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Impact of Watershed Treatment on Land use pattern, Cropping intensity, Yield and Economic Parameters of farmers in Garnalakotra watershed of Udaipur district

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ABSTRACT
The study was conducted in GarnalaKotra watershed of Udaipur district of Rajasthan state. For the impact study of watershed treatment on developmental parameters, socio economic analysis was done. IGWDP has been implemented in district since 2009 with its integrated soil and water conservation (SWC) measures. The project almost completed in the period of five years. Therefore, the project needs to be evaluated for its impact on developmental parameters. The impact was determined by the changes in parameters such as land use patterns, cropping intensity, irrigation potentiality, employment generation, yield and economic parameters of area before and after watershed development programm. In the study change in land use pattern, cropping intensity and yield are key factors to study impact of watershed treatment. After critical analysis it was found that arable area increased by 16.5% and irrigated area was increased by 63% due implementation of watershed programme. Similarly cropping intensity increased from 117% to 143%. Change in production and productivity was also observed due to implementation of watershed programme and there was also remarkable increase in income. Knowledge and adaption of soil and water conservation measures played important role in increase of yield, cropping intensity and income of farmers which shows positive impact of watershed of treatment.
Keyword: *Cropping intensity; Employment; Irrigation potentiality; Land use pattern; Productivity; Socio-economic analysis*

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INTRODUCTION

Udaipur district is situated between $23^0$46' and $25^0$05' north latitude and $73^0$09' and $74^0$35' east longitude. It is located in the south eastern part of Rajasthan and lies in Aravali ranges. The district is having 11630.66 km^2 area surrounded by hills out of which 4, 05,327 ha is under forest, 5,01,641 ha is under cultivation and 2, 56, 098 ha is not used for cultivation due to excessive slope and other factors (Source:- Central Ground Water Board, Ministry of Water Resources, Government of India).

Almost entire district is facing problem of ground water scarcity. However, there are some areas vulnerable for pollution and depleted water table. The study area is one of the backward parts of the district. Major issues of concern in the study area are as follows:

- Land Resources are not developed properly thus do not produce biomass to its utmost capacity (food & fodder).
- Large quantity of water flows out of the region without any productive use.
- Even after having good rainfall and high runoff received from upper reaches of irrigation coverage is limited
- Due to lack of proper technological interventions people have to bear high input cost.
- Farmers have limited knowledge/skill of agriculture –Animal Husbandry nutrient cycle (Nutrient cycle is related with human-animal-land). For food grains and vegetables human beings are dependent on land as well as animals for fodder and again the human and animal excreta is used as manure in the land which produces grains, vegetables and fodder.)

- Higher dependency on cultivation leading to limited work opportunities beyond monsoon period.
- Limited employment opportunity leading to high incidences of migration and intern community is getting fragmented

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MATERIALS AND METHODS

IGWDP has been implemented in GaranalaKotra since 2009 with its integrated soil and water conservation measures. This project almost completed the period of five years. Therefore, the project needs to be evaluated for its impact on developmental parameters. The impact was determined by the change in parameters such as land use pattern, cropping pattern, yield and economic parameters of area before and after watershed development programm. Base year for the study was 2009 and study year was 2017-2018.

For the assessment of impact of watershed treatment on developmental parameters, socio economic analysis was done. Socio-economic condition of the farmers prior to the treatment was taken from project report of the watershed and; interviews with the farmers were conducted for the present condition. Out of the total beneficiaries (553) in GarnalaKotra watershed, 150 were selected randomly with the view that these will give true representation of the area. The farmers were selected on the basis of their land holding viz, less than 1 ha, 1-2 ha, 2-4 ha and more than 4 ha. A proforma was developed and farmers were interviewed as per information required in the proforma. Finally, the impact of watershed treatment were studied in relation to resource development and income.

Proforma for Socio-Economic Survey:

1. Name of watershed _____
2. Name of village _____ Tehsil _____
3. Name of farmer _____ father's name _____
4. Details about family members:
   Name Age Sex Education Occupation
5. Details about land holding:
   Cultivated land :
   Irrigated land :
   Unirrigated land :
   Pasture/ bare land :
6. Details about animals :
   Type of Animal no. Age Bread Average Milk Production
   Source of fodder for animals:
7. Annual total earnings :
   Agriculture :
   Any other :
8. Details of farm assets ;
   (a) Irrigation structures and equipment's:
   (b) Implements and machineries:
9. Irrigation facilities available and area under irrigation:
   Source Area irrigated Lifting Device Method of irrigation
10. Crop enterprises: kharif and Rabi season.
    Cropping pattern, input used Output with its disposal
    i. Name of crop;
    ii. Area(ha);
    iii. Variety used:
    iv. Irrigation source:
    v. Average yield:
    vi. Any other information
11. Management of pasture land:
    Grazing area available:
    Condition of area:
    Available grass species:
12. Status of soil conservation measures:
13. Any other information:

