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Impact of watershed development programme on farming system of micro watershed Dari of Tikamgarh district of Madhya Pradesh

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Abstract
The study was carried out in Dari micro watershed under the Integrated Watershed Development Programme in the Tikamgarh district, Madhya Pradesh during 2015 – 16. Study aimed to assess the impact of watershed development programme on change in natural resources, land use pattern, cropping pattern and crop productivity. An area under cultivable pasture land was increased by 233.33%, whereas the area under horticulture and vegetation was increased by 100%, respectively. The construction of soil and water conservation structures improves ground water level, which increases digging of number of wells (50%) and hand pumps (66.67%). As improvement in land and water resources, the livestock population under different categories were increased by 15 to 73 %. Whereas fodder availability was increased by 166.67%. An area under irrigation was increased by 333.33% and average cropping intensity was increased by 135%. Cultivation area under Urd was highly changed by 17.10 ha (88.60%) as compared to other crops in kharif season, whereas Wheat crop in rabi season was secured 41.56% change in cultivation area. Significant higher increase in crop productivity was recorded for Soybean crop (66.67%) in kharif season, whereas Mustard secured 40.00% increase in productivity in rabi season.

Keywords: Agriculture, Dari micro-watershed, Integrated watershed management programme, Changes in land use pattern, changes in crop area and productivity

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INTRODUCTION

The 60 per cent peoples of the country are engaged in agriculture activities (Anonymous, 2011). Approximately 195 million hectares land area of the country comes under cultivation, out of that area around 63 percent area is rain fed (Devi, 2015). Whereas, 146.8 mha area of the country is degraded due to different artificial and natural causes (Anonymous, 2010). The problems in sustainable development such as groundwater depletion and soil degradation, investments in resource conservation and increased productivity are reported as crucial factors by Bouma *et al.* (2007) for poverty alleviation and the development of India's semi-arid regions. The peoples of the country lagging behind in respect of proper utilizing the natural resources especially land and water (Mondal *et al.,* 2012). The cropping pattern, productivity of agricultural crops mainly depends on the availability of land, water and livestock resources. The quick socio-economic development activities also energies land use changes and changes in cropping pattern (Wagner *et al.,* 2013). An implementation of watershed management programmes increases surface and ground water resources (Pathak *et al.,* 2013). They reported that the wells of the Gokulpura-Goverdhanpura watershed was 52% functioning during 4 - 8 months, and 114% increase was observed in perennially functioning of wells (8 - 12 months in a year). Soil erosion also reduces due to the construction of mechanical soil and water conservation structures, and other biological measures. Mechanical soil and water conservation structures such as loose stone structures are the effective structures for soil and water erosion control in rainfed areas (Nabi *et al.,* 2017). Such structures can reduce 40– 90 % sediment yield. Such conservation measures in watershed management programmes may increase availability of soil and water resources, which helps to improve cropping pattern, land use pattern, crop productivity and ultimately improve in socioeconomic conditions of local peoples (Jaullkar et al., 2002; Kumar et al., 2002; Kassa *et al.,* 2013; Kassam *et al.,* 2014).

The Micro watershed Dari from Tikamgarh block of Tikamgarh district, Madhya Pradesh (1220 ha area) was selected for this study during 2010-11. The main objective of this study is to find the impacts of watershed implementation on certain key indicators on biophysical aspects, production related

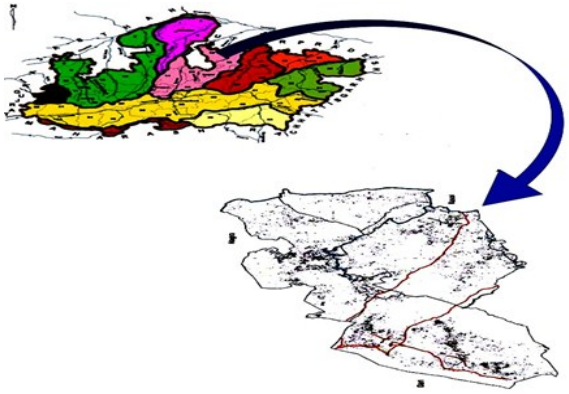

Fig.1. *Study area.*

components and socio economic issues.

MATERIALS AND METHODS

Dari micro watershed (Code: 2C2B4J1E) of the IWMP – 7 watershed project of Tikamgarh district, Madhya Pradesh was purposively selected for the study during 2015 – 16 (Fig. 1). This micro-watershed covered 1220 ha area and 613 total households. The IWMP – 7 project was started at Dari in 2010 – 11, hence it was considered as base year and all the beneficiaries under this project were considered as respondents for the present study. The total 250 benefices were benefited through soil and water conservation structures, out of which 20% beneficiary farmers were selected randomly for the study (Alvi, 2016). Pre testing interview schedule was prepared for primary data collection, whereas the secondary data were collected from revenue dept., Zillah Panchayat through direct face to face interviews. The simple percentage distribution was used as statistical tool for analysis of data (Hamdullahpur *et al.,* 2017).

