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Original Research Article

An Impact Analysis of Integrated Watershed Management Programme (IWMP): A Case Study in Baramulla District of Jammu & Kashmir

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ABSTRACT

The study aims to evaluate the impact of the Integrated Watershed Management Programme (IWMP) in Baramulla District, Jammu & Kashmir, focusing on agricultural productivity, and socio-economic benefits for local communities. In the current study, the Rafiabad area was selected as Kashmir's first IWMP (Integrated Watershed Management Programme) was implemented in 2011-12. A multi-stage random sampling design was used for sample collection. Accordingly, 100 beneficiary samples/ respondents were selected randomly from the 13 villages, respectively. Considering the non-beneficiary respondents to be 25 per cent of the beneficiary respondents, *i.e*., 25 non-beneficiary farmers were selected randomly from the neighbouring villages where the IWMP project is not implemented for the comparative study which makes a way to find out the difference between the watershed and non-watershed implemented villages, respectively making it a total of 125 respondents. The three main characteristics of the watershed development methods are, supporting rural economic growth, creating jobs, and restoring ecological equilibrium. The cultivated area, production, and productivity of major crops showed a significant change in the post-IWMP scenario in relation to the pre-IWMP conditions. The project helped increase in majority of the farm and livestock inventories. The cropping intensity among the beneficiaries in the present scenario is 151.36 per cent against the pre-IWMP levels of 116.54 per cent and 110.68 per cent among the non-beneficiaries which depicts the positive development in the cropping pattern among the beneficiary farmers. There was a 34.70 per cent surge in employment among the beneficiaries against the pre-IWMP levels and it was also found that presently, the employment was 9.08 per cent higher among the beneficiaries compared to non-beneficiaries which shows the prominence of the IWMP project.

Keywords: *IWMP, Watershed, Beneficiaries, Non-beneficiaries, Income*

1. INTRODUCTION

A watershed is a geo-hydrological unit that drains to a common point. This unit becomes a perfect one for technical works to conserve soil and water and maximize surface and groundwater for increasing crop production (Reddy *et al.,* 2023). Efficient water and land use are crucial for growth and sustainable development. Watersheds are increasingly being emphasized for water management through enhanced in-situ soil moisture conservation and protective irrigation. This watershed-based approach is considered the most suitable method, as it focuses on meeting the total water demand within the watershed using available resources Patil & Kadale 2023). Watershed development aims to strike a balance between land and water resource conservation, regeneration, and human usage within a watershed (Singh *et al.,* 2010). In India, the watershed concept was first implemented in 1987 by then-existing programmes are Desert Development Program (DDP) and the Drought Prone Area Program (DPAP). The National Wasteland Development Boards' Integrated Watershed Development Projects, which began in 1989, likewise intended to develop wastelands using the Integrated Watershed Development idea (Wani *et al.,* 2008). In dryland areas such as the Indian semi-arid tropics,

watershed projects aim to maximize the quantity of water available for crops, livestock, and human consumption through on-site soil and moisture conservation, infiltration into aquifers, and safe runoff into surface ponds (Ahmed *et al.,* 2023). Rainfed agriculture lodges about 51 percent of the country's net sown area and accounts for approximately 40 percent of the total food production. Rainfed regions account for about 65 per cent of India's arable land, and 55 per cent of its agricultural output, and provide food for 40 per cent of the country's population hence, Watershed Development Projects focus on these areas. Poverty and marginalization are distinguishing traits of the majority of people living in rain-dependent, ecologically fragile rural areas, owing to low agricultural production, insufficient water for agricultural use, and a lack of fodder for cattle. As a result of the increased strain on biomass utilization, natural resources are being over-exploited, and land management is being neglected (Satish & Janardhan, 2012). The Integrated Watershed Development Program was initiated in three sub-watersheds, Devak and Ramkote Shivalik region of Jammu and Dudhganga in Karewas region of Kashmir province, due to environmental degradation. The IWDP Phase-I was originally conceived in 1990 for seven years with World Bank funding of US$18.57 million, with a deadline of June 30, 1997. World Bank approved the IWDP Phase-II after Phase-I was completed successfully. The project IWMP Rafiabad-A (2011-12) is the first IWMP project in the Baramulla District (Mushtaq *et al.,* 2019). The implementation works began in September 2011. Rafiabad-A (IWMP-I/2011-12) comprised three micro-watersheds. Fagipora, Bakhipora, and Batpora with the code names Brm 1-3, Brm 1-6, and Brm 1-5, respectively given by the implementing agency, were the three micro watersheds that encompass thirteen villages and include six Gram panchayats namely, Bakhipora, Sheikhpora, Pazalpora, Hachaypora, Chatoosa, and Chanam (Anonymous, 2019). The fundamental goal of the watershed strategy, essentially a land-based initiative with a rising emphasis on water, is to raise agricultural production through protective irrigation and increased in situ moisture conservation for the socioeconomic development of rural communities (Joshi, 2005). The watershed approach has great potential to foster sustainable crop and dairy farming in drought-prone areas by addressing both the explicit and implicit needs of farmers. Thus, evaluating the impact of watershed interventions is deemed essential for future planning and development (Sharath *et al.,* 2021).

