SYMPOSIUM ON WATER MANAGEMENT : EXPERIENCES OF THE PAST AND DIRECTIONS FOR FUTURE

Volume I : Papers for Discussion

53rd Board Session

Central Board of Irrigation and Power

New Delhi

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F O R E W O R D

The ultimate objective of all Irrigation Development is to increase agricultural production. The national target is to achieve a growth rate of atleast 4 percent in agricultural production as compared to the historical growth rate of nearly 2.8 percent. The reaping of maximum benefits from the already completed and the on-going irrigation projects is therefore a priority task to achieve the needed growth rate. Irrigation Engineers should accordingly bestow maximum attention on the Management and efficient use of Irrigation Waters.

Most of the Irrigation projects are planned to bring as large an area under command as possible so as to extend the benefits to the maximum cultivated area and thereby contribute to the betterment of the largest number of farmers. However, in actual practice, the development has been in a somewhat different direction. The initially envisaged cropping pattern is not adhered to and different crops are being grown based on market factors and farmer's individual preferences. Thus it sometime becomes difficult to operate the irrigation projects so as to satisfy the aspirations of all the beneficiaries.

Recognising the need to have a review of the water management experiences in different projects of the country, the present symposium has been organised. An attempt has been made to collect case histories of the actual operation and performance of a number of irrigation projects in different regions of the country. Thirty three papers have been received for discussion at the symposium. The authors have put forward their views based on their experiences. Keeping in view the limitations of time available for discussion, 20 papers have been selected for detailed consideration, representing mainly case studies. These are included in Vol.I of the proceedings. The balance 13 papers have been included in Vol.II as additional papers.

It is our earnest hope that the discussions at the symposium will help us to clarify many of the issues and enable us to project directions for the future in respect of improved water management practices so as to obtain the maximum return from the investments made in our irrigation projects.

(C.V.J. VARMA) 16/6/83
Member Secretary
Central Board of Irrigation and Power

New Delhi
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CONTENTS

53rd Board Session
Paper No. 1

Symposium on Water Management: Experiences of the Past & Directions for Future

EVOLUTION OF MANAGEMENT SYSTEM ON DECCAN CANALS

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SYNOPSIS

Canals constructed in low rainfall zone of the Western Maharashtra in the early periods were basically for providing protective irrigation. However, in these semi-arid tracts, the staple crops were being raised on rainfall and demand for canal water came up only during long breaks of rain. With perennial supplies of canal waters, better class of crops started being raised in the canal command. In the interests of better economic returns to the State and to the farmers, these crops were ensured water supplies. Not weather cotton and groundnut, rabi wheat etc., having better economic returns, were also being grown on canal waters. All in all, a caloidoscopic pattern of crops developed on these canals which lead to the rise of "Supply on demand" system on Deccan Canals. The management technique developed, was to assure waters to selective areas in the command with a caloidoscopic crop-pattern and distribute sanctions to as large number of farmers as possible. This resulted in development of block system of crops for irrigation. Having thus defined the areas to be irrigated, the water supply to these areas was to be ensured at regular intervals for all sorts of crops. This was done by adopting the Shejpali system. The evolution of this system and the conditions which caused it are described in this paper. It is, therefore, concluded that every management system has been developed to suit natural conditions existing in the region and no one system may be suitable to meet all conditions.

1. INTRODUCTORY

1.1 The low rainfall tracts of Western Maharashtra - Satara, Sangli, Pune, Ahmednagar and Nasik Districts are prone to drought condition

owing to uncertain rainfall. Investments in these areas were basically for providing protective irrigation schemes, even though commercial viability was considered before undertaking the projects.

1.2 The Krishna Canal with Khodshi Weir (no storage) was first constructed and opened in 1862. Near absence of fair weather flow, a distinctive feature of Deccan rivers, focussed the attention on the need of storage for firming up the canal supplies in fair weather. As a result, in subsequent schemes, a backing up storage in the up-Ghats was made a prime feature. Accordingly, in 1880, Mutha canals were opened with Khadakwasla storage; Nira Left Bank Canal opened in 1885 was provided with a storage dam at Bhatghar on Yelwandi river a tributary of Nira; Godavari canals with storage on Darna was opened in 1911-12, Pravara canals with Bhandharadara storage in 1923 and Nira Right Bank Canal with bigger Bhatghar dam in 1927-29.

