Research Paper

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Role of Reservoirs in Flood: A Case Study of Flood in 2000 in Murshidabad, West Bengal

Geography

KEYWORDS : Flood in Murshidabad, Massanjore Dam, Mayurakshi River Basin, Damodar Valley Corporation

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ABSTRACT

In India, for controlling flood emphasis has been on structural measures especially construction of multipurpose projects due to economy of construction cost. They are required to moderate the incoming floods to the maximum possible extent as well as store enough water during the monsoon period so that the conservation purpose are best served during the remaining period of the year. But unfortunately these structural measures have been proved futile for flood management. The main problem of these reservoirs is heavy siltation and inappropriate maintenance. In most cases, the actual rate of siltation is found to be higher than the design rate. For the 23 reservoirs the annual loss in live storage capacity is 0.912% of the original live storage capacity. These 23 reservoirs have already lost 23.11 % of LS by 2006. This paper attempts to find out the problems regarding the Massanjore Dam in controlling flood in Murshidabad, in particular based on secondary data from various government reports. It may help the administration of the district to find the solution of the flood problem in other way than depending on controlling flood through reservoir regulation.

INTRODUCTION

Most parts of India being dependent for water on 3-4 month long monsoon, reservoirs are created to store water for use in non- monsoon months. India has by now about 4500 large reservoirs and lakhs of smaller reservoirs. The irrigation was the prime objective of 96% of 4291 dams built in India (WCD, 2000). The flooding resulted not from higher rainfall but from a failure to balance properly flood control with other objectives of big dams—irrigation and hydro-power. Flood control demands that dams allocate adequate space to receive flood surges; maximizing hydro-power potential means that water level in dams is kept as high as possible. The reservoirs, created by dams on rivers, also get silt in the water of the rivers that enters the reservoirs and a significant proportion of the silt settles down in the reservoir, thus reducing the space available for storage of water. Moreover, studies over the years have shown that the silt gets deposited in both the dead storage (the storage at the bottom, below the Minimum Draw Down Level, which is not used under normal circumstances) and in the Live Storage (LS). Siltation results in reduction in benefits from the projects constructed at huge costs to the nation. Siltation of reservoirs can also have a number of other impacts, including increased evaporation losses, increased backwater flooding and also could damage the power house turbines.

After independence in July 1957 there was a firm declaration in the Parliament that country will do all that is possible to curb and confine floods more and more. Massive programme of structural measures with the construction of dams and reservoirs were taken up with flood control as one of the major objectives. But because of unpredictable pattern of rainfall, the flood moderation through reservoir detention and its releases failed to achieve the desired level of objective. The limitation of structural intervention was compounded by another important social factor. The dichotomy of interest between people affected by submergence of lands due to reservoirs and that of people of the benefited area came to surface. This conflict has come up sharply into focus in recent times. With these factors new tension was added in the parlance of flood -'the reservoir release, a cause of flood'. The different reservoir releases during monsoon months suddenly came to the forefront as a dominant issue of flood and at times even replacing the extreme adverse natural causes. All these relevant factors and recent experiences of other countries induced changes at policy decision level. The stress given to control flood just after independence gradually took a turn towards an achievable pragmatic approach of flood management (National Commission for Integrated Water Resources Development, 1999).

OBJECTIVES AND DATABASE

The paper has the following objectives:

1. To describe the present status of the reservoirs in terms of their capacity to control floods.
2. To analyse the functions of Massanjore Dam and DVC in controlling flood.
3. To indicate the role of Massanjore Dam in controlling flood of 2000 in Murshidabad and its adjoining parts.

The sources of the data used in the study are of secondary sources. Various Government Reports and literature like publication from Irrigation & Waterways Department, Govt. of West Bengal, Annual Report of Central Water Commission, Govt. of India, publications of South Asia Network on Dams, Rivers & People (www.sandrp.in) etc.

