Indian J. Dryland Agric. Res. & Dev. 2015 30(1) : 10-14 DOI 10.5958/2231-6701.2015.00002.0

Increasing Water Availability for Enhancing Crop Productivity through Dovetailing Activities and Participatory Mode – A Case Study

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ABSTRACT: In a study through dovetailing the various activities for some development work, a suitable site was selected and converted into a huge water storage body through participatory approach. It helped to develop a water storage body of sufficient size which not only retained huge amount of runoff but also recharged the nearby open well and tubewell. The activity made possible to bring additional 4 ha area under wheat (Now it is 7 ha wheat, 2 ha chickpea and 1 ha other crops) and allowed farmer to diversify his cropping pattern and he could grow potato, summer maize, vegetables and sweet potato for his own use and family which was otherwise not possible before. It was also observed that immediately after the construction of the tank, the productivity of both the kharif and rabi crops increased. Similarly, the area under wheat increased tremendously than chickpea because of increased water availability for sufficient irrigation water to grow wheat crop which require 2-3 more irrigation than chickpea. Further, this also reduced the amount of runoff which was otherwise leaving the watershed area without aiding to surface and sub-surface storage. The increased water availability also brought new area under high remunerative rabi crops and increased their productivity on sustainable basis.

Key words: Participatory approach, water recharging, harvesting tank, crop productivity

Besides many mandates, the Operational Research Project for the Dryland Agriculture, College of Agriculture, RVSKVV Campus, Indore has been actively working in different watersheds of Malwa region to achieve a firsthand working experience in the development of area on watershed basis to serve as a model for extension agencies and to provide consultancy services to the extension agencies for transfer of dryland technologies. It was observed through the project that in Malwa region, limiting moisture in the soil has been the major cause of concern like most of the rainfed areas due to uneven rainfall distribution, prolonged dry spells and vagaries of monsoon for growing satisfactory *kharif* crops in general (Agrawal and Narain, 1997, Ariyabandu, 2001 and Rana and Gupta, 2010). It has also been observed that due to early withdrawal of monsoon, the soils do not retain sufficient moisture where *rabi* crops can be planted without experiencing severe moisture stress throughout crop growth period. Thus, providing irrigation water to *kharif* crops during prolonged dry spells and for *rabi* crops as pre sowing or post sowing through any means enhances the crop productivity and many evidences have been reported on these aspects from time to time (Narayan *et al.*1988, Mishra *et al.*1998, and Ranade, 2014). Further, in most of the rainfed areas, it has been observed that in *kharif* season, rainfall is adequate for agriculture; irrigation is required for *rabi* and summer season (Chakraborty and Mandal, 2008, Jakhar *et al.*, 2011). Therefore, it is desirable to make the provision for sufficient irrigation water for this purpose either as surface and sub surface water sources. Exploring suitable sites for the storage of runoff water both for surface storage and sub surface storage through groundwater recharge is a major requirement in each of the rainfed watershed in order to enhance the overall productivity and thus the farm income. However, availability of fund with any research project or with any developmental agency for this purpose limits the size of water storage body to accomplish the overall objective of these agencies. Thus, dovetailing of various schemes and participation by the farmer through land, labour or cost can easily help to develop a water storage body of sufficient size which not only retained huge amount of runoff but also recharged the nearby open wells and tubewells. With this objective in view, the present study was made to explore such site, develop it so that both the purpose of surface storage and ground water recharge can be obtained with an aim to provide sufficient water to the farmers so that they continue to grow satisfactory crops even despite aberrant monsoon conditions by involving Operational Research Project for the Dryland Agriculture, College of Agriculture, RVSKVV Campus, Indore and Department of Agriculture and farmers welfare, Madhya Pradesh.

Materials and Methods

In the year 2010, as per the requirement, under Operational Research Project for the Dryland Agriculture (ORP), a village Gaddukhedi (22^{0}48'N and 75^{0}50'E, altitude 540 m) was finalized by considering various aspects and in consultation with administrative and Agriculture officials of Dewas district of Madhya Pradesh. After making several visits, a suitable ORP site is selected. Before formulating the technical programme, deciding research strategies, conservation approaches and technologies, it is desirable to collect basic information on various aspects. A detailed Participatory Rural Appraisal (PRA) was conducted to establish rapport with the village community as well as to identify and define problems for prioritization in this village itself by the ORP team, alongwith many officials of Department of farmers' welfare and Agricultural development, Dewas. The idea was to dovetail the activities in the village Gaddukhedi atleast for some development work. Based on the information gathered, a suitable site was selected and converted into a huge water storage body through the active participation by Operational Research Project for the Dryland Agriculture, Department of farmers' welfare and Agricultural development and the farmers of the area.

