Chapter IV

HISTORY OF FLOOD AND PHASES OF CONTROLLING IN THE LOWAR DAMODAR

4.1 INTRODUCTION

Flood is an issue which has drawn human attention from time immemorial and the issue is still significant in developing and developed countries as well with different modes of production. Floods and flood related issues are addressed by various disciplines like engineering sciences, hydrology, meteorology, economics, sociology etc. In geography, flood is given required weightage taking a spatial perspective. In geomorphology, flood is a topic which has been included in the course contents of pure or theoretical geomorphology and applied geomorphology as well. This inclusion in both the fields is justifiable as flood, flood borne materials and flood built features are fundamental entities in theoretical geomorphology but in applied geomorphology they no longer remain as fundamental entities. They are treated as resource or hazard or both depending on the combination of other physical environmental parameters and socio-economic situation. Thus, they become functional entities in applied research.

Flood control structures can be interpreted as effective indicators of progress and development of a community or a society. Transfer of flood water from surplus region to deficit region and from surplus season to deficit season through control structures are in fact associated with hydraulic civilization, or in other words, the rational use of flood water can be taken as one of the factors behind progress of civilization.

From the Puranas and the Government reports as well it is evident that the Lower Damodar is an endemic flood prone tropical river. Flood propensity of the river also reflected in old maps.

Investigation on the controlled Lower Damodar begins with flood problems which necessitated to adopt flood control measures from embankments to multipurpose reservoir in the said section. Control structures are the effects and flood is the cause. In this chapter both 'cause and effects' are considered giving equal weightage.

4.2 OBJECTIVES

Objectives of this Chapter are to:

i. trace the changing courses of the Lower Damodar which lead to flooding.
ii. trace the flood history of the Lower Damodar.
iii. trace control structures chronologically and chorologically.

4.3 METHODOLOGICAL ISSUES

Flood is hydro-geomorphological process controlled by hydro-meteorological factors in a physical environment, where physical laws dictate all physical phenomena. But the decision on flood control measures is taken on the basis of cultural practices and socio-economic situations which are always location specific. Therefore, method has to be
CHANGING COURSES OF LOWER DAMODAR

Bega Hana was opened in 1865 and at present most of the flood water flows through Kanki-Mundeshwari.

Main Channel of Damodar in 1550 (After De Barros)

Main Channel of Damodar in 1660 (After Vandenberg)

Active Channel from 1590 to 1660

Defunct section of Amta Channel

Diversion into Hugli by sluice at Ulughat in 1862

Mondal Ghat River, a small branch of main Damodar in 1660 (After Vandenberg) and a small creek in 1690

Falta

Fig. 4.1

After Sen 1962 and Basu 1989
ideographic. But the statement does not imply that the physical parameters of flood phenomena are ignored. Infact, hydro-geomorphological information are applied to solve flood related socio-economic problems.

At flood stage a river crosses its normal boundary inundating large part of its valley floor. A river thus, spatially extends. The spatial scale of the Lower Damodar has varied in different flood years and this variable spatial scale must be considered when floods and flood related issues are examined.

The flood history of the Damodar has been traced from 1665 to 1995. Though the recorded flood history dates back from 1730. The time span is 330 years that is from 1665 to 1995. Embankments, the first control structures on the Lower Damodar have been mentioned in the Government report of 1852 (Ricketts, 1853; Voorduin, 1947). This report states that the embankments are century old. From this statement it can be inferred that the embankments were in existence from 1752. The Rangamatia dyke or dam, the last control structure in the studied section is only 1 year old. Therefore, the time span between the first control structure and the last control structure is 244 years.

The major data source is the Government reports and records. Data have also been generated and inferences have been drawn from old maps, the basic tools in this chapter. Technique adopted is transfer of non-geomorphic information gleaned from Government records, reports and old maps into geomorphic information. The first recorded information on the Damodar embankment is available form 1846 onwards (Sage et al., 1846). For later years data from the D.V.C. have been used. More or less there is a continuity of data on control structures and other hydrological information from 1933 onwards. In this chapter mostly passive data have been used. Only for the Rangamatia cross dyke or dam and embankments constructed upstream of the Durgapur Barrage, active field data have been incorporated in the present study.

4.4 SEQUENCE OF DISCUSSION

To understand the flood behaviour of the Lower Damodar, the cardinal applied issue in this chapter, the changing courses of the river in the historical past need to be examined. The vascilating nature of the river must have caused flood hazards in the agriculturally properous Barddhaman Hugli plain, therefore, the changing courses of the Lower Damodar has been discussed first. Flood history of the Lower Damodar has been discussed next. Then the control structures has been focussed on. The approach is chronological and chorological as well.

4.5 CHANGING COURSES OF THE LOWER DAMODAR

The Lower Damodar had an extensive delta formation which was older than the Ganges-Brahmaputra-Meghna delta. The changing courses of the Lower Damodar exemplify that in an unstable deltaic environment rivers keep on shifting. Shifting of channels, it is obvious is always associated with avulsion and floods.

