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Impact Analysis of Mid-Himalayan Watershed Development Project on Socio-Economic and Agricultural Status of Beneficiary Farms in Ani Tehsil of Kullu District in Himachal Pradesh

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A B S T R A C T

Mid-Himalayan Watershed Development Project has been reckoned as an instrument to bring the second-generation Green Revolution through, increasing productivity in rainfed areas. The study revealed that the dependency ratio with respect to total workers was found to be 0.40 in case of beneficiary families and 0.26 in case of non- beneficiary families. It was found that with the interventions of the project there has significant change in area of major crops, increase in productivity and net returns of the beneficiary farms. The change in area of vegetables was significantly high in both Kharif and Rabi season *i.e.*, 81.48 and 433.33 per cent under beneficiary as compared to non-beneficiary farms. The increase in productivity was found to be highest in case of potato (40.91%) followed by ginger (37.50%), chilli (33.37%) and tomato (28.89%) on beneficiary farms as compared to non-beneficiary farms. The increase in net returns was found to be highest in case of potato (139.27%) followed by ginger (90.62%), tomato (61.72%) and chilli (49.91%) on beneficiary farms as compared to non-beneficiary farms. The percentage change in the net returns per hundred plants of mango, almond and apple crops was found to be 39.75 per cent, 20.31 per cent and 14.60 per cent higher in case of beneficiaries as compared to non-beneficiaries.The average output- input ratio of maize, wheat, urad, kulath, okra, cauliflower, cabbage, tomato, chilli, ginger, onion and potato were calculated as 1.53, 1.47, 1.23, 1.38, 1.73, 1.66, 1.48, 1.80, 1.71, 1.77, 1.63 and 1.65, respectively in beneficiary farms as compared to 1.50, 1.33, 1.22, 1.35, 1.59, 1.55, 1.59, 1.46, and 1.30 in non-beneficiary farms. The returns on per rupee of investment of agriculture and horticulture crops were higher in beneficiary farms compared to non-beneficiary farms.

Introduction

Agriculture is the backbone of Indian economy and is largely dependent upon natural resources like soil, water and vegetation. These resources are limited in supply and are getting depleted day by day. The practical solutions for conservation of limited natural resources and sustainable development is through proper watershed development strategy. In India, most watershed projects are implemented with the twin objectives of soil and water conservation and enhancing the livelihoods of the rural poor (Sharma and Scott, 2005). Different types of treatment activities carried out in a watershed include soil and moisture conservation measures in agricultural lands,

drainage line treatment measures (loose boulder check dam, minor check dam, major check dam, and retaining walls), water resource development (percolation pond, farm pond, and drip and sprinkler irrigation), crop demonstration, horticulture plantation and afforestation (Palanisami and Kumar, 2005). The aim of watershed programme is to ensure the availability of drinking water, fuel wood and fodder to raise income and employment of farmers and landless labourers through improvement of agricultural production and productivity (Rao, 2000). The State of Himachal Pradesh characterized by undulating, highly erodible and degrading tracts, having more than 80 percent of rainfed area (Anonymous, 2016), the watershed approach constitute the most suitable approach of development for such hilly areas.

The Government of Himachal Pradesh has launched many watershed development projects financed by national and international donor agencies with a view to rehabilitate the degraded environment and improve the economy of the state. The Mid-Himalayan Watershed Development Project (MHWDP) happens to be one such project operational in mid-hill regions of the state since 2005. The Mid-Himalayan Watershed Development Project (MHWDP) is a 222,951 hectare land husbandry initiative in Himachal Pradesh that aims to achieve green growth and sustainable development by establishing the watershed ecosystem. The project aims to reverse several decades of degradation of the natural resources and improve the productivity and incomes of the rural households in the project area. It also aims at to improve water harvesting, increase the area under irrigation to diversify agriculture, horticulture and sustainably develop soil and water resources. This discussion indicates that watershed development projects play an important role in rain fed areas and government is spending huge amounts on various projects of watershed development. Present study was carried out with following specific objectives:

To study the impact of MHWDP on socio-economic characteristics of sampled households in selected micro-watershed.

