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Multidimensional Poverty in Rural Tripura- *A Fuzzy Set Analysis*

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Abstract

The aim of this study is to analyse the persistence of multidimensional poverty in sector of Tripura taking into account the non-monetary dimensions for a better characterization of the poor. The work is done using data from the full based on primary data which is obtained from household survey on poverty assessment (2012). The methodological approach of AF approach and Dagum and Costa (2004) on the fuzzy set theory has been adopted. The results have shown evidence of fuzzy multidimensional poverty in the study area. The study suggest the measures that would likely alleviate rural poverty include: raising the standard of living of rural households while promoting education, access to drinking water, electricity, resources, lasting goods and the best fuel for cooking.

Key Words: Household, Fuzzy Multidimensional Poverty.
JEL Code*: I3, I32*

1.1: Introduction: Poverty is the state of human subsistence where one finds oneself unable to participate fully in the process of economic activities, to earn wages or at least to cover the cost of a healthy & hygienic living. A person in poverty in not only deprived of a healthy & productive living standard but he is also unable to make good use of any evolving opportunity due to his/her lack of access to adequate resources. As we know that to eradicate poverty the prior thing to do is to measure it correctly.In independent India poverty has been anticipated and experienced by our National Planners as a serious threat to development right from the beginning of Five Year Plan and so direct intervention approach was initiated with perceived comprehensiveness. Therefore, in practical sense, measurement of poverty has always gone through serious difficulties and dilemma in India. Time and again, the methodology adopted for measuring poverty has been subjected to serious scrutiny for modification and restructuring. However, until recently Planning Commission of India has consistently relied on the Money Metric or income/consumption approach which is also known as Uni-dimensional approach. The estimation procedure of poverty in India is based upon two different components:-

(i) Information regarding consumption expenditure and its distribution across households provided by the NSS (National Sample Survey) consumption expenditure surveys.

(ii) Expenditures by households are evaluated with reference to a given critical value considered as poverty line (cut off) and identification of poor households with consumption expenditure below the cut off are considered as poor.

Tripura has also been at the realm of poverty since long. Long-term strategy of poverty eradication of the State Government is going on along with "Approach to Peoples Plan in Tripura" which was formulated in 1996 by the State Planning Board. The Planning Commission's latest data shows that on the basis of Head Count the percentage of poor people in Tripura stands at 52.67 percent (NSS 66th round, 2009-10), urban poverty is 7.47 percent. Undoubtedly, poverty in Tripura is still a matter of great concern for the development economists. The task of eradication of poverty in Tripura is overlaid by the problem that Planning Commission's estimates of poverty of Tripura are based on head count ratio of Assam. Thus as per the estimates of the incidence of poverty released by Planning Commission as a Nodal Agency for Government of India, the poverty line along with measures of poverty and inequality for Tripura is same as those of Assam, and so could not depict poverty in Tripura in real terms. The rational requirement of the time is to estimate poverty in Tripura by data obtained from the state itself. Again the new wave in poverty measurement has been its multidimensionality. We cannot deny the multidimensional aspects of poverty but at the same time we cannot deny the importance of income or uni-dimensional measurement as income indirectly influences those multiple attributes of poverty that shapes the multidimensionality concept of the same. Therefore, in this study attempts will be made to go for interdisciplinary approach by investigating connection between income/consumption and multidimensional poverty measurement.

1.2: Importance of the Study: There have been a plethora of theoretical debates regarding the measurement of poverty. Eventually there has been substantial improvement and paradigm shift can be seen from the traditional one-dimensional view to new concepts like social exclusion and multidimensional deprivation. The arguments over how poverty will be conceptualised, defined and finally measured go beyond the semantic and academic debates. The question on the nature of poverty cannot be answered by simple sentences since it really opens up a multiplicity of debates. However, along with those diverse opinions on poverty there seems to be a unifying and unequivocal statement that poverty is a complex, multidimensional phenomenon. Traditional measures of poverty, such as, the headcount ratio or poverty gap index focuses exclusively on a money-metric, i.e., income based evaluation of the phenomenon. As income relates to welfare, captured by the utility function in standard economics, this is indeed an intuitive approach. Due to the quality of easy acceptability, most empirical studies and policy decisions regard an increase in income as an indication of an increase in welfare. Most of the researches in India show poverty denoted only in critical minimum income failure terms, but on the basis of only one critical minimum criteria is not a sound approach as such measure divides the population into

below subsistence and above subsistence categories. The aim of such measurement is to find out some group of population who will be at the receiving end of some benefits accruing out of government programmes. But beyond that our concentration should centre on whether lion share of population, if not all, have been at the affluent level of income. Moreover as poverty appears to be multidimensional in nature, an estimation method based on fuzzy set theory can be uniquely formulated to tackle the problem of arbitrary poverty line and to integrate multiple dimensions into an intuitive way. It can avoid the problem of poverty line entirely by introducing the concept of membership function which represents a degree of inclusion in a fuzzy subgroup poor. In this back drop, the present study is designed in the context of Tripura with a specific objective to address.

