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Short Communication

Solving Dual Problems of Water Logging and Water Scarcity in Nimar Region – A case study

D.H. Ranade, Santosh Mujalde and Indu Swarup

Operational Research Project for Dryland Agriculture,
RVSKVV campus - College of Agriculture, Indore-452 001, Madhya Pradesh

Email: dhranade@rediffmail.com

The high runoff potential, scarcity of irrigation water, undulating topography, poor and restricted drainage system, temporary/permanent water logging, high erodible nature of soils, uncontrolled runoff are the major reasons for the lower productivity of both *kharif* and *rabi* crops (Ranade and Tomar, 2004) resulting in abandoning of the cultivable lands or restricting its further use for higher production in Nimar region. The problem of each field is different and thus needs a site-specific technological solution which requires technical guidance for proper natural resource management (Ranade and Verma, 2007). In this context, the present study was initiated during 2014-2015 in the village Limbai (Dist. Barwani) of Nimar region under Operational Research Project on Dryland Agriculture, College of Agriculture, Indore. The few fields of the village were facing the typical problem of water logging during monsoon season resulting in lower productivity of *kharif* crops and later delayed sowing of *rabi* crops or leaving of few fields fallow during *rabi* due to higher moisture conditions. Further, non availability of surface and ground water during *rabi* season also aggravated the situation resulting in lower productivity. Therefore, a study was initiated during 2014, in farmer's field mainly to address the dual problems of water logging and water scarcity through participatory approach.

The experimental site of Operational Research Project (ORP) on Dryland Agriculture is situated in village Limbai block Rajpur (Dist. Barwani) of Nimar region. In Limbai, village a meeting alongwith the line department officials was held during September 2014. It was informed by a farmer Smt. Nathibai that despite owning 2.5 ha cultivable land in the village, she is not able to produce traditional crops satisfactorily even during *kharif* season. Some portions of her land do not allow interculture operations in *kharif* and crops suffer due to heavy weed infestation. These cultivated fields remain in marshy condition till December and planting of *rabi* crops gets delayed. Though, she owns an open well which remains full during monsoon season, it does not provide sufficient water to provide irrigation to *rabi* crops when it is required most. Thus, in both the season, she is not able to harvest *kharif* and *rabi* crops like others. Because of overflowing of ground water from her open well, adjoining area of about 15 ha was also getting affected and was producing lesser crop yields during *kharif* and *rabi* seasons. The ORP team visited the site and suggested the probable solutions to for increasing the crop productivity, during both *kharif* and *rabi*.

Assessment of the problem

It was observed that due to undulating topography and continuous slopy field conditions, the soil is severely eroded with development of rills in various fields. Further, it was assessed that not only the fields are severely eroded but also water logging and stagnation of water in the fields affecting crop growth and productivity. The soil of the fields was clayey in nature and underlain by fragmented basalt (murrum) and basaltic stones. The soil depth is also a limiting factor in few fields as soil depth varied from shallow to medium depth. Further, it was observed that due to continuous ground water recharge from ground soil strata, the *kachha* open well located in the middle of the farmer's field gets fully recharged during monsoon. Due to nearby hilly terrain continuous ground water recharge takes place during monsoon season from July month onward and the excess underground ground water fills the well and flows/oozes out from the well and moves into to the lower area and creates problem of water logging in the cultivated fields severely affecting the *kharif* crops. It was revealed that the excess water from the well not only stagnates the fields but also remains in the fields till December end. Thus, it doesn't allow the farmer to cultivate the field with *rabi* crops. After December month, the water table suddenly goes down and the poor availability of water from the well does not make possible even palewa (pre sowing irrigation) for *rabi* crops. In January, the open well gets totally dried up and remains dry till July end. Overflowing of ground water from the open well was also affecting the cultivated fields of about 15 ha of other adjoining farmers during monsoon season and resulting in lower yield levels during *kharif* and delay in sowing of *rabi* crops.

Strategy and solution of the problems

It was assessed that with scientific and appropriate interventions, not only the dual problem of water logging and water scarcity can be tackled but also fertility of a large portion of the field can be restored. Thus, it was decided to provide suitable drainage system so that the excess water drains out safely and the depressions and low lying fields to be reclaimed to avoid water stagnation. Similarly, to increase the irrigation water availability, it was decided that an excavated water harvesting tank be constructed which will collect the runoff water and the excess drainage water from the drainage system to avoid the water logging. Thus this will collect the huge amount of runoff and drainage water to be used during the limiting moisture conditions. Further, the

excavated soil would be spread on the upstream side fields to make them level so that water stagnation in the field does not take place and water moves out the fields towards tank site without causing damage to crops. At the same time due to location of the tank, it would be possible to safely dispose off the excess water from the tank outlet and therefore avoiding the chances of water logging.

Water recharging cum harvesting tank

A suitable site in the lowest portion of the field was selected considering all the hydrological aspects in September 2014. Technical guidance was provided to line department personnel and an excavated tank was developed using watershed funds of 1.0 lakh available with line department in May 2015 using JCB machines and tractor trolleys for the transportation of excavated soil to portions of the depressed field portions on the upstream side. The work was completed by providing suitable stone inlet and outlet. This tank of 3000 cu.m. capacity was allowed to fill with the runoff water in the following monsoon season. By using the excavated soil, a sort of diversion bund was provided on the upper portion of the adjoining fields of other farmers to divert the runoff safely.

A depressed portion of the farmer's field on the upper side of well was elated using the excavated soil so that a sort of bedding system is developed to grow the crops like maize, cotton which are more susceptible to water logging.