To access the impact of MHWDP on agricultural and horticultural productivity of sampled households.

Materials and Methods

The methodology of the present study was described under following sub-headings:

Selection of study area

Mid Himalayan Watershed Development Project (MHWDP) was implemented on 30th September 2005 in 45 developmental blocks of Himachal Pradesh. 272 micro-watersheds over 710 Gram Panchayats were identified for the project operation in 10 districts of the state. Mid-Himalayan Watershed Development Project of Ani tehsil in district Kullu was selected purposively.

Sampling design and sample size

The simple random sampling design was used for the selection of respondents (beneficiary and non-beneficiary farms). The sampled project beneficiaries were characterized into three farm categories marginal (<1 ha), Small (1-2ha) and semi medium (>2ha) on the basis of total land holding. A sample of 30 project beneficiaries as well as 30 non-beneficiaries was drawn from the project sites as check farmers for assessing the impact of project.

Data collection

Both primary as well as secondary data were collected in order to fulfill the requirement of specific objectives of the study. The primary

data were collected from the sampled households on specifically designed and pre-tested survey schedule. The data were collected through personal interview method pertaining to agricultural year 2013-14.The secondary data were required to the profile of the study area. The information about Anni tehsil of district Kullu with respect to population, literacy, land utilization, cropping pattern, irrigation, and production of crops, project interventions in farm and non-farm activities was collected from the office of MHWDP and BDO *Anni* and publications of other line departments engaged in the project. The information regarding the project soil conservation and water harvesting was obtained from the office of MHWDP.

Analytical techniques

The collected data were compiled and analyzed by using simple tabular method. The results have been presented by working out averages and percentages. Following formulae/expression were used for estimation of different parameters:

Sex ratio

Sex ratio represents the number of females per thousand males and was calculated for the total sampled households with the following formula:

$$\text{Sex Ratio} = \frac{\text{Total population of females}}{\text{Total population of males}} \times 1000$$

Literacy rate

Literacy is an important indicator judging the quality of human resource, it was calculated by deducting the population below five years of age (non-school going) from the total sampled population

$$\text{Literacy rate (\%)} = \frac{\text{Total number of literate persons}}{\text{Total population} - \text{Population below 5 years}} \times 100$$

Literacy index

Literacy Index is calculated by sum of weighted value for literacy category ***(***primary, middle, matric, senior secondary and graduate & above) to the number of persons to be literate

$$\text{Literacy Index} = \frac{\sum \text{Wi Xi}}{\sum \text{Xi}}$$

Where;

W_i = Weights (0, 1,2,3,4 and 5) for illiterate, primary, middle, matric, senior secondary and graduate & above respectively

X_i = Number of persons in respective category.

Dependency ratio

Dependency ratio is calculated by the ratio of total number of dependents in a family to the total workers

$$\text{Dependency ratio w.r.t. total workers} = \frac{\text{No. of dependents in a family}}{\text{Total workers}}$$

Cropping intensity

The cropping intensity has been worked out as the ratio of gross cropped area to the net sown area, expressed in percentage

$$\text{Cropping intensity (\%)} = \frac{\text{Gross Cropped Area}}{\text{Net sown Area}} \times 100$$

Per cent change in selected parameters

The production, productivities, input use, labour use, costs and returns etc. associated

with different crop enterprises were estimated both for project beneficiaries and non-beneficiaries.

The impact of project interventions was analysed by working out per cent change with following expression:

$$\text{Per cent change} = \frac{X_1 - X_2}{X_2} \times 100$$

X_1= value of parameter under project beneficiaries

X_2= value of parameter under non-project beneficiaries

Gross return

Gross return refers to the total income of the farmers earned from crop.

Net returns

Return obtained by subtracting the total cost from gross return.

Output- input ratio

It is the ratio of gross returns to the cost of cultivation.

