Health, nutrition and poverty: Linking nutrition to consumer expenditures

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THERE IS NOW SUBSTANTIAL RECENT LITERATURE ON THE IMPACT OF IMPROVEMENTS in the health status of a country's population on its aggregate economic performance (Bloom and Canning 2000; Bhargava et al. 2001). The main conclusion of this set of literature, with a few exceptions, is that improvements in health provide a substantial boost to the economies of countries where they occur. There is also evidence that the aggregate economic performance of a country can influence the health status of its population (Pritchett and Summers 1996). While there is some debate about the actual magnitude of this effect (see Subramanian 2004 and Ruger et al. 2001 for a review), its overall direction is not subject to much debate. In fact, more can be said about the association between increased income and health empirically.

Increases in the average income are also associated with declines in the poverty ratio, especially when the overall distribution of income does not simultaneously worsen too much. To the extent that commonly used measures of absolute poverty incorporate expenditure required to achieve the consumption of a 'minimal basket of food items,' or the purchase of food items required to achieve a 'minimal level of energy defined in calories', it is reasonable to argue that increases in the average income, taking account of disparities, will tend to be associated with improvements in the nutrition of the poorest. In this regard, Bhargava (1999) suggests that when people can afford to do so, they do consume healthier diets. Bhargava (1991) presents evidence from International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) data that improvements in 'permanent' income are positively associated with improvements in the consumption of food items and some nutrients. (This debate was triggered by the pioneering study of Behrman and Deolalikar (1987) which showed, in (six) ICRISAT villages of south India, the income elasticity of calorie intake was quite low, and not significantly different from zero in statistical terms. The authors note that even among the very poor, as incomes rise, households mostly purchase additional 'taste'.) Nutrition has been positively associated with anthropometrical indicators such as height and weight (e.g. Jamison et al. 2003). Nutritional deficiency (e.g. of iron, calcium, vitamins A, B and C) in the human body has been associated with a variety of adverse health conditions (Willett 1998).

Since the 1980s, there has been a consistent decline in India's poverty rate, together with a significant growth in the real income per capita. During 1980-2000, India's real per capita income has nearly doubled, having grown at an annual average rate of 3.3%. In 1983, as per the head-count measure, India's poverty ratio was 45.7% in rural areas and 40.8% in urban areas, which declined to 27.1% and 23.6%, respectively, by the year 2000 (Planning Commission 2001). This has been used to bolster the claim that India's rapid economic growth can be effective in substantially reducing poverty (Lal et al. 2001; Datt and Ravallion 2002). This ought, by implication of the discussion in the preceding paragraph, to enhance the ability of the Indian poor to reduce the level of their malnutrition.

This paper adds two wrinkles to the above set of issues relating to poverty in the Indian context. First, we broaden the definition of 'minimal consumption' that, for purposes of measuring poverty, focuses only on energy intake (in calories). We do this by incorporating in the notion of minimal consumption the requirements of a balanced diet across a vector of nutrients, such as proteins, vitamins, fats, carbohydrates, etc. Second, we move away from the focus on the 'minimal basket of pre-identified food items' to allow for variation in the relative proportions of different items consumed, as well as the inclusion of newer items in the food consumption basket.

Further, we argue that this departure does not loosen the comparability of the poverty line over time. This is because the poverty line is constructed by the method of estimating the smallest consumption expenditure required to achieve a fixed (minimum) nutritional requirement.

We provide some justification for these modifications to the way in which poverty is assessed in India. In particular, there is one advantage of these modifications over the traditional approach to measuring poverty. This is the benefit that results from being better able to account for the nutritional impact of relative price changes in food commodities, and also of the evidence from the nutritional literature of the need for a 'balanced diet' that includes a variety of nutrients. Moreover, we argue that many of the arguments against using these modifications are not as debilitating as has been suggested in the literature.

