www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(9): 172-175

www.thepharmajournal.com
Received: 13-07-2021
Accepted: 15-08-2021

ML Jadav
All India Coordinated Research Project for Dryland Agriculture, RVSKVV - College of Agriculture, Indore, Madhya Pradesh, India

DH Ranade
All India Coordinated Research Project for Dryland Agriculture, RVSKVV - College of Agriculture, Indore, Madhya Pradesh, India

SK Choudhary
All India Coordinate d Research Project for Dryland Agriculture, RVSKVV - College of Agriculture, Indore, Madhya Pradesh, India

DV Bhagat
All India Coordinated Research Project for Dryland Agriculture, RVSKVV - College of Agriculture, Indore, Madhya Pradesh, India

N Kumawat
All India Coordinated Research Project for Dryland Agriculture, RVSKVV - College of Agriculture, Indore, Madhya Pradesh, India

Ashish Upadhyay
All India Coordinated Research Project for Dryland Agriculture, RVSKVV - College of Agriculture, Indore, Madhya Pradesh, India

OP Girothia
All India Coordinated Research Project for Dryland Agriculture, RVSKVV - College of Agriculture, Indore, Madhya Pradesh, India

Corresponding Author:
ML Jadav
All India Coordinated Research Project for Dryland Agriculture, RVSKVV - College of Agriculture, Indore, Madhya Pradesh, India

Evaluation of percolation tank as soil and water conservation measure in Malwa-Nimar region

ML Jadav, DH Ranade, SK Choudhary, DV Bhagat, N Kumawat, Ashish Upadhyay and OP Girothia

Abstract
In a study conducted by AICRPDA Indore during 1991-2019 on the rainwater management aspects through percolation tanks constructed in on farm and on station trials at various locations in *Malwa* and *Nimar* region, it was observed that construction of percolation tanks and thus collection of runoff water is very beneficial in terms of enhancing water availability in nearby open wells and tube wells. Based on the experiences gathered from all these percolation tanks, it can be pointed out that these percolation tanks are instrumental in enhancing availability of irrigation water, modifying crop diversification, reducing offsite damage to environment and downstream fields due to uncontrolled runoff and through recharging the ground water and ultimately in increasing the farm productivity and income. Further, it is observed that in *Malwa* and *Nimar* region, various geological situations are such located that many percolation tanks can be constructed which can ultimately enhance the availability of ground water in the area and crop production through better rainwater management.

Keywords: ground water recharge, irrigation, percolation tank, rainwater management

1. Introduction
Availability of irrigation water is the most important factor for the production of *rabi* crops mostly in rainfed areas like *Malwa* region. It is also instrumental in achieving the potential yield of any *rabi* crop if it is available in sufficient amount. However, it is a fact that the availability of irrigation either on surface or in groundwater depends mainly on monsoonic rainfall pattern. Rainfall amount and distribution during *kharif* also decides the cropping pattern of *rabi* season. If sufficient rainfall is received during monsoon, the farmers opt for crops like potato, wheat, onion etc. during *rabi* otherwise they cultivate mostly gram during *rabi* season of scanty rainfall year (Ranade *et al* 2018) [4]. Even during good rainfall year, it is observed that most of tube wells started providing water at the reduced rate since December onwards and even then farmers fail to provide required water in last critical crop stage. Over exploitation of groundwater in the region mainly due to increasing demands for irrigated agriculture causing severe groundwater depletion when less amount of rainfall recharge (Surinaidu *et al.*, 2018) [10]. The runoff potential is very high in the region due to inherent soil properties (black *vertisol*), the harvesting of excess water at suitable locations in farm ponds has been found to be beneficial by providing supplemental irrigation water for the crops other than tube well water (Ranade *et al.*, 2021) [5]. However, efforts should also be made to enhance the ground water recharge through percolation tanks as in this region many such topographical and hydrological situations are existed. Many researchers advocated for the construction of percolation tanks for enhancing ground water recharge. Rangarajan *et al*. (2014) [7] conducted a case study in basalt watershed of Ujjain district of *Malwa* region in Madhya Pradesh and concluded that infiltration of monsoon precipitation through unsaturated zone is the principal source of natural recharge. Srivastava R. C. (2007) [9] and Bhagyawant *et al.* (2008) [2] reported that percolation tanks are constructed for increasing water table depth below the ground surface. Reena Kumari *et al.* (2014) [6] observed that rainfall is the principal means for replenishment of moisture in the soil water system and recharge to ground water. Farmers have increasingly recognized the enhanced reliability of supplementary wet season and dry season irrigation with groundwater that brings with it reduced risk of investment losses and higher levels of agricultural productivity (Bhaduri *et al.*, 2009) [1]. Small dams or groundwater supplies are used for supplementary watering to grow crops during the monsoon (*Kharif*) season and dry winter (*Rabi*) (Garg *et al.*, 2011) [3].