2. METHODOLOGY

The methodology is a systemic way to solve a problem. The Rafiabad area was selected as it is Kashmir's first IWMP (Integrated Watershed Management Programme) which was implemented in 2011-12. A multi-stage random sampling design was employed for sample collection. The primary stage unit was the IWMP-1 [Rafiabad-A] project. At the secondary stage, three micro-watersheds—Bakhipora (Brm 1-6), Batpora (Brm 1-5), and Fagipora (Brm 1-3)—were selected. The tertiary stage included all 13 villages within these micro-watersheds where the project is implemented: Bakhipora, Sheikhpora, Batpora, Doniwari, Kiterdachi, Mondina, Seen, Hatchepora, Tangmula, Fagipora, Waripora, Pazalpora, and Astanpora. Finally, respondents from these respective villages constituted the final stage units. The proportionate allocation method, based on the 2011 Census of India, was used to select respondents from each micro-watershed according to the population size of the beneficiary villages.

Accordingly, 100 beneficiary samples/ respondents were selected randomly from the 13 villages, respectively. Considering the non-beneficiary respondents to be 25 per cent of the beneficiary respondents, *i.e.,* 25 non-beneficiary farmers were selected randomly from the neighbouring villages where the IWMP project is not implemented for the comparative study which makes a way to find out the difference between the watershed and non-watershed implemented villages, respectively making it a total of 125 respondents.

2.1 Paired t-test of comparing means

A paired t-test is used when interested in the difference between two variables for the same subject. Often the two variables are separated by time like in the case of the impact of IWMP, *i.e.,* before and after the implementation of IWMP.

$$t = \frac{\sum d}{\sqrt{\frac{n(\sum d^2) - (\sum d)^2}{n-1}}}$$

Where, d = difference per paired value n = number of samples t = paired t-test

2.2 Cropping intensity

It refers to the raising of several crops from the same field during one agricultural year. The cropping intensity may exceed 100 per cent where more than one crop is harvested each year. It can be expressed through the following formula.

$$CI(\%) = \frac{GCA}{NSA} * 100$$

Where: GCA = Gross Cropped Area
NSA = Net Sown Area
CI = Cropping Intensity in per cent

2.3 Inputs and cost concepts

2.3.1 Variable costs: The variable costs include the cost of seeds, fertilizers, pesticides, wages of human and bullock labour, and interest on capital.

2.3.1.1 Labour Cost

The cost of hired labour for men and women was calculated by multiplying the man-days with the existing wage rate per day. The cost of family labour was imputed considering the wage rate prevailing in the study area. Machine labour was measured in hours and valued at existing hourly rates in the area for different operations performed by machines, mainly tractors.

2.3.1.2 Cost of material and inputs

Cost of various inputs such as seeds, fertilizers, Farm Yard Manure (FYM), plant protection chemicals, and others are considered in this category and were valued at their actual purchase price. While the value of owned farm inputs was imputed at current prices.

2.3.2 Fixed costs: Fixed costs are costs incurred even if no output is produced. These include Depreciation on farm implements and machinery, Interest on fixed capital, and Rental value of land.

