
WATERSHED DEVELOPMENT AND INCOME INEQUALITIES: A STUDY OF HIMACHAL PRADESH

Dr. Anil Kumar

Ph.D., Department of Economics, Himachal Pradesh University, Summer Hill, Shimla

Abstract

The inequalities are natural as well as man-made. The natural inequalities occur mainly due to different geographical conditions prevailing in different regions, climatic differences, different topography and differences in soils, while the man-made disparities are caused by unequal distribution of means of production, economic concentration, poverty, capital intensive technology, low productivity per unit of labour, unemployment and under development, population growth, lack of irrigation, lack of employment opportunities in the industrial sector, as well as lack of transportation, power, education and health facilities. The results of the present study show that the watershed development programme increased the income and employment opportunities in the watershed areas. The income inequality among the beneficiary households is comparatively less as compared to non-beneficiary sample households.

Key Words: Watershed, Income, Inequalities

Introduction

The socio-economic inequalities in India, is not simply the outcome of population increase, stagnation of national output and rigidity of social systems. They are only the symptoms of the real disease. The real cause of Indian socio-economic disparities lies more in unemployment and inequality and distortions in the structure of production than in population increase, rigidity in the social systems and stagnation of national products. These disparities are also caused by the lack of purchasing power and paucity of consumer goods needed by the weaker-sections (i.e. scheduled castes, scheduled tribes, backward classes etc.). The degree of inequality of income and wealth, the concentration of economic surplus in relatively fewer hands and the fragmented allocated mechanisms constitute as socio-economic problem in which powerful dynamic forces tend to perpetuate and even accentuate low standards of living of significant proportion to our population.

Watershed development programme ensures best utilization of every drop of water and every inch of land to maximize the production of food, fodder, fiber, fruit and fuel. Watershed is a basin like landform defined by peaks which are connected with the ridge lined that descends into lower elevations and small valleys. The watershed based technology reduces erosion,

increases the water table and gives stability to production. The concept of watershed therefore covers not only the nature of endowment of land and water resources but also their use. Watershed also refers to a hydrological unit area which draining the runoff into a river or a reservoir or a pond or a common point. It has its own natural drainage system and responds more effectively to the various management techniques to maximize production. Watershed management is the balanced utilization of land and water resources for optimum production with hazards to natural resources. It essentially relates to soil and water conservation in the watershed which means land use according to land potential, protection of land, maintaining soil fertility, conserving water use, proper management of water drainage, flood protection and increasing productivity from all kinds of land use. The benefits of watershed management are; increase in cropping intensity, increase in production and productivity of crops, shifts in cropping pattern from less remunerative crops to profitable crops, increase yield and income of the farmers, creation of employment, rise in wages and increase in the number of working days per year for labour. The watershed planning involves evaluation of alternative uses of land at the micro-level for maximizing income and employment and improving the quality of life of the people living in a particular watershed. Watershed Planning may be defined as optimization of land use according to its production capacity, subject to proper conservation measures.

The watershed management programmes were initiated way back in 1880 on the recommendation of Famine Commission and subsequently by the Royal Commission of Agriculture in 1928 respectively. Both commission laid the foundation for organized research in a watershed framework. After Independence, the Government supported programme started in mid 1950's, when focus on watershed programme was sharpened with the establishment of the Soil Conservation Research, demonstration and training centres at eight locations. In a landmark decision, the soil and water conservation research and training institute was established by linking all the eight centres in 1956. The centre started watershed activities in locations mainly at a small-scale to understand the technical processes of soil degradation as well as soil conservation. The idea of area development in the context of drought prone area programme was put into practice by Government of India in 1971. Government of India to promote higher productivity in degraded and drought prone areas, as well as to protect these land and environment launched special programmes and implemented them

through concerned ministries and State Governments. The main purpose was to mitigate the adverse effects of drought, promote ideal land use and increased (biomass) production on a sustained basis by following watershed technique. The watershed development programmes are in operation in Himachal Pradesh, which includes mainly four programmes i.e. integrated wastelands development programme (IWDP), drought prone area programme (DPAP), desert development programme (DDP) and integrated watershed management programme (IWMP) are being implemented on watershed approach in the State as per the guidelines of the Government of India. The objectives of this programme are: To harvest the rainwater for the use of the farmers, main focus will be given to develop the rain fed areas in the State on watershed approach under integrated watershed management programme (IWMP).