RESULTS AND DISCUSSION

According to the data from CWC and the Regional Remote Sensing Service Centre (RRSSC), Jodhpur the actual rate of siltation of the reservoirs in India is found to be higher than the design rate. For the 23 reservoirs the annual loss in live storage capacity is 214.2 MCM that is 0.912% of the original live storage capacity. These 23 reservoirs have already lost 23.11 % of LS by 2006. The distribution of reservoirs with respect to proportion of original LS lost through siltation is as follows.

That siltation is a serious issue and action is required to arrest the destruction of productive reservoir capacity created at such huge costs has been known for many years. Morris (1995) believed that the overall picture indicates that reservoir sedimentation is a serious national problem which requires immediate action. According to the Mid Term Appraisal of the 9th Plan (Oct 2000), there is an urgent need to review the status of reservoir sedimentation. However, most such warnings have gone unheeded and catchment area treatment that can help reduce the siltation has largely remained non- existent, except on paper. The Report of the Govt of India's National Commission of Integrated Water Resources Development (1999) implies that India is losing about 1.3 BCM of storage capacity each year. That should be alarming enough for everyone as at today's rates creation of 1.3 BCM storage capacity would cost Rs 1448 crores. That means that on an average, each day we are losing Rs 4 crores worth of storage capacity through siltation.

Table 1 Loss of Live Storage of 23 Reservoirs of India

Loss (%)	>40	25-40	20-25	15-20	10-15	5-10	<5
No. of Reservoirs	2	3	4	5	4	2	4

Source: National Commission for Integrated Water Resources Development, 1999

This shows that we have already lost about a quarter of the LS capacity of the 23 reservoirs studied here, due to siltation. The proportion of capacity lost from reservoirs all over India would be similarly order of magnitude. This has huge implications as this means significant reduction in benefits from the reservoirs in terms of hydropower generation, irrigation, water supply and flood management. In economic terms, creation of 1.95 BCM of capacity would at today's costs would require at least Rs 2017

crores. This means that we are daily losing reservoir capacity worth Rs 5.53 crores.

The Damodar Valley reservoirs were built with the multipurpose idea of flood control, power generation and irrigation in comparatively dry Rarh tract of West Bengal. The Massanjore and Kansabati Project had no flood control plan. About five decades have passed since construction of this mighty reservoirs and the alarming rate of siltation has reduced the capacity appreciably. Only the DVC reservoirs were planned to have three tier water storage systems- the dead storage, live storage and flood storage. The combined flood storage capacity of four DVC reservoirs is 1270 million cubic metre which is proved frequently inadequate to accommodate the huge discharge generated during a high torrential rainfall. The data relating to continued sedimentation in two major DVC reservoirs namely Maithan and Panchet are furnished below showing the loss of capacity.

Table 2. Loss of Live Storage Capacity of Maithan Reservoir (capacity in '000 ac ft)

Zones	1955 Original	1963	1965	1971	1979	1987	1994
Dead Zone (upto EL. 435 ft)	167.4	27.0 16.2%	31.9 19.0%	36.6 21.9%	54.9 32.8%	72.3 43.2%	90.5 54.0%
Live Zone (EL 435-480 ft)	492.3	27.0 5.5%	31.0 36.4%	50.8 10.3%	67.1 13.6%	93.8 19.1%	110.5 22.4%
Flood Zone (EL 480-495 ft)	309.8	Negligible		1.1 0.3%	3.4 1.1%	8.1 2.6%	13.3 4.3%
Overall (upto EL 495 ft)	969.5	51.2 5.3%	59.8 6.2%	88.5 9.1%	125.4 12.9%	174.2 18.0%	214.3 22.1%
Sediment deposit Rate (acft/sq.mile/year)		3.2	3.0	2.8	2.6	2.7	2.7

Table 3. Loss of Live Storage Capacity of Panchet Reservoir (capacity in '000 ac ft)

