The Journal of Rural and Agricultural Research Vol. 20 No. 2, 65-70 (2020)
Received September 2020; Acceptance November 2020

Economic Evaluation of Watershed Development in the Himalayan State of Uttarakhand

SUBHASH CHANDRA
Asstt. Professor, Agricultural Economics, Balwant Vidyapeeth Rural Institute, Bichpuri, Agra, U.P.
Corresponding author:dr_subhash78@rediffmail.com

Abstract

The economic evaluation of watershed development in the Himalayan state of Uttarakhand has been evaluated in a 'pre' and 'post' framework. This study used primary data from randomly selected 75 farm families and secondary data from different sources. Descriptive data analysis method was used. Overall, the watershed development programmes increased agricultural land, productivity and cropping intensity in all cropping seasons. The watershed development programme increased the number of technology users and household income in all categories of farmers. Majority of them had expressed "lack of subsidized rate input supply", as one of the major constraint followed by others. Frequent visits of the extension worker and expansion of agriculture infrastructure should be encouraged to help increase benefit from watershed development.

Key words*:* - Socio-economic**,** Watershed, Hill Area, Uttarakhand

Introduction

The Himalayan massif is a relatively young and geo-morphologically unstable region. It is a major contributor of run-off and sediment in the principal rivers of South Asia. Constitutional wisdom holds that widespread deforestation and population pressure have exacerbated erosion and led to increased downstream flood hazards (Datta and Virgo, 1998).Soil and water are two most important resources that need to be conserved and utilized efficiently to increase agricultural production. To archive this, watershed development programme has been started in many region of the India. A watershed can be described as a biophysical, socio-economic and often a community unit for the purpose of planning and development. Mountain eco-system are however characterized as source for ground and surface water, rich in bio-diversity. Therefore, conservation of natural resources in the mountain areas is an issue of utmost concern for sustainable development and improving livelihood securities. The watershed management programmes were initiated in India over 40 years ago, initially with a focus on drought prone areas. In the past several useful studies have been concluded to assess the socio-economic impact of watersheds programme Dhyani et al 1993; Farrington Lobo1997; Marothia,1997; Samra,1997;Deshpande and Thimmaiah,1999; Kerr et al 2000; Rao H 2000;Joshi et al 2004; Babu, et al 2004; Chandra et al 2016). These evaluation studies provided useful insights on the performance of various watersheds and examine the condition for the success across different regions. Kuriyagad micro-watershed is one of the watershed management programme initiated in the study area.

Kuriyagad micro-watershed is established and managed over 600 ha area. It lies between $79^{0}32'$ longitude and $29^{0}18'$latitude. The activities done for its development were undertaken by the State Department of Agriculture under National Wasteland Development Programme for Rrainfed Areas (NWDPRA). Micro Watershed Progrmme (MWS) area gets annual rain with varying months of start and the volume and intensity is decreasing from time to time and not sufficient for rainfed agriculture in the area. In the study area the decrease in volume and frequency in monsoon season from time to time has impact on agricultural production. Therefore this study is designed to evaluate the Socio-economic impact of watershed development in Uttarakhand.

Importance of watershed development in the region

The Uttarakhand is very rich in natural resources

especially forest and water, as it has more than 12000 glaciers, dense forest mountain peaks and network of 8 major rivers catchment act as the lifeline for the entire hydrological system of Indo-Gangetic plain (Watershed Management Directorate, 2015) . The hilly parts of the state have several typical features such as undulating topography, steep slopes, poor accessibility, heavy run-off, light textured poorly fertile soils, marginality, high risk low pay off agricultural production system, and poor economic conditions of the farmers etc. At the same time, mountain system is highly energized, dynamic and extremely vulnerable to unscientific land use changes. Therefore, conservation of natural resources in the mountain areas is an issue of utmost concern for sustainable development and improving livelihood securities. Due to the undulating topographic features the major part of the precipitation received through rains rushes down to 'Bhabhar' and 'Tarai' region of the state and other plains often creating the flood situation.

Agriculture and allied enterprises are the mainstays of the people of Uttrakhand. About 14 per cent of the area is under cultivation and of this only 10.7 per cent is irrigated. In hilly region, the agriculture has been at subsistence level and thus increasing population, both of human and animal, exerting excessive pressure on the natural resources. Indiscriminate exploitation of these valuable resources has turned the ecological situation unfavorable and unbalanced.The productivity of the crops particularly in hilly terrains is quite low. The available produce from the farms is just sufficient to cater the need of the farmers for 6-10 months. Therefore, to arrest the declining resources, boosting the crop productivity and uplifting the socio-economic conditions of the farmers, the only way to achieve these objectives is to adopt a development programme in a watershed[1] mode for sustainability of the ecosystem.