The early maps of Jao De Barros, 1550; Bleav, 1645; Vanden Broucke, 1660; Rennel, 1779-81 and others maps and charts of the unknown cartographers provide cognizable evidences of changing courses of the Lower Damodar (Fig.- 4.1). Superimposing the
present river system on the river shown in the Rennel’s map, some trend lines can be obtained; one course bifurcates from Selimabad and flows in a south-easterly direction and then in a north-easterly direction and enters into the river Bhagirathi near Noaserai above Tribeni; the main flow is found in a southerly direction, passing through the Amta channel and falling into the Hugli river. Another old course flows in an easterly direction below Barddhaman meeting the Bhagirathi river near Kalna, which can be identified with the present Gangur river approximately (Sen, 1962).

According to De Barros 1550, the main flow of the Damodar in the 16th century was restricted to the present Kana Damodar channel taking off below Selimabad and meeting the river Hugli at Uluberia. In 1660, Vanden Broucke’s map shows the main channel of the Damodar flowing through the Moja Damodar meeting the river Rupnarayan near the present Bakshi Khal. At the same time a large branch used to flow through Barddhaman, apparently along the line of the present course of the Gangur and Behula river and falling into the river Bhagirathi near Kalna. In the Bengali folklore ‘Manashar Bhasan’, 1640 it is stated that the dead body of Lakhindar, the hero of the epic was taken by his wife Behula in a boat along this river. This story reveals that in that period (1640), a great volume of the Damodar water used to pass through this route. In the same period (1660), a smaller branch of the main Damodar used to flow through the Amta channel falling into the Hugli river opposite of Falta and was known as Mondal ghat river, and the same was shown as a small creek in a chart of 1690. Shortly after 1660, the Damodar deserted the branch flowing the line of the Gangur–Behula river. The Kana Damodar became the main channel. Subsequently another branch opened along the Kana and Kuntinadi. The Kana Damodar in that period entering Noaserai 4.81 Km. above Tribeni and 62.76 Km. above Howrah showed deterioration owing to the diversion of its supply to Kana Nadi. In the maps and accounts of the 17th and beginning of the 18th century the Kana Damodar was called as the Jan Perdo river i.e., a river for large ships (Census, 1961), and its importance is still attested by the long marshes and populous villages along its bank. This Kana Damodar is represented as an insignificant creek in Ritchie’s and Lacam’s chart of 1785 (Stevenson et al., 1919; Sen, 1962).

In the meanwhile changes had taken place in the Kana and Kunti Nadi which were flowing in an unnatural direction i.e., from south-south east to north-north east. This can be realized from the fact that the Swaraswati which left the Hugli river at Tribeni, would have been flowing in a generally parallel but reverse direction to the Kunti Nadi, the later must, therefore, when the Hugli level was high, have acted as an effluent owing to the Hugli river backing up into it and changing into an affluent when the periodic flood came down the Damodar (Stevenson et al., 1919).

People of the adjacent country it may be presumed tried to maintain the channel by constructing marginal embankments and thus giving the river an artificial and precarious existence for a period. An additional supply from the Kana Damodar was diverted in this river and the bed level had risen particularly in the Kunti Nadi which could not accommodate the supply and hence the volume of the main river had been diverted from it (Stevenson et al., 1919). Rennel, around 1760 during his survey referred to the Kana and Kunti as the old Damodar (Sen, 1962).

44
In 1858, W.S. Sherwill in his report on the rivers of Bengal says that although it is not recorded, but tradition says that about the year 1762, the Damodar which formerly flowed into the Hugli at Noaserai, burst its embankment (Sherwill, 1858). From these evidences of changing course of the Lower Damodar, conclusion can be drawn that the entire tract between Noaserai and Mundeswari was inundation prone in the historical past. At present the Amta channel is chained with embankments thus restricting further shifting of the lowest part of the Lower Damodar.

4.6 FLOOD HISTORY OF THE LOWER DAMODAR

In old records the Damodar has always been referred to as a river of sorrow. Hunter in his report (1876) writes that during floods, the rainwater used to pour off the hills through hundreds of channels with such suddenness to the river bed that water heaped up to form dangerous head wave, known as 'hurpaban': these were of great breadth and appeared like a wall of water sometimes 1.5 m in height causing irreparable damage to land, property and people (Hunter, 1876). The flood rose and subsided rapidly and its duration was ordinarily from one to three days. But, long before Hunter, an anonymous poet referred to Damodar flood of 1665 (Mitra, 1946). The first recorded flood was in 1730 (Voorduin, 1947). Since, 1730 floods of different magnitudes have occurred every 8 to 10 years. Floods with peak flow of 8496 or more cumec occurred in the year 1823, 1840, 1855, 1860, 1864, 1865, 1866, 1877, 1913, 1916, 1917, 1935, 1938, 1940, 1941, 1942, 1946, 1950, 1951, 1956, 1958, 1959 and 1978. The flood of 1823, 1840, 1913, 1935, 1941, 1958, 1959, 1978 had peaks of more than 16,992 cumec. A peak flow about 18,678 cumec have been recorded thrice in August 1913, August 1935 and October 1941.

