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Impact evaluation of soil and water conservation measures in tribal area of district Satna (Madhya Pradesh)

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Abstract

This study was carried out by Milli-Watershed Krishi Vigyan Kendra, Satna (M.P.) during 2003-07 to assess the impact of watershed activities implemented during 1996-2003. Various mechanical measures viz., bunding, bench terracing, trenching, contour cultivation, construction of earthen check dams, ponds and loose bolder checks and biological measures viz., mulching, crop residues management, crop geometry, agri-horti and agri-silvi systems were adopted in addition to farmers motivation. The productivity of major crops and availability of water in the watershed managed area has increased appreciably. The average increase of 53.24% was recorded in the yield of paddy, 30.28% in sorghum, 18.69% in pigeonpea, 58.02% in chickpea, 43.25% in wheat and 68.40% in mustard. The availability of ground water was also increased upto 3.12 m and tremendous increase in irrigated area (3170 ha) was also recorded. Because of watershed activities the cropping intensity, family income and educational standards were also increased.

Keywords: Water conservation, tribal area, pigeonpea, chickpea, wheat

Introduction

Land and water together support plant and animal life. Conservation of these basic resources is the key of food security and food supply. Water is the prime mover in agriculture development, especially in rainfed areas. Although India receives a total precipitation of about 400 million hectare meters but much of it is lost through evaporation and run off (Singh 1998). This is not only the water wastage, but also creates the problem of soil erosion and land degradation. Such problems are more serious in hilly and ravine areas. Watershed technology augments soil and ground water resources. It also enjoins the biophysical, social and economic inputs, which is optimally managed lead diversified high agriculture production, control of environmental degradation and provide a mechanism for the recharge of ground water aquifers. Impact evaluation of dry land technologies is essential to know an overall impact of soil and water conservation measures adopted in the particular watershed area (Gupta *et al.* 2000). Keeping in the view, a study was undertaken to evaluate the impact of soil and water conservation measures in Milli Watershed Krishi Vigyan Kendra, Majhgawan, Satna (M.P.).

Materials and Methods

Characterization of watershed and its problems

The study was conducted at Milli watershed Krishi Vigyan Kendra, Majhgawan, situated in the Vindhyan hill range. It extends from 24^{o} 51`15``to $24^{o}$ 57`30``N latitude and 80^{o} 43`30`` to $80^{o}$ 54`15``E longitude in Satna district (M.P.) at about 45kms away from district place. The total area of the watershed is 12536 ha covering 18 villages. It is characterized by its backwardness, poverty, illiteracy, soil erosion and low crop productivity along with other soil economic constraints. Annual rainfall of the area varies from 800 to 1100 mm. About 90% of the total rainfall received during monsoon. There is no dependable source of water in the area. The maximum and minimum temperature of the area is 48 ^{o}C and 3 ^{o}C, respectively. The soil in the plains is sandy loam to loamy in texture. It is shallow in depth, poor in organic matter content and other plant nutrients. The soil's moisture

holding capacity is low, so it is only able to support crops of an inferior nature under rain-fed conditions. During the high rainfall months, water flows freely on the ground surface, due to poor percolation and the compact nature of soil. The details of conservation measures are discussed as –

Conservation measures

Various treatments planned and executed in the watershed area were broadly classified in three categories.

Mechanical measures

Mechanical measures usually involve construction of mechanical barriers across the direction of flow of rain water to retard or retain the runoff and thereby reduce the soil and water loss. These measures, as practiced in India, include contour cultivation, contour bunding, farm bunding, bench terracing, trenching and retention or detention reservoirs. The important principles are to be kept in view at planning of mechanical control measures are :

- Increasing the time of concentration of runoff and thereby allowing more of it to be absorbed and held by the soil.
- Intercepting a long slope into several short ones so as to maintain less than a critical velocity for the runoff water.
- Protection against damage due to excessive runoff.

To retard velocity of flowing water, 5078 stone check dams, 13 brushwood check dams, 104454m contour trenches and 02 gabbion structures were constructed. To ensure water availability in the project area 36 rain water harvesting ponds and 203 *nalla* bunds were constructed at suitable sites for providing life saving irrigation and to meet domestic water needs.

Biological measures

Crop management practices such as mulching and crop-residue management, improved varieties, seed bed preparation, seed rate and crop geometry, cropping systems, soil fertility management, pasture/grass land development and plantations under agri-horti and agri-silvi systems were adopted in vast area to reduce the impact of raindrops and increase the infiltration rate.

Socio-economic measures

Various training programmes, farmer's meetings, exposure visits, demonstrations and farmers fair were organized for farmer's motivation and their active participation and creating awareness about watershed programme.