1.3 From the experience of irrigation on these canals emerged a pattern of irrigation management imbibing principles of economy in the use of water, equality in distribution of waters to large and small farmers, assurance of water supply in the season and over a period of years for better agricultural development and so on. This system called "Shejpali System" had to cater for the changing nature and uncertain needs of canal water for a variety of crops grown on Deccan soils. The development of this management system over the past 100 years is a lesson in retrospect.

2. DECCAN CONDITIONS

2.1 The concept of water use in the Deccan was developed to suit the agro-climatic and soil conditions existing in the canal areas. The rainfall here is about 500 mm to 625 mm, with heavy showers predominantly in the months of September and October. However, many times, there are long breaks in the monsoons, when the crops suffer. There are many dugwells dispersed in the tract but the recuperation depends on the subsoil water-table, rainfall and is prone to be unreliable. Because of above conditions, there is sudden demand for canal water in drought years, while in years of fairly good rainfall, the demand for canal water drops off.

2.2 The rainfall in any year is again not uniform in the command. While there is good amount of rainfall and no demand for canal water on one distributary, there may be no rainfall and keen demand on another.

2.3 The soils in the command are derived from the Deccan trap and known as black cotton soils (vertisols). The depth of soil mantle varies from 25 cms to 2.40 meters, as one moves towards nallas and river. They are underlain at places by the draining substrata of murum (disintegrated rock).

2.4 While medium soils (45 cms to 240 cms) are favourable to irrigation, shallow soils are not suitable as large part of water applied porcolates into the substratum and causes water-logging and salt offlorescene lower down in the valley. On the other hand deep soils have little drainage capacity and physical state of the soil is damaged by heavy irrigation.

2.5 Large variations in soil depths exist from outlet to outlet in contrast to uniform soil conditions elsewhere. The demand for high water consumptive crops especially that of perennials, keeps on changing, requiring close control by the Management. In essence, all areas cannot be treated equally and irrigation needs to be regulated by restricting sanctions to perennials within limits fixed for each outlet.

2.6 The black cotton soil has relatively large water retentive capacity in the root zone, because of its high content of clay. But for this excellence of black soils, the evil results of the drought would have been greater. On the other hand, in normal years, the yields of traditional cereal crops grown on rainfall are fairly satisfactory and irrigation does not cause any appreciable increase in the profit-margins of a farmer. There was thus a lukewarm response for growing such crops under irrigation.

3. EVOLUTION OF THE CONCEPT OF WATER USE FOR SELECTIVE IRRIGATION FOR A MIXED MODEL OF CROPS

3.1 Originally these canals were designed e.g. Nira Left Bank Canal, assuming uniform demand for water over the command so as to give about 1 cusec per 300 acres of culturable command. However, when Nira Right Bank Canal was taken up, it was planned to deliver water to suit requirements for crops likely to be grown on each distributary and outlet.

3.2 Experience indicated necessity to include better class of crops in irrigation planning. It is, interesting to see the Government of India directions in May 1921 for Nira Right Bank canal project. They were:

> "It is essential that a perennial supply of water should be guaranteed, if better class of crops are to be irrigated and for this the storage obtainable at Bhatghar is insufficient."

The better class of crops were valuable, so that any damage caused by untimely waterings was very serious. It was, therefore, recognised that this must be prevented by all means in the power of the State. As a direct consequence of this fact, the full responsibility for giving water when it is required and in exact quantities, squarely rests on the Irrigation Department. There is also the conviction that this management responsibility is essential for economic and efficient use of precious waters.

