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Rural Poverty in India: Alternative Indices and Sensitivity Analysis

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Abstract

In this paper, we have used consumption expenditure survey data for 2011-2012, 2022-2023 and 2023-2024 focussing on rural poverty. Apart from the headcount ratio, we have used alternative indices of poverty measures suggested in the literature. These measures often emphasize relative dimensions of poverty by segregating groups of the poor from the non-poor and generating ordinal rank weights. Four poverty indices have been estimated as given by Sen, Thon, Takayama and Srivastava. The poverty indices show that, in general, the rural poverty index has fallen sharply over time between 2011-2012 and 2022-2023. We have undertaken a sensitivity analysis with respect to all the poverty measures, including the headcount ratio, to examine whether there is a lot of bunching around the poverty line such that small increases in the poverty line lead to large increases in the incidence of poverty. Our results show that the nature of sensitivity changes according to the years under consideration. The fall in rural poverty indicates the impact of social support measures adopted by the central and state governments for lower-income groups in recent years.

Keywords

Rural Poverty in India, Poverty Indices, Sensitivity Analysis, Consumption Expenditure, Headcount Ratio, Sen Index, Takayama Index, Thon Index, Srivastava Index, NSSO Survey, Poverty Alleviation Policies

1. Introduction

In India, poverty line has officially been defined based on exogenous norms using nutritional norms and associated needs of the poor people. Poverty lines have been updated from time to time and studies pertain to state specific and aggregate measures of poverty.

The recent household consumption expenditure survey data provide details of state-wise and fractile-wise expenditure data. It may be noted that the methodological and sampling framework of NSSO data for these three years, namely 2011-2012, 2022-2023 and 2023-2024, are similar. In all three cases, data for the modified mixed recall period (MMRP) have been used. These surveys are referred to as the thick rounds of national sample surveys. As compared to the 2011-2012 survey, when only one visit was involved, the 2022-2023 and 2023-2024 surveys were based on three separate monthly visits in a quarter[1]. These recent data can potentially serve as useful guides in designing national level poverty alleviation policies.

In the present analysis, we have data for 12 fractiles and 28 states, except in 2011-2012, when there were 27 states[2]. State-wise fractiles range from 0% - 5% of the population at the lower end and 95% - 100% at the upper end. Apart from the headcount ratio, we have considered four measures of poverty defined in the literature, namely Sen (1974, 1976), Thon (1979), Takayama (1979) and Srivastava (1987). These incorporate relative dimensions of poverty to different degrees. All of these measures arise from Sen's seminal work on the measurement of poverty, where he had proposed an axiomatic framework where one individual's income or expenditure is compared with that of another individual, not in terms of actual values but only in terms of ordinal ranks. Further, in the case of the Sen Index, these ordinal ranks are generated within the group of poor persons. For the remaining three indices, the ordinal rank weights are generated considering the population of poor and non-poor together. Poverty in all these cases is viewed as the weighted sum of the difference of the income/expenditure of the poor from either the poverty line or from the mean income/expenditure of a censored distribution. While our findings indicate that directionally all the indices indicate a fall over time in India's rural poverty, the results are sensitive to the particular index used. Further, sensitivity analysis is taken up in order to study how the poverty indices change as the poverty line is gradually increased from a baseline.

This article is divided into seven sections. Apart from the introduction in Section 1, Section 2 provides an overview of the literature on poverty estimates, largely focusing on measuring rural poverty. Policymakers have specifically addressed rural poverty through a range of support initiatives for farmers and other low-income groups, including employment programs and direct benefit transfers. Section 3 provides an overview of estimation methodologies with reference to the four measures focussing on the population of the poor alone. Section 4 provides methodologies for poverty measurement focussing on the population of the poor as well as the non-poor. Section 5 provides estimates of poverty in rural India for three years, namely 2011-2012, 2022-2023, and 2023-2024, using comparable NSSO surveys for household consumption expenditure. Section 6 provides the results of a sensitivity analysis where the poverty line is successively increased from 1% to 5% over the baseline. Section 7 provides concluding observations.

[1]https://www.mospi.gov.in/sites/default/files/publication_reports/Factsheet_HCES_2022-23.pdf.
[2]For comparability over time, Jammu and Kashmir has not been included.

2. Overview of Literature

The literature on poverty measurement in India has evolved from early calorie-based consumption poverty lines to multidimensional, spatial, and inequality-sensitive approaches. Foundational work by Dandekar and Rath (1971) used calorie norms to derive rural-urban poverty thresholds, shaping later official methods adopted by the Lakdawala Committee (1993) and revised by the Tendulkar Committee (2009) to reflect updated consumption requirements. A major methodological advancement came from Deaton and Drèze (2002), who harmonised NSS rounds from 1983 to 1999-2000, corrected for price differentials, and showed substantial rural poverty reduction during the 1990s. Research on liberalisation and inclusiveness such as Topalova's (2010) district-level difference-in-differences analysis and Jha's (2000) study, using Foster-Greer-Thorbecke and other indices, emphasised that despite national poverty decline, post-1991 growth generated sharper inequality and uneven poverty reduction across regions. State-level analyses by Panagariya and Mukim (2014) highlighted broad-based reductions between 1993-1994 and 2009-2010, particularly during 2004-2005 to 2009-2010, while Himanshu (2019), drawing on long-term data from the 1950s to 2012, confirmed accelerated poverty decline in the 2000s driven by rural wage growth and welfare schemes, even as inequality rose.

Social and spatial heterogeneity has also been extensively documented. Thorat and Dubey (2012) showed, using pooled NSS rounds from 1983 to 2009-2010, that SCs, STs, and Muslims consistently experienced higher poverty incidence and severity. Multidimensional approaches such as Alkire and Seth (2015) applied the Alkire-Foster multidimensional poverty indices to National Family Health Survey and Census datasets to show a sharp decline in multidimensional poverty between 2005-2006 and 2015-2016, especially in poorer states. More recent work on shocks and welfare responses includes Bhalla, Bhasin, and Virmani (2022), who incorporated in-kind transfers into poverty estimates and found extreme poverty below 1% in 2020-2021. Singh's (2012) 'inequality of poverty' index further highlighted the need to capture how deprivation is distributed across subgroups rather than relying solely on aggregate headcounts.