2.3.2.1 Depreciation:

Depreciation of each farm implement used in the cultivation of crops in the study area was worked out by a straight-line method of computing depreciation

$$Depreciation = \frac{\text{Purchase value} - \text{Junk value}}{\text{Average life of an asset}}$$

2.3.2.2 Interest on fixed capital:

Interest on fixed capital was calculated at the rate of 9 per cent, as the fixed deposits in commercial banks would give this rate of interest. Farm implements and machinery are the items considered under fixed capital. Interest was considered on the value of these assets after deducting the depreciation for the year.

2.3.3 Marketing costs: Marketing costs include the cost of transportation, loading and unloading, packing, labour charges, and commission charges. The actual cost incurred by farmer producers in the study area for marketing of produce was considered.

2.3.4 Cost of cultivation: Refers to the total expenses incurred in cultivating one hectare of crop. Calculated by adding fixed costs, variable costs, and marketing costs and expressed on a per unit basis.

2.3.5 Total cost: It is the sum of total variable cost and total fixed cost

Total cost of cultivation = Total variable Cost (TVC) + Total fixed cost (TFC)

2.3.6 Returns

2.3.6.1. Gross Returns:

Gross return is the value of the main product and the by-product imputed based on post-harvest prices prevailing in the study area.

Gross Returns = yield × price

2.3.6.2. Net Returns:

Net returns were estimated by subtracting the cost of cultivation from gross returns and also, and the returns per rupee of cost were calculated by dividing gross returns by the total cost of cultivation.

Net Returns = Gross Returns - (TVC+TFC)

$$\textbf{Returns per rupee of investment} = \frac{\textbf{Total Gross Returns}}{\textbf{Total Cost}}$$

2.3.7 Farm income

Farm income refers to the total income of the family earned by all the members of the family from all farm sources during the one year of study. Gross income included crop income, dairy income, off-farm activity income, etc.

2.3.7.1. Crop Income:

The entire gross product (main and by-product) is evaluated at market prices.

2.3.7.2. Dairy Income:

The entire gross produce (milk and dung) is evaluated at village prices

2.3.7.3. Agricultural labour income:

The actual earnings to the family members from the labour activities on the other farms of the study area.

3. RESULTS AND DISCUSSION

3.1 Cultivated area of the major crops per farm in the study area

The cultivated area of the major crops per farm before and after IWMP in the study area is shown in Table 1, revealing significant improvements due to watershed interventions such as wells, P-bunds, earth dams, and nala bunds. Paddy and apple crops saw highly significant increases in average cultivated area per farm, with improvements of 0.06 ha and 0.05 ha respectively, significant at the 1 per cent level. This is attributed to increased water availability, making these crops preferred choices. Maize and mustard also showed improvements of 0.02 ha and 0.01 ha per farm respectively, significant at the 5 per cent level. However, pulses and vegetables, primarily grown for household consumption, showed no significant changes. Overall, there was a substantial 62.50 per cent increase in total cultivated area. Specifically, rice cultivation increased by 120 per cent, maize by 100 per cent, apple by 71.42 per cent, and pulses, vegetables, and mustard each by 33.3 per cent, highlighting the positive impact of the irrigation facilities provided by the project.

Table 1: Cultivated area of the major crops per farm before and after IWMP in the study area

Crops	Before IWMP	After IWMP	Difference	Percentage change	t-value	p-value
	Average area	Average area				
Paddy	0.05	0.11	0.06	120	6.37**	<0.001
Maize	0.02	0.04	0.02	100	2.03*	<0.05
Pulses	0.03	0.04	0.01	33.33	0.52^{NS}	>0.05
Vegetable	0.03	0.04	0.01	33.33	1.05^{NS}	>0.05
Mustard	0.03	0.04	0.01	33.33	2.35*	<0.05
Apple	0.07	0.12	0.05	71.42	6.58**	<0.001
Total	**0.24**	**0.39**	**0.15**	**62.50**	**11.22****	**<0.001**

Note: ^{NS} non-significant

** Significant at 1 per cent level of significance

* Significant at a 5 per cent level of significance

3.2 Productivity differences of major crops between beneficiaries and non-beneficiaries in the study area.

The difference in the productivity of major crops among beneficiaries and non-beneficiaries is shown in Table 2. The average productivity of the major crops like paddy, maize, pulses, vegetables, mustard and apple grown in the non-watershed area is 29.52, 39.63, 31.53, 17.36, 11.48, 136.58 quintals per hectare, respectively against the productivity of 37.26, 48.53, 36.24, 19.21, 14.20, and 182.59 quintals per hectare, respectively for the same in the watershed area. A noticeable difference in the productivity of the crops is found among the watershed and non-watershed areas. The major difference was observed in crops like pulses, apple, and paddy with 26.79, 25.20, and 20.77 per cent followed by vegetables, mustard, and maize with 20.04, 19.15, and 18.34 per cent.

