

## Exploring Livestock and Agricultural Income Poverty among Farming Households: Study Based on Mirzapur District of Uttar Pradesh

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### ABSTRACT

This paper investigates poverty indices related to livestock and crop income among farming households. Data was collected from 400 households in the Mirzapur district. The study highlights the significant role of livestock ownership in poverty reduction, rural development, and food security, with women often managing livestock, contributing to their socio-economic empowerment. Various poverty indices, such as Headcount ratio, Poverty gap ratio, and Income gap ratio, were calculated for households with and without livestock. Results show that households with livestock earn around 21 per cent of their income from livestock and 73 per cent from crops, while households without livestock derive 89 per cent of their income from crops alone. Poverty indices are lower for households with livestock than those without, indicating that livestock ownership reduces poverty severity. The findings emphasize the need for policies promoting sustainable livestock production systems to alleviate poverty, particularly among small and marginal farmers. Providing access to subsidized livestock breeds and enhancing rural livestock promotion could contribute to higher incomes and employment generation in rural areas.

**Keywords:** Poverty indices, Livestock income, crop income, sustainable livestock production

**JEL codes:** O13, Q12, Q18

I

### INTRODUCTION

Livestock plays a crucial role in rural India, where rearing animals is a traditional way of life (Singh et al., 2020; Tisdell & Gali, 2000). The demand for livestock is driven by population growth and rising incomes (Thornton, 2010). Historically, rural households have engaged in both agriculture and animal husbandry, maximizing the use of farm by-products to improve soil fertility while providing financial support. For small and marginal farmers, livestock offers self-employment and supplementary income (Birwal, 2017; Boyal & Mehra, 2017; Feuerstein et al., 1987; Kumar et al., 2015; Shahid et al., 2013). Livestock also provides essential protein-rich foods like milk, eggs, meat, and other value-added products, with milk and dairy being a key protein source for vegetarians (Herrero & Thornton, 2013; Rademaker et al., 2017). Additionally, livestock contributes valuable agricultural inputs, such as manure and urine, while draught power and animal dung are primary energy sources in rural areas (Waters-Bayer & Bayer, 1992). It is deeply integrated into the social, cultural, and traditional fabric of communities, acting as a financial safety net for poor households during emergencies. Livestock also supports industries like leather by providing hides

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and skins, creating employment opportunities, and boosting exports (BIRTHAL & NEGI, 2012; FEUERSTEIN ET AL., 1987; SATI, 2016).

Livestock and crop farming are key income sources for rural households, with income from livestock helping meet essential needs (SHAHID ET AL., 2013). India has abundant livestock resources, and the sector's compound annual growth rate was 7.93 per cent from 2014-15 to 2020-21 (PIB, 2023). A major advantage of the livestock sector is its inclusive growth, benefiting smallholders and landless households more than crop farming. However, while livestock growth is more inclusive, the sector faces challenges, particularly in poverty-stricken areas. Poverty remains a complex issue, where severe poverty restricts individuals from achieving a basic standard of living. Income and consumption levels are traditionally used to measure poverty, with those earning below a defined threshold classified as poor. On the one hand, livestock helps alleviate poverty by offering a reliable income source; on the other, rural communities still struggle to overcome deep-rooted poverty despite this support.

The concept of a poverty line has its challenges. Individuals with incomes at or below this line are labelled poor, while those above it are considered non-poor. However, moving above the poverty threshold does not immediately resolve poverty issues. A more nuanced understanding of poverty sees it as a continuous condition with varying levels. Despite these conceptual issues, the discrete poverty line remains widely used for practical reasons. Section II reviews the literature, Section III covers data and methodology, Section IV presents the study's findings, and Section V offers conclusions and policy suggestions based on the results.

## II

### REVIEW OF LITERATURE

Research in the livestock sector plays a vital role in India. Much of the research has been focused on explanations of the cattle holdings and economics of dairying (MISHRA, 1995). DELGADO ET AL. (1999) examine the evolving dynamics of the livestock sector worldwide and its implications for agriculture, food security, and the environment. The authors advocate for policies and investments that promote efficient and sustainable livestock production to meet the growing demand while addressing social and environmental concerns.