3.3 Though irrigation was optional, it enriched ground waters in the command by percolation. Hence the farmers, who were already accustomed to private dugwell irrigation, practised the same in a large way. Restriction on perennial crops under canal irrigation load them to use their well waters and waters of nallas and drains (by lifting) to raise such crops for their own benefit. Thus developed an irrigation model of the Deccan Commands in which canal irrigation, well irrigation and nalla and drain lift irrigation co-exist. In essence, regenerated waters from the irrigated areapercolating to ground and drains were used again. On Pravara canals for example, even the main river Pravara below the pick-up weir is bunded by a series of weirs. Thus regenerated flows

(which are not saline) stored in these weirs are used for raising better class crops. In such an irrigation model the overall efficiency is maximum and optimum production results. Intermixing of well and canal waters is not permitted. The situation is thus fraught with all possibilities and hence rigid rules are framed for canal irrigation. However, in the final analysis, the State stands to achieve the most with limited water resources spread over larger areas with the mixed model of irrigation.

3.4 It is interesting to see that the intensity of canal irrigation to total service area is hardly about one third e.g. on Nira Right Bank Canal "out of the gross area of 2,23,863 ha, it was anticipated that 52,800 ha will be irrigated annually".

3.5 In Maharashtra State, even in the ultimate perspective, only about one third of the total cropped area would receive canal waters. The State irrigation policy was, therefore, to spread over the benefits to as large area as possible with equitable distribution amongst the various farmers. The reports of Irrigation Inquiry Committee (Chairman Sir M. Visweshwaraya) of 1938 set out that:

> "It is now proposed to redistribute the irrigable area under each canal as equitably as possible by giving to each village and as as far as possible to each cultivator in it, just enough irrigable land and no more, so that the acreage available for irrigation may nowhere constitute a surfeit."

3.6 This policy, as it was translated into reality, evolved the system of selective irrigation on Deccan Canals, serving as large number of farmers as possible.

4. DEVELOPMENT OF A CALEIDOSCOPIC CROP PATTERN OVER DECCAN CANALS

4.1 A few words about crops grown on Deccan Canals would throw better light on problems of management on Deccan Canals.

4.2 The main commercial crop presently grown under Deccan conditions has been sugarcane. Prior to 1940, even the areas of this crop were fluctuating depending on prices of jaggery. However, with development of sugar industry in co-operative sector between 1940 & 1950, the demand for canal water for sugarcane crop increased and several now cultivators, hitherto growing only cereals, started growing cane. Thus better class crop of sugarcane has proved to be a stabilising demand for the efficient and effective functioning of the old Deccan Canals. The Government however imposed ceilings on sanctions to individual farmer, in an effort to distribute the benefits to a large number.

4.3 Traditional rabi crops follow next. They are normally sown on rain. These crops have a high peak demand in rabi when there is a long break in monsoon for canal water. Hybrid varieties and rabi wheat, however, have more consistent demand for canal water. Kharif bajari, groundnut and pulses require few waterings depending on rainfall deficits.

4.4 Of late, the demand for hot weather cotton and groundnut has been on the increase in view of attractive prices. These crops have

demand for canal water partly in hot weather and partly in Kharif. Experience has revealed that irrigation supplies can be better distributed in all three seasons so that canals are not allowed to go into disuse and kept in fit condition. The State has therefore welcomed these demands which have enabled utilisation of waters remaining in the lakes after meeting the fluctuating demands of rabi crops.

4.5 Deccan Canals thus serve a number of crops with different crop calenders and watering intervals. Therefore, a proper water management technique was required to be evolved to meet the exacting demands of caleidoscopic pattern of different crops - perennials, seasonal cereals, with different and wide water requirements in the three seasons of the year.

5. "SUPPLY-ON-DEMAND" SYSTEM

5.1 The history of irrigation development on Deccan Canals during the initial years showed wide fluctuations. In the semi-arid tracts of these canals, the cereals, which formed the bulk of area were raised on rainfall. So only during long breaks of rainfall, the demand for canal water came up for such crops. Even this was only from such parts where the failure of rains was severe. Hence the demand was not constant, nor it was for all areas under the command. Such a diverse demand evolved the management concept of supply on demand.