The 1913 flood originated from a mean rainfall of 30.23 cm. in days over the basin where as the mean rainfall of 23.29 cm. in 3 days caused the 1935 flood. The 1943 flood with a comparatively low peak flow (9,911 cumec) resulted from a mean rainfall of 21.34 cm. over the catchment. Despite of low peak flow the damages caused by this flood was the highest on record which have been assessed on the basis of prices prevailing in 1951 (D.V.C., 1995). In the month of September, 1958, due to heavy rainfall for three days at a stretch, the Damodar and the Barakar rivers experienced a flood with peak flow greater than that recorded in the past. Had there been no dams, the maximum observed peak flow at Durgapur would have been of the order of 18,537 cumec. The D.V.C. reservoirs succeeded in moderating this flood to a flow of 5,802 cumec only at Durgapur. Similarly from the 1st to the 3rd October, 1959 the Damodar and Barakar rivers experienced a peak flow even greater in magnitude than anything recorded till then in the history of these rivers. Without the intervention of the dams, the peak flow at Durgapur would have been of the order of 22,923 cumec. The flow was actually moderated to 9,905 cumec only at Durgapur. The 1978 flood can taken as greatest disaster of the century. The cyclonic rain storms in-between the 27th and the 29th September followed by a secondary peak between the 2nd and the 4th October caused heavy rainfall above 500 mm in the Damodar catchment. Highest combined inflow at the Maithon and Panchet has, however, been recorded as 21,070 cumec on the 27th September 1978 which was moderated to the combined outflow of 4,616 cumec. It was further augmented to 9,345
cumec at Durgapur and 10,919 cumec at Rhondia causing widespread flood in the Lower Bengal (D.V.C, 1978; Sen, 1985). Lastly in 1995 also, the lower Valley witnessed a normal flood with a flow of 6,522 cumec at Rhondia. So, recorded history of the endemic flood prone areas of the Damodar can be traced from 1730 onwards up to 1995.

Inundations have occurred several times between 1730 and 1816 with an average interval of 13 years whereas the next inundation occurred at an interval of 7 years i.e., in 1823. The next flood surfaced in 1834 with an interval of 11 years, the next took place in 1840 at an interval of 6 years, the subsequent intervals were further shortened. Severe floods occurred in 1841, 1844 and 1845. Hence with the time span of 115 years, 13 severe inundations took place, out of which 7 occurred in the first 85 years and 6 in the last 30 years (Sage et al., 1846). In ancient period, overflow irrigation from the Damodar was considered beneficial for agriculture. Sir William Willcocks, an Egyptian Engineer in his lectures delivered at the Calcutta University in 1930 considered the soils of the Lower Damodar Valley as one of the richest soils in the world. He further stated that traveller in 1660 used to consider central Bengal as rich as Egypt. In 1815 Hamilton passed through the districts of Burdwan (present Barddhaman), Hugli and Haora and described the tract as the most productive agricultural land in entire Hindustan (undivided India) (Willcocks, 1930). Canals were also in existence. But from 1815 onwards the landlords and tenants of central Bengal had neglected these canal systems. The negligence probably began in the undivided Bengal during the Mahratha-Afgan war and later in Barddhaman in the later half of the 18th century. These waterways remained as neglected and unused after the war. British thought that these waterways were only for navigation and they left them as they were. As these deteriorating waterways or canals took less amount of water, more and more water remained in the Damodar and it became a menace for the riparian tract (Willcocks, 1930).

The Flood history during the period 1857 to 1917 can be traced from the E.L. Glass report submitted to the then Bengal Government as observed at Raniganj, a few Kms upstream of Durgapur (Sen, 1962). Corresponding data for the period between 1933 and 1957 and 1958 and 1996 at Rhondia are given.

**Flood History of the Damodar.**

**Table 4.1a Raniganj**

*During 61 years (1857–1917)*

<table>
<thead>
<tr>
<th>Category</th>
<th>No of floods</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of extremely abnormal floods</td>
<td>1</td>
</tr>
<tr>
<td>No of abnormal floods (above 8496 cumec)</td>
<td>12</td>
</tr>
<tr>
<td>No of normal floods (between 5664–8496 cumec)</td>
<td>33</td>
</tr>
<tr>
<td>No of subnormal floods (below 5664 cumec)</td>
<td>15</td>
</tr>
</tbody>
</table>

**Table 4.1b at Rhondia**

*During 25 years (1933–1957)*

<table>
<thead>
<tr>
<th>Category</th>
<th>No of floods</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of extremely abnormal floods</td>
<td>2</td>
</tr>
<tr>
<td>No of abnormal floods (above 8496 cumec)</td>
<td>7</td>
</tr>
<tr>
<td>No of normal floods (between 5664–8496 cumec)</td>
<td>11</td>
</tr>
<tr>
<td>No of subnormal floods (below 5664 cumec)</td>
<td>5</td>
</tr>
</tbody>
</table>
PHASES OF CONTROLLING THE DAMODAR
BRITISH PERIOD (1906-1946)

