

Modified traditional water-harvesting system for irrigation

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During Monsoon average rainfall in Malwa region of Madhya Pradesh is 1,000 mm. The high intense rains coupled with low infiltration rate of black soils of the region produces 22 to 25% runoff (220 to 250 mm) mainly from the cultivated fields despite all efforts to restrict runoff using various soil and water conservation measures viz. use of mechanical or vegetative barriers within the fields, sowing across the slope and planting of more surface area covering crops like soybean during kharif. The major constraint in growing a second crop in many areas particularly in Malwa region is the lack of suitable irrigation water. Therefore, creating water storage tanks in the cultivated field for storing the excess runoff (common feature in this region due to low infiltration rate of the soil and high intense rainfall) is one of the best options available with the farmers.

Key words: Harvesting, Irrigation, Water

DESPITE high runoff volume, many a times the *kharif* crops suffer due to limited moisture condition at maturity stage because of earlier withdrawal of monsoon. Erratic rainfall conditions and prolonged dry spell are also one of the major hindrances in producing higher yield of *kharif* crops. Delayed withdrawal of monsoon and winter rains sometimes increases the prospect of *rabi* crops but it is experienced that planting of *rabi* crops requires either pre-sowing irrigation (*paleva*) or irrigation after dry sowing for better germination and its survival. Like other parts of India, the adverse climate was the pattern of this region and found to be affecting particularly rainfed farming since long. Thus, in this region, it is almost impossible to produce satisfactory *rabi* crops purely under rainfed situations without making any advantage of *in-situ* and *ex-situ* moisture conservation measures for proper rainwater management adopted during *kharif*. Most of the time, germination of *rabi* crops is severely affected without these

conservation measures due to limited moisture condition in soil profile. Therefore, producing the different crops with satisfactory yield levels without total damage to crops grown even under adverse climatic conditions should be the adaptation strategies for rainfed production system. It is observed that increasing irrigation water availability through water harvesting tank could be a successful way to mitigate adverse climatic conditions in Malwa region.

Besides, many interesting experiences were gathered by the operational research project team particularly for the effective utilization of the stored and available water in the ponds. Traditionally to ensure proper germination, survival and ultimately for higher productivity, the farmers of the region who were irrigating these crops using various irrigation systems like open well, conjunctive use of surface and groundwater. Since then, these traditional systems were modified by few farmers with the help and encouragement by scientific community in upscaling and better rainwater management and increasing

water availability for enhancing crop productivity, not much scientific information is available on this important aspect. With this objective in view and document these improved techniques, during 2013-14, study was initiated by a team of Operational Research Project for Dryland Agriculture, College of Agriculture, Indore.

Traditional system of filing pond/*talab* with tube-well water and then using it for irrigation

Generally in this region, the tube-wells provide groundwater with reduced discharge after the termination of monsoon as groundwater depletes at faster rate due to over exploitation. Thus generally very few tube-wells operate throughout the year as most of the tube-wells go dry or supply water only for 2-3 hr that too with very reduced quantity. At the same time electric power supply is a deterrent in providing continuous irrigation to field crops. Sometimes even after hours of pump running water supply from tube-well is so less that direct



Figs. 1-4. Traditional system of filling pond/talab with tubewell water and then using it for irrigation

irrigation is not possible. Therefore, the well or tube-well water is collected in the tanks 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 a time. Similarly since the percolation rates of these tanks are meager, the farmers collect tube-well water in these tanks for summer/vegetable crops. Thus the farmers rely more on stored water in the tanks than the tube-well water as most of the tube-wells dry up abruptly due to ground water depletion.

Construction of water harvesting tank in farmers field

The team of Operational Research Project for Dryland Agriculture was involved with the farmers of the region and carrying out various scientific agricultural activities which may help the farmers to produce both *kharif* and *rabi* crops without any significant yield reduction even under adverse climatic abrasions. Since soil

and water management is highly critical for adaptation to climate change, the project made several attempts towards water conservation and water harvesting improvement in irrigation accessibility in the farmers' fields. To deal with the impact of climate change, attempts were made to enhance the water availability by constructing various water harvesting through farmers participation and dove tailing activities. Further, technical guidance were provided to the farmers for the creation of water-bodies in the farmers' fields for improving water and rain-water management. It was observed that excavation of water harvesting tank in the individual farmers' field was extremely useful in arresting the runoff, bringing the fields into leveled condition through spreading of excavated soil in depressed area thus in avoiding even temporary water-logging and reducing the chances of soil erosion. It also enhanced the water availability and allowed to

adjust the cropping sequence, including changing the timing of sowing, planting, spraying, and harvesting. This helped farmer to take advantage of the changing duration of growing seasons and associated heat and moisture levels with appreciable increase in the crop productivity by turning the mono-cropped area into multi-cropped/crop diversified area. The conjunctive use of ground and harvested surface water allowed to alter the time to sow or plant. It also helped the farmer to regulate the length of the growing season to better suit the adverse climatic conditions. These adaptation strategies farmers and saved crops from total failure and minimized losses compared to adjoining farmers. Thus, it is evident that the enhanced water availability not only increases the crop productivity and farm income but also farmers get confidence and they start experimenting by including new crops and varieties.