RESULTS AND DISCUSSION

Socio-economic analysis

Study revealed that before the implementation of the project the watershed suffered from low productivity leading to low farm income and consequently poor investment capacity of the farmers. Off farm activities consist of animal husbandry where outputs are mainly related to production levels in agriculture. The associated problems were moisture stress faced by the crops due to erratic behaviour of rainfall, declining productivity trend, soil erosion due to uncontrolled runoff, poor vegetative cover on non-arable lands and inadequacy of drainage line during high intensity rainfall and lack of alternative employment opportunities.

Status of farm families

The total numbers of farm families are 553 and average size of family was 5-6 members. The literacy per cent in the watershed was about 51. The distribution of land holding is as follows:

Size group	No. of farmers	Percentage
Land less	26	4.70
Marginal holdings(0-1 ha)	491	88.79
Small holdings(1-2 ha)	28	5.06
Medium holdings(2-3 ha)	7	1.27
Large holdings(above 4 ha)	1	0.18
Total	**553**	**100**

The farmers of the area are progressive and inclined to adopt improved technologies.

Change in land use pattern as affected by watershed programme

After the evaluation of the project it was seen that there is a phenomenal change in the Arable and Silvi-Pasture land of the watershed. The arable land was 356.09 ha out of 921 ha total land of the watershed in the base year has been increased up to 415.19 ha The Silvi-Pasture land was 168 ha out of 921 ha total land of the watershed in the base year has been increased up to 381.41 ha and additional area of 29 ha had been brought under irrigation. The details of change in land use patterns are given in Table 1.

Table 1: Change in land use patterns before and after the project

S.NO.	Particulars	Before the Project (ha)	After the Project (ha)	(%) Change in Area
1.	Arable Land	356.09	415.19	16.60%
2.	Irrigated Area	46	75	63%
3.	Non-Arable Land	564.91	505.81	-10.46%
	Private Waste Land	114.35	12.3	-89.24%
	Govt. Waste Land	227.6	57.14	-74.89%
	Horti-Pasture	168	381.41	127.03%
4.	Other	54.96	54.96	-
Total		**921**	**921**	**-**

Cropped area and cropping intensity

With the implementation of soil and water conservation measures, increased irrigation facilities and use of improved techniques, a major area has been brought under cultivation both in kharif as well as in rabi season. The cropping intensity which was 117.8 per cent in the base year has increased to 143.7 per cent in the study year. It has been found that the area under wheat, maize, Gram and vegetable has increased. Due to increase in irrigation facilities, there is a significant change in cropped area of wheat in rabi season and maize in kharif season.Due to the availability of irrigation water in the open wells and soil moisture some new vegetable crops were introduced in the watershed area in summer season also. The details are given in Table 2.

Productivity status

Due to the effect of soil and water conservation measures, CVH in particular and use of improved seeds, fertilizers the crop yields have been increased. The productivity increased by a maximum of 160 per cent in the black gram crop and minimum of 12.9 per cent in Paddy. The productivity status of wheat, maize and jowar showed an increase of 24.7, 44.9 and 14.2 per cent respectively. This is on account of levelling of the plots and increased moisture status after construction of CVH in the cultivated area. The details of productivity status are given in Table 3.

Table 2: Area under different crops and cropping intensity before and after the implementation of the project

S.NO.	Crop	Before the Project (ha)	After the Project (ha)	(%) Change in Area
1.	Kharif			
	Maize	200	249	24.5
	Jowar	144.5	168.5	16.6
	Paddy	3.5	3.5	0
	Black Gram	8	15	87.5
2.	Rabi			
	Wheat	45.80	74	61.5
	Gram	13	50.5	225
	Mustard	3.20	15	368
	Jow	1.50	6.50	333
3.	Summer			
	Vegetable	-	5	-
	Green Gram	-	10	-
	Total	419.5	597	-
	Cropping Intensity	**117.8%**	**143.7%**	**-**

