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IMPACT OF SOLAR IRRIGATION ON FARM INCOME DISTRIBUTION, CONSUMPTION AND SAVING PATTERN IN ANANTHAPUR DISTRICT OF ANDHRA PRADESH, INDIA

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ABSTRACT

Solar farmers with a Gini coefficient of 0.339 showed lesser inequality relative to 0.406 Gini value of non-solar farmers in respect of income distribution.Family expenditure pattern of solar and non-solar farmers showed Rs.3,31,388 and Rs.3,17,081 per household per annum respectively.With the family expenditure being more or less closer for the selected two groups of the farmers, the savings did not show much of a deviation between the two categories of the farmers. The amount of savings generated by the two categories of the farmers stood at Rs.32,702 and Rs.31,504 per annum respectively.

KEYWORDS: *income distribution, family expenditure pattern, savings, gini coefficient.*

INTRODUCTION

The Government of India has set a target of doubling farmers' income by 2022. It has also set an ambitious target of 100 GW of solar power generation by 2022. Sharing the same time period, the twin goals are very much in tandem with each other. In the growth of agriculture in India, the role of irrigation, especially groundwater irrigation, is well documented and hence to enhance farmers' income, groundwater irrigation has to play a major role. The groundwater extraction for irrigation now totally depends on electric and diesel sources of energy, which plays a crucial role in breaking the vicious cycle of poverty by providing food and income security. There are around 26 million irrigation pumps in India. Of which, about 8 million pumps are diesel-run and 18 million are electric pumps. Agricultural sector shared 17.30 per cent of the total electricity consumption in India during 2015-16 (MOSPI, 2017) [(1)] and accounted for about 13 per cent of total diesel consumption in India (PPAC, 2013) [(2)]. It has been estimated that the replacement of existing diesel and electricity based pumpsets can lead to a reduction of 62 billion kilogram equivalent of carbon dioxide ($kgCO_2e$) emissions and savings of USD 11.5 billion per annum (Infraline Energy, 2014)[(3)].

In Andhra Pradesh, Ananthapur district required a boost of electricity for irrigation of crops, which was limited in the region, and thus affecting the farming community. Addressing this concern, an NGO Rural Development Trust (RDT), Ananthapur introduced pumpsets, driven by solar power and systems of drip irrigation, which supplied water to horticulture crops timely and efficiently to reduce the use of fossil fuel powered conventional electricity. RDT, Ananthapur had its own program running for solar pumpsets to the farmers of Ananthapur from 2005 and till March, 2016, 518 (each for 10 acres) solar pumpsets has been granted covering 2208 ha in 317 villages. With information and assistance from RDT, farmers had shifted their cropping pattern from groundnut to horticulture and vegetable crops. Considering the above facts, the present study entitled "Impact of solar irrigation on farm income distribution, consumption and saving pattern in Ananthapur district of Andhra Pradesh" has been taken up with following specific objectives.

OBJECTIVES

1. to compare the farm income distribution among the sample farmers, and
2. to study the impact of farm income on consumption and saving pattern of the sample farmers.

METHODOLOGY

The present study was conducted in Ananthapur district of Andhra Pradesh state. Purposive-cum-random sampling technique was employed for the selection of sample in the present study. Ananthapur is an arid zone with frequent droughts where rainfed and dry land agriculture is predominant, wherein the need for electricity for irrigation purpose is very high. Government and NGOs are trying to transform the district into a horticulture hub with subsidies on saplings and solar irrigation pumps and on drip irrigation system. Hence, Ananthapur district was purposively selected for present study. The list of mandals along with corresponding number of solar pumpsets was prepared. Four mandals with highest number of solar pumpsets was identified and purposively selected. The list of all villages covered under four mandals was prepared and analogously one village from each mandal with highest number of solar pumpsets was purposively selected. All the farmers in the selected four villages with solar pumpsets were listed out and 50 farmers were randomly selected. Another set of 50 farmers without solar pumpsets from the same villages were also randomly selected to serve as a control group. The information related to the present study was collected using a well-defined and pre-tested schedule through personal interview method. Detailed information was collected and it pertained to the agricultural year 2016-17.

TOOLS AND TECHNIQUES OF ANALYSIS

MEASURES OF INEQUALITY

The simplest way to measure inequality is by dividing the population into quintiles from poorest to richest, and reporting the levels or proportions of income that accrue to each level.