1.3: Objective:

- To analyse the multidimensional poverty in Tripura with fuzzy set analysis.

1.4: Research Question:

What is the nature and extent of multidimensional poverty in Tripura?

The rest of the paper is organized as follows. We do a literature review in Section-2. In section-3 we develop the methodology for the analysis of poverty. We apply this methodology to the case of rural sector of Tripura in Section-4 and we conclude the work in Section -5.

2: Review of literature: The art of modelling poverty seem to be preoccupied in receipt of the best criteria for the judgment of the poverty status of individuals. Apart from their obsession with monetary approach for the measurement of poverty, more literatures are now trying to come up with its multidimensional poverty facet.

Ravallion (1998) shows how poverty line helps focus the attention of governments and civil society on the living conditions of the poor. The paper offers a critical overview of alternative approaches to setting poverty lines. In reviewing the methods found in practice, the paper tries to throw light on, and goes some way toward resolving, ongoing debates about poverty measurement, emphasizing those debates which would appear to have greatest bearing on policy discussions.

Danziger (2001) evaluates concepts and procedures for deriving the poverty threshold, definitions of family resources, and procedures for annual updates of poverty measures. It explores issues underlying the poverty measure, analyzes effects of any changes in poverty rates, and discusses the impact on eligibility for public benefits.

Bourguignon (2002) proposed an approach for multidimensional poverty ordering and asserted that there is need to consider poverty from the multidimensional point of view because in addition to insufficient income, other attributes like literacy and access to health care can determine the level of economic well-being. It was stressed that a genuine measure of poverty should be based on monetary as well as non-monetary attributes.

Dagum (2002) compared uni-dimensional and fuzzy set estimated multidimensional poverty indicators using the Bank of Italy sample data for 1993, 1995, 1998 and 2000. The multidimensional analysis identified educational level of the house head and his/her father, housing condition, and educational level of the spouse as the most important cause of poverty. The superiority of the multidimensional approach over the uni-dimensional one was judged by the low correlation coefficient, implying that those classified as poor by the two approaches differ.

Qizilbash (2004) identifies a set of indicators of multidimensional poverty like employment, health, access to clean water, shelter, knowledge, energy use, and participation in the life of the community. The multidimensional poverty analysis integrates these composite indicators into simple indices for the understanding of poverty profile in the population.

Maggio (2004) provides new confirmation on income poverty and lifestyle deprivation with cross sectional data collected in Great Britain between 1991 and 2000. It concludes that income cannot be the only indicator for analyzing poverty, and that the multivariate analysis seems to be the most proper choice if poverty and deprivation are to be investigated in a population.

Alkire and Santos (2010) present the Multidimensional Poverty Index (MPI), which reflects the deprivations that a poor person faces simultaneously with respect to education, health and living standards. This reflects the same three dimensions of welfare as the HDI but the indicators are different in each case and are linked to the MDGs. The three major components of MPI are weighted equally (a third each) but cover 10 indicators (two each for health and education and six for living standards), so the one-third weight assigned to each of the three dimensions or components is distributed equally among the subcomponents. The index is used to classify the population into poor or non-poor in the context of multidimensional deprivation. If the weighted score is 30% of the maximum achievable score, the household is classified as poor.

3: Methodology: The research process and the methodology followed in this study are depicted in this section.

3.1: Sample and data: Study area is the rural sector of West Tripura district of Tripura. (One of the eight districts of Tripura).The study is based on a household survey conducted in 2012 and schedule was designed for obtaining the desired information. Schedule included information on demographics; household income, household assets, and health status etc. Information was collected from the Household head/ breadwinners of the household spouse. A random sample of 120 households from rural area was interviewed. Almost all the households coming within the reach of the survey were willing to partake in the survey.

