

Rainwater harvesting for augmenting

rainfed based agricultural income: A success story

G L Meena*, Ashok Kumar, Shakir Ali, H R Meena, B L Mina and Charan Singh

ICAR-Indian Institute of Soil and Water Conservation, Kota, Rajasthan 324 002

The success story demonstrates the impact of soil and water conservation (SWC) technology on farmers' income. An attempt was made to familiarize the farming community with improved technologies for rehabilitating the degraded land especially ravine land and make them productive along with creating some irrigation facility in rainfed area. Compartmental bunding, levelling and bunding on the downside to collect and store harvested rainwater, were the three implemented SWC technologies in the field of a poor farmer during 2018–19. This helped the farmer get good quality and sufficient fodder production for his animals. Also, the increased income and good quality fodder production directly showed promising results on his cattle which reflected in their productivity, thereby benefitting the farmer immensely.

Keywords: Farmers' income, Rainfed agriculture, Soil and water conservation (SWC)

ECONOMY of India, like other preserving the natural resources for safe future of the forthcoming generation is a challenge which tops the global agenda. The situation is far more alarming in the Indian context. India has about 18% of the world's human population and 15% of livestock with only 2% of the total land resource of the world. Considering the expected growth in its population, India needs to increase grain production by at least 50% in the next 25 years to maintain self-sufficiency in agricultural production. The challenging and neck cutting demand for land, as well as agriculture production increment, needs a quantum jump to judicious and productive utilization of marginal and degraded lands.

Nearly 57% of the land resources in India are facing physical or chemical degradation and ravines are the worst form of terrain deformation and are usually spread within 2 km of the river banks. In India, about 3.67 million hectares (mha) of land is under influence of gully erosion along with the various river systems including

Yamuna, Chambal, Kalisindh, Mahi, Narmada, Sabarmati, Ganga and Beas rivers and their tributaries. In Rajasthan, out of 0.452 mha ravine infested area of the state approximately 78% is along the river Chambal and its tributaries. The networks of gullies are intensifying slowly but steadily engulfing adjoining table lands wherever adequate measures are lacking. For restoring the ravine ecosystems to their optimum production level, the ICAR-IISWC has developed various developmental and technological packages. The adoption of these land improvement packages of practices (PoPs) is still implemented in very few areas in India, especially in the hinterlands of the country and is in a nascent stage. In this case, attempts are made to implement and demonstrate the soil and water conservation technologies for improving degraded land for productive use along with creating irrigation facilities in the rainfed areas of the semi-arid region of India.

Sustainable management of natural resources entirely depends

on the direct beneficiaries or farmers. The rejuvenation of the ravine area and the impact of soil and water conservation technologies on land improvement directly depends on farmers' participation at all stages of the program, viz. resource appraisal, planning and implementing of the program, and educating and motivating farmers for adopting an improved package of practices.

Study area

Manditya is a medium size village located in Bundi, Rajasthan with a total of 39 families residing about 30 km away from district headquarters. This village has a population of 215 comprising 111 males and 104 females (Census 2011). The average sex ratio and child sex ratio of the village is higher than that of Rajasthan state. It has a lower literacy rate compared to Rajasthan. Manditya village is administrated by Sarpanch (Head of Panchayat). Most of the village population belongs to the scheduled tribe (ST) which constitutes 84% while others are near about 16% of the total population. Elevation ranges from 757–782

m amsl showing a wide range of topography. The climate of the study area is semi-arid subtropical and is characterized by extremes of temperature and low wind velocity. The average annual rainfall is around 773.40 mm, which is marked by high spatial and temporal variability. The monsoon rain (nearly 90% of total rain) is received as south-west monsoon, from June–September and normal rainy days in the district are about 35.4 in a year. The average annual temperature is 25.8°C with an annual maximum and minimum temperature of 33.02°C and 18.62°C, respectively. The MWST and MSST was greater than 5°C. The temperature regime is hyperthermic. The relative humidity remains least in the hot weather months and highest during the monsoon months.

Manditya was one of the villages, which was selected by the ICAR-IISWC, Research Center, Kota, Rajasthan to carry out different activities for sustainable development in the village. Improvement and rehabilitation of degraded ravine land was one of the activities taken up under the Tribal Sub Plan (TSP) program funded by Govt. of India. The aim of this program is to improve the living well-being of the weaker section especially tribal communities by increasing their income. This can be realised by means of assisting them either by providing technical support or some physical inputs and implements for improving their means of livelihood. Shri Jagdish Meena, one of the resource-poor farmers of this village was selected under the TSP program for demonstrating soil and water conservation (SWC) technologies in his field. The farmer has an operational holding of about 1.80 ha land. However, he did not have any source of irrigation. His total agriculture was dependent on rainfall prior to the implementation of SWC technologies. In addition, more than 50% of the land was severely degraded or eroded by gullies and he hardly utilized 40–50% potential of his land.

Impact of Implementation of Soil and Water Conservation Technologies

Keeping in view the facts and circumstances, the team of experts from the research centre decided that rainwater harvesting along with other SWC measures should be taken up for providing irrigation and reclamation of degraded land for productive use. So, in near about 2 ha area, 3 SWC technologies, viz. compartmental bunding, levelling and bunding on the downside to collect and store harvested rainwater, were implemented on Shri Jagdish Meena's field during 2018–19. Compartmental bunding was done in the whole field and the field was divided into four portions with a 45 cm high bund for each part. Then levelling within each compartment was done. The lower side two compartments of the rehabilitated area were kept deep as compared to the above portions. The lower bund of the whole area was made up to 100 cm in height.