We summarize below some of the key studies examining rural poverty in India.

Dandekar and Rath (1971) produced one of the earliest systematic estimates of poverty in India. Using NSS consumption data and a calorie-deficiency approach, they constructed poverty lines based on minimum calorie requirements and compared these with estimated household per-capita consumption expenditure for 1950s-1960s. Methodologically they relied on simple headcount measures (poverty incidence) and examined rural-urban and state differences. Their key result was the identification of substantial and geographically uneven poverty in rural India.

Datt and Ravallion (1996) assembled a consistent, consumption-based poverty series for the period covering 1950s-1990s and used Foster-Greer-Thorbecke (FGT) decompositions and growth-poverty elasticities to examine to what extent rural/urban growth and sectoral growth reduced poverty. Their methodology com-

bined reconstruction of consumption series from NSS rounds, standard poverty lines (and sensitivity checks), and decomposition analysis to attribute changes in poverty levels to sectoral/compositional effects. They showed that rural consumption growth was the principal driver of poverty reduction through most of the period. Further agricultural/rural growth tended to be more directly linked to rural poverty reduction than urban industrial growth.

Ravallion (1998) used NSS consumption data covering the 1990s and poverty measures to examine how food-price changes and policy reforms affected measured poverty. Methodologically, he emphasized the sensitivity of poverty counts to the choice of poverty line and to measurement of real consumption and used decomposition methods to separate price and real-income effects. The study highlighted that rising food prices could offset gains from income growth for the poor and that poverty measurement requires careful treatment of price changes and real consumption. The paper also illustrated how measurement choices can change the interpretation of poverty trends.

Deaton & Dreze (2002) produced integrated poverty and inequality estimates for India using data from NSS rounds pertaining to 1987-1988, 1993-1994 and 1999-2000. Methodologically, they emphasized measurement problems (survey design changes, mixed recall periods, and imputation) and adjusted consumption series to improve comparability, using alternative poverty lines and distributional measures including headcount, poverty gap, and inequality indices. They found that poverty fell in the 1990s but that the magnitude and pattern of decline were sensitive to how the NSS consumption series is adjusted and the choice of poverty line. The study also stressed increased inter-state disparity and measurement uncertainty, arguing for caution in interpreting short-term changes.

Himanshu (2007) used NSS-based consumption series and poverty lines to provide updated poverty estimates for the 1990s-2000s. He deployed standard poverty measures such as headcount, poverty gap, etc. and investigated rural-urban and regional patterns. He highlighted issues pertaining to sampling, recall period, and the role of non-farm rural incomes in the measurement of the extent of poverty. The results showed that poverty declined in the 1990s and 2000s, but was uneven. The decline in rural poverty was marked by large interstate variation.

The Tendulkar Committee Report (Government of India, Planning Commission, 2009) marked a significant shift in India's poverty estimation methodology by moving away from calorie-based norms to a broader consumption-based approach. It introduced a uniform poverty line basket for rural and urban areas, included essential non-food items like health and education, and relied on NSSO's[3] Mixed Reference Period data for price adjustments. This resulted in higher poverty estimates, with the 2004-2005 headcount ratio revised from 27.5% to 37.2%, reflecting the inadequacy of earlier norms (Planning Commission, 2009; Deaton & Dreze, 2009). While praised for being more realistic, the approach faced criticism for remaining consumption-centric and ignoring multidimensional poverty

[3]61st Round for 2004-2005.

aspects (Himanshu, 2010). The report sparked debates that led to the Rangarajan Committee (Government of India, Planning Commission, 2014) and later adoption of multidimensional poverty measures aligned with global standards.

Government of India, Planning Commission (2014) commonly referred to as Rangarajan Expert Group, recommended updated MPCE-based poverty lines using NSS 68th round (2011-2012) consumption patterns and a different approach to nutritional and non-food needs. They constructed a normative consumption basket, using mixed-recall (MMRP) NSS consumption data to create rural and urban poverty lines. Their results showed higher rural poverty incidence estimates for some years compared with official Tendulkar estimates (and found larger rural-urban gaps), illustrating that changes in the poverty line construction materially alter measured rural poverty incidence and inter-state rankings. Rangarajan's work and its critics underline that the choice of base year, recall adjustments and basket composition strongly influence rural poverty numbers.

Roy & van der Weide (2022) developed a reproducible method to produce NSS-compatible poverty estimates for India for 2015-2019 by utilizing the Consumer Pyramids Household Survey (CPHS) by CMIE. The authors first diagnose and correct selection and representativeness biases in CPHS via a reweighting (max-entropy) procedure, then convert CPHS consumption into an NSS-type aggregate using two complementary imputation approaches. They validate results using multiple auxiliary sources (PLFS, NFHS, national accounts indicators, nighttime lights). Their preferred estimates indicate a substantial decline in headcount poverty from 22.5% in 2011 to 10.2% in 2019, with rural poverty falling much more than urban poverty. They also find some moderation of consumption inequality and show that the pace of poverty reduction implied by CPHS is smaller than some projections based on national accounts.

NITI Aayog (2021) represents India's first official attempt to measure multidimensional poverty using a globally recognized methodology developed by OPHI and UNDP. Based on National Family Health Survey 4 (2015-2016) data, the MPI captures deprivations across three dimensions—health, education, and standard of living—through 12 indicators such as nutrition, schooling, sanitation, housing, and access to bank accounts. The report estimates that 25.01% of India's population was multidimensionally poor, with a stark rural-urban divide: 32.75% in rural areas compared to 8.81% in urban areas, underscoring the concentration of poverty in rural regions. The intensity of poverty among the poor was estimated at 47.13%, indicating that deprived households suffer multiple simultaneous disadvantages. The findings highlight the need for targeted interventions in rural areas and poorer states, as well as the importance of addressing non-income dimensions of poverty to achieve SDG target 1.2 of halving poverty in all its forms.

Recent literature on rural poverty in India reflects a methodological shift from purely monetary measures to multidimensional approaches, while continuing to explore income inequality dynamics. Studies using National Family Health Survey (NFHS) data (Ogbonna et al., 2025; Debi & Devi, 2025; Jatav & Singh, 2025; Biswas & Sharma, 2025) apply the Alkire-Foster MPI framework, revealing persistent ru-

ral deprivation despite improvements between NFHS-4 and NFHS-5. These papers emphasize governance quality, social identity (SC/ST), and agro-climatic vulnerability as critical determinants of rural poverty. In contrast, income-based studies (Pandey & Devi, 2024; Shukla, 2025; Panda, 2024) highlight land ownership, education, and agricultural income as primary drivers of rural inequality, with decomposition analyses showing heterogeneity across states.