Using this perspective, we construct revised estimates of the head count measure of poverty in India for two periods-1993-94 and 1999-2000-and for individual provinces, further classified into rural and urban populations. We found first the poverty line (PL) based on a 'balanced diet' measure to be higher than that calculated by the Planning Commission methodology. Second, the poverty ratio in our framework declines at a rate that is markedly slower than the poverty measure used by the Planning Commission at the all-India level. In addition, there are major differences in trends in the two sets of poverty estimates at both the provincial levels, as well as for rural and urban populations.

Our main conclusions are as follows. If the focus of the food-poverty line is a minimal level of nutritionally balanced diet, the official method of estimating poverty that typically fails to fully account for the impact of changes in relative prices and a diet that includes the consumption of micro-nutrients, is inadequate for assessing the impact of rising incomes on the health of the poor. Moreover, why relative prices change and the role that governments sometimes play in bringing about such change is a subject of crucial policy importance.

Poverty Line Measurement with Reference to a Nutritionally Balanced Diet

This section examines the way poverty is usually measured in India, and lays out the case for the approach taken in this paper.

Measuring Absolute Poverty

The standard approach to measuring poverty is to define a 'poverty line' level of income (or expenditure), and then to estimate the proportion of total population that lives below the PL, to arrive at the so-called 'head count' measure of poverty.

The PL defines an absolute minimum level of consumption of food and non-food items that is necessary for sustenance and acceptable to a society. The standard approach is to first define a 'food-poverty line (FPL)' which estimates the expenditures needed to fund a minimum level of nutrition. There are two main (but related) ways of doing this. First, one can estimate the minimum amount of expenditure needed to achieve a certain minimum level of nutrition typically expressed in energy units (kilocalories). This approach allows for variation in the proportion of food items consumed (as well as the types of food consumed), and the combination chosen is the one that minimizes the cost of achieving a pre-specified calorie intake. The second method also focuses on the expenditures used to achieve a minimum energy level but, unlike the first method, it requires predetermining the combination of food items and their proportions at some base-year level, and then calculating the expenditure needed on this combination to achieve the requisite energy level. It is entirely possible and, in fact, very likely that the first approach will yield a lower PL than the second in the base year.

Having defined the FPL by either of the above techniques, the challenge is then add some non-food expenditure component to the FPL that reflects a minimal level of consumption of non-food items. In India, the share of non-food expenditure in total spending for the household on the margin of poverty is based on an exogenously determined normative standard. As per the approach adopted by the Planning Commission, on an average, this share amounted to about 26.50 per cent of total spending in urban areas and 19.58 per cent of total expenditure in rural areas (Malhotra 1997). Another approach has been to estimate this additional amount *as being the non-food expenditures* of the individual whose food expenditure equals the food poverty-line level of spending. Adding the food- and the non-food components of the PL yields the PL level of expenditures.

There are several conceptual and empirical issues that arise with these methods of arriving at the PL. These methods need to be understood clearly since they have implications for the methods used in this paper. First, it has been argued that the method of estimating the FPL using a predetermined food basket is more desirable than the approach that estimates a minimum-cost food combination. This is because the latter method can sometimes give rise to cost-minimizing combinations that may not be culturally acceptable, or that are not 'tasty' (Stigler 1945). Moreover, some have noted that the cost-minimizing approach poses difficulties in solving linear programming problems and so, may be expensive in terms of computing time (Lanjouw 1997). Finally, it has been suggested that the cost-minimizing approach is less well suited for making inter-temporal comparisons since it is not comparing 'like with like' combination of goods.

It is not apparent to us, however, that the above, in fact constitute reasons enough to discard the least cost-minimizing approach. First, extremely powerful and relatively cheap mathematical computing software are now available (e.g. MATHEMATICA and MATLAB), which can solve, what appear at the first sight to be complex linear programming problems.

Second, it is not apparent to us that a base-year combination of food items can be taken as more-or-less descriptive of population tastes. Patterns of food consumption (including proportions of items consumed) depend on the price levels, relative prices and income, and they may reflect the nutritional needs (e.g. Bhargava 1991). If food consumption is allowed to change along these lines, it is no longer obvious why a base-year food-consumption basket possesses any more validity than a food-consumption basket for any other year. Food habits may be slow to change, but change they will; and that will pose challenges for extended inter-temporal comparisons under the currently preferred method of a predetermined food basket.

