

Innovative and efficient water management practice

through value system in pipeline

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During 2007-2008, a village Shriram Panod (district Indore) was selected by the team of Operational Research Project for Dryland Agriculture, College of Agriculture, RVSKVV Campus, Indore to achieve the major objectives of the project. It is assessed based on the information gathered through PRA exercise that the runoff potential of the soils (Vertisols) of the area is very high due to their low infiltration rate. The safe disposal/ storage of this runoff would be beneficial. The storage of the runoff water would help the farmer to utilize it during the moisture stress period. Thus attempt was made to enhance the water availability in the farmers' fields.

Key words: Harvest, Irrigation, Management, Rabi, Water



Figs. 1 and 2. Wild flooding for pre-sowing irrigation



Fig. 3. Pre-sowing irrigation

IT was observed in Shriram Prasad village, Indore that due to non-availability of ground water, many area could not be brought under cultivation during *rabi* many a times in this village. It is therefore, decided to increase the runoff water storage in the selected farmers' field of Shri Dharmendra Bhagwat Singh Chouhan, which is otherwise run out of the field after creating sheet erosion losses and development of washes.

Construction of excavated water harvesting tank

A suitable site in the field of Shri Chauhan was selected considering all

the hydrological aspects in January 2008 and an excavated tank was developed in March 2008 through participatory approach. The idea was mainly to provide the technical guidance and sharing the cost to the tune of 50% from the project side and to motivate the farmers for devoting a portion of his land for the construction of tank besides 50% cost so that the stored water could be utilized during the stress period. Before the site selection, it was ensured that the site retains the water without causing any appreciable losses in the storage (Figs 1 and 2). For this purpose, back hoe loader machines was used for the excavation

purpose and dumper were used for transporting and spreading the excavated only top black soil (available up to 2 m) in the nearby fields which was severely affected by rill and sheet erosion process (Fig. 3). The farmers then engaged the tractor drawn levellers for spreading the excavated materials and making the fields almost levelled. The yellowish soil excavated beyond 2 m was also used for the construction of side bunds and peripheral bunds of the farmers and also for the construction of farm roads. The inlet of the tank was provided on the either side bund facing the cultivated field. The outlet was also constructed so that it safely



Water is pumped using diesel or electric pump from the water harvesting tank

drains off the excess water into a natural waterway so that the excavated tank would collect the runoff water in the forthcoming rainy season, which could be utilized during the stress period for irrigating the crops.

The other details are: Catchment area: 20 ha, Storage capacity: 0.55 ha.m, Maximum depth: 2.85 m

The excavated tank collected the runoff water in the following rainy season in 2008 and farmer also filled it with available groundwater in the nearby tubewell as its discharge was not sufficient enough to be used directly for pre-sowing irrigation through the border. Subsequently three irrigations to wheat grown in 4 ha and one irrigation to chickpea in 2 ha were provided through the conjunctive use of surface and ground-water stored in the tank in the first year itself (Figs. 4, 5 and 6). Since then every year, the tank is getting filled with the runoff water and the stored water was used mainly during the *rabi* for providing irrigations to adjoining crops. The available water in the tank gave so much confidence in the farmer (Shri Dharmendra Bhagwat Singh Chouhan) that he brought more area under wheat which requires more irrigation.

Refilling of tank with tube-well water

Generally in this region, the tube-wells provide groundwater with reduced discharge after the termination of monsoon season as groundwater depletes at faster rate due to over exploitation. Therefore, few tube-wells operate throughout the year otherwise most of the tube-wells go dry or supply water only for 2-3 hr that too with reduced quantity. At the same time, electric

power supply is a deterrent in providing continuous irrigation to fields' crops. Sometimes the supply of tube-well is so less that direct irrigation is not possible as water advancement process does not take place particularly in medium and deep clayed soils due to cracking pattern and irrigation process is not completed despite pump running for several hours. Therefore, after using the harvested water for pre-sowing irrigation during 2009, the farmer also started refilling this water harvesting tank with nearby tube-well water and then use it to irrigate the nearby fields using a high discharge diesel/electric pump so that a larger area can be irrigated at a time. Thus the farmer rely more on stored water in the tank than the tube-well water as most of the tube-wells dry up suddenly/abruptly due to groundwater depletion.