3.2: Model: Fuzzy Set Functional Form: Since its inception (Zadeh: 1965) the theory of fuzzy sets has advanced in a variety of ways and in many disciplines. Most of our traditional tools for formal modelling, reasoning, and computing are crisp, deterministic,

and precise in character. Crisp means dichotomous, that is, yes-or-no type rather than more-or-less type (Zimmermann: 2010). The idea of a fuzzy set is quite simple in itself. A classical set is just a container that wholly includes or wholly excludes any given element. In fuzzy sets theory an element is allowed to partially belong to a set. Therefore, it is generalizations of classical sets in that they are classes within which the transitions from the membership to non-membership take place gradually rather than all of a sudden. Here we are considering the fuzzy set model as in the lines of the work of Dagum and Costa (2004) and Apiah-Kubi et al (2007). Basically fuzzy set approach is used for those types of cases where any attribute has more than two categories. In such case we can have the third case that is the partial membership which is decided within a single attribute. But in our case we have considered all the attributes in dichotomous form where having an attribute is assigned the value '0' and is considered as low risk to poverty and not having that attribute is assigned '1' and considered as high risk of poverty. After a thorough assessment upon the requirement of our study the fuzzy set model has been transformed as following:

3.3: Method for Multidimensional Fuzzy Poverty Analysis: As per AF methodology is concerned Multidimensional Poverty Index has been used to determine the acute multi-dimensional poverty. It reflects the deprivation in very basic services. The Multidimensional Poverty index reveals the combination of deprivation that batter a household at the same time. A household is identified as multi-dimensionally poor if and only if, it is deprived in some combinations whose weighted sum exceeds 30 percent of deprivation. AF- Multidimensional poverty index has three dimensions like health, education and standard of life and these three dimensions are divided into10 indicators. The dimensions of MPI presented are as below.

1. Health (Each Indicator is weighted equally at 1/6)

- Child Mortality: Deprived if any child has died in the family.
- Nutrition: Deprived if any adult or child for whom there is nutritional information of malnourishment.

2. Education (Each Indicator is weighted equally at 1/6)

- Years of Schooling: Deprived if at least one household member has not completed five years of schooling.
- Child Enrollment: Deprived if any school aged child is not attending the school in years 1 to 8.

3. Standard of Life (Each Indicator is weighted equally at 1/18)

- Electricity: Deprived if house hold has no electricity.
- Drinking Water: Deprived if household has no access to clean drinking water.
- Sanitation: Deprived if they do not have an improved toilet or if there toilet is shared.
- Flooring: Deprived if the household has dirt, sand and dung floor.
- Cooking Fuel: Deprived if they cook with wood, charcoal and dung.
- Assets: Deprived if the household does not own radio, TV, telephone and bike.

The fuzzy approach followed here is same as the UNDP Human Development Report Office and the Oxford Poverty and Human Development Initiative (OPHI) released acute Multidimensional Poverty Index (MPI) (Alkire and Santos: 2010). The MPI is constructed using ten indicators covering three dimensions. The three dimensions are health, education, and standard of living. The indicators are nutrition (anthropometric measures) and child mortality for health; years of schooling and school attendance for education; and electricity, water, sanitation, cooking fuel, flooring, and asset ownership for living standard. Each dimension is equally weighted at one-third. Each indicator within a dimension is also equally weighted. Thus the health and education indicators are weighted at one-sixth each, and standard of living at one-eighteenth. The MPI first identifies who is deprived in each of the 10 indicators. The indicators, cut-offs and weights are summarized in the figure below. Note at this point that we take the household as the unit of analysis. For standard of living indicators, a person is deprived if his/her household is deprived in that particular indicator. However for health and education indicators, a person's deprivations depend on the achievements of his/her other household members. The details of all the indicators can be found in table.1.

we have followed the methodology applied by Costa(2002) and expounded the degree of membership to fuzzy set of poverty (P) of the a_i^{th} household (i=1,2,3…….n) with respect to the j^{th} attribute (j=1,2,….,m) as:

$$F_p = \{X_j(a_i)\} = X_{ij} \quad \text{----------(1)} \qquad \text{Where, } 0 \leq X_{ij} \leq 1$$

In other words we can write that $X_j(a_i)$ represents an m-order vector of socio-economic attributes (in our case m=10) which will result in the state of poverty of a household a_i if the particular attribute is partially or not possessed by the household.
In this case:

- X_{ij}=1, iff the a_i^{th} household does not possess the jth attribute (it completely belongs to the poor set)
- X_{ij}=0, iff the a_i^{th} household possesses the jth attribute (it is absolutely non-poor).