Objectives and Methodology

In the present study an attempt has been made to examine the impact of Watershed Development Programme on income inequalities among the beneficiary and non-beneficiary sample households. The present study has been carried out during agricultural year 2014-15. A multistage random sampling technique has been adopted in order to select a representative sample of households. At the first stage all districts have been arranged in an ascending order on the basis of the number of watershed in each district. After this one tribal district i.e. Kinnaur and two non-tribal districts viz., Mandi and Shimla have been selected randomly. At the second stage all the blocks in the selected districts have been arranged according to their watershed numbers in an ascending order on the basis of treated area and one block has been selected randomly from each selected district i.e., Kalpa block in Kinnaur district, Dharmpur block in Mandi district and Mashobara block in Shimla district. At the third stage all the watersheds have been arranged according to their treated area in an ascending order and then we have selected one watershed randomly in each selected block i.e., Pangi Watershed in Kalpa block, Sajao-Piplu Watershed in Dharmpur block and Sheepur Nala Watershed in Mashobara block. After this a sample of 250 beneficiaries and 120 non-beneficiaries' farmers from all the selected watersheds has been selected randomly in proportion to the total number of households falling in each land holdings category. Further, the selected farmers have been divided into three categories according to their size of holdings, i.e. marginal farmers having less than 1 hectare, small farmers having 1-2 hectares and medium farmers having 2-10 hectares. In the present

study among the beneficiary households 125 farmers fall under the marginal holding, 75 on the small holding and 50 farmers fall on the medium size of holding group. Whereas among the non-beneficiary households 50 farmers fall in the category of marginal holding, 40 farmers on the small holding and 30 farmers fall on the medium size of holding group. It is important to mention here that there is no large size of holding in this study.

In the present study extent of income inequalities has been worked out with help of Lorenz Curve and Gini-coefficient. The value of Gini-coefficient for the distribution of per month average income among all the households has been worked out as follows:

$$G(Y) = 1 + \left(\frac{1}{n}\right) - \left(\frac{2}{n^2 z}\right) \sum_{i=1}^n (n+1-i)y_i$$

Where,

G = Gini-coefficient

y = Income (Rs.)

n = Population Size

z = Mean Income (Rs.)

y_i = Income of the i th person (Rs.)

To work out the impact of watershed development the percentage change has been worked out with the help of following formula

$$\text{Percentage Change} = \frac{X_1 - X_2}{X_2} \times 100$$

X_1 = value of parameter under project beneficiaries

X_2 = value of parameter under non-project beneficiaries

Results and Discussions

1 Extent of Income Inequalities among the Beneficiary Sample Households

This section deals with the extent of income inequalities among the beneficiary sample households.

1.1 Extent of Income Inequalities among the Beneficiary Marginal Households

The cumulative percentages of the household per month average income as well as the number of persons falling in each income groups among the marginal beneficiary households has been presented in Table 1. The cumulative percentage of income and population of the household falling on

the marginal holding group, when plotted on a graph paper gives the resultant shape of the Lorenz Curve which is evident from Figure 1. This Figure clearly shows that the bottom 30 per cent of the population is sharing about 24 per cent of total income, whereas the top 30 per cent of the population shared 39 per cent of the total income, which indicates minimum income inequalities in the distribution of income among the households falling on the marginal size of holding group.

Table: 1
Income Inequalities among the Beneficiary Marginal Households

(Income in Rs.)

Income Group (Rs.)	Monthly Income (Rs.)	Cumulative Monthly Income (Rs.)	Cumulative Percentage	No. of Persons	Cumulative Persons	Cumulative Percentage
0-10000	407252	407252	32.93	268	268	41.55
10000-12000	149500	556752	45.02	82	350	54.26
12000-14000	277500	834252	67.46	140	490	75.97
14000-18000	280356	1114608	90.13	104	594	92.09
18000 & Above	122000	1236608	100.00	51	645	100.00

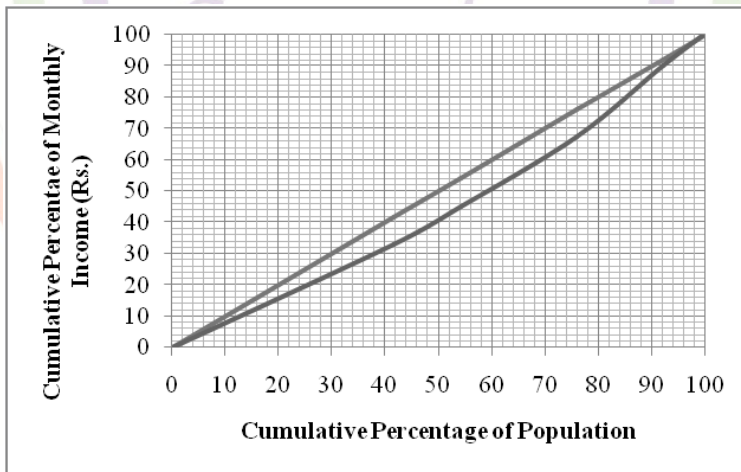


Figure: 1
Income Inequalities among the Beneficiary Marginal Households

The value of Gini-coefficient for the distribution of per month average income of households falling on the marginal size of holding group has been worked out as follows:

$$G(Y) = 1 + \left(\frac{1}{n}\right) - \left(\frac{2}{n^2 z}\right) \sum_{i=1}^n (n+1-i)yi$$

$$\sum_{i=1}^n (n+1-i)yi = 345515092$$

$$n = 645$$

$$Z = \frac{1236608}{645} = 1917.22$$

Therefore,

$$\begin{aligned} G(Y) &= 1 + \frac{1}{645} - \frac{2}{645^2 \times 1917.22} (345515092) \\ &= 1.0015 - \frac{2}{797611450.50} (345515092) \\ &= 1.0015 - 0.0000000025 (345515092) \\ &= 1.0015 - 0.8664 = 0.1351 \end{aligned}$$