Table 2: Productivity of the major crops among beneficiary and non-beneficiary farmers
(q/ ha)

Crops	Beneficiaries	Non-beneficiaries	Difference	Percentage difference
	Average productivity	Average productivity		
Paddy	37.26	29.52	7.74	20.77
Maize	48.53	39.63	8.9	18.34
Pulses	36.24	26.53	9.71	26.79
Vegetable	19.21	15.36	3.85	20.04
Mustard	14.20	11.48	2.72	19.15
Apple	182.59	136.58	18.7	25.20

3.3. Impact of IWMP on cropping pattern in the study area

3.3.1 Impact of cropping pattern among beneficiary

The cropping pattern before and after the IWMP implementation, among the sample farmers, is elucidated in Table 3. The gross cropped area (GCA) before and after the implementation of the IWMP was 23.60 and 38.75 ha, respectively with the net cropped area for the same being 20.25 and 25.60 ha, respectively. Before the implementation of the IWMP, apple and paddy were the major crops grown with 28.39 and 22.88 per cent of the gross cropped area, respectively followed by vegetables, pulses, maize, and mustard with 15.04, 14.41, 10.17 and 9.11 per cent, respectively. This shows that apple and paddy together comprised of more than 50 per cent of the GCA. Whereas in the post-implementation of the IWMP, it got to known from the very same respondents that, there was a whopping improvement with respect to the cultivated area of paddy and apple to the other crops. This time, it could be observed that apple and paddy together made a way to have more than 55 per cent stake in the GCA*, i.e.,* 31.87 and 28.13 per cent, respectively. It was followed by vegetables, mustard, pulses, and maize, respectively. Subsequently, even though the cultivated area has been improved concerning all the crops, only apple, and paddy had an improvement in proportion to GCA after the implementation of IWMP. This shows the importance of the paddy and apple crops in the study area. Overall, it can be observed that a decent improvement in the cropping intensity (CI) post-IWMP*, i.e.,* 151.36 per cent compared to 116.54 per cent of pre-IWMP conditions. The cropping intensity is

higher in the post-IWMP in comparison with the pre-IWMP due to increased water availability upon watershed intervention, which in turn favoured the diversification of the crops where farmers went on cultivating more than one crop in an agricultural year. The study conducted by Nirankusha (2015) also revealed similar results where the cropping pattern and cropping intensity were influenced by watershed interventions which resulted in improved soil health and moisture-holding capacity of soils.

Table 3: Cropping pattern in the IWMP area

Crops	Beneficiaries			
	Before IWMP		After IWMP	
	Area (ha)	Proportion to GCA (%)	Area (ha)	Proportion to GCA (%)
Annual crops				
Paddy	5.40	22.88	10.90	28.13
Maize	2.40	10.17	3.65	9.42
Pulses	3.40	14.41	3.75	9.68
Vegetables	3.55	15.04	4.30	11.10
Mustard	2.15	9.11	3.80	9.81
Fruit crops				
Apple	6.70	28.39	13.70	31.87
GCA (ha)	23.60		38.75	
NCA (ha)	20.25		25.60	
CI (%)	**116.54**		**151.36**	

Note: GCA- Gross Cropped Area, NCA-Net Cropped Area, CI- Cropping Intensity

3.3.2 Comparison of cropping pattern among beneficiaries and non-beneficiaries under the current scenario

A comparison with respect to cropping patterns among beneficiary and non-beneficiary farmers was made based on the current situation and the results have been presented in Table 4. The Gross Cropped Area (GCA) and Net Cropped Area (NCA) of 25 non-beneficiary framers are 5.70 and 5.15 ha, respectively. Among beneficiary farmers, apple and paddy were the major crops contributing more than 55 per cent together to the GCA, in the case of non-beneficiaries, maize, and apple were the major crops among less than 50 per cent of the GCA followed by paddy, pulses, vegetables, and mustard with 17.54, 17.54, 11.40 and 9.65 per cent to the GCA, respectively. The cropping intensity was 110.68 per cent, which was too less compared to the beneficiary farmers at 151.36 per cent. These results are in line with the study conducted by Thakur *et al.* (2014) which reported that on an average, cultivated area, production and productivity of different crops were found to be increased after the implementation of the project.