REFERENCES

River
--- Canals and distributaries
--------- Embankments
---------- Railways
----------- Highways
_= Sluice
------ Proposed canals and distributaries

Fig. 4.2
Table 4.1c at Rhondia

<table>
<thead>
<tr>
<th>Description</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of extremely abnormal floods (above 12744 cumec)</td>
<td>0</td>
</tr>
<tr>
<td>No of abnormal floods (above 8496 cumec)</td>
<td>2</td>
</tr>
<tr>
<td>No of normal floods (between 5664-8496 cumec)</td>
<td>2</td>
</tr>
<tr>
<td>No of subnormal floods (below 5664 cumec)</td>
<td>35</td>
</tr>
</tbody>
</table>

During the period of 1857 – 1917 (Table 4.1a) the number of normal floods was 33 which was reduced in later periods (1935–1957) to 11 and (1958–1996) 2 respectively. In the post dam situation i.e., after 1958 only two high floods have occurred, one in October 1959 and the other in September–October 1978.

In the present century the 1978 flood is regarded as the greatest disaster of the century in South-Bengal. The huge amount of sand deposited by the Damodar are still to be observed in the adjacent villages near Gaitanpur, Panchpara etc. The riverine sand bars still exhibit sand heaps deposited during this flood. In no way, floods that have occurred after 1978 are comparable to the 1978 flood. The floods of 1995 is not so insignificant compared to many other floods that have occurred in the historical past, but in magnitude it cannot be compared with the 1978 flood.

4.7 PHASES OF CONTROLLING THE LOWER DAMODAR

The floods-prone Damodar river has necessitated construction of control structure from very ancient time. “In uninhabited regions the rivers are wayward and restless, ever shifting from place to place within the bounds of the valleys, that are theirs to sprawl across at will.......But as soon as a country acquires a settled population this unstable habit of running water is corrected. For many reasons, human interests demand that a stream shall have a fixed course” (Lamplugh, 1914: 651 ). The validity of the statement can not be denied as our rivers was also restless over the Rarh plain which was populated even in the distant historical past by a highly civilized community known as Gangaride. Agricultural prosperity has continued for centuries. So, it may not be a wild conjecture if it can be stated that flood control measures in the Lower Damodar were taken long ago and one of the earliest control measures was embankments. It is most likely that those ancient embankments were non-engineered earthen embankments which have been totally destroyed due to shifting of rivers. But a geomorphological map prepared by Niyogi in 1975 shows the palaeo-channels and old levees. It is unfortunate that the literature has discussed the shifting courses of the Lower Damodar but has remained reticent on the embankment issue. Therefore, the discussion on control structures begins with embankments which have been mentioned or shown in Governments reports or in old maps.

4.7.1 Embankments

The origin of embankments constructed on the Lower Bengal rivers is difficult to trace out. The embankments along the Damodar River it may be presumed, were constructed most probably by local landlords to protect their land and property from floods (Gastrell,
Embankments were constructed to save paddy crop, the main crop of Bengal as well as to protect the towns and villages (Sengupta, 1951). According to Kopil Bhattacharyya (1959) hydraulic engineer the Damodar embankments are of four thousand years old.

4.7.1.1 Zamindary Period

It is difficult to trace exactly when and where such flood disaster abatement measures were adopted first, however, these embankments date to a period anterior to the British rule (O'Malley and Chakraborty, 1909). Earlier papers refer mainly to the condition and management of the embankments which at the time of January, 1852 were said to have existed for a century (Voorduin, 1947). In 1760 the districts of Barddhaman and Medinipur were ceded to the East India Company; these embankments already existed there, the most important being within the Burdwan Raj Estate i.e., within the present Barddhaman, Hugli and Haora districts. (O'Malley and Chakraborty, 1912). The system of embankments was never very extensive along the river bordering the Bankura district as the main channel here was quite broad and shallow and sufficed to carry off most of the flood waters (Gastrell, 1863). It was the duty of the local landlords to secure their lands from inundation by renovating or repairing the embankments locally known as ‘pulbandi’ measures. Detailed quantified information about these zamindary embankments is not available but it may be stated that a uniform system of bunding of river had never been thought of. The report of the embankment committee formed in 1846, states that these embankments were irregular and levels were uncertain. If one portion of the embankments were 0.91 meter above the highest flood rise, the adjoining one was low enough to be overtopped or breached during floods. Initially, these were not even continuous, therefore, flood waters of the Damodar rushed through the gaps in between embankments causing devastating floods. Embankments were never properly maintained. So, breaching of embankments was a regular phenomenon. The cost of repairing the embankments was realized by the zamindars from the tenants concerned. The maintenance of embankments was inefficient and neglected (O'Malley and Chakraborty, 1912) and inundation did naturally surface from the breaching of embankments.