After four years, a survey was conducted for the impact study, sampling with single stage stratification technique was applied by covering different social groups of the watersheds. 170 farmers were selected from each social group. Participatory Rural Appraisal (PRA) techniques were applied to collect the information on project accomplishments and feedback from farmers. Secondary data on land use statistics, crop yields etc, were also collected. Pre project period (1996) data were considered as the bench mark to judge the impact of the project.

Result and Discussion

Crop productivity

Implementation of watershed management programme in relation to sustain agricultural productivity was found to be very effective in changing the scenario of land capability of the area as well as to sustain the food requirements of farmer's family.

The productivity of major crops in watershed managed areas has increased appreciably (Table 1). The average increase (2003-2007) in the yield of paddy, shorghum, pegionpea, chickpea, wheat, mustard was

recorded 53.24, 30.28, 18.69, 58.02, 43.25 and 68.40%, respectively due to availability of water, reduced soil and water loss and adoption technologies (Kanaujia *et al.* 2000).

Table 1 Increase in productivity of agricultural crops

S. No.	Crop	Production (q/ha)							
		Before Treatment	After Treatment						(%) Increase
			2003	2004	2005	2006	2007	Average	
1.	Paddy	10.30	14.20	19.60	14.60	16.40	16.50	15.78	53.24
2.	Sorghum	6.00	7.20	8.00	8.30	8.10	8.20	7.82	30.28
3.	Pigeonpea	7.40	8.60	9.50	8.50	8.50	8.70	8.78	18.69
4.	Chickpea	8.10	11.00	12.50	11.30	15.70	15.60	12.80	58.02
5.	Wheat	15.80	21.00	23.50	21.60	24.20	25.30	22.63	43.25
6.	Mustard	6.30	6.50	7.80	9.40	10.02	10.50	8.42	68.40

Ground water recharge

The cumulative effect of earthen check dams, bolder dams, trenching, bunding, ponds and other treatments had caused significant improvement on recharge capacity of water in the wells and hand pipes. Prior to the project wells of the village used to become dry during the critical summer months April to June, the observations made in the wells of the village showed the positive trend of water availability (Table 2).

Table 2 Average increase in water level of wells in watershed Area

Year	Annual Rainfall (mm)	Availability of water (m)			
		In May	Increase over	In December	Increase
Pre project	905.40	0.93	-	1.80	-
2003	899.70	2.03	1.10	3.67	1.87
2004	600.50	3.09	2.16	4.36	2.56
2005	1094.85	3.85	2.92	4.85	3.05
2006	748.00	3.90	2.97	4.92	3.12
2007	635.00	3.76	2.83	4.80	3.00

There was gradual increase in the water level of wells year after year had noticed during the year 2003 and 2007 in spite of low annual rainfall in harvesting years. This is because of improvement in percolation of and down ward movement of water in the wells (Kanaujia *et al.* 2000). It was interesting to observe that harvested rain water that automatically caused more recharge of the ground water accumulation of the water was more in the wider and deeper wells in comparison to narrow and shallow wells. It was further noticed that availability of ground water in the well had also enhanced near the perennial sources. The observation of this phenomenon further helped in planning and implementation of watershed programmes in the next phases of villages.

The availability of safe drinking water in hand pipes caused significant change in social life of people of these watershed villages, as they are able to save their time for procurement of water from long distance during summer months. Further, children are less suffering from dysentery and worm problems.

Impact on irrigated area

Various water storage structures (Table 3) caused visible impact in increasing the irrigated area. This increase is due to bringing the new additional area of about 3170 ha. Under irrigation through earthen embankment (2424.5 ha), ponds (409.4 ha) and natural nalla (336.1 ha).

Table 3 Change in irrigated area

S. No.	Sources of Irrigation	Irrigated area (ha)		
		Pre Treatment 1996	After Treatment 2007	Increase
1.	Earthen embankment	19.5	2444	2424.5
2.	Pond	11.6	421	409.4
3.	Natural *Nalla*	34.9	371	336.1
	Total	66	3236	3170

Outputs and outcomes

After successful completion of watershed development the cropping intensity in the watershed area showed steady increase reaching to 136% and the average family income with in watershed area increased by Rs. 7800 per annum.

Change in social aspects

Concerted effort were made to implement the watershed development programmes for improvement of the village conditions, change in attitude of tribal families towards the education, health, environmental protection, human right, self realization for future production and co-operative life. In the beginning of the project, only 55 children were noticed to go school. But with improvement in life style of villagers, in the year 2007, 1174 students were recorded to seek education. Even most of the tribal families have started to send their children in Chitrakoot and Satna for better education. Awareness about environmental protection has been realized by villagers as a result more reduction in forest restoration is visible co-operative system has also developed to maintain natural resources of village as farmers are voluntarily contributing Rs. 50,000/acre as irrigation charges in watershed area.

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