1. Gini Coefficient of Inequality

Gini coefficient of inequality was defined as the proportion of area under diagonal line which is known as Lorenz curve. Its value ranges from 0 to 1. More equal the income distribution, closer is the ratio to zero and if the degree of inequality is greater, then closer is the ratio to one. A Gini ratio of zero would mean that every individual would receive exactly the same income, while a ratio of one would mean an individual received all the income. The following formula was used to calculate the Gini concentration ratio.

$$GCR = 1 - \sum P_j (Q_j + Q_j - 1)$$

where,

GCR	=	Gini concentration ratio
P_j	=	Proportion of families in the j^{th} group
$Q_j + Q_j - 1$	=	Cumulative proportion of incomes in the j^{th} and $(j-1)^{th}$ farm household.

2. Lorenz Curve

Lorenz curve is a graphical device to represent the size distribution of income. The curve relates the cumulative proportion of the population to the cumulative proportion of income received. To construct the Lorenz curve graph, the cumulative percentage of households (from poor to rich) on the horizontal axis and the cumulative percentage of income on the vertical axis were taken. If all the members of the population received equal income or wealth, the Lorenz curve would coincide with the curve of absolute equality. Otherwise, it would be below the diagonal. The diagonal line is the curve ofequal distribution. The departure of the actual curve from the line of perfect equality shows the degree of inequality. A merit of the Lorenz curve technique is that it enables to compare the distribution in dissimilar units.

RESULTS AND DISCUSSION

1. COMPARISON OF FARM INCOME DISTRIBUTION AMONG THE SAMPLE FARMERS

Rainfed agriculture poses many challenges to the farming community. Farmers struggle year after year under the uncertanities of rainfed agriculture. This poor farmers need some sort of assistance to circumvent the effects of uncertain agriculture. Several programmes have been initiated by the government and NGOs from time to time with an objective of improving access to water for irrigation, reduce the cost of irrigation to the farmers and improving agricultural productivity. Solar pumps backed up by water harvesting techniques and drip irrigation can provide farmer's control over water supply and this may allow them to diversify their cropping pattern and produce high value commodities. Now the interest is studying the impact of the intervention of solar pumpsets on income distribution of beneficiaries vis-a-vis non-solar farmers.

1.1 MEASURES OF INCOME INEQUALITY

1.1.1 Distribution of Households of Solar Farmers According to Income

The particulars of distribution of incomes among farm families of solar farmers are presented in **Table 1.A.1** The lower income earning families accounted for 4 per cent of the total farm families and their share in the total income earned by all the selected families was 1.52 per cent. The percentage of families in the highest income group was 2 and they earned 18.06 per cent of the total income. Nearly 78 per cent of the farm families was between the income limit of Rs.45,000 and their share in the total income was 25.91 per cent.

Table 1.A.1 Distribution of households of solar farmers according to income

Income	No. of farmers	Percentage of farmers	Cumulative percentage of farmers	Average income	Percentage of income	Cumulative percentage of income
0 - 9000	2	4	4	7,185.00	1.52	1.52
9001 - 18000	20	40	44	15,443.40	3.26	4.77
18001 -27000	2	4	48	25,192.50	5.31	10.09
27001 -36000	9	18	66	32,722.00	6.90	16.99
36001 -45000	6	12	78	42,297.17	8.92	25.91
45001 -54000	3	6	84	52,908.00	11.16	37.07
54001 -63000	4	8	92	61,521.00	12.98	50.04
63001 -72000	2	4	96	71,535.50	15.09	65.13
72001 -81000	1	2	98	79,687.00	16.81	81.94
81001 -90000	1	2	100	85,650.00	18.06	100.00
Total	**50**	**100**		**4,74,141.57**	**100.00**	

1.1.2 Distribution of Households of Non-Solar Farmers According to Income

The particulars in **Table1.A.2** revealed that the least income earning families accounted for 24 per cent of the total farm families and their share in the total income earned by all the selected families was 1.15 per cent. The percentage of families in the highest income group was 4 per cent and they earned 18.77 per cent of the total income. 72 per cent of the farm families was between the income limit of Rs.45,000 and their share in the total income was 24.69 per cent.