4.7.1.2 British Period

It is equally difficult to distinguish the government embankments from the zamindari embankments till 1833. Since 1836, the embankment question was taken up seriously by the British Government. In 1840 the town of Barddhaman was laid in water three times in a single year due to breaching of the left bank embankments in 113 places, though Willcocks stated that these were all secret breaches by farmers to take flood water into their fields. (Willcocks, 1930). In 1845 about 89 masonry sluices were constructed in lieu of cuts which were formerly made by people or landlords. In 1846 the general question of embanking the rivers was reviewed by an expert committee. The committee report begins with the statement that all the rivers should be kept unconfined. The committee further recommended for the total abolition of the embankments also. (Sage, et al., 1846). Questions were also raised concurrently whether these embankments were responsible for gradual shallowing of the river thus augmenting the flood propensity in the lower reach. There were correlated fiscal issues regarding maintenance of
PHASES OF CONTROLLING THE DAMODAR
POST-BRITISH PERIOD

REFERENCES
- River
- Reservoir and dam
- Canal
- Embankment
- Abandoned embankment

Fig. 4.3
embankments. Questions were also raised whether embankments were responsible for deprivation of fertile silt in the neighbouring flood basin (Sage, et al., 1846). The lands between the embankments and the rivers were acclaimed precious for which the landlords could have removed the embankments a mile-off the river. The land left outside the embankments, despite gradual deterioration had to pay a higher rent (Ricketts, 1853). Several committees were formed to investigate the following issues:

i. Embankments have increased sedimentation at the river bed thus making the river shallower.

ii. Flood propensity is increasing due to shallowing of the river bed.

iii. Landlords are not happy as they have to pay for the maintenance of embankments.

iv. Embankments are restricting lateral spread of flood water thus depriving the adjacent plain from flood borne fertile silt.

v. Landlords are reluctant to pay higher rent for these silt deprived so called protected lands.

vi. Removal of embankments is the solution of these problems.

What is to be noted is that all of these problems had a very strong applied connotation. Embankments were constructed for the benefit of flood affected communities. It is ironical to state that on the basis of observations on embankments, river discharge and river bed sedimentation several proposals were made to remove embankments for the benefit of the same communities. The proposals made by several persons are discussed below:

4.7.1.2.1 Proposal for removing the right bank embankment

Beadle, the then secretary of the Military Board in 1852 proposed that the right bank embankments of the river Damodar should be abolished in order to relieve the works on the left bank. He observed that on the right bank, the land rises to a short distance from the river and it slopes down towards its junction with the Hugli river. So, considerable space on the left side would be inundated if the embankments were removed from both sides (Ricketts, 1853).

Barker (1852), the then consulting engineer of the railway department commented that the channel between the embankments was quite inadequate for discharging enormous quantity of flood water. During the floods, 18275 cubic meter of water per second had to be disposed off at an average velocity of 0.91 m per second, and for that a channel with 3.2 Km width and 6.1 m depth was required. But the river was nowhere 3.2 Km wide. These earthen embankments were not strong enough to keep such a flood within the channel. Baker also proposed for the maintenance of a perfectly efficient embankments on the left side but on the right, the embankments could be abandoned wherever necessary to admit a free efflux for floods in that direction.

Goodwyn, the then superintending engineer of the South East Province based his conclusion on the assumed power of water to scour out and deepen the channel when it was contracted laterally. In his support he quoted the Italian engineer Guliemini “if we restrict river’s bed by art, we cause it to deepen its bed, while if the bed is too wide, or
divided into several branches its bottom will be raised in proportion” (Goodwyn, 1854:47). He refers to the features of the country as being unfavorable to the project of removing the embankments on the right bank of the Damodar and deprecates any such measures as unnecessary and fraught consequences to the country.

Dickens, the then assistant secretary of the Military Board (1853), pointed out that the Damodar was deteriorating from about 25.6 Km west of Barddhaman to Amta. It could not carry out one-eight of the flood discharge, it received from the upstream reach. He mentioned that the breaching of embankments in 1840, in 113 places was due to the diminution in the capacity of the channel from Sungutgolah, a few Km west of Barddhaman to Amta. He added that no breach had occurred above Sungutgolah in 1840. Passing through the sandstone rich Gondwana sedimentaries with high rate of declivity and in a district liable to heavy falls of rain after a long intervening periods of dry weather, the Damodar is subject to heavy floods and brings down an enormous quantity of sand upon the plains. The river does not improve by the closure with embankments, as sufficient velocity can not be obtained by that means to transfer excess water and sediments down stream. Any complete and permanent measures for securing the country on both banks from inundation was not possible. An observation was then made on the effect of removing the bunds from the right bank and it appeared that though the tract on both sides would be liable to heavy floods but floods would be less severe than before and at the same time the flood level of the river from about 8 Km west of Barddhaman downwards would be reduced by from 2.44 m to 1.22 m rendering the embankments on the left bank comparatively safe (Dickens, 1853). It was finally concluded that the removal of the right embankment for about 32.2 Km would provide a complete security to the left bank.