Zones	1956 Original	1962	1964	1966	1974	1985	1996
Dead Zone (upto EL. 392 ft)	191.51	41.8 21.8%	50.8 26.5%	51.5 27.0%	67.4 35.2%	90.1 47.0%	94.5 49.6%
Live Zone (EL 392-410 ft)	204.5	20.1 9.8%	22.1 10.8%	26.5 13.0%	36.3 17.8%	47.1 23.0%	55.5 27%
Flood Zone (EL 410-445 ft)	885.7	2.3 0.3%	5.4 0.6%	7.8 0.9%	14.0 1.6%	13.0 1.5%	30.3 3.4%
Overall (upto EL 445 ft)	1281.7	64.2 5.0%	78.3 6.1%	85.8 6.7%	117.7 9.2%	150.3 11.7%	180.6 14.1%
Sediment deposit Rate (acft/sq.mile/year)		2.8	2.6	2.2	2.1	1.4	1.36

Source: DVC

It is alleged that the DVC often takes a calculated risk and stores water in the reservoirs up-to flood storage during July- August to ensure irrigation forbore cultivation. Since the September rainfall is uncertain, the Dam authority wins the gambling in years when the late monsoon rainfall is scanty. But when there is torrential rain in late September sudden release of water from reservoir is a common practice causing devastation in the lower reach. Man Singh Committee (1959) noted that before the construction of the DVC dams, the flood peaks were high but the duration was small. The construction of dams has moderated the peak but increased the duration of floods. This increase in duration has enhanced the chances of synchronization of floods from upper and lower valleys as also from adjoining river basin.

From the counterpart rupee fund created through supplies of wheat and other materials from Canada for use in India, Canada devoted those rupees to the further development of the Mayurakshi dam project. The Massanjore dam (also called Canada Dam), across the Mayurakshi, was commissioned in 1955. It was formally inaugurated by Lester B. Pearson, Foreign Minister of Canada. Unfortunately, the Massanjore dam located near Dumka in the state of Jharkhand (erstwhile Bihar) was not allowed to have any flood reserve. Simultaneously with construction of dams the state government in 1956, selectively took over flood control embankments till then maintained by the landlords or local bodies. Massanjore dam is about 65 km upstream from Siuri in West Bengal. It is 47 m high from its base and is 660 m long. The reservoir has an area of 67.4 km^2 when full and has a storage capacity of 620,000,000 m3. It had cost Rs. 16.10 crore

Massanjore Reservoir plays an important role in flood of Murshidabad. Massanjore Reservoir is constructed on Mayurakshi River, a major river Murshidabad in West Bengal, India, with a long history of devastating floods. Mayurakshi has its source on Trikut hill, about 16 km from Deoghar in Jharkhand state. It flows through Jharkhand and then through the districts of Birbhum and Murshidabad in West Bengal before flowing into the Hooghly River. The river is about 250 km long. Annual rainfall over the basin varies between 765 and 1607 mm with an average of 1200 mm of which 80% occurs during the monsoon season from June to September. Some of the historically important floods in this river were recorded by L.S.S. O'Malley in the Bengal District Gazetteers for the districts of Murshidabad and Birbhum. For the district of Birbhum, O'Malley has noted "in 1787 there was a high flood which it is said, in some places swept off villages, inhabitants and cattle, the crops on the ground, with everything that was moveable." O'Malley also recorded that "in 1806 the Mayurakshi and Ajay had a sudden extraordinary rise and floods washed away whole villages." In September 1902, because of heavy rains the Brahmani and the Mayurakshi overflowed their banks and inundated the surrounding country in some places to the depth of 6.1 m.

In the four decades between 1960 and 2000 only five years could be identified as flood free years, when only less than 500 km^2 of area were inundated. After major floods in 1978, West Bengal suffered consecutively in 1998, 1999 and 2000. In 1978, seventy two hours of continuous and concentrated rainfall over the western river basin areas of the Bhagirathi viz. from the Pagla-Bansloi to the Ajay, generated so huge flood volume that all embankments on the eastern side of the Bhagirathi were almost washed away and the whole of Nadia district, a larger part of Murshidabad district and northern areas of North 24 Parganas district were flooded and remained underwater for a long period of time. Massanjore reservoir has no flood storage capacity. The initial capacity of Massanjore reservoir was 61.67×10000000 m3. The Kansabati reservoir could accommodate 123.35×10000000 m3 of water. According to the report of the Irrigation and Waterways Directorate, the capacity of Massanjore dam has been reduced by about 48 per cent in dead storage and 15 per cent in live storage. But on the 18th September 2000 when the storage in the reservoir reached the threshold limit of 358000 acre feet, 42690 cusecs water was released. This is an indication that the overall capacity of reservoir has been reduced by about 28 per cent during preceding five decades.