RESULTS AND DISCUSSION

Change in land resources: Watershed developmental activities with an integrated approach helps to improve status of land resources (Lodha and Gosain, 2008; Sarvade, 2015). The mechanical and biological measures of soil and water conservation, improves resources availability and also improves condition of degraded lands (Pathak *et al.,* 2013; Kaushal *et al.,* 2017). Such positive impacts were governed through reducing soil erosion (Kulshrestha *et al.,* 2014; Sarvade, 2015) and improving ground water level (Baker and Miller, 2013). In present study, highly positive change was noticed in degraded land (base year 2010-11) which was converted into cultivable pasture land (233.33%), area under horticultural crops (100%) and vegetation of the watershed area (100%), due to wasteland development (Table 1). Thus, the positive change clearly indicates healthy impact by the adoption on horticultural and forestry practices. Forestry programme was observed only on wasteland, panchayat and government land, very few farmers planted forest plants, bushes and grasses in the study area. This might be due to marginal and small land holdings, where they preferred to grow food grain crops rather than the tree plantation (Desai *et al.,* 1997).

Change in water resources: The data presented in Table-2 revealed that no soil and water conservation structures were constructed before implementation of watershed development programme. Whereas, 12 water harvesting structures have been constructed through this programme. Due to increase in ground water status some new wells and hand pumps were also constructed through other Government schemes for improvement of drinking water facilities water run-off reduced by small structures resulted in increased agriculture area. Wells and hand pumps, which used to dry up during the summers have been converted into perennial sources of water, the conservation of soil in the farms has resulted in the better productivity of crops in the study area (Lodha and Gosain, 2008; Verma, 2008; Pathak *et al.,* 2013; Kulshrestha *et al.,* 2015; Kaushal *et al.,* 2017). Gebregziabher *et al.* (2016) gives photographic proof for the impact of soil and water conservation

Table 1. Change in land resources use activities in Dari micro watershed.

Change in land resources use activities (ha)	Pre-project status (ha)	Post-project status (ha)	Absolute change (ha)	Per cent change
Increase area under pasture	6	20	14	233.33
Increase in area under horticulture crops	0	3	3	100.00
Increase in vegetation area.	0	22	22	100.00
Status of waste land development.	0	44	44	100.00

Table 2. Change in water resources in Dari micro watershed.

Change in water resources	Pre-project status (No.)	Post-project status (No.)	Absolute change (No.)	Per cent change
Number of soil and water conservation structure	0	12	12	1200
Number of Wells	20	30	10	50
Number of Hand pump	6	10	4	66.67

Table 3. Change in livestock status in Dari micro watershed.

Live stock	Pre-project status (No.)	Post-project status (No.)	Absolute change (No.)	Per cent change
Cow	22	38	16	72.73
Bullock	40	46	6	15
Buffalos	74	102	28	37.84
Goats	90	140	50	55.56
Fodder availability (qt.)	150	400	250	166.67

Table 4. Change in land use pattern in Dari micro watershed.

Change in land use pattern	Pre-project status	Post-project status	Absolute change	Per cent change
Arable land (ha)	276.19	290.19	14	5.07
Non-arable land (ha)	44.29	30.29	-14	31.61
Change in cropping intensity (%).	65%	135%	70	107.69
Increase in Agriculture Land (ha)	180	290.19	110.19	61.22
Change in area under irrigation (ha)	15	65	50	333.33

Table 5. Change in cultivation area of major crops in Dari micro watershed.

Major crops (ha)	Pre-project status (ha)	Post-project status (ha)	Change in area (ha)	Per cent change
Kharif crops				
Soybean	119.60	130.50	10.9	9.11
Paddy	24.10	29.20	5.1	21.16
Urd	19.30	36.40	17.1	88.60
Sesame	17.60	19.21	1.61	9.15
Rabi crops				
Wheat	60.4	85.5	25.1	41.56
Mustard	17.64	20	2.36	13.38
Gram	13.4	16.8	3.4	25.37
Barley	4.51	5.1	0.59	13.08

Table 6. Change in productivity of major crops in Dari micro watershed.

Crops	Pre-project status (qt /ha.)	Post-project status (qt /ha.)	Absolute change (qt /ha.)	Per cent change
Kharif crops				
Soybean	12	20	8	66.67
Paddy	25	30	5	20.00
Urd	8	10	2	25.00
Sesame	3	4.2	1.2	40.00
Rabi crops				
Wheat	30	33	3	10.00
Mustard	10	14	4	40.00
Gram	12	15	3	25.00
Barley	18	22	4	22.22

structures on surface, sub-surface and ground water resources under watershed development programme in Ethiopia.

