# THE IMPACT OF THE DAMODAR VALLEY PROJECT ON THE ENVIRONMENTAL SUSTAINABILITY OF THE LOWER DAMODAR BASIN IN WEST BENGAL, EASTERN INDIA

**Susmita Ghosh**
Scottish Church College, 1&3, Urquhart Square, Kolkata– 700006, India
Corresponding author: chak.susmita@rediffmail.com

 ISSN 1923-6654 (print) ISSN 1923-6662 (online).
Available at http://www.ssrn.com/link/OIDA-Intl-Journal-Sustainable-Dev.html

**Abstract:** The Damodar Valley Project is the first major Multipurpose River Valley Development Project in Eastern India after the country became independent in 1947 from the British rule of over 200 years. Originating from the Khamarpet Hills (1050 meters above mean sea level) of the Chotonagpur Plateau in Jharkhand state and flowing thereafter over the heavily dissected plateau in the upper valley part in the west; the River Damodar enters the rolling plains of West Bengal in the east and taking a sharp right-angle bend, it ultimately joins the Bhagirathi – Hugli River (Ganga River) which falls into the Bay of Bengal. The Upper Damodar Basin is wide fan-shaped in nature where the up-valley hill slope is very steep in contrast to the Lower Damodar Basin which is very narrow and elongated with gentle topography. Again, the river flows just in opposite direction of rain – bearing south west monsoon wind. So, during the monsoon period, the lower Damodar Basin becomes saturated first with the monsoon water and when the south west monsoon wind reaches the Jharkhand state and there is heavy downpour; the rain water rushes through the Damodar and causes floods of various magnitude in the lower segment in each and every year. Therefore, devastating floods of high destructive nature were of regular occurrences for which the river was typically known as the 'Sorrow of Bengal'.

Flood in the lower Damodar Basin has a long history since the first recorded flood of 1730. Apart from the small scale participatory initiative by the local people in managing floods by jacketing the lower course in order to restrict the spreading of the flood water of the Damodar River, the first worth-mentioning project on part of the British rulers was the excavation of the Eden Canal so as to divert the monsoon flood water into the Bhagirathi-Hugli River. However, this venture was not so effective in mitigating the agony of people of the lower Damodar Basin. The Government of India invited Mr.Voorduin, to prepare the project report. Finally, a Multipurpose River Valley Project under Damodar Valley Corporation (DVC) was initiated by the Government of India for the entire basin in 1948. In this Project known as Damodar Valley Project (DVP), four big dams viz. Tilaiya, Konar, Maithon and Panchet were constructed in the upper valley and a barrage at Durgapur in the middle valley segment instead of eight dams as proposed in the original plan due to shortage of funds.

This paper tries to trace out the objectives and implementation of the Damodar valley project in the upstream segment of the Damodar River and its impact on environmental sustainability of its lower valley segment within a period of fifty years of construction of big dams – the wonder of modern technological development f the 20$^{th}$ Century. Because of massive diversion of upper Damodar water into canals, the lower Damodar is now starved of its natural flow resulting gradually either de-linking of some of the distributaries from the mother Damodar river and / or a few surviving distributaries turning into *kana nadi* (blind river). Thus, life drainage has been modified into defunct drainage. Unfortunately, this created just the opposite reaction i.e. instead of controlling the natural flood; the lower Damodar basin is repeatedly devastated by the release of huge amount of water from the up valley reservoirs i.e. Man – made floods. Storing of monsoon rain water in dams and barrage further aggravated the problem of siltation in the river bed instead of replenishing the fertility of the land as the annual flushing was greatly checked. Therefore, lesser availability of surface water flow through rivers, have forced the farmers to tap ground water

for which ground water level has gone down considerably. Therefore, there is a great impact of construction of big dams and barrages under the multipurpose river valley project on the environmental sustainability of the lower reaches of the mighty Damodar River.

**Keywords**: Dams, Defunct Drainage, Environmental Sustainability, Flood, Multipurpose project.

## INTRODUCTION

The River Damodar rises from the Khamarpet Hills (1050 meters) of the Chotonagpur Plateau in Jharkhand in eastern India. Leaving behind the dissected plateau of Chotonagpur in the west, the river enters the rolling plains of Bankura – Bardhaman districts of West Bengal (Fig.1) and ultimately flows through the flat plains of Hugli – Haora districts and joins the Bhagirathi – Hugli River (Ganga River) which falls into the Bay of Bengal. The River Damodar was typically known as the 'Sorrow of Bengal' for its notorious shifting and flooding activity that affected most of the years the people of the lower Damodar Basin mainly. In spite of its small size (540 kilometer long) in comparison to other Indian rivers, the River Damodar ranked high in its destructive capacity. Because of these recurring catastrophic floods, immediately after the Independence of the country in 1947, a Multipurpose River Valley Project following the Tennessee Valley Authority (TVA) of USA was initiated by the Government of India for the entire basin in 1948, under Damodar Valley Corporation (DVC). In this Project known as Damodar Valley Project (DVP), four big dams viz. Tilaiya, Konar, Maithon and Panchet were constructed in the upper valley and a barrage at Durgapur in the Middle Valley segment.

