

# A Review of Phad Irrigation System and River Development in Maharashtra

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**ABSTRACT:** Diversion head techniques was introduced from very long years ago in the world. The one of the traditional techniques in divert water from river to irrigation land is Phad Irrigation System. In this paper we are introducing the benefits and demerits of Phad irrigation system on the basis of various reviewers and analysts. The main aim of the review study of this system was to find out improvement in methods before and after transfer of irrigation management. The paper discusses the outcome of this study, reasons for good or poor performance, and difficulties in functioning, area which needs attention, challenges in silting and choking of canal etc., and the steps taken by the researcher to solve the difficulties in progress of system. The Phad irrigation system produces overcome technique to worldwide scarcity of water, food and land management.

**KEYWORDS:** Challenges, Irrigation management, Phad Irrigation, Traditional Techniques, Scarcity.

## I. INTRODUCTION

The system of irrigation adopted in the areas served by bandhara is known as Phad system of irrigation. In this system, 'thal' or the irrigated area under each bandhara is divided into 3 or 4 parts called 'phads' or small blocks. Each phad has a number of agriculture plots in it belonging to different cultivators of same village. In one year, only one kind of crop is grown on all the plots of one phad. On different phads different crops may be grown during the same year. The crop grown in a phad may be changed next year to introduce the rotation of crop for maximum yield.

Phad irrigation scheme is essentially a diversion irrigation scheme on small streams which are mostly non-perennial. It is a minor irrigation scheme in which small streams are provided with bandharas. A bandhara is a low masonry weir of height 1.2 to 4.5m, which is constructed across a small stream for diverting the water of the stream into a small main canal taking off from the upstream side of the bandhara. The canal usually takes off only from one side and the flow in the canal is controlled by a head regulator. The length of the main canal is usually restricted to about 8 km. In this scheme of irrigation generally direct irrigation is carried out from the main canal. However, in some when the main canal is of fairly big size and the irrigated area is wide enough, a distributary may be taken from the main canal.

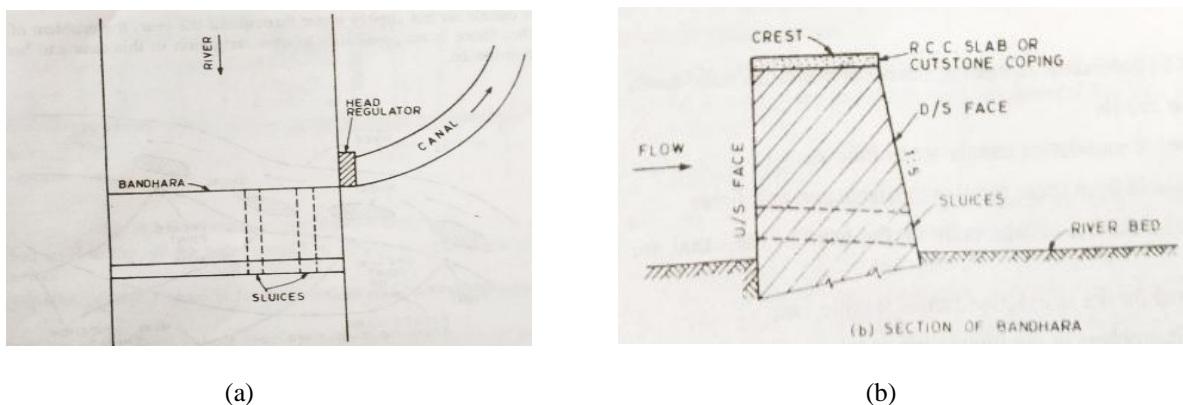


Fig. 1. Text Detection (a) Typical Layout of bandhara scheme (b) General cross section of bandhara

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## II. ADVANTAGE OF BANDHARA IRRIGATION SCHEMES

The various advantages of bandhara irrigation schemes are as follows.

1. Small quantities of water flowing in irrigation the streams which would have otherwise gone as waste, are utilised for irrigation to the maximum possible extent.
2. As the canal system in this case extends over a short length, the seepage and evaporation losses are less.
3. The area irrigated being small and close to the source, high duty of water may be achieved and also intensive irrigation may be carried out.
4. The initial and maintenance costs of system are low.