Colonel Garstin, the then officiating chief engineer (1854) pointed out that the system of embankments in this part of the country was not satisfactory and this system should never have been adopted. But he realized that the abolition of the vicious system which had been allowed to grow up and extend itself, was not an easy matter and many points must be considered and different interest groups must be consulted before any viable recommend to be made. Garstin did not realize that it would injure the railways if the bunds were abolished on both banks of the Damodar. Taking this question of removal of the right embankments ultimately he recommended for the abandonment of the bunds on the right bank of the Damodar as the best measure. The opinions expressed by different technical experts on the embankment issue reveal that all of them had doubt about the efficiency of the ill-defined and mal-constructed embankments as viable flood control measures. Secondly, they were particularly vocal on the removal of the right bank embankments.

4.7.1.2.2 Removal of the right bank embankments

The Bengal Government recommended the adoption of colonel Garstin’s view. In May 1855 orders were received from the supreme Government for the demolition of 32.19 Km of the right bank embankment from Sungutgolah down to Begua (Fig.-4.2, 4.3) for controlling the Damodar floods and for the safety of the continuous line of the left bank embankment which affords a complete security to the town of Barddhaman, the East
India railway line and the populous districts of Hugli and Barddhaman. Before the flood season of 1959, a full extent of 32.19 Km of the right bank embankments from Sungutgofiah down to Begua was removed. The embankments parallel to the river were only removed but the embankments of shoulder angles or where the banks were low or of loose formation were not removed. In some cases embankments were strengthened and put in order. On the right bank, with the exception of a continuous line of 28.8 Km long from the Begua breach to the villages of Deboorsoot and a few detached short lengths of no importance the embankments were completely removed. In 1889 another 16.1 Km of the right bank embankments was removed (Voorduin, 1947).

4.7.1.2.3 Proposal for remodelling the left bank embankment

There were several recommendations on remodelling the left bank embankment and some of the recommendations were translated into action. Between 1856 and 1860, the zaminders’ embankment along the left bank of the river was realigned and reinforced. The left bank embankments were made continuous for 176.87 Km and were provided with many sluices (Biswas, 1975).

The great Damodar floods affected the river levels at Calcutta due to cross country spill from Barddhaman and flow from the Kana nadi. The Kana-nadi was first closed at its head in 1853 by the construction of left bank embankment, it breached in 1856 and was left open until 1863 when once again it was completely closed by a bund over which the metalled road from Memari was laid (Stevenson et al., 1919). At present there are double embankments at Amirpur, Gaitanpur, Jujuti and above Panchpara double embankments are also observed. Due to severe bank erosion at these places the embankments are being eroded away (Pl.-4.1, 4.2), therefore, these flood jacketting measures have been taken. Embankments have also been constructed on the left bank above Durgapur Barrage near Andal due to excessive bank erosion (Pl.-4.3, 4.4). Initially the embankments were made of locally available mud and they had little vegetal cover. But now they have been protected by laterite and basalt slabs on the inward side in many places. Strip plantation on the embankments has provided further protection and the embankments are covered with morums also (Pl.-4.5). The embankments are not only important landforms in an otherwise monotonous landscape but also a significant feature in the rural resource base. During floods people take shelter on the embankments. They use the flat surface of the embankment for drying paddy and other cereals. Embankments form important transport link between villages though these are motorable in dry season only. Embankments are lined with energy plants like Eucalyptus, Akasmoni etc. (pl.-4.5). In a way embankments have become an important resource base in the rural economy.

4.7.1.2.4 Weirs, sluices and canals

The bed of the Damodar is considerably higher than the water level of the Hugli and there are several natural water courses draining the country between the Damodar and the Hugli into the latter. Sluice gates of a type to take off only the top water of the Damodar during the flood time were fixed to the embankments near the upper reaches
of these water courses. The left bank embankment has been provided with many sluices (Fig.-4.2), the most notable one is at Kamarul constructed in 1883-84; a channel inside the sluices was excavated in 1889-90.

Attempts were also made to transfer excess water from the Damodar river to some of the decaying distributaries through the Eden canal in 1881. In 1873, the first step towards the construction of the canal was taken up by the opening out the head of the Kanarnadi. In 1874, cuts were made connecting the channel with the Kana Damodar river and the Saraswati river, the work was carried out from time to time. The complete scheme consists of a head sluice at Jujuti, to admit water of the Damodar river to the Banka nala, the abandoned channel of the Damodar river (Pl.-4.6). The water flew along the Banka nala for 11.27 Km up to Kanchannagore weir and then admitted into the Eden canal by an anicut. Therefore, the canal runs parallel to the left bank of the Damodar river for about 32.2 km. diverting the water into the Kana Damodar at Jamalpur, where head regulator was built in 1874. There was also a cut connecting the Kana-nadi with the Saraswati near Gopalnagore (O’Malley and Chakraborty, 1912).

In 1933, the Damodar canal system was opened; water from the main river was admitted into the canal with the help of a weir at Rhondia near Panagarh of Barddhaman district (Fig.-4.2, Pl.-4.7). It is known as Anderson weir having a length of 1,143 meter. The main Damodar canal is 42.55 Km with a branch canal of 34.51 Km and a network of distributaries and villages channels totalling a length of 344.78 Km.