5.2 Further the sugarcane areas were distributed in the whole command. This crop had more or less constant demand in all three seasons at regular intervals. The management was therefore required to cater to these areas scattered over the command. The system of "Supply-on-demand" suited such dispersed irrigation, of course, with much stress on the management & planning of optimum water use. In such a system irrigation was necessarily optional. This system has also enabled the State to disperse economic benefits to large areas and many farmers.

6. BLOCK SYSTEM OF CROPS FOR EFFICIENT WATER-DISTRIBUTION

6.1 In the optional irrigation system, it is necessary for the canal manager to precisely ascertain the water demand and for that purpose enter into some agreement with cultivators for supply of water for known crops. This was being done through a system of seasonal or yearly sanctions in the past. There was no firm demand from year to year and areas to be irrigated were also changing from year to year. The distribution system was thus prone to excessive waste.

6.2 It was therefore necessary to firm up the demands and to clearly delineate the irrigation areas. Even in the interest of cultivators an assurance of water supply over longer periods than one season or one year, was necessary to organise successful irrigation. For all these purposes, the first step taken was the introduction of blocks by Sir M. Visweshwaraya in 1905.

The proposed system was described by him:

"There is a fairly steady demand for irrigation for a few selected classes of crops in the Bombay Presidency but such crops of which sugarcane is the most important, require capital, manure and enterprise for their successful cultivation. They cannot be grown over any large continuous areas like wheat or rice or in the same land year after year, that is without resting the land or some kind of crop-rotation. The local peculiarities of soil and climate render a general extension of irrigation to cereals or other staple crops of the country impossible except in seasons of drought. It follows, therefore, that the cultivation of sugarcane and other high class crops should be encouraged in the Deccan by a system of rules and management specially adapted for their development."

"The object of the system is to distribute the benefits of an irrigation work over a large number of villages and to concentrate the irrigation in each village within blocks of specified limits and in selected soils and situations. The total area of the blocks in each village should be large enough to enable everyone who is able to grow an irrigated crop to have a share, but not too large to constitute a surfeit, or cultivators to neglect the advantages of water supply in good seasons."

"Only one third of the area in each block is to have sugarcane or other perennial crop at a time and in the remaining two thirds either vegetable or monsoon or rabi crop may be grown up to the end of February. After February, water will be given for only one third of the area, that is, for the area on which a perennial crop is grown. There will thus be a sort of triennial crop rotation in each blocks."

"Water applications will be sanctioned once in six years."

6.3 There was criticism against the block system that "it does not give a special incentive to economy in use of water". To combat this, Mr. A. Hill, the then Chief Engineer proposed (Government Resolution of May 1911):

i) to issue definite volumes of water to each block - distribution of water by time to whole blocks

ii) to dispense with measurement of crops, and

iii) to remove restrictions on extensions of perennial irrigation within the blocks by use of well water or otherwise.

However, this call failed to evoke response as "everyone know that it was impossible to issue definite volumes of water varied to suit the seasons to each block".

6.4 The next step taken to reduce the waste of water was the introduction of "Bund" rules in 1913 by T.S.Pipe and Sir C.C. Inglis. The idea was to construct large outer bund around the block to prevent canal water wasting on to adjoining lands and damaging them. The small internal bunds were for the division of block into small plots with a field channel leading to each so that water volume is controlled. The bunds enabled inspection of irrigation and easy identification of waste and irregular use. Above all these rules lead to great deal of levelling being done by the cultivators and resulted in increase in area irrigated per cusec. The canal tract become comparatively dry and damage was reduced.

6.5 Further in 1922, the whole of the block area was unitised into half acre plots and this practice was extended to all canals. Block sanctions were given in multiples of half acres.

6.6 All in all, there is now readily identifiable standardised areas of irrigation with permanent field channel system. When the outlet discharge is more or less fixed at a known value, the canal water supply could be controlled to give a known required quantity on a time basis. On Deccan Canals, rigid modules were tried at the heads of some distributaries of Nira Left Bank Canal but could not succeed. We have to be satisfied with steel-gate-controlled semi-modular outlets and regulators.

