

# **Measures of Poverty**

Manoranjan Pal

# Introduction

- Many studies have been conducted on poverty all over the world. It was seen that, despite considerable growth, the level of poverty did not decrease in the same rate for many countries.
- Different concepts of poverty have emerged in course of time. Thus, there exists poverty even in developed countries.
- It is necessary to understand the concept of poverty, measure the degree of such poverty and ameliorate it as much as possible by formulating appropriate programs.

# Absolute Vs. Relative Poverty

**Absolute Poverty:** Rowntree defined a family to be poor if its total earning was insufficient to obtain the minimum necessities for the maintenance of merely physical efficiency. In this definition we consider the biological/nutritional requirements for survival of persons with full efficiency. The goods considered for this purpose are the basic need goods, e.g., food, shelter, clothings etc. If the basic needs are not fulfilled by a family, the family will be declared as poor.

**Relative Poverty:** On the other hand, the relative poverty comes from the concept of relative deprivation. So, there is a direct relation of these poverty measures with the inequality measures. The people in the bottom category may not be able to share in the diets, customs and activities when compared to the society's style of living, which is more or less fixed. In other words, they face the condition of deprivation relative to the rest of the society.

**If the incomes of all the people are increased in the same proportion, then the poverty rate will not change in the relative sense whereas the absolute poverty will drastically change.**

