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Research Article

# ENHANCING CROP PRODUCTIVITY THROUGH WATER HARVESTING TANK UNDER CHANGING CLIMATIC CONDITIONS

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**Abstract:** The study, conducted during, 2011-2018 on the rainwater management aspect through water harvesting tank in a farmer's field, it was observed that collection and utilization of runoff water is very beneficial in terms of enhancing crop production and farm income, modifying adverse effect of prolonged dry spells, crop diversification, reducing offsite damage to downstream fields due to uncontrolled runoff and through recharging the ground water. The same water harvesting tank can also be used for storage of pumped water and its subsequent efficient use as irrigation to black soils during *rabi* season. On an average, the lifesaving irrigation to soybean enhanced the soybean production by 10 q/ha and on the other hand the supplemental water increases the chickpea yield from 6 q/ha to 18 q/ha.

**Keywords:** *Water harvesting tank, Crop diversification, Rainwater management*

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## Introduction

Due to climate change, water shortage problems are increasing throughout the world in both developing and developed countries [1]. It is predicted that change in climate will affect soil moisture, ground water and frequency of flood or drought [2,3]. The changing climate is a global challenge to sustainable livelihoods and economic development [4]. Constructions of rainwater harvesting structures have been the strategy to stop migration of the people [5]. Water harvesting and enhancing productivity of available water is the key to provide food for increasing population [6]. Thus, in order to meet the increased irrigation water, augmentation of existing water sources by development of additional sources of water and conjunctive use of surface and ground water will be needed [7]. Rainwater harvesting technologies are among which has long been recognized as a critical factor for productivity of agricultural crops [8]. Rainwater harvesting represent fundamental tools for land and water development, because it uses the scattered and intense precipitation for productive purposes [9]. Rainwater harvesting measures could play a key role in further mitigation strategies against the global warming instead of carbon dioxide avoidance policy [10]. Therefore, to evolve the mitigation strategy, a study was initiated during 2011 in Malwa region under NICRA (National innovations on climate resilient agriculture) Project. Rainwater management can minimize the risk due to changing climatic conditions associated with farming [11]. Water resource management acts as a catalyst for socioeconomic development for the country [12]. In Malwa region, water level is depleting, therefore need of rainwater harvesting is essential to enhance irrigation water availability [13]. As the runoff potential of black soils of Malwa region is very high due to its inherent properties, it is decided to harvest the runoff at suitable locations and its subsequent utilization with conjunctive use of ground water. The increased water availability will thus ensure the provision of life saving and supplemental irrigation under changing climatic conditions.

## Material and Methods

The team of scientists of All India Coordinated Research Project for Dryland Agriculture, College of Agriculture, Indore have been visiting different villages of Malwa region from time to time to study about the adopted agricultural practices by the farmers. The main objective of this study is to evaluate these techniques scientifically for modifying it and to provide to the farmers for enhancing their crop production and farm income. This on-site and on-farm study also decides future research work. It has been observed by the team that for adopting scientific methods the farmers also consider various hypothesis. However, the team continuously motivating the framers to adopt these advanced practices. A similar attempt has been made by the team during 2010-11 in the village Ningnoti (22°47'23.9N,75°54'17.1.9E) of Sanwer block of Indore district under project NICRA financed by ICAR New Delhi. The main objective of this project is to reduce the adverse effect of changing climate on the crop production. For this, attempts have been made to reduce the cost of cultivation by contingent plan, enhancing irrigation water availability and use of improved farm implements.

In an initial study, it was observed in 2010 that farmers of the village use mostly tube well for irrigating the crops. Most of the farmers having more than one tube wells therefore due to deeper ground water level almost all the existing open wells are defunct. The soils of the village are deep soil, which is very fertile, but most of the farmers cultivate chickpea due to scarcity of the irrigation water despite good rainfall, the water availability from the tube well is gradually reduced after the month of December. Therefore, it was estimated that if the runoff from the cultivated field is collected at a suitable location it will not only increase the *rabi* crop productivity but also will provide lifesaving irrigation to kharif crops during prolonged dry spell. Thus, by storing the runoff water at suitable location in individual farmer's field can diversify the *rabi* crops by including potato, onion, garlic and wheat in place of chickpea, besides increasing productivity. Initially the farmers of the village were reluctant to construct water harvesting tank because it is hypnotized that due to tank construction a sizable part of land would be wasted and will not be in use for crop cultivation. The continuous persuasion and attempts by the team, ultimately was successful in convincing a farmer Shri Balu Singh s/o Shri Nathu Singh for the construction of water harvesting tank in his field.

In March2011, a suitable site was located in the existing drainage line for the construction of water harvesting tank in the field of Shri Balu Singh. For this purpose, a JCB machine for 150hours was provided from project side on participatory approach. The excavated soil was lifted using two dumpers and was used for levelling the field of Shri Balu Singh and other farmers. The cost of two dumpers was born by the farmer. By this way Shri Balu Singh not only recovered the cost of hiring dumpers by selling the excavated soil to other farmers but also brought a sizable portion of his undulating field to levelled condition. In this manner in March 2011 itself, a tank of storage capacity of 1400 $m^3$ was constructed. The collected runoff water stored during rainy season of 2011 and filled to its full capacity.

**Result and Discussion**

The stored water was used by Shri Balu Singh during kharif and *rabi* season. The emptied tank was refilled by the farmer's by using tube well. This way, Shri Balu Singh continue to use surface and ground water in conjunction. Since 2011 onwards to till date the tank is getting filled continuously by runoff and the farmer using ground and surface water appropriately.

