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Case Studies of Innovative Irrigation Management Techniques

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Abstract

Irrigation is a vital input in the agricultural productivity and agricultural growth. More than 80% of available water resources worldwide as well as in India are being presently utilized for irrigation purposes. However, in India, the average water use efficiency of Irrigation Projects is assessed to be only of the order of 30-35%. There is no doubt that modernization of irrigation system like concrete lining to the inner surface of the open channel; canal automation etc. will save water significantly. But these techniques require huge capital investment, hence uneasy to adopt. On this background it is appropriate to know the innovative, simple, low cost, easy to adopt, water conveyance techniques used in the command of few irrigation projects in Maharashtra. The paper discusses the need to increase the Water Use Efficiencies of existing Irrigation Projects and new projects and the success case studies in detail. The findings show that such pioneering techniques shall be implemented in the command areas of other irrigation projects as and where found techno economically feasible to achieve improvement in crop yield and good water management with high water use efficiency.

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Keywords:Irrigation water management; crop water requirment; water use efficiency; innovative water conveyance techniques

1. Introduction

Ultimate irrigation potential of India is 140 million hectare. Irrigation potential to the tune of about 102 million hectare has been created through Major/Medium/minor surface water irrigation projects and use of ground water. However, potential utilisation is about 87 million hectare only Mahato (2013).Irrigation sector is the biggest consumer of water as more than 80% of available water resources in India are being presently utilized for irrigation

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purposes. However, the average water use efficiency of Irrigation Projects is assessed to be only of the order of 30-35%. Mahato (2013). Presently the annual agricultural output is just sufficient to sustain our food grain requirement. To meet the challenge of regular expansion of size of population, the productivity of the water and land has to grow, as both the resources are limited. Water is a major and vital input to increase agricultural productivity. Hence it is a Supplying water to the crop at right time, right place and right quantity is the main objective of good irrigation management, but in case of surface water reservoirs, the irrigation water is conveyed to the farm with the conventional wide spread open channel water distribution network. In fact, the above system is not capable to meet time based crop water need due to depletion of water use efficiency of the system with age. As the time passes lot of deficiencies including low water use efficiency get involved in this type of network.

1.1 Major Findings for Low Water Use Efficiency

The following major reasons have been identified for low Water Use Efficiency of Irrigation projects Mahato (2013):

- Poor or no-maintenance of canals/distributaries/minors of irrigation systems resulting in growth of weed & vegetation, siltation, damages in lining etc.
- Distortion of canal sections due to siltation or collapse of slopes resulting in some channels carrying much less and some other channels carrying much more than their design discharges
- Non Provision of lining in canal reaches passing through permeable soil strata;
- Leakages in gates and shutters;
- Damaged structures;
- No regulation gates on head regulators of minors causing uneven distribution of water;
- Over irrigation due to non-availability of control structures and facilities for volumetric supply of irrigation water to farmers;
- Poor management practices;
- Lack of awareness among farmers about correct irrigation practices and cropping pattern

1.2 Poor Irrigation management

Lot of efforts is being taken to manage the irrigation effectively. The conventional wide spread open channel water distribution network, neither meet the water requirement of the crop sown in the command area of an irrigation project nor able to irrigation at right time and right place. This induces moisture stress reduces the crop yield radically.

2. Case Studies of Innovative Irrigation Management

The Irrigation Engineering and associated sciences are all the while engaged in finding better solutions to overcome the deficiencies listed above. On this background, it is interested to understand the innovative measures adopted in the command of few irrigation projects in Maharashtra. They replaced the open channel water distribution network with innovative specially designed gravity flow PVC pipe water distribution network to resolve the above problems. On the other hand, their system has inbuilt effective and simple water management. They have brought revolution in irrigation sector. A light is thrown over such innovative Case studies situated in different parts of Maharashtra State.