Construction of water drainage system

It was observed that the water logging was taking place due to continuous recharge of ground water in the open well (during monsoon and post monsoon season till November month) which was coming out of the well and moving toward fields located on lower side of well laterally. Thus, it was planned that the excess water to be drained out in the excavated water harvesting tank by connecting the well and tank by a subsurface drain. For this purpose, a PVC underground pipe line (7.5 cm dia.) of 150m length below 45 cm soil surface was laid from well to tank site so that the excess water was diverted safely to the tank area without overflowing the well and causing any water logging in the lower side fields. Thus, provision of draining the excess ground water over flowing the well was made so that it is collected in the excavated water harvesting tank. The underground PVC pipe line from open well to water harvesting tank was so laid that it would not interfere with the normal cultivation operations in the fields. A lid was also placed at both the ends of pipeline to avoid entry of rodents, etc. into the pipeline during dry period. The cost of drainage system (₹ 20,000/-), was borne by farmer under the technical guidance of ORP team Thus, for carrying out the work of exaction of water harvesting tank and installing sub surface drainage system to tackle the dual problem of water logging and water scarcity, the convergence and dovetailing of the funds from line department, technical support and guidance from the ORP side and farmer participation was ensured.

Effect of water harvesting tank

The timely onset of monsoon season during June 2015 in the area, allowed the sowing of various crops in the farmers field. Further, two runoff events took place which filled the water harvesting tank in the month of June 2015 itself. However, thereafter, a dry spell of about 20 days took place which resulted in moisture stress condition. Since, the open well was totally dry during June-July month, no ground water was available for irrigation. However, the harvested water in the tank was utilized by the farmer for providing life saving irrigation mainly to *kharif* crops like maize, green gram and pegionpea. The monsoon revived again thereafter, and subsequent runoff events filled the tank again.

A fifteen days dry spell was again experienced in September 2015 and this time also the harvested water was utilized for providing supplemental irrigation to *kharif* crops. However this time onward, the open well recharged to its full capacity and the provision of sub surface pipe system drained safely the excess well water into the tank to refill it again. After the harvesting of *kharif* crops, the harvested water was again utilized for providing palewa in 0.5 ha area for the planting of *rabi* crops (Table 1).

Impact of sub surface drainage system

As predicted, after the arrival of monsoon and continuous ground water recharge thereof, the existing open well got fully charged in the first week of August 2015. At this time, the lids placed at the both end of the underground pipe line was opened which safely drained the excess ground water otherwise overflowing from open well. The immediate impact of this system was realized and observed that no water logging and water stagnation was observed in the fields located on the lower side of the well. This not only restricted the weed infestation in these fields but also saved the *kahrif* crops from getting damaged due to marshy condition. This also allowed the timely interculture operations and ensured better crop growth. Therefore, due to provision of sub surface drainage system, *kharif* crops were harvested successfully for the first time by the farmer which were otherwise almost one third of the normal yield levels. The sub surface drainage system allowed timely sowing of *rabi* crops like other normal fields in November 2015.

The sub surface drainage system not only drained off the excess ground water safely to protect the *kahrif* crop getting damaged due to overflowing of open well but also stored it in the constructed water harvesting tank. The additional stored water other than the surface runoff was thus collected in the tank and utilized for providing irrigation to both *kahrif* and *rabi* crops which was otherwise not possible.

After the treatment, it was also observed that the 15 ha cultivated fields of other adjoining farmers also improved tremendously and thus allowing growing both *kharif* and *rabi* crops to their satisfaction. No longer, these fields are suffering due to water logging and severe weed infestation resulting in higher yield levels of *kharif* crops. This also allowed these

farmers to carry out timely interculture operation and sowing of *rabi* crops (Table 1).

It is concluded from the above study that assessing the site specific problem and then providing solution can enhance the crop productivity in field which otherwise lying unused or underused due to various reasons related to natural resource management aspects. In the present case too, a dual problem of water logging and water scarcity was tackled successfully by following principles of soil and water management through providing suitable drainage system and by constructing water storage structure in participatory mode by dovetailing and convergence process. Many site-specific problems related to natural resource management still exist in the region and can be tackled scientifically.

Table 1 : The land use area of the farmer before and after the construction of water harvesting tank and installation of sub surface drainage system

Particulars	**Crops and their conditions**				
Before the treatment	*Kharif* crops	Maize	Groundnut	Pegionpea	Green gram
	Area (ha)	1	0.5	0.5	0.5
	Weed	severe	severe	moderate	severe
	The yield levels were almost 1/3 of the normal yields.				
	Rabi crops	Wheat	Gram	-	-
	Area (ha)	0.5	0.5		
	The yield levels were almost 1/3 of the normal yields.				
	About 1.5 ha was kept fallow due to water stagnation and limited water availability during *rabi*				
	About 15 ha area of other farmers was also getting affected due to water stagnation problem. Fields were heavily infested with weeds.				
	Irrigation from open well – 1 or 2 during *kharif* and only once in *rabi*				
After construction of water harvesting tank and laying of subsurface drains (0.1 ha was used for tank construction)	*Kharif* crops	Maize	Groundnut	Pegionpea	Green gram
	Area (ha)	1	0.4	0.5	0.5
	Weed		Almost free from weed infestation.		
	A threefold increase in yield was recorded in *kharif* season in 2015.				
	Rabi crops	Wheat	Gram	Onion	-
	Area (ha)	1.5	0.4	0.5	
	No area was kept fallow due to water stagnation and limiting water.				
	Timely sowing of *rabi* crops was possible and condition of the crop was very satisfactory like other normal fields in November 2015.				
	No area of other farmers affected due to water stagnation problem and they are growing normal crops like cotton, green gram, onion, chilli, pegiopea, ground nut, maize, wheat and gram etc.				
	Irrigation from open well – 1 or 2 during *kharif* and only oncew in *rab*i.				
	Irrigation from tank – 2 in *kharif* and once in *rabi*				

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