Results and Discussion

The results obtained from the present investigation were presented below:

Demographic profile of sample households

The size and structure of the family among the beneficiary and non-beneficiary farmers are the important factors influencing the crop production, which happens to be family labour based occupation at the village level. The table 1 shows that the average family size was 7.80 persons, out of which 55.22 per cent were males and rest were females in the beneficiary households. Whereas in case of non-beneficiary the average family size was 8.09 person, out of which 53.91 per cent were males and rest were females. In case of beneficiary farmers per cent of joint and nuclear families were 66.67 and 33.33.In case of non-beneficiary farmers this proportion was 60 and 40 per cent. A positive relationship was found between the farm size and the family in the study area. The literacy rate of beneficiary and non-beneficiary families was 87.50 and 90.16 per cent, respectively which is slightly higher than the beneficiaries.

However, the literacy index of beneficiary families was found to be 2.53, while in case of non-beneficiary families' literacy index was 2.72.This highlights the fact that literacy rate in the study areas is higher, but the quality of education is poor as indicated by low literacy index.

Per household occupational structure of the selected beneficiary farmers is noted from the table that agriculture is the main occupation as 63.47 per cent of work force practice farming, 5.99 per cent workers population was engaged in business and 30.54 per cent workers population was engaged in services in private/public sectors. Similarly, in case of non-beneficiary families 52.72, 11.46 and 33.85 per cent workers population was engaged in agriculture, business and services in private public sectors.

However, services and business sector workers population was less in beneficiaries as compared to non-beneficiaries while agriculture sector workers population was higher. The overall dependency ratio with respect to total workers was found to be 0.40 in case of beneficiary families and 0.26 in case of non-beneficiary families in the micro-watershed.

Land utilization pattern of sample cultivators

Land is the basic resource, which can be allocated for different farm and non-farm activities for maximization of household income depending upon its nature and type. The farmers with large holdings have more opportunities of land utilization as compared to small holdings, however there may be problems of management with large holdings. The land utilization pattern prevailing in the study area has been summarized in figure 1. The figure reveals that average size of total land holding of the beneficiary farms was 1.24 ha, whereas 1.23 ha on non-beneficiary farms. It can be seen from the figure that the available land was allocated for cultivation of crops, ghasnis and pasture and fallow land by the beneficiary and non-beneficiary farmers. Among these land uses, the proportion of area put under cultivation of crops and orchard was found to be highest i.e.73 and 60 per cent of total holding under beneficiary and non-beneficiary farmers. However, about 17 and 18 per cent of area was allocated to pasture and grazing lands for beneficiary and non-beneficiary farmers for the purpose of grasses and grazing of animals. About 9 per cent under beneficiaries and about 22 per cent under non-beneficiaries land holding was kept fallow. Under the project, various soil and water conservation activities were undertaken due to which around 16 percent of the total holding and 22.2 per cent of cultivated area was brought under irrigation in case of beneficiary whereas around 8.13 per cent of the total holding and 13.5 per cent of the cultivated area of non-beneficiary farmers was irrigated as shown in figure 2.

Cropping pattern changes due to MHWDP

The cropping pattern indicates the percentage distribution of total cropped area among different crops in a particular agricultural year. The analysis of cropping pattern during an agricultural year indicates the relative importance of crops in a particular region. The main aim of the project is to conserve soil and water, which in turn be responsible for the allocation of area to the cash crops. Therefore, in order to study the impact of project on cropping pattern, the existing cropping pattern of the project beneficiaries has been compared with the non-beneficiaries and is presented in table 2. The table indicates that among different food grain crops in the micro-watershed, area under kharif crops such as cereals, pulses and vegetables has increased from 50.00, 13.33 and 81.48 per cent on beneficiary as compared to non-beneficiary farms. Area under rabi crops such as cereals and some rabi vegetables has increased 15.56 and 433.33 percent. Area under orchards has also increased from 44.44 percent on beneficiary as compared to non-beneficiary farms. Similar trend was observed by Nasurudeen and Mahesh (2006), Arya and Yadav (2006), Paul *et al.,* (2009) and Kulshrestha, (2014).It is interesting to note that, the area under vegetable crops has significantly increased as compared to cereals and pulses, because of higher availability of irrigation water the beneficiary farmers shifted their pulses to vegetables. This was in line with findings of Srinivasa (1988) and Naik *et al.,* (2009) who observed that the watershed helped farmers to bring more area under vegetables (rabi season) as well as higher availability of water had resulted in diversification of cropping pattern with the substation of more profitable crops.