Rainwater harvesting technologies are among which has long been recognized as a critical factor for productivity of agricultural crops (Schlenker and Lobe, 2010) [8]. All India Coordinated Research Project for Dryland Agriculture, College of Agriculture, Indore, project team have been visiting different villages of various districts to have live contact with the farmers. During 1990, it was demanded by the farmers that project should make attempt to enhance the water availability for irrigation so that agriculture production can be enhance in the area. Since then, several attempts have been made by the AICRPDA, College of Agriculture, Indore to enhance the availability of surface and subsurface water through rainwater management mainly through storage of runoff water at suitable locations in the farmers fields from time to time. Thus in the present study, an attempt has been made to assess the impact of various percolation tanks developed and constructed by the project on participatory approach and also by providing technical guidance for the same. Similarly, various stop dams are constructed by village panchayats, the impact of these are also assessed in this study from few villages.

Material and Methods

The team of All India Coordinated Research Project for Dryland Agriculture (AICRPDA), College of Agriculture, Indore is working in *Malwa* region of Madhya Pradesh. The team has been constructing the Rain water harvesting structure at farmer's field. The Project team also visited so many locations of *Malwa* and *Nimar* related with dryland agriculture. The team experienced that region have several geographical situations where water storage tank could not constructed, as the cultivated fields with shallow black soils are underlain by fragmented by basalt which is having very high percolation rate and thus the runoff could be collected and stored only for few days. The construction of percolation tanks would be beneficial from the point of view of ground water recharge and for reducing the amount and velocity of the runoff. For this purpose, from time to time since 1990 onwards as per the requirement, suitable sites have been selected and percolation tanks are constructed in various farmers' fields in *Malwa* region (Table 1). The impact and experiences gathered from these percolation tanks on agricultural activities presented in this study.

Results and Discussion

The details of different percolation tanks constructed through participatory approach and under the technical guidance of the project team year wise are presented in Table 1. These tanks provided several direct indirect benefits to the nearby farmers/beneficiaries by collecting huge amount of runoff and controlling the erosive velocity of the runoff water (Table 2).

Various tanks in farmers' fields and their advantages

During 1991 at the lowest boundary of College of Agriculture, Indore, a percolation tank was constructed with the provision of gabion structure at outlet. The tank is collecting huge amount of runoff as per its capacity and than during the excess water safely into the natural drain.

In 2000, the project identified a portion, which was adjoining the ridgeline of the field of Shri S.C. Sharma of village Baroli district Indore. The runoff water from the ridgeline used to enter with the high velocity in field of Shri Sharma and was eroding the parts of cultivated field and thereby damaging the crops and retarding the fertility. The project attempted to construct a 190 m long and 2m wide earthen bund in this wasteland by using a bulldozer.

In 2000, the project team helped technically to an NGO for the construction of a big percolation tank in the village Hatuniya, tehsil sanwer district Indore.

In 2005, also the project-using bulldozer in a field adjoining to ridgeline in the village Jetpura, block Sanwer district Indore constructed a percolation tank.