4.7.1.3 Post British Period

A full century before dam closure Dickens looked into the possibility of storing, instead of trying perennially to build defences against floods in the Damodar. He was supported by Garnault in 1864, by Horn in 1902, by Addams Williams in 1814 and by Glass in 1918-1919. The foresight of these Bengal engineers was remarkable (Hart, 1956). In order to alleviate the distress which was caused to the inhabitants by the removal of the right bank embankments, proposal for storage reservoirs in the upper reaches of the Damodar and the Barakar were considered between 1864 and 1866 (Horn, 1902).

But the measures for control of flood control of flood in the valley received top priority after the devastating flood of 1943. The British Government became conscious only after 1943 when a medium flood with a peak flow of only 9,912 cumec breached the Damodar left bank embankment near Amirpur, a few Km downstream of Barddhaman, on the night of 16/17 July 1943; the river forced its way through the breach as the slope was much more favourable. Water passed through an old and abandoned course of the river and over flooded the country on its way towards the Bhagirathi near Kalna. The country side was flooded with water level rising up to 1.83 to 2.13 meter and the entire rail, road and telecommunication system was totally disrupted. (Hart, 1956, Mookerjea, 1992).

The Second World War was then at its height and the INA under the leadership of Netaji Subhas Chandra Bose was advancing first towards India from Burma (1943) with active support and help from the Japanese Government. Because of the disruption of the
rail, road communication facilities from North India all the army installations at Calcutta and Eastern India were isolated, having lost all logistics to sustain the army. The situation was so critical that the British Government had to adopt 'Scorched Earth' policy and retreat from Calcutta towards Panagarh base and ultimately to Ranchi, the head quarter of the Eastern Command. The then Bengal Government had also set up the Damodar flood Enquiry Committee to advise on the permanent measures to control floods in the Damodar (Mookerjea, 1992).

4.7.1.3.1 Damodar flood enquiry of 1944: conception of the D.V.C.

The committee met for the first time on the 17th January, 1944 and submitted its final recommendation by March 10, 1944. The committee under the chairmanship of Maharajadhira Bahadur Uday Chand Mahtab, king of Barddhaman did magnificent work during the period of 3 months which paved the way to the creation of the D.V.C., a corporate body for the solution of river basin problems affecting two states, Bihar and West Bengal. During this time Tennessee Valley Authority (T.V.A.) had been completed for taming of a wayward river, Tennessee in the USA and produced a model for the world showing how river with more or less similar features could be controlled with the help of different types of engineering works constructed in the river basin. It also demonstrated the need and utility of soil conservation measures including erosion control and afforestation in the catchment to arrest depletion of soil and retention of run-off in the river catchment. In fact the T.V.A. method later became the standard engineering practice for moderation of floods (Report, 1944; Mookerjea, 1992).

The committee gave definite and positive recommendation regarding construction of dams, barrages, hydro-power stations, construction of water conveyance systems for extending irrigation facilities in the lower valley, conservation of the Lower Damodar by occasional flushing, setting up meteorological and flood forecasting stations in the upper catchment as also for introduction of soil conservation, land management measures in the upper catchment through the Government of Bihar (Report, 1944; Mookerjea, 1992).

The Government of India then commissioned the central technical power board to study the proposal and invited Mr. W.L. Voorduin, a senior engineer of the T.V.A. to study the problem of the Damodar and to make his recommendation for its comprehensive development. Accordingly in utility of soil conservation measures including erosion control and afforestation in the catchment to arrest depletion of soil and retention of run-off in the river catchment. In fact the T.V.A. method later became the standard engineering practice for moderation of floods (Report, 1944; Mookerjea, 1992).

The planner estimated the design flood of 28,321 cumecs with a hundred year frequency. To protect the lower valley, it was estimated that the design flood be moderated to 7,080 cumecs which was the total capacity of the Lower Damodar. However, due to financial and other constraints, the participating Government of West Bengal, Bihar and Central Government approved the construction of only 4 multipurpose dams (Voorduin, 1947).
4.7.1.4 Post Independence Period

The Damodar valley corporation came into existence on the 7th July 1948 and proposed for multipurpose dams. The Maithon dams was constructed on the Barakar river in 1957, the Panchet dam was constructed on the main Damodar in the year 1959 (Pl.-4.8, 4.9; Appendix-I). The construction of a barrage at Durgapur was started in 1952 and inaugurated in 1955 and subsidiary structures were completed by 1958 (Fig.-4.3; Pl.-4.10). The barrage is about 692.20 meter long. The main canal on the left bank is 137 Kms and the main canal on the right bank is 89 Kms. Branch and minor canals distributaries and drainage channels are about 2,270 Kms. Later on Sadar ghat bridge was constructed to connect Barddhaman and Bankura district.

4.7.1.4.1 Lower Damodar scheme

To mitigate the flood problem and water logging of the Lower Damodar valley, the West Bengal Government has envisaged a scheme known as the Lower Damodar scheme. It aims at removal of flood hazards together with the improvement of drainage condition of a vast tract of the trans Damodar area in the districts of Barddhaman, Hugli and Haora districts.