Arrangement of typical pumping unit

The stored water in the water harvesting tank allowed the farmer (Shri Chouhan) to use some innovative ideas mainly for efficient utilization of harvested water and use of harvested tank very effectively. Since the time electric power supply is a deterrent in providing continuous irrigation to fields' crops, in 2010, he made a typical water pumping arrangement for lifting water from the water harvesting tank and irrigate the adjoining fields without interruption. For this purpose, he made the provision of submersible horizontal pump (locally known as *Pandubbi*) and diesel pump connected to main supply pipe-line through Y-shaped connectors so that the water can be pumped using either of the pumping unit. In the absence of electric power supply, the fields are

irrigated using diesel pump. A generator is also provided for lifting the water with both diesel and electric pump simultaneously in the absence of electric power supply. The farmer also started collecting the tube-well water into the tank (after the use of harvested water mainly for pre-sowing irrigation) for few days and then the stored water is used for irrigating the nearby fields using a high discharge diesel/electric pump so that a larger area can be irrigated at one time. This provision of typical water pumping unit ensured the timely and uninterrupted irrigation of *rabi* crops and thus helped the farmer to enhance his productivity and farm-income.

Conventional methods of sowing and irrigation of *rabi* crops

Traditionally in Malwa region, *rabi* crop is sown in two ways:

1. *Land preparation*: It is carried out for *rabi* sowing after *kharif* crop harvesting. The prepared fields are provided pre-sowing irrigation through flood method and then sowing of *rabi* crops by seed drill is carried out. In the sowed field, borders (preferably 1.8 m wide) are formed using bund former along the field slope for providing subsequent irrigations to the cropped field as per the availability of water and requirement of the crops. This practice is adopted when monsoon is terminated early and soil becomes dry and deep cracks are formed in the fields. The fields are irrigated through wild-flooding and uneven distribution of irrigation water affects the germination.

2. *Dry sowing of rabi crop*: It is carried out after land preparation and then borders are formed along the field slope for providing irrigation as



Fig. 7. Main pipe line from the water source till the field boundary and above all borders



Fig. 8. End of the main pipe line tightly closed using a cap



Fig. 9. Innovative and time saving multi irrigating systems provision valve systems in pipeline.

per the crop requirement and water availability. This practice is followed when sufficient moisture is available in the soil profile due to late withdrawal of monsoon or higher rainfall which allows dry sowing. Better irrigation water distribution is possible in this practice due to border irrigation as water moves in strips which ensure better and uniform germination in the field.

In traditional border irrigation system during *rabi*, many farmers pump the water and release directly into the border using flexible rubber pipes (Fig. 7). In case of direct release of water through pipe in the border, faster movement of water front takes place and it requires attention to avoid water wastage. However, uncontrolled delivery of water in border cause sheet erosion and affects the germination and water gets stagnate at the end of the border and moves out of the border (Fig. 8).

In another practice, irrigation water is pumped through PVC pipe and left into a furrow formed at the upper portion of bordered field for carrying water from first border to last border. The furrow in the upper portion carries the water till end with reduced water conveyance efficiency between 60 and 75% depending upon soil profile moisture condition). Water is then released into various borders one-by-one from this furrow and it is controlled manually by opening and blocking the bunds using spade continuously during pumping hours. If it is not done attentively, uncontrolled and over-irrigation due to high discharge rate damages the borders and germination is affected. Thus, border irrigation is a labour and time consuming work and it requires experienced and

devoted skilled-labour for better and efficient irrigation.

In this region, it is observed that due to peak hour requirement of electric power, electricity is supplied in the villages in two shifts i.e. 5 hr each in day and night respectively during *rabi*. Obviously, particularly during night hours, it is impossible and very tedious to be in the fields' whole night to irrigate the crops in unbearable cold. Therefore, the farmers normally put the pump on till the electric power is available and allow the water at higher pumping discharge rate to move in the fields on their own through pipes without attending it all the time. This system not only over irrigates the fields but also wastes the precious water and allows it to move out of the fields without covering the maximum possible fields under irrigation.

Innovative and efficient water management and saving system for irrigating *rabi* crops

To avoid the chances of over irrigation and wastage of precious irrigation water and also to save labour and time, during 2015 it was thought that if a controlled system is used so that discharge is reduced and regulated in each border resulting water moves uniformly in various borders. Similarly, it will be beneficial, if the number of borders to be irrigated simultaneously can be increased or reduced as per the power supply schedule without over irrigation and wastage of water. It is also required to make the arrangements for regulating the water in each border depending upon the soil moisture profile. It is observed that when sufficient moisture is available in the soil profile, water

moves faster into the borders otherwise in dry profile, it moves slowly. Thus as per the requirement, the water flow and movement can be regulated and number of borders to be irrigated can be enhanced or reduced. Further, it is also desirable that after setting the system, personal attention and presence in the field is not required continuously.

