

## **NUTRITIONAL DEPRIVATION AT THE HOUSEHOLD LEVEL IN RURAL INDIA: CAUSES AND CONCERNS**

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### **ABSTRACT**

*The aim of the paper is to quantify the proportion of undernourished households in rural India without relying on any particular calorie cut-off point. For that, mean RDA (Recommended Dietary Allowance) has been estimated at the household level, after adjusting for age and gender distribution of the sedentary household members. The two NSS rounds that pertain to the years 2004-05 and 2011-12 are used here. The results confirmed that it was among the lowest expenditure group that seems to have reported the highest increase in RDA between 2004-05 and 2011-12. An investigation of the determinants of calorie deprivation leads us to the finding that poor ST and OBC households, regular wage and self-employed in non-agriculture and Christians have the greater probability of being calorie deprived.*

**Keywords:** Deprivation, RDA, Undernutrition, Poverty

### **Introduction**

With the celebrated reduction of rural poverty, a commensurate fall in the level of undernutrition may not come about in reality. The growing divergence between hunger and poverty and the public policy inertia with regard to undernutrition (Basu and Das, 2014; Rao, 2016) has contributed to a number of studies in the area. However, none of them are satisfactory in that it often revolves around arbitrary calorie norms and its likely correlates.

As is well-established, undernutrition stems from imbalanced diets and from the perceived deficiencies of macro and micro nutrients. Since low socio-economic status of a household is inextricably linked to undernutrition, an understanding of the level and proximate causes of undernutrition forms the bedrock of this paper. The recent undernutrition levels in rural States have been improved but the temporal improvement is far from satisfactory. For example, the chronic energy deficiency of adults (proportion of adults with body mass index less

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than 18.5) which was at 40 per cent in 2000-01, fell to 35 per cent in 2011-12 (Radhakrishna, 2005; Dreze, 2007, NNMB, 2012). With the significant strides in poverty reduction, a modest improvement was only discernible in case of the outcome indicator, which was reflected by the body mass index of the population. Hence, it is necessary to look at the input indicator that accommodates the nutritional intake of the household; the deficiency of it surmounts to the nutritional deprivation.

There is a consensus among the studies that poverty ratios in rural areas seem to have declined. The divergence between hunger and poverty suggests that there will be some problems either with the measurement of poverty or with the measurement of undernutrition or with both the measures. To get around the issues relating to the measurement of undernutrition, we have estimated the calorie requirements without relying on any calorie thresholds and then arrived at the nutritional deprivation of households. Our estimation has largely been based on the age and gender adjusted requirements of nutrients by the rural population. Such an innovative approach is followed on account of the fact that food and nutritional intake vary with the age and gender differences due to the differences in activity status, metabolism rates and other physiological factors. Apart from this, there is lingering and unequal distribution of food to the old and girl child within the family.

The monthly per capita consumption expenditure is adopted here as a proxy for the

economic status of the household. The nutritional status of the household is also conditioned by household types, occupation categories, religious factors, among others.

### **Rural Transformation in India**

Rural India has dramatically changed since the mid-2000s, enough to accommodate the urban settings, which has now been christened as 'Rurban' (Gupta, 2015). People are migrating from rural to urban areas in search of education and self-employment. The non-farm sector has virtually left agriculture behind. As a result, the percentage of non-agricultural households has increased to 42 per cent in 2009-10 from a low of 32 per cent in 1993-94. Moreover, the contribution of non-farm sector to the rural net state domestic product hovered around 65 per cent in 2009-10. Alongside these changes, consumption poverty has sharply declined between 2004-05 and 2011-12. The potential role of non-farm sector in reducing rural poverty has already been recognised in literature. For example, Kumar et al (2011) found that with one per cent increase in the share of rural non-farm employment, the rural poverty would be reduced by 0.5 per cent. In another study, Lanjouw and Shariff (2004) pointed out that poverty rates can also be reduced by the growth of non-farm sector and its trickle-down effects on agricultural wage rates. These studies have well-recognised the potential role of non-farm sector in generating employment opportunities in the rural sector and thereby increasing food and nutritional security of the country.

**Brief Description of Database**

This study makes use of the NSS unit record data that pertains to 2004-05 and 2011-12 years. The unit record data give a sample of approximately 80,000 and 60,000 rural households, respectively, in these two rounds. A stratified multi-stage design was used for these surveys. The First Stage Units (FSUs) comprise the 2001 Census villages in the rural sector and Urban Frame Survey (UFS) blocks in the urban sector. The Ultimate Stage Units (USUs) are the households in both the sectors. Within each district of a State/UT, two basic strata were formed: (1) rural stratum comprising all rural areas of the district and (2) urban stratum comprising all urban areas of the district.

The unit record data provide information relating to household and demographic features, in addition to household production and consumption of various food items in terms of quantity and expenditure. Broadly speaking, there are five different sources of household consumer expenditure which can be met via purchase, home-grown stock, receipt in exchange of goods and services, transfer receipts including gifts, loans and charities and the remaining expenditure of the household is met by way of free collection.

The NSS unit record data report the socio-economic and demographic features of all sample households under review. However, the quantity figures of food items of some households are found to be missing or unreported. At the same time, household characteristics are given. For the sake of

uniformity, we have dropped these households for whom it is not possible to estimate the nutrients consumption. Thus, ten households that belong to the States of Andhra Pradesh, three from Maharashtra and one household from Kerala have been dropped in 2004-05. Similarly, two households that belong to Madhya Pradesh and Arunachal Pradesh have been excluded in 2011-12. By doing this elimination procedure, we tried to avert the problem of missing calories at its best.