The literature also documents the impact of shocks, notably COVID-19, on rural poverty. Tian (2024) and Ram and Yadav (2024) report heightened vulnerability among rural households, especially SC/ST and casual labourers, with poverty rates exceeding 50% in some states during the pandemic. Studies have reported the positive impact of government schemes, including MGNREGA (Mahatma Gandhi National Rural Employment Guarantee Scheme) on poverty reduction and related outcomes such as food security, savings and health in India (Klonner & Oldiges, 2022; Fan et al., 2000; Emad, 2013; Ambasta et al., 2008; Patwardhan & Tasciotti, 2023).

3. Estimating Poverty Based on a Relative Approach: Focus on the Population of the Poor

In the ensuing discussion, we consider a community of "n" people whose per capita consumption expenditures are arranged in a non-decreasing order. Thus, per capita consumption expenditures are written as:

$$y_1 \le y_2 \le \cdots \le y_m \le z \le y_{m+1} \le \cdots \le y_n$$

where

n = total population.

z = poverty line based on absolute or relative approach.

m = number of poor, i.e., people below poverty line.

y_i = income of the ith individual.

μ, μ_p, μ_π are mean incomes of the whole population, population of the poor, and that of the non-poor, respectively.

The poverty line "z" can be defined as a fraction of the mean income of the whole population (μ).

Various summary measures of poverty have been defined in the literature. The most commonly used measure is the headcount ratio (H), which is the ratio of the number of poor (m) to the total population (n), that is,

$$H = \frac{m}{n} \tag{1}$$

Another aggregate measure is the aggregate poverty ratio, also called the poverty gap ratio, which is defined as the sum of the excess of the poverty threshold over the individual incomes of all the poor. Thus, the poverty gap ratio (G) is given by

$$G = \frac{\sum_{i=1}^{m}(z - y_i)}{mz} = \frac{1}{mz} \cdot \left[mz - \sum_{i=1}^{m} y_i \right] = \frac{1}{mz} \cdot \left[mz - m\mu_p \right], \text{ since } \mu_p = \frac{\sum_{i=1}^{m} y_i}{m} \tag{2}$$

Thus,

$$G = \frac{z - \mu_p}{z} \quad \text{or} \quad G = 1 - \frac{\mu_p}{z} \tag{3}$$

In the case when H is used, there is no reference to the income of the poor. In the case when G is used, a reference is made to the income of the poor and this income is related to the poverty line. However, all individual poverty gaps are considered comparable or given the same weight. It is, however, considered desirable to give a higher weight to the person whose poverty gap is relatively more.

There are two approaches to giving the relative weights: cardinal and ordinal. In the case when the ordinal approach is applied, only a ranking is generated between two individuals. The person with the higher income or lower poverty gap is given a lower weight, but this weight relates only to the rank of the person in the interpersonal distribution of income. The magnitude of the difference of the two incomes is not considered material. When a cardinal approach to giving weights is applied, then the weights depend on the magnitude of the difference of incomes or the extent of the poverty gap of individuals. Both the approaches have been followed in the literature. A well-known measure of poverty defined by Sen follows the ordinal approach of weighting the poverty gaps. An example of the cardinal approach is the well known poverty index called the Foster-Greer-Thorbecke (FGT) index (Foster, Greer, & Thorbecke, 1984). The Sen index is defined as below.

$$P(\text{Sen}) = \frac{2}{(m+1)\cdot nz} \cdot \sum_{i=1}^{m} (m+1-i)\cdot(z - y_i) \tag{4}$$

Here, $m+1-i$ is the weight attached to the poverty gap of the ith individual. These are ordinal rank weights.

Sen's index considers information on the non-poor as relevant in poverty measurement to the extent of their numbers only. It ignores the income characteristics of the non-poor, i.e., it is primarily based on the view that for the measurement of the degree of poverty in a society, one should only look at the incomes of the poor. The weighting scheme provides transfer sensitivity to the measure: if income is transferred from a poor to a higher-income poor, poverty would increase, provided the richer person does not cross the poverty line. Its transfer sensitivity may produce somewhat perverse results if the transfer of income from a poor to a richer poor enables the latter to cross the poverty line in the sense that the poverty measure may register a decrease in such a case.

It can be shown that the minimum value of the Sen index is zero and its maximum value is the headcount ratio. The minimum value of the Sen index is when there are no poor in the society, that is, for all y_i, incomes are equal to z or higher than z. When $y_i = z$, then $P(\text{Sen}) = 0$ since the term $z - y_i$ becomes equal to 0 in equation (4). The index has a maximum value when no poor has any income. In this case, equation (4) can be written as

$$P(\text{Sen}) = \frac{2}{(m+1)\cdot nz} \cdot \sum_{i=1}^{'} (m+1-i)\cdot(z) \tag{5}$$

Or

$$P(\text{Sen}) = \frac{2\cdot z}{(m+1)\cdot nz} \cdot \frac{m\cdot(m+1)}{2} = \frac{m}{n} \tag{6}$$

Thus, the upper limit of the Sen index is the headcount ratio (as given in equation (1)).

In contrast to the Sen index, the FGT index is defined as below:

$$P(\text{FGT}) = \frac{1}{n} \cdot \sum_{i=1}^{m} \left(\frac{z - y_i}{z} \right)^2 \tag{7}$$

In this case the weights are the relative poverty gaps themselves, that is, equation (5) can be rewritten as:

$$P(\text{FGT}) = \frac{1}{n} \cdot \sum_{i=1}^{m} w_i \left(\frac{z - y_i}{z} \right) \tag{8}$$

where $w_i = \frac{z - y_i}{z}$ which is a cardinal weight in the sense that both magnitudes z and y_i are defined. Subsequently, the index was generalised by substituting the square term by a parameter called α which has been interpreted as the poverty aversion parameter. In this paper, however, we focus on the poverty measure defined by Sen and its subsequent modifications.