2.1 Jai Malhar Water user Association, Indore Minor Irrigation Project, Dist: Nasik

It is established in the command of Indore Minor irrigation Project, 22 km away from Nasik city. The command of the project was 157 hectare. Before implementation of the innovative PVC pipe conveyance and water distribution network, only 20 to 30 hectare area was getting the irrigation benefit as there were huge conveyance losses in the conventional open channel water distribution network. Beneficiaries were fetching problems to survive as their farm income was very low due to lack of irrigation support. Very few farmers in the head reach were getting the benefit. Tail Enders was deprived. To maximize the benefit and equitable distribution of water, the WUA discarded the use of open channel and established an innovative water conveyance and distribution PVC pipe system.

2.1.1 Innovative Water conveyance and distribution technique

A jack well of three meter diameter is constructed inside the reservoir. Two submersible pumps of 25 HP each are installed inside the jack well. The discharging capacity of each pump is 50 liter per seconds (lps). The water is lifted, conveyed by a rising main PVC pipe of 315 mm diameter, delivers it in to the main distribution chamber, constructed on a higher elevation than that of Tank bund level. The diameter of the distribution chamber is 3 meter and the depth is kept as 2 meter. 115 PVC pipe pieces of 63 mm diameter and 300 mm in length are fixed over the vertical wall of the chamber exactly at same level as shown in figure 1. These pipes works as pipe out lets. There number is equal to the number of shareholders. The 100 lps water delivered inside the chamber get divided equally among the 115 pipes and 0.87 lps water flows out from each pipe out let. Discharge of one pipe outlet is assigned to one shareholder. The shareholders are divided in to various groups. A group has 3 to 11 members. Peripheral compartments for each group are formed as shown in the figure below. Each compartment receives water from 3 to 11 pipe outlets depending upon the members of that group. Bhalage (et al 2009).

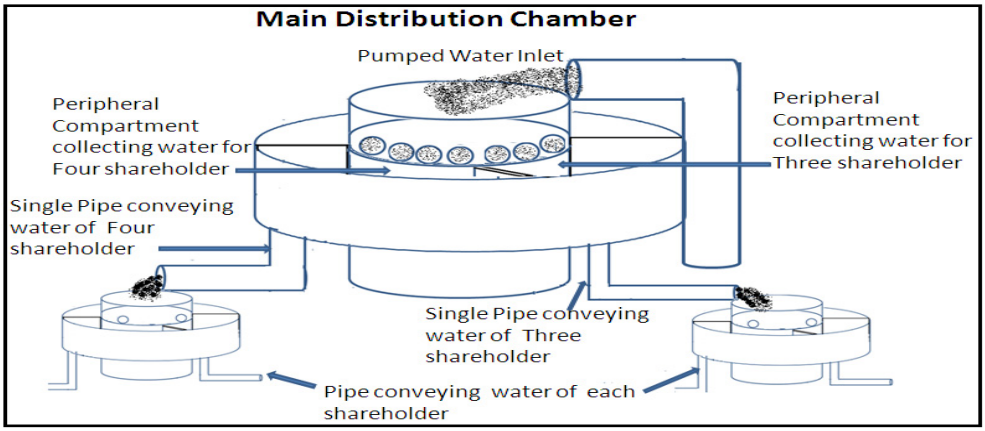

Fig. 1Main Water Distribution Chamber

2.1.2 Zero water loss in Conveyance network and equitable water distribution

It is clear that all peripheral compartments receive water proportionate to the no of shareholder in that group. Let, there is one group of 4 members, then the water collected in the compartment form 4 pipe outlets is then conveyed through a common pipe line at the cost of that group, up to the secondary distribution chamber constructed at a suitably located common point of that group. Cost of pipe line is saved due to group formation. The secondary distribution chamber has same number of pipe outlets (i.e 4 in the case under consideration) fixed over is vertical wall. The water collected in this chamber is equally divided among the four pipe outlets and flows out from each pipe outlet fixed on the vertical wall of the secondary distribution chamber. The water coming out from each out let is then collected in individual compartment/chamber; and is conveyed to the individual's field. Many of them have made an arrangement to collect it in their open dug well. Thus all the share holders will get equal quantum of water at the same time, thus partitions like head, middle and tail reach farmers is avoided. As the water is conveyed through PVC pipe, except the water loss in broken pipe till the time of repair, there is no loss. Every group has a

group head. He is authorized to solve the dispute among them if arises. Due to involvement of people's participation, the scheme runs smoothly as the powers and responsibility are decentralized. It becomes possible to produce export quality grapes and vegetables. The tactic enables them to adopt advance irrigation techniques such as Drip and Sprinkler irrigation. The water use efficiency is more than 8o to 85%.