Thus, the value of $G(Y) = 0.1351$

The shape of Lorenz curve as well as the value of Gini-coefficient for the income distribution of household falling on the marginal holding group which came out 0.1351, clearly shows the fact that the extent of relative income inequalities among the marginal households is minimum.

1.2 Income Inequalities among the Beneficiary Small Households

The cumulative percentages of the household per month average income as well as the number of persons falling in each income groups among the beneficiary small households has been presented in Table 2. The cumulative percentage of income and population of the household falling on the small holding group, when plotted on a graph paper gives the resultant shape of the Lorenz curve which is evident from Figure 2. This Figure clearly shows that the bottom 30 per cent of the population is sharing about 18 per cent of total income, whereas top 30 per cent of the population shared about 52 per cent of the total household income.

Table: 2
Income Inequalities among the Beneficiary Small Households

(Income in Rs.)

Income Group (Rs.)	Monthly Income (Rs.)	Cumulative Monthly Income (Rs.)	Cumulative Percentage	No. of Persons	Cumulative Persons	Cumulative Percentage
0-10000	58000	58000	2.59	29	29	6.32
10000-20000	372000	430000	19.18	124	153	33.33
20000-35000	838000	1268000	56.57	204	357	77.78
35000 & above	973514.5	2241514.5	100.00	102	459	100.00

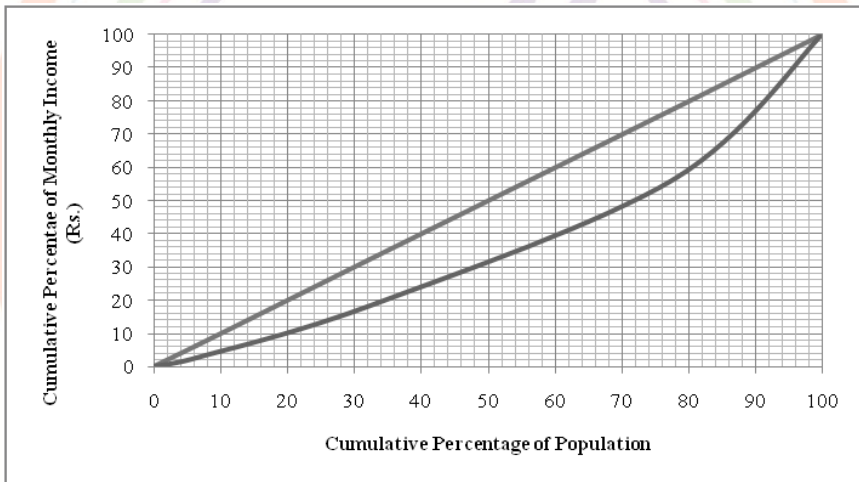


Figure: 2
Income Inequalities among the Beneficiary Small Households

The value of Gini-coefficient for the distribution of per month average income of households falling on the small size of holding group has been worked out as follows:

$$G(Y) = 1 + \left(\frac{1}{n}\right) - \left(\frac{2}{n^2 z}\right) \sum_{i=1}^n (n+1-i) y_i$$

$$\sum_{i=1}^n (n+1-i)y_i = 343435514.50$$

$$n = 459$$

$$Z = \frac{2241515}{459} = 4883.47$$

Therefore,

$$G(Y) = 1 + \frac{1}{459} - \frac{2}{459^2 \times 4883.47} (343435514.50)$$

$$= 1.0022 - \frac{2}{1028854343} (343435514.50)$$

$$= 1.0022 - 0.000000002 (343435514.50)$$

$$= 1.0022 - 0.6869 = 0.3153$$

Thus, the value of $G(Y) = 0.3153$

The shape of the Lorenz curve as well as the value of Gini-coefficient i.e. 0.3153 of the income distribution among the households falling on the small size of holding group, if compared with the shape of the Lorenz curve and the value Gini-coefficient of the income distribution among the marginal households, i.e. 0.1351 clearly indicates relatively higher inequalities of income distribution among the former holding group than the latter holding group.

1.3 Income Inequalities among the Beneficiary Medium Households

The cumulative percentages of the household per month average income as well as the number of persons falling in each income groups among the beneficiary medium households have been presented in Table 3. The cumulative percentage of income and population of the households falling on the semi-medium holding group, when plotted on a graph paper gives the resultant shape of the Lorenz Curve which is evident from Figure 3. This Figure clearly shows that the bottom 30 per cent population is sharing 10 per cent of total income, whereas the top 30 per cent population shared 56 per cent of the total household income.