For estimating the macro nutrients, the quantity figures of food items of each household given in the NSS unit record data are multiplied by the nutrient contents. This is further divided by household size and by 30 in order to get the daily consumption of nutrients per person. The information on the nutrient content of each food item is sourced from the publications of the National Institute of Nutrition (Gopalan et al, 2000). The number of food items reported in the Nutritive Value of Indian Foods (NVIF) is close to 451 and there was nearly a perfect match of food items in the NVIF and NSS consumer expenditure reports for more than 102 food items. For about 15 items that were listed in the National Sample Survey Data, there was no corresponding match in Gopalan et al., either because these items were cooked, or were less commonly consumed. In these cases, the nutrient content is matched with the closest substitutes.

Instead of relying on a particular calorie cut-off point, the mean RDA has been estimated at the household level after adjusting for age,

gender and activity status. To materialise this, the revised RDA for Indians published by the Expert Group of ICMR (2010) is used. According to the revised RDA, the recommended dietary allowance of calories, protein and fat would be in the order of 2320, 60 and 25, respectively, for males who are aged over 18. In the case of females, the age, gender and activity-adjusted requirements of nutrients can vary and it is 1900, 55 and 20, respectively. However, both pregnant and lactating women, who demand higher calories, are not possible to be identified in the NSS Unit Record Data. In addition, the activity status of all household members is reckoned as sedentary. It is widely believed that the nutrient requirements of an individual varies with age, sex, height, weight, activity pattern, climate, water quality and so on (Himanshu, 2010).

## Results and Discussion

### **State-wise Trends in MPCE and Calorie Intake:**

The Monthly Per Capita Consumption Expenditure (MPCE) is the total household monthly consumption expenditure adjusted for household size. In unit level data, MPCE is given in paisa and some adjustments have to be made. Table 1 brings out the median income of households that belong to rural areas. The use of median suggests that around 50 per cent of rural households are lower than the average MPCE and close to 50 per cent of rural households are higher than the average MPCE. Thus, the median divides the total households into two equal parts.

In 2004-05, rural States had an average MPCE of ₹ 548 which rose to ₹ 1269 in 2011-12.

Among the States, Kerala, Punjab, Haryana, Gujarat and Rajasthan rank high in terms of monthly per capita consumption expenditure. It has also to be noted that the Southern States such as Andhra Pradesh, Tamil Nadu and Karnataka have grown more in terms of income than that of the prosperous State of Maharashtra. Among the backward States, the States that have made notable progress in terms of MPCE are Rajasthan and West Bengal. In these States, income has more than doubled between 2004-05 and 2011-12.

Table 1 also depicts the proportion of rural households that fail to earn at least ₹ 1000 per month. In 2011-12, a significant improvement in income could be reflected in all the developed States. Notable among them were Punjab (6.4 per cent), Kerala (8.9 per cent) and Haryana (9.9 per cent) in this regard. In most of the backward States, the income growth was not substantial to help improve the nutritional intake in those States. Having these issues, Rajasthan and West Bengal have made headway in terms of income growth. In these States, around 70 per cent of rural households had an average income of above ₹ 1000.

Table 2 provides these results on median calorie consumption in rural States. The increase in calorie intake in rural areas was marginal as compared to income. During 2004-05 and 2011-12, calorie intake has grown more than 30 per cent in Karnataka, Tamil Nadu and Maharashtra.

Income has contributed positively to the calorie consumption in most of the leading States. However, this was not the case with backward States, where calorie intake has registered a decline in the States of Rajasthan, Madhya Pradesh, Bihar and Uttar Pradesh.

**Table 1: Median MPCE and Proportion of Rural Households Below ₹ 1000**

| State          | 2004-05     | 2011-12      |
|----------------|-------------|--------------|
| Andhra Pradesh | 543 (85.83) | 1413 (19.30) |
| Gujarat        | 593 (84.83) | 1391 (20.91) |
| Haryana        | 736 (72.92) | 1742 (9.97)  |
| Karnataka      | 483 (92.01) | 1264 (28.42) |
| Kerala         | 869 (58.59) | 1970 (8.95)  |
| Maharashtra    | 530 (87.49) | 1372 (21.92) |
| Punjab         | 803 (66.71) | 1902 (6.44)  |
| Tamil Nadu     | 541 (86.05) | 1418 (20.67) |
| Assam          | 556 (92.66) | 1066 (44.02) |
| Bihar          | 426 (96.35) | 1040 (47.04) |
| Madhya Pradesh | 432 (93.36) | 1003 (49.60) |
| Odisha         | 373 (94.79) | 874 (61.35)  |
| Rajasthan      | 558 (89.49) | 1386 (22.76) |
| Uttar Pradesh  | 492 (90.07) | 980 (51.72)  |
| West Bengal    | 530 (89.57) | 1146 (38.00) |
| Total          | 548 (85.78) | 1269 (31.54) |

Note: Proportions are given in parentheses.

Source: Calculated by the author from NSS unit record data.