# Relative vs. Absolute Poverty

## (A Diagrammatic Representation)

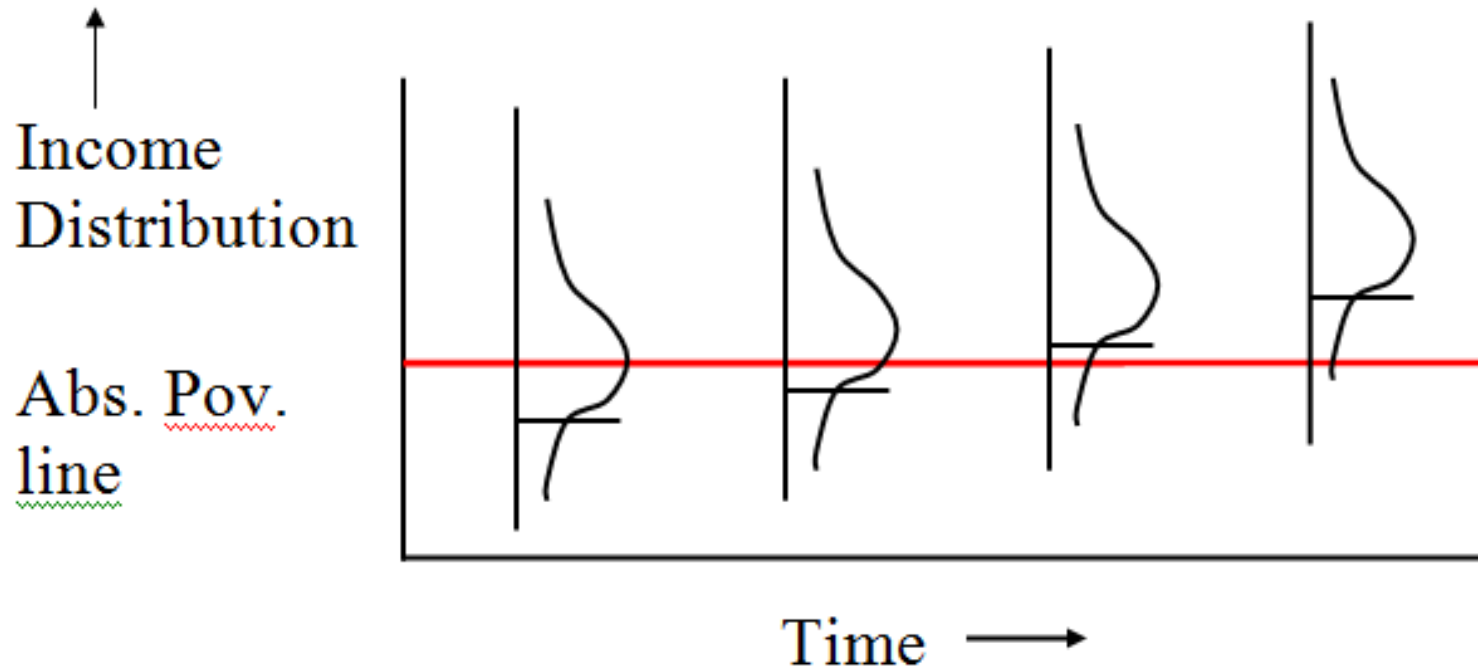


Diagram 1: Reduction in the absolute poverty when general income level rises

# Absolute Poverty and Inequality

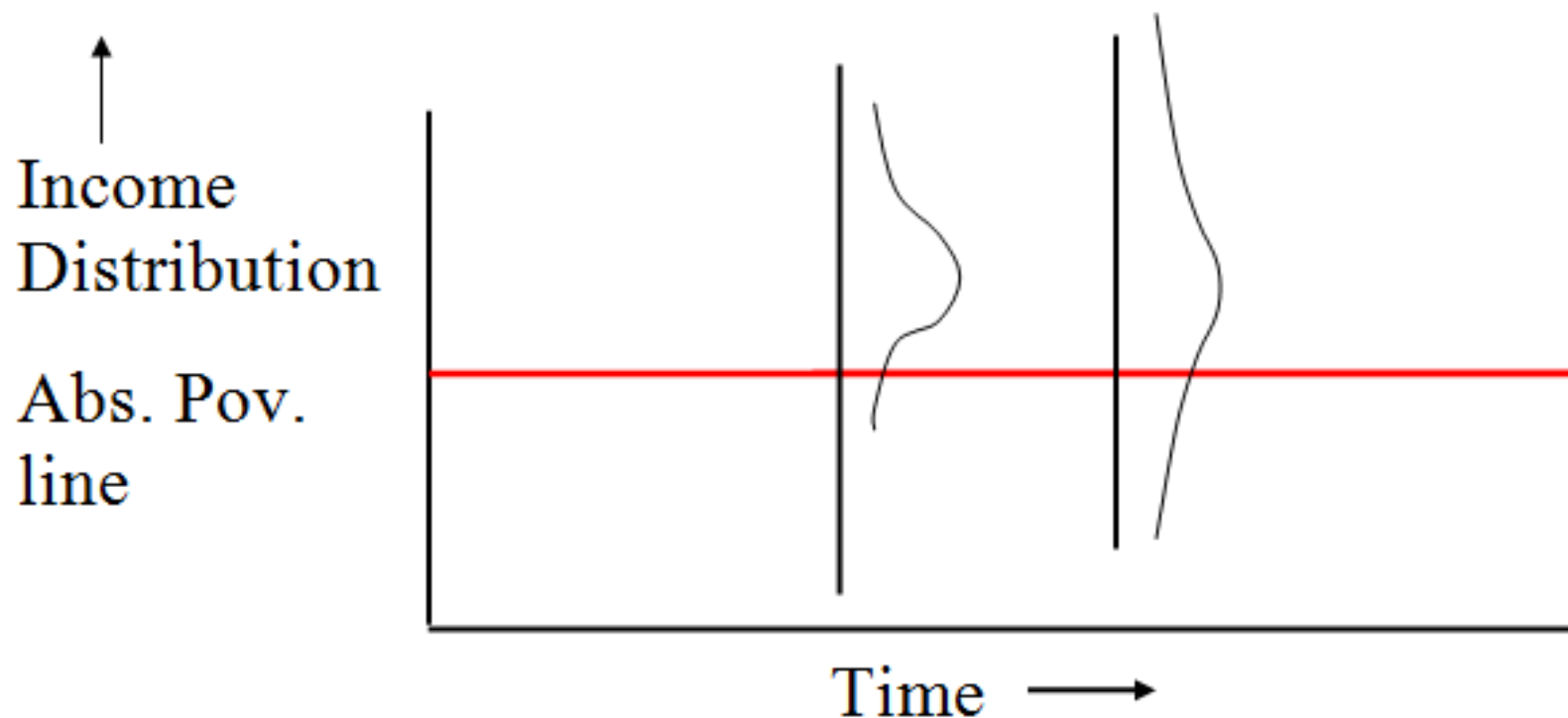


Diagram 2: Increase in the absolute poverty when inequality increases

# Difficulties in Defining Absolute Poverty

- Nutritional requirements may not be same for all persons. They vary with age, sex, body weight, nature of work of the individuals. Even for a single individual the needs are hard to specify with precision. Any set of norms is bound to be arbitrary to some extent.
- Moreover, the translation from minimum nutritional requirements into minimum food requirements depends on the choice of food items. We can of course solve the so called “diet problem” by the simplex method in linear programming. The solution would give the least cost basket of food items, sold at specified prices, which just meets the various requirements of calories, proteins etc. The solutions may not be acceptable to the people under consideration.
- Third, the minimum needs are hard to specify for nonfood items like clothing, fuel etc. One can overcome the hurdle by assuming that a specified proportion of total income will be spent on food. This would give the poverty line income once one has got the cost of the minimum need food basket. However, the proportion of income spent on food – called the Engel Ratio – varies with the income and also with relative prices.

# Direct method Vs. Income method

- **Direct Method:** In the direct method, one identifies those whose actual consumption basket leaves some basic needs unsatisfied, like all households with inadequate intake of calories as revealed by household budget data.
- **Income Method:** In the income method, on the other hand, one specifies a poverty line figure – a threshold income – and considers everyone below this as poor. This income, in principle, is such that all the specified needs are satisfied at or above this level of income, but not satisfied if actual income falls short of this figure.

The income method has some important advantages. Consider a consumer who has income above the poverty line determined by the income method but whose intake of calorie and/or proteins, say, falls short of the requirements. This person has the ability to meet his calorie and protein needs but does not use that ability. There is every justification of treating him to be non-poor and this is done in the income method.

# Size and Composition of Households

- Measurement of poverty is usually based on data collected for families (or households) rather than for individuals, and difficulties arise because size and composition vary across families. One can utilize per capita figures, dividing family totals by the number of family members.