Table: 3
Income Inequalities among the Beneficiary Medium Households
(Income in Rs.)

Income Group (Rs.)	Monthly Income (Rs.)	Cumulative Monthly Income (Rs.)	Cumulative Percentage	No. of Persons	Cumulative Persons	Cumulative Percentage
0-25000	120000	120000	2.64	24	24	6.67
25000-30000	390000	510000	11.22	90	114	31.67
30000-40000	840000	1350000	29.70	106	220	61.11
40000 & above	3195741	4545741	100.00	140	360	100.00

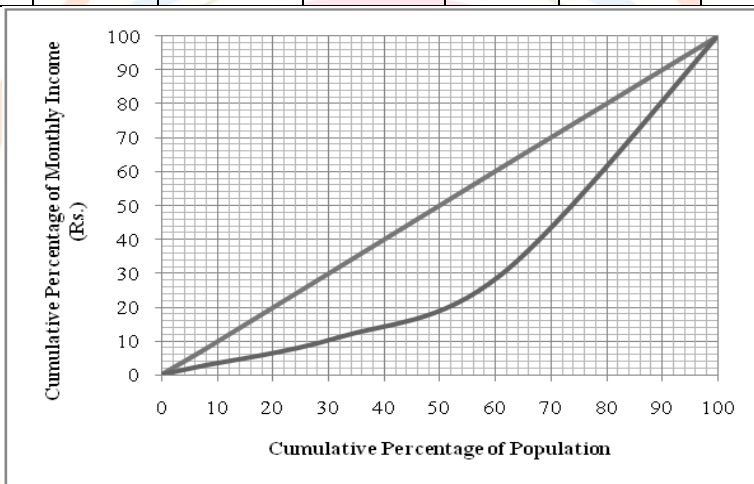


Figure: 3
Income Inequalities among the Beneficiary Medium Households

The value of Gini-coefficient for the distribution of per month average income of households falling on the semi-medium size of holding group has been worked out as follows:

$$G(Y) = 1 + \left(\frac{1}{n}\right) - \left(\frac{2}{n^2 z}\right) \sum_{i=1}^n (n + 1 - i)yi$$

$$\sum_{i=1}^n (n + 1 - i)yi = 323055741$$

$$n = 360$$

$$Z = \frac{4545741}{360} = 12627.06$$

Therefore,

$$\begin{aligned} G(Y) &= 1 + \frac{1}{360} - \frac{2}{360^2 \times 12627.06} (323055741) \\ &= 1.0028 - \frac{2}{1636466976} (323055741) \\ &= 1.0028 - 0.0000000012 (323055741) \\ &= 1.0028 - 0.3877 = 0.6151 \end{aligned}$$

Thus, the value of $G(Y) = 0.6151$

The shape of the Lorenz curve as well as the value of Gini-coefficient i.e. 0.6151 of the income distribution among the households falling on the medium size of holding group, if compared with the shape of the Lorenz curve and the value of Gini-coefficient of the income distribution among the small households, i.e. 0.3153 clearly indicates relatively higher inequalities of income distribution among the former holding group than the latter holding group.

1.4 Income Inequalities among All the Beneficiary Households

The cumulative percentages of the household per month average income as well as the number of persons falling in each income groups among all the beneficiary sample households has been presented in Table 4. The cumulative percentage of income and population of the household falling on the all holding group, when plotted on a graph paper gives the resultant shape of the Lorenz Curve which is evident from Figure 4. This Figure clearly shows that the bottom 30 per cent of the population is sharing 12 per cent of total income, whereas top 30 per cent of the population is sharing about 68 per cent of the total household income.

Table: 4
Income Inequalities among All the Beneficiary Households

(Income in Rs.)

Income Group (Rs.)	Monthly Income (Rs.)	Cumulative Monthly Income (Rs.)	Cumulative Percentage	No. of Persons	Cumulative Persons	Cumulative Percentage
0-25000	1786608.00	1786608.00	22.27	822.00	822.00	56.15
25000-35000	1228000.00	3014608.00	37.57	294.00	1116.00	76.23
35000-40000	1813514.50	4828122.50	60.17	208.00	1324.00	90.44
40000 & above	3195741.00	8023863.50	100.00	140.00	1464.00	100.00