**Table 2: Median Intake of Macro Nutrients Across the Rural Households**

| State          | 2004-05 |    |    | 2011-12 |    |    |
|----------------|---------|----|----|---------|----|----|
|                | C       | P  | F  | C       | P  | F  |
| Andhra Pradesh | 1779    | 45 | 22 | 2122    | 52 | 42 |
| Gujarat        | 1563    | 48 | 33 | 1910    | 50 | 56 |
| Haryana        | 2363    | 75 | 58 | 2145    | 63 | 57 |
| Karnataka      | 1442    | 39 | 22 | 2017    | 50 | 44 |
| Kerala         | 1618    | 46 | 33 | 1924    | 53 | 44 |
| Maharashtra    | 1611    | 46 | 31 | 2099    | 55 | 53 |
| Punjab         | 2269    | 70 | 61 | 2272    | 65 | 63 |
| Tamil Nadu     | 1437    | 37 | 17 | 1901    | 48 | 39 |
| Assam          | 1849    | 47 | 23 | 1991    | 49 | 26 |
| Bihar          | 2219    | 64 | 31 | 2115    | 59 | 35 |
| Madhya Pradesh | 2127    | 66 | 35 | 2093    | 61 | 41 |
| Odisha         | 2061    | 50 | 18 | 2102    | 50 | 23 |
| Rajasthan      | 2660    | 87 | 61 | 2230    | 67 | 56 |
| Uttar Pradesh  | 2297    | 70 | 36 | 2077    | 59 | 39 |
| West Bengal    | 1887    | 48 | 24 | 2039    | 50 | 32 |
| Total          | 2068    | 58 | 30 | 2079    | 54 | 40 |

Source: As in Table 1.

**Concept of Deprivation:** By deprivation we mean relative disadvantage. Townsend (1987) defines deprivation as “a state of observable and demonstrable disadvantage relative to the local community or the wider society or nation to which an individual, family or group belongs.” Deprivations come in a variety of forms such as starvation, undernourishment, morbidity, mortality, illiteracy and so on (Sen, 2000). These deprivations are masked by the income distribution statistics. The present study focuses on deprivation with regard to the undernourishment alone.

Broadly speaking, there are two ways by which one can identify the number of households which are deprived. These are (1) absolute deprivation and (2) relative deprivation. According to absolute deprivation, the standard would be fixed as a norm by an expert group. Households which cannot achieve that specified amounts are considered as deprived households.

Relative deprivation is used in an objective sense to depict situations where people lack income, favourable employment conditions or power, than do others. For relative deprivation, the standard is set according to the society or class to which it belongs and households which cannot achieve that standard are called relatively deprived. In other words, relative deprivation is more concerned with the inequality in nutritional intake across the groups. An objective diagnosis of conditions of relative deprivation calls for an objective understanding of feelings of deprivation.

Any deprivation measurement can be either unidimensional or multidimensional. The unidimensional measures based on FGT indices are more common in the poverty and nutrition literature. The FGT indices are based on the monotonicity and transfer principles; the incidence of undernutrition violates the monotonicity axiom but it is captured by the depth of undernutrition, let alone the transfer principle. Both the axioms are incorporated when the severity of undernutrition is used. The monotonicity axiom looks at the increase in undernutrition as a result of lower calorie achievement levels. On the other hand, the transfer axiom proposes a decrease in undernutrition levels when food is transferred from the richer household to the poorer household (Alkire and Foster, 2011).

The Foster-Greer Thorbeck indices (1984) that measure the incidence, depth and severity of undernutrition are computed here for all macro nutrients. These indices are the most reliable ones when the deprivation is unidimensional in nature. The FGT index can be specified as follows:

$$FGT^{\alpha} = (1/n) \sum [Q^R - Q^E / Q^R]^{\alpha} \quad (1)$$

Where  $Q^R$  is the minimum required calories (RDA),  $Q^E$  = estimated calorie intake of the household and  $n$  is the total number of households. The sigma symbol refers to the summation of all households which consume less than minimum requirement.

When  $\alpha = 0$ , the formula shows the Head Count Index which represents the proportion of households whose calorie consumption fall

below the minimum requirement. This simple measure discards the depth of undernourishment. When  $\alpha=1$ , the Proportionate Gap Index can be calculated. It measures the average distance from the minimum requirement, but it is insensitive to the distribution among the undernourished. When  $\alpha=2$ , the FGT2 index can be calculated. The index takes into account inequality among the undernourished and shows the severity of undernourishment by assigning greater weights to those households which are far from the minimum required calories. Thus, FGT2 index incorporates the idea 'relative deprivation', as measured by outcome inequality among the deprived households.

### Results on Nutritional Deprivation

**All-India Estimates:** As evident in Table 3, there is a significant prevalence of calorie undernutrition which ranges from 32 to 60 per cent during 2011-12. The prevalence of calorie deprivation was more or less stagnant at 45 per cent. On the other hand, fat deprivation has declined more precipitously than the protein deprivation.

The depth of calorie deprivation was up from 12 to 37 per cent during 2004-05 to 2011-12. At the same time, the depth of deprivation of both proteins and fats declined and it was more pronounced in respect of fats. As far as the severity of undernutrition is concerned, the severity of calories and proteins increased over the period 2004-12.

**State-level Estimates:** The State-level estimates exhibit an interesting pattern; the status of Southern and Western States is dubious, given

their higher head count ratio of nutrients. Thus, Andhra Pradesh, Kerala, Karnataka, Tamil Nadu, Gujarat and Maharashtra are historically notorious for calorie deprivation and this pattern is consistent with the studies by Sharma (2015), Jha and Gaiha (2003) and Meenakshi and Vishwanathan (2003). The use of calorie thresholds and age-gender adjusted nutritional norms do not produce contrasting results when we look at the case of some leading States, already noted above. These leading States due to better infrastructure, better healthcare and good sanitation facilities have improved the ways of absorption of nutritional intake. Furthermore, how recall method is able to trace out the consumption of home-away cooked meals, processed foods and beverages in its totality is doubtful in the case of developed States. Hence, the nutritional deprivation in these States does not matter for the policy makers.

