Lecture Note

Paper: DSE – 3 (FLUVIAL GEOMORPHOLOGY)

Unit 2; Section - 8

DVC as a Watershed Planning Unit: Success and Failure

By –

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1. Introduction:

The Damodar is the most important tributary to the Bhagirathi-Hugli River. It originates from Palamou hills (600 m above MSL) of Chotanagpur Plateau and travels south-eastward for about 540 km and ultimately discharges into the Hugli River through Mundeswari and Amta channel. The former finds its outlet through Rupnarayan estuary and the latter discharges directly into the Hugli River near Shyampur of Haora district. In 1970, a shorter outlet was excavated to connect the Damodar with the Hugli and a lock was constructed across it at Garhchumbak to intercept the reversal of flow during high tide

Since the upper catchment is largely overlain by granite-gneiss which does not allow quick infiltration of water and generates huge run-off during torrential rain, the lower Damodar is proverbially flood prone.

The flood enquiry committee (1944) estimated the run-off coefficient between 54 and 90% of the storm rainfall. The average slope of the river declines from 19 m/km in upper reach to 19 cm/km in the lower reach and thus cannot discharge water quickly. The tidal backflow at both the outfalls creates drainage congestion and aggravates the flood. The upper Damodar basin contains many mineral resources while the lower catchment is famous for its agricultural prosperity. These two factors were causes of drastic clearing off the natural vegetation and resulted in enormous sand deposits in the bed of Damodar. The scholars working on the complex hydro-geomorphology of this basin unanimously opined that the problem of Damodar is not so much the disposal of its surplus water but that of surplus sand. The Damodar which bestowed prosperity to Bardhaman and adjoining region was labelled as the **sorrow of Bengal** for its recurrent floods.