The Sen poverty index defines poverty line in an absolute sense and suggests a weighting scheme which uses relative ordinal weights.

4. Estimating Poverty Based on a Relative Approach: Covering Population of the Poor and Non-Poor

A number of poverty measures have been proposed in the literature where in generating the ordinal rank weights it is not only the population of the poor but also that of the non-poor which are used. For example, Thon (1979) proposes the following index:

$$P(\text{Thon}) = \frac{2}{(n+1)\cdot nz} \sum_{i=1}^{m} (n+1-i)\cdot(z - y_i) \tag{9}$$

Viewed as a normalised weighted sum, this measure differs from P(Sen) in defining the weights w_i as $(n+1-i)$ rather than $(m+1-i)$ indicating that if the number of non-poor in the economy increases, the heightened sense of relative deprivation would be reflected by an increase in the n in the generation of ordinal rank weights. On the other hand, since n also enters into the denominator of the normalisation constant, it would also have an effect on the poverty measure in the opposite direction.

The relative aspects of poverty are more adequately captured in the measure suggested by Takayama (1979). This measure has the additional merit of being a very close translation of the Gini coefficient of income inequality into a measure

of poverty. The poverty measure is defined as the Gini coefficient of inequality for the censored income distribution y_i^*, Where $y_i^* = y_i$, for $i = 1, 2, \cdots, m$ and $y_i^* = z$ for all $i = m+1, \cdots, n$.

The mean income of this censored distribution is given by

$$\mu^* = \frac{\left[m \cdot \mu_p + (n-m) \cdot z\right]}{n} = H \cdot \mu_p + (1-H) \cdot z \tag{10}$$

The poverty measure is defined as

$$P(\text{Takayama}) = \frac{2}{\mu^* \cdot n^2} \cdot \sum_{i=1}^{n} (n+1-i) \cdot (\mu^* - y_i^*) \tag{11}$$

where μ^* is the mean income for the censored distribution. If we replace y_i^* by y_i and μ^* by μ, we get the Gini coefficient for the actual income distribution.

This measure can also be written as:

$$P(\text{Takayama}) = \left[\frac{2}{\mu^* \cdot n^2} \cdot \sum_{i=1}^{m} (n+1-i) \cdot (z - y_i)\right] + \left(1 + \frac{1}{n}\right) \cdot \left(1 - \frac{z}{\mu^*}\right) \tag{12}$$

The detailed derivation of equation (12) is given in Appendix 1. A discussion on the underlying axiomatic framework for different poverty measures is given in Srivastava (1988). For a discussion on the underlying axiomatic framework for the Gini coefficient see Sen (1974, 1976).

As such, it can be taken as a special case of the equation for measuring the Gini coefficient given below

$$\text{Gini coefficient for income inequality} = \frac{2}{\mu \cdot n^2} \cdot \sum_{i=1}^{n} (n+1-i) \cdot (\mu - y_i) \tag{13}$$

Equation (11) can be compared with equation (13) since the difference arises only because of replacing μ by μ^*.

Takayama's measure is attractive as it is a close translation of the Gini coefficient. It also captures the relative aspects of poverty. In particular, if the number of persons above the poverty line increases this would be reflected in the poverty index as the ordinal rank weights attached to the poverty gap of the poor will increase. This measure, however, is still insensitive to increases in income of the non-poor as neither the weighting scheme nor the scaling factor μ^* would be affected.

P(Takayama) can be viewed in two ways:

1) As a normalised weighted sum of poverty gaps; and

2) As the Gini coefficient of income inequality of a "censored" income distribution.

This censored income distribution is obtained by truncating the income distribution at the poverty line, assigning a value z to all non-poor incomes.

In the first part of his paper, Takayama considers Sen's (1974) axiomisation of the Gini coefficient of income inequality. With the help of these axioms he establishes that Sen's axiomisation is not complete unless an additional normalisation axiom is added.

Srivastava (1987) has argued that Takayama's derivation of his poverty index is

also not fully axiomised unless an additional normalisation axiom is added. Takayama's index violates the monotonicity axiom whereas a range can be specified in this family of measures where this axiom would not be violated. Axioms given by Srivastava give rise to not one but a family of poverty measures. He defines a poverty index which is a special case of this family of indices.

Consider now a class of censored income distributions $y^*(z,k)$

$y_i^* = y_i$, for $i = 1,2,\cdots,m$ (i.e. $y_i < z$)

and $y_i^* = z + k$ for all $i = m+1,\cdots,n$ (i.e. $y_i \geq z$)… (14)

Let μ_k^* be the mean income of the censored income distribution (y_i^*) for any given value of *k*, and let *k* be any non-negative arbitrary number. Srivastava specifies the value of k as $\mu_\pi - z$. This gives rise to the following censored income distribution:

$y_i^{**} = y_i$, for $i = 1,2,\cdots,m$ (i.e. $y_i < z$)

and $y_i^{**} = \mu_\pi$ for all $i = m+1,\cdots,n$ (i.e. $y_i \geq z$)… (15)

where μ_π refers to the mean income of the non-poor.

Then the following poverty index can be defined:

$$P(\text{Srivastava}) = \frac{2}{\mu \cdot n^2} \cdot \sum_{i=1}^{n} (n+1-i) \cdot \left(\mu - y_i^{**}\right) \tag{16}$$

In other words, the mean income of the censored income distribution given by (15) is the same as the overall mean income, that is,

$$\mu = \frac{\sum_{i=1}^{m} y_i + (n-m)\mu_\pi}{n} = m \cdot \mu_p + \frac{(n-m)\mu_\pi}{n} \tag{17}$$

where μ_p is the mean income of the poor $= \frac{\sum_{i=1}^{m} y_i}{m}$.

Srivastava argues that if the poverty index is defined as above, it is a closer translation of the Gini coefficient into a measure of poverty as compared to Thon or Takayama index. Srivastava measure can also be seen as a normalised weighted sum of poverty gaps plus a constant as given below. Equation (16) can be written as:

$$P(\text{Srivastava}) = \frac{2}{\mu \cdot n^2} \cdot \sum_{i=1}^{n} (n+1-i) \cdot \left(\mu - z + z - y_i^{**}\right) \tag{18}$$

This can be rewritten as

$$P(\text{Srivastava}) = \frac{2}{\mu \cdot n^2} \cdot \sum_{i=1}^{n} (n+1-i) \cdot \left(z - y_i^{**}\right) + \frac{2(\mu - z)}{\mu \cdot n^2} \cdot \sum_{i=1}^{n} (n+1-i) \tag{19}$$

The second term in equation (19) is a constant while the first term is a normalised weighted sum of poverty gaps. In subsequent discussions we refer to *P*(Srivastava) as *P*(*S*) and *P*(Takayama) as *P*(*T*).