- It is better to consider *per equivalent adult*. Here one uses some equivalence scale where one adult male is taken as the standard types of member and other types of members are expressed in terms of number of equivalent adults (called **Adult Equivalent Scale**) and the family total is divided by this number to obtain figures per equivalent adult.



# Summary

- There are two basic problems in measurement of poverty. First problem is the identification of poor and the second is the aggregation of available information to arrive at a reasonable estimate of degree of poverty.
- We have so far discussed identification of poor.

# Aggregation of Data

- Suppose that one has data on incomes of all the persons in a community and one has defined a poverty line income, denoted  $Z$ , such that those with income  $< Z$  can be regarded as poor. Denote the total number of persons in the community by  $n$ , and the number of poor persons by  $q$ . Let the incomes of the poor persons be denoted as  $y_1, y_2, \dots, y_q$ . It will be assumed that these incomes are in decreasing order, i.e.,

$$y_1 \geq y_2 \geq \dots \geq y_q.$$

The poverty gap of the  $i$ th poor person is  $g_i = Z - y_i$ ,  $i = 1, 2, \dots, q$ .

The total poverty gap of the poor, denoted  $g$ , is sometimes used:

$$g = \sum_{i=1}^q g_i = \sum_{i=1}^q (Z - y_i).$$

# Head Count Ratio

- The commonest measure of poverty is the Head Count Ratio (H):

$$H = q/n.$$

This is the proportion of persons below the poverty line.

- This has been extremely used for comparisons over time or across regions, countries and social classes. It measures one aspect of overall deprivation – how many are poor, never mind how much. It ignores the poverty gaps, i.e., the extent of income shortfall of poor people. It can be reduced by lifting those slightly below Z, ignoring those far below Z.

# Income Gap Ratio

- The other popular measure is the Income Gap Ratio:

$$I = \frac{1}{q} \sum_{i=1}^q \frac{(Z - y_i)}{Z} = \frac{(Z - \bar{y}_q)}{Z} = 1 - \frac{\bar{y}_q}{Z}.$$

where

$$\bar{y}_q = \frac{1}{q} \sum_{i=1}^q y_i$$

denotes the average income of the poor.

- Clearly,  $I$  is the average poverty gap of the poor expressed as a fraction of the poverty line income. It catches the other aspect of the poverty, namely, how much is the poverty gap, on the average, never mind suffered by how many.

# Problems with H and I

- H and I taken together should give a fairly complete picture. But Sen pointed out that both of them ignore the inequality of incomes among the poor. One can have very different situations with the same values of H and I, that is, of  $q$  and  $\bar{y}_q$ .
- Thus, one can have a situation where all the poor persons have incomes close to and another situation where some of them have incomes well below. The measure of poverty should be able to discriminate between the two situations, taking a higher value for the second.