UPTON (2004), RANDOLPH ET AL. (2007), and THORNTON (2010) explore livestock's role in promoting rural development, poverty reduction, and enhancing food security in developing and poor countries and highlight the socioeconomic benefits of livestock ownership and methods for measuring the impact. They link livestock ownership to improve nutrition and food security in developing countries, especially smallholder farmers, highlighting its importance for poverty alleviation. McDERMOTT ET AL. (2010) examine the complex interactions between livestock, environment, and socio-

economic factors, emphasizing the need for sustainable intensification to enhance productivity while minimizing negative environmental impacts.

The distribution of livestock resources favours households at the lower end of land distribution where poverty is acute. Results indicate that growth in the livestock sector will significantly impact poverty compared to a similar increase in the land-intensive crop sector. Livestock production is largely the domain of women, and a dynamic livestock sector will aid in their socio-economic empowerment (BIRTHAL & NEGI, 2012). COVARRUBIAS ET AL. (2012) analyse rural livelihoods in Tanzania, emphasizing the role of the livestock sub-sector in income generation and asset access. Livestock are vital for rural livelihoods in developing countries, providing income, employment, and nutrition (HERRERO ET AL., 2013). Livestock contributes to women's livelihoods, focusing on gender-specific impacts and benefits in poverty reduction (KRISTJANSON ET AL., 2014).

OOSTING ET AL. (2014) examine the need for increased productivity in tropical smallholder mixed-crop-livestock systems to meet rising demands for animal-based foods, reduce poverty, and minimize environmental impacts. PANDEY & DIXIT (2017) observed that poverty indices of household sources of income from agricultural labour activities have more value than any other activities. SHIKUKU ET AL. (2017) reveal increased income and modest poverty reduction for households adopting improved livestock feeding strategies, regardless of cow breed in sub-Saharan Africa (SSA). Additional economic gains are observed when providing cows to cow-less households. BOYAL & MEHRA (2017) highlight the importance of animal husbandry in Rajasthan's rural economy, particularly in arid regions. Livestock supports employment and poverty reduction and acts as insurance against drought. Rajasthan significantly contributes to India's livestock population, with livestock being integral to agriculture, especially in the Thar Desert. BIRWAL (2017) examines how many rural households lack access to land, capital, technology, and markets, limiting their ability to benefit from the increasing demand for dairy in Bhatsana village, Haryana. Medium and large farmers face labour shortages despite having enough fodder. An informal livestock rental market exists, enabling small farmers to lease livestock, often leading to exploitation. The study advocated the need for supportive state policies to address challenges.

DO ET AL. (2022) pointed out that livestock production influences income inequality in rural Vietnam. Improving access facilities to credit, rural education and infrastructure, and empowering households can mitigate negative livestock income and enhance income equality. DATTA ET AL. (2024) explore agriculture-forestry-livestock systems in Bangladesh to achieve the Sustainable Development Goals by 2030. KUN ZHOU ET AL. (2024) found increasing nutrient demand for crops, regional overloading in western China, and significant impacts of environmental regulation and economic development on livestock production and resource-environmental carrying capacity (LS-RECC) from 2005 to 2020.

This paper aims to investigate how occupational, livestock, and agricultural income at the household level contribute to the economic well-being of farming households and their potential to alleviate poverty. The specific objectives of the study are two-fold: first, to understand the contribution of livestock to the family income at the household level and to examine the determinants of livestock diversification at the household level. The inquiry is guided by the following research questions: what is the share of income from livestock? What are the factors affecting the livestock at the household level?