In 2008, a progressive farmer Shri Keval Singh Patel from village Hatod, block Depalpur District Indore contacted the project team and requested to construct water-harvesting tank through technical guidance. the project team immediately inspected his site and observed that after the construction of tank it would not be possible to retain the stored water for longer time as this portion is underlain by basaltic murram which is having very high percolation rate when this was inform to Shri Patel, he was very distressed initially because he wanted a water harvesting tank. However he agreed to got constructed percolation tank in this portion. With the help of technical guidance from project team Shri Patel invested Rs 3 lakhs for the construction of a big percolation tank. Actually, this portion of land of Shri Patel was adjoining to a ridgeline and was severely affected by soil erosion.

In 2010, a percolation tank (2500 m^3) was constructed by a farmer shri Patidar in village Panod block Sanwer district Indore under the technical guidance of AICRPDA team. The farmer also provided two stored shafts for insuring deeper percolation of the stored runoff water in these two shafts were provided with metallic filter material to avoid the entry of foreign materials in ground water.

The direct effect of percolation on water availability from open well / tube well realized from all these tanks and are presented in Table 3. There has been tremendous increase in the irrigating after the construction of these tanks, which ultimately reflected in higher yield production from *rabi* crops grown in adjoining areas (Table 4).

Table 1: Year wise Details of constructed percolation tanks

Year	Location of the tank	Beneficiary
1991	College of Agriculture, Indore	College farm
1991	Hingonia Tehsil-Depalpur, District Indore	Villagers of Hingonia
2000	Village- Baroli, Tehsil-Sanwer, District- Indore	Shri S.C.Sharma
2000	Village -Hatuniya, Tehsil-Sanwer, District- Indore	NGO
2005	Village -Jetpura, Tehsil-Sanwer, District- Indore	Villagers
2008	Village- Hatod, Tehsil-Depalpur, District Indore	Shri Keval Singh Patel
2010	Village- Panod, Tehsil-Sanwer, District- Indore	Shri M.K.Patidar
2014	Village –Lonsara,Tehsil- Rajpura, District- Barwani	Villagers
2018	Research field of AICRPDA, Indore	AICRPDA
2018	Village- Harsola, Tehsil- Mhow, District, Indore	Shri lokendrasingh tomar
2019	Village-Ningnoti, District, Indore	Shri Bishan Singh

Table 2: Direct indirect benefit of Percolation tank

Particular	Before	After
Runoff collection	was not possible	Huge amount of runoff is collecting
Soil erosion	High velocity runoff eroding the soil.	Safe disposal of excess water
Degraded and wasted land use adjoining the ridge line	was not in use	converted into tank area and cultivated fields
Downstream fields	Eroding the parts of cultivated field, thereby damaging the crops, and retarding the fertility due to high runoff velocity.	Reduced the chances of heavy damage in the lower portion of the fields due to controlled runoff velocity
Ground water recharge	No recharge	During monsoon season itself, tank area were filled several time with runoff and were percolated. Enhanced ground water recharge.
Soil erosion control measure	Farmers adopted different measures like loose boulder structures to control the runoff, effective control was not possible.	No need of such measures, storage of runoff in percolation reduced erosive velocity tremendously.
Field leveling	Uneven field, Not possible	excavated soil spread into unleveled field to make the fields levelled