5. Estimating Poverty for Rural India: 2011-2012, 2022-2023 and 2023-2024

In our study we have covered all the major states. Data has been arranged with respect to two coordinates of mean expenditure namely with respect to states and

a fractiles. Although it has been a practise from early studies on poverty that were initiated in India in the 1970's to study poverty at a state level, an all-India estimate could be derived by taking a weighted average of the state poverty headcount ratio, the weights being the number of poor in the respective states. The argument for this state-wise approach was that cost of living differs across states.

A number of considerations can inform a choice between using state-wise poverty lines vis-à-vis a national poverty line. First, over time, interstate cost differentials have come down, particularly with respect to the food and other items that contribute to nutritional intakes. Second, public finance literature favours formulation of national level poverty alleviation policies rather than at the sub-national level in a federal setup. The idea is that state level policies for poverty alleviation would encourage interstate migration for the purpose of seeking more rewarding state specific benefits aimed at poverty alleviation. Such migration should be in search of higher incomes or for promotion of efficiency. Third, in India the central government has designed a number of poverty alleviation programs that have common norms across states and are commonly available in the states. Examples of such programs are Pradhan Mantri Garib Kalyan Anna Yojana (PMGKAY)[4] where free foodgrains covering basic needs are given to citizens across states. Further, the same ration card made in any state can be used to access free or subsidized benefits linked to a ration card throughout India. The central government also runs a guaranteed rural employment scheme which was called as Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGA)[5]. In this scheme, common norms applied to all states. Fourth, in India considerable interstate migration exists where both skilled and unskilled labour move across states. A basic characteristic of a federal state is that is facilitates and ensures the existence of a common market which is fiscal barriers-free. This encourages movement of low income citizens from poorer states to higher income states in search of better job opportunities. There is also a lot of migration out of rural areas to urban areas within states and to other states. Thus, a poor person or household often moves out and therefore state-differentiated poverty policies do not have much relevance.

Fifth, the quantification of state specific poverty lines, utilizes consumer price inflation data where base year is 2011-2012. This base year has remained static for a number of years. Any updation of state-level poverty lines will be affected by the weighting structure of the base year which has been subject to change over time. State-specific poverty lines may not thus be considered as devoid of measurement errors. State-specific poverty headcount ratios implicitly assume static population of the poor which is not true given the extensive interstate migration of low-income persons or households. However, even if families are relatively anchored to give up certain locations, the nature of market access has changed enormously in India. The extent of digital commerce and digital transactions has increased ex-

[4]https://www.pib.gov.in/PressReleasePage.aspx?PRID=1980686&reg=3&lang=2.

[5]now called as VB-G RAM G scheme; Viksit Bharat Guarantee For Rozgar and Ajeevika Mission (Gramin); https://www.pib.gov.in/PressReleasePage.aspx?PRID=2207187&reg=3&lang=2.

plosively in India in recent years. Comparing 2024-2025 data with 2017-2018 data, the total volume of digital payments has increased by 15.2 times and the value of total digital payments has more than doubled from INR1370 lakh crore to INR2862 lakh crore[6]. The only reason why retail prices may not converge across states is because of inefficiency in the working of markets or barriers in interstate trade. This used to be the case when there were too many rigidities in movement of goods across states. Also, the state level indirect taxes that were loaded onto the state specific prices differed. After the states have adopted a goods and services tax with common rates across states such tax load onto state specific prices have also become common. There may be differences in the composition of demand to some extent but this difference is minimal with respect to the basket of goods relevant for the nutritional requirements. In fact, the working of an efficient market requires as a condition that locational differences in prices become lower and lower. It is therefore useful, particularly in the context of designing national level poverty alleviation policies to use a common poverty line rather than considering poverty lines that differ across states or differ across districts within the states. At any rate, we are not arguing for replacing state-specific poverty lines. Our objective in this paper is to provide supplementary information in the context of rural poverty measurement in India based on using a common poverty line.

Much of this is subsidized by the central government and delivery is made through the Public Distribution System where prices tend to be uniform across states. Also, population has become far more mobile across states and the poor of one state move to another state in search of employment opportunities. We have therefore preferred to estimate directly all-India poverty indices by covering all the states and taking a common poverty threshold. It is also notable that our all-state poverty headcount ratio is quite comparable to that of the Rangarajan Committee (Government of India, Planning Commission, 2014) weighted average for 2011-2012. In their case this weighted average was 30.9% for rural poverty at the all-India level while the corresponding headcount ratio at the all-state level in our estimates is 32.0%. Our poverty line is higher compared to theirs by only a few rupees. We do recognize that there is a compositional implication of using state-specific poverty lines and state-specific poverty headcount ratios. **Table 1** shows that there is a certain recognizable pattern of state-specific poverty lines in the base year. In fact, it is the lower-income states where the poverty line is also lower than the all-India line. This implies that if lower poverty lines are used for lower-income states, the incidence of poverty would also be lower in these states. Using a common poverty line implies that the poverty headcount ratio of the poorer states is higher than would be the case if state-specific poverty lines are used. Thus, if the headcount ratio of 30.9% is increased to 32.0%, the implicit change can be interpreted as providing a higher weight to the poverty headcount ratios of the poorer states. In the design of national poverty alleviation programs, this may be a helpful feature.

[6]RBI annual report (various issues).

Table 1. State-specific poverty lines in 2011-2012.

States/UTs	Poverty line	State/UT	Poverty line
Odisha	876	Kerala	1054
Uttar Pradesh	890	Himachal Pradesh	1067
Jharkhand	904	Maharashtra	1078
Chhattisgarh	912	Tamil Nadu	1082
West Bengal	934	Gujarat	1103
Tripura	936	Meghalaya	1111
Madhya Pradesh	942	Sikkim	1126
Bihar	971	Punjab	1128
Karnataka	975	Haryana	1128
Assam	1007	Arunachal Pradesh	1151
Uttarakhand	1015	Manipur	1185
Andhra Pradesh combined	1032	Goa	1201
Rajasthan	1036	Nagaland	1230
Jammu & Kashmir	1045	Mizoram	1231
		All-India	972

Source: Rangarajan committee report (2014).