We do not deny that certain habits such as vegetarianism (Bhargava 1991) may be difficult to give up, but that is a much less restrictive imposition than the share of different items in the food basket. One can think of various methods to incorporate culturally acceptable food consumption patterns, although none of them are perfect. One way is to calculate the PLs for each State, and by rural and urban populations in each State, to account for the differences across space. Another way is to pre-specify the tastes, and directly incorporate them as additional constraints (or a constraint) in the linear programming exercise. There will be some degree of arbitrariness in describing these constraints but this problem can be addressed by taking account of the patterns of food consumption by populations over fairly long periods of time.

Finally, we do not see why comparing 'like with like' of food items is so crucial for inter-temporal comparisons of poverty ratios. Suppose the issue is one of achieving a minimal level of energy intake for people living at the very margin of survival. What is relevant is comparing like with like in 'energy units', which is taken account of by the cost-minimizing combination method. As one obvious, albeit extreme, example of survival needs determining food intake, and not merely culturally determined tastes, one has to consider only the food habits of the survivors of the recent tsunami in Indonesia and the Andaman Islands, many of whom lived off coconuts and the bark of coconut trees (Gray 2005). Moreover, the predetermined food basket method for estimating PLs and comparing poverty ratios over time is not equipped to handle non-trivial changes in relative prices, especially if individuals are likely to change their food consumption patterns in response.

The approach taken in this paper has another attractive feature, which has to do with the concern about substitution elasticity between different types of food, mainly on account of the high price elasticity of the demand for non-cereal food items. Nutritionists see high substitution elasticities as a cause for concern, at least among the poor, since the nutritional status is thereby threatened by price increase (Deaton and Muellbauer 1980). This does cause a difficulty with the standard food-basket formulation of the FPL, which may remain unchanged even when the relative prices change, and therefore are unable to capture nutritional deficiencies among the poor that might result from a change in the relative prices. Notice that a definition based on estimating the smallest expenditure required to achieve some minimum nutritional level will reflect this, by means of an upward shift in the FPL. By emphasizing the role of relative prices in influencing the level of nutrition, this method can help draw policy attention to a variety of government policies that affect prices of different food items-price support systems, public distribution systems, and the like.

A second set of conceptual issues arises with respect to the calculation of the non-food component of the PL level of expenditures. As mentioned above, the most popular approach has been to use as the non-food poverty line-the average non-food expenditures of individuals whose food expenditures equal the FPL. Caution must be exercised, however, because if this estimate is constructed separately for each year for which data are available, it may lead to unsatisfactory results. For instance, rising food prices may lead individuals to consume more non-food items even if non-food item prices are unchanged (because their prices relative to food items have fallen), and thus there will be a simultaneous increase of the food-and non-food poverty lines. That, in turn, may lead to sometimes spurious findings of increasing poverty, or higher urban poverty than rural poverty (Ravallion and Bidani 1994). One approach to fix this would be to use either some base year level of the 'non-food poverty line' (scaled up to reflect the inflation over time); alternatively, one could use a base-year ratio of non-food to food expenditures. The Planning Commission estimates in India effectively use the base year numbers updated to calculate price increases over time.

A Nutritionally Balanced Diet

We have argued that a cost-minimizing approach to estimate the FPL is not only readily feasible, but may also be conceptually more satisfying than an approach that works with a fixed basket of food items, apart from being flexible enough to capture most of the good points of the latter method. We now make the case for estimating an FPL that requires the estimation of the lowest expenditures needed to achieve a 'minimum combination' of nutrients. The 'minimum combination' is defined not just as the energy requirement (in calories) but also as the requirement for a vector of nutrients, including both macro- and micronutrients, such as carbohydrates, proteins, fats, Vitamins A, B, and C, carotene, iron, riboflavin and calcium.