Evolution of watershed program in Uttarakhand

The concept of watershed management in the region was evolved after the occurrence of dreadful flood in August, 1978 in Northern India. The Government of India appointed a working group to formulate an action plan for flood control in Indo-Gangetic basin. The Central Working Group (CWG) submitted its report to the Government of India in 1979. As per the recommendations of Working Group, the Government of India decided to take-up plan for treatment of the catchments of various rivers and their tributaries. In November 1981, the forest department of the erstwhile Uttar Pradesh formulated an overall development plan for treating this region. It was decided to get the work done on the basis of the watershed areas through a 'Multi-disciplinary Force' on the basis of micro-watershed approach. It led to establishment of separate WMD at state level in 1981 to carry out the work under the principles to check the obscure problems. Subsequently watershed management projects were undertaken in the Himalayan region of Uttar Pradesh (presently Uttarakhand) w.e.f. 1982-83 with financial assistance of World Bank and European Union. An approach to watershed development in the region was evolved through I to V generation projects (Table 1).

Besides above watershed development programs funded by external agencies, various programs funded by the central government were also undertaken in the state. From the information available with WMD, it is envisaged that in Uttarakhand various projects under IWDP, DPAP, NWDPRA and River Valley programs are in vogue since the inception of state.In the backdrop of above discussion it is imperative to assess the impact of such a holistic approach for area development in the state.

Methodology

The study is based on the data collected under the study 'Comprehensive Assessment of Watershed Programme in India: Case Study of Watershed

Table 1: Evolution of watershed development in the region Uttarakhand

Projects	Year	Aided by
First Generation	1982-1988	European Union: South Bhagirathi Phase-I, World Bank: Himalayan IWMP
Second Generation	1988-1992	European Union: South Bhagirathi Phase-II
Third Generation	1993-2005	European Union: Doon Valley Project, World Bank: IWDP Shivalik Hills-II
Fourth Generation	2004-2011	World Bank: Uttarakhand Decentralized Watershed Development Project (GRAMYA)
Fifth Generation	2014-2021	World Bank: Uttarakhand Decentralized Watershed Development Project (GRAMYA II)

Source: Data compiled from various sources, including from the WMD site, Uttarakhand

Programme in Uttarakhand'.The watershed programme in Uttrakhand , Kuriyagad I in Bhimtal Block of Nainital district was selected considering the budget utilization and size of the project for assessing its socio-economic impact. The watershed development unit is a part of the NWDPRA. The study used quantitative and qualitative information collected through pre-tested schedule on various socio-economic indicators and production aspect in two situations viz. pre and post-project from various sources and participants. In order to draw sample out of 6 villages 75 farmer-respondents (about 10 percent of total beneficiaries) were selected at randomly. The selected farmer-respondents on the basis of their holdings were categorized in three size groups viz. Small (<0.40 ha), Medium (0.40-1 ha) and Large (> 1 ha). Descriptive data analysis method was used. The Secondary data were collected from PIA/DRDA and other related agencies in the district.

Results and Discussion

Family structure of sample farms

The average family size did not vary much among different categories of farmers' ranging from 5.74 persons per family in case of marginal to 6.71persons per family in case of large farmers. The average family size was 5.90 persons per family. The percentage of male members was more than females, irrespective of farmer type. The percentage of children was the maximum (15.38%) in marginal size of farms. It decreased in the order of 15.38 in marginal size group and 11.70% in large size group of farms (Table 2).

Table 2: Family structure of sample farms

Sl No. Items	Size groups			
	Marginal	Small	Large	Total
1. No. of household	43	17	14	75
2. No. of family members				
a) Total male	114	55	45	214
i) Average male	2.65	3.24	3.21	2.85
ii) Percentage	46.15	53.92	47.87	48.30
b) Total female	95	32	38	165
i) Average female	2.21	1.88	2.71	2.20
ii) Percentage	38.46	31.37	40.43	37.25
c) Total children	38	15	11	64
i) Average children	0.88	0.88	0.79	0.85
ii) Percentage	15.38	14.70	11.70	14.45
d) Total population	247	102	94	443
i) Average family size	5.74	6.00	6.71	5.90
ii) Percentage	100	100	100	100

Source: Field survey

Status on literacy

Literate members were found in all the categories of farmers (Table 3), however, with varying level of education. . The trend showed post graduate 1.62 per cent in marginal households, 2.9 per cent in small farm households and the maximum 5.32 per cent in case of large households. In Kuriyagad MWS area total of 18.7 per cent population was illiterate dominating more in marginal households.