In 1971, this scheme was sanctioned. It envisages jacketting of the Mundeswari from Beuga Hana to allow a discharge of 7,080 cumec of flood water. The work started but was stopped because of the fact that a large number of people living in between the embankments and the proposed jacket vehemently objected to it. They apprehended perpetual flooding of the area. The human problem played a vital role in this regard. Subsequently, Ram Ballav Chakraborty Committee was set up to find out acceptable solution (Halder, 1992).

A new scheme was envisaged. It suggested for re-sectioning of the original main Damodar channel to carry 708 to 849.6 cumecs of flood below the Begua Hana to be carried to the Rupnarayan from Thalia, a place down Amta of Haora district. The work started but met the same fate. Ultimately at Ulughata, near Garchumukh of Uluberia, a 58 vented outfall sluice was constructed in 1982 (Halder, 1992; Fig.-4.3; Pl.-4.11). So, the inflow of any appreciable quantity of flood water in the Amta Channel will get proper exist to the Hugli river. Tidal water from the Hugli will also flow through the Ulughata sluice into the Damodar for irrigation purpose also. In between the Hugli and the Damodar a canal has been cut to carry excess water from the Damodar to the Hugli and to carry tidal water from the Hugli to the Damodar for irrigation purpose.

The last control structure is the indigenous cross dyke or dam at Rangamatia which is locally known as the Rangamatia dyke. The main purpose of this is to divert the flow, coming from the Durgapur barrage off the South Rangamatia sandbar (Pl.-4.12a and 4.12b).

River training is a ongoing process. The processes like closing of the Jujuti sluice by sand bags and spill channels and remodelling of the left bank embankment by boulder pitching are still going on (Pl.-4.13a, 4.13b). In many places flow of the Damodar is obstructed by sand bags. Temporary bridges have been constructed in order to take sand
from river bed sand quarries (Pl.-4.14, 4.15). Thus the Lower Damodar due to human interference to river system through longitudinal and transverse dykes has now become a controlled river with little natural behaviour left. Or in Petts’ word (1984) the Lower Damodar has transformed from a natural river to a reservoir river.

4.8 SUMMARY

The Lower Damodar has always been a flood-prone river. It has changed its mainflow several times in the historical past and shifting courses can be identified if one collates archival maps. Recorded flood history, however, dates back from 1730. Since 1730 floods of different magnitudes have occurred every 8 to 10 years. In the present century the September flood of 1978 is interpreted as the greatest disaster of the century in South Bengal.

Embankments are obviously the first control measures on the Lower Damodar. These were constructed by local land lords but the issues on embankments were extensively examined during colonial regime. The right bank embankments were removed and the left bank embankments were raised and fortified.

The left bank embankments have also been provided with many sluices, the Jujuti sluice is one of them. But due to lack of maintenance some of the sluices do not operate properly. Canals were dug to divert excess water from the river and to revive some of the decaying distributaries of the Damodar through water transfer from canal to the river. The Eden canal for this purpose was constructed in 1881.

The most important control structure on the Lower Damodar is the Panchet reservoir which is an outcome of the D.V.C. which conceptualized in 1948 and started functioning from 1959. Despite several control measures taken by the D.V.C. the lower most part of the Lower Damodar i.e., the Amta channel is deteriorating. So, at Ulghata a 58 vented outfall sluice has been constructed in 1982 as a programme of the lower Damodar Scheme 1996. The last mention worthy control structure is the Rangamatia cross dyke locally referred to as Rangamatia dam at Rangamatia sandbar.

River controlling process is an ongoing process, strengthening of embankments, closure of spill channels, drainage diversion etc., are components of this process.

But the process itself is an anthropogenic process which has given rise to several cultural features such as embankments, weirs, sluices, barrage and reservoirs etc. These cultural features are the indicators for identifying the characteristics of the Lower Damodar. The stretch between the Panchet reservoir to the Falta outfall is thus culturally defined.
4.1 Boulder covered embankment.

4.2 Breached embankment during 1995 flood.
4.3 Scoured river-bed during 1995 flood near Damodar Char mohana.

4.4 Newly constructed embankment above Durgapur barrage at Ramprasadpur to protect Andal town.
4.5.a. River-bed with sandy bed load.

4.5.b. Earthen embankment strengthened with boulder pitching.

4.5.c. Strip plantation.


4.6.b. River above Jujuti sluice.
4.7 Rhondia weir.

4.8 Maithon Dam
4.9 Panchet Dam

4.10a Durgapur barrage.

4.10.b. D.V.C. canal. (left bank main canal).

4.11 Ulughata sluice.
   a) An excavated channel connecting Damodar with Hugli
   b) The Hugli.

4.14 Breached left bank for making a passage.

a) Temporary non-monsoon bridge has been constructed on the river-bed itself for transporting sand quarried from the river bed itself.
b) Note the piles of sand bags on both sides of the bridge.
c) Heavy vehicle like lorry can ply over this bridge.
d) Left bank embankment has been breached for movement of vehicles.

4.15 Breached left bank enlarged.