th>
<th>Width of the river upstream of nodal point in Km</th>
<th>Width of the river downstream of nodal point in Km</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Morkong Selack</td>
<td>4.8</td>
<td>11.7</td>
<td>9.6</td>
</tr>
<tr>
<td>2. Near Desangmukh</td>
<td>5.1</td>
<td>11.0</td>
<td>10.0</td>
</tr>
<tr>
<td>3. Downstream of Jhajimukh</td>
<td>3.75</td>
<td>8.0</td>
<td>8.4</td>
</tr>
<tr>
<td>4. Downstream of Dhansirimukh at Gamiri</td>
<td>4.4</td>
<td>11.0</td>
<td>5.2</td>
</tr>
<tr>
<td>5. Upstream of Tezpur</td>
<td>3.6</td>
<td>5.5</td>
<td>12.3</td>
</tr>
<tr>
<td>6. Upstream of Dhansiri (north)</td>
<td>4.0</td>
<td>9.6</td>
<td>7.5</td>
</tr>
<tr>
<td>7. Pandu</td>
<td>1.2</td>
<td>11.0</td>
<td>7.5</td>
</tr>
<tr>
<td>8. Sualkuchi</td>
<td>2.4</td>
<td>8.0</td>
<td>10.5</td>
</tr>
<tr>
<td>9. Pancharatna</td>
<td>2.4</td>
<td>8.0</td>
<td>10.5</td>
</tr>
</tbody>
</table>

PLATE 34. Erosion at Mathola during monsoonal season of 1972.

PLATE 35. Erosion at Maijan during 1974. Note a portion of the Tea Estate under the grip of the Brahmaputra river.

PLATE 37. A view of bank erosion during 1980 at Maijan. The erosion has pushed the bank line almost up to D.R.T. Road. Tea bushes (T.B) are seen in the grip of the river.

PLATE 38. Erosion at Maijan during monsoonal season of 1976. The Tea Estate road is encroached.

PLATE 40. A view of the Brahmaputra river at Mathola during the flood of 1974.