Productivity of major crops grown by sample cultivators

It is hypothesized that productivity of crops increases because of watershed development activities. Therefore, productivity of major crops grown in watershed project area and adjacent area was worked out and presented

in table 3. The productivity of major crops grown by beneficiary farms was increased due to the increase in irrigation facility, improvement in the soil fertility and increased moisture retention capacity. The table reveals that on beneficiaries, among the cereals crops the productivity of maize (15.18 q/ha) was found to be highest followed by wheat (10.17 q/ha). The productivity of *kulath* (6.13q/ha) was found to be highest followed by *urad* (5.71 q/ha). The table further indicates that there is no significant difference in the productivity of cereals and pulses among beneficiary and non-beneficiary farm. It was mainly due to fact that on the beneficiary farms these crops were also grown under rainfed conditions. Among the vegetable, the productivity of tomato was found to be highest (110.63 q/ha) followed by okra (57.27 q/ha) and ginger (55.00 q/ha). The table further reveals that the productivity of vegetable crops was significantly higher on beneficiary farms as compared to non-beneficiary. The increase in productivity was found to be highest in case of potato (40.91 %) followed by ginger (37.50 %) on beneficiary farms as compared to non-beneficiary farms. The higher level of productivity on beneficiary farms may be attributed to the irrigation facilities created under the project and adoption of better management practices. The relatively higher crop productivity on beneficiary farms indicates the direct impact of the Mid Himalayan Watershed Development Project.

Table.1 Demographic profile of sample households

Particulars	Beneficiary farmers	Non-beneficiary farmers
Size of the family		
Average size of Family (No)	7.80	8.09
Number of Males (%)	54.27	53.91
Number of Females (%)	45.73	46.09
Sex Ratio	842.52	854.96
Structure of family		
Joint families (%)	66.67	60.00
Nuclear Families (%)	33.33	40.00
Educational status		
Illiterate (%)	11.54	9.02
Non School Going (%)	7.69	8.28
Literate (%)	80.77	82.69
Primary	19.23	17.68
Middle	13.72	13.10
Hr. Secondary	17.95	18.17
Sr. Secondary	16.67	17.31
Above Sr. Secondary	13.21	16.44
Literacy rate (%)	87.50	90.16
Literacy Index of the families	2.53	2.72
Occupational status (%)		
Service	30.54	33.85
Business	5.99	11.46
Agriculture	63.47	52.72
Average no. of workers	5.57	6.4
Dependency ratio w.r.t. total workers	0.40	0.26

Figures in parentheses indicate percentage to total

Table.2 Changes in the cropping pattern of sample cultivators

(in ha)

Crops	Beneficiary farms	Non-beneficiary farms	% Change
Kharif season			
Cereals	0.33	0.22	50.00
Pulses	0.51	0.45	13.33
Vegetables	0.049	0.027	81.48
Rabiseason			
Cereals	0.52	0.45	15.56
Vegetables	0.016	0.003	433.33
Orchards	0.13	0.09	44.44
Gross cropped area	1.56	1.24	
Net sown area	0.91	0.74	
Cropping intensity (%)	171.43	167.57	

Table.3 Productivity of field crops on sample cultivators

(q/ha)

Crops	Beneficiary farms	Non-beneficiary farms	Change (%)
Maize	15.18	14.27	6.38
Wheat	10.17	9.24	10.06
Urad	5.71	5.55	2.88
Kulath	6.13	6.07	0.99
Okra	57.27	51.67	10.84
Cauliflower	45.50	0.00	-
Cabbage	51.75	0.00	-
Tomato	110.63	85.83	28.89
Chilli	11.67	8.75	33.37
Ginger	55.00	40.00	37.50
Onion	49.30	0.00	-
Potato	51.67	36.67	40.91

Table.4 Productivity of horticulture crops per 100 plants on sample cultivators

(q/100 plants)

Crops	Beneficiary farms	Non-beneficiary farms	Change (%)
Mango	33.87	26.45	28.04
Almond	28.50	24.85	14.69
Apple	53.75	49.95	7.61