The income distribution pattern revealed that in respect of solar farmers the percentage of farmers within the income range of Rs.9,000 was 4 as against 24 per cent in respect of non-solar farmers. Analogously the percentage farmers in the range of Rs.9,001-18,000 was 40 per cent in the case of solar farmers against 12 per cent with respect to non-solar farmers. It evidently shows that solar farmers were placed in a higher income range compared to non-solar farmers.

Table 1.A.2 Distribution of households of non-solar farmers according to income

Income	No. of farmers	Percentage of farmers	Cumulative percentage of farmers	Average income	Percentage of income	Cumulative percentage of income
0 - 9000	12	24	24	5,078.67	1.15	1.15
9001 - 18000	6	12	36	11,876.50	2.68	3.83
18001 -27000	2	4	40	22,285.00	5.03	8.86
27001 -36000	10	20	60	30,165.30	6.81	15.68
36001 -45000	6	12	72	39,889.33	9.01	24.69
45001 -54000	4	8	80	50,020.50	11.30	35.99
54001 -63000	6	12	92	58,178.17	13.14	49.13
63001 -72000	1	2	94	64,930.00	14.67	63.80
72001 -81000	1	2	96	77,135.00	17.43	81.23
81001 -90000	2	4	100	83,100.00	18.77	100.00
Total	**50**	**100**		**4,42,658.47**	**100.00**	

1.1.3 Gini Coefficient of Income Inequality

The values of Gini coefficient and area under Lorenz curve are presented in **Table 1.B.** The Gini coefficient for the households of solar and non-solar were 0.339 and 0.406 respectively.

The Gini coefficient value was relatively less for households of solar farmers against non-solar farmers. The relatively low Gini coefficient ratio indicates that there were relatively less imbalances in the distribution of income among the solar farmers over non-solar farmers. Therefore, it is a good sign of the intervention of solar pumpsets on the distribution of disposable income of the solar farmers.

Table 1.B. Gini coefficient and area under Lorenz curve for annual household income distribution among solar and non-solar farmers

S. No.	Particulars	No. of observations	Gini coefficient (%)	Area under Lorenz curve (%)
1.	Solar farmers	50	0.339	33.03
2.	Non-solar farmers	50	0.406	29.70

1.1.4 Lorenz Curve Approach

The inequality shown by the Gini coefficient *i.e.,* divergence from the ideal situation of perfect equality was computed by Lorenz curve. The diagonal line in **Fig.1.a.1** and **1.a.2** is a curve of equal distribution which is known as equi-distribution line representing the most egalitarian distribution. The shape of the Lorenz curve is convex. In Lorenz curve less inequality in distribution means less pronounced convex. More inequality in income distribution implies more convex Lorenz curves. The shapes of the Lorenz curve is therefore a good visual indicator of how much inequality

there was in an income distribution. From the **Fig.1.a.1** and **1.b.2** it could be seen that the inequalities were more pronounced in solar farmers than non-solar farmers.

From the above results it could be inferred that solar pumpsets not only facilitated an increase in the income of the solar farmers' households, but also helped in reducing the inequalities in the distribution of income among the households. These results were found to match with the findings of Mishra (2006).