### III

#### DATA AND METHODOLOGY

For the estimation of monetary measures of poverty, there is a choice between using income or expenditure as the indicator. Information on various sources of income, such as crop income, livestock income, and total income, has been collected from agriculture households in the Mirzapur district of Uttar Pradesh. A total of 400 agricultural households have been surveyed, out of which, 277 households have livestock and 123 households are without livestock. In the present paper, poverty indices have been calculated for households' total annual income, monthly income, per capita annual income and per capita monthly income, annual crop income, monthly crop income, per capita annual crop income, per capita monthly crop income, livestock annual income, monthly livestock income, livestock annual per capita income, and livestock monthly per capita income.

All the measurements of poverty have been estimated to compare whether the higher indices are lower for the households' monthly income, per capita monthly income, crop monthly income, per capita crop monthly income, livestock monthly income, and livestock per capita monthly income. Half of the median value is set for the poverty line for the measuring indices. Poverty indices for the agriculture households like Headcount ratio, Per capita poverty gap, Poverty gap ratio, Income gap ratio, Watts index, family of Foster–Greer–Thorbecke class indices, family of Clark–Hemming–Ulph class indices, Thon, Sen and Takayama indices have been utilised (Clark et al., 1981; Foster et al., 1984; Saisana, 2014; Sen, 1976; Takayama, 1979; Thon, 1979).

### IV

#### RESULTS

The present section deals with the results of the empirical analysis based on the methodology presented in section III for the agriculture households. The empirical analysis has been done based on income and expenditure in terms of total and per capita. Table 1 presents the distribution of the average income of farming households, differentiating between those with livestock and those without livestock in Mirzapur district.

TABLE 1. AVERAGE HOUSEHOLD INCOME WITH LIVESTOCK, WITHOUT LIVESTOCK, AND ALL THE FARMING HOUSEHOLDS

Income	All Households			Households with Livestock			Household without Livestock		
	Household	Average Income	Per Cent	Household	Average income	Per Cent	Household	Average income	Per Cent
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Annual Income from Livestock	400	46324	16.12	277	66894	21.04	123	-	-
Monthly Income from Livestock	400	3860	16.12	277	5574	21.04	123	-	-
Per Capita Income from Livestock	400	12129	14.83	277	17515	19.29	123	-	-
Per Capita Monthly Income from Livestock	400	1011	14.84	277	1460	19.30	123	-	-
Annual Income from Crop	400	220064	76.58	277	230961	72.66	123	195525	89.41
Monthly Income from Crop	400	18339	76.58	277	19247	72.66	123	16294	89.41
Per Capita Income from Crop	400	64253	78.57	277	68595	75.56	123	54474	88.60
Per Capita Monthly Income from Crop	400	5354	78.57	277	5716	75.56	123	4540	88.62
Total Income of the Farmer Household	400	287382	-	277	317884	-	123	218690	-
Monthly Income of the Farmer Household	400	23948	-	277	26490	-	123	18224	-
Per capita Total Income of the Farmer Household	400	81773	-	277	90784	-	123	61482	-
Per Capita Monthly Income of the Farmer Household	400	6814	-	277	7565	-	123	5123	-

Note: Calculation based on survey Data.

It includes household income from various sources, including livestock, crops, and other sources, as well as annual, monthly, and per capita income. The average annual income from livestock for all 400 households (with and without livestock) is Rs. 46324. The average annual income from livestock for 277 households is much higher at Rs. 66894. This shows that higher incomes are directly linked to cattle ownership for households that own them. The average monthly income from livestock for all 400 households is Rs. 3860, with an average annual per capita income of Rs. 12129 and a per capita monthly income of Rs. 1011. The income from livestock is substantially higher for households with livestock (277), with an average monthly income of Rs. 5574, an annual per capita income of Rs. 17515, and a monthly per capita income of Rs. 1460. The average crop income for agricultural households with and without animals is shown in the table. The average monthly crop income for all 400 households is Rs. 18339, while the average yearly crop income is Rs. 22064. An average annual crop income of RS. 230961 and a monthly income of 19247 are earned by households with livestock (277). Compared to other households, those that do not own livestock (123) earn an average income of Rs. 16294 per month and Rs. 195525 per year from their crops. The average monthly income per household is Rs. 5354, and the average annual crop income is Rs. 64253. The yearly and monthly per capita income of households with livestock is greater, coming in at Rs. 68595 and Rs. 5716, respectively.