Figs 5 and 6. Construction of water-harvesting tank in the lower most portion in the cultivated field

Modification of conventional system of pond/talab for irrigation through gravity

After encouragement and technical guidance by the team of Operational Research Project for Dryland Agriculture, a farmer Mr Gopal Patidar of the village Kitoda (Ujjain district) constructed a water harvesting tank (2,000 m³ storage capacity) in 2005 in lower most portion of his field for collecting runoff water, which irrigate 5 to 10 ha area under *kharif* and *rabi* regularly. Since the runoff potential of the area with black soil is very high (at least 7 to 10 runoff events every season), the extra and additional runoff water drains out of the tank after filling to its full capacity into the nearby drainage line. To restrict the wastage of this runoff water, the farmers adopted a unique technique and tried to modify the traditional irrigation system of pond/talab for irrigation through gravity.

For this purpose, on the upper

most portion of his field, the farmer constructed an overhead cemented tank of 5.45 m height and 46.35 m dia to store 1,150 m³ additional irrigation water Figs 7-8. In this tank, outlets of PVC pipes were fitted so that water can be conveyed to 10 ha area with the help of pipes and valves. This way, the farmer modified the traditional irrigation system for irrigation through gravity by constructing cemented overhead water storage tank instead of pond/talab by investing ` 5 lakh. This way the farmer has made dual arrangement for runoff water storage in his field. Thus stored water in both surface and overhead storage tanks were used by the farmer for irrigating *kharif* and *rabi* crops.

The main objective of construction of overhead tank was not only storing water in less area but also to reduce the seepage losses and losses of crops due to seeped water from the otherwise constructed traditional water storage

tank on the upper most land. In conventional system, field channels were used which have less water conveyance efficiency. These losses were reduced tremendously due to use of PVC pipes in modified overhead irrigation system. Thus the advantages of the modified system are as follows:

- Increase additional runoff storage.
- Provide irrigation to *kharif* and *rabi* crops through gravity.
- Reduce the land loss for the construction of water storage tank for gravity irrigation.
- Alternate to water storage structure for irrigation through gravity.

Modification of traditional system filing of pond/talab with tube-well water and then using it for irrigation

As the tube-well of a farmer Mr Blaram Jat, in village Munjakhedi (District Ujjain), regularly provides groundwater with reduced discharge after the termination of monsoon. To overcome this problem in 2015, he



Figs. 7 and 8. Modification of traditional system of pond/talab for irrigation through gravity.



Fig. 9 and 10. Modification of traditional system filing of pond/talab with tubewell water



Figs 11 and 12. Elevated cement tanks in series filled with water from the gullied portion for irrigating crops in adjoining fields by gravity using micro irrigation system

constructed cemented overhead tank of 9 m height and 13 m dia with 1,193 m³ storage capacity for storing tube-well water into the tank and using it for irrigation through gravity. Besides, the overhead tank also collects tube-well regularly and used for irrigating the crops through PVC pipes with almost no conveyance losses.

Modified traditional system of irrigation in Nimar region

Many farmers of the Nimar region similarly construct cemented tanks of 3 m height and 15 m dia with 445 m³ storage capacity at higher elevation, which are filled by lifting the runoff water flowing in the gullies using pumps during rainy season. However, the topography of this part is such that the valley portion receives seeped water from the ridge lines continuously throughout the year and the gullied portion become perennial source of

water which is also pumped into the elevated cement tanks in post-monsoon season. The stored water in the tank is delivered through an outlet for using drip system for irrigating maize, cotton and vegetables. According to size of field and crops to be grown, numbers of cemented tanks are constructed at different locations in the field for filling those with naturally flowing water in the valley portion using pumps and drip irrigation system through gravity to enhance crop productivity and farm income.

SUMMARY

Due to increased water availability through the development of water harvesting tank, many adaptation strategies viz. introduction of tolerant cultivars resistant to temporary water logging and drought, modifying crop management practices, improving water and rainwater management,

adopting new farm techniques such as crop diversification particularly to deal with the impact of climate change could be adopted successfully to minimize the damage to crops due to adverse and changing weather conditions. Therefore, increasing irrigation water availability through water harvesting tank could be a successful way to mitigate adverse climatic conditions in Malwa region. Since soil and water management is highly critical for adaptation to climate change, attempts towards water harvesting, improvement in irrigation accessibility and water-use efficiency should be made on priority basis.

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