7. "SHEJPALI" SYSTEM OF WATER DISTRIBUTION

7.1 On Deccan Canals, once the irrigation benefits are equitably distributed amongst the farmers by way of block sanctions, what is left to be done, is the need to ensure timely and adequate supplies to the sanctioned areas. The "Shejpali" is a system of water supply evolved just to meet this purpose, in pursuance of water use concept of serving selective areas in the command, where mainly better class of crops are grown. The main thrust of Shejpali is on ensuring timely deliveries to sanctioned areas. This system is well adopted by the farmers over the last six decades. This is different from the philosophy adopted in arid regions where there is uniform demand even for cereal crops and where the basic need is to allocate waters to all areas.

7.2 Under the "Shejpali System", a preliminery programme is drawn up every year depending on water availability. If water is available, apart from long term block sanctions, applications are invited from the farmers for different crops and areas they wish to grow. Water is sanctioned taking into account crops to be grown and the total demand, the system can satisfy. If the demand exceeds, the sanctions are curtailed by proportionately reducing the areas in an effort to serve the interests of large number of farmers.

7.3 To serve the fixed areas, a schedule called "Shejpali" is then prepared for an orderly system of water supplies from the tail to head. A rotational water supply is adopted to serve the area. The rotation interval depends on the intervals required by the high water consuming crops and lighter crops on the same outlet. Light crops receive their

supplies in alternate rotations or so. These rotations are notified in advance prior to the season and prior to the start of rotation, the Canal Inspector meets all the irrigators under outlet and gives them definite dates, serially according to the schedule of Shejpali when they have to take water to their fields. With a view to effect economy and curtail tendency for irrigating excessively, a "rigid Shejpali" is being enforced by giving in addition to definite date, specified times in hours equated to the sanctions during which an irrigator can draw his supplies.

7.4 For applying the above system effectively, it is absolutely necessary to have telegraph or telephone systems for quick means of communication for appraising demands, controlling supplies, preventing wastage etc. Similarly a system of gauges along the canal and measuring devices at heads of distributaries and minors is essential for an orderly and efficient operation of the delivery system to stabilize supplies to each outlet. Night irrigation on Deccan canals has not been a problem, perhaps because of the high water consuming crops on each outlet.

8. MONITORING

8.1 Preparation of preliminary irrigation and completion irrigation programmes for the water year and rotation-wise performances reports giving distributari-wise discharges drawn and areas irrigated and maintained by the controlling officers serve as a monitoring arrangement.

8.2 The water released at canal heads and drawn at distributary heads fairly give the transit losses in the main canal. However, monitoring of cusec-hours coming out of outlets giving fixed discharge may give a better insight into the distributary losses and outlet head duties.

9. VOLUMETRIC SUPPLIES

9.1 With the emergence of sugar factories, several agreements were concluded on Deccan Canals with Joint Stock Companies and co-operative Saswad Mali Farm for supply of canal water on volumetric basis for growing sugarcane. The farms of Joint Stock Companies have since been taken over by Maharashtra State Farming Corporation (a Government Company) Water supply to these farms is measured at the distributary heads by recorders fixed on S.W.Fs. The gauges are also observed by field staff and the register countersigned by Company representatives in token of acceptance. The supply is limited at 310 cms per year per acre of cane crop. Even Kharif and Rabi crops are supplied with water on volumetric basis.

9.2 However, co-operative societies have not been formed and have not come up to take over the management below distributary head.

10. DISTRESSING DEVELOPMENTS

10.1 *Overgrowth of Cane:*

The coming up of several co-operative sugar factories has led to increase demand of cane. This has led to over-plantation on areas served by wells. Such cultivators are tempted to steal the canal water especially in hot weather, when well-supplies fall short.

Another disturbing feature is that the crushing season of sugar factories has extended right upto May. This resulted in wasteful and infructuous utilisation of canal waters, especially in hot weather, for sustaining the grown-up cane crop for additional idle period before crushing.