Table 3: Effect of percolation on water availability from open well/tube well

Year	Location	Before	After
1991	College of Agriculture, Indore	The adjoining open well had only limited water	The adjoining open well which has started providing irrigation water almost throughout the year since then
2000	Village- Baroli, Tehsil-Sanwer, District- Indore	Wells had no sufficient water	enhanced water availability in the step well and other open well located in the fields
		tube wells never recharged fully	tube wells getting recharged fully and filled up to the brim every year
2000	Village -Hatuniya, Tehsil-Sanwer, District- Indore	Not recharged of nearby tube wells and open wells.	Regular recharge of nearby tube wells and open wells.
		wells located in tank area itself was not providing ground water during summer season.	the tube well and open well located in tank area itself and thus providing ground water even during summer season which is very rare and impossible phenomena.
2005	Village -Jetpura, Tehsil-Sanwer, District- Indore	Wells not recharged	Huge amount of runoff was collected in the tank area, enhanced the recharge of nearby open well, and tube well.
2008	Village- Hatod, Tehsil-Depalpur, District Indore	Rain water was not collected	Stored water collected during rainy season since 2008 onward is getting percolated and recharging nearby open well and tube wells.
		Nearby tube well was not recharged	Helping other farmers to save their fields from the soil erosion losses and helping their tube wells from being recharged.
2010	Village- Panod, Tehsil-Sanwer, District- Indore	Not recharged nearby tube wells	recharged the nearby two tube wells, which provided sufficient irrigation water
2014	Village –Lonsara,Tehsil-Rajpura, District- Barwani	Open wells was not constructed	About 100 open wells constructed ground and water is available within 2-3 m from ground level
		Tube wells had submersible pumps because low water table	few tube wells are replaced by centrifugal pumps as ground water are available within 3-4m
2018	Research field of AICRPDA, Indore	Huge amount of runoff water leaving the field and was damaging the lower fields due soil erosion.	No runoff took place and all the excess water retained and used for ground water recharge, saved lower cropped areas from getting damaged.
2018	Village- Harsola, Tehsil-Mhow, District, Indore	not possible at all	This portion immediately served as a percolation tank and recharge the nearly open well to convert it into an irrigation source
2019	Village-Ningnoti, District, Indore	Runoff water leaving the field and was damaging the lower fields.	Served as a percolation tank and recharge the nearly open well. Saved lower cropped areas from getting damaged.

Table 4: Irrigation to rabi crops from the enhanced water availability

Year	Village	Before	After
1991	College of Agriculture, Indore	Irrigate chickpea only in 1 ha land with using open well water.	5 ha area during rabi season could be irrigated chickpea and wheat production.
2000	Village- Baroli, Tehsil-Sanwer, District- Indore	Irrigate only 0.75 ha land using open well water.	10 ha area during rabi season could be irrigated chickpea and wheat production
2000	Village -Hatuniya, Tehsil-Sanwer, District- Indore	Scarcity of tubewell water	Huge tubewell water, saved downstream fields from erosion
2005	Village -Jetpura, Tehsil-Sanwer, District- Indore	Scarcity of tubewell water	Huge tubewell water, erosion process restricted in lower fields
2008	Village- Hatod, Tehsil-Depalpur, District Indore	Impossible before the construction of percolation tank	Rabi crops are being grown successfully in most of cultivated fields
2010	Village- Panod, Tehsil-Sanwer, District- Indore	Not possible	Sufficient irrigation water available for rabi crops in almost 10 ha area
2014	Village –Lonsara,Tehsil-Rajpura, District- Barwani	Few crops were grown despite locating on the bank of seasonal river	Growing various crops with wide range of crop diversity specially fruits and vegetables like maize, tomato, cucumber, watermelon etc.

2018	Research field of AICRPDA, Indore	Scarcity of ground water	Enhanced irrigation availability to farm tube wells
2018	Village- Harsola, Tehsil- Mhow, District, Indore	Scarcity of ground water	Even open well is filled up to brim and huge amount of ground water available.
2019	Village-Ningnoti, District, Indore	Scarcity of ground water.	Enhanced irrigation availability to farm tube wells.

Benefits of percolation tank in AICRPDA, Indore research field

In March 2018, in the research field of AICRPDA, a percolation tank of 907 m^3 storage capacity was constructed. This percolation tank was so constructed that it not only receives excess water from the HDPE lined water-harvesting tank but also collects the runoff from other agricultural field since the soil of the area is underlain by basaltic murram which is having 18-20 cm percolation rate per day. Therefore, the stored water in the percolation tank continuous get percolated which ultimately enhances the chances of ground water recharge. Before the construction of this percolation tank the excess water from lined water harvesting tank and runoff water from other areas continuously eroding the lower portions of farm area due to higher velocity of runoff water. Immediately within the construction of water harvesting tank this runoff water is stored in the percolation tank, which ultimately controlled the soil erosion and its adverse effect in appreciable farm area. This way in AICRPDA research field the runoff water is stored in percolation tank for its ultimate utilization for ground water recharge. This rainwater is properly being managed for its further utilization during *kharif* and *rabi* season and thus reducing the losses to offsite fields due to soil erosion.