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Massanjore reservoir has reduced the intensity of flood by about 30 per cent since the flow of river was controlled from 377000 cusec to 262000 cusec. The DVC reservoirs reduced the flow of Damodar from 430000 cusec to 210000 cusec (The Irrigation and Waterway Department, 2000). Had there been an uncontrolled river system, the flow of water would have not been to the tune of 387000 cusec or 430000 cusec. The controlled system allows the pond level to achieve an alarming height and then releases the water. The velocity of water thus multiplies many times. For example, the pond level of Massanjore reservoir was raised from 378 ft. to 402.61 ft. between 17th September to 21st September, 2000. This added a tremendous momentum to the released water which caused havoc in the downstream areas. On the 18th of September, Tilpara barrage started to release water, highest discharge released was reportedly 1076.38 cusec. The Deucha barrage on Dwarka river and Baidhara on the Brahmani river, were outflanked simultaneously and consequently a huge sheet of water rushed eastward and swept away many villages. On the 21st September at 12 noon, the Tilpara barrage released 2562.97 cusec of water. The combined peak contribution of Ajoy and Mayurakshi systems into Bhagirathi at Katwa was measured to be 4.50 × 100000 cusec. The hydraulic dam created thereon intercepted the southward flow of the Bhagirathi, which received continuous upstream supply of water from Pagla and Bansloi river and the Farakka Feeder canal

At about 21.00 hrs on the 21st of September, the Bhagirathi breached its left embankment at Kalukhali and opened an alternate route through the Gobra nala toward Jalangi river. The fast flowing water delinked the road and railway near Subarnamrigi Station and swept away three villages, namely Kalukhali, Baliramna and Subarnamrigi, claiming 37 lives. The railway between Beldanga and Berhampore was delinked at eleven points. All water rushed eastward and flooded extensive areas of Murshidabad and Nadia. Some engineers argue that the western reservoirs played vital role in reducing the magnitude of flood by accommodating substantial amount of water. The argument seems to be untenable. The flow of water in an uncontrolled river system can never be abruptly high as happens in a controlled system when a reservoir suddenly releases huge discharge. For example, the water level at Massonjore reservoir was 378 ft on the 17th September. This was raised to 402,60 ft on the 21st September when 200500 cusec of water was released. The water gained tremendous momentum and destruction in the lower reach surpassed all previous records. Being located downstream, pond level in Tilpara barrage was elevated from 202 ft to 2111.40 ft and consequently 256297 cusec of water was released. The bankful capacity of the Mayurakshi River below Tilpara barrage hardly exceeds 30,000 cusec.

The excess water breached left bank embankment at several places and rushed eastward toward the Bhagirathi. The flowing sheet of water achieved a height of about eight feet and swept away many landmarks on its way. A striking sequence of hydrological events was noticed. The flood in Birbhum district started on the 18th September when Baidhara and Deucha barrages were outflanked. The situation became worst on the 21st September when more than 2.50×100000 cusec of water was released from Tilpara. The water level in and around Katwa and Nabadwip towns abruptly went up from knee-deep to more than three metres. The waters of Bhagirathi, which subsequently opened a new outlet through Gobra nala, had already flooded the Berhampur, the district headquarters of Murshidabad. Since the breach of the Bhagirathi embankment and Lalgola bound Railway near Beldanga at about 9 pm on the 21st September, water logged Berhampur got relieved, but situation in Nadia started to deteriorate. On the 24th of September, huge sheet of water submerged 3900 sq. km area and a population of about 3.80 million was marooned. The floodwater subsequently rushed southward through moribund Ichhamati and devastated extensive areas in North 24 Parganas. On the 26th September, Bongaon, Bagda, Swarupnagar, Gaighata areas were under three meters high water. The residents of North 24 parganas were totally unprepared to face such disaster as only 190 mm rainfall was recorded there and misery was unbearable.