It is also notable that by using a common poverty line, we are able to estimate a number of poverty measures suggested in the literature, such as the Sen, Takayama et al. poverty indices which have not been estimated regularly with reference to earlier data available from the NSSO. So far, in the literature, there are not many exercises where these measures have been used for quantification of the poverty index. In this respect, our exercise provides empirical estimates in the Indian context for these ordinal poverty measures which fills up a gap in the literature.

Available data from NSSO can be arranged in ascending order of mean incomes of a state and fractile combination. The underlying assumption is that the population for the state, fractile combination is centred on the mean income of that group. Thus, for 2011-2012 we get 27×12 state-fractile groups, that is, 324 groups. For 2022-2023 and 2023-2024, we get, 28×12 state-fractile groups, that is, 336 groups. As these are arranged in an ascending order, a defined poverty line will divide the entire population into two groups of poor and non-poor. We have utilized the Rangarajan Committee poverty line norm for 2011-2012 and increased it by CPI (rural) inflation for 2022-2023 and 2023-2024 with marginal rounding up. These provide baseline poverty lines which are successively increased by margins of 1% to 5% for the sensitivity analysis. Key aggregates for the baseline are summarized in Table 2.

Table 2. Key aggregates common for all poverty measures (INR per month).

Years	Weighted mean expenditure (INR)				Poverty line
	Total population	Population of poor	Population of non-poor	mu* (weighted mean of Takayama censored population)	
2011-2012	1424	773	1730	910	975
2022-2023	3775	1543	3989	1818	1845
2023-2024	4110	1692	4236	1937	1950

Source: Author's estimates.

As mentioned, our rural poverty line is marginally higher than the poverty line updated recently by Das et al. (2025) for 2022-2023. They had derived the updated poverty line using updated Rangarajan Committee norms. However, they cover only 19 states and if we use an all-state poverty line by a weighted average of the state specific poverty lines, it amounts to INR1765 per month. Our poverty line is slightly higher than this at INR1845 for 2022-2023 covering 27 states and using CPI relativity. It is increased further to INR1950 for 2023-2024.

A summary of different poverty indexes including the headcount ratio is given in Table 3 with respect to the poverty line for the base scenario.

Table 3. Poverty estimates for rural areas: Sen, Thon, Takayama and Srivastava indexes.

Year	Indices (%)				
	Headcount ratio	Sen	Thon	Takayama	Srivastava
2011-2012	32.0	9.2	12.0	5.7	15.2
2022-2023	8.8	2.0	2.8	1.4	5.2
2023-2024	5.0	0.9	1.3	0.6	2.9

Source: Author's estimates.

Table 3 highlights that:

1) Rural poverty has fallen sharply from 2011-2012 to 2022-2023. This is indicated by all the indices. The headcount ratio has fallen from 32.0% to 8.8% between these two years. There has been a further fall in the headcount ratio to 5% in 2023-2024.

2) Among the four poverty indices that have been estimated here, the lowest values are for the Takayama and the highest for the Srivastava index. However, directionally all of these indicate a downward trend in the incidence of rural poverty in India.

3) In all these cases, the poverty index value is lower than the headcount ratio.

In a recent study by Das et al. (2025), a comparable study has been undertaken for estimating poverty headcount ratio for 2022-2023 using the NSSO Household Consumption Expenditure data for 2022-2023. Their study covers 19 states. The weighted headcount ratio for these states in their case is estimated at 6.7% for rural

areas. Their poverty line was defined as INR1765, considering the weighted average of the 19 states. In contrast, our poverty line is slightly higher at INR1,845 with coverage of 27 states.

6. Sensitivity Analysis with Variable Poverty Lines

It may be useful to design national-level poverty alleviation policies after taking into account the sensitivity of poverty measures to incremental changes in the poverty line. This would be reflected in the extent of increase in the incidence of poverty if the poverty line is increased by small margins. In order to undertake a sensitivity analysis, we have increased the base poverty lines successively by 1%, 2%, …, 5%. The results show variation according to the year of study.

Table 4 gives the impact of incremental changes in the poverty line for the three years studied here namely 2011-2012, 2022-2023 and 2023-2024, on the headcount ratio and other poverty indices. We observe that the coefficient of variation linked to incremental increases in the poverty line shows an increase between 2011-2012 and 2022-2023 and then a fall between 2022-2023 and 2023-2024 with reference to the headcount ratio and the Srivastava index. However, in the other three cases, it shows a progressive increase comparing the three years of the study. Considering the headcount ratio which has come down significantly in 2023-2024 as compared to 2011-2012 even if the poverty line is increased all the way upto 5% points, the headcount ratio increases from 5% to only 5.41%. Thus, policies designed to alleviate poverty would be robust as marginal underestimation of poverty line would not have much impact on the headcount ratio.

Table 4. Results of sensitivity analysis: Change in index of poverty.

		Poverty line	Headcount ratio	Sen	Thon	Takayama	Srivastava
		INR			%		
				2011-2012			
% increase over baseline	Baseline	975	31.96	9.24	11.97	5.72	15.19
	1%	985	33.49	9.67	12.41	5.92	15.73
	2%	995	33.52	9.91	12.84	6.12	15.75
	3%	1005	34.60	10.30	13.27	6.32	16.12
	4%	1014	34.60	10.51	13.67	6.50	16.12
	5%	1024	34.60	10.75	14.09	6.69	16.12
Coefficient of variation			0.031	0.056	0.061	0.058	0.023
				2022-2023			
% increase over baseline	Baseline	1845	8.77	2.02	2.80	1.38	5.21
	1%	1864	8.77	2.09	2.94	1.45	5.21
	2%	1882	8.77	2.15	3.07	1.52	5.21

Continued

	3%	1901	9.47	2.30	3.22	1.59	5.56
	4%	1919	9.64	2.38	3.36	1.66	5.65
	5%	1938	9.96	2.49	3.51	1.73	5.81
Coefficient of variation			0.057	0.081	0.084	0.084	0.049
			2023-2024				
	Baseline	1950	4.97	0.89	1.30	0.64	2.93
	1%	1970	5.17	0.95	1.38	0.68	3.03
	2%	1989	5.17	0.99	1.47	0.73	3.03
% increase over baseline	3%	2009	5.41	1.05	1.55	0.77	3.16
	4%	2028	5.41	1.09	1.64	0.81	3.16
	5%	2048	5.41	1.14	1.72	0.85	3.16
Coefficient of variation			0.035	0.091	0.105	0.106	0.031

Source: Author's estimates.