## III. DISADVANTAGE OF BANDHARA IRRIGATION SCHEMES

The various advantages of bandhara irrigation schemes are as follows.

1. The supply of water in these schemes is unreliable and seasonal in the case of non-perennial streams.
2. The area irrigated from each bandhara is more or less fixed and hence even if more water is available in some year it cannot be utilized.
3. Even small streams are provided with bandharas and their water is used for irrigation, the population on the downstream of bandhara do not get enough water for their domestic use during dry periods.

## IV. SELECTION OF SITE FOR BANDHARA

The main point to be consider for selection of site for bandhara are as follows.

1. The site should be within a reasonable distance from the area to be irrigated.
2. Hard and sound rock foundation must be available at a stream bed level or slightly below the bed, at the sight of bandhara.
3. Sufficient quantity of water must be available for irrigation.
4. At the site the natural banks of streams should be high enough to avoid submergence of land on either side of the banks during floods.
5. The site should preferably be below the confluence of tributary and main stream so as to have good supply of water and very few cross drainage works.
6. The cost of construction of the works should not be high.

## V. FORM AND DESIGN OF BANDHARA

1. Bandhara is designed as a low dam with a rectangular section if it is very low and a trapezoidal section if it is fairly high. The trapezoidal section has its upstream face vertical and there is a batter on the downstream face in the range of 1 in 2 to 1 in 5 as required from the stability considerations.
2. The crest width of bandhara is decided from the stability considerations and it should be wide enough to be used as roadway during fair weather. The minimum crest width of bandhara is usually 1.2m.
3. During floods the surplus water flows over its entire length. The discharge formula for a bandhara is as for a broad-crested weir viz.

$$Q = 1.7 LB^{3/2}$$

Where Q = discharge in cumec;

L = length of bandhara in m;

H = height of water above the crest of bandhara in m.

4. Scouring sluice of size 1 m x 1.2 m should be provided at the bottom at suitable interval to remove the silt.
5. The section of the bandhara is checked for the following two Conditions.
  - a. When there is no flow over the bandhara, the water on the upstream side is assumed to be upto the crest level and there is no water on the downstream side.
  - b. When there is flow over the bandhara, there will be afflux on the upstream and the difference in the water level on the upstream and downstream sides, i.e. differential head, should be considered for checking the stability of the section.

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The Phad system on canals has been in use since the medieval period on Panzara, Girna, Mosam & Burairivers, which flow through Nasik and Dhule districts. Water is diverted by constructing bandanas (weir) across these rivers. Several beneficiaries belong to a single Phad. A sole crop is used to be grown in a Phad: perennial crop in the first Phad, two seasonal in the second, seasonal in the third whereas a crop would be grown in the fourth in case water is available. The crops are rotated in different Phads in a 4-year cycle [1].

## VI. STATISTICS OF MAHARASHTRA

1. Maharashtra is the third largest state in India with an area of 308 lakh hectares.
2. It is bordered by the states of Madhya Pradesh to the north, Chhattisgarh to the east, Andhra Pradesh to the southeast, Karnataka to the south, and Goa to the southwest. The state of Gujarat lies to the northwest, with the Union territory of Dadra and Nagar Haveli sandwiched in between. The Arabian Sea makes up Maharashtra's west coast.
3. The Western Ghats or Sahyadri ranges run parallel to the coast, at an average elevation of 1,200 metres (4,000 ft).
4. To the west of these hills lie the Konkan coastal plains, 50–80 kilometres in width and to the east of the Ghats lies the flat Deccan Plateau.
5. The Western Ghats form one of the three important watersheds of India, from which many
6. South Indian rivers originate, like Godavari, Bhima, Koyna and Krishna
7. Population: 11,23,72,972 (2011 Census) 35 districts.
8. Growth rate: 14.23%.
9. Per capita income: 74,027 as against national average of 46492
10. Literacy rate 76.88% as against National average of 64.84%
11. Contribute to about 14.7% of National GDP, highest in country
12. It is the second most populous after Uttar Pradesh and third largest state by area in India.
13. Percentage gross irrigated area (4037 thousand ha) as compared to gross cropped area 22655 thousand ha): 17.7% (against National av. Of 44.6% (Mah. Economic Survey 2010-11, GOM)
14. Percentage urban population 42.43 % (most urbanized state in India) as against national average of 27.82%, though this is extremely concentrated[2].