Table.5 Impact of MHWDP on economics of major crops per ha on the sample cultivators

Farms	Crop	Gross returns	Cost of cultivation	Net returns	Output- input ratio
Beneficiary farms	Maize	22772.73	14856.50	7916.23	1.53
	Wheat	14242.31	9687.44	4554.87	1.47
	Urad	40000.00	32497.50	7502.5	1.23
	Kulath	39812.50	29875.68	10937.05	1.38
	Okra	143181.82	44313.94	60603.32	1.73
	Cauliflower	91000.00	35990.24	36324.5	1.66
	Cabbage	77625.00	34668.21	25274.36	1.48
	Tomato	165945.00	92365.32	73579.68	1.80
	Chilli	110865.00	64752.63	46112.37	1.71
	Ginger	165000.00	93245.50	71754.50	1.77
	Onion	123250.00	75447.07	47802.93	1.63
	Potato	103340	62468.65	40871.35	1.65
Non-beneficiary farms	Maize	21409.09	14276.42	7132.67	1.50
	Wheat	12942.22	9715.58	3226.64	1.33
	Urad	38838.71	31750.20	7588.51	1.22
	Kulath	39464.29	29240.50	10223.79	1.35
	Okra	129166.7	81256.64	47910.03	1.59
	Cauliflower	-	-	-	-
	Cabbage	-	-	-	-
	Tomato	128745	83247.64	45497.36	1.55
	Chilli	83125	52365.25	30759.75	1.59
	Ginger	120000	82357.27	37642.73	1.46
	Onion	-	-	-	-
	Potato	73340	56258.49	17081.51	1.30

Table.6 Economics of horticulture crops per 100 plants on the sample cultivators

Farms	Crop	Gross returns	Cost of cultivation	Net returns	Output- input ratio
Beneficiary farms	Mango	169350	71853.62	97496.38	2.36
	Almond	114000	46972.55	67027.45	2.43
	Apple	193500	78625.38	114874.62	2.46
Non-beneficiary farms	Mango	132250	59485.42	72764.58	2.12
	Almond	99400	42685.68	56714.32	2.28
	Apple	174825	72584.95	102240.05	2.34