2.1.3 Innovative Management to meet Crop water requirement

As the system ensures equitable water supply, when needed, at the start of Rabi season, the WUA plans the area under different crops that can be irrigated with available water in the reservoir and accordingly the farmers grow different crops to suit the volume they will receive.

2.1..1 Guaranteed irrigation for Grape

Water is managed in such a way that every shareholder is guaranteed to get water sufficient to irrigate one hectare Grapes. The annual amount of water required for grape planted, inclusive of evaporation and other losses is kept reserved and the surplus water is then utilized for other crops as decided by the WUA. This strategy enables them to switch over from traditional rain fed crop to high yielding Grape plantation and vegetables.

2.1.4 Adoption of the advance irrigation Like drip irrigation method

The water received by the individual is then let in to their own well. The collected water is then utilized for irrigation with drip irrigation system. Due to adoption of the drip system the water is utilized efficiently and the farm yield is increased many times.

2.1.5 Assessment and Recovery made easy

The engineer in charge will take the reservoir water level at the start and at the end of the season. The amount of evaporation and other losses is deducted and the volume of water content used by the WUA is assessed, with the help of area capacity table of the reservoir. He prepares the water bill and gives it to WUA. There is no need to measure the individual's area or crop irrigated. After receiving the water bill, the WUA add the predefined additional charges in to the bill and divide the total amount by 115 i.e. number of shareholders, Prepares a bill of each group by multiplying the number of members in that group. The bill is given to the group leader. The group leader then collects the charges from his member and submits to the WUA. And then the WUA pays it to water Resources Department.

2.1.6 Efficient and conjunctive use of ground and surface water

The farmers start the irrigation with the ground water available in to their well. The well yield get reduces in the month of December or January. At such time WUA takes the decision to deliver the water stored in the reservoir. Pumping hours per day of the main pump on the reservoir are worked out in such a way that the surface waterharvested in the reservoir will be available to irrigate one hectare of land of each shareholder, till the starts of the monsoon.

2.1.7 Multiple gains in farm income

Due to assured and timely water supply the farmers able to raise the crops like grape and vegetables. Thus their farm income is multiplied in many folds. Per hectare average income is raised from Rs. 2500 to Rs. 93000.

2.1.8 Increase in farm produce per unit of water use

The per hectare water use at the reservoir out let head is considerably reduced from 12778 cubic meter to 2742 cubic meter and thus the per cubic meter water productivity is increased from Rs. 1.96 to Rs. 33.91

2.1.9 Increase in utilization of Irrigation Potential

Though the irrigation potential creation of this tank was 157 ha, the area irrigated was not more than 22 ha, But after implementation of the scheme the area irrigated is more than 287 ha. It is worth to note that out of the total 287 ha area, 112 ha. is perennial Grape crop.

2.1.10 Benefits to Government

The management is made very simple. Conflicts are reduced. Irrigation staff requirement is reduced, thus saving in wages of management staff. Assessment of water charges is made simple. Recovery of water charges is 100%. The irrigation revenue is increased from Rs. 5000 to Rs. 1 30 000 per annum.

2.2. Wavi Harsh Water User Association, Dist. Nasik

It is a lift irrigation scheme, lifting water from the Vaitarana Major Project and supplying irrigation to the established for tribal farmers on the upstream sides of the reservoir. It is situated in Nasik District of Maharashtra. A common jack well is constructed on the upstream side of the dam. The hilly command area of the WUA is 371 ha, divided into 20 small chaks (A chak is a command area of an outlet).