Thus the deprivation index of the a_i^{th} household, $F_p(a_i)$ (i.e. the degree of membership of the a_i^{th} household to the fuzzy set P) can be defined as the weighted average of x_{ij} :

$$F_p(a_i) = \frac{\sum_{j=1}^{m} x_{ij} w_j}{\sum_{j=1}^{m} w_j} \text{----------(2)}$$

Where, w_j is the weight attached to the j^{th} attribute. It is an inverse function of the degree of deprivation of this attribute by the population of households. In order to reduce the arbitrariness involved in the estimation of weights we have applied the method suggested by Cerioli and Zani (1990) which is as follows:

$$w_j = \log\left[\frac{n}{\sum_{i=1}^{n} x_{ij} n_i}\right] \geq \text{----------(3)}$$

n_i represents the weight attached to each household a_i. Note that n_i is equivalent to n times the relative frequency of household a_i in the total population.
On the basis of different values of the index we have

Table.1: Fuzzy Multidimensional Membership Function Values

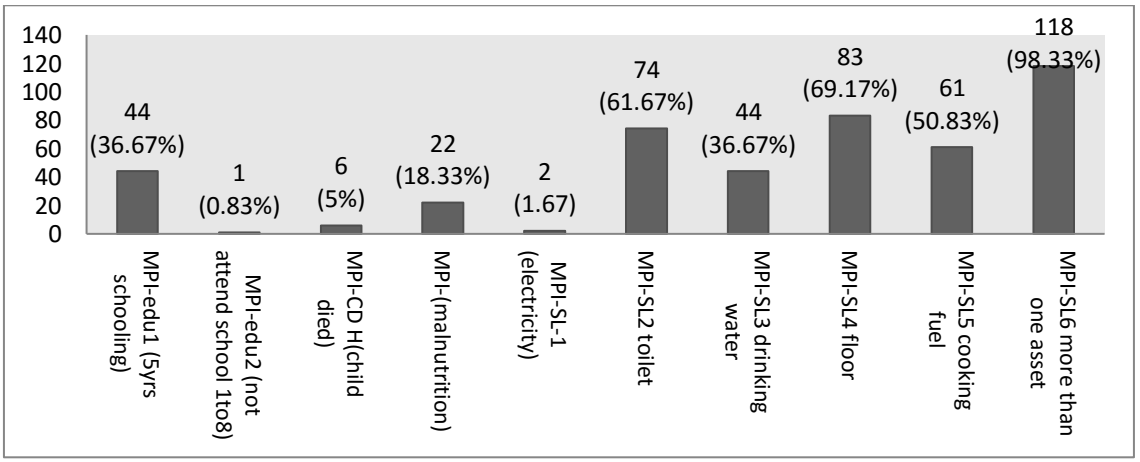
CATEGORIES	Limit Values
RICH	Fp(ai)=0
NON- POOR	0< Fp(ai)< 0.3
NOT SO POOR	Fp 0.3≤ (ai)≤ 0.5
VERY POOR	Fp(ai)>0.5

Source: Authors calculation from primary data

4. Data Analysis

4.1. Multidimensional Poverty: The Multidimensional Fuzzy membership function values are presented in Table-1. In case of Multidimensional Fuzzy Poverty estimation it is found that on the basis of membership values 44 households are found to be deprived in first indicator of education i.e not completed five year of schooling. For the second indicator that is any school-aged child not attending school in years 1 to 8, only one household (0.83 percent) are found to be deprived. In case of health 6 household (5 percent) are found to have infant mortality and 22 households (18.33 percent) are found having malnutrition problem. While analysis the standard of living, 2 households (1.67 percent) are found not to have electricity and 74 households (61.67 percent) are not having improved toilet. Where 44 households (36.67 percent) are found to have no access to clean drinking water and 83 households (69.17 percent) are found to have dirt, sand or dung floor and 61 households (50.83 percent) are found to cooking with wood, charcoal or dung. Finally for the indicator of owning not more than one asset 118 households (98.33 percent) are identified to be deprived in this category. In total, it is found that 12 households out of 120 are found to be poor in AF method. The percentage of households deprived in at least one aspect out of the ten indicators is

Figure-1: Multidimensional Poverty



4.2. Fuzzy Multidimensional Poverty: The descriptive statistics of the fuzzy poverty membership for multidimensional approach show that average membership value is 0.129 minimum value and maximum membership value 0.545 (the household wise membership values are given in Table-A in appendix section).