Change in livestock status: The data in Table-3 revealed that before project implementation, livestock population was less as compared to after project implementation situation. The positive change in livestock population was found due to improvement by trainings, which was given by the veterinary doctors and of fodder availability, balanced feeding of animals and vaccination in animals has also increased in the study area. Watershed development programme showed positive impact on farming community. The availability of resources for fodder production through different land uses such as agriculture, agroforestry and pasture lands (Shrivastava *et al.,* 1996). Resource conservation measures also helps to increase in vegetation cover and biodiversity which serves higher fodder availability for livestock (Gebregziabher *et al.,* 2016). Such situations convey farmers to strengthen their livestock population and improve socioeconomic conditions (Sarvade, 2015).

Change in land use pattern: Activities of the people in the particular piece of land showed relation with land use. Land use pattern indicates the spatiotemporal sequence of area under different uses. The study of land use is most important not only in agriculture dominated, over populated countries but also for whole world because it shows relationship with different human phenomenon. In case of

agriculture dominated country such as India, the availability of resources varied due to number of climatic, edaphic and biotic factors (Sarvade, 2015). The watershed development programmes helps in improving resource availability and contribute positively on land use pattern. The impact of watershed development programme in terms of change in land use pattern in the present study is presented in Table-4. After the implementation of watershed development programme, 31.61 % non -arable land was brought under the cultivation. It enhances the total arable land cover by 5.07 %. The data also revealed that the irrigated area was increased by 333.33% and 135% average cropping intensity as compared to 65% cropping intensity in the base year (2010 – 11). Therefore, it could be inferred from the table that due to the participation in the watershed management activities farmers were able to gear up their adoption on soil and water conservation practices for sustainable agriculture practices (Desai *et al.,* 1997; Panda *et al.,* 2007; Dev *et al.,* 2017).

Change in cultivation area: Data presented in Table-5 revealed that the total cultivable area under different crops of kharif and rabi season have been increased after implementation of watershed programme. Significant higher increase in cultivation area under Urd by 17.10 ha (88.60%) in *kharif season, which was significantly higher as compared to other kharif crops*. Cultivable area under Soybean was increased by 10.90 ha (9.11%), under Paddy by 5.10 ha (21.16%), under Sesame by 1.61 ha (9.15%). While in case of rabi season significant higher cultivation area was recorded in Wheat (41.56%) followed by Gram (25.37%), Mustard (13.88%) and Barley (13.08%). The sufficient availability of irrigation water, timely availability of agricultural inputs and training imparted by extension agents, under the watershed development programme (Kulshrestha *et al.,* 2015). Palanisami and Kumar (2009) studied impacts of watershed development programmes from Tamil Nadu and concluded that the activities carried out in watershed programmes helps in significant positive impacts on soil and water conservation, soil fertility, soil and water erosion in cropped area, changes in cropping pattern, cropping intensity, production and productivity of crops. Whereas, Panda *et al.* (2007) studied an impact of watershed development under Integrated Wasteland Development Programme (IWDP) on cropping pattern, food security and level of deprivation in Kashipur block of Rayagada in Kalahandi, Bolangri, and Koraput (KBK) districts of Orissa. They reported that the availability of irrigation water farmers shifted towards the cultivation of valuable cash crops.

Change in crop productivity: Crop productivity can be described as a performance of different crops in regards output per unit area (Bhatia, 1967). It is both, dynamic and complex, many researchers have developed different methods for their measurement. Crop productivity may varied due to variation in resources availability and the different cultivation practices followed by farmers. It is evident from the Table-6. Highest increase in productivity was observed in Soybean crop (66.67%) followed by Sesame (40.00%), Urd (25.00%) and Paddy (20.00%) in kharif season. Whereas, significant highest crop productivity was recorded in Mustard (40.00%) which was followed by Gram (25.00%), and wheat (22.22%) in rabi season. High yielding varieties, recommended doses of fertilizers, timely irrigation and use of recommended plant protection measures may be the possible reasons of such results (Jat *et al.,* 2008; Singh, et al., 2009; Dev *et al.,* 2017). Whereas, Mondal *et al.* (2012) concluded that the favorable changes in various bio-physical indicators/ indices like irrigation status, cropping pattern and cropping intensity which ultimately resulted in higher crop productivity from their study on decomposition of productivity growth in watersheds in Bundelkhand region of Madhya Pradesh, India..

Conclusion

The overall watershed management practices in the study area have positive and effective changes on agricultural area, crop productivity, land use, use of land resources, water resources, and livestock due to increase in availability of water in the study area. Positive change was also found in agricultural land (61.22%), irrigated area (333.33%), cropping intensity (107.69%), area under horticultural and vegetables crops. Similarly cattle population was also increased due to sufficient availability of water and fodder in watershed area. The results of the study suggested that appropriate steps needed to be taken by the farmers for rational use of cultivated land, wasteland, forests and other common property resources. The co-ordination of farmers and government functionaries, land development activities were some of the measures for improving the Micro Watershed Dari. Better co-ordination between development agencies and voluntary organizations is also essential for effective implementation of watershed development programme.

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