Keeping in view, the objectives and points in 2106 Mr Chouhan has made arrangement for irrigating the chickpea and wheat grown in borders in consultation with operational research project team members.

In this system, a main PVC pipe line (consisting of various pipes of 6 m, 75 mm dia pipe each) is laid along the head of borders in the entire cropped field to carry the irrigation water from the water source (in the present case it is water harvesting tank) till the upper portion of last border near field boundary thus ensuring higher water conveyance efficiency (almost 100%), (Figs 10 and 11).

In main pipeline, the end pipe is kept closed using a cap so that irrigation water can not be delivered directly in the border through pipe. Significantly in this system, only PVC pipe mainline is laid and thus no provision of a water carrying furrow is made which is otherwise formed in traditional system through which water is diverted manually into various borders. Provision of end cap and no formation of furrow also restrict the wastage of water and avoid any damage to borders and crops due to sheet erosion. Further, in each pipe of 6 m, three openings of 2.5 m dia each at 1.8 m interval are provided and valve system is attached to it to regulate and control



Figs. 10 and 11. Each Valve system in main pipe line to be delivered in each border - flow can be regulated using valve

the water flow for irrigating borders of 1.8 m wide. Thus, due to provision of valve, discharge in the each border can be controlled by opening and closing the valve. Normally six valves are used at a time for irrigating six borders individually. Initially an assessment is made by considering soil moisture profile, water front advancement in the border and duration of irrigation which can be given without physical attention in the field to calculate the time required in irrigating entire border length. Then the discharge rate is fixed in all the valves to facilitate and ensure uniform and simultaneous water front movement in all the six borders. Thus, as per the calculated required time for irrigating entire border, the attendant can come to stop the delivery of water in all six borders and can make arrangements for irrigating the next six borders in row (Fig. 12). The position of all these valves are kept facing upward so that kinetic energy of water is dissipated and no sheet erosion takes place in borders. Normally, six valves are used for irrigating six borders individually. However, the number of openings can be increased or

decreased depending upon the soil profile moisture in the borders. For first irrigation, only six valves are used as soil moisture profile is relatively dry. However, in subsequent irrigations, the water front moves fast with same discharge in each border due to relatively wet soil moisture profile than that of the initial irrigation. Thus, the number of openings can be increased up to twelve to irrigate twelve borders by regulating the valves (Fig. 13).

Controlling valves are also provided in main lines after 1.8 m so that by using these valves, flow in the main pipeline beyond that point can be regulated or restricted for maintaining the desired pressure and discharge in each individual border by opening or closing the valve in main line. Thus, by using this innovative and efficient water management device, it is observed that the use of the system not only allows uniform water front movement in the entire border being irrigated simultaneously, but also saves labour, time and the wastage of water. Further the regulated and controlled delivery of water in border avoids the chances of sheet erosion and water stagnation at the end of borders, ensuring better germination.

ADVANTAGES

The advantages of the system are: water flow and movement can be regulated and number of borders to be irrigated can be enhanced or reduced; the



Fig. 13. Irrigating many borders at a time. Uniform movement of water front in all borders.

system avoids the over irrigation and wastage of precious irrigation water; water moves uniformly in various borders; number of borders to be irrigated simultaneously can be increased or reduced as per the power supply schedule; personal attention and presence in the field is not required continuously; can be run whole night during electric power availability without attending the system; the discharge rate can be regulated and various borders can be irrigated simultaneously; can be made in local workshop; very useful under limited power supply at night; and dependency on the labour can be reduced.

SUMMARY

By using the system (device), it is evident that the border irrigation is no more labour and time consuming work and can be operated by unskilled-labour with better and efficient irrigation. Further it is to inform that this innovative idea came only after the construction of water harvesting tank in the field through one ICAR-funded project by ORP team. It is important to mention here that water-harvesting tank not only collects the runoff water but also can be used as storage tank for collecting tube-well water for its timely and efficient use. The increased water availability not only increases the crop productivity and farm income but it also gives confidence in the farmer to allow him to do experiments on various aspects of crop and water management.

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Fig. 12. Irrigating many borders at a time