2.2.1 Innovation

Area of each chak is approximately 20 ha. Instead of providing one or two high hp pumps, an individual Electric pumps are designed and installed in the jack well, to supply irrigation water to each chak. Water supply at the rate of 1 liter per second lps per hectare is decided for selection of the appropriate type of the pump set and accordingly the diameter of the main pipe line conveying water from jack well to the chak head are designed and installed. Thus 20 submersible pumps have been installed in the jack well. A control room is constructed over the jack well above Ground level. All the starters and switches of pumps are fixed on a single control panel, placed vertically in the control room. Chak numbers are painted on the respective delivery pipe and the starters of pumps. Discharge measuring meters are installed on each delivery pipe line. The PVC main delivers water in to the distribution chamber constructed near the chak head. A operator is employed by the WUA and assigned the duty of operation of the pumps. The water use efficiency is more than 80% as there is no conveyance loss.

2.2.2 on demand water supply to meet Crop water requirement

The individual Group decides the running time of their pump to receive quantum of water as per the irrigation needed to crops sown. Accordingly instructions on mobile are conveyed to the operator to start or shutdown of the pumps. Thus all the groups receive on demand water supply limited to their sanction water use. This innovative water delivery system facilitates frequent irrigation of desired depth. This enables them to grow vegetables. Now the tribal farmers are fetching very good financial returns

2.3.0 Chandrabhaga Medium Project

Chandrabhaga Medium Project is located in Tapi river basin in Amaravati District of Maharashtra State. Open channel gravity flow irrigation network up to the Minors were established and pipe out lets were provided over the Minor as per conventional practices. The discharging capacity of the pipe out let is kept as 30 lps.

2.3.1 Innovation

On the request of the project authorities Water and Land Management Institute, Aurangabad, Maharashtra has designed the PVC pipe distribution network in the command of two chaks on pilot basis. The chak area is sub divided in to sub chak of 3 to 5 ha. Independent pipe turnout is located in the highest elevation in that sub chak. A lateral PVC pipe terminating in to pipe turnout is designed to deliver discharge proportionate to the area of that sub chak. A sub main pipe is designed to feed tow of more laterals or Sub main. A small distribution chamber at the chak head of size 1.5 m x 1.5m x 1.5m is constructed. The outlet on the Minor, delivers water into this distribution chamber. The running time of every turnout will be the same as that of the running time of the outlet. Thus water is distributed equitably among the beneficiaries at the same time. It is executed and tested. The farmers appreciated this system and then it is executed over a large command area (More that 7000 ha). A conveyance loss as happens in open field channel is totally avoided.

3. The common Values of above case studies are listed below

- Simple, low maintenance, low cost, long lasting and adoptable system
- High water use efficiency
- No land is wasted. No land acquisition.
- Built in transparency. No scope for malpractice in the water distribution.
- Equitable water distribution.
- Built faith of the system.
- Helps to ensures water rights.
- Minimum conflicts.
- No one can draw water out of turn.
- Any individual farmer can exchange his share with the adjacent needy farmer.
- Tail Enders water right is assured.
- Manageable turnout discharge
- Construction of pipe network is much easier, cheaper and quicker than the open channel water distribution network
- Induces Crop diversification and adoption of high yielding crops.
- conjunctive use of surface and Ground water is possible
- No water logging

4. Constraints

When sufficient slopes are not available, water from the reservoir is needed to lift to a sufficient head, which requires availability of electric power. The underground pipe lines may get pinch after few years of installation due to roots of trees, if not protected properly.

5. Conclusion

It is concluded that specially designed closed pipe water distribution network improves the crop yield significantly. It saves considerable amount of water with trouble-free irrigation management. Land acquisition being the major hurdle in development of irrigation potential can be avoided which helps to maximize the utilization of created irrigation potential.

Reference

Bhalge P.S. &Holsambre, D.G; 2009, PVC Pipe Distribution Network - An alternative solution to open channel gravity flow irrigation network', International Conference on food security and environment Sustainability, IIT Kharakpur, Dec. 17-19, 2009. Paper

Mahto Shankar (2013), Present Status of Water Use Efficiency on Irrigation Projects in India and Action taken for its improvement including role of role of farmers, Training Program on Increasing Water Use Efficiency (WUE) in irrigation Sector, NWA, Pune, 21 January – 1 February 2013, 09-19.