Effect of stop dams and watershed activities

Similarly, the team visited village Lonsara tehsil Rajpura district Barwani in the year 2014 for assessing the problems and providing technical guidance to village farmers. The team observed that in between two ridgelines an earthen dam was constructed in 1990, which is collecting and storing huge amount of water and providing irrigation through canal in various village for irrigation that has been found very helpful in increasing the crop productivity.

Various village panchayats of different villages constructed stop dams in gullied portion that resulted in stabilization of gullies and in draining off runoff water safely for enhancing water availability in the village. In a training programme at AICRPDA to different watershed committees in 2016, it was suggested that area between two stop dams in stabilized gullied should be excavated to construct sunken pond in the series. It was also suggested that the excavated soil should be spread into unleveled field or in fellow land so that crop production can be increased. Shri lokendra Singh Tomar village Harsola, block Mhow District Indore adopted this suggestion and constructed sunken pond in the gullied portion and used the excavated soil to make a new field to make it suitable for crop cultivation.

Conclusion

The success stories generated from all above mentioned percolation tank, many farmers are getting motivated and contacting the project team for providing technical guidance for the construction of percolation tank in their field, which was otherwise a rare gesture. Based on the experiences gathered from all the percolation tanks, it can be pointed out that percolation tanks are very useful in storing the runoff and recharging the ground water and even controlling the erosion losses to offsite field located on downstream site. In *Malwa* and *Nimar* region various geological situations are such located that many water harvesting tanks and percolation tanks can be constructed which can store the runoff water safely and enhance the availability of surface water. This way, percolation tank is considered at par with water harvesting tank in terms of enhancing availability of irrigation water.

References

1. Bhaduri A, Aarasinghe UA, Shah T. Groundwater expansion in Indian agriculture: past trends and future opportunities. International Water Management Institute, Colombo, Sri Lanka 2009,181-196p.
2. Bhagyawant RG, Jadhav SB, Raut DV, Payal SD, Shinde RV. Percolation tank- An effective tool of groundwater recharge. International Journal of Agril. Engg 2008;1(2):115-118.
3. Garg KK, Bharati L, Gaur A, George B, Acharya S, Jella K *et al*. Spatial Mapping of agricultural water productivity using SWAT model in Upper Bhima Catchment, India. Irrigation and Drainage Journal 2011, doi:10.1002/ird.618.
4. Ranade DH, Mujalde Santosh, Swarup Indu. Modified traditional water harvesting system for irrigation. Indian J Dryland Agric. Res. & Dev 2018;33(2):86-88.
5. Ranade DH, Jadav ML, Indu Swarup, Girothia OP, Bhagat DV, Ashish Upadhyay. Crop Productivity Enhancement under Soybean Based Cropping System through Harvested Rain Water in Malwa Region. Legume Research 2021;10:18805/A-5447.
6. Reena Kumari, Singh R, Singh RM, Tewari RK, Dhyani SK, Dev I *et al*. Impact of rainwater harvesting structures on water table behavior and groundwater recharge in Parasai-Sindh watershed of Central India. Indian J of Agroforestry 2014;16(2):47-52.
7. Rangarajan R, Andrade R, Shankar GBK, Muralidharan D, Peters E. Understanding area specific recharge process from Vadoze zone resistivity variations – a case study in basalt watershed, Ujjain district, Madhya Pradesh. India. J Ind. Geophys. Union 2014;18(2):211-224.
8. Schlenker Wolfram, Lobe DB. Robust negative impacts of climate change on African agriculture. Environ. Res. Lett 2010;5(014010):8, doi: 10.1088/1748-9326/5/ 1/014010.
9. Srivastava RC, Verma HC, Nanda BK, Mohanty S. 'SODEPT' A Software for Design of Percolation Tank. Water Resour Management 2007;21:1955-1972 .
10. Surinaidu L, Raviraj A, Rangarajan R. Evaluation of Percolation Tank Efficiency on Groundwater Recharge: A Case Study for Karnampettai Percolation Pond, India. J Ind. Geophys. Union 2018;22(3):292-305.