

## IMPACT OF WATERSHED PROGRAMME ON THE ECONOMY OF FARM HOUSEHOLDS IN ANDHRA PRADESH

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In India, 67 per cent of 143 million hectares of arable land which contributes 44 per cent to the food basket and supports 40 per cent of the population, depends on rain. Further, it is estimated that about 450 million bovine population are thriving on rainfed farming. Most of the areas under coarse cereals, oil seeds, cotton and even rice to a little extent are under rainfed situation. This indicates the need for substantial efforts both from research and development fronts to meet the increasing demand for food, shelter and clothing due to the steadily mounting demographic pressure coupled with decreasing availability of per capita cultivable land. It is ironical that even after harnessing all the irrigation water resources (113 m. ha.) 50 per cent of cultivable land in India will continue to be rainfed. Hence, management of dry land area assumes prime position in Indian Agriculture. (Ital et al., 1998).

Of the total 329 million hectares geographical area of our country, 150 million hectares (45.6%) are threatened by water and wind erosion, 7 million hectares (2.13%) by excessive salt, 6 million hectares (1.8%) by water logging, 4 million hectares (1.21%) by ravines and 3 million hectares (0.911%) by shifting cultivation. It is estimated that the country loses 5300 million tonnes of top fertile soil every year resulting in denudation of cultivated areas. The annual degradation rate of land is as much as 2.5 million hectares. At present, land that is not fit for agriculture cropping is 175 million hectares.

To halt the process of soil erosion, degradation, deterioration and to maintain soil fertility for sustainable production, a holistic approach of watershed management is essential. The watershed programme envisages great opportunities for improving the productivity, profitability and sustainability of dry farming areas. Watershed development is the only solution to ensure drought proofing and to mitigate the distress caused by frequent drought.

As the Government is spending a Substantial amount of money under this programme, concurrent evaluation is needed in order to assess the set objectives, degree of achievement and to also know the impact of the project over various sectors. Several watershed management initiatives like construction of check dams, rock fill dams, stone bunds and percolation tanks were undertaken in the study area both by the Central Government and the State Government.

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Hence this study was undertaken to know the impact of watershed programme on the income of the farmers and also to compare the income inequalities among the farmers in watershed area over the farmers in the non-watershed area.

## Methodology

The present study was purposively undertaken in the rainfed area of Rangareddy district where watershed development programme is under operation. Manthangoud and Manthangourelli villages of Yacharam mandal were selected in the watershed area. Similarly Mangalpalli and Patelguda were selected in the Non-watershed area for the purpose of comparison. Thirty farmers of which 15 are large and 15 small were selected randomly from each of the two villages of watershed area and non-watershed area. Thus the total sample size consisted of 120 farmers. They were interviewed and the results were analysed using Lorenz curves and Gini concentration ratio to know the impact of the watershed programme in terms of distribution of farmer's incomes.

The impact of the watershed programme on the economy of farm household was also assessed in terms of comparison of cropping pattern, cropping intensity, income and employment levels of farmers in watershed area with that of farmers in non-watershed area. In this context, income is calculated from the sum of earnings by all the members in the household from all the sources i.e. from farm and non-farm sources. Lorenz curves were used to relate the cumulative percentage of aggregate benefits to the cumulative percentage of aggregate population receiving these benefits. Gini concentration ratio was used to study the pattern of income distribution.

The range of Gini ratio is from 0 to 1. The ratio of '0' means that every individual receives exactly the same benefits, while the ratio of '1' means one individual receives all the benefits.

$$GCR = 1 - \left( \sum_{j=1}^n P_j (Q_j + Q_{j-1}) \right)$$

Where,

$P_j$  = Proportion of household in  $j$ th group

$Q_j$  = Cumulative proportion of income in  $j$ th group

$Q_{j-1}$  = Cumulative proportion of income in  $(j-1)$  group

$n$  = Total number of groups

## Results and Discussion

### Socio-economic characteristics

The impact assessment of watershed development is easily facilitated if the socio-economic indicators of the selected sample farmers in the watershed and non-watershed areas are homogenous. If there is heterogeneity, the information on the differences that exist help in drawing meaningful interpretation from the results. With this view the socio-economic characteristics of the sample farmers are discussed here with detailed perspectives.