Why does one need to go beyond the criterion of energy intake, irrespective of the source (carbohydrates, fats or proteins)? For one, even if energy intake were the sole objective, it matters how such energy is obtained. Thus, Jamison et al. (2003) report that the proportion of energy consumed in the form of proteins matters much more for anthropometric indicators such as height and weight, than the overall energy intake. Bhargava (1991) notes that the consumption of proteins without carbohydrates in the diet has an adverse effect on the ability of the dietary proteins to replace body proteins. Some of these theories have been disputed. For instance, Jamison et al.'s paper has been criticized by a number of influential commentators for its weak methodology and, moreover, the impact of protein on the human body has been questioned previously by Sukhatme (Sukhatme 1974; Martorell 2003). However, other research has tended to agree with Jamison et al.'s conclusions (Bhargava and Guthrie 2002).

Second, nutrients matter in ways that go beyond a narrow focus on energy intake. The lack of calcium, vitamins A, B1, B2, and C, and iron has been associated with a higher frequency of certain types of cancers, cardiovascular conditions, and other serious health disorders. In fact, it has been suggested that the results of Jamison et al. were confounded by the presence of other micronutrients that could also influence height and weight. Again, there is one key contentious issue. Researchers have noted that the energy intake levels tend to be highly correlated with the intake of other nutrients as well, because most diet and foods that constitute major energy sources also contain at least some quantity of key micronutrients (Willett 1998). That might suggest a preferential focus on energy intake only. Two considerations militate against this viewpoint. First, focusing only on energy-intensive diets may be an economically inefficacious way of obtaining the requisite level of micronutrients. Moreover, nutrition research suggests that the quantity of various micronutrients in the diet continues to impact for disease risk, even after being scaled by the level of energy intake (Willett 1998). This calls for attention to individual components of the minimum nutrition vector discussed above.

What precisely should the minimum be even if one agrees in principle with the notion that a certain minimum combination of nutrients is necessary? For instance, energy consumption (and therefore needs) typically varies among individuals by their weight, level of physical exertion/activity (including in occupation), and the metabolic rate (the efficacy with which the body absorbs energy-providing foods). For people living on the margins of poverty, one can reasonably construct some estimate of their daily energy needs based on the nature of their jobs and some intelligent guesses about weight for given age and sex. In India, the average minimum energy requirement has been stated to be 2100 calories for an average urban resident and 2400 calories for someone living in a rural area.

In our framework, for each category of minimum energy intake, we must also define a corresponding quantity of micronutrients to be consumed. Given the current state of scientific knowledge, this is possible only roughly, by defining a 'recommended dietary allowance' (RDA), based on research that shows the efficacy of different types of nutrient consumption per calorie consumed in influencing specific types of disease risk. As defined in the literature, RDA is not some minimum requirement, however, and we are still only learning about the possible consequences of having too much of a specific nutrient. Moreover, if we were to set out the ideal RDA as one that achieves some minimum desirable health status (e.g. impact on overall mortality risk), then the task of coming up with an RDA is well-nigh impossible since we still know very little about interactions between various nutrients and how they translate as a combination into mortality risk, for instance.

The difficulty outlined in the previous paragraph possibly explains the dominant focus in the poverty literature on energy intake. However, that ought not to divert us from emphasizing the role of other micronutrients. To address the lack of precision about the amount of other nutrients required, we can assess alternative PLs and poverty ratios for different levels of the RDA vector.

A second rationale for focusing solely on energy intake is the following argument: provided that the minimum energy needs are met, the poor may be able to participate effectively in the labour market and the additional incomes earned from their labour can then be used to support the purchase of food items containing other nutrients (Bhargava 1991). This sort of 'hierarchy of human needs', even if observed in practice, appears to us to be unsatisfactory as a rationale for defining the FPL. The FPL, however defined, is a static concept, which describes the expenditure that is just enough to meet the minimum nutrition requirements. If household income/expenditure is just enough to purchase minimum energy requirements, and falls short of what is needed to purchase other desirable nutrients, then that is all the information we have. It is difficult to conclude from this fact alone the future prospects of the individual, or the household, since future earnings depend on a host of other exogenous variables that can affect labour market conditions. More significantly, behaviour by desperate households living on the margins of below survival levels of income cannot be taken as an indicator of a normative standard to which the FPL is closer in spirit.