Table 4: Comparing cropping patterns among IWMP and non-IWMP area

Crops	Non-beneficiaries (n_2=25)		Beneficiaries (n_1=100)	
	Area (ha)	Proportion to GCA (%)	Area (ha)	Proportion to GCA (%)
Annual crops				
Paddy	1.00	17.54	10.90	28.13
Maize	1.05	18.42	3.65	9.42
Pulses	1.00	17.54	3.75	9.68
Vegetables	0.65	11.40	4.30	11.10
Mustard	0.55	9.65	3.80	9.81
Fruit crops				
Apple	1.45	25.44	13.70	31.87

GCA (ha)	5.70	38.75
NCA (ha)	5.15	25.60
CI (%)	**110.68**	**151.36**

Note: GCA- Gross Cropped Area, NCA-Net Cropped Area, CI- Cropping Intensity

3.4 Impact of IWMP on employment generation among sample farmers

3.4.1 Impact of IWMP on employment generation before and after IWMP

Before the implementation of the IWMP, on average, the beneficiary farmer worked approximately 110 days (44.24 %) in agricultural and horticultural activities, which was the basis of their livelihoods, followed by 58 days (23.43 %) as an agricultural laborer, 47 days (18.72 %) in animal husbandry activities and 34 days (13.59 %) as a non-agricultural laborer, making it a total average of 249-man days in a year. Whereas, an improvement in employment was observed in the post-IWMP scenario where an average farmer spent 141 days (41.92 %) in agricultural and horticultural activities, followed by 75 days (22.21 %) as an agricultural laborer, 67 days (20.02 %) in animal husbandry activities and as a non-agricultural laborer for 53 days (15.83 %), making a total count of 335-man days. The employment sources like agriculture and horticulture, animal husbandry, and agricultural laborer showed a significant difference with the t-values of 7.91, 15.61, and 4.37, respectively, at a 1 per cent level of significance. However, the employment from non-agricultural activities was statistically insignificant with a t value of 1.85. It was a 34.70 per cent overall improvement in employment when compared to the pre-IWMP scenario and showed a highly significant difference at a 1 per cent level of significance. There has been a huge surge in agricultural and horticultural activities followed by agricultural-laborer opportunities and others as shown in Table 5. The small beneficiary farmers found a great improvement in the opportunity to work in the fields of other farmers (agricultural-laborer) as there was an increase in the cultivated area after the IWMP, which provided a basic irrigation facility through canals. This, in turn, made the farming community hire labour for work in their fields. In the case of wage rates in the study area, the average labour wage rate before and after the IWMP was ₹306/- and ₹494/-, respectively, which is a 61.43 per cent improvement in the post-IWMP scenario. An average beneficiary farmer had an average farm income of ₹63,180/- before the IWMP and ₹1,51,970/- per annum after the IWMP, which is a whopping increase of 140.53 per cent. Statistically, both the wage rates and the farm income among the beneficiaries before and after the intervention of the IWMP project showed a significant difference with t-values of 24.36 and 21.13, respectively at a 1 per cent level of significance. The results are in line with Rathod and Rathod (2017)

Table 5: Employment generation among the beneficiary farmers

(man-days)

Source	Beneficiaries (n_1=100)			
	Before IWMP	**After IWMP**	**t-value**	**p-value**
Agriculture and Horticulture	110 (44.24)	141 (41.92)	7.91**	< 0.001
Animal husbandry	47 (18.72)	67 (20.02)	15.61**	< 0.001
Agricultural Labour	34 (13.59)	75 (22.21)	4.37**	< 0.001
Non-agricultural labour	58 (23.43)	53 (15.83)	1.85^{NS}	> 0.05