The prevalence of calorie deprivation was as low as 32 per cent in Punjab and Rajasthan. The reasons are yet to be explored for the lower calorie deprivation in Rajasthan, despite the poor health status and widespread illiteracy of the State (Sagar, 2010).

As for the head-count index, calorie deprivation was higher in the States of Gujarat (60 per cent), closely followed by Tamil Nadu (59 per cent), and Kerala (56 per cent) during 2011-12. Among the backward States, calorie deprivation was pronounced in the States of Assam (56 per cent), West Bengal (48 per cent), Odisha (43 per cent) and Madhya Pradesh (43 per cent). It should also be noted that in some

States such as Haryana, Bihar, Madhya Pradesh, Rajasthan and Uttar Pradesh, calorie deprivation has considerably increased between 2004-05 and 2011-12. The increase in calorie deprivation in Rajasthan was higher than in Madhya Pradesh.

The head-count index of protein deprivation ranged from 1 per cent (Rajasthan) to 69 per cent (Tamil Nadu) in 2004-05 and from 4 per cent (Punjab) to 11 per cent (Kerala) in 2011-12. Barring Rajasthan, the prevalence of protein deprivation has declined in all the major

States. Another interesting pattern that emerges here is fat deprivation, declined more sharply than that of protein deprivation.

When we delve deeper into the State-wise comparison, it can be seen that fat deprivation is higher at 3 per cent in Kerala, Gujarat and Tamil Nadu. Overall, fat deprivation has declined in all the States. This matches with the fact that fat consumption has not ratified any declining trend for rural India as the per capita consumption of edible oils steadily improved (Deaton and Dreze, 2009; Gupta, 2012).

**Table 3: State-wise Head Count Ratios of Macro Nutrients**

| State          | 2004-05 |       |       | 2011-12 |       |      |
|----------------|---------|-------|-------|---------|-------|------|
|                | C       | P     | F     | C       | P     | F    |
| Andhra Pradesh | 56.85   | 54.19 | 56.60 | 41.94   | 5.91  | 1.43 |
| Gujarat        | 73.23   | 51.64 | 32.80 | 60.40   | 10.84 | 2.93 |
| Haryana        | 27.26   | 7.20  | 4.58  | 38.90   | 5.40  | 1.15 |
| Karnataka      | 68.65   | 64.79 | 57.47 | 51.22   | 8.32  | 2.02 |
| Kerala         | 64.21   | 56.82 | 33.30 | 55.84   | 11.09 | 3.21 |
| Maharashtra    | 67.17   | 5.47  | 3.91  | 43.82   | 6.48  | 1.51 |
| Punjab         | 34.90   | 12.12 | 2.22  | 32.47   | 3.87  | 0.75 |
| Tamil Nadu     | 70.09   | 69.01 | 66.72 | 59.87   | 11.06 | 2.94 |
| Assam          | 61.31   | 51.94 | 65.49 | 56.48   | 7.67  | 1.52 |
| Bihar          | 30.27   | 11.69 | 34.84 | 39.49   | 5.75  | 1.31 |
| Madhya Pradesh | 40.36   | 14.20 | 26.97 | 43.11   | 7.17  | 1.83 |
| Odisha         | 44.86   | 47.60 | 77.48 | 43.36   | 6.14  | 1.41 |
| Rajasthan      | 13.95   | 1.36  | 2.85  | 32.49   | 4.38  | 0.92 |
| Uttar Pradesh  | 29.02   | 9.05  | 27.21 | 40.20   | 5.89  | 1.35 |
| West Bengal    | 56.11   | 52.71 | 55.03 | 48.29   | 7.06  | 1.54 |
| Total          | 45.18   | 33.92 | 41.63 | 45.12   | 7.01  | 1.70 |

Source: Estimated from NSS Unit Record Data.

**Table 4: Depth of Deprivation of Macro Nutrients**

| State          | 2004-05 |       |       | 2011-12 |      |      |
|----------------|---------|-------|-------|---------|------|------|
|                | C       | P     | F     | C       | P    | F    |
| Andhra Pradesh | 21.43   | 19.92 | 25.68 | 47.59   | 7.93 | 2.08 |
| Gujarat        | 21.57   | 11.99 | 10.00 | 50.64   | 8.96 | 2.43 |

(Contd.....)