Table 3: Educational level of sample household

S. No. Items	Size group			
	Marginal	Small	Large	Total
1. Illiterate	49(19.84)	19(18.6)	15(16.0)	83(18.7)
2. Literate				
a) Primary	41(16.60)	19(18.6)	8(8.5)	68(15.4)
b) Middle	63(25.50)	22(21.6)	15(16.0)	100(22.6)
c) High school	55(22.27)	23(22.6)	22(23.4)	100(22.6)
d) Intermediate	22(8.90)	6(5.9)	20(21.3)	48(10.8)
e) Graduate	13(5.26)	10(9.8)	9(9.6)	32(7.2)
f) Post graduate	4(1.62)	3(2.9)	5(5.3)	12(2.7)
3. Total	247(100)	102(100)	94(100)	443(100)

Figures in parenthesis indicate percentage to total
Source: Ibid

Nature and status of employment

The nature of occupation of different number family is presented in table 4. In the rural economy, the main economic activities providing opportunities to the work force are mainly in the sphere of agriculture, animal husbandry and non-agricultural activities. Across the farm size, the maximum 68.99 per cent members were involved in farming activates, followed by dairy (10.08 per cent). In large size groups of farms 6.06 per cent members were engaged in government while 10 per cent small size groups of farms in private services.

Table 4: Distribution of sample household according to their occupation (Numbers)

Name of the Occupation	Size groups			
	Marginal	Small	Large	Total
Agriculture	81(66.39)	50(71.43)	47(71.21)	178(68.99)
Dairy	14(11.48)	6(8.57)	6(9.09)	26(10.08)
Farm labour	7(5.74)	3(4.29)	2(3.03)	12(4.65)
Govt. services	5(4.10)	2(2.86)	4(6.06)	11(4.26)
Pvt. Services	12(9.84)	7(10.00)	5(7.58)	24(9.30)
Business/Trade	3(2.46)	2(2.86)	2(3.03)	7(2.71)
Total	122(100)	70(100)	66(100)	443(100)

Source: Ibid

Cultivated area under irrigated and rainfed conditions

Irrigation plays an important role in increasing agricultural production, diversifying cropping pattern and improving economic base of the farmers. The details showing irrigation resources pre and post watershed in the watershed area are shown in Table 5. The total cultivated area in the watershed increased from 40.87 ha to 43.20 ha during the implementation period indicating conversion of waste land into cultivated land. There was reduction in rainfed area, being 1.66 per cent and increase in irrigated area being 12.5 percent.

Table 5: Cultivated area under irrigated and rainfed condition

Period	Irrigated (ha)	Rainfed (ha)	Total
Pre watershed	18.74	22.14	40.87
Post watershed	21.42	21.78	43.20
Percent increase	12.5	1.66	5.37

Source: Ibid

Cropping Pattern

Table 6: Cropping pattern of sample farms during pre and post watershed (Area ha)

Name of the crop	Pre watershed Area	%	Post Watershed Area	%
Kharif				
Cereals	16.75	41.19	14.63	33.20
Vegetable	0.27	0.66	0.475	1.08
Pulses	0.80	1.97	1.07	2.43
Others	3.10	7.62	0.82	1.86
Fodder	0.00	0.00	0.78	1.77
Spices	0.00	0.00	3.62	8.22
Rabi				
Cereals	16.88	41.51	15.92	36.13
Pulses	1.04	2.56	1.51	3.43
Vegetable	0.55	1.35	1.49	3.38
Fodder	0.28	0.69	0.96	2.18
Oilseeds crops	0.30	0.74	0.61	1.38
Spices	0.08	0.18	0.96	2.18
Others	0.00	0.00	0.10	0.23
Summer				
Cereals	0.62	1.52	0.95	2.16
Vegetables	0.00	0.00	0.68	1.54
Total	40.665	100.00	44.07	100.00