Total average employment days per year	249 (100)	335 (100)	7.14**	<0.001
Change in total employment (%)	**34.70**			
Average labour wages per day (₹)	306	494	24.36**	< 0.001
Change in labour wages per day (%)	**34.70**			
Average annual farm income	63,180	1,51,970	21.13**	< 0.001
Change in income (%)	**140.53**			

Note: Figures in the parentheses indicate the percentage to the total

^{NS} non-significant

** Significant at 1 per cent level of significance

* Significant at a 5 per cent level of significance

3.4.2 Impact of IWMP on employment generation among the beneficiary farmers

Among the non-beneficiary farmers, on average they were working as a non-agricultural labourer for almost 144 days followed by 89 days in agricultural and horticultural works, 40 days in animal husbandry activities, and 32 days as an agricultural labourer, making it a total count of 305 man-days, which is 9.08 per cent lesser compared to the beneficiary farmers' employment levels. This was mainly because of the lack of resources for the farming sector in the villages, like irrigation, and hence there is a huge stake of non-agricultural labour who are into towns in search of other jobs than farming. The average wage rate is also ₹436/- which is 13.30 per cent lesser than that of the beneficiary farmers' wages of ₹494/- per day. The average farm income per annum for non-beneficiaries is ₹ 1,19,750/-, which is 26.90 per cent lesser than the average beneficiary farmer in the present scenario (Table 6).

Table 6: Employment pattern among beneficiary and non-beneficiary farmers

(man-days)

Source	**Employment pattern**	
	Non-beneficiaries *(n_2=25)*	**Beneficiaries (n_1=100)**
Agriculture and Horticulture	89 (29.12)	141 (41.92)
Animal husbandry	40 (12.96)	67(20.02)
Agricultural Labour	32 (10.56)	53 (15.83)
Non-agricultural labour	144 (47.35)	75 (22.21)
Total average employment days per year	305 (100.00)	335 (100.00)
Difference in total employment (%)	**9.08**	
Average labour wages per day (₹.)	436	494
The difference in average labour wages per day (%)	**13.30**	
Average annual farm income (₹.)	1,19,750	1,51,970
Difference in average income (%)	**26.90**	

Note: Figure in parentheses indicates the percentage

3.5 Impact of IWMP on cost, and returns of major crops per hectare in the study area

3.5.1 Impact on costs and returns of major crops among beneficiaries

From Table 7, it can be interpreted that, the cost of cultivation per hectare is more in the case of the post-IWMP scenario when compared with the pre-IWMP scenario in the case of all four crops. It is highest in the case of apple followed by paddy, pulses, and maize, respectively. The returns also follow the same order and it can be said that apple and paddy are the most important crops for the livelihood of the farmers in the study area relative to maize and pulses. The returns per rupee of expenditure with respect to crops like apple, paddy, maize, and pulses before the implementation of the IWMP (After discounting at the rate of 12%) are 1.74, 1.46, 1.38, and 1.11, respectively. Whereas the returns per rupee of expenditure on the same crops after the implementation of the IWMP are 2.36, 1.84, 1.79, and 1.56, respectively. This shows a positive change of 35.45 per cent in apple, 25.98 per cent in paddy, 29.62 per cent in maize, and 40.62 per cent in pulse crops.

Table 7: Impact on costs and returns of major crops among beneficiaries

Crop	Apple		Paddy		Maize		Pulses	
	B^d	A	B^d	A	B^d	A	B^d	A
Total variable costs- TVC	366046	409000	63781	67580	43260	46520	74873	81250
Total Fixed costs- TFC	221846	230800	20798	21570	15252	17560	28424	35850
Marketing costs- MC	65167	85000	7487	8450	2773	3850	4160	4525
Total costs- TC	653060	724800	92066	97600	61285	67930	107457	121625
Gross returns- GR	1136962	1709200	134494	179625	84579	121520	119242	189790
Net returns- NR	483902	984400	42428	82025	23294	53590	11786	68165
Returns per rupee of expenditure	1.74	2.36	1.46	1.84	1.38	1.79	1.11	1.56
Change in returns per rupee of expenditure (%)	35.45		25.98		29.62		40.62	

Note: Bd: Costs and returns of crops before IWMP implementation (Discounted at the rate of 12%), A: Cost and returns of the crops after IWMP implementation