The average age (Table 1) of both watershed and non-watershed farmers was around forty (42.42 and 38.56 years, respectively), which represents the potential age for taking appropriate farm decisions and also to carry out timely operations with leadership and enthusiasm. The average family size was also almost the same between the groups (5.6 and 6.1 in watershed and non-watershed areas, respectively). This confirmed approximately to norms specified as ideal size of the family. The number of the sample farmers who belonged to forward caste, backward caste and scheduled caste were almost the same. However, the number of sample farmers who belonged to scheduled tribes were comparatively more in watershed (46.66%) area over non-watershed (28.33%) area. The number of heads of the household who were illiterate and with primary education were almost the same in both the groups. However, the number of heads of the household with secondary education were exactly the same in both the groups (7). Watershed development in the region has no discernable impact on the education level of the target groups.

On the whole, the watershed and non-watershed families reflected more or less a homogenous group with respect to socio-economic characteristics like age, family size, caste and educational status.

**Table 1: Socio-economic characteristics of the sample farmers in non-watershed and watershed areas**

Sl. No.	Particulars	Non-watershed group	Watershed group
I	Sample size	60	60
II	Average age of the head of the family (yrs)	38.56	42.42
III	Family members (No.)		

	a. Adult male	116 (31.69)	104 (31.33)
	b. Adult female	105 (25.69)	88 (26.50)
	c. Children	145 (39.62)	140 (42.17)
	d. Total	366 (100)	332 (100)
	e. Average family size	6.10	5.53
IV	Caste		
	a. Forward caste	15 (25)	12 (20)
	b. Backward caste	17 (28.33)	14 (23.34)
	c. Scheduled caste	11 (18.34)	6 (10)
	d. Scheduled tribes	17 (28.33)	28 (46.66)
	Total	60 (100)	60 (100)
V	Education status of the head of the household		
	a. Illiterate	21 (35)	20 (33.34)
	b. Primary school	32 (53.34)	33 (55)
	c. Secondary school	7 (11.66)	7 (11.66)
	Total	60 (100)	60 (100)

*Figures in parentheses indicate percentages to the total*

### **Cropping pattern**

Details of cropping pattern of the sample farmers in non-watershed and watershed area are presented for comparison in Table 2, which reveals that the average size of the holding in non-watershed area was 3.94, 1.36 and 2.65 hectares for large, small and pooled farmers, respectively. Similarly the average size of the land holding in the watershed area was in the order of 3.89, 1.34 and 2.61 hectares.

In kharif season redgram (0.95 ha) occupied a major cropped area followed by Jowar (0.76 ha) and paddy (0.5 ha), in non-watershed area in case of pooled

farmers. Whereas, paddy (36.11%) occupied a major cropped area followed by jowar (32.14%) and redgram (31.75%) in that order in the watershed area.

In rabi season, bajra (0.55 ha) occupied a major cropped area followed by castor (0.41 ha), jowar (0.18 ha) and redgram (0.13 ha), respectively in non-watershed area in case of pooled farmers. In the watershed area castor (44.10%) occupied a major cropped area followed by jowar (20%), bajra (18.47%) and redgram (13.02%).

A critical observation of the cropping pattern (Table - 2) indicates that the area under paddy was relatively higher in watershed area (36.11%) as compared to non-watershed (22.62%) area as the farmers propensity to bring additional land under paddy cultivation was more pronounced due to assured irrigation facility, input supply and technical know-how. However, the area under *kharif* jowar was almost similar in watershed and non-watershed areas.

As bajra is a drought tolerant dry land crop, it occupied a major cropped area (44.10%) during *rabi* in non-watershed area, whereas, the area under jowar, (20%), redgram (13.02%) and castor (44.10%) was relatively higher in watershed area over non-watershed area (14.18, 10.24 and 32.28%, respectively). The improved soil moisture condition due to moisture conservation measures undertaken in the watershed area have resulted in increased area under the above crops.

**Table 2 : Comparison of cropping pattern in non-watershed and watershed areas**

Sl. No.	Season/ crop	Non-watershed			Watershed		
		Large	Small	Overall	Large	Small	Overall
<b>I</b>	<b><i>Kharif</i></b>						
1.	Paddy	0.75 (22.39)	0.25 (23.36)	0.5 (22.62)	1.38 (36.12)	0.45 (36.58)	0.91 (36.11)
2.	Jowar	1.09 (32.54)	0.43 (40.19)	0.76 (34.39)	1.26 (32.99)	0.36 (29.27)	0.81 (32.14)
3.	Redgram	1.51 (45.07)	0.39 (36.45)	0.95 (42.99)	1.18 (30.89)	0.42 (34.15)	0.8 (31.75)
4.	Fallow	0.59	0.29	0.44	0.07	0.11	0.09