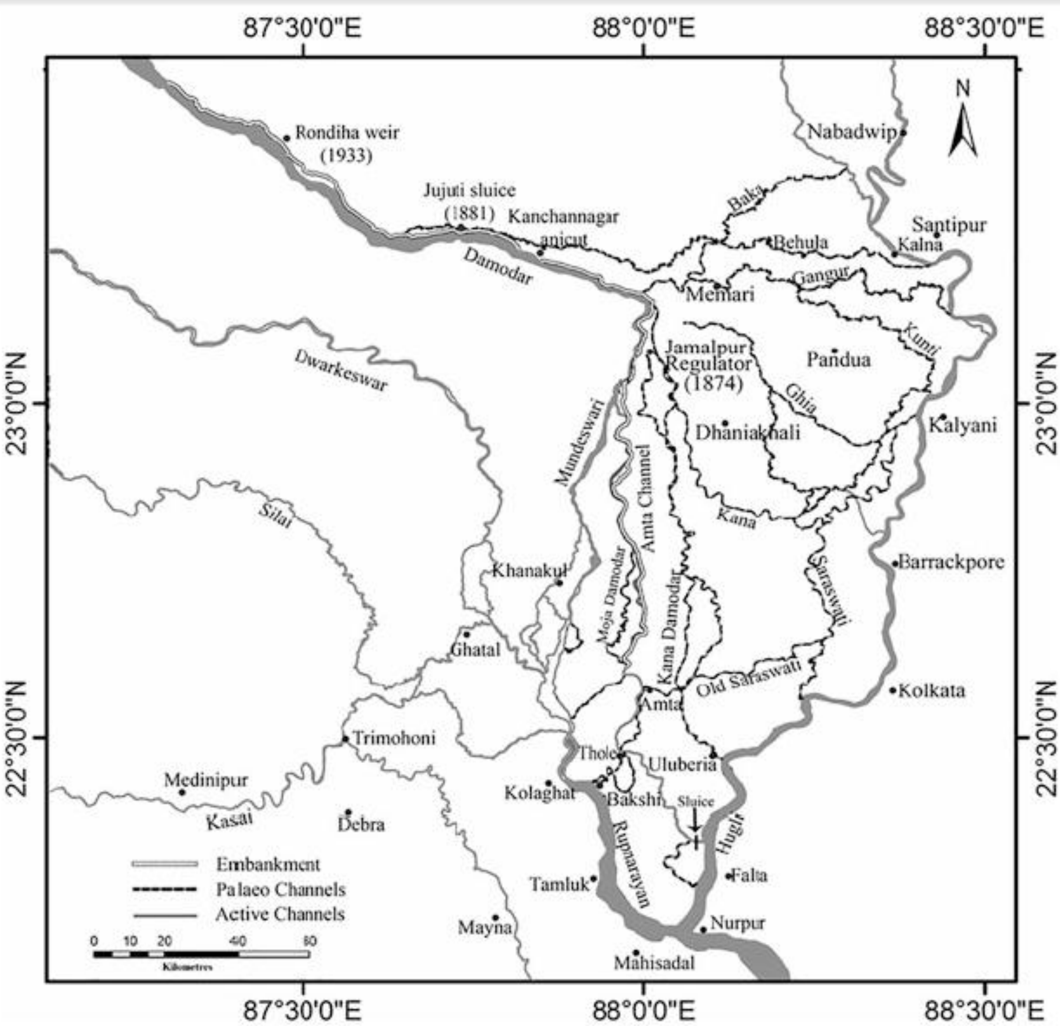

Fig. 1: Lower Damodar Basin (Source: Rudra, 2018)

2. History of DVC:

The greatest recorded flood was to the order of 6,50,000 cusec and experienced in 1913 and 1935. The flood 1943 was of much lower intensity and carried 3,50,000 cusec of water. But even with this lower intensity, the river breached its left embankment near Amirpur downstream of Bardhaman. The countryside was marooned under two-metre depth of water, and the railway roads and telecommunication system were disrupted (Mookerjea 1992). This deepened the anxiety of the British Government as the logistic support to their army involved in the Second World War was interrupted. The Flood Enquiry Committee was constituted in 1944 under the chairmanship of **Uday Chand Mahtab**, the Maharaja of Bardhaman. This paved the way to the constitution of the Damodar Valley Corporation under the light of **Tennessee Valley Authority**. **Prof. Meghnad Saha** and **Sri K. S. Ray** (1944) wrote:

"*It is possible to treat the Damodar river basin, at no great cost, to full measures of planned reclamation, and thus convert a destructive river system into a beneficial agency, producing large amount of electrical power, ensuring water for irrigation and flushing the river basins throughout the year, removing the eternal menace to rail and road communication, and guaranteeing public health.*"

The flood enquiry committee made its final recommendation on the **10 March 1944**.

In view of observations made by the committee, a preliminary memorandum on the unified development of the Damodar (PMUD) River was prepared.

3. Major Considerations for DVC Making:

The following issues were taken into consideration by PMUD for DVC making –

i. **Flood Control:**

In view of the experiences of earlier floods, the top priority was assigned on flood control. The plan of development took into account the peak discharge of one million cusec at Rhondia that could be generated out of 135 inches (343 mm) of storm rainfall.

ii. **Storage Reservoirs:**

There was a plan to build a system of eight dams and a barrage. The topography of the basin made it impossible to locate any dam below Dissergarh where Barakar joins the Damodar. The aggregate storage of eight dams was estimated as 4,700,000 acre-feet or 5797 million m3. That storage was expected to reduce the maximum design flood to a flow of about 250,000 cusec at Rhondia. The experts thought that the maximum possible flood from the uncontrolled catchment of the river below the lowest practicable dam site could, in any case, amount to some 20,000 cusec and as such committee found no justification of increasing the flood storage volume.

iii. **Irrigation:**

The area served by the Rhondia weir–Jujuti sluice–Kanchan Nagar anicut–Eden canal and Jamalpur regulator system was 186,000 acres prior to construction of reservoirs but that area was partially irrigable due to the dwindling lean season's flow in the Damodar. The proposed plan was expected to ensure perennial irrigation in 760,000 acres including the 186,000 acres that were earlier partially irrigated.

iv. **Power:**

The memorandum was optimistic for combining hydroelectric plants with the generating capacity of 200,000 kW along with some 150,000 kW of thermal power generating. capacity in large modern units. Taking into account the transmission–distribution loss, the system was expected to generate 300,000 kW, making available about 1420 million kW hours annually.

v. **Navigation:**

The experts of PMUD were speculative about the improvement of navigation channel and noted that taming of this river with the concomitant of a substantial minimum flow would, however, bring the establishment of a navigable waterway within the realms of practical consideration (Mathews 1947).