It is also notable that the magnitudes in the four poverty indices pertaining to Sen, Thon, Takayama and Srivastava are quite different. These four measures can be considered in sets of two measures for purposes of comparison. In the cases of Sen and Thon indexes, the poverty measure focuses only on the population of the poor. The difference is in their scheme of ordinal rank weights. In Sen's case, the weights are generated from the population of the poor only. In Thon's case, the weights are generated using the overall population consisting of the poor and non-poor. However, in both cases, these sets of weights are attached to deviations of incomes of the poor from the poverty line. The other group is that of Srivastava and Takayama. In these two cases, the population and incomes of the non-poor are used although in different ways. In Takayama's case, incomes of the non-poor are centred at the poverty line *z*. In Srivastava's case, these are centred at the mean income of the non-poor. The overall mean of the censored income distribution in these two cases differ. Thus, the deviations from the weighted means also differ and play a role in determining the magnitude of the respective poverty indexes. This may be highlighted by deducting the Takayama index from the Srivastava index.

It can be seen that $P(S) > P(T)$ if

$$\left(P(T) + \frac{(\mu_\pi - z)}{(\mu - \mu^*)} \cdot \frac{(n-m)\cdot(n-m+1)}{n^2} \right) < 1 \tag{20}$$

This condition depends on two relativities namely $\frac{(\mu_\pi - z)}{(\mu - \mu^*)}$ which is the ratio of the excess of the mean income of the non-poor over the poverty line relative to the excess of the overall income of Takayama's distributions from the mean income

of Takayama's censored distribution. The second ratio $\frac{(n-m)\cdot(n-m+1)}{n^2}$ depends on the number of non-poor *n-m* and the overall population. This ratio brings in the effect of ordinal rank weights. See Appendix 2 for a detailed derivation. Illustratively, we have derived the relevant relativities for the case when poverty line is as per the base case for 2023-2024. This is shown in Table 5.

Table 5. Condition when poverty index given by Srivastava exceeds that of Takayama: 2023-2024, base case.

Term	Magnitude
$\frac{(\mu_\pi - z)}{(\mu - \mu^*)}$	1.052
$\frac{(n-m)\cdot(n-m+1)}{n^2}$	0.903
$\frac{(\mu_\pi - z)}{(\mu - \mu^*)}\cdot\frac{(n-m)\cdot(n-m+1)}{n^2}$	0.950
$P(T)$	0.006
$P(T)+\frac{(\mu_\pi - z)}{(\mu - \mu^*)}\cdot\frac{(n-m)\cdot(n-m+1)}{n^2}$ (Equation (20))	0.957 (*less than* 1)

Source: Author's estimates.

7. Concluding Observation

Consumption expenditure data released by the NSSO have recently become available for 2022-2023 and 2023-2024. These data are based on a thick expenditure survey and are comparable with the earlier 2011-2012 data. There has been a gap in these surveys in the intervening period. The availability of this rich data on expenditure provides a means for the study of inequality and poverty. In this paper, we have focused on measuring the trends in rural poverty and understanding its nature in terms of its sensitivity to successive poverty line increases. If there is a bunching of the poor along the poverty line, it points to their vulnerability.

Literature on poverty has come with a number of alternative measures of poverty, distinguishing between absolute and relative approaches. Relativity can be introduced in terms of various dimensions of poverty, including its measurement in cardinal and ordinal terms and the coverage with respect to poor and non-poor. Four indices that we have utilized in this study have been proposed at various times by Sen, Thon, Takayama and Srivastava. Their perspectives differ in terms of coverage of poor and non-poor, but they all have emphasized the importance of relativity in the measurement of poverty.

We find that rural poverty has fallen sharply from 2011-2012 to 2022-2023, as

indicated by all the indices. The headcount ratio has fallen from 32.0% to 8.8% between these two years. There has been a further fall in the headcount ratio to 5% in 2023-2024. Among the four poverty indices that have been estimated here, the lowest values are for the Takayama and the highest for the Srivastava index. However, directionally, all of these indicate a downward trend in the incidence of rural poverty in India. In all these cases, the poverty index value is lower than the headcount ratio.

A sensitivity analysis indicates that for 2011-2012, poverty indices increase from the baseline estimates upto 2% of increase. After that, the range of increase from 3% to 5% in the poverty line does not affect much the headcount ratio or the Srivastava index, although in other cases, some marginal increase is observed. For 2022-2023, there is not much bunching of the poor upto 2% above the poverty line as the headcount ratio and the Srivastava index does not change at all. In the two other indices, there is a small increase that is observed. There is again a bunching in the headcount ratio when the poverty line is increased by margins of 3% - 5%. For 2023-2024, there are two individual blocks where the poverty index is not showing sensitivity, namely in the range of 1% - 2% and again in the range of 3% - 5% in terms of the headcount ratio and Srivastava index. In other indices, there are some marginal changes that are observed.