# Two Axioms of Sen

- **The Monotonicity Axiom (M):** Other things remaining equal, an increase in the income of any one below the poverty line must strictly reduce the poverty measure and *vice versa*.
- **The Weak Transfer Axiom (WT):** Other things remaining equal, a transfer of income from a poorer person to a richer person below the poverty line – which does not make the latter person cross the poverty line – must strictly increase the poverty measure.
- H fails to satisfy both these criteria, while I satisfies the axiom M but not the axiom WT, being blind to the inequality of incomes of the poor. They will be adequate when taken together only if all the poor persons have the same income. They, however, have one good property: they do not depend on the actual income of the non-poor.

# Sen's Index of Poverty

- Sen derived an important index of poverty, which is theoretically quite satisfactory, based on an ordinal concept of welfare. This takes account of the relative deprivation of poor persons *vis-à-vis* other poor persons. He first proposes that the index will be of the form:

$$P = A \sum v_i g_i,$$

- where  $v_i$  is the weight of poverty gap  $g_i = Z - y_i$  of the  $i$ th poor person and  $A$  is a normalizing constant, possibly depending on  $n$ ,  $q$  and  $Z$ .

# Sen's Index of Poverty

- **Axiom R: Ranked Relative Deprivation:** The weight  $v_i$  in the index  $P$  above may be taken as the person's income rank among the poor:

$$v_i = i, \quad i = 1, 2, \dots, q.$$

- **Axiom A: Normalized Absolute Deprivation:** If all the poor persons have the same income, then

$$P = HI.$$

- These two axioms lead to the following conclusion:
- **Theorem:** The only poverty measure satisfying R and A is given by:

$$P = \frac{2}{(q+1)nZ} \sum_{i=1}^q (Z - y_i)i.$$



# Different Forms of Sen's Index

- This can be expressed in other forms. Since the Gini coefficient of the incomes  $y_1, y_2, \dots, y_q$  of the poor people can be written as:

$$G = 1 + \frac{1}{q} - \frac{2}{(q^2 \bar{y}_q)} (y_1 + 2y_2 + 3y_3 + \dots + qy_q),$$

- one gets

$$P = H \left[ 1 - (1 - I) \left( 1 - \frac{Gq}{q + 1} \right) \right].$$

- If  $q$  is very large, then  $\frac{q}{q+1} \cong 1$ , and hence

$$P = H[1 - (1 - I)(1 - G)].$$

- or,

$$P = H[I + (1 - I)G].$$

- Thus,  $P$  depends on all three aspects of the situation measured by  $H$ ,  $I$  and  $G$ , respectively. It satisfies both the axioms  $M$  and  $WT$  stated above.

- If one puts  $I = 1 - \frac{\bar{y}_q}{Z}$ , one gets another popular form of  $P$ :

$$P = H \left[ 1 - \frac{\bar{y}_q(1 - G)}{Z} \right].$$

# Other Indices of Poverty

- Many variants of the Sen's Index P have been constructed by modifying the axioms R and A.
- Suppose one modifies the income gap ratio I by expressing the mean poverty gap as a fraction of the mean income  $\mu$  of the entire community and not as fraction of Z. One may write:

$$I^* = \frac{1}{q} \sum_{i=1}^q \frac{(Z - y_i)}{\mu}.$$

- Then,

$$HI^* = \frac{q}{n} \frac{1}{q} \sum_{i=1}^q \frac{(Z - y_i)}{\mu} = \sum_{i=1}^q \frac{(Z - y_i)}{n\mu}$$

is the ratio of aggregate poverty gap to the total income of all persons. One may now consider the following axiom.

- **Axiom A\*:** Alternative normalized absolute deprivation: If all the poor persons have the same income  $\bar{y}_q$ , then the poverty measure should be equal to  $HI^*$ .

# Index by Sudhir Anand

- The axioms  $A^*$  and  $R$  lead to a modified poverty measure  $P_{SA}$  proposed and used by **Sudhir Anand**.

$$P_{SA} = \frac{PZ}{\mu} = \frac{H}{\mu} [Z - \bar{y}_q(1 - G)].$$

- The index  $P_{SA}$  declines when the income of a non-poor person rises. So, it is not strictly a measure of the state of the poor.
- But it may be superior to  $P$  if one wishes to measure the community's potential ability to meet the challenge of poverty or the poverty of the community as a whole.
- Note that  $HI^*$  is the fraction of the aggregate income that would have to be transferred if poverty were to be wiped out by redistribution of income.