Results and Discussion

Outcome of Participatory Rural Appraisal (PRA)

Through active participation of all the stakeholders, research and developmental agencies in the PRA and through secondary data, it was observed that the Vertisols of the village are low in Nitrogen content with medium P and high K level. The soil is very shallow near the ridge line and in the middle reaches; soils are medium to deep in nature. Further, it has been classified as *rainfed agro ecosystem and oil seed based production system.* The average rainfall is 1067 mm with an average 45 rainy days. Thus, it offers potential (apart from the above identified need) for rainwater harvesting in the district. The runoff potential in this village 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. Since the soil profile is underlain by basaltic murrum, even the stored water would no longer be retained for longer time. But its percolation may enhance or recharge the underground tube well or open well available in the vicinity (Auja, 2007 and Naik, 2009). Even in village Gaddukhedi, due to poor/non-availability of ground water, lot of area could not be brought under cultivation during rabi season many a times in this village. Since runoff and associated soil losses thereby reduced fertility, non-availability of surface as well as sub-surface water, limiting moisture conditions has been the major problems of the region. It was thought that attempts should be made to water availability in the farmers fields so that besides *kharif* crops i.e. mainly Soybean, Maize, other rabi crops like chickpea and wheat are grown without fail at least in some areas. Similarly, this would be an entry point activity for ORP so that enhanced water availability would ensure the cultivation of *rabi* crops for further help in achieving the other objectives i.e. to evaluate the performance of each component of dryland technology under the farmers management conditions both singly and in combination and to provide feedback to the research stations for fine tuning sub-optima recommendations. In the meeting it was, therefore, decided to increase the runoff water storage in the nearby existing natural gully or nala by creating storage pockets located in the vicinity of selected farmer's field which is otherwise runs out of the field with soil and nutrient losses through sheet erosion.

Water recharging cum harvesting tank

A suitable site in the field was selected considering all the hydrological aspects in April 2010 during the PRA exercise. In this portion, technical guidance was provided to line department personnel and an excavated tank was developed using watershed funds available with line department and finally a suitable cemented structure in the form of outlet was constructed totally under the guidance of ORP team in June 2010. This tank of 1500 cu.m. capacity was allowed to fill with the runoff water in the following monsoon season and as expected most of the water percolated and very limited water was available for the irrigation purpose as not much back water can be stored on the upward sloping upstream site.

Further, it was then decided to make use of the available cemented out let waste weir during March 2011. For this purpose the existing nala portion other than the tank area towards upstream was excavated using the back hoe loader machines so that the back water retained in the nala and may aid to nearby open well. Participatory mode was adopted for this purpose and farmers were asked to bear the cost of excavation by providing his tractor and trolleys so that the excavated soil is spread in the undulating fields of the farmer's fields and the basaltic material is used for the construction of field bunds. Also the excavated basaltic material was used at the field bunds for providing waste weirs in the bund portion so that the silt free water from the cultivated fields enters into the nala. This brought a sizable portion of the farmer's fields into leveled condition and also provided a safe disposal to runoff water.

However, in a watershed area, it is not possible to assess the direct or indirect advantage of this water harvesting cum recharge tank on many fields and farmers away from the tank area. Therefore, it was decided that the data are generated from a farmer who is directly drawing water from this tank area and from his open well located very nearby hardly 3 m and connected through tank with a pipe for recharging purpose. Thus, this study was carried out 2010 onward with an objective to generate data on water availability and to observe its effect on increase in rabi cropped area.

Because of increased capacity of the pond area due to excavation, full advantage of the waste weir was explored. An additional storage of 2200 cu.m. was possible because of this activity during the monsoon period of 2011-12. It is clear that the area under irrigation during rabi season increased tremendously in comparison to before the construction of tank and also prior to ORP interventions (Table 1). Immediately after the harvest of soybean, the adjoining fields (10 ha) were irrigated using the submersible pumps. The stored water was used for pre-sowing irrigation and subsequently for

Table 1 : Details of pre-sowing irrigation through tank applied during rabi season

Particulars	Year				
	2009-10	2010-11	2011-12	2012-13	2013-14
Amount of Water used (m^3)	-	1500	3000	3000	3000
Area Irrigated (ha)	1.5 (using tube well)	5 (conjunctive use)	10 (conjunctive use)	10 (conjunctive use)	10 (conjunctive use)

two more additional irrigations. The excavated portion also ensured ground water recharge in the nearby open well and this ensured operation of tube well located in the open well for additionally for one more month than the others located in various fields.