The work of implementation of SWCs was completed during the summer months of 2018–19. As rainfall occurs during the monsoon of 2018–19, farmers sowed *kharif* crops in the improved field. During 2018–19, there was good rain at the beginning of the rainy season. The farmer observed that two lower parts of his field were submerged in collected rainwater and there was a good stand in the remaining part of the field. As the rainy season proceeded, the amount of harvested rainwater progressively increased. Two factors, viz. rainfall and location of the farmers' field, mainly contributed to the quantity of harvested rainwater. In the later stage of the monsoon, he harvested rainwater for irrigation of *kharif* crops. After harvesting the crop, the farmer used harvested rainwater for pre-sowing irrigation of the remaining area and sold out spared harvested rainwater to his neighbours. Earlier there was no irrigation facility in the area as the total area came under the rainfed area. After selling out the spared harvested rainwater, the farmer grew *rabi* crops (mustard and gram) in his field on stored soil profile

moisture and got a very good crop in that particular area.

During 2018–19, he got a very good income (from increased crop production as well as from selling spared harvested rainwater). Upon seeing the impact of technology adoption on his income and livelihood, the owner of the field also invested some money and raised the height of the bund up to 1.5 m (toward the downside) and started harvesting and collecting more rainwater in the field. Presently, the farmer is harvesting about 5000 m³ of rainwater in his field. This quantity of harvested rainwater is presently being utilized for irrigation of near about 8 ha (50 Bigha) land. The owner of the field started selling the harvested rainwater to the neighbours for either saving of *kharif* crop (if required) or for pre-sowing irrigation of *rabi* crop and got near about ₹30–35 thousand additional income from harvested rainwater. After selling the harvested water on the basis of conserved moisture in the soil profile, he successfully grew *rabi* crops (usually gram or mustard) and got a good harvest. As per the farmer, now he is getting additional up to ₹40–45 thousand from crop production and near about ₹30–35 thousand from harvested rainwater.

Thus annually, he is getting near about ₹70–80 thousand in addition to his regular income prior to the SWCs technologies intervention. Nowadays, the farmer is also getting good quality and sufficient fodder for his animals. Both, increased income and good quality fodder production directly showed exciting results on his cattle which reflects in their productivity. The remaining increment in farmers' annual income over the period can be credited to the changes in market prices of the produces (Table 1). The farmer stated "I got a very good benefit from this work. Previously, I was hardly able to get half of the production that I am getting now. In the present scenario, I am producing both crops (*rabi* and *kharif*) per year. I am also getting sufficient produce for my animals also. If I tell you about overall benefits, then you can consider that I got one lakh

Table 1. Impact of soil and water conservation technology on farmers' income

Particular	Total expenditure* (₹)		Yield (Q)		Price (MSP or market) (₹)		Gross Income (₹)		Net income (₹)		Change in yield (%)	Monetary Increase (%)
	2018–19#	2020–21\$	2018–19#	2020–21\$	2018–19#	2020–21\$	2018–19#	2020–21\$	2018–19#	2020–21\$		
Gram	18160	27650	16	21	3425	4620	54800	97020	36640	69370	31.25	89.33
Mustard	19120	31450	17.5	22.58	3700	4650	64750	104997	45630	73547	29.03	61.18
Black Gram	7070	13300	7.5	14	4625	6300	34688	88200	27618	74900	86.67	171.20
Livestock	12000	21600	1120	1680	35	40	39200	67200	27200	45600	50.00	67.65
Overall impact of technology adoption							193438	357417	137088	263417		92.15

*-Includes cost of all inputs like seed, fertilizers, PP chemical, field operations, transportation and family labour.

#- Status of farmers livelihood production components before SWCs intervention.

\$- Status of farmers livelihood production components after SWCs intervention.

per year additional income after this work). One of the important reasons for a good harvest during *rabi* season may be due to fertile sediment load; which is deposited in his field by harvested rainwater (runoff from the upper catchment area). Here, implementation of SWC technologies worked in two ways, viz. first is harvesting additional rainfall water and secondly arresting the silt load of the runoff water. It is a well-known fact that arrested silt has a very high amount of nutrients. Thus it also improved the fertility

of the field. Upon implementing SWCs, the farmer got good crops and income; his neighbours also got water for their crops and enhanced their income. In this way, near about 50 Bigha (8 ha) area is getting irrigation water after implementing this intervention in the area.

SUMMARY

Implementation of soil and water conservation technologies can play a vital role in rehabilitating the highly degraded and eroded land. The results of these interventions

show that re-platforming (research organisations to farmers) and reforming of SWC technologies (as per farmers' requirement) to bring them within farmer's reach is time-driven demand for restoring the potential of degraded land along with enhancing farming community livelihood in the hinterlands of the country. Adoption of these technologies compresses the farmers' technological transformation into a shorter time frame through an aggressive and progressive technological adoption and orientation which can convert challenges into opportunities and advantages. We can change the orientation of land by implementing these technologies for augmenting the fertility and productivity of the soil. By implementing these technologies, one can (i) harvest extra rainwater for further utilisation, (ii) improve stored soil moisture, especially for *rabi* crop, (iii) arrest siltation load, (iv) create irrigation facility for crops, (v) sell spared harvested rainwater for others, (vi) get additional income by selling spared harvested rainwater and (vii) reduce soil loss and runoff. Moreover, by adopting SWCs, some rainfed areas can be brought under limited irrigated areas.



Overview of undulated and degraded field prior to implementing soil and water conservation technologies



Harvested rainwater used for crop production



*Corresponding author's e-mail:
gl82meena@gmail.com