5.	Total kharif	3.35	1.07	2.21	3.82	1.23	2.52
II	Rabi						
1.	Jowar	0.25 (13.16)	0.12 (17.91)	0.18 (14.18)	0.56 (19.58)	0.21 (20)	0.39 (20)
2.	Redgram	0.09 (4.74)	0.17 (25.38)	0.13 (10.24)	0.45 (15.73)	0.23 (21.9)	0.34 (17.43)
3.	Castor	0.68 (35.79)	0.15 (22.38)	0.41 (32.28)	1.38 (48.25)	0.35 (33.33)	0.86 (44.10)
4.	Bajra	0.88 (46.31)	0.23 (34.33)	0.55 (43.30)	0.47 (16.44)	0.26 (24.77)	0.36 (18.47)
5.	Fallow	2.04	0.69	1.38	1.03	0.29	0.66
6.	Total rabi	1.9	0.67	1.27	2.86	1.05	1.95
III	Average size of farm	3.94	1.36	2.65	3.89	1.34	2.61

Note : Figures in parentheses indicate percentage to gross cropped area

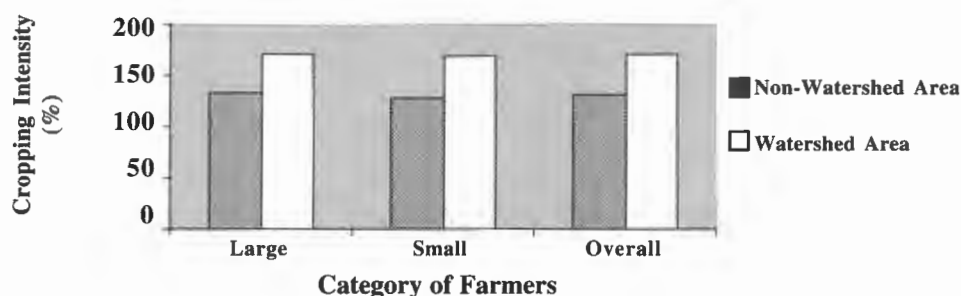
### Cropping intensity

It is evident from Table 3 that, the cropping intensity of large, small and pooled farmers (171.72, 170.14 and 171.64%, respectively) in watershed area was relatively higher than that of non-watershed area (133.24, 127.94 and 131.69%, respectively), the gross cropped area was more in case of watershed area (4.48 ha) compared to non-watershed area (3.49 ha). Apart from increase in the cultivated area, area under double cropping (71.64%) also increased in watershed area as compared to non-watershed (31.69%) area mainly because of better conservation of residual moisture in the *rabi* season. As a result, cropping intensity increased (171.64%) on watershed area.

The results, corroborate with the studies conducted by Jahagirdar (1991), Neema *et al.* (1991), Manhot *et al.* (1992) and others who observed that the programme had resulted in decline in the area under waste land and increase in cropping intensity. Therefore, in order to bring fallow land under cultivation and to increase cropping intensity, farmers need to be encouraged to follow watershed technology.

**Table 3: Cropping intensity of the sample farmers in non-watershed and watershed areas**

Category	Gross cropped area (ha)		Net cropped area (ha)		Cropping intensity (%)	
	Non-Watershed Area	Watershed Area	Non-Watershed Area	Watershed Area	Non-Watershed Area	Watershed Area
Large	5.25	6.68	3.94	3.89	133.24	171.72
Small	1.74	2.28	1.36	1.34	127.94	170.14
Overall	3.49	4.48	2.65	2.61	131.69	171.64

**Fig. 1 Cropping Intensity in Non-watershed and Watershed Areas**

### Impact on Income and Employment

The details of the overall per household income in the non-watershed and watershed areas are presented in Table 4.

The extent of income generated in watershed area for large farmers (Rs.45267.27) was higher by 28.4% over that of non-watershed area (Rs.35252.31). Similarly, the total income generated in watershed area for small farmers (Rs. 17043.88) was higher by 53.6% than that of non-watershed area (Rs. 11090.64). The extent of income generated in case of pooled farmers in watershed area (Rs.30655.56) was significantly higher (32.29%) than that of non-watershed area (Rs. 23171.47). So also the income generated in watershed area in case of pooled farmers in agriculture sector (Rs.27376.24), tree crops (Rs.817.66) animal husbandry (Rs.1480.83) was higher (43.62%, 2.10%, 5.27% respectively) than that of non-watershed area (Rs.19060.73, Rs. 800.83 and Rs. 1406.66, respectively). However, in case of labour the income generated was higher by (70.99%) in case of non-



watershed area. The income generated in watershed area in others is higher by (67.3%) than that of non-watershed area.

