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Evaluating Socio-economic Impacts for Micro Watersheds of Sabarkantha and Aravalli Districts of Gujarat, India

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Abstract:- Soil and water conservations practices are vital for the agriculture economy and financial sustainability in rainfed areas. Therefore, an integrated watershed development program is necessary to achievedifferent goals in rural agriculture. Integrated watershed development is recognized as an effective model for watershedplanning. A watershed is considered the basic hydro-geographical unit for area development by integrating various biophysical, agricultural, social, economic, and policy-making factors with the modern era. The present study was conducted to evaluate the impacts of the watershed developmentprograms on the social and economic aspects in themicro-watershedsof Sabarkantha and Aravalli districts, Gujarat,India, considering various social and economic parameters like increase in livestock, reduction in migration, employment, saving and expenditure capacity. The economic evaluation of the projects is carried out using netpresent value (NPV) and benefit-cost ratio (BCR) methods.A structured questionnaire was used on 2 selected micro watersheds, and data were collected by personal interviews, group discussions from selected households, and joint field observations in watersheds.This study recognized that the projects had positive effects that strengthened the socio-economic characteristics of the landowners and landless families. The soil and water conservationpractices have increased the income through livestock, reduction in migration, employment, saving, and expenditure capacity.

Keywords:- *Soil and water conservation, watershed development, socio-economic impacts, watershed economy, watershed conservation practices.*

I. INTRODUCTION

The rain-fed areas are hotspots for poverty, malnutrition, food insecurity, severel and degradation, water insecurity, and poor social and institutional infrastructure (Rockström et al., 2004):(Singh et al., 2014). Therefore, the watershed development program is considered an effective solution for many of these problems. In India, the watershed program was designed to conserve water, soil, forests, and pasturelands harmonizingly(Palanisami & Kumar, 2009). It is a multidimensional approach to augment agricultural income by increasing crop productivity yield and creating employment by altering cropping patterns. The water shed development project also aimed to improve the stakeholders' involvement by developing community-based institutions. These institutions develop community interaction and encourage activities in the groups. In their study, (Kumar et al., 2014)noted that identifying the linkage between the biophysical and social factors influences the program's success. The major problems encountered in the study area before implementation of watershed projects were soil erosion, low rainfall causing frequent draughts, excessive run-off downstream resulting in low crop production and productivity, lack of irrigation facilities, etc. Themajor development programs initiated in Sabarkantha and Aravalli districts include Drought-Prone Area Development Programme (DPAP), Integrated Wasteland Development Project (IWDP), Hariyali Project, and National Bank for Agriculture and Rural Development (NABARD) Watershed Programmes. These programshave increased the crop productivity in degraded areas through the soil and water conservation practices, including the construction of contour bunds, farm bunds, field bunds, contour trenches, deep ploughing, minimum and zero tillage, composting, various irrigation practices, levelling, and smoothening, construction of check dams, farm ponds, gully plugs, nalla plugs, pits excavation, etc. (Datta, 2015) noted that for capturing the impacts of water shed development on activities that preclude the employment of a large number of specialists equipped with sophisticated instruments to measure hydrological and various environmental and ecological parameters, it is pretty justified to estimate the changes in terms of well-defined and easily measurable indicators such as cropping intensity, crop diversity, agricultural income, and costs of cultivation. Assessing the social impacts of a watershed project requires the measurement of defined social consequence indicators before the project implementation and conditional on the same hands after the performance of a project. Most of the villagers of these areas have agriculture as their primary occupation. The traditional agricultural practices mainly depended on monsoon rains occurring between June and September months. (Mishra & Saxena, 2009) indicated that economic value is complemented by descriptive non-monetary changes. Wherever possible, the impacts are valued in monetary terms as to costs (of intervention) and benefits (of outcomes). A negative externality is considered a cost and a positive externality is considered a benefit. An impact that cannot be monetized has been considered as a non-economic benefit/cost and included in the report in descriptive terms. (Palanisami & Kumar, 2009) indicated that the reasons for the successful implementation of watershed development activities in the country include physical and agro-climatic conditions of the watershed villages like rainfall, soil type, and hydro-geological features. In addition, some of the administrative and