4. Proposal by Tennessee Valley Authority:

The Central Technical Power Board (CTPB) sought the opinion of W. L. Voorduin, an expert from Tennessee Valley Authority. After detailed investigation, Voorduin proposed the construction of -

(a) seven dams at Tilaiya, Deolbari, Maithon, Aiyar, Sonalpur (near Panchet Hill), Konar and Bokaro. He added that the proposed dams would be capable of accommodating a million cusec of flood water and keep the monsoonal discharge of the Damodar within 0.25-million cusec at Rhondia; Voorduin further proposed the establishment of

(b) hydro-power generating station at each dam;

(c) a thermal power station at Bokaro;

(d) a barrage across the Damodar to ensure perennial irrigation to agricultural fields of Bardhaman, Hugli, Haora and Bankura;

(e) power transmission lines; and

(f) a low diversion dam and power canal at Bermo where the river debouches sharply.

5. Making of DVC Dams:

Shortly after the independence, an Act (XIV of 1948) was passed in the Parliament of India to facilitate the execution of the project. **Apart from flood control, two other major objectives of the DVC project were irrigation and power generation. It was expected that project would generate 1.50 lakh kW of power and irrigate 3,29,826 ha of land through 2495-km-long irrigation canals.**

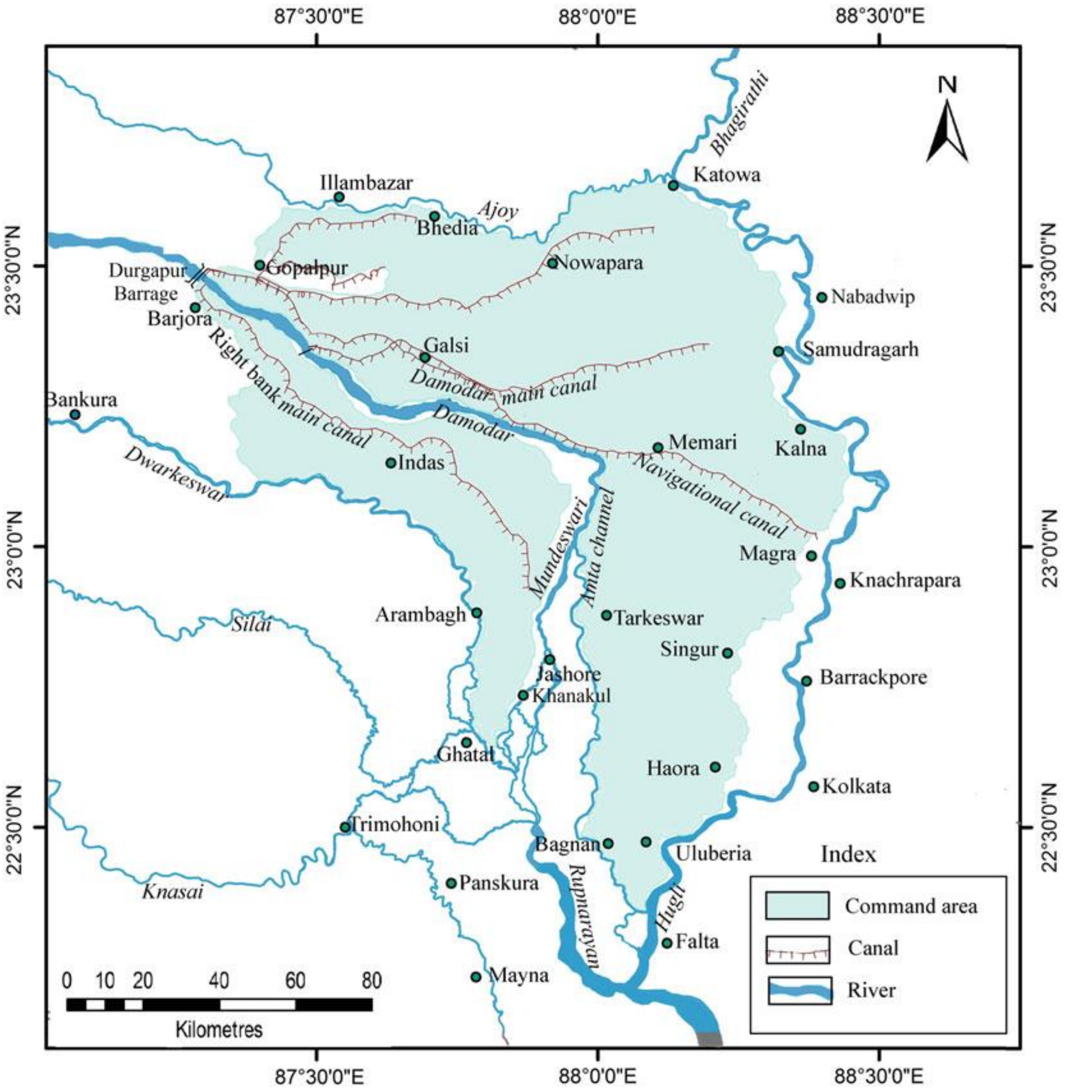

Fig. 2: Command area of the DVC (Source: Rudra, 2018)

Table 1: DVC Dams at a glance

	Tilaiya	Konar	Maithon	Panchet
Commissioning	1953	1955	1957	1959
On river	Barakar	Konar	Barakar	Damodar
Length (m)	366	4535	4860	6777
Power generating capacity	4 MW	–	60 MW	80 MW
Storage capacity (mcm)				
Dead storage	75	60	207	170
Total storage	395	337	1362	1498
Allocation in different sectors (mcm)				
Irrigation & power	142	221	612	228
Flood control	178	56	543	1087
Catchment area (km^2)	984	997	6293	10966
Reservoir areas (km^2)				
At dead storage level	15.38	7.49	24.28	27.92
At maximum conservation pool	38.45	23.15	71.35	121.81
Area top of gates	74.46	27.92	107.16	153.38

Source: http://www.dvc.gov.in , [Rudra, 2018]

6. Major Objectives & Achievements:

Three major objectives have been set to make the DVC project successful like - Flood Control, Power Generation and Irrigation.

1. Flood Control:

While preparing the Preliminary Memorandum of Plan of Unified Development (PMUD) of the Damodar River, W. L. Voorduin noted that 'the primary consideration for a plan of development of the Damodar Valley should be control of floods. The Government of West Bengal formed a committee in 1959 under the chairmanship of Sardar Man Singh. The Committee concluded in its final report—'*Before the construction of D.V.C dams, the flood peaks were high but duration was small. The construction of dams moderated the peaks but increased the duration of floods*'. The altered hydraulic regime of the lower Damodar area has been one of causes of the recurrent floods. In September 1978, torrential rain in the catchment of the reservoirs compelled the DVC authority to release 160,000 cusec of water which synchronized with 220,000 cusec of water generated in uncontrolled lower catchment and the total flow of 380,000 cusec marooned about 86% area of the lower Damodar basin. On the 22 September 2000, Durgapur barrage released 230,000 cusec of water and that water rushed over extensive areas of Bardhaman, Hugli and Haora.

2. Power Generation:

The second major objective of the Damodar Valley Corporation was to generate both hydro-power and thermal power (Table 10.6). But there was a conceptual void as it was difficult to ensure both irrigation and power generation from the same reservoir. The generation of power requires uninterrupted release of water from the reservoir to rotate the turbine; while irrigation requires the storage and transfer of the monsoon water for the non-monsoon season. Since there is no separate allocation of water in the DVC reservoir for power generation and irrigation, one of the objectives has to be sacrificed to ensure the other. It was next to impossible to serve the dual purposes from a single reservoir. It is to be noted that the total installed power generating capacity of the DVC is 2854 MW, of which hydro-power contributes only 144 MW or 5%.

3. Irrigation:

The four reservoirs supply water to Durgapur barrage which was supposed to ensure irrigation in 394,000 ha of land annually through a network of 2494-km-long canals. The maximum possible target was to irrigate 393,768 ha of paddy field in rainy season, 18,450 ha of winter crop and 69,790 ha of dry season paddy (www.wbiwd.gov.in). In addition, 30,000 ha of land within controlled catchment were supposed to be irrigated by lift irrigation from 16,000 check dams.