3.5.2 Comparing costs and returns among beneficiaries and non-beneficiaries

As mentioned in Table 8, both the costs and returns are higher in the case of beneficiaries when compared with the non-beneficiaries. There is a considerable difference between the same. The cost of cultivation and returns is more for apple in both cases as it takes more investment. The returns per rupee of expenditure on apple, paddy, maize, and pulses are 1.80, 1.26, 1.21, and 1.17, respectively in the case of non-beneficiaries in the non-watershed area against 2.36, 1.84, 1.79 and 1.56, respectively in case of beneficiaries in the watershed area. This shows a considerable difference between them of 30.93 in

apple, 46.53 in paddy, 48.06 in maize, and 33.12 per cent in pulses wherein beneficiaries are on the positive side.

Table 8: Comparing costs and returns among beneficiaries and non-beneficiaries

Crop	Apple		Paddy		Maize		Pulses	
	NB	B	NB	B	NB	B	NB	B
Total variable costs- TVC	351600	409000	53750	67580	36520	46520	61532	81250
Total Fixed costs- TFC	190800	230800	18257	21570	12680	17560	21350	35850
Marketing costs- MC	85000	85000	5635	8450	4250	3850	3580	4525
Total costs- TC	627400	724800	77642	97600	53450	67930	86462	121625
Gross returns- GR	1130000	1709200	97520	179625	64580	121520	101350	189790
Net returns- NR	502600	984400	19878	82025	11130	53590	14888	68165
Returns per rupee of expenditure	**1.80**	**2.36**	**1.26**	**1.84**	**1.21**	**1.79**	**1.17**	**1.56**
Difference (%)	30.93		46.53		48.06		33.12	

Note: NB: Non-beneficiaries from the non-watershed area, B: Beneficiaries from the watershed area

4. CONCLUSION

The area and productivity of major crops cultivated were observed to be higher in the watershed area compared to the non-watershed area. The overall percentage increase in the cultivated area of major crops after the IWMP in the watershed area was 62.50 per cent. The productivity of all the major crops in the study area showed a significant positive change after the IMWP interventions were made in the study area.

Apple and paddy together accounted for more than 55 per cent of the cultivated area (GCA) among the beneficiaries in the study area. It was followed by vegetables, mustard, pulses, and maize. Overall, there was a decent improvement in the cropping intensity (CI) post-IWMP, *i.e.,* 151.36 per cent from the pre-IWMP levels of 116.54 per cent. The GCA and NCA of 25 non-beneficiary framers are 5.70 and 5.15 ha, respectively, accounting for a cropping intensity of 110.68 per cent, which is lesser than the cropping intensity of the crops among the beneficiaries.

The beneficiary farmers found a great improvement in employment as there was an increase in the cultivated area after the IWMP. Compared to the pre-IWMP scenario, there was an overall improvement in employment days of 34.70 per cent, i.e., from 249 to 335 man-days. The wage rates in the study area were ₹306/- before and ₹494/- after the IWMP, respectively. This represents a 61.43 per cent improvement in the post-IWMP situation. An

average beneficiary farmer's average farm income increased from ₹63,180 before the IWMP to ₹1,51,970 after the IWMP, a rise of 140.53 per cent. When compared with the non-beneficiaries, beneficiaries' employment level was 9.08 per cent higher, the average income level was 26.90 per cent and the average wage rate was 13.30 per cent higher.

Beneficiaries enjoyed higher returns. Irrigation facilities have intensified crop production. Apple and paddy are the most important crops for beneficiary farmers in the research area compared to maize and legumes. Apple and legumes had a 35 per cent increase, while paddy and maize increased by 25 per cent in the post-IWMP scenario among the beneficiaries. Apple cultivation and yields require greater investment. Beneficiaries and non-beneficiaries differ by 30.9 percent in apple, 46.5 per cent in paddy, 48.6 per cent in maize, and 33.12 per cent in legumes with respect to returns per rupee of expenditure. This was attributed to the improved soil fertility, farm inventory improved intercropping systems, enhanced cropping strategies like mixed cropping, and crop rotation with pulses and cereals due to timely irrigation. This contrasted with non-beneficiaries in non-watershed areas and beneficiaries in watershed areas before IWMP adoption.

Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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