10.2 *Emergence of Demand for other crops:*

The traditional staple crops did not demand much artificial irrigation. However, with the development of hybrid varieties and high yielding varieties of food crops, the situation has changed. Added to this, the prices of food crops have gone up. The demand for canal water for these crops has, therefore, picked up especially from irrigators in tail areas, who have no sanctions for cane. As a matter of social justice they cannot be denied canal water. Further, in 1975, Government took the decision of cutting down cane areas by 25% and using the available waters for food crops. Hence more water was made available. However, the canal capacities which were sized for lower intensity fell short of requirements, especially in rabi season.

Sensing the mood of the society, the State permitted, as a temporary measure, an increase in rotation period upto 21 days in Kharif and Rabi and 18 days in hot weather to enable canal authorities to meet these demands. However, this has resulted in fall of duties (i.e. $\frac{AI}{DC}$). Secondly, the high yielding varieties and other crops could not sustain for 42 days to receive water in alternate rotations and thus had to be given water twice in three rotations. The net effect is distressing enough. Unless the canals are resectioned to deliver higher discharges, it would be difficult to bring in again an orderly system. Modernisation of these canals is therefore overdue.

11. INTROSPECTION

11.1 Literature on Management is scarce. Well organised courses are few. With developmental activities in full swing, young intelligent engineers shy away from management. There is dearth of well trained canal officers who have digested the implications of the system and able to plan and run the canals efficiently in day-to-day practice.

11.2 The basic ideas of block system in fixing irrigation areas in firming up the field channel system and bunding up the areas to reduce waste are slowly disintegrating. Temporary sanctions, annual and seasonal ones, are once again surfacing with the consequent increase in transit losses.

11.3 Coupled with this, the erosion of authority of the management and the fact that it can be bent under the social pressures have created special problems. As it stands today, the solution lies in the development of co-operative organisations organised for each outlet. The Bagayat Sangh for each outlet and water Panchayat Committee for the distributaries must come into effective existence. A rigid Pali Patrak and Shejpali System must be implemented for that purpose. However, without the requisite infrastructure, by which adequate supplies to the outlets over the whole system are guaranteed, Shejpali or Rotational Water Supply System cannot work. How can a farmer at head of an outlet wait till his turn comes, if he is not sure, that there will, at that time, be water running out of the outlet? In essence, the management system can work only when the entire delivery system including field channels is attuned to meet the new demands.

12. CONCLUSIONS

12.1 Certain preconditions have raised points for policy consideration on Deccan Canals. The first is the semi-arid areas, where even though the rainfall is low and uncertain, staple crops could be grown on rainfall on high retentive soils of the Deccan. The corollary of this is the non-uniform demand for such crops. Secondly multiplicity of crops are grown in the Deccan which have diverse demands. If an irrigation system is to prove effective in obtaining better economic returns to the State and if such economies are to be distributed equitably amongst the large number of farmers, the policy decision taken on Deccan Canals, to practise irrigation in few selected and distributed areas for raising better class of crops, while in the remaining areas other crops could be grown on rainfall, wells etc., has proved to be successful. It is in such situation that the management system on Deccan Canals has developed and Shejpali system has been evolved to ensure supplies to the caleidoscopic pattern of crops. Of course systems like Warabandi operate in different set of conditions and for serving different purpose. It is our conviction that Shejpali system is suitable to Deccan conditions of soil, crops and climate. The philosophy is conducive to fuller utilisation of water for optimum returns to the State and farmers. Equity is achieved by distribution of irrigated areas amongst large number of farmers.

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53rd Board Session
Paper No.2

Symposium on Water Management: Experiences of the Past & Directions for Future

A CASE STUDY OF MULA PROJECT IN MAHARASHTRA

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SYNOPSIS

Development of Major Irrigation Projects in Maharashtra started with the construction of protective irrigation works for draught affected areas. The projects envisaged extensive irrigation to disperse the benefits to large areas and population. Most of the water was proposed to be utilised for seasonal food crops.

Actual development however has shown that the farmers prefer cash crops like Sugarcane which give them better return although water required for the crop is high.

The project objectives of extensive irrigation is in conflict with the individuals' interests.

The area actually brought under irrigation is much less than the irrigable area due to cultivation of high water consuming crops, heavy seepage losses etc.

A case study of Mula Irrigation Projects has been presented to indicate the development of