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institutional issues such as guidelines for effective watershed development, the role of different organizations like the state and central governments, line departments, and type of Project Implementing Agencies (PIAs), play crucial roles in implementing watershed development activities. With this background, the present study was undertaken to assess the project's impacts on social and economic aspects by comparing the before and after watershed project implementation scenarios. With this in view, the study was conducted to determine the effects of watershed development programs on increased irrigated areas, income, employment generation, yields, and recommended watershed technologies.

II. STUDY AREA AND METHOD

A. Study Area

The present study was conducted at two micro watershed development projects of Gujarat state's sabarkantha and Aravalli districts as shown in Figure 1. Out of two watershed projects, Valunaand Molli watersheds have been implemented under IWDP and DPAP, respectively. Both the schemes were launched by the Department of Land Resources, Ministry of Rural Development, Government of India. The latitudinal and longitudinal extent of the basin is between 23.5138°N & 72.7361°E.Respectively. The maximum temperature of the study area ranged between 40^0C to 42^0C and minimum temperature ranges between 9 ^{0}C to11^0C and mean relative humidity was approximately 49.6 percent. The average rainfall of the study area was 731 mm.As the area comes under a semi-arid region, scarcity of water for agricultural processes is a severe problem, and the site frequently suffers from drought circumstances. The part is commonly affected by a high erosion rate due to high gradients during the rainy season. Apart from this, shallow and poor soils, lack of fertility, and scrappy land reduce land productivity. The soil texture of this region is loamy silt to light sandy loam, lacking phosphorus and nitrogen, neutral to alkaline in reaction (pH 6.5–7.5), and responsive to zinc and potassium.

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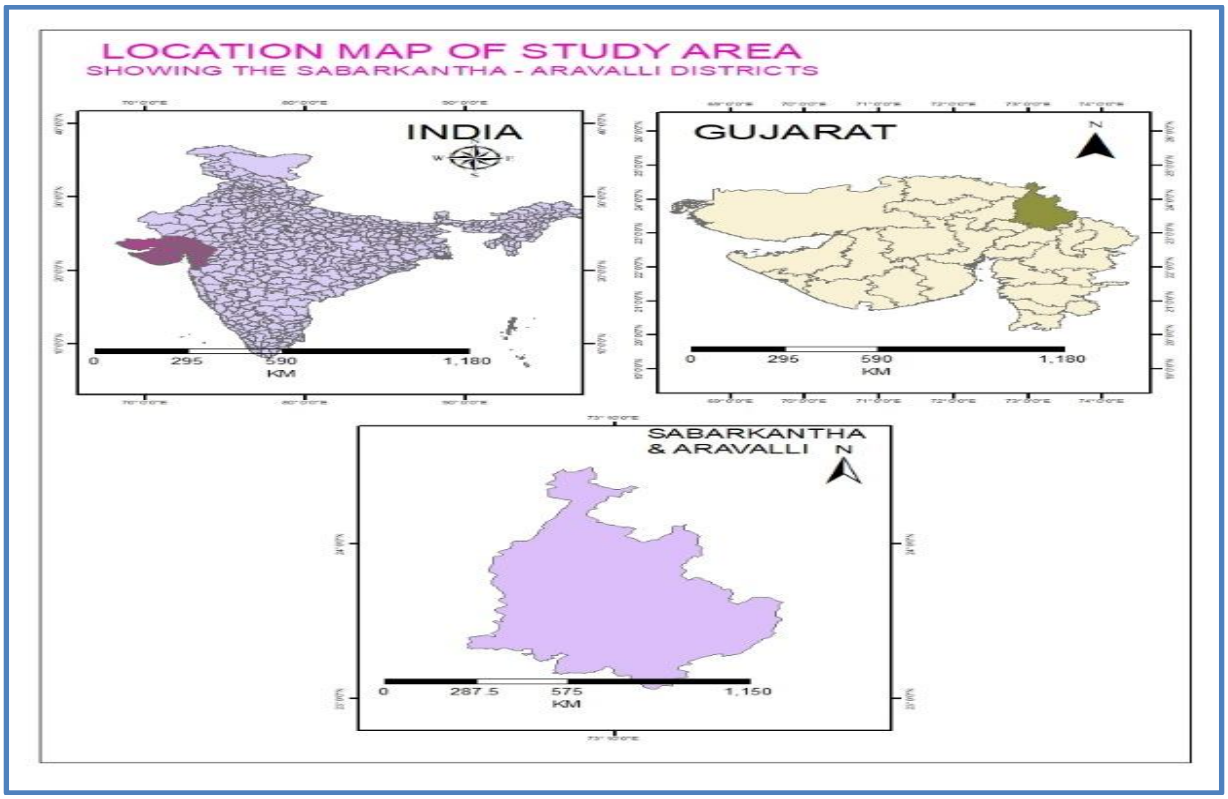