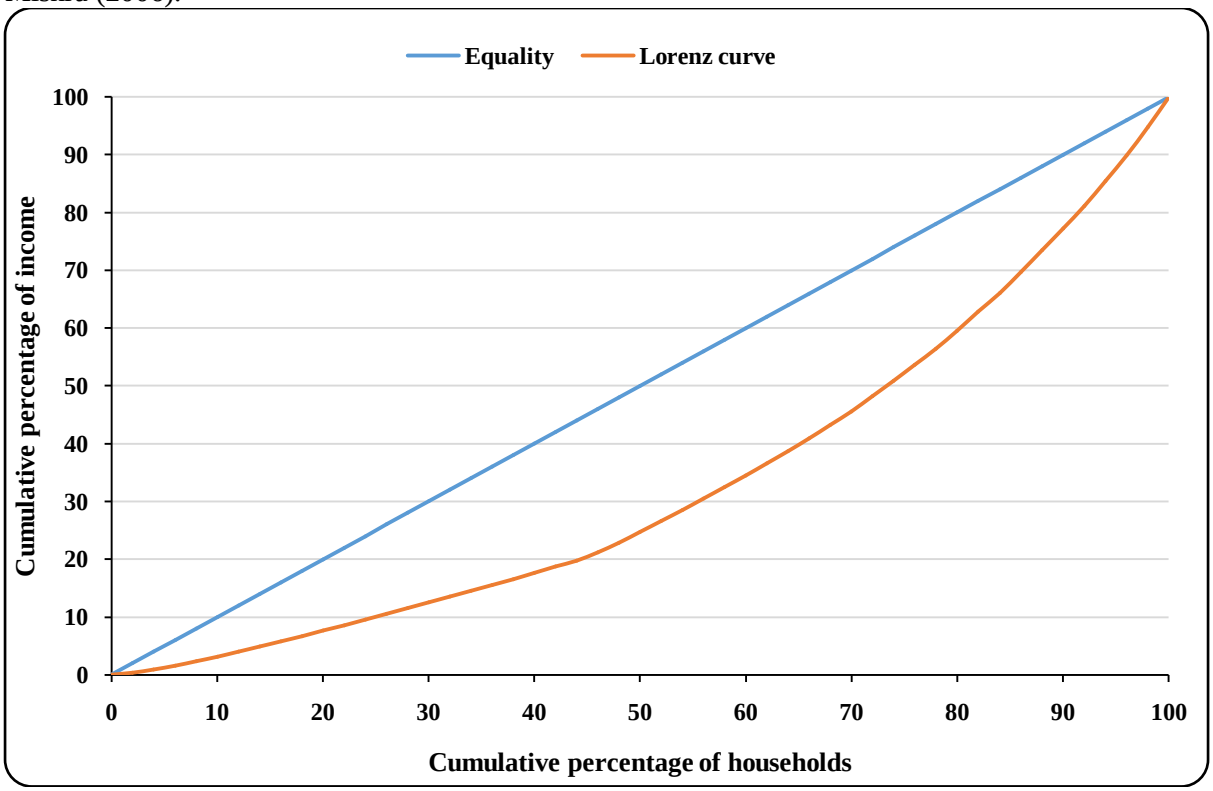

Fig. 1.a.1. Lorenz curve for annual income distribution in households of solar farmer