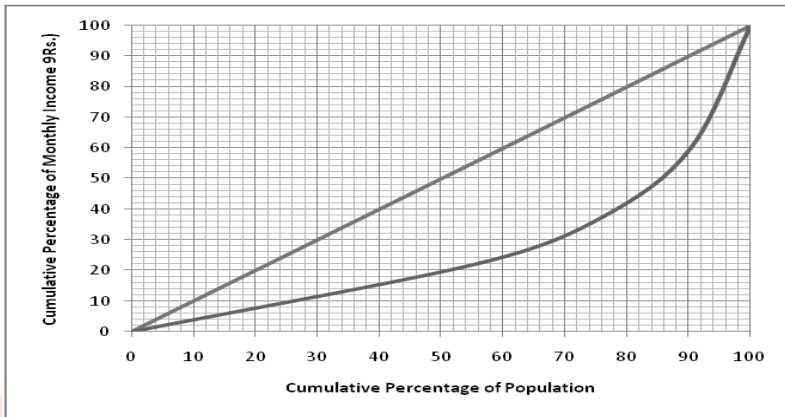


Figure: 4
Income Inequalities among All the Beneficiary Households

The value of Gini-coefficient for the distribution of per month average income among all the households has been worked out as follows:

$$G(Y) = 1 + \left(\frac{1}{n}\right) - \left(\frac{2}{n^2 Z}\right) \sum_{i=1}^n (n+1-i)yi$$

$$\sum_{i=1}^n (n+1-i)yi = 2612243090$$

$$n = 1464$$

$$Z = \frac{8023863.50}{1464} = 5480.78$$

Therefore,

$$G(Y) = 1 + \frac{1}{1464} - \frac{2}{1464^2 \times 5480.78} (2612243090)$$

$$= 1.0007 - \frac{2}{11746936164} (2612243090)$$

$$= 1.0007 - 0.0000000002 (2612243090)$$

$$= 1.0007 - 0.4447 = 0.5559$$

Thus, the value of $G(Y) = 0.5559$

Both the shape of Lorenz curve as well as the value of the Gini-coefficient i.e. 0.5559 which are based on the aggregated analysis of the distribution of household income clearly indicate the overall income inequality prevailing among all the sample households in the study area. But the analysis of income distribution with the help of disaggregated analysis by size class of holdings clearly reveals the sharp variation in the distribution of household income among the different holding groups i.e. the extent of relative income inequalities indicates an increasing tendency with an increase in the size of holdings.

2. Extent of Income Inequalities among the Non-Beneficiary Sample Households

This section deals with the extent of inequalities in the distribution of income among the non-beneficiary sample households.

2.1 Income Inequalities among the Non-Beneficiary Marginal Households

The cumulative percentages of the household per month average income as well as the number of persons falling in each income groups among the non-beneficiary marginal households has been presented in Table 5. The cumulative percentage of income and population of the household falling on the marginal holding group, when plotted on a graph paper gives the resultant shape of the Lorenz Curve which is evident from Figure 5. This Figure clearly shows that the bottom 30 per cent of the population is sharing 22 per cent of total income, whereas the top 30 per cent of the population shared 48 per cent of the total income, which indicates minimum income inequalities in the distribution of income among the households falling on the marginal size of holding group.

Table: 5
Income Inequalities among the Non-Beneficiary Marginal Households
(Income in Rs.)

Income Group (Rs.)	Monthly Income (Rs.)	Cumulative Monthly Income (Rs.)	Cumulative Percentage	No. of Persons	Cumulative Persons	Cumulative Percentage
0-2000	25156	25156	11.45	36	36	15.06
2000-3000	54446	79602	36.24	79	115	48.12
3000-10000	62066	141668	64.49	88	203	84.94
10000 & above	78000	219668	100.00	36	239	100.00

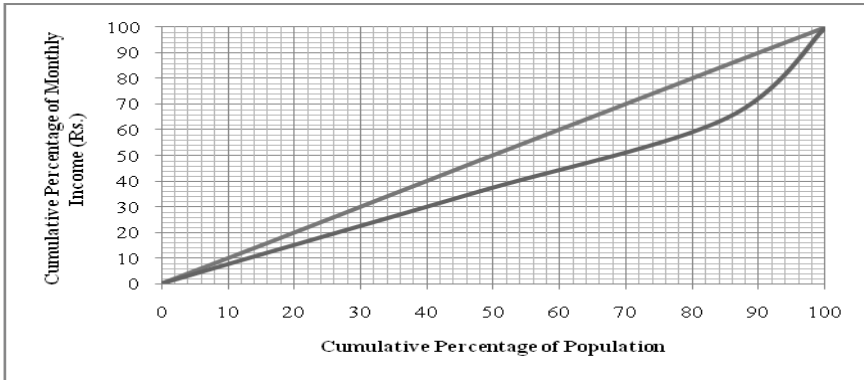


Figure: 5

Extent of Income Inequalities among the Non-Beneficiary Marginal Households

The value of Gini-coefficient for the distribution of per month average income of households falling on the marginal size of holding group has been worked out as follows:

$$G(Y) = 1 + \left(\frac{1}{n}\right) - \left(\frac{2}{n^2 Z}\right) \sum_{i=1}^n (n+1-i)yi$$

$$\sum_{i=1}^n (n+1-i)yi = 2119354736$$

$$n = 239$$

$$Z = \frac{219668}{239} = 918.11$$

Therefore,

$$G(Y) = 1 + \frac{1}{239} - \frac{2}{239^2 \times 918.11} (2119354736)$$

$$= 1.0042 - \frac{2}{52443361.31} (2119354736)$$

$$= 1.0042 - 0.000000038 (2119354736)$$

$$= 1.0042 - 0.8054 = 0.1988$$

Thus, the value of $G(Y) = 0.1988$

The shape of Lorenz curve as well as the value of Gini-coefficient for the income distribution of household falling on the marginal holding group which came out 0.1988, clearly shows the fact that the extent of relative income inequalities among the marginal households is minimum.