Fig. 1: Map showing Study area (Sabarkantha & Aravalli Districts of Gujarat, India)

B. Study Method

Pre-post factor research design with before-after analysis was followed for the study. The study was carried out in Valunaand Molli watersheds implemented under IWDP and DPAP, respectively, and launched by the Department of Land Resources, Ministry of Rural Development, Government of India. The study area districts come under a scarce rainfall zone with the lowest rainfall of 740 mm per annum and possess the highest area covered under soil and moisture conservation measures. In the present study, the social impacts like changes in livestock, milk production, migration, migratory expenses and labor period, employment, saving and expenditure capacity, other economical impacts like NPV, BCR, etc. were assessed by taking into consideration the difference in their means before and after the implementation of the watershed program. Table 1 shows the details of watershed projects covered in the study area. Table 2 shows the characteristics of sample households in the Valuna and Molli watersheds.

Data used to evaluate social and economic parameters in this study were obtained from a well-structured questionnaire followed by personal interviews, group discussions, and joint field visits within the selected watershed areas. Data from the pre-and post-project period were collected through a preliminary survey of available records of the selected beneficiary households.Opinion data were used for analysis wherever ready physical values were not available for reference. Different socio-economic parameters were calculated for before and after watershed scenarios in the study area. In the present study, the data and analysis for before implementation scenario and after implementation scenario are represented as 'before practices' and 'after practices,' respectively. The numbers of sampled households per village were proportionate to the expected size of that village and identified faliya wise so that all the faliyas can be covered for proper representation of watershed area information.

Name of Block	Name of Watershed	Name of Watershed scheme	Area (Ha.)
Meghraj	Valuna	IWDP*	503
Malpur	Molli	DPAP**	500

Table 1: Details of Watersheds covered in the study area

*IWDP – Integrated Wasteland Development Programme
**DPAP – Drought Prone Area Development Programme

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Particulars	Valuna watershed	Molli watershed
Farm size (Ha.)	0.71	1.17
Household size	4.07	4.43
Average land costing	250000	241500
(Rs./Ha.)	37300	35400
Average HH income	157	132
(Rs./year)	4	3
No. of wells/borewells	47.67	52.63
No. of persons in HH	648	594
Literacy rate(%)		
Livestock (No.)		