# Kakwani's Index

- Kakwani presented another index:

$$P_K = \frac{H}{\mu} \left[ Z - \frac{\bar{y}_q}{(1 + G)} \right]$$

- This was obtained by varying axiom R, making the weight  $v_i$  on  $g_i$  proportional to the income of all the poor persons richer than person  $i$ .

# Index by Blackorby and Donaldson

Blackorby and Donaldson generalized Sen's Index by proposing a general formula of the form:

$$P_{BD} = H \left( 1 - \frac{e}{Z} \right),$$

where  $e$  is the equally distributed equivalent income of the poor based on some social evaluation function, i.e.,  $e$  represents that level of income which, if enjoyed by each of the poor, would be judged by the social evaluation function to be as good as the actual distribution of income of the poor. Note that  $(1 - e/Z)$  is the proportionate gap between  $Z$  and  $e$ .

# Thon's Index

- One property of the Sen Index  $P$  is that it can fall when a transfer from a poorer person to a richer one enables the latter to cross the poverty line. Whether this is undesirable or not has been debated in the literature. Thon proposes a modification of  $P$  as

$$P_T = \frac{2}{(n+1)nZ} \sum_{i=1}^q (Z - y_i) R(i).$$

where  $R(i)$  is the income rank of the  $i$ th poor person among all people in the community. This index increases for all transfers of income from a poorer person to one who is richer.

# Decomposition of Poverty Measures

- The computation of poverty index is only a first step in the analysis of poverty. One should go deeper and enquire into the concomitants of poverty, or better, the factors contributing to poverty by analyzing time series or cross section data on distribution of per capita income or consumption expenditure.
- One way of doing this is to compute indices of poverty for different segments of the population, using an index which is additively decomposable in the sense that, given a population partitioned into  $k$  groups with respect to some regional or socioeconomic characteristic, one has

$$P = \sum_{i=1}^q \frac{n_i}{n} P_i ,$$

- where  $P$  is the poverty index for the entire population,  $P_i$  that for the  $i$ th group ( $i = 1, 2, \dots, k$ ),  $n_i$  the population of the  $i$ th group, and  $n = \sum_i n_i$ .
- If this is done, one can study the contribution of different groups to total poverty, and this can help in formulating anti-poverty programmes.

# Measures that Satisfy Decomposition by Population Subgroup

- The **head count ratio** is obviously decomposable. Let the  $i$ th group have  $q_i$  poor persons and  $q = \sum q_i$ . Then

$$H = \frac{q}{n} = \sum_i \frac{n_i}{n} \frac{q_i}{n_i} = \sum_i \frac{n_i}{n} H_i,$$

where  $H_i$  is the head count ratio of the  $i$ th group.

- Most of the existing indices of poverty including Sen's index are not decomposable. There are two additively decomposable indices which are popular in the literature. One of these was proposed by **S. R. Chakravarty** and the index is:

$$P_{SRC} = \frac{1}{n} \sum_1^q \left[ 1 - \left( \frac{y_i}{Z} \right)^e \right], \text{ where } 0 < e < 1.$$

- It satisfies the monotonicity and transfer axioms. The parameter  $e$  determines the degree of sensitivity of the poverty measure to transfers of income at various points on the income scale. If the population is divided into  $k$  mutually exclusive groups, then the overall index is the weighted arithmetic mean of the group indices, the weights being  $n_i/n$  as for the head count ratio.



# Foster, Greer and Thornbecke (FGT) Index

- The other index which satisfies these properties has been developed by Foster, Greer and Thornbecke. They have proposed a class of measures as follows:

$$P_{FGT} = \frac{1}{n} \sum_{i=1}^q \left( \frac{Z - y_i}{Z} \right)^{\alpha}, \text{ where } \alpha > 1.$$

- Observe that this measure reduces to H when  $\alpha$  tends to 0 and to HI when  $\alpha = 1$ . However, a more frequently used formula of the poverty index is one special case of  $P_{FGT}$  which is obtained by putting  $\alpha = 2$ . This is usually referred to as **Squared Poverty Gap Index**.