**Table : 4 Comparison of incomes of the sample farmers in non-watershed and watershed areas**

Sl. No	Source	Large		Small		Overall	
		Non-watershed	Watershed	Non-watershed	Watershed	Non-watershed	Watershed
1.	Agriculture	30244.15	40905.27	7877.31	13847.21	19060.73	27376.24
2.	Tree crops	1103.33	1130.33	498.33	505.00	800.83	817.66
3.	Animal husbandry	1723.33	1856.67	1090.00	1105.00	1406.66	1480.83
4.	Labour	1788.17	787.67	1398.33	1136.67	1593.25	462.17
5.	Others	393.33	587.33	226.67	450.00	310.00	518.66
6.	Total income	35252.31	45267.27	11090.64	17043.88	23171.47	30655.56
7.	Percentage change	28.40		53.67		32.29	

The per household income generated (Table 4 ) from the watershed area (Rs.30655.56) was found to be relatively higher than that of non-watershed area (Rs.23171.47). In percentage terms, the corresponding increase was 32.29 per cent. The positive change in yield levels and employment as well as additional income generated from multipurpose trees and animal husbandry brought about by effective implementation of watershed programme had given the opportunity to increase the income of the beneficiaries.

Past studies have revealed similar changes in income due to watershed development. Norman *et al.* (1991) reported 6.5 per cent increase in per household total income, Kumar and Dhawan (1992) observed 38.37, 52.99 and 53.45 per cent increase in per household income for small, medium and large farmers respectively after the project.

### **Income distribution**

It is necessary to note that the level of income and more so the level of equality achieved due to the watershed programme are important in evaluating the impact. Hence, the pattern of income distribution among the respondents in non-watershed and watershed areas was studied. To assess the pattern of income distribution the income of the individuals was divided into nine groups as shown in Tables 5 and 6.

**Non-watershed area**

It was observed (Table 5) that the lowest income earning families accounted for 15 per cent of the total households and their share in the total income earned by all the sample households was 5.6 per cent. The average income for the lowest income group was Rs.8657.03. The percentage of households in the highest income group was only 1.67 per cent and they earned 4.3 per cent of the total income. Nearly 64 per cent of the families share only 37.8 per cent of the total income.

**Table 5: Income distribution pattern among the sample farmers in non-watershed area**

Income groups (Rs)	Number of households	Per cent of households	Cumulative percentage	Total aggregate income in each group (Rs.)	Percentage of aggregate income	Cumulative percentage
< 10000	9	15.00	15.00	77913.30	5.60	5.60
10000 – 15000	22	36.67	51.67	265394.26	19.09	24.69
15000 – 20000	0	0.00	51.67	0.00	0.00	24.69
20000 – 25000	1	1.67	53.33	22851.87	1.64	26.34
25000 – 30000	6	10.00	63.33	160116.04	11.52	37.85
30000 – 35000	5	8.33	71.67	162252.98	11.67	49.52
35000 – 40000	10	16.67	88.33	385452.53	27.72	77.25
40000 – 45000	6	10.00	98.33	256516.05	18.45	95.70
> 45000	1	1.67	100.00	59791.75	4.30	100.00
Total	60	100.00		1390288.78	100.00	



### **Watershed area**

It is seen from Table 6 that the lowest income earning households accounted for 18.33 per cent and their contribution to the total income was 7.99 per cent. The average income for the lowest income group was Rs.13574.67. The percentage of farm families in the highest income group was 28.33 per cent and they contribute 54.36 per cent of the total income. Nearly 51.67 per cent of the families share 28.76 per cent of the total income.