Source: Ibid

Since, irrigation is a basic requirement for the spread of high yielding varieties, a shift from traditional to the modern variety and from subsistence crop to commercial crop is the normal outcome of enhanced irrigation facilities. Comparable data on cropping pattern followed by the sample farmers are presented in Table 6, The pre and post watershed implementation programme clearly indicated significant shift in cropping pattern of the micro-watershed. The total area under cereals decreased from 16.75 ha (41.2%) to 14.63 ha (33.2%), while area under pulses and vegetables increased. During summer season, vegetables were introduced to an area of 0.68 ha. Area under fodder also increased and hybrid napier grass was also planted in waste land and bunds of the cultivated fields. Thus a comparison of the cropping pattern pre and post indicated that there was a trend toward commercialization of agriculture.

Cropping intensity pre and post watershed

As expected, with the increase in irrigated area under watershed and use of modern input, the intensity of cropping as measured by the ratio of net cropped area to gross cropped area ncreased.The details are shown in Table 7. In all the size group of farms, the cropping intensity was found to increase. The mean increase was 8.16 per cent. The maximum increase in cropping intensity was noticed with small farmers, the increased being 12.32 per cent, and the lowest being with marginal farmers, increase being 4.83 per cent.

Table 7: Cropping intensity pre and post watershed

Size groups	Cropping intensity (%)		
	Pre project	Post project	%tage change
Marginal	170.23	178.45	4.83
Small	156.78	176.09	12.32
Large	144.81	156.82	8.29
Average	157.27	170.45	8.16

Source: Ibid

Productivity of different crops

Comparative picture of yield rates of selected crops pre and post implementation of watershed among different size of sample households are presents in Table 8.The yield of most of the crops increased remarkable due to effects mode in the watershed programme. The crops, which witnessed significant increase in the yield levels were rice, from 16.1 to 22.2 , wheat 12.9 to 16.3 q/ha *,kharif* pulses 5.7 to 6.8q/ha, rabi pulses6.0 to 9.4 q/ha, Ginger 37.3 to 56.2 q/ha. Winter maize was also introduced in the area with a productivity level of 15.2 q/ha. However, the yield of *Kharif* maize was

found to decreased from 15.7 to 12.4 q/ha. This decrease was mainly noticed due to farmers' diversion towards other high value crops. The vegetable yield increased in all the resource however, the highest increase was observed in case of rabi vegetable(47.2 per cent).

Table 8: Yield of different crops (q/ha) pre and post watershed

Crops	Size groups			
	Marginal	Small	Large	Average
Pre project				
Kharif				
Paddy	15.07	15.49	16.20	16.10
Maize	16.20	11.49	22.39	15.70
Millets	4.86	10.44	7.08	7.50
Pulses	5.55	5.38	6.125	5.70
Vegetable	22.10	15.00	30.00	22.40
Ginger	45.5	46.07	21.55	37.30
Rabi				
Wheat	13.00	12.46	15.00	12.90
Barley	16.00	11.48	10.00	12.50
Pulses	6.50	4.50	6.95	6.00
Vegetable	47.00	53.33	40.00	46.8
Post project				
Kharif				
Paddy	24.20	17.99	21.63	22.20
Maize	13.30	12.48	8.72	12.40
Millets	5.93	4.27	13.50	7.90
Pulses	9.44	4.52	6.29	6.80
Vegetable	27.50	0.00	52.50	25.60
Ginger	61.60	46.63	41.67	56.20
Rabi				
Wheat	18.17	12.71	16.23	16.30
Barley	5.44	22.12	18.00	11.19
Maize	0.00	15.22	0.00	15.20
Pulses	11.54	8.06	8.46	9.40
Vegetable	43.38	22.00	63.69	47.20

Source: Ibid

Technology adoption

Few farmers were following improved agricultural practices at the time of launch of the programme, however, a remarkable increase in adoption of HYVs, fertilizer consumption and pesticide use was noticed due to watershed programme. At the beginning of the program only 61 farmers were recorded as technology user. The watershed development programme increased the number of technology users to 121. Marginal farmers participation increased by 64.18 per cent and small land holders participation also increased by 39.13%. Large sized farmers participation increased by 25.8. The result shows that after gating adequate extension education and training, farmer's participation in technology adoption increased because their awareness changed and practically see the contribution of watershed development to output increase in the area. Watershed development requires commitment and participation to make it sustainable (Table 9).