Fig.1 Land utilization pattern of sample cultivators

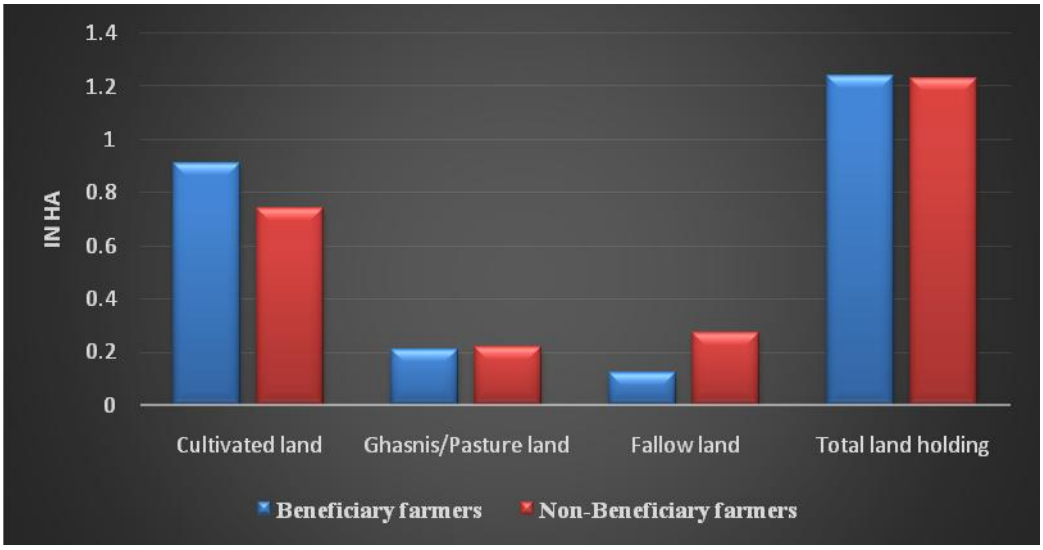
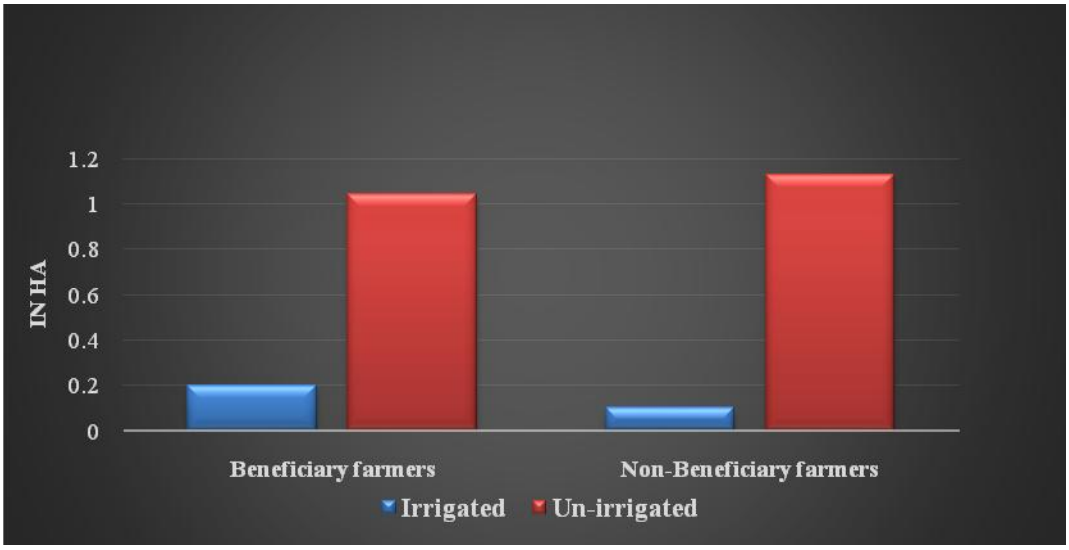


Fig.2 Irrigation pattern of sample cultivators



As a result of the project implementation, some additional area was bought under irrigation through various water harvesting structures and farmers could make use of irrigation water for their crop production.

The results were in line with the findings of Panwar *et al.*, (2016), Paul *et al.*, (2009), Sengar *et al.*, (2008) and Singh and Jain (2004) who observed that soil moisture and fertility in watershed area led to increase in the crop productivity positively.

Productivity of horticulture crops grown by sample cultivators

A comparison of the productivity of different horticulture crops on beneficiary and non-beneficiary farms has been presented in table 4. It can be observed from the table that

productivity of mango, almond and apple on an average farm situation under beneficiary was higher level as compared to non-beneficiary farms. Among the horticulture, the productivity of apple was found to be highest (53.75q/100 plants) followed by mango (33.87q/100 plants) and almond (28.50 q/100 plants). The increase in productivity was found to be highest in case of mango (28.04%) followed by almond (14.69%) and apple (7.61%) on beneficiary farms as compared to non-beneficiary farms. The relatively higher crop productivity on beneficiary farms indicates the direct impact of the Mid Himalayan Watershed Development Project. As a result of the project implementation, some additional area was bought under irrigation through various water harvesting structures and farmers could make use of irrigation water for their crop production.