**Table 6: Income distribution pattern among the farmers in watershed area**

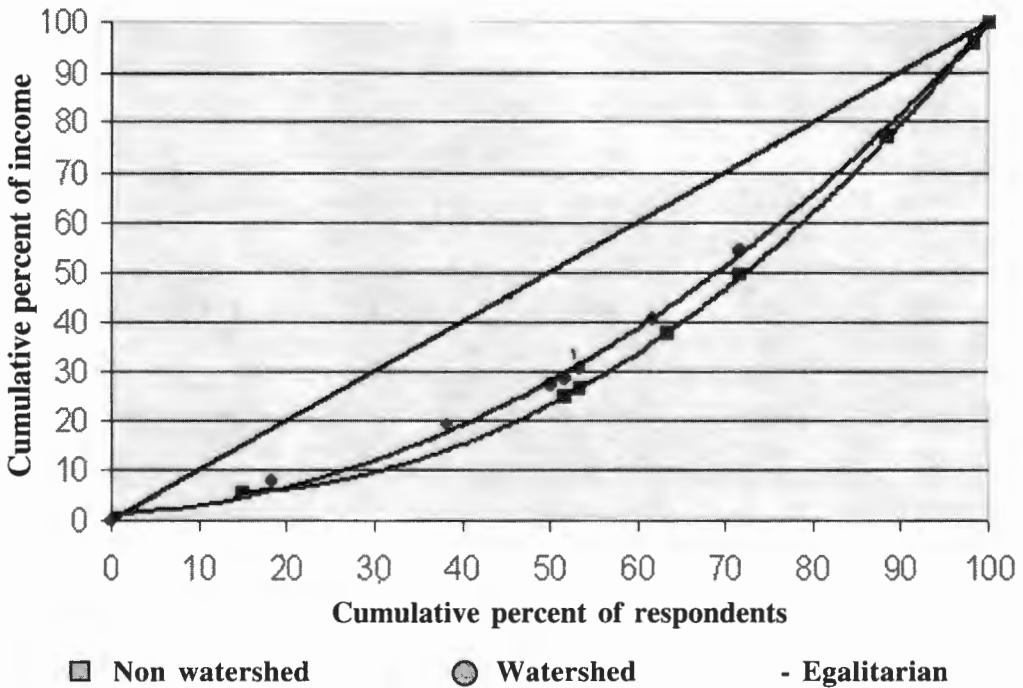
<b>Income groups (Rs.)</b>	<b>Number of house holds</b>	<b>Per cent of house holds</b>	<b>Cumulative percentage</b>	<b>Total aggregate income in each group (Rs.)</b>	<b>Percentage of aggregate income</b>	<b>Cumulative percentage</b>
< 10000	0	0.00	0.00	0.00	0.00	0.00
10000 – 15000	11	18.33	18.33	149321.38	7.99	7.99
15000 – 20000	12	20.00	38.33	208157.42	11.14	19.12
20000 – 25000	7	11.67	50.00	153837.60	8.23	27.35
25000 – 30000	1	1.67	51.67	26356.92	1.41	28.76
30000 – 35000	1	1.67	53.33	32683.00	1.75	30.51
35000 – 40000	5	8.33	61.67	187929.60	10.05	40.56
40000 – 45000	6	10.00	71.67	257941.92	13.80	54.36
> 45000	17	28.33	100.00	853096.73	45.64	100.00
Total	60	100.00		1869324.57	100.00	

The percentage of farm families in the highest income group (28.33% of the total household) in the watershed area was relatively higher over non-watershed (1.67%) area.

In order to compare the pattern of income distribution in non-watershed and watershed areas, the above values were presented in the form of Lorenz curve (Fig 2.)

It is clear from the curves that there exists an inequality in income distribution between the two groups (non-watershed and watershed area). Both the curves fell well below, the egalitarian line. To compare the two curves, the curve which represent the farmers group from the watershed area showed lesser inequality against the other group (non-watershed area).

**Figure:2 Lorenz curves depicting income inequalities in non-watershed and watershed areas**



**Quantification measures of distribution of income**

The distribution of income among pooled farmers in non-watershed and watershed areas were quantified with the help of gini concentration ratios (Table7). The Gini concentration ratio for the farmers in non-watershed area was 0.32 and the value reduced to 0.27 in watershed area.



**Table 7: Quantified values of income distribution in non-watershed and watershed areas**

	Non-watershed area	Watershed area
Gini concentration ratio (GCR)	0.32	0.27

After analyzing the two situations, the pattern of income distribution is comparatively better for watershed area than non-watershed area. There is a gradual movement of individuals from lower income group to higher income group. Lorenz curves plotted in order to study income inequalities revealed that there exists inequality in income distribution in both the groups i.e., watershed and non-watershed. However, the curve, which represents the farmers of watershed group, showed less inequality as against the non-watershed group. The inequalities in income were less in the watershed area because of higher returns due to adoption of watershed technology which accrued to more number of farmers in the watershed area.

Similarly, the Gini-concentration ratio for the farmers in the watershed area was 0.32 and for the farmers in the non-watershed area it was 0.27. The Gini-concentration ratio closer to zero indicates higher inequalities and the ratio nearer to the value one indicates less inequalities. It can be observed that comparatively lesser inequalities were associated with the farmers' income distribution in the watershed area. The results obtained in this study are in conformity with Arya and Grewal (1994) who reported that income disparities reduced after the project.