Table.2: Fuzzy Multidimensional Membership Function Values

CATEGORIES	Limit Values	Frequencies
RICH	Fp(ai)=0	0
NON- POOR	0< Fp(ai)< 0.3	109
NOT SO POOR	Fp 0.3≤ (ai)≤ 0.5	10
VERY POOR	Fp(ai)>0.5	1

Source: Authors calculation from primary data

From the Table-2 it is clear that 11 households are found to be fuzzy multidimensionally poor and no households are found to belong in rich household category. It is also observed from the table that 109 households belong to non-poor category.

5. Conclusion and Recommendations: It is empirically established that consumption alone fails to capture deprivations faced by households. Thus income/consumption based uni-dimensional measurement of poverty is an insufficient measure of poverty. Based upon the advantages of the proposed methodological framework, it is argued that AF method should officially be adopted to estimate poverty in India. Though it is a small area based study but still the study has revealed a few out of the ordinary things. This paper has argued for comparing uni-dimensional and multidimensional framework to estimate poverty and identify the poor for rural Tripura. Data has been analysed on 10 indicators pertaining to three valuable dimensions: education, health, standard of living and 12 households out of 120 are found to be poor in AF method. Where, with fuzzy approach we have got that exactly 11 households are poor. Thus it can be understood that both the AF approach and Fuzzy Multidimensional approach gives same line of picture as poverty is concerned. The paper finds that there is enough evidence of having multidimensional poverty in the study area of Tripura.

Adding to these the study suggest the measures that would likely alleviate rural poverty include: raising the standard of living of rural households while promoting education, access to drinking water, electricity, resources, lasting goods and the best fuel for cooking. Finally it should be noted that this work has enabled us to static results, however, a dynamic study will better analyze the phenomenon of poverty in rural sector of Tripura.

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Appendix

Table-A: Fuzzy Multidimensional Membership Function Values

Households	Fuzzy Membership Value	Households	Fuzzy Membership Value	Households	Fuzzy Membership Value
household 1	0.306	household 41	0.268	household 81	0.149
household 2	0.051	household 42	0.149	household 82	0.342
household 3	0.149	household 43	0.168	household 83	0.001
household 4	0.090	household 44	0.149	household 84	0.207
household 5	0.186	household 45	0.109	household 85	0.090
household 6	0.109	household 46	0.051	household 86	0.090
household 7	0.149	household 47	0.109	household 87	0.040
household 8	0.001	household 48	0.140	household 88	0.062
household 9	0.099	household 49	0.207	household 89	0.001
household 10	0.382	household 50	0.149	household 90	0.001
household 11	0.423	household 51	0.168	household 91	0.040
household 12	0.000	household 52	0.168	household 92	0.100
household 13	0.121	household 53	0.090	household 93	0.023

household 14	0.207	household 54	0.207	household 94	0.090
household 15	0.324	household 55	0.149	household 95	0.207
household 16	0.265	household 56	0.248	household 96	0.081
household 17	0.189	household 57	0.109	household 97	0.090
household 18	0.149	household 58	0.001	household 98	0.081
household 19	0.001	household 59	0.060	household 99	0.149
household 20	0.149	household 60	0.168	household 100	0.023
household 21	0.040	household 61	0.001	household 101	0.069
household 22	0.001	household 62	0.001	household 102	0.062
household 23	0.001	household 63	0.150	household 103	0.062
household 24	0.001	household 64	0.383	household 104	0.207
household 25	0.001	household 65	0.081	household 105	0.207
household 26	0.149	household 66	0.306	household 106	0.207
household 27	0.149	household 67	0.060	household 107	0.081
household 28	0.001	household 68	0.001	household 108	0.267
household 29	0.226	household 69	0.060	household 109	0.207
household 30	0.109	household 70	0.256	household 110	0.001
household 31	0.001	household 71	0.189	household 111	0.248
household 32	0.000	household 72	0.546	household 112	0.150
household 33	0.001	household 73	0.001	household 113	0.001
household 34	0.090	household 74	0.306	household 114	0.208
household 35	0.001	household 75	0.207	household 115	0.051
household 36	0.023	household 76	0.168	household 116	0.208
household 37	0.051	household 77	0.149	household 117	0.248
household 38	0.051	household 78	0.306	household 118	0.001
household 39	0.001	household 79	0.306	household 119	0.248
household 40	0.090	household 80	0.109	household 120	0.149

Source: Authors calculation from primary data