Table 3: Productivity status of different crops

S.NO.	Crop	Yield Before the Project (q/ha)	Yield After the Project (q/ha)	(%) Change in Yield
1.	**Kharif**			
	Maize	7.38	10.7	44.9
	Jowar	3.50	4	14.2
	Paddy	9.30	10.5	12.9
	Black Gram	2	5.20	160
2.	**Rabi**			
	Wheat	18.6	23.20	24.7
	Gram	7.50	9.7	29.3
	Mustard	6.20	12.5	101
	Jow	15.50	21.70	40
3.	**Summer**			
	Vegetable	-	20	-
	Green Gram	-	7.2	-

Additional farm income

After detailed analysis it is revealed that total additional income works out as 3630247 rupees which are average additional income in the watershed area. Average additional income per hectare in the area was Rs.6080 which highlights the direct benefits of soil and water conservation works. The maximum return is from maize followed by wheat and gram. The details are given in Table 4.

Table 4: Increase in the agricultural income after implementation of project in GarnalaKotra watershed

S.NO.	Crop	Yield Increased (q/ha)	Value of Additional Income (Rs.)
1.	Kharif		
	Maize	3.32	1364022
	Jowar	0.5	143225
	Paddy	1.2	6510
	Black Gram	3.2	249600
2.	Rabi		
	Wheat	4.6	519110
	Gram	2.2	424957.5
	Mustard	6.3	378000
	Jow	6.2	56823
3.	Summer		
	Vegetable	20	200000
	Green gram	7.2	288000
Total			**3630247**

Source (Rate):- https://dbie.rbi.org.in/DBIE/dbie.rbi?site=statistics

Total additional income = Rs.3630247

Additional income = Rs. 6080/ha

Irrigation potentiality

The number of open wells in the watershed increased from 42 in the base year to 67 in the study year. Further, on interviewing the farmers it was revealed that 7 wells which were dry before the start of the project are now having the adequate quantity of water because of recharging and deepening both and now these wells are used for irrigation. Before the implementation of watershed programme the average water table depth was about 10-11 m which during a course of 8 years has risen to about 8-9 m due to increased ground water recharge. At the beginning of the project the availability of water in the wells was only for 6 months and in the hand pumps up to the march but after the implementation of project water is available for the whole year in the wells of the watershed area as well as in the hand pumps of the area. Thus the change of ground water recharge has brought the prosperity among the farmers.

Employment generation and occupational structure

The project had provided tremendous employment opportunities to the local people. Considerable labour was employed during the execution of soil and water conservation works viz. contour vegetative hedges, contour furrows, and staggered trenches etc. during 2009-10 to 2010-11. Further, the increased gross cultivated area and cropping intensity has also provided considerable employment opportunities. Before the commencement of the project 30 per cent farmers were engaged in agriculture which has risen to 45 per cent. Agriculture plus dairy has shown an increase from 20 to 30 per cent due to increased and secured fodder production from non-arable lands. Agriculture plus casual labour has shown a decreasing attitude of farmers towards it which shows a reduction from 45 to 30 per cent. This reduction takes place only due to employment opportunities in the agriculture sector. Numbers of agricultural labours migrating to town/ cities have shown a decreasing trend from 8 to 4 per cent due to employment opportunities generated by the implementation of the project.

Table 5: Occupational changes in farm families

Occupation	Per cent of sampled family adopting the particular occupation	
	Before project	After project
Agriculture	30	45
Agriculture + Dairy	20	30
Agriculture+ Casual labours	45	30
No. of agricultural labours migrating to towns/cities	8	04

CONCLUSIONS

The analysis of socio-economic survey revealed that the farmers have been benefited in all respect, like increase in cropping intensity, arable land, irrigation potentiality, productivity status, additional income and employment generation.

1. Most of the farmers of the study area were financially poor. About 49 per cent farmers are illiterate. Although the land holding of most of the farmers is scattered and small yet the watershed management programme enhanced the farm income of the farmers of the watershed area.
2. Before the implementation of the project the local people were migrating to the cities to earn money but after some years of the project due to increased water level in the wells and soil moisture they started the farming at their farm and earning money.
3. Almost all the farmers were benefitted in terms of increased crop yield due to watershed management practices in the study area but the big and literate farmers were benefitted more than those of small farmers.
4. Cropping intensity has increased from 117 per cent in the base year to 143 per cent in the study year due to implementation of soil and water conservation measures.
5. Occupational change has also taken place in the watershed. About 15 per cent of the farmers shifted to agriculture and an additional 10 per cent of the farmers shifted to agriculture plus dairy.
6. Wells located within the watershed area were found to have higher recuperation rate in comparison to the wells located outside the watershed area.

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