Table 9: Pre and post watershed adoption of improved technology on sample farms

Activity	Size groups			
	Marginal	Small	Large	Total
Pre project				
HYVs*	12	7	10	29
Fertilizers	8	6	9	23
Pesticides	4	1	4	9
Total	24	14	23	61
Post project				
HYVs*	28	11	13	52
Fertilizers	24	9	12	45
Pesticides	15	3	6	24
Total	67	23	31	121
Percentage increase	64.18	39.13	25.80	

*HYVs: High yielding varieties

Source: Ibid

Constraint in implementation of watershed development programme

Watershed development programme cannot be implemented smoothly without experiencing obstacles in one form or the other. Hence, the constraints as perceived by the farmer are to be sorted out and put forth before the implementing agencies for taking appropriate measures to overcome them. Table 10 shows the constraints as perceived by the participating farmers have been placed in order of the rank. Of all the household surveyed, majority of them had expressed "lack of subsidized rate input supply", as one of the major constraint (54.4percent) followed by," inadequate water harvesting structure for irrigation",(52.3 percent)," poor extension services" (48.1 percent)," Inadequate funds allocated for the development work (46.5 percent) as perceived by the participating farmers. Among other constraints like, "Irregular organization of training", "Insufficient

Table10: Constraints in implementation of watershed development programme

Constraints	Percentage	Rank
Inadequate funds allocated for the development work	46.5	IV
Inadequate water harvesting structure for irrigation	52.3	II
Lack of subsidized rate input supply	54.4	I
Poor extension services	48.1	III
Irregular organization of training	38.4	V
Insufficient infrastructure facilities	36.3	VI
Lack of scientific motivation about recommended practices	30.0	VII

Source: Ibid

infrastructure facilities", Lack of scientific motivation about recommended practices, around 30 to 38 per cent household expressed their views in its favors.

References

Anonymous. (2012). Watershed Management Directorate, Government of Uttarakhand, Dehradun. Culled from www.wmduk.gov.in

Anonymous. (2013). *Statistical Dairy of Uttarakhand.* Government of Uttarakhand, Dehradun. Culled fromwww.wmduk.gov.in

Babu, G., Singh, R.K., and Singh, B. (2004). Socio-economic impact of watershed development in Kanpur. *Agricultural Economics Research Review*. **17**: 125-130.

Datta, S.K. and Virgo,K. J. (1998). Towards sustainable watershed development through people's participation: Lessons from the lesser Himalaya, Uttar Pradesh. *India. Mountain Research and Development.* **18** (3): 213-233.

Deshpande, R. S. and Thimmaiah, G. (1999). Watershed development approach and experience of National Watershed Development in the country. *Journal of Rural Development*. **18** (3): 453-469.

Dhyani, B.L., Babu, R., Ram, S., Katiyar, V.S., Arora, Y.K., Juyal, G.P., and Vishwanathan, M.K. (1993). Economic analysis of watershed management programme in Outer Himalaya: A case study of operational research project, Fakot. *Indian Journal of Agricultural Economics*. **48** (2): 237-245.

Farrington, J. and C. Lobo. (1997). Scaling up participatory watershed development in India: Lessons from the Indo-German Watershed Development Programme. *National Resource Perspective*. umber 17. February 1997.Overseas Development Institute, London, U.K.

Hanumantha. Rao.C.H. (2000). Watershed development in India-Recent experience and emerging issues. *Economic and Political Weekly*".35(45):3943-47

Joshi, P.K., Pangare, B., Shiferaw, B., Wani, S.P., Bouma, J.,and Scott, C. (2004). Watershed development in India:Synthesis of past experiences and needs for future research. *Indian Journal of Agricultural Econmics*. **59** (3): 303-320.

Kerr, J., Pangare, G.., and George, P.J. (2000). *An evaluation ofdryland watershed development in India*. EPTD Discussion Paper No. 68. International Food Policy Research Institute, Washington.

Marothia, O.K. (1997). Agriculture technology and environmental quality: An institutional perspective. *Indian Journal of Agricultural Economics*. **52** (3): 473-487.

Rao, C.H.H. (2000). Watershed developmentin India: Recent experience and emerging issues. *Economic and Political Weekly*. **35** (45): 3943-3947.

Samra, J.S. (1997). *Status of research on watershed management.* Central Soil and Water Conservation Research and Training Institute, Dehradun.

Chandra S. and Raverkar K. P. (2016). Economic evaluation of Badrigad watershed, Uttarakhand. Indian Journal of Economics and Development.12 (2)293-300.