# Discussions

- Most of the existing measures of poverty depend on the poverty line.
- The poverty line, in turn, depends on the price structures, consumption pattern as well as age-sex-occupation composition of each region.
- If the estimates of number of poor persons are to be supplied each year, then the whole process of collection of data and estimation is to be repeated every year.

# A Brief Review on the Estimation of Poverty in India

Team/Working group	Set up by (year)	Year of submission	Salient Features
1. Working Group	The Planning Commission (1962)	?	<ul style="list-style-type: none"> <li>• The poverty line: Rs. 20 per capita total expenditure per month at 1960-61 all India prices.</li> <li>• The basis: the minimum normative food basket.</li> <li>• No rural-urban distinction.</li> </ul>
2. Task Force	The Planning Commission (1977)	1979	<ul style="list-style-type: none"> <li>• Age and sex categories were considered for calculations of calorie requirements.</li> <li>• <b>Official poverty lines</b> : Rs. 49.09 in rural areas and Rs. 56.64 in urban areas for the base year 1973-74.</li> </ul>
3. Expert Group	The Planning Commission (1989)	1993	<ul style="list-style-type: none"> <li>▪ Same as above. Minor modifications in the state level poverty estimation were suggested. I. e., Use CPIAL (A for Agricultural) for rural and for urban a simple average of CPIIW (I for Industrial) and CPINMW (NM for Non-manual) for updating poverty line.</li> </ul>
4. Team	The Dept. of Stat. (GOI) (1996)	1997	<ul style="list-style-type: none"> <li>• Six alternative poverty lines by taking different combinations of poverty line and updated using different price adjustments.</li> </ul>

# **The Report of the Expert Group Headed by Prof. Tendulkar**

- An Expert Group headed by Professor S. D. Tendulkar was formed by Planning Commission in 2005 to review the methodology for estimation of poverty. This group submitted its report in 2009.
- The report can be summarized in a nutshell by pointing out that the expert group recommends uniform Poverty Line Basket (PLB) corresponding to 25.7 percent urban Head Count Ratio (HCR) according to 61<sup>st</sup> round NSS data. PLB is defined as goods and services consumed by those households at the borderline separating the poor from the non-poor. The poverty lines are specified in terms of per capita total consumer expenditures (PCTE). The poverty lines for all India, rural India and rural and urban sectors of states of India are found by converting the reference poverty line using appropriate price indices.

# Salient Features of the Report

- **Use of NSSO Consumption Data recommended:** The estimates of poverty will continue to be based on private household consumer expenditure collected by NSSO.
- **Single Dimension:** Other dimensions of poverty will not be taken into account.
- **Calorie Norms done away with:** It moves away from the calorie norms.
- **PLB of urban India as reference PLB:** The urban PLB corresponding to 61<sup>st</sup> round NSS data leading to 25.7 per cent of urban HCR is recommended to be the reference PLB. The revised poverty line for urban India corresponds to average calorie intake 1776 Kcal per capita per day which is close to the minimum calorie norm 1800 Kcal per capita per day for India recommended by FAO.

# Salient Features of the Report

- **Adopt MRP:** The expert group has decided to adopt the Mixed Reference Period (MRP) based estimates instead of Uniform Reference Period (URP) based estimates.
- **A Uniform PLB:** A uniform PLB has been suggested for both rural and urban sectors.
- **The Price Adjustments made internally:** The price adjustment procedure is based on the same data set incorporating weights arising from quantities consumed and thereby giving proper weight to each commodity including health and education. Fisher index is suggested.
- **Validation made:** Additional external validation checks were carried out for the consistency of the new poverty lines with regard to nutritional, educational and health outcomes derived from the related specialized outcome-oriented surveys.

# Salient Features of the Report

- **Base Year as 2004-05:** The expert group recommends that the new sets of poverty calculations be started with the base year 2004-05 and suggests the procedure for taking them forward in time to be noted subsequently.
- **Update from the same NSS urban data:** The poverty lines should be updated using consumption data from 66<sup>th</sup> round (i.e., 2009-10) of NSSO once data becomes available for use. Fisher index should be used for updating all India urban poverty line

# Discussions

- Most of the existing measures of poverty depend on the poverty line.
- We have mainly discussed Income Poverty. But there are other dimensions of Poverty. A multi-dimensional poverty measure is needed.



*Thank you*