**Before the tank construction**

Before the tank construction Shri Balu Singh was cultivating soybean with an average production of 12 q/ha during *rabi* and chickpea was being planted with an average yield 6 q/ha. Even some time, no crop could be cultivated successfully for the want of sufficient irrigation water.

**After the tank construction**

Through participatory approach, a tank of 1400 $m^3$ capacity was constructed under NICRA Project during 2011 in the field of Shri Balu Singh. The site for the tank was selected in such way that the natural drainage line is not obstructed but after filling tank should continue drain of excess water naturally. Similarly, it was ensured that the field of Shri Balu Singh does not get inundate after filling the tank and excess water from the tank does not initiate soil erosion in downstream field. In March2011, the tank was constructed and it got filled in June 2011 itself. The stored water was used for irrigating the kharif crops as lifesaving irrigation during prolonged dry spell. This enhances the productivity of soybean by 10 q/ha in the field of Shri Balu Singh, In comparison to that of other farmers in September 2011. The tank got refilled with runoff water which was again used for pre sowing irrigation to 1.75 ha field. After using the stored water, the tank was refilled with tube well water. This way the conjunctive use of stored run off water and tube well water, the farmer could provide pre sowing irrigation to 03 ha field with chickpea (Dollar) and second irrigation after 15-20 days crop stage. This way after the construction water harvesting structure the farmers could provide 18q/ha chickpea (dollar) which was three times more than the chickpea production before the construction of water harvesting tank. The dollar chickpea also ensured higher income in comparison to desi variety of chickpea. Thus, it is very clear that the construction of tank was benefited Shri Balu Singh for enhancing crop production and farm income [Table-1].

Table-1 *Change in cropping pattern before and after the tank construction*

| Particulars | Before the tank construction | After the tank construction |
|---|---|---|
| Soybean | 12q/ha-lower productivity | 22 q/ha-higher productivity |
| Onion | Not sown | 100q (0.25ha) -2011 |
| | Not sown | 300q (0.75ha) -2013 |
| Garlic | Not sown | Start cultivation |
| Potato | Not sown | Start cultivation |
| Chickpea | 6q/ha (desi) | 18 q/ha dollar |
| Fallow during *Rabi* | 1 ha | None |
| Pre sowing irrigation | None | 1.75ha |

In 2013 Shri Balu Singh started cultivation of onion in 0.25 ha besides cultivation chickpea (dollar). He harvested almost 100q onion in 2013. Since 2014 onwards, he is cultivating onion in 0.75 ha land and harvested 300 q onion and earning additional farm income. Before the construction of water harvesting tank, Shri Balu Singh invested for number of borings to get tube well water but was not successful in getting appreciable amount of ground water and lost handsome amount for these unsuccessful attempts. During the construction of tank the excavated soil was use by him for making his field levelled and for enhancing its fertility. On the other hand, the excess excavated soil was sold by him to other farmers for spreading into their fields. This way he earned a sum of Rs. 53100 by selling the excavated soil and helped him directly and indirectly in many ways [Table-2]. After the construction of the tank and it's filling by runoff water the tube well also getting recharged and providing more water than earlier. Since 2012 onwards, Shri Balu Singh is utilizing the harvested water for irrigating kharif and *rabi* crops and again refilling it with tube well water for efficient irrigation as gradually reducing discharge from tube well November onward is not able to provide sufficient irrigation and cover the cultivated fields if provided directly. This way by storing tube well water in the tank, same is utilized for irrigation purpose using high discharge pump.

Table-2 *Direct indirect benefits of the tank construction*

| Particulars | Before the tank construction | After the tank construction |
|---|---|---|
| Storage of tube well water | not possible | possible |
| Excess runoff water storage | not possible | possible |
| Conjunctive use of surface and ground water | Not possible | possible |
| Excavated soil | Not available | Spread in the field and sold to other farmers and earned 53100/- |
| Soil fertility | - | Enhanced |
| Levelling land | Undulation | possible |
| Lifesaving irrigation during prolonged dry spells for kharif crops from runoff water | Was not possible | possible |
| Investment for borewell/tube well | Lot of amount | - |
| Nearby tube well | never recharge and have lesser water | Fully recharged and have sufficient water |
| Soil erosion | Continued | Reduced and controlled |
| Recharge of tube-well | not possible | Possible and increased |

**Conclusion**

It can be concluded that the decision of Shri Balu Singh to go for construction of water harvesting tank was very much beneficial to him and has become a source of motivation and inspiration for other farmers and helped him directly and indirectly. Similarly, the hypothesis that with construction of tank in a portion of cultivated field is not beneficial proved to be wrong and invalid. This is a success story of farmer who is not only storing the runoff water but also diversifying the cropping pattern successfully through conjunctive use of surface and ground water for efficient irrigation. The stored water is used for providing lifesaving irrigation to kharif crop during prolonged dry spell and for providing supplemental irrigation to *rabi* crops.

**Application of research:** Study are applicable in the field of rainwater management, water harvesting techniques, irrigation water management and have field applicability.

**Research Category:** Rainwater management.

**Abbreviations:** RVSKVV, Rajmata Vijayaraje Scindia Krishi Vishwa Vidhyalay

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**Study area / Sample Collection:** Malwa region

**Cultivar / Variety / Breed name:** *Rabi* crops

**Conflict of Interest:** None declared

**Ethical approval:** This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

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