Table 2: (A) Thermal power generation by the DVC. (B) Hydro-power stations of the DVC [Source http://www.dvc.gov.in]

(A)			
Name	Location	Capacity (MW)	Commissioning
Bokaro	Dist—Bokaro State—Jharkhand	630	Between 1986 and 1993
Chandrapura	Dist—Bokaro State—Jharkhand	390	Between 1964 and 1968
Durgapur	Dist—West Bardhaman State—West Bengal	350	Between 1966 and 1982
Mejia	Dist—Bankura State—West Bengal	1340	Between 1996 and 2008
Total Thermal		**2710**	
(B)			
Name	River	Existing capacity (MW)	Commissioning
Tilaiya	Barakar	4	1953
Maithon	Barakar	60	1957–1958
Panchet	Damodar	80	1959 and upgraded in 1991
Total Hydro-power		**144**	
Grand total		**2854**	

7. Challenges or Failures:

- All reservoirs of the world are losing their storage capacity at the average rate of one per cent per year and so the lifespan of a reservoir cannot be longer than a century. Since the DVC reservoirs are within tropical climate region and the basin is degraded, the rate of sedimentation in reservoirs is very high. It was estimated that the rate of sedimentation in Maithon reservoir would be 0.84×10^6 m3/year but the observed rate has been 7.30×10^6 m3/year. The sedimentation in Panchet reservoir has been four to five times higher than the anticipated rate. The age-old mining, deforestation and expansion of agriculture have contributed substantial sediment in the river leading to the decay of the channels as well as reduction of storage capacities of reservoirs (Table 3). All four reservoirs have lost their storage capacity between 23 and 43% till 2016.

Table 3: Reducing capacity of the DVC reservoirs [Source: Report CWC (2001); Rudra, 2018]

Reservoir/year of commissioning	Catchment area (km^2)	Initial capacity (MCM)	Rate of silting (MCM/year)	Loss of capacity till 2016	
				MCM	% Loss
Maithon (1955)	6294	1362	6.77	413	30
Panchet (1956)	10,878	1498	5.57	340	23
Tilaiya (1953)	984	395	2.81	169	43
Konar (1955)	997	337	1.75	108	32

- No one denies that the DVC was dedicated to the nation with the pious intention of service to mankind. But the gap between the irrigation potential promised and that actually achieved continues to increase with the reduction in the capacity of reservoirs. The transmission–distribution loss of water is so much that areas lying in the lower reach of the command area are not served. The farmers continuously exploit groundwater table which tends to deplete. The concept of controlling flood by storage of water in reservoirs remains elusive. Thus, the experiences of the last six decades were often bleak but lessons were important.
- The area actually irrigated is fell short of expectation, and farmers of DVC command area rely largely on groundwater which has gone down due to overexploitation.
- It should be noted that the basic objective of DVC reservoirs to regulate the flow within 2.5-lakh cusec at Rhondia was not fulfilled in the years like 1956, 1958, 1959, 1978, 1995, 2006 and 2007, and the flood continues to imperil the area as usual.
- Considering the irrigation demand of Boro (1500 mm), Amon (1000 mm) Rabi (400 mm) and the potential area to be cultivated for these three crops, the total water demand amounts to 3958 mcm, which is more than the combined storage capacity of the four reservoirs.
- In years of excessive precipitation in the month of September, (as was in the case of 1978 and 2000), they were forced to open the gates of reservoirs causing dam-induced floods in its lower reaches.
- The demand of water for irrigation has increased many times with the introduction multiple cropping. The demand is so high that no ecological flow is released from the Durgapur barrage during lean months.

Disclosure: *This note has been prepared from the compilation of work of mainly Rudra (2018) for the simplification of your study. It is not my original work.*

The references for further studies related to this are given below –

Rudra, K. (2018). Rivers of the Ganga-Brahmaputra-Meghna Delta. Springer International Publishing, Cham, Switzerland. https://doi.org/10.1007/978-3-319-76544-0_10

Mathews, H.M. (1947). Preliminary memorandum on unified development of Damodar river/summary and observations. Reprinted in Evolution of the Grand Design, DVC, Kolkata

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