### Study area

### Location

The Lower Damodar Basin lies in between 87 degrees 45 minutes and 88 degrees 15 minutes east and 22 degrees 15 minutes and 23 degrees 10 minutes north. The study area covers 3393.27 sq. km. There are 243 villages (*mouzas*) in 19 police stations of the 3 districts - namely Bardhaman, Hugli and Haora of West Bengal. The area is bounded by the catchments of the Dwarakeswar – Rupnarayan Rivers in the west, the Saraswati – Hugli riverine system in the east and the Banka River in the north (Fig.1).

### Topography and Drainage

Topographically, it is a vast low lying plain where the general slope of the Rarh Plain on the western bank of the Hugli River is towards the east i.e. towards the north – south running Bhagirathi-Hugli River; the Damodar in its own area is having a southward slope as reflected by the sharp right-angled bend near

Bardhaman in the north (Fig. 1) The lower Damodar basin is drained by the river Damodar and its distributaries on either side, a few of which are unceremoniously terminating within the land area; earning the nick name '*kana'* or blind. The main distributaries are Mundeswari in the west and *Kana* Damodar in the east. The plain is frequented by a number of marshy lowlands and cut off channels.

### Climatic Characteristics

Due to its typical tropical location, the lower Damodar basin is characterized by the 'Tropical Monsoon' climate. Temperature increases during the summer months and this apparent dry pre-monsoon summer receives some occasional smart showers (Nor' Westers) which help the starting of some earlier crops. Later on, this continuous rise in temperature drops down considerably by 6 degree to 8 degree centigrade with the outburst of the south–west monsoon rain during June and September (annual rainfall ranges between1200 mm and 1800mm) before it starts to retreat for the year. Since the drainages here are all rain-fed, the seasonal flow variation in the rivers would not be uniform had the monsoon downpour becomes erratic. The winter sets in very gradually from November and lasts for three months with practically no rain for which the rivers of the study area reduce practically into sandy–clay beds (Photo#1).

So, the general impact of the monsoon on the hydrological conditions of the study area is that usually dried up rain fed rivers of the pre-monsoon period here, swell up with the full burst of monsoon causing heavy flood.

### Methodology

The present work necessitates detailed investigations i.e. the study and use of topographical sheets (1: 50,000 scale), published by The Survey of India, the study of micro relief conditions ( at 03 meters contour interval) [1], consultation of old maps, Government publication and reports. Information and photographs are taken during field-work. Finally, during post-field period, analysis and interpretations are made and conclusions are drawn with suitable recommendations.

### Result and discussion

The Damodar is a monsoonal rain-fed flashy river. With the burst of monsoon, widespread heavy rains

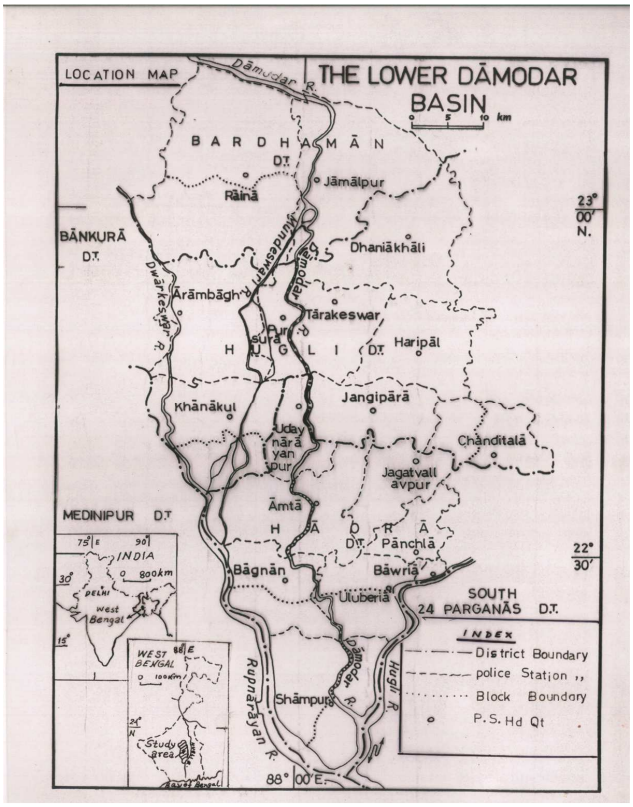


Fig. 1: The Lower Damodar Basin of West Bengal. Lower Damodar basin shows that the River Damodar Flows southward after taking a Right Angle Bend. Its Main Distributary, the Mundeswari Also Flows Southward to Meet The Rupnarayan River