Table 2: Characteristics of sample households in watershed villages

III. RESULTS AND DISCUSSION

A. *Livestock Population, Milk Production and Income due to Milk Production*

Livestock population, milk production, and income due to milk production have improved after implementing the watershed program in the watersheds, as indicated in Table 3. The total livestock population per household increased from 1.71 to 4.29 in the Valuna watershed and from 1.57 to 2.43 in the Molli watershed. Due to the increase in livestock population, the milk production and income due to milk production have also increased. The milk production has increased from 1.29 to 25.71 in the Valuna watershed and from 9.43 to 14.57 in the Molli watershed. This leads the income also due to milk production from 1.09 lacs to 3.47 lacs in Valuna watershed and from 1.00 lacs to 1.97 lacs in Molli watershed. There is a tremendous change in the Valuna watershed in livestock- milk production linkages. The population of goats, sheep, buffaloes, and cows and their milk production with leading income due to milk production have increasedtremendously on all farms. The increase in the livestock population was much higher on smallholdings. This indicated that the watershed has helped in livestock and milk production and hence the household income.

Livestock Impacts per HH	Valuna Watershed				Molli Watershed			
	Before Practices	After Practices	Change	Change (%)	Before Practices	After Practices	Change	Change (%)
Livestock No.	1.71	4.29	2.57	150.00	1.57	2.43	0.86	54.55
Milk Production (Lit. per day)	10.29	25.71	15.43	150.00	9.43	14.57	5.14	54.55
Income due to Milk Production (Lacs)	1.09	3.47	2.38	219.48	1.00	1.97	0.97	97.50

Table 3: Change in Livestock, Milk production and Income due to Milk Production

B. *Migration, Migratory Expenses, and Migratory Labour Period*

Migration, migratory expenses, and labor period due to migration have improved after implementing the village's watershed program, as indicated in Table 4. The number of persons migrating per household for the search of employment decreased from 2.29 to 0.43 in the Valuna watershed and from 2.43 to 1.14 in the Molli watershed. Due to the decrease in migrating population, the migratory expenses and migratory labour period have also decreased. The migratory expenses per person havedecreased from 0.28 lacs to 0.04lacs in the Valuna watershed and from 0.29 lacs to 0.10 lacs in the Molli watershed. Due to the reduction in migration, the migratory labour period has also decreased from 553 hours to 78.86 hours in the Valuna watershed and from 583.29 hours to 206.86 hours in the Molli watershed. It seems that there is a tremendous reduction in migratory labour period as 85.74% in the Valuna watershed and 64.54% in the Molli watershed. After the implementation of watershed projects, the agricultural productivity is enhanced and soil and water conservation practices have impacted at a very high rate to the watershed agricultural practices and land use. This has led to the requirement of labour and manpower and villagers have been getting a wide opportunity to work at a local village. With compared to the Molli watershed, the Valuna watershed has a larger impact on persons migrating for employment as per the values shown in Table 4.

Migration Impacts	Valuna Watershed				Molli Watershed			
	Before Practices	After Practices	Change	Change (%)	Before Practices	After Practices	Change	Change (%)
No. of Persons Migrating	2.29	0.43	-1.86	-81.25	2.43	1.14	-1.29	-52.94
Yearly Migratory Expenses (Lacs per person)	0.28	0.04	-0.24	-85.74	0.29	0.10	-0.19	-64.54
Yearly Migratory Labour Period (hours)	553.00	78.86	-474.14	-85.74	583.29	206.86	-376.43	-64.54

Table 4: Change in Migration, Migratory Expenses and Migratory Labour Period

C. Employment, Expenditure and Saving capacity

Employment and the capacity for saving and expenditure for necessary lifestyle have improved after implementation of the watershed program in the villages, as indicated in Table 5. The employment (in mandays) has increased from 19404 to 27126 in the Valuna watershed and from 14896 to 16264 in the Molli watershed. Due to the increase in employment, the yearly expenditure capacity has increased from 36.14 lacs to 57.82lacs in the Valuna watershed and from 27.14 lacs to 39.95 lacs in the Molli watershed. Due to the increase in employment, the yearly saving capacity has increased from 21.68 lacs to 46.98lacs in the Valuna watershed and from 16.64 lacs to 23.30 lacs in the Molli watershed. After implementation of watershed projects, soil and water conservation practices have impacted at a very high rate to the watershed agricultural practices and land use leading to the requirement of labour and manpower with a wide opportunity to work at a local village. With compared to the Molli watershed, the Valuna watershed has a larger impact on employment and capacity of saving and expenditure as per the values shown in Table 5.