**Table 4 (Contd.....)**

| State          | 2004-05 |       |       | 2011-12 |       |      |
|----------------|---------|-------|-------|---------|-------|------|
|                | C       | P     | F     | C       | P     | F    |
| Haryana        | 3.99    | 0.85  | 0.67  | 14.75   | 1.68  | 0.31 |
| Karnataka      | 29.86   | 26.46 | 25.42 | 53.42   | 9.42  | 2.44 |
| Kerala         | 23.90   | 19.53 | 10.22 | 45.55   | 9.35  | 2.92 |
| Maharashtra    | 23.10   | 1.65  | 1.33  | 35.96   | 5.23  | 1.29 |
| Punjab         | 5.39    | 1.32  | 0.24  | 13.98   | 1.46  | 0.28 |
| Tamil Nadu     | 29.15   | 28.01 | 34.13 | 59.48   | 11.72 | 3.31 |
| Assam          | 12.26   | 10.03 | 18.40 | 56.79   | 8.80  | 1.95 |
| Bihar          | 4.59    | 1.39  | 7.45  | 19.96   | 2.53  | 0.53 |
| Madhya Pradesh | 7.48    | 2.07  | 5.50  | 22.38   | 3.48  | 0.86 |
| Odisha         | 8.66    | 8.94  | 30.64 | 53.95   | 9.25  | 2.35 |
| Rajasthan      | 1.75    | 0.24  | 0.40  | 9.07    | 0.91  | 0.17 |
| Uttar Pradesh  | 4.85    | 1.22  | 6.05  | 19.13   | 1.93  | 0.57 |
| West Bengal    | 13.28   | 11.47 | 16.61 | 49.22   | 8.33  | 2.07 |
| Total          | 12.06   | 9.08  | 14.57 | 37.57   | 6.28  | 1.63 |

Source: Estimated from NSS Unit Record Data.

When 2004-05 and 2011-12 are considered, the depth of calorie deprivation has increased in all the States without exception (Table 4). In some States namely, Haryana, Assam, Odisha, Rajasthan, Uttar Pradesh and West Bengal, the depth of calorie deprivation has increased by four times between the two periods.

There are some gainers and losers if one looks at the depth of protein deprivation. The

depth of protein deprivation increased from 2 to 5 per cent over the period. In other States such as Haryana, Punjab, Bihar, Madhya Pradesh, Odisha, Rajasthan and Uttar Pradesh, the depth of protein deprivation has marginally increased. On the other hand, the depth of fat deprivation has virtually declined in all the States and it is not important to be considered.

**Table 5: Severity of Deprivation of Macro Nutrients**

| State          | 2004-05 |       |       | 2011-12 |      |      |
|----------------|---------|-------|-------|---------|------|------|
|                | C       | P     | F     | C       | P    | F    |
| Andhra Pradesh | 10.74   | 9.92  | 14.99 | 7.21    | 1.38 | 0.57 |
| Gujarat        | 8.41    | 4.17  | 4.57  | 2.92    | 0.48 | 0.19 |
| Haryana        | 0.88    | 0.16  | 0.16  | 3.72    | 0.51 | 0.12 |
| Karnataka      | 16.20   | 13.86 | 14.48 | 4.98    | 0.88 | 0.27 |
| Kerala         | 11.60   | 9.06  | 4.61  | 9.45    | 1.96 | 0.62 |
| Maharashtra    | 10.51   | 0.70  | 0.63  | 3.45    | 0.94 | 0.40 |

(Contd.....)

**Table 5 (Contd.....)**

| State          | 2004-05 |       |       | 2011-12 |       |      |
|----------------|---------|-------|-------|---------|-------|------|
|                | C       | P     | F     | C       | P     | F    |
| Punjab         | 1.23    | 0.24  | 0.05  | 0.97    | 0.13  | 0.02 |
| Tamil Nadu     | 15.27   | 14.55 | 21.64 | 14.25   | 2.63  | 0.77 |
| Assam          | 3.44    | 2.77  | 7.12  | 49.42   | 13.37 | 5.15 |
| Bihar          | 1.08    | 0.30  | 2.34  | 25.79   | 5.83  | 2.01 |
| Madhya Pradesh | 2.05    | 0.48  | 1.67  | 14.22   | 2.78  | 0.86 |
| Odisha         | 2.52    | 2.52  | 15.11 | 56.51   | 17.83 | 7.54 |
| Rajasthan      | 0.40    | 0.11  | 0.10  | 5.31    | 1.16  | 0.37 |
| Uttar Pradesh  | 1.26    | 0.29  | 1.92  | 20.93   | 4.62  | 1.55 |
| West Bengal    | 4.25    | 3.44  | 6.78  | 28.48   | 6.22  | 2.03 |
| Total          | 4.92    | 3.78  | 7.12  | 23.02   | 6.90  | 3.07 |

Source: Estimated from NSS Unit Record Data.

A glance at Table 5 shows that the severity of calorie deficiency was as high as 56 and 49 per cent in Odisha and Assam, respectively. In Punjab, Haryana and Rajasthan, the severity of deprivation in terms of all macro nutrients was found to be low.

A marginal improvement in the severity of protein deprivation was recorded in the States of Haryana, Maharashtra, Madhya Pradesh and Rajasthan. In all backward States, except Madhya Pradesh and Rajasthan, the severity of fat deprivation has considerably increased between 2004-05 and 2011-12. In 2011-12, the severity of fat deprivation was much higher at 18 and 13 per cent in Odisha and Assam, respectively.

When the severity of deprivation is considered, it marks an impressive performance of the Southern States over time. Except in Kerala, the severity of fat deprivation was as high as 14 per cent in 2004-05. In Odisha, fat

deprivation has halved between the periods while a modest improvement was perceptible in case of Rajasthan.

#### ***Income as a Way Out of Calorie Deprivation:***

How much income is needed for the rural households to escape from the label of being calorie deprived? This section tries to answer this question, by comparing the average income of calorie deprived and calorie non-deprived households. If the recommended dietary allowance of calories is greater than that of the derived calorie intake from the quantities of food items, then the household will sink into the situation of being calorie deprived. On the other hand, if the recommended dietary allowance of calories is less than or equal to the daily calorie intake of households, then these households can be counted as calorie non-deprived.