Photo 1: Sandy–clay beds

Table 1. Capacity Loss of Maithon and Panchet Reservoirs Due to Sedimentation

| Year | Overall Elevation Maithon | Overall Elevation Panchet |
|---|---|---|
| 1955 | 969.5 | 1281.7 |
| 1965 | 909.7 | 1201.4 |
| 1975 | 844.1 | 1164.0 |
| 1985 | 795.2 | 1131.4 |
| 1995 | 755.2 | 1101.0 |
| 2005 | 704.1 | 1140.0 |

At present, the situation is that only 150,000 cusec flood water can pass through the Damodar River and if the DVC releases more than that; flood becomes inevitable in Hugli and Haora districts.

amounting 1500 mm on an average increase the water flow in the river and cause floods of high magnitudes almost every year since the first recorded flood of 1730. It is very surprising that in spite of huge economic loss and human agony on account of large--scale damages to lives and properties, it took over 200 years to have a systematic plan to mitigate floods till DVC in 1948. Considering the severity of the flood of 1943 that disrupted the railways and other means of communication with the city of Calcutta (presently Kolkata), the British consulted Mr. W.L.Voorduin, a Tennessee Valley Authority (TVA) expert. The Government of India invited Mr.Voorduin, to prepare the project report. Again, where flood-control was the top priority of DVC following the temperate model in a tropical land; instead of eight dams as proposed in the original plan, only four were constructed due to shortage of funds. Hence, from the very beginning only the peak flow was moderated to a certain extent but not the complete protection of the land from floods of high magnitude.

**Changes in the Frequency and Magnitude of Floods**

The situation relating to floods has totally been changed after the construction of the dams and barrages of DVC. These four reservoirs operating since 1958 have reduced the unregulated flows. According to available data, peak flow exceeding 11,000 cumec during the pre – DVC period occurred at Rhondia only in 1933 and 1949, while the same have occurred 11 times between 1955 and 1978. It tends to prove that the frequency and intensity of floods have increased during the post - DVC period. Actually, the water – holding capacity of all the four dams which are fifty years old has been reduced to a greater extent than

that of calculated estimation of the DVC. Hence, it is interesting to note that the present day floods have been caused by the unprecedented water discharge from the above reservoirs and the failures of the lower channels to carry out the excess water. As a result, the degree of flood damages was more serious in canal – served central part of the valley i.e. Arambagh, Khanakul, Pursura, Tarakeswar, Amta, Udaynarayanpur, and Jagatballavpur police stations. Thus, severe flood situations are caused nowadays by the DVC reservoirs and canal network.

**Changes in Fluvial Environment during the Post–DVC Period**

Before the execution of DVC Multipurpose River Valley Project, the Damodar overflowed regularly during heavy monsoon rains. Due to this unregulated free flow, a number of distributaries e.g. Behula, Kunti, Kantool, Ghia, *Kana* (blind ) Damodar etc. emerged from the Damodar river where it has taken a sharp bend changing its course from east to south. As the four dams (Tilaiya, Konar, Maithon and Panchet) came into operation after 1948, the huge monsoon water flows of the upper Damodar catchment area were held back in the adjacent reservoirs of those four large dams. Furthermore, diversion of the downstream flow from the Durgapur Barrage through the Left and Right Bank Main Canals, lower Damodar became a lean and thin stream considerably feeble flow (Photo#2).