2.2 Income Inequalities among the Non-Beneficiary Small Households

The cumulative percentages of the household per month average income as well as the number of persons falling in each income groups among the small households has been presented in Table 6. The cumulative percentage of income and population of the household falling on the small holding group, when plotted on a graph paper gives the resultant shape of the Lorenz curve which is evident from Figure 6. This Figure clearly shows that the bottom 30 per cent of the population is sharing less than 20 per cent of total income, whereas top 30 per cent of the population shared about 51 per cent of the total household income.

Table: 6
Income Inequalities among the Non-Beneficiary Small Households
(Income in Rs.)

Income Group (Rs.)	Monthly Income (Rs.)	Cumulative Monthly Income (Rs.)	Cumulative Percentage	No. of Persons	Cumulative Persons	Cumulative Percentage
0-5500	34020	34020	4.90	33	33	16.26
5500-6000	63210	97230	14.00	52	85	41.87
6000-8000	80220	177450	25.54	33	118	58.13
8000-40000	103800	281250	40.48	21	139	68.47
40000 & above	413481.2	694731.2	100.00	64	203	100.00

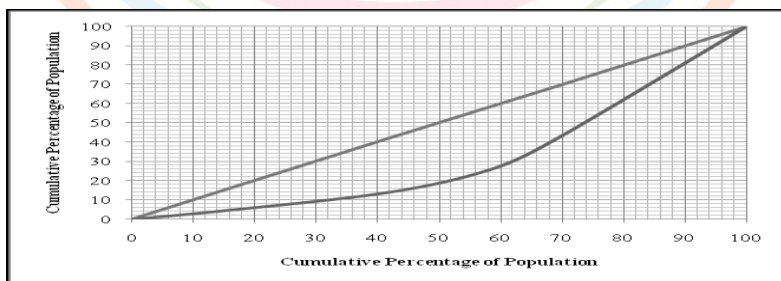


Figure: 6
Income Inequalities among the Non-Beneficiary Small Households

The value of Gini-coefficient for the distribution of per month average income of households falling on the small size of holding group has been worked out as follows:

$$G(Y) = 1 + \left(\frac{1}{n}\right) - \left(\frac{2}{n^2 z}\right) \sum_{i=1}^n (n+1-i)yi$$

$$\sum_{i=1}^n (n+1-i)yi = 41780130.33$$

$$n = 203$$

$$Z = \frac{694731.20}{203} = 3422.32$$

Therefore,

$$G(Y) = 1 + \frac{1}{203} - \frac{2}{203^2 \times 3422.32} (41780130.33)$$

$$= 1.0049 - \frac{2}{14103038.80} (41780130.33)$$

$$= 1.0049 - 0.000000014 (41780130.33)$$

$$= 1.0049 - 0.5849 = 0.4200$$

Thus, the value of $G(Y) = 0.4200$

The shape of the Lorenz curve as well as the value of Gini-coefficient i.e. 0.4200 of the income distribution among the households falling on the small size of holding group, if compared with the shape of the Lorenz curve and the value Gini-coefficient of the income distribution among the marginal households, i.e. 0.1988 clearly indicates relatively higher inequalities of income distribution among the former holding group than the latter holding group.

2.3 Extent of Income Inequalities among the Medium Non-Beneficiary Households

The cumulative percentages of the household per month average income as well as the number of persons falling in each income groups among the non-beneficiary medium households have been presented in Table 7. The cumulative percentage of income and population of the households falling on the semi-medium holding group, when plotted on a graph paper gives the resultant shape of the Lorenz Curve which is evident from Figure 7. This Figure clearly shows that the bottom 30 per cent population is sharing less

than 20 per cent of total income, whereas the top 30 per cent population shared about 82 per cent of the total household income.

Table 7
Income Inequalities among the Non-Beneficiary Medium Households
(Income in Rs.)