In the Indian context, there is a long history of debate between experts who have sought to incorporate the notion of a balanced diet, or adequate nutrition in the definition of poverty (e.g. Rao 1997; Sukhatme 1977, 1978), and those who have underplayed it (e.g. Dandekar 1996). The latter perspective has tended to dominate the calculations of PL in India. However, as biomedical research increasingly highlights the importance of micronutrients for health as against a pure energy intake, it is difficult to bypass this perspective on nutrition. Dandekar (1996) has argued that poverty and under-nutrition are different and that, '...want of adequate income, howsoever defined, is poverty; deficiency of energy appropriately defined is under-nourishment. These two are related in the sense that statistically they go together. But the two are not identical; in fact they are two different phenomena.' If we take poverty as more than just income deprivation, and include it to mean deprivation in other areas, such as health and nutrition, as per Sen's capability approach (Sen 1985), efforts to divorce under-nutrition from the notion of poverty appear less justified.

Poverty Line Measurement: A 'How to' for this paper

Estimating the food- and the non-food poverty line

The standard approach to measuring poverty is to define a PL level of income (or expenditure), and then to estimate the proportion of total population that lives below the PL, to arrive at the so-called 'head count' measure of poverty.

We estimated the balanced diet-based PLs for all the major States, and associated rural and urban areas of India, for two years, i.e. 1993-94 and 1999-2000. The estimation of the PL involved two steps. First, we calculated the minimum expenditure required for meeting the predefined nutritional basket of the Indian Council of Medical Research (ICMR). This provided us with the FPL. Second, we constructed an estimate for minimal non-food expenditures. These two components added together, yielded the required PLs. The methods of estimating these two components of the PL are described below.

Food expenditure cut-off (FPL)

We will estimate the least possible expenditures required to achieve a predefined minimum nutritional basket, taken for our purposes, the RDA. Let this basket be denoted by the n x 1 vector N, where $N = [N_1\ N_2 \dots N_n]$.

Suppose there are m types of possible food items, whose quantities consumed are described by the m x 1 vector f, where $f = [f_1\ f_2 \dots f_m]$. Let the corresponding per unit prices of each food item be described by m x 1 vector P, where $P = [P_1\ P_2 \dots P_m]$. Finally, let each food item F_i (i = 1... m) have a corresponding n x 1 nutrient content vector fi = [Ni1, Ni2 ... Nin]. Then the problem of solving for the FPL becomes one of solving the following linear programming problem:

(1) Minimize f'P
Subject to
$Ff \geq N$ and $N \geq 0$

Here F is the nutrient content matrix, of dimension n x m. The first constraint $Ff \geq N$ ensures that the nutrient intake equals or exceeds the RDA. The second constraint ensures that only non-negative amounts are consumed. It is also possible to introduce other constraints to satisfy requirements of 'tastiness' or other 'cultural characteristics'. We will discuss some of these extra constraints later. Solving (1) yields the cost-minimizing expenditure E^* that is a scalar product of two vectors-a given price vector P, and the optimal combination of food items f^*. We undertook this exercise for all States, rural and urban areas of India, and for years 1993-94 and 1999-2000. The resulting estimates yield the FPL, which also indicates minimum expenditure required for the minimum balanced nutrition on a per capita basis.

Non-Food Expenditure Allowance

For estimation of the non-food component of the PL for the corresponding years, we estimated the State, and rural- and urban-specific ratios of food and non-food expenditure for the marginally poor (defined here as individuals belonging to households with per capita expenditures that lie in a band of 10% (5% above and 5% below) of the PL as defined by the Planning Commission methodology[1] for the year 1993-94. The non-food expenditure ratio so worked out was used to calculate the minimum necessary allowance for non-food consumption items.