In India, policymakers have focused on various income support measures that would reduce the incidence of rural poverty. Studies show that interventions for the rural areas, including various programs such as the MGNREGA employment scheme and PM Garib Kalyana Anna Yojana, which ensures distribution of free food, have played a significant role in reducing rural poverty. There is a need to continue with these schemes in the medium-term to ensure a continued pace of reduction of poverty, particularly since there are ranges within which there is a bunching of the poor around the existing poverty lines.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Appendix

Appendix 1: Decomposition of the Takayama Index

$$P(\text{Takayama}) = \frac{2}{\mu^* \cdot n^2} \cdot \sum_{i=1}^{n} (n+1-i) \cdot (\mu^* - y_i^*) \tag{A1}$$

$$= \frac{2}{\mu^* \cdot n^2} \cdot \sum_{i=1}^{n} (n+1-i) \cdot \left((z - y_i^*) + (\mu^* - z)\right) \tag{A2}$$

For $i = 1, \cdots, m$

$y_i^* = y_i$;

$y_i^* = z$ for $i = m+1, \cdots, n$

$$P(\text{Takayama}) = \frac{2}{\mu^* \cdot n^2} \cdot \sum_{i=1}^{m} (n+1-i) \cdot \left((z - y_i) + (\mu^* - z)\right) + \frac{2}{\mu^* \cdot n^2} \cdot \sum_{i=m+1}^{n} (n+1-i) \cdot \left((z - z) + (\mu^* - z)\right) \tag{A3}$$

$$= \frac{2}{\mu^* \cdot n^2} \cdot \sum_{i=1}^{m} (n+1-i) \cdot \left((z - y_i) + (\mu^* - z)\right) + \frac{2 \cdot (\mu^* - z)}{\mu^* \cdot n^2} \cdot \sum_{i=m+1}^{n} (n+1-i) \tag{A4}$$

$$= \frac{2}{\mu^* \cdot n^2} \cdot \sum_{i=1}^{m} (n+1-i) \cdot (z - y_i) + \frac{2 \cdot (\mu^* - z)}{\mu^* \cdot n^2} \cdot \sum_{i=1}^{m} (n+1-i) + \frac{2 \cdot (\mu^* - z)}{\mu^* \cdot n^2} \cdot \sum_{i=m+1}^{n} (n+1-i) \tag{A5}$$

$$= \frac{2}{\mu^* \cdot n^2} \cdot \sum_{i=1}^{m} (n+1-i) \cdot (z - y_i) + \frac{2 \cdot (\mu^* - z)}{\mu^* \cdot n^2} \cdot \sum_{i=1}^{m} (n+1-i) + \frac{2 \cdot (\mu^* - z)}{\mu^* \cdot n^2} \cdot \sum_{i=m+1}^{n} (n+1-i) \tag{A6}$$

$$= \frac{2}{\mu^* \cdot n^2} \cdot \sum_{i=1}^{m} (n+1-i) \cdot (z - y_i) + \frac{2 \cdot (\mu^* - z)}{\mu^* \cdot n^2} \cdot \left[\sum_{i=1}^{m} (n+1-i) + \sum_{i=m+1}^{n} (n+1-i)\right] \tag{A7}$$

$$= \frac{2}{\mu^* \cdot n^2} \cdot \sum_{i=1}^{m} (n+1-i) \cdot (z - y_i) + \frac{2 \cdot (\mu^* - z)}{\mu^* \cdot n^2} \cdot \frac{n \cdot (n+1)}{2} \tag{A8}$$

$$P(\text{Takayama}) = \left[\frac{2}{\mu^* \cdot n^2} \cdot \cdot \sum_{i=1}^{m} (n+1-i) \cdot (z - y_i)\right] + \left(1 + \frac{1}{n}\right) \cdot \left(1 - \frac{z}{\mu^*}\right) \tag{A9}$$

Appendix 2: Relationship between Poverty Indices of Srivastava and Takayama

Symbols have meaning as in the text

$$P(T) = \left[\frac{2}{\mu^* \cdot n^2} \cdot \sum_{i=1}^{m} (n+1-i) \cdot (z - y_i)\right] + \left(1 + \frac{1}{n}\right) \cdot \left(1 - \frac{z}{\mu^*}\right) \tag{A10}$$

$$P(T) - \left(1 + \frac{1}{n}\right) \cdot \left(1 - \frac{z}{\mu^*}\right) = \frac{2}{\mu^* \cdot n^2} \cdot \sum_{i=1}^{m} (n+1-i) \cdot (z - y_i) \tag{A11}$$

$$\frac{\mu^{*}\cdot n^{2}}{2}\left[P(T)-\left(1+\frac{1}{n}\right)\cdot\left(1-\frac{z}{\mu^{*}}\right)\right]=\sum_{i=1}^{m}(n+1-i)\cdot(z-y_{i}) \tag{A12}$$

$$\begin{aligned}P(S)=&\frac{2}{\mu\cdot n^{2}}\sum_{i=1}^{m}(n+1-i)\cdot(z-y_{i})+\frac{2}{\mu\cdot n^{2}}\sum_{i=1}^{m}(n+1-i)\cdot(\mu-z)\\&+\frac{2}{\mu\cdot n^{2}}\cdot\sum_{i=m+1}^{n}(n+1-i)\cdot(\mu-\mu_{\pi})\end{aligned} \tag{A13}$$

Replacing $\sum_{i=1}^{m}(n+1-i)\cdot(z-y_{i})$ in P(S) with $\frac{\mu^{*}\cdot n^{2}}{2}\left[P(T)-\left(1+\frac{1}{n}\right)\cdot\left(1-\frac{z}{\mu^{*}}\right)\right]$ we get

$$\begin{aligned}P(S)=&\frac{2}{\mu\cdot n^{2}}\cdot\frac{\mu^{*}\cdot n^{2}}{2}\left[P(T)-\left(1+\frac{1}{n}\right)\cdot\left(1-\frac{z}{\mu^{*}}\right)\right]\\&+\frac{2}{\mu\cdot n^{2}}\sum_{i=1}^{m}(n+1-i)\cdot(\mu-z)\\&+\frac{2}{\mu\cdot n^{2}}\cdot\sum_{i=m+1}^{n}(n+1-i)\cdot(\mu-\mu_{\pi})\end{aligned} \tag{A14}$$

It can be shown that

$$\left(1-P(T)\right)>\frac{(\mu_{\pi}-z)(n-m)\cdot(n-m+1)}{(\mu-\mu^{*})n^{2}}-\frac{1}{n} \tag{A15}$$

When n is large, $\frac{1}{n}$ is near zero. Thus,

$$\left(1-P(T)\right)>\frac{(\mu_{\pi}-z)(n-m)\cdot(n-m+1)}{(\mu-\mu^{*})n^{2}}\quad\text{or if} \tag{A16}$$

Thus, $P(S)>P(T)$ when

$$\left(P(T)+\frac{(\mu_{\pi}-z)}{(\mu-\mu^{*})}\cdot\frac{(n-m)\cdot(n-m+1)}{n^{2}}\right)<1 \tag{A17}$$