Turning back to the period of 2004-05, the median MPCE of calorie deprived was higher than that of calorie non-deprived in the backward

States such as Assam and Bihar and Odisha. The relationship between income and calorie deprivation is dubious in these States. The high-income growth period of 2011-12 suggests that income-augmenting policies have worked better in the States of Punjab, Haryana and Rajasthan.

As presented in Table 6, at least 5 per cent income growth is necessary to elevate the

calorie deprived households from their status in 2004-05. In 2011-12, the median difference of income between calorie deprived and calorie non-deprived households has increased to 19 per cent. The notable income difference in Punjab, Haryana, Rajasthan, Uttar Pradesh and Bihar points to the worsening income inequality in these States.

**Table 6: Average Difference of Income Among Rural Households**

| State          | 2004-05     |              |                       | 2011-12     |              |                       |
|----------------|-------------|--------------|-----------------------|-------------|--------------|-----------------------|
|                | MICD<br>(1) | MICND<br>(2) | Difference<br>(2)-(1) | MICD<br>(3) | MICND<br>(4) | Difference<br>(4)-(3) |
| Andhra Pradesh | 521         | 570          | 49                    | 1352        | 1455         | 103                   |
| Gujarat        | 591         | 598          | 7                     | 1350        | 1474         | 124                   |
| Haryana        | 639         | 765          | 126                   | 1384        | 1998         | 614                   |
| Karnataka      | 464         | 537          | 73                    | 1183        | 1340         | 157                   |
| Kerala         | 814         | 1016         | 202                   | 1950        | 2007         | 57                    |
| Maharashtra    | 522         | 544          | 22                    | 1310        | 1418         | 108                   |
| Punjab         | 739         | 837          | 98                    | 1448        | 2198         | 750                   |
| Tamil Nadu     | 528         | 577          | 49                    | 1355        | 1521         | 166                   |
| Assam          | 569         | 539          | -30                   | 1011        | 1157         | 146                   |
| Bihar          | 430         | 426          | -4                    | 861         | 1178         | 317                   |
| Madhya Pradesh | 428         | 436          | 8                     | 948         | 1060         | 112                   |
| Odisha         | 402         | 353          | -49                   | 823         | 910          | 87                    |
| Rajasthan      | 507         | 566          | 59                    | 1062        | 1565         | 503                   |
| Uttar Pradesh  | 454         | 508          | 54                    | 801         | 1156         | 355                   |
| West Bengal    | 518         | 547          | 29                    | 1109        | 1187         | 78                    |
| Total          | 533         | 560          | 27                    | 1153        | 1369         | 216                   |

Source: Calculated from NSS Unit Record Data.

Note:

MICD – Median Income of Calorie Deprived.

MICND – Median Income of Calorie Non-Deprived

**Average RDA: State-wise and Decile-wise Comparisons:** Till now, we focused on the nutritional deprivation that does away with the rural households. Besides, we kept our attention on the income needed as a pathway out of undernutrition. The question unaddressed so far

is whether the Recommended Dietary Allowance (RDA) has marked a downturn with the passage of time. The State-wise comparison substantiates that median RDA of calories has increased in all the States, with the exception of Kerala and West Bengal (Table 7). As a result,

the median RDA of calories in the countryside increased from 2040 to 2080. With regard to the median RDA of proteins, all the States have exhibited an increasing trend while it was more or less stagnant in case of fats.

The calorie requirement of the bottom 30 per cent of the population was as low as 1700 in comparison to other expenditure groups (Table 8). Also, it was among the lowest expenditure group that seems to have reported the highest

increase in RDA between 2004-05 and 2011-12, by recording an increase of 47 percentage points, from 1723 calories to 1770. Interestingly, the RDA of the proteins and fats was more or less stagnant, irrespective of the expenditure groups. One reason behind is that it is not possible to identify pregnant and lactating women who demand higher proteins when one resorts to the NSS unit record data on consumer expenditure. This is one of the drawbacks of our analysis.

**Table 7: Median RDA of Macro Nutrients Among Rural Households**

| State          | 2004-05 |    |    | 2011-12 |    |    |
|----------------|---------|----|----|---------|----|----|
|                | C       | P  | F  | C       | P  | F  |
| Andhra Pradesh | 2065    | 52 | 25 | 2110    | 55 | 24 |
| Gujarat        | 2060    | 51 | 25 | 2072    | 52 | 25 |
| Haryana        | 2040    | 49 | 26 | 2078    | 52 | 25 |
| Karnataka      | 2074    | 52 | 25 | 2093    | 54 | 24 |
| Kerala         | 2068    | 53 | 24 | 2054    | 54 | 24 |
| Maharashtra    | 2058    | 51 | 25 | 2105    | 52 | 24 |
| Punjab         | 2073    | 51 | 25 | 2110    | 54 | 25 |
| Tamil Nadu     | 2080    | 55 | 24 | 2110    | 55 | 24 |
| Assam          | 2033    | 49 | 26 | 2070    | 51 | 25 |
| Bihar          | 1944    | 46 | 26 | 2042    | 49 | 26 |
| Madhya Pradesh | 2005    | 49 | 25 | 2074    | 51 | 25 |
| Odisha         | 2040    | 51 | 25 | 2110    | 53 | 25 |
| Rajasthan      | 1980    | 47 | 26 | 2073    | 50 | 26 |
| Uttar Pradesh  | 1968    | 46 | 26 | 2031    | 49 | 26 |
| West Bengal    | 2040    | 50 | 25 | 2086    | 52 | 25 |
| Total          | 2040    | 50 | 25 | 2080    | 52 | 25 |

Source: As in Table 1.