Families without livestock earn less per person annually and monthly, which is Rs. 54474 and Rs. 4540, respectively. In addition, the total income of farming households with and without livestock is also presented in the table. The average yearly total income for all 400 households is Rs. 287382, and the average monthly total income is Rs. 23948. With an average total income of Rs. 317884 annually and Rs. 26490 monthly, households with cattle (277) earn more money overall. On the other hand, the income of the 123 households that do not own livestock is lower, averaging Rs. 18224 per month and Rs. 218690 annually. The average annual household income across all households is Rs. 81773, while the average monthly income is Rs. 6814. Per capita, income is higher in households with livestock, at Rs. 7565 per month and Rs. 90784 per year. The annual and monthly per capita incomes of households without livestock are Rs. 61482 and Rs. 5123, respectively, which are lower.

Incomes are greater in all categories for households that own livestock. These households make much more from their livestock and have higher agricultural revenue than those without livestock. As a result, their annual and monthly household income is higher. Households with livestock also have better per capita income, whether monthly or annual, from crops and livestock. The presence of livestock significantly raises agricultural households' overall and per capita revenue. Approximately 16 per cent of total income comes from livestock among farming households, while about 77 per cent of income is from crops. Households that have livestock see around 21 per cent of total income from livestock and about 73 per cent from crops. In contrast, households without livestock have no income from livestock, with around 89 per cent of their total income coming from crops.

Table 2 presents various poverty estimates of the income from different sources for all the 400 surveyed households. The headcount ratio among the surveyed households shows that 34.75 per cent are below the poverty line based on livestock income, 22.75 per cent on crop income, and 17.25 per cent on total household income. The per capita poverty gap is Rs. 389.00 for livestock, Rs. 492.00 for crops, and Rs. 496.00 for total income. The poverty gap ratio is 32.20 per cent for livestock, 8.92 per cent for crops, and 6.16 per cent for total income. The income gap ratio is 92.67 per cent for livestock, 39.19 per cent for crops, and 40.49 per cent for total income.

TABLE 2. VARIOUS POVERTY ESTIMATES OF THE INCOME OF HOUSEHOLDS FROM VARIOUS SOURCES

Poverty measures (1)	Monthly livestock income (2)	Monthly Per capita livestock income (3)	Monthly Crop Income (4)	Monthly Per capita Crop Income (5)	Monthly household Income (6)	Monthly per capita household income (7)
Headcount ratio %	34.750	36.250	22.750	22.000	17.250	17.500
Per capita poverty gap	389	102	492	126	496	134
Poverty gap ratio %	32.202	32.770	8.916	8.910	6.161	6.198
Income gap ratio %	92.667	90.400	39.190	40.499	35.714	35.420
Watts index	2.197	3.033	14.870	15.032	9.296	9.583
Index FGT(0.5)	33.029	33.835	13.105	13.065	9.634	9.649
Index FGT(1.5)	31.754	32.176	6.559	6.579	4.280	4.342
Index FGT(2.0)	31.489	31.804	5.069	5.111	3.152	3.225
Index FGT(2.5)	31.319	31.557	4.058	4.115	2.424	2.501
Index FGT(3.0)	31.204	31.386	3.338	3.403	1.925	2.006
Index FGT(3.5)	31.121	31.262	2.806	2.872	1.567	1.653
Index FGT(4.0)	31.060	31.169	2.399	2.465	1.301	1.392
Index FGT(4.5)	31.012	31.099	2.081	2.145	1.097	1.192
Index FGT(5.0)	30.975	31.043	1.827	1.887	0.937	1.036
Clark et al. index (0.10)	309.592	310.394	13.916	14.036	8.857	9.091
Clark et al. index (0.25)	124.950	125.705	12.708	12.785	8.264	8.437
Clark et al. index (0.50)	63.251	63.935	11.120	11.154	7.427	7.531
Clark et al. index (0.75)	42.587	43.210	9.895	9.904	6.737	6.799
Clark et al. index (0.90)	35.670	36.259	9.283	9.282	6.379	6.425
Thon index	53.963	54.717	16.563	16.564	11.640	11.718
Sen index	34.498	35.814	12.304	12.164	8.419	8.561
Takayama index	32.177	32.726	8.417	8.424	5.854	5.899
Poverty line in Rs (1/2 of median)	1208	313	5516	1418	8054	2155

Note: Calculation is based on the survey data. Poverty estimates for 400 households. The value of the FGT index and CLU, thon, Sen, and Takayama indices are multiplied by 100.