Poverty Line

Finally, the PL level of expenditure (food and non-food) was estimated by using the formula:

$FPL \times 1/(1-\alpha)$

where FPL = food expenditure cut-off (or the FPL)

α = non-food expenditure ratio to the total household expenditure for the base year 1993-94.

This specification implies that to estimate the PL, we scale up the minimum expenditure required for nutritionally balanced food expenditure, or the FPL, by an allowance for some minimum needed non-food expenditure.

Sources of data

Our definition of the RDA was obtained from the ICMR. This information was available at the individual level, classified by age and sex. A simple average across age and sex of the RDA for 10 nutrients was calculated to arrive at the per capita RDA. The per capita RDA has been used as the minimum threshold of nutritional requirement at the household level. On the basis of the ICMR recommendations of different nutritional requirements for different age and sex, the calculated average per capita RDA for the 10 nutrients are given in Table 1.

Table 1

Average per capita RDA per day of various nutrients

Nutrients	Per capita RDA per day
Calorie	2300
Protein	60
Fat	40
Iron	28
Calcium	400
B carotene	2400
Riboflavin	1.4
Thiamin	1.2
Niacin	16
Vitamin C	40

RDA: recommended dietary allowance
Source: Based on ICMR, 2002

In addition, we needed information on the price vector P, the nutrient content matrix F, and the various types of food items available. Various types of food available and consumed were listed based on the data collected by the National Sample Survey Organization (NSSO) in four nationally representative consumer expenditure surveys, 1983-84, 1987-88, 1993-94 and 1999-2000. These surveys provided information on 125 different food items.

The information on prices was obtained from the previously

1 ● We worked out three parallel estimates of the share of non-food expenditure. These are non-food expenditure share of (i) all poor below the Planning Commission poverty line; (ii) the marginally poor, who are around (5% below and 5% above the Planning Commission poverty line; and (iii) bottom 30% of the population as per the monthly per capita expenditure (MPCE). Poverty line estimates produced under these different procedures are not very different from each other.

mentioned consumer expenditure surveys as well. Unfortunately, there are several complications in defining these prices. First, different households face different food prices, and they may be purchasing different quality products for which no information is available in the survey. To an extent, some of these differences can be addressed by constructing PLs for different States, and across rural and urban areas within a State. That may still not fully address the problem. To this end, we defined 'implicit' prices, as reflected by household-level information on expenditures for specific items, and the quantities purchased of each. The ratio of the total expenditures to the total quantity purchased is taken as the implicit price.

The nutrient content of food items is described in Appendix 1. This information was obtained from publications of the National Institute of Nutrition (Gopalan et al. 1989). The number of food items covered by Gopalan et al. (1989) is approximately 450 and there is a perfect match for more than 100 items between those in their study and the consumption baskets of households in the NSSO consumer expenditure surveys. However, the data for about 15 food items do not match, either because these items were cooked, or were less commonly consumed. For these items, estimates of the nutrient content were based on their closest substitute in the list of Gopalan et al.. The nutrient values per 100 g of food items were calculated.

Although the data are extremely comprehensive (and valuable), several cautionary remarks are in order. First, the nutrient content of a food item can vary considerably across geographical areas, depending on a variety of conditions including the quality of soil (Willett 1998). Second, the theoretical nutrient content of food and the actual nutrient consumption of a person may vary markedly depending on the method of food processing, and the combinations in which they are consumed. For instance, cut fruits rapidly lose some of their nutrients if not consumed soon; chemical properties of foods change in the process of cooking; the properties of yoghurt, milk and skimmed milk are vastly different and surveys may not always distinguish these products (Willett 1998). Third, nutrient consumption is not synonymous with nutrient intake. For example, as noted earlier, for dietary proteins to effectively replace body proteins, the simultaneous consumption of carbohydrates appears to be essential (Bhargava 1991).

Findings

Based on the methodology and data sources mentioned above