**Table 8: Median RDA of Calories, Protein and Fat Across Expenditure Classes**

| Expenditure Class  | 2004-05 |    |    | 2011-12 |    |    |
|--------------------|---------|----|----|---------|----|----|
|                    | C       | P  | F  | C       | P  | F  |
| Bottom 30 per cent | 1723    | 40 | 23 | 1770    | 41 | 23 |
| Middle 40 per cent | 2024    | 50 | 25 | 2062    | 52 | 25 |
| Top 30 per cent    | 2253    | 58 | 30 | 2259    | 58 | 30 |
| All                | 2040    | 50 | 25 | 2080    | 52 | 25 |

Source: As in Table 1.

**Factors Influencing Nutritional Deprivation:**

The previous studies have estimated the calorie deprivation of rural India by accommodating a set of norms such as 1800, 2100, 2200, 2400 and 2700 (Meenakshi and Viswanathan, 2003; Suryanarayana and Silva, 2008; Gupta and Mishra, 2013; Mishra, 2010). These studies are largely misleading owing to the inclusion of arbitrary norms. In an exceptional study by Sharma (2015) the RDA has been calculated after adjusting for age, gender and occupation of the households. As the RDA requirements of different households is different, the present study also offers an error-free approach in this regard by working out the age, gender and occupation adjusted calorie requirements and finally measures the calorie deprivation if the RDA surpasses the calorie intake of the household. The methodological difference of the work lies in the inclusion of calories (proteins/fats) derived from those food items such as pan, ganga, toddy, country/foreign liquor, beer and other intoxicants. Our presentiment is that the exclusion of these unhealthy food items is likely to intensify the nutrient deprivation in rural India.

The binary logistic regression method has been used to study the income-calorie nexus. The  $CD_i$  is the dependent variable and monthly per capita consumption expenditure, household size and land ownership are the independent variables of interest. The  $CD_i$  is equal to one if the household is calorie deprived and otherwise zero is recorded.

To get an insight into the probability of being calorie deprived across socio-economic

and demographic groups, a logit model has been fitted as:

$$\ln(\pi_i/1-\pi_i) = \alpha + \beta X_i + \varepsilon_i \quad (1)$$

Where  $(\pi/1-\pi)$  is called the odds ratio. The estimated probability ( $\pi$ ) is obtained as follows:

$$\pi = 1/1 + e^{-x} \quad (2)$$

Where  $x$  is the predictor variable and  $e$  is the base of natural logarithm with a value of 2.7183.

In case more than one explanatory variable is included, then the model becomes:

$$\ln(\pi_i/1-\pi_i) = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + \dots + \beta_k X_{ki} + \varepsilon_i \quad (3)$$

**Rationale Behind Selection of Variables**

**Income:** The impact of monthly per capita consumption expenditure, a proxy for income, is well-documented in literature. As MPCE goes up, calorie deprivation also decreases. However, there are chances that when income increases, households may not apportion all of their income on calories. As a result, the impact of income on calories would be less influential.

As given in Table 9, the logit model shows that below median households are severely calorie-deprived, with the odd ratio of 1.68. It implies that income effect works in the opposite direction on calorie deprivation.

**Household Size:** As is well-known, the larger households often utilise price discounts when purchased in bulk quantities (Meenakshi et al, 2000). The relationship between household size

and calorie consumption can be either positive (Kaicker and Gaiha, 2013) or negative (Gaiha et al, 2010). This could be due to the higher (lower) proportion of adults in the household relative to the dependent population such as the aged and children.

In both small and medium-sized households, calorie deprivation has significantly gone down. The opposite results hold for medium-sized households which were perceptible in case of protein deprivation.

**Land Ownership:** Land ownership exerts a negative influence on calorie deprivation. The coefficient for land ownership is significant but negative. It implies that when a household has access to land, its calorie deprivation decreases. This goes in line with the argument that self-production of cereals contributes to an increment in calorie intake (Basu and Basole, 2012).

Table 9 shows that the below median MPCE households are at a greater risk of calorie deprivation. It displayed the odd ratio of 1.68.

Among the social groups, ST households followed by OBC households face more calorie deprivation than SC households. The households which belong to regular wage and self-employed in non-agriculture are the most deprived categories. Though calorie deprivation has declined among casual labour in agriculture/non-agriculture, the results were not significant. Among the religious groups, Christians face more calorie deprivation than all other religious groups for whom a decline in calorie deprivation was reported.

A quick perusal of Table 10 shows that medium-sized households are more likely to be protein deprived. Also, SC households have improved their protein intake which was not the case with calorie intake. Not surprisingly, the regular wage earning households and households which are self-employed in non-agriculture are the most calorie and protein deprived households. This could be due to the heavy job pressure, less time available for cooking and regular skipping of meals to reach the offices in time.

**Table 9: Logistic Regression Analysis of Probability of Being Calorie Deprived (N = 59693)**

|                                           | Coefficient | OddsRatio | P value |
|-------------------------------------------|-------------|-----------|---------|
| Constant                                  | 0.553       | 1.738     | 0.000   |
| MPCE                                      | 0.517       | 1.678     | 0.000   |
| Below Median MPCE<br>(REF = above median) |             |           |         |
| Household Size                            |             |           |         |
| Small                                     | -0.717      | 0.488     | 0.000   |
| Medium<br>(REF = Large)                   | -0.153      | 0.858     | 0.000   |
| Land Ownership                            |             |           |         |
| Have Some Land<br>(REF = Landless)        | -0.117      | 0.889     | 0.004   |

(Contd.....)