Employment, Expenditure & Saving capacity Impacts	Valuna Watershed				Molli Watershed			
	Before Practices	After Practices	Change	Change (%)	Before Practices	After Practices	Change	Change (%)
Employment (Mandays)	19404.00	27126.00	7722.00	39.80	14896.00	16264.00	1368.00	9.18
Yearly Expenditure (Rs. In lacs)	36.14	57.82	21.68	60.00	27.74	39.95	12.21	44.00
Yearly Saving (Rs. In lacs)	21.68	46.98	25.29	116.67	16.64	23.30	6.66	40.00

Table 5: Change in Employment, Expenditure, and Saving

D. Economic Impacts of Watershed Development Projects

The yearly income has been calculated as 4.57 lacs and 3.98 lacs per household in the Valuna watershed and Molli watershed respectively. The total cost of the project incurred for the implementation of watershed programs for various expense heads like physical structures, entry point activities, training and capacity building, administrative expenses, etc. is 19.42 lacs and 17.68 lacs in Valuna and Molli watersheds respectively. Total annual income has been calculated as 904.49 lacs and 605.20 lacs in both watersheds as per Table 6. Net present value has been calculated as 4165.07 and 2570.34 in Valuna and Molli watersheds respectively with a 10% discount rate. The present value of cost has also been calculated as 815.64 and 742.56 for Valuna and Molli watersheds with a discount rate of 10%. The benefit-cost ratio (BCR) comes as 5.11 for the Valuna watershed and 3.46 for the Molli watershed. With compared to the Molli watershed, the Valuna watershed has a larger impact on economical parameters like NPV, BCR, etc.as mentioned in Table 6.

Economic Impacts	Valuna Watershed	Molli Watershed
Yearly Income (Rs.In lacs) per HH*	4.57	3.98
Cost of Project (Rs. In lacs)	19.42	17.68
Total Annual Income (Rs. In lacs)	904.49	605.20
Net Present Value	4165.07	2570.34
Present Value of Cost	815.64	742.56
Benefit-Cost Ratio	5.11	3.46

* HH: Household

Table 6: Economic Impacts of Watershed Development Projects

IV. CONCLUSION

This study presents an evaluation of the impacts of the micro-watershed development project onthe performance of watershed management programsonthe socio-economic conditions of the RTValuna and Molli watersheds. The positive improvements were in the perceptions of socio-economic conditions as found by calculating various socioeconomic parameters from the data collected on before- after project implementation approach. Significant improvements have been observed in employment opportunities, wages of workers, and percapita income has been observed, thereby reducing poverty and out-migration forwork, improving living standards, and boosting the social status of local residents.Due to the improvement in the level of education, awareness, skills, and earning capacity,women had started to work in SHGs/NGOs/local institutions and activelyparticipate invillage development and decision-making activities. Therefore, their status in societyhad improved.The number of livestock had increased due to fodder andwater availability for livestock. Milk production has also increased due to the increase in livestock. A substantial decline in run-off and soil erosion had been perceived by respondents as aresult of the construction of water harvesting structures, bench terracing, land smoothening,gully reclamation, increased vegetal cover, and grazing lands. As Valuna and Molli watersheds are from IWDP and DPAP implementation schemes, implementation guidelines also played a crucial role in the impacts of watershed development on the socio-economic status of both watersheds. As per the guidelines of IWDP and DPAP, the implementation criteria, release of the fund, involvement of stakeholders and local community, role of PIA, etc. factors have impacted the social and economical growth in both watersheds. The criteria are much more simplified in the IWDP scheme than the DPAP scheme according to the results obtained from this study, with a high impact rate in the Valuna watershed.

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