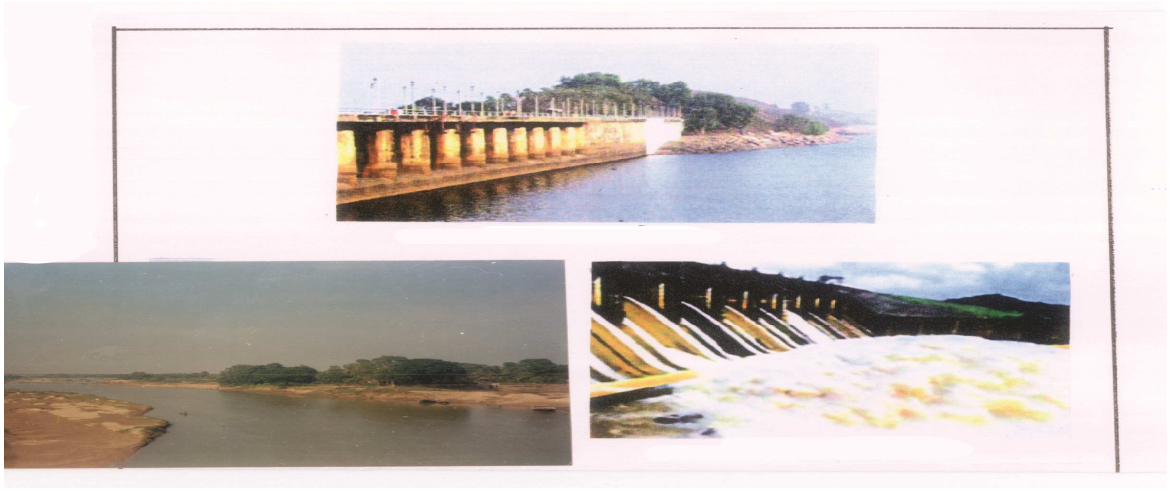

Photo 2: The Lean and Thin Damodar during the Dry Winter Months (Left), the Panchet Dam (Above) and the Release of Water from the Maithon Dam during The Period of Heavy Monsoon Rain (Right)**.**

Photo 3: clearly indicates the nature of past flow of the Damodar River i.e. during the Pre - DVC period. It shows the extent of agricultural activities and human settlement on the vast floodplain which is self-explanatory of the load–discharge aspect of the Damodar River in the past.

**De-functioning of left Bank Distributaries Channels**

"Through the stages of complete jacketing of lower Damodar and after the completion of the DVP along with diversion of most of Damodar water through the right and left bank canal systems, the easterly distributaries gradually lost their life-flow from the Damodar and become completely de-linked from the mother river," [2]. This is a unique example of how human interference to natural drainage system has caused changes over the past the fluvial environment modifying the life drainage into defunct one. As these rivers used to carry a considerable part of the annual water flow of the Damodar in the past, passing through the stages of gradual decaying, it seems now that they can not serve their normal functions i.e. sharing a large volume of flood discharge and making the adjoining areas less liable to flood hazards, irrigating the agricultural fields, renewing the fertility status of soils apart from fishing, navigation etc.

**Human-Induced River Capture and Changes in Flow Direction of Channel**

This area of south Bengal having per humid monsoon condition, obviously set these cut off channels e.g. Behula, Kantool, Ghia etc. as drains of the country side to carry the flow further south eastward into the adjoining Saraswati River. Hence these rivers that were once distributaries of the Damodar River now became the tributaries of the Saraswati River. This is a unique example of human induced river capture [2]. The *Kana* Damodar on the other hand, still having a feeble upstream link with the left bank of the Damodar River, has been subsequently connected with the Hugli River by man - made canal (Haora drainage canal). Thus, at present, the surface drainage of the area under study comprises mainly of the Damodar, *Kana* Damodar, and the Kanki-Mundeswari Rivers along with a good number of channels (i.e. the old beds of the Damodar River) and marshes. Though the Damodar falls into the Hugli River, the Mundeswari has a special dual status of channel designation – it is acting as a distributary being originated from the Damodar River and at the same time it is playing the role of a tributary joining another master river i.e. the Rupnarayan which also flows ultimately into the Hugli River (Fig.1).

**Sedimentation Problem in the lower Damodar River and its Distributaries and Degeneration of Fertility Status of Soil**

At present, the Damodar is the River of destruction which is in many ways related to massive sedimentation in the bed and bank. The lack of concern for the protection of vegetation in the upper catchments and its rapid deterioration due to continuous deforestation had a crucial role to play in the degeneration of the state of the lower valley. Continuous sediment generation and its transportation to the lower part of the valley kept on raising the river bed year after year pushing it more towards the left of the near right angular bend. Storing of monsoon rain water in the up-valley dams and barrages further aggravated the problem of siltation as the annual flushing of sand-silt-clay was greatly checked. In this way, the then dynamic Damodar is now flowing very sluggishly through the braided course. The bars and islands are so stable that not only those are used for crop production due to higher fertility status but even settlements have been developed in many places as also the pathways across the river in the dry period (Photo#1). Prolonged negligence on part of the local people and interference in one form or other has reduced the width- depth ratio to a great extent. In some places, river bed lies at higher position than the level of the villages by the side of the embankment. Thus, due to holding back of huge quantity of water in the dams and barrages, the lower Damodar drainage system has lost the vitality of life, making a great bearing upon the natural environment. With the control of repeated normal river floods, the new fertile alluvial soil formations have virtually been stopped.