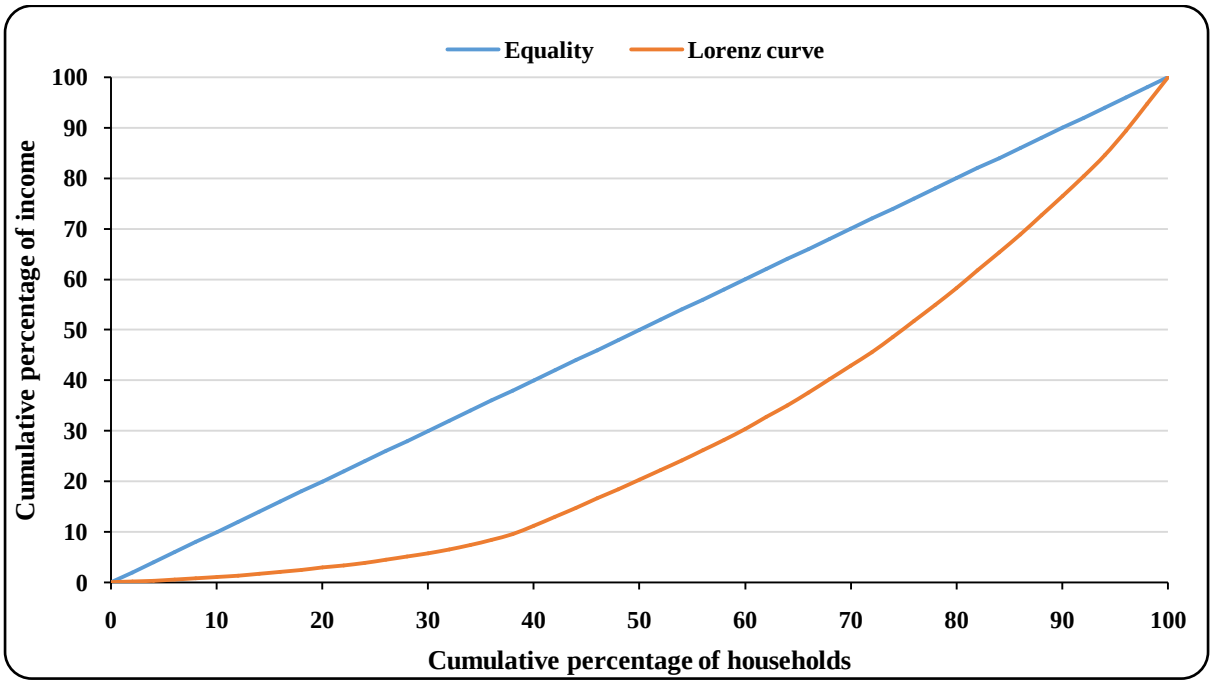

Fig. 1.a.2. Lorenz curve for annual income distribution in households of non-solar farmers

2 IMPACT OF FARM INCOME ON CONSUMPTION AND SAVING PATTERN OF THE SAMPLE FARMERS

2.1 Impact of Farm Income on Consumption Pattern of the Sample Farmers

Table 2.A shows the family consumption pattern of solar and non-solar farmers' households.

Food was found to be the major item of expenditure of both solar and non-solar farmers' budget. The percentage of expenditure was more or less closer in respect of the two categories of farmers. It was 48.46 per cent to former category and 49.89 per cent in latter category. Households of both the category seemed to incur more or less the same expenditure on food, which also shows that the living standards of both the categories appeared to be more or less the same. Next item was education for both the categories forming 10.51 and 10.29 per cent for the two categories of farmers respectively. Housing followed very closely with Rs.32,090 in respective of solar farmers and Rs.29,657 regarding non-solar farmers. Clothing was the later item to follow with a percentage expenditure of 8.70 and 8.39 for the corresponding farmers. Health expenditure also had a share of 6.72 and 6.64 per cent for the respective categories of farmers. More than 80 per cent of expenditure was incurred on the afore said items by the two categories of the farmers. Other items of expenditure were transport, fuel and religious ceremonies *etc*. on which the remaining portion of the annual expenditure was allocated. The details of the family expenditure of the solar and non-solar farmers evidently revealed that there was not much of a distinctive difference in the family consumption expenditure.

Table 2.A. Family expenditure pattern of solar and non-solar farmers (in rupees per household per annum)

S. No	Items	Solar farmers	Non-solar farmers
1.	Food	1,60,606 (48.46)	1,58,198 (49.89)
2.	Education	34,815 (10.51)	32,614 (10.29)
3.	Housing	32,090 (9.68)	29,657 (9.35)

4.	Clothing	28,841 (8.70)	26,603 (8.39)
5.	Health	22,262 (6.72)	21,063 (6.64)
6.	Marriage & social ceremonies	13,687 (4.13)	12,817 (4.04)
7.	Transport	11,194 (3.38)	10,797 (3.41)
8.	Fuel	7,849 (2.37)	7,510 (2.37)
9.	Religious Ceremonies	6,460 (1.95)	5,852 (1.85)
10.	Lighting	6,298 (1.90)	5,870 (1.85)
11.	Others	7,287 (2.20)	6,099 (1.92)
Total		**3,31,388 (100)**	**3,17,081 (100)**

Note: Figures in parentheses indicates percentages to the total.