Table 4. Loss of Live Storage Capacity of Massanjore Dam (Capacity in MCM)

Original LS (mcm)	Reassessed LS Capacity	Loss (mcm)	Span	Loss (%)	Annual Loss (%)	Rate of Siltation (mcm/yr)	Capacity Loss Anticipated till 2006	
							In mcm	In %
547.59	474.82	72.77	45	13.29	0.295	1.617	82.47	15.045

Source: WCD, 2000

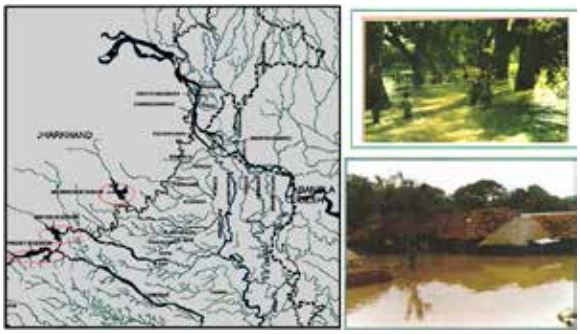
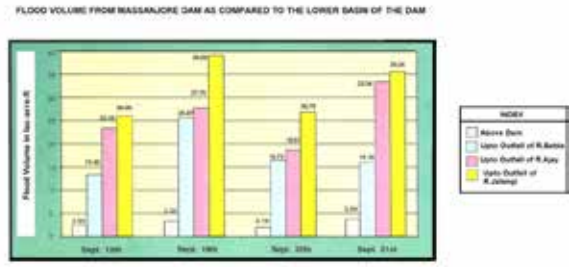
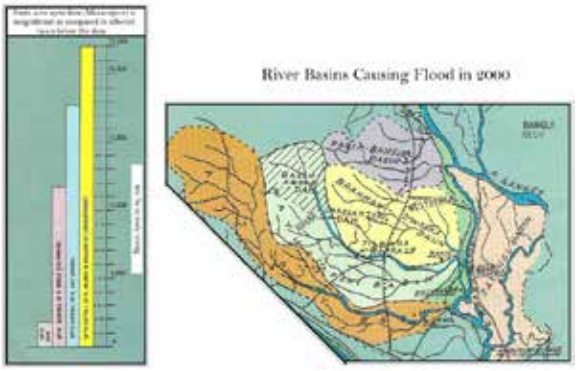


Figure 1a-b: Flood Volume and River Basin Areas. (From left): 1a. River basins and their areas; 2b. Flood volume from Massanjore dam



Box 1a: Discharge Pattern from Massanjore Dam
Source: Irrigation & Waterways Department, 2000



Box 1b: River Basins and their areas contributing flood
Source: Irrigation & Waterways Department, 2000

CONCLUSION

A comprehensive flood-management program should revolve around improving flood-coping mechanisms and flood-preparedness. Some key areas that must be addressed in India include sustaining and improving natural systems' ability to absorb floodwaters; improving dam management, and instituting clearly defined and transparent operating rules that are stringently enforced; improving the maintenance of existing flood infrastructure rather than spending money on new dams and embankments; undertaking a credible performance appraisal of existing infrastructure in a participatory way, and removing embankments that are found to be ineffective; and producing transparent disaster management plans intended to be implemented in a participatory way. Perhaps most importantly, In-

dia needs to assess the potential impacts of climate change on rainfall and on the performance of flood-related infrastructure, and begin planning for the necessary adaptation to the changing climate.

In conclusion, there is mounting evidence that structural measures have been largely ineffective in its claims of controlling floods, and in fact, have worsened flooding in many parts of the country. Yet the state and national governments in India – with support by international agencies like the World Bank, the Asian Development Bank and the Japanese Bank for International Cooperation –is pushing for more, not less of the same structural solutions. The opportunity provided by the report of the World Commission on Dams in reviewing planning and decision-making frameworks for large dams appears to have been completely lost on India's water managers.

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