From ORP side, the advantage of this outlet was explored and through this sunken pond, the nearby open well gets recharged automatically in the monsoon season of 2011-12. The increased water availability and enhanced recharging of nearby ground water sources brought a clear change in the rabi cropping pattern since 2011-12 onward (Table 2). This also helped the farmers to bring an appreciable amount of cultivated area under additional irrigation. Similarly, in the year 2012-13, the advantage of the increased storage capacity was very much visible as the open well located in the adjoining field remained fully recharged and allowed farmer to draw more water than other wells located in the same area but away from the influential zone of the water harvesting tank. Similarly, during 2013-14, the heavy runoff due to more rainfall resulted in the tank remained full to its capcity almost throughout the monsoon period. The adjoining wells and tubewells got recharged and provided extra water available for irrigation. The farmer utilized the stored surface water by using floating submersible pump during the month of October and November to provide pre-sowing irrigation to adjoining fields and brought the fields under cultivation of gram and wheat. It is to emphasis that the site was such selected that despite erratic rainfall pattern, the tank area and extended portion remained full throughout the rainy seasons of 2010, 2011, 2012 and 2013 and provided surface irrigation water for pre sowing irrigation in 10 ha area. This has allowed him to bring additional 4 ha area under wheat (Now it is 7 ha wheat, 2 ha chickpea and 1 ha other crops). Otherwise, the farmer was somehow managing to grow, chickpea in 8 ha and wheat in 2 ha (Table 2). This has allowed farmer to diversify his cropping pattern and he could grow potato, summer maize, vegetables and sweet potato for his own use and family which was otherwise not possible before.

It was observed and monitored that even in the month of October throughout all these years, the open well of the farmer was full when there was no water in the all the three open wells located 150 m away from the tank area. The open well and tube well provided water even in the summer month's which was not possible before the construction of water harvesting cum recharge tank.

It has been observed that immediately after the construction of the tank, the productivity of both the kharif and rabi crops increased. Similarly, the area in his field under wheat has increased tremendously than chickpea which is a clear cut indication that he is regularly getting sufficient irrigation water to grow wheat crop which require 2-3 more irrigation than chickpea (Table 2). The yield enhancement was also influenced by the change in traditional crop varieties of wheat and chickpea due to availability of additional water for irrigation (Table 3). Even in the year 2013-14, despite good monsoon rainfall (1339 mm), a continuous dry spell of 25 days in the month of September brought especially long durational varieties of soybean under severe moisture stress. The farmer provided a supplemental irrigation of 3 cm in two ha area to soybean variety RVS 2001-04 at this pod forming stage and this increased the soybean yield by 1.5 times than the other fields with same variety.

Before the construction of the tank, as the farmer owned four buffaloes and one cow, he was trying to earn extra income through dairy business but could not succeed as ground water was not sufficient enough to grow fodder crops and even for drinking purpose of live stocks especially during post monsoon season. But after the construction of the tank and thereby due to increased surface and sub-surface water, he bought fifteen buffaloes in March 2012 and earning through dairying.

Table 2 : Change in rabi cropping pattern due to additional availability of water in the tank and ground water

Crops	Year wise Area under rabi cultivation (ha)				
	2009-10	2010-11	2011-12	2012-13	2013-14
Gram	7.5	5	2	2	2
Wheat	2	4.5	7	7	7
Potato	-	-	0.5	0.5	-
Vegetables	0.25				
	0.25	0.2	0.2	0.2	
Sweet potato/ground nut		0.05	0.1	0.1	0.1
Sorghum fodder	0.2	0.2	0.2	0.2	0.7

Table 3 : Average increase in yield of chickpea and wheat due to extra tank and ground water

Crops	With irrigation (kg/ha)	Without irrigation (kg/ha)	Increase in yield (kg/ha)
Chickpea	1600	900	700
Wheat	5600	3400	2200

CONSTRUCTION OF WATER RECHARGING TANK IN GADDUKHEDI (2010)
TECHNICAL GUIDANCE TO LINE DEPARTMENT

A nearby well and tube well in September 2012

Conclusions

It can be concluded from the above study that dovetailing of various schemes and participation by the farmer through land, labour or cost can easily help to develop a water storage body of sufficient size which not only retains huge amount of runoff but also recharges the nearby open well and tubewell. Further, this could reduce the amount of runoff which is otherwise leaving the watershed area without aiding to surface and sub-surface storage. The increased water availability can also bring new area under high remunerative rabi crops and thus increases their productivity on sustainable basis.

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Received: May 2015; Accepted: June 2015