**Problem of Surface and Sub-Surface Water Utilization**

Through the human induced changes along with the execution of the DVC projects, all the canals, rivers and their branches were fully jacketed to control further overflow and floods. As a result, the upper basin-wash sediments that were carried along the channels and canals continued to sit at their beds. This led to the development of increasing quantum of defunct channels (*kana* or blind rivers, marshes, ox-bow lakes, etc. [1]. To save the dams from bursting due to overfilled reservoirs, the DVC authorities release huge quantity of water with a very short notice, making an avalanche of water flow over the already monsoon submerged agricultural fields and settlements, as occurred in the most acute form in 1978 and 2000. On the other hand, during the dry summer *rabi* season while the farmers are hoarsely crying for irrigation water for their parched fields to save *boro* paddy, wheat, vegetables etc, the DVC remains reluctant to release adequate quantity of water as that may lower the water level in the reservoirs affecting adversely the generation of hydel power which is committed for the industries in the upper catchments. Under such circumstance i.e. lesser availability of surface water flow through the rivers, streams, canals etc. on one hand and

increasing demand for food grains, pulses, oilseeds, and vegetables on the other hand, have forced the farmers to tap the ground water more and more for irrigating their lands during the dry summer, late monsoon and winter period. In this way, in many places, especially outside the DVC command area, ground water level has gone far down. Over exploitation through heavy-duty tube wells led to the minimum of net annual resource available for future exploitation. The matter is very serious leading to environmental hazards in Arambagh, Pursura, Khanakul areas.

**Conclusion**

Due to holding back of water in these dams and diversion of water from the Durgapur Barrage through Left and Right Bank Main Canals for irrigation purpose, the fluvial environment of the lower Damodar basin has undergone gradual changes since 1960s till today. This has a great impact in terms of volume and velocity of water flows in the Damodar and its distributaries, depth of thalweg, load–discharge relationship, river bank erosion, frequent shifts in the direction of river courses and discontinuation of water flows into some left bank distributaries making them blind rivers (*kana nadi*). The most worth mentioning of these human induced changes is the transformation of once distributary channel of the Damodar River into tributary of the Rupnarayan River as happened in case of the Mundeswari River (Fig 1).

Hence, it draws our attention for investigation into what changes have occurred gradually over the years after damming the mighty Damodar River with a bid to tame the wild turbulent river and to make it civilized in order to mitigate floods and to wipe out the sorrows of the people of West Bengal. Along with the primary objective of 'flood control' during the wet monsoon months, the mission of irrigating the parched fields during the dry winter months and generating hydroelectricity for industrialization in the Post- Independence period have turned the DVP into 'Multipurpose Project' in its true sense and the first ever in India. Undoubtedly, it is the miracle of modern technological development envisioned for the socio-economic benefit of mankind but it has not fulfilled its primary mission of saving the people from natural calamity of floods; instead it has now given much more emphasis on hydropower generation for country's industrialization.

Thus, different types of environmental hazards are in operation directly in the lower Damodar Basin and the consequences are becoming serious more and more in the hands of man. Indiscriminate tree-felling, construction of longitudinal embankments as well as cross-bunds disintegrating the river in its length, expansion of settlement, transformation of fertile floodplains into agricultural lands and continuous encroachment onto the river bed for sand, diversion of river water through different irrigation canals as well as exploitation of ground water – all these activities relating to the Damodar drainage system in particular, and the land-river-soil-vegetation complex in broader perspective; are doing harm to our environment. With a view to maximize the immediate return, man is interfering regularly to the nature's own domain with his technological expertise in return of which the environment is giving negative feedback by endangering our life and economy as happened in this region. Of course, it is to be mentioned that the construction of dams and barrages has made here the worst and the most critical effect.

**Acknowledgement**

This Paper is based on PhD Research work and partially funded under Faculty Improvement Programme (FIP) of the University Grants Commission (UGC), Government of India, during the Ninth Plan Period. The author wishes to express her deep sense of gratitude to her teacher, guide and supervisor Prof. (Dr.) S.C. Mukhopadhyay of the University of Calcutta. She is also immensely grateful to Prof. K. N. Mukherjee for guidance and inspiration.

**References**

[1] Bagchi K & Mukherjee K.N. (1978-80): Diagnostic Survey of Rarh Bengal, Calcutta, pp 9-54 & 10- 47.

[2] Mukherjee K.N., Ghosh T.K. (1993): Relationship between Life-Drainage and Defunct-Drainage (LD: DD): Institute of Landscape Ecology and Ekistics 16(1), 112 – 115.