The Foster-Greer-Thorbecke (FGT) indices are widely used to measure poverty by accounting for its incidence and severity. These indices assign greater weight to more severe poverty cases with higher values of  $\alpha$ . In this analysis, FGT(0.5) for livestock income is 33.029, indicating higher poverty than crop income (13.105) and household income (9.634). As the value of  $\alpha$  increases, the gap widens. For example, FGT(1.5) shows values of 31.754 for livestock income, 6.559 for crop income, and 4.280 for household income. This trend continues with FGT(2.0), where livestock income records 31.489, crop income 5.069, and household income 3.152. As  $\alpha$  rises to 2.5, the FGT index for livestock income is 31.319, while crop income decreases to 4.058 and household income to 2.424. By FGT(3.0), livestock income still dominates poverty measures with 31.204, compared to 3.338 for crop and 1.925 for household income. Even at higher values like FGT(4.0) and FGT(5.0), livestock income shows persistent poverty at 31.060 and 30.975, respectively, while crop and household incomes continue to decline, highlighting lower poverty levels. The Clark et al. indices also assess poverty, focusing on income inequality among the poor, parameterized by  $\beta$ . Higher values of  $\beta$  emphasize greater sensitivity to income distribution. Clark et al. index (0.10) shows significantly higher poverty for livestock income (309.592) compared to crop income (13.916) and household income (8.857). As  $\beta$  increases to 0.90, the index still shows severe poverty for livestock income at 35.670, while crop and household incomes register much lower at 9.283 and 6.379, respectively. This highlights the persistent and more severe poverty associated with livestock income across various measures.

This table also provides poverty estimates of the Thon, Sen, and Takayama indices for household income from different sources. The Thon Index for households relying on livestock income is 53.963 compared to crop income (16.563) and total household income (11.640). The Sen Index shows higher poverty levels for livestock income (34.498) compared to crop income (12.304) and total household income (8.419). Similarly, the Takayama Index reflects the highest severity of poverty for livestock income (32.177) compared to crop income (8.417) and total household income (5.854). This indicates higher poverty levels among livestock-dependent households. The poverty lines are set at 1208 Rs for livestock income, 5516 Rs for crop income, and 8054 Rs for total household income.

Table 3 provides various poverty estimates for 277 households that depend on livestock. These poverty estimates are presented for livestock, crop, and total household income. They are also divided into monthly and per capita household income. Households relying on crop income generally experience more poverty than those depending on livestock income. The headcount ratio for the crop and livestock income is 22.383 per cent and 18.773 per cent, respectively. The per capita poverty gap is Rs. 505 for crop income and Rs. 113 for livestock income. The poverty gap ratio is 8.778 per cent for crop income and 5.715 per cent for livestock income. Similarly, the income gap ratio is 39.218 per cent for crop income and 30.445 per cent for livestock income. The Watts index, measuring the incidence and depth of poverty, is higher for



crop income at 14.789 compared to 8.498 for livestock income. All the families of FGT indices, Clark et al. indices, and Thon, Sen, and Takayama indices also show higher crop income values than livestock income.