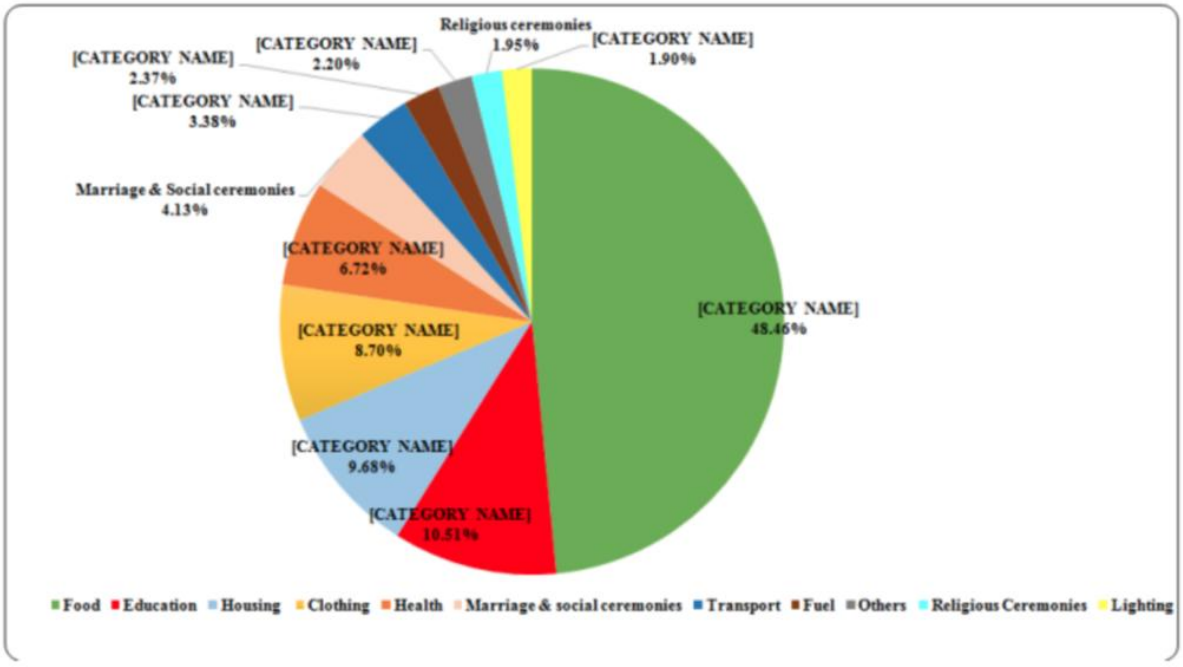

Fig. 2.a.1. Family expenditure of households of solar farmer

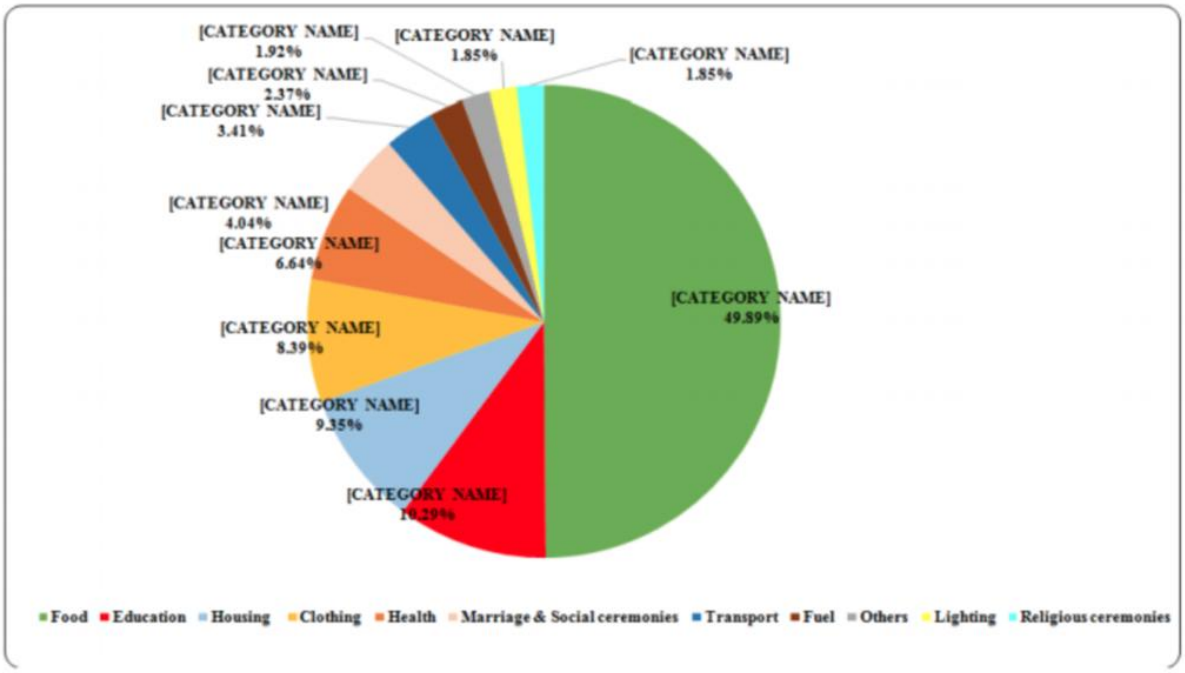

Fig. 2.a.2. Family expenditure of households of non-solar farmer

2.2 Impact of Farm Income on Saving Pattern of the Sample Farmers

The details of the saving pattern of the selected farmers are presented in **Table 2.B.**

As per the details presented, there was a distinct difference between gross income of solar and non-solar farmers. Solar farmers were generating Rs.6,14,880 against Rs.4,93,957 for non-solar farmers. But in respect of solar farmers the higher gross income was accompanied by corresponding higher operational expenditure which has offset the position of higher income. With the family expenditure being more or less closer for the selected two groups of the farmers, the savings did not show much of a deviation between the two categories of the farmers. The amount of savings generated by the two categories of the farmers stood at Rs.32,702 and Rs.31,504 respectively.