## VII. RIVERS OF MAHARASHTRA

1. The geographical area of Maharashtra state is 308 lakh ha and its cultivable area is 225 lakh ha. Out of this, 40% of the area is drought prone. About 7% of the area is flood prone.
2. The highly variable rainfall in Maharashtra ranges from 400 to 6000mm and occurs in a four month period between June - Sept with the number of rainy days varying between 40 and 100.
3. The estimated average-annual availability of water resources consist of 164 km<sup>3</sup> of surface water and 20.5 km<sup>3</sup> of subsurface water.
4. In Maharashtra, of the 5 river basin systems, 55% of the dependable yield is available in the four river basins (Krishna, Godavari, Tapi and Narmada) east of the Western Ghats. These four river basins comprise 92% of the cultivable land and more than 60% of the population in rural areas.
5. \* 45% of state's water resources are from West Flowing Rivers which are mainly monsoon specific rivers emanating from the Ghats and draining into the Arabian Sea.

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Fig. 2. River Map of Maharashtra

## VIII. CONCLUSION

Maharashtra has a unique traditional water-harvesting technique, known as the 'Phad' system, whose roots can be traced back over 300 years. This system, which consists of a check dam built across a river from which canals spread out into the fields, was widely prevalent in the north western and Vidarbha regions of Maharashtra till almost 20 years ago. The advent of modern irrigation systems may have spelt the death knell for many of these traditional water-harvesting systems; however, there are still a few examples of successful operation of the Phad system in the state. Driving past Mendhla village, a dusty spot on the map, situated within Yavatmal district of Maharashtra, one encounters a few 'Dhangars' – members of a nomadic tribe, whose occupations include managing livestock, besides wandering the countryside in search of fodder and of course, water. Dhangars settled in Mendhla village around 30 years ago, and their hamlet within the village is aptly christened Dhangarwadi, where they practice animal husbandry as a profession. The Dhangars have been successful in reviving the Phad system through ingenious means[1].

Earlier, lack of irrigation was a major issue of concern for the Dhangars, threatening cultivation of fodder and other agricultural crops during the Rabi season. Dhangarwadi has a minor irrigation structure, constructed by the government, where a fair amount of water seeped continuously through the main body. One of the more enterprising Dhangars saw an opportunity in this and tapped the seepage from the irrigation structure gainfully, by constructing an earthen embankment to store water and laying down Phad channels to divert water to his field. This helped him irrigate about nine acres of land throughout the year. DilasaSansthan, a non-profit organisation working in the region, came to know about the Phad irrigation system followed by Dhangars and approached the CInI Cell, the nodal agency for Central India Initiative (CInI), to help replicate the success of the Phad system in other areas. Identifying innovative ideas and piloting them for systematic replication is the *raison d'être* of the CInI Cell. Along with Dilasa, CInI Cell initiated the process of the revival of the Phad system, with the aim of developing a strong replicable model for wider acceptance [2].

Subsequently, two low-cost masonry structures were constructed to store water for irrigation Dhangars were involved in modifying the design of the Phad channels along the contours. Along with the physical interventions, inputs towards water and crop management, especially the cottoncrop, were also provided to the farmers. The CInI Cell meticulously documented the process followed jointly by the Dhangars and Dilasa, besides its own inputs, to revive the Phad system and turn it into a viable irrigation system. The initial results were encouraging. The irrigated area has increased from 9 acres to 72 acres, thereby improving the yield of crops. Irrigation is now assured for both Rabi and Kharif seasons. Encouraged by this successful intervention, Dilasa is planning to review Phad systems in two new villages in Yavatmal district. The district administration has now shown interest, and has called for feasibility reports for potential sites for implementing the Phad system in Yavatmal. In light of the positive experience, the CInI Cell proposes to

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collaborate with Dilasa over the coming year, with the aim of studying and exploring further opportunities for upscaling of similar initiatives, whilst concurrently locating and supporting meaningful livelihood programmes within the central India region[2].

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