TABLE 3. VARIOUS POVERTY ESTIMATES OF THE INCOME OF HOUSEHOLDS FROM VARIOUS SOURCES FOR THE 277 HOUSEHOLDS WITH LIVESTOCK

Poverty measures (1)	Monthly Livestock Income (2)	Monthly per capita livestock income (3)	Monthly crop income (4)	Monthly per capita crop income (5)	Monthly household income (6)	Monthly per capita household income (7)
Headcount ratio %	18.773	18.051	22.383	20.217	13.357	15.523
Per capita poverty gap	113	35	505	115	371	100
Poverty gap ratio %	5.715	6.854	8.778	8.265	4.140	4.360
Income gap ratio %	30.445	37.968	39.218	40.884	30.991	28.084
Watts index	8.498	10.626	14.789	14.010	5.820	6.053
Index FGT(0.5)	9.595	10.371	13.036	12.105	6.907	7.589
Index FGT(1.5)	3.810	4.903	6.406	6.080	2.706	2.771
Index FGT(2.0)	2.748	3.694	4.920	4.693	1.878	1.884
Index FGT(2.5)	2.094	2.887	3.919	3.749	1.365	1.347
Index FGT(3.0)	1.658	2.319	3.210	3.075	1.029	1.003
Index FGT(3.5)	1.351	1.903	2.691	2.575	0.799	0.773
Index FGT(4.0)	1.125	1.589	2.298	2.195	0.636	0.613
Index FGT(4.5)	0.953	1.345	1.995	1.898	0.516	0.499
Index FGT(5.0)	0.819	1.152	1.755	1.663	0.426	0.416
Clark et al. index (0.10)	8.100	10.090	13.782	13.039	5.596	5.825
Clark et al. index (0.25)	7.568	9.371	12.536	11.845	5.289	5.513
Clark et al. index (0.50)	6.825	8.362	10.939	10.323	4.844	5.064
Clark et al. index (0.75)	6.218	7.537	9.733	9.175	4.465	4.685
Clark et al. index (0.90)	5.906	7.112	9.135	8.606	4.264	4.484
Thon index	10.785	12.906	16.299	15.430	7.924	8.304
Sen index	8.042	9.341	12.010	11.165	5.680	6.095
Takayama index	5.396	6.521	8.275	7.839	3.962	4.139
Poverty line in Rs (1/2 of median)	1979	514	5751	1388	8957	2301

Note: Calculation Based on the survey data., Poverty estimates for 277 Households with livestock. The value FGT index and CLU, thon, Sen and Takayama indices are multiplied by 100.

Table 4 presents the poverty indices for households with no livestock compared to crop and total income. It is evident from the table that almost all the poverty indices are higher in the case of crop income compared to the household's total income. In summary, poverty indices show higher levels and deeper poverty for crop income than

livestock income for households with livestock. This indicates that poverty is more severe for households relying only on crop income.

TABLE 4. VARIOUS POVERTY ESTIMATES OF THE INCOME OF HOUSEHOLDS FROM VARIOUS SOURCES FOR THE HOUSEHOLDS WITH NO LIVESTOCK.

Poverty measures	Monthly livestock income	Monthly per capita livestock income	Monthly Crop Income	Monthly Per capita Crop Income	Monthly household Income	Monthly Per Capita household Income
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Headcount ratio %	-	-	21.951	24.390	21.138	19.512
Per capita poverty gap	-	-	462	139	518	148
Poverty gap ratio %	-	-	9.199	9.799	8.345	8.625
Income gap ratio %	-	-	41.907	40.178	39.477	44.204
Watts index	-	-	14.907	16.391	12.939	14.097
Index FGT(0.5)	-	-	13.258	14.383	12.465	12.399
Index FGT(1.5)	-	-	6.846	7.284	6.011	6.393
Index FGT(2.0)	-	-	5.340	5.723	4.548	4.960
Index FGT(2.5)	-	-	4.309	4.671	3.566	3.984
Index FGT(3.0)	-	-	3.563	3.917	2.873	3.286
Index FGT(3.5)	-	-	3.000	3.351	2.364	2.767
Index FGT(4.0)	-	-	2.559	2.911	1.979	2.368
Index FGT(4.5)	-	-	2.205	2.558	1.677	2.055
Index FGT(5.0)	-	-	1.915	2.269	1.437	1.803
Clark et al. index (0.10)	-	-	14.087	15.398	12.295	13.288
Clark et al. index (0.25)	-	-	12.990	14.095	11.426	12.220
Clark et al. index (0.50)	-	-	11.458	12.321	10.197	10.750
Clark et al. index (0.75)	-	-	10.217	10.922	9.186	9.577
Clark et al. index (0.90)	-	-	9.583	10.220	8.663	8.983
Thon index	-	-	17.030	18.056	15.484	16.034
Sen index	-	-	12.338	13.426	11.154	11.219
Takayama index	-	-	8.694	9.228	7.853	8.174
Poverty line in Rs (1/2 of median)	-	-	5023	1420	6211	1717