Table 2.B. Saving pattern of solar and non-solar farmers (in rupees per household per annum)

S. No.	Particulars	Solar farmers	Non-solar farmers
1.	Gross income from all sources	6,14,880	4,93,957
2.	Operational expenditure	2,50,790	1,45,372
3.	Family expenditure	3,31,388	3,17,081
4.	Savings	32,702	31,504

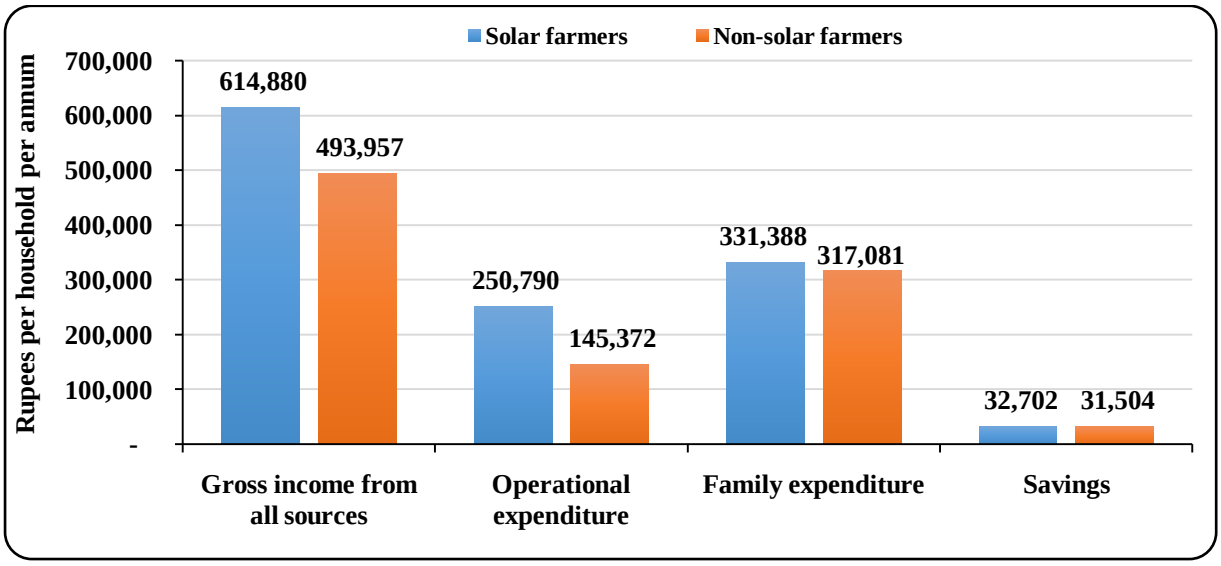

Fig. 2.b. Gross income from all sources, operational expenditure, family expenditure and savings of households of solar and non-solar farmers

CONCLUSIONS

The Gini coefficient ratios for households of solar and non-solar were 0.339 and 0.406 respectively. The Gini coefficient value was relatively less for households of solar farmers against the non-solar farmers. The relatively low Gini coefficient ratio indicates that there were relatively less imbalance in the distribution of income among the solar farmers over non-solar farmers. Therefore, it is a good sign of the intervention of solar pumps on the distribution of disposable incomes among solar farmers.

Food was found to be the major item of expenditure of both solar and non-solar farmers' households. More than 80 per cent of expenditure was incurred on food, education, housing, clothing, health by the two categories of the farmers. The details of the family expenditure of the solar and non-solar farmers evidently revealed that there was not much of a distinctive difference in the family consumption expenditure.

The amount of savings generated by the two categories of the farmers stood at Rs.32,702 and Rs.31,504 respectively.

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