**Table 9 (Contd.....)**

|                           |        |       |       |
|---------------------------|--------|-------|-------|
| <i>Social Group</i>       |        |       |       |
| ST                        | 0.232  | 1.262 | 0.000 |
| SC                        | 0.074  | 1.076 | 0.009 |
| OBC                       | 0.180  | 1.197 | 0.000 |
| (REF = Others)            |        |       |       |
| <i>Religion</i>           |        |       |       |
| Hindu                     | -0.622 | 0.537 | 0.000 |
| Muslim                    | -0.642 | 0.526 | 0.000 |
| Christian                 | 0.189  | 1.208 | 0.033 |
| (REF = Others)            |        |       |       |
| <i>Household Type</i>     |        |       |       |
| Self-employed in Agri     | -0.225 | 0.798 | 0.000 |
| Self-employed in Non-agri | 0.071  | 1.074 | 0.079 |
| Regular wage/salary ear   | 0.088  | 1.092 | 0.036 |
| Casual labour in Agri     | -0.010 | 0.990 | 0.826 |
| Casual Labour in Non-agri | -0.041 | 0.960 | 0.342 |
| (REF = Others)            |        |       |       |

Source: Computed from NSS 68<sup>th</sup> round unit-record data.**Table 10: Logistic Regression Analysis of Probability of Being Protein Deprived (N = 59693)**

|                       | Coefficient | Odds Ratio | P value |
|-----------------------|-------------|------------|---------|
| Constant              | -0.108      | 0.897      | 0.302   |
| <i>MPCE</i>           |             |            |         |
| Below Median MPCE     | 0.466       | 1.594      | 0.000   |
| (REF = above median)  |             |            |         |
| <i>Household Size</i> |             |            |         |
| Small                 | -0.055      | 0.946      | 0.151   |
| Medium                | 0.070       | 1.073      | 0.068   |
| (REF = Large)         |             |            |         |
| <i>Land Ownership</i> |             |            |         |
| Have Some Land        | -0.178      | 0.837      | 0.000   |
| (REF = Landless)      |             |            |         |
| <i>Social Group</i>   |             |            |         |
| ST                    | 0.331       | 1.392      | 0.000   |
| SC                    | -0.048      | 0.953      | 0.096   |
| OBC                   | 0.128       | 1.136      | 0.000   |
| (REF = Others)        |             |            |         |
| <i>Religion</i>       |             |            |         |
| Hindu                 | -0.539      | 0.583      | 0.000   |
| Muslim                | -0.701      | 0.496      | 0.000   |
| Christian             | -0.202      | 1.224      | 0.019   |
| (REF = Others)        |             |            |         |

(Contd.....)

**Table 10 (Contd.....)**

|                                             | Coefficient | Odds Ratio | P value |
|---------------------------------------------|-------------|------------|---------|
| <i>Household Type</i>                       |             |            |         |
| Self-employed in Agri                       | -0.273      | 0.761      | 0.000   |
| Self-employed in Non-agri                   | 0.080       | 1.083      | 0.051   |
| Regular wage/salary ear                     | 0.083       | 1.086      | 0.051   |
| Casual labour in Agri                       | 0.027       | 1.028      | 0.569   |
| Casual Labour in Non-agri<br>(REF = Others) | -0.169      | 0.844      | 0.000   |

Source: Computed from NSS 68<sup>th</sup> Round Unit Record data.

### Concluding Remarks

The aim of the paper was to quantify the proportion of undernourished households in rural India without relying on any particular calorie cut-off point. To do so, median RDA has been estimated at the household level, after adjusting for age and gender distribution of the sedentary household members. In order to pin down the nutritional deprivation, an attempt has been made to estimate the nutrients consumption derived from the quantity figures laid out in NSS unit record data and the nutrient contents drawn from the nutritive value of Indian foods. The two NSS rounds that pertain to the years 2004-05 and 2011-12 are used here.

Across the States, it can be seen that the median RDA of calories has increased. This was the case with proteins except the fats where the increased disease burden may not induce the fat consumption any longer. Our results confirm that the argument in favour of any further reduction of calorie requirements cannot be granted by any reason.

Given the depth and severity of calorie deprivation, the stagnant incidence of calorie deprivation is not a cause for celebration. The paper also highlighted the notable income difference between calorie deprived and calorie

non-deprived households in a handful of States such as Punjab, Haryana, Rajasthan, Uttar Pradesh and Bihar that points to the worsening income inequality in these States. The stagnant calorie deprivation could be due to the plausible omission of pregnant women and children and the conventional treatment of all rural households as sedentary ones. Although a number of government programmes are in operation, income growth is not sufficient for the well-being of rural households in general and for the nutritional adequacy in particular.

An investigation of the determinants of calorie deprivation leads us to the finding that poor, ST and OBC households, regular wage, self-employed in non-agriculture and Christians have the higher probability of being calorie deprived. Among the backward States, higher incidence of nutritional deprivation persists among Assam, Madhya Pradesh, Odisha and West Bengal. The legacy of higher calorie deprivation in leading States is not a cause of worry. Lower the nutritional intake, higher will be the absorption level in Southern and Western States due to their improved ways of living. This is further reflected in the lower incidence of stunting and underweight among children in these States (Mishra and Mishra, 2009).

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