The employment levels of the farmers in the non-watershed and watershed areas are depicted in Table 8. The total employment days were conveniently divided into five groups viz., agriculture, tree crops, animal husbandry, labour and others. Others include business and service. The total employment generated in watershed area for large farmers (272.58 man days) was higher (10.47%) than that of non-watershed area (246.73 man days). Similarly the total employment generated in the watershed area for small farmers (2.68.2 man days) was higher (11.68%) than that of non-watershed area (240.14 man days). The total employment generated for pooled farmers in the watershed area (270.39 man days) was significantly higher (11.07%) than that of non-watershed area (243.43 man days).

The total employment generated for pooled farmers in the watershed area was significantly higher (11.07%) than that of the non-watershed area, from all the sectors/activities. In absolute terms, the total employment generated for pooled farmers per hectare in the watershed area from agriculture sector (173.77 man

days) was higher than the non-watershed area (152.25 man days). This was brought about by the improved level of technology which watershed farmers had practiced because of the favourable conditions in terms of better moisture conservation created by soil and water conservation measures as well as increase in cultivated area, cropping intensity and decrease in fallow land in watershed area especially during rabi season. Similar results were reported by Swarnalatha et al. (1994), Karam Singh et al. (1993) and Neema et al. (1991).

**Table 8: Employment levels of the sample farmers in non-watershed and watershed areas (in man days)**

Sl. No.	Source	Large		Small		Overall	
		Non-watershed	Water shed	Non-watershed	Water shed	Non-watershed	Water shed
1.	Agriculture	156.00	180.17	148.50	167.37	152.25	173.77
2.	Tree crops	11.40	15.87	9.80	15.20	10.60	15.53
3.	Animal husbandry	40.17	44.67	38.00	44.10	39.08	44.38
4.	Labour	28.83	17.37	35.77	28.53	32.30	22.95
5.	Others	10.33	14.50	8.07	13.00	9.20	13.75
6.	Total employment	246.73	272.58	240.14	268.20	243.43	270.39
7.	Percentage change	10.47		11.68		11.07	

### Farmers' perception

All the 60 sample farmers within the watershed area were asked to list their perceived benefits from the watershed project (Table 9 ).

All except two of the 60 farmers opined that the watershed development project was beneficial in realization of increased income, increased moisture availability, higher productivity and generation of additional employment. Reduced weed population and soil erosion, increased ground water recharge and safeguarded environment were the other benefits indicated by the farmers.



The main objective of the watershed development programme is improvement of productivity and elimination of poverty and unemployment of the village community. Due to the adoption of improved technology there was a significant increase in crop yields and employment generation in the watershed area, which had resulted in increased income to the farmers.

It is interesting to note that the practice of watershed technology was found beneficial in the form of control of weeds as opined by the farmers. This may be due to restriction of flow of run off water from one field to another carrying weed seeds because of contour bunds, live bunds, boulder bunds etc. The practice of watershed technology and adoption of soil and water conservation structures might have resulted in reduction of soil erosion and increased water conservation which led to recharge of ground water and a more safeguarded environment. Similar findings were reported by Shah and Patel (1997).

**Table 9: Farmer's perception about the benefits of the watershed development programme (n = 60)**

Sl. No.	Benefits	Number of respondents
1.	Increased moisture availability	31 (51.66)
2.	Weed control	26 (43.33)
3.	Reduced soil erosion	25 (41.66)
4.	Safeguarding environment	12 (20.00)
5.	Increased ground water recharge	14 (23.33)
6.	Increased productivity	29 (48.33)
7.	Increased employment	28 (46.66)
8.	Increased income	35 (58.33)
9.	No benefits	2 (3.33)

*Figures in parentheses indicate percentage to the total*

## **Conclusion**

The income generated per household from the watershed area was found to be relatively higher by 32.29 percent than that of the non-watershed area. Gini concentration ratio for the farmers in the watershed area was 0.32 and for the farmers in non-watershed area, it was 0.27, which indicates that comparatively lesser

inequalities were associated with the farmers' income distribution in watershed area. Watershed programme helps in generating additional income in rural areas.

The majority of the farmers felt that the watershed technology is beneficial and hence its adoption needs to be encouraged in rainfed areas. Watershed programme helps in generating additional income and employment in rural areas. Therefore, it can be taken up as a means of additional income and employment generation in rural areas.

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