Note: Calculation is based on the survey data. Poverty estimates for 123 households with no livestock. The value FGT index and CLU, thon, Sen and Takayama indices are multiplied by 100.

#### V

#### CONCLUSION AND POLICY SUGGESTIONS

The study reveals that livestock ownership significantly reduces poverty among farming households in the Mirzapur district of Uttar Pradesh. Households with livestock earn a substantial portion of their income from this source, contributing to their financial stability and reducing poverty severity compared to those without livestock. Livestock also provides an important buffer in times of crisis, particularly for small and marginal farmers, and plays a critical role in women's empowerment, as women often manage livestock. The analysis highlights that poverty indices such as the Foster-Greer-Thorbecke (FGT) and Clark et al. indices are consistently lower for households with livestock than those without. This suggests that livestock ownership increases household income and helps reduce the depth and severity of poverty. The

study also shows that crop income alone cannot lift households out of poverty, underscoring the importance of income diversification through livestock.

The findings point to several policy implications. There is a need for government support to promote sustainable livestock production systems, especially targeting small and marginal farmers. This could be achieved through subsidies for livestock breeds, improved veterinary services, and better market access. Rural development policies should also focus on empowering women through livestock ownership and management, recognizing their critical role in this sector. By providing better infrastructure and support for livestock farming, policymakers can help enhance rural incomes, create employment opportunities, and contribute to long-term poverty alleviation.

#### NOTE

##### 1. Measures of poverty

Head-count index  $H = q/n$ ,  $q$  - number of poor and  $n$  - total population. Poverty gap index is extent to which individuals fall below the poverty line as a proportion of the poverty line. The Income Gap Ratio ( $I$ ) is the mean distance of the incomes of the poor from the poverty line,  $I = \sum_{i \in S(z)} \frac{g_i}{qz}$ . The income gap  $g_i$  of any individual  $i$  is the difference between the poverty line  $z$  and his income  $y_i$ ,  $g_i = z - y_i$ ,  $g_i$  will be nonnegative for the poor and negative for others. The Watts poverty index (1968) is  $W = \frac{1}{N} \sum_{i=1}^m (\log z - \log x_i) = \frac{1}{N} \sum_{i=1}^m (\log \frac{z}{x_i})$

The Foster Greer Thorbecke index is  $P_\alpha = \frac{1}{N} \sum_{i=1}^q \left( \frac{z - y_i}{z} \right)^\alpha$ ,  $\alpha \geq 0$ . FGT index can be calculated for the various values of  $\alpha$ , i.e. 0.5, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5 and 5.0. Clark Hemming and Ulph took an entirely different approach to construct a distribution sensitive poverty index with the help of Atkinson's class of Inequality measures CHU index for poverty is as,  $C_\beta = \frac{1}{\beta} \left[ H - \frac{1}{n} \sum_{i=1}^q \left[ \frac{y_i}{z} \right]^\beta \right]$

The Sen Index of poverty  $PS = H[I + (1 - I)G^*]$   $G^*$  is the Gini index of inequality among the poor,  $H$  and  $I$  are head-count and income gap. Sen Index can be written as  $PS = \frac{2}{(q+1)nz} \sum_{i=1}^q (q+1-i)(z - y_i)$

Where  $q$  is the number of poor,  $n$  is the number of the person in the population and  $z$  is poverty line.

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