Income Group (Rs.)	Monthly Income (Rs.)	Cumulative Monthly Income (Rs.)	Cumulative Percentage	No. of Persons	Cumulative Persons	Cumulative Percentage
0-10000	84570	84570	4.87	56	56	29.95
10000-15000	93960	178530	10.28	52	108	57.75
15000-90000	387340	565870	32.57	44	152	81.28
90000 & above	1171389	1737259	100.00	35	187	100.00

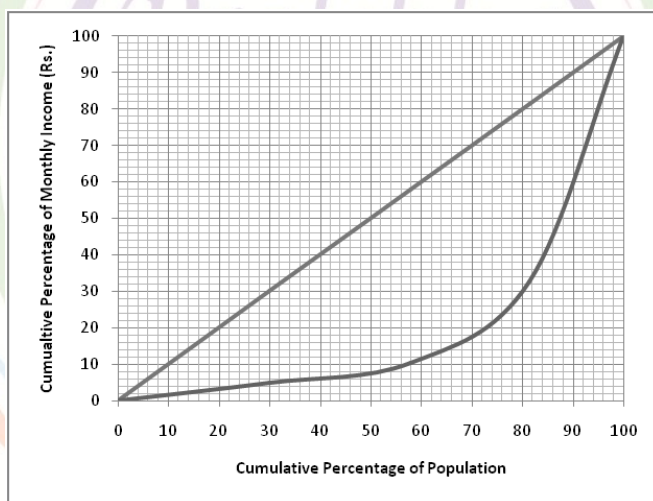


Figure: 7
Income Inequalities among the Non-Beneficiary Medium Households

The value of Gini-coefficient for the distribution of per month average income of households falling on the semi-medium size of holding group has been worked out as follows:

$$G(Y) = 1 + \left(\frac{1}{n}\right) - \left(\frac{2}{n^2 Z}\right) \sum_{i=1}^n (n+1-i)y_i$$

$$\sum_{i=1}^n (n+1-i)y_i = 48425526.19$$

$$n = 187$$

$$Z = \frac{1737259}{187} = 9290.16$$

Therefore,

$$G(Y) = 1 + \frac{1}{187} - \frac{2}{187^2 \times 9290.16} (48425526.19)$$

$$= 1.0053 - \frac{2}{324867605} (48425526.19)$$

$$= 1.0053 - 0.000000006 (48425526.19)$$

$$= 1.0053 - 0.2905 = 0.7148$$

Thus, the value of $G(Y) = 0.7148$

The shape of the Lorenz curve as well as the value of Gini-coefficient i.e. 0.7148 of the income distribution among the households falling on the medium size of holding group, if compared with the shape of the Lorenz curve and the value of Gini-coefficient of the income distribution among the small households, i.e. 0.4200 clearly indicates relatively higher inequalities of income distribution among the former holding group than the latter holding group.

1.2.8 Extent of Income Inequalities among All the Non-Beneficiary Households

The cumulative percentages of the household per month average income as well as the number of persons falling in each income groups among all the non-beneficiary sample households has been presented in Table 8. The cumulative percentage of income and population of the household falling on the all holding group, when plotted on a graph paper gives the resultant shape of the Lorenz Curve which is evident from Figure 8. This Figure clearly shows that the bottom 30 per cent of the population is sharing less than 10 per cent of total income, whereas top 30 per cent of the population is sharing about 80 per cent of the total household income.

Table: 8
Income Inequalities among All the Non-Beneficiary Households
 (Income in Rs.)

Income Group (Rs.)	Monthly Income (Rs.)	Cumulative Monthly Income (Rs.)	Cumulative Percentage	No. of Persons	Cumulative Persons	Cumulative Percentage
0-10000	403688.00	403688.00	15.22	377.00	377.00	59.94
10000-25000	171960.00	575648.00	21.71	88.00	465.00	73.93
25000-40000	103800.00	679448.00	25.62	21.00	486.00	77.27
40000 & Above	1972210.20	2651658.20	100.00	143.00	629.00	100.00

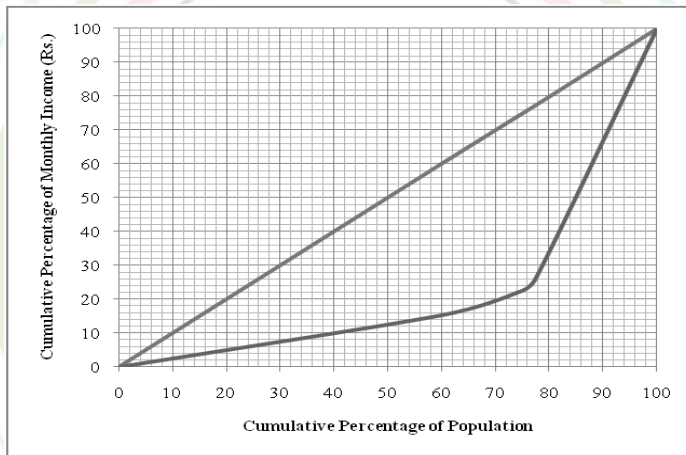


Figure: 8
Income Inequalities among All the Non-Beneficiary Households

The value of Gini-coefficient for the distribution of per month average income among all the households has been worked out as follows:

$$G(Y) = 1 + \left(\frac{1}{n}\right) - \left(\frac{2}{n^2 z}\right) \sum_{i=1}^n (n+1-i) y_i$$

$$\sum_{i=1}^n (n+1-i) y_i = 366247905.32$$

$$n = 629$$

$$Z = \frac{2651658.10}{629} = 4215.67$$

Therefore,

$$\begin{aligned} G(Y) &= 1 + \frac{1}{629} - \frac{2}{629^2 \times 4215.67} (366247905.32) \\ &= 1.0016 - \frac{2}{1667891894} (366247905.32) \\ &= 1.0016 - 0.0000000012 (366247905.32) \\ &= 1.0016 - 0.3914 = 0.6102 \end{aligned}$$

Thus, the value of $G(Y) = 0.6102$

Both the shape of Lorenz curve as well as the value of the Gini-coefficient i.e. 0.6103 which are based on the aggregated analysis of the distribution of household income clearly indicate the overall income inequality prevailing among all the sample households in the study area. But the analysis of income distribution with the help of disaggregated analysis by size class of holdings clearly reveals the sharp variation in the distribution of household income among the different holding groups i.e. the extent of relative income inequalities indicates an increasing tendency with an increase in the size of holdings.

3 Percentage Change in the Extent of Income Inequalities among the Beneficiary Sample Households In comparison to Non-Beneficiary Sample Households

The percentage change in the extent of income inequalities among the beneficiary sample households in comparison to non-beneficiary sample households has been presented in Table 9.

Table: 9
Percentage Change in the Extent of Income Inequalities Distribution among the Beneficiary Sample Households In comparison to Non-Beneficiary Sample Households

Particulars	Extent of Income Inequalities		
	Beneficiary Households	Non-Beneficiary Households	Percentage Change
Marginal Holdings	0.1351	0.1988	-32.04
Small Holdings	0.3153	0.4200	-24.93
Medium Holdings	0.6151	0.7148	-13.95
All Holdings	0.5566	0.6102	-8.75

This Table shows that among the beneficiary sample households the value of Gini-coefficient has been worked out -32.04, -24.93, -13.95 and -8.75 less on the marginal, small, medium and all size holdings in comparison to non-beneficiary sample households.

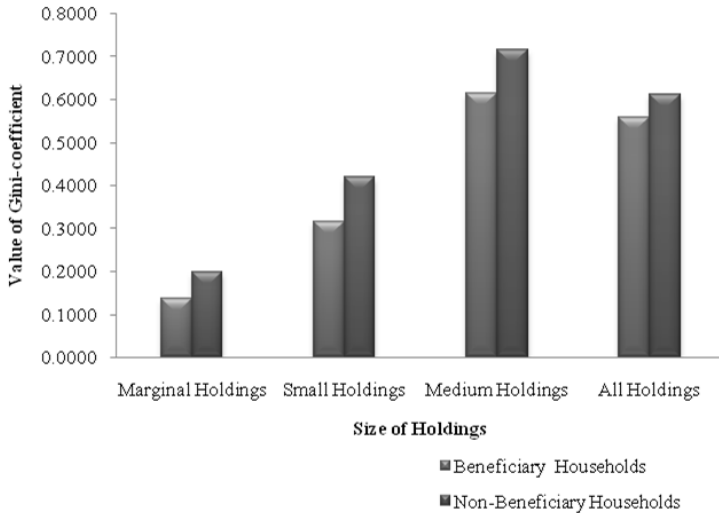


Figure: 9
Extent of Income Inequalities among the Beneficiary and Non-Beneficiary the Sample Households

It is also evident from the Figure 9 that there exists, less inequalities among the beneficiary households in-comparison to non-beneficiary households. This change among beneficiary households occurs due to watershed development works on their farms.

Conclusions and Recommendations

Thus from the above analysis it can be concluded that there exists less income inequalities among the beneficiary households in comparison to non-beneficiary households. These percentage changes in income inequalities among the beneficiary households occurs due to watershed development activities on beneficiary farms such as soil and conservation, land development works etc. To reduce the extent of income inequalities among the non-beneficiary sample households Government must also provide desired high yielding variety of seeds on cheap rate, open more fertilizer outlets in the watershed areas, distribute organic manure to the households

to overcome the problem of manure, provide more adequate supply of plant protection material on cheap rate and more extension services regarding agriculture should be provide to households to keeping their knowledge update. Government must open horticulture nurseries in the watershed areas. The sapling of desired variety must be distributed in the watershed areas on cheap rate to overcome the problem of high cost of orchard establishment and more extension service regarding horticulture should be provided to orchardists through various awareness camps, training seminar etc. Thus it can be concluded that the watershed development programme is an area based approach which works toward inclusive growth and sustainable development. The adoption of watershed approach has improved the production, productivity and thereby the income of the beneficiary households in the study areas.

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