Economics of major crops

Data in table 5 shows that the average gross returns of various major crops under beneficiary was quite high as compared to non-beneficiary farms. In the impact study the average cost of cultivation per hectares of ginger were highest followed by tomato, okra, onion, chilli and potato etc. i.e. Rs.93245.50, Rs.92365.32, Rs.82578.5, Rs.75447.07, Rs.64752.63 and Rs. 62468.65, respectively under beneficiary farms as compared to non-beneficiary farms which was found to be highest on tomato followed by ginger, okra, potato and chilli, Rs. 83247.64, Rs. 82357.27, Rs. 81256.64, Rs. 56258.49, Rs. 52365.25, respectively. The average net returns per ha of tomato was highest followed by ginger, okra, onion, chilli and potato etc. i.e. Rs. 73579.68, Rs.71754.50, Rs.60603.32, Rs.47802.93, Rs.46112.37 and Rs.40871.35 respectively under beneficiary farms as compared to non-beneficiary farms which was found to be highest on okra followed by ginger, chilli and potato *i.e.* Rs.47910.03, Rs. 45497.36, Rs.36642.73, Rs.30759.75 and Rs. 17081.51, respectively. The percentage change in the net returns of cereal crops among maize and wheat was found to be 10.99 and 41.16 per cent higher in case of beneficiaries as compared to non-beneficiaries. The percentage change in the net returns of pulse crops among beneficiary and non-beneficiary farms was marginally low and it was found to be 5.84 and 6.98 per cent higher in case of beneficiaries as compared to non-beneficiaries. Similar results were found by Choudhary (2013).

The table further reveals that the net returns from vegetables crops were higher on beneficiary farms as compared to non-beneficiary farms.

The increase in net returns was found to be highest in case of potato (139.27%) followed by ginger (90.62%), tomato (61.72%) and chilli (49.91%) on beneficiary farms as compared to non-beneficiary farms. The higher level of net returns of beneficiaries could be attributed to the irrigation facilities created under the project, adoption of better management practices and availability of planting material provided by the project.

The average output- input ratio of maize, wheat, urad, kulath, okra, cauliflower, cabbage, tomato, chilli, ginger, onion and potato were calculated as 1.53, 1.47, 1.23, 1.38, 1.73, 1.66, 1.48, 1.80, 1.71, 1.77, 1.63 and 1.65, respectively in beneficiary farms as compared to 1.50, 1.33, 1.22, 1.35, 1.59, 1.55, 1.59, 1.46, and 1.30, respectively in non-beneficiary farms. Similar results were found by Jat *et al.,* (2008).

The returns on per rupee of investment of these crops were higher in beneficiary farms compared to non-beneficiary farms. There had been positive impact due to adoption of

the Mid-Himalayan Watershed Development Project in raising the level of income and productivity of various crops in watershed area under beneficiary farms. Mid-Himalayan Watershed Development Project would have been more beneficial when all the development works (watershed harvesting structures) of the watershed were completed. Therefore, the Mid-Himalayan Watershed Development Project approach may be replicated in other dry land areas for the sustained development of agriculture and conserving the precious natural resources of the area.

Economics of horticulture crops

A perusal of table 6 reveals that the average gross returns of various horticulture crops under beneficiary was quite high as compared to non-beneficiary farms. The percentage change in the average cost of cultivation per hundred plants of mango, almond and apple crops was marginally low and it was found to be 14.99per cent, 7.52 per cent and 5.42 per cent higher in case of beneficiaries as compared to non-beneficiaries. The percentage change in the net returns per hundred plants of mango, almond and apple crops was found to be 39.75 per cent, 20.31 per cent and 14.60 per cent higher in case of beneficiaries as compared to non-beneficiaries. The higher level of net returns of beneficiaries could be attributed to the irrigation facilities created under the Mid-Himalayan Watershed Development project, adoption of better management practices and availability of planting material provided by the project.The average output- input ratio of various horticulture crops such as mango, almond and apple were calculated as 2.36, 2.43 and 2.46, respectively in beneficiary farms as compared to 2.12, 2.28 and 2.34, respectively in non-beneficiary farms. The returns on perrupee of investment of these crops were higher in beneficiary farms compared to non-beneficiary farms.

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 others natural resources. Using modern inputs like high yielding varieties, chemical fertilizers, irrigation, and plant protection measures, etc., increased the productivity of crops. The co-ordination of farmers and government functionaries, land development activities were some of the measures for improving the Mid-Himalayan Watershed Development. Watershed technology has helped in augmenting returns from dry land crop production as well as other subsidiary needs to be continued and extended to other areas. Better co-ordination between development agencies and voluntary organizations is also essential for effective implementation of watershed programme. The lack of effective co-ordination among project officials, agriculture extension department, agriculture research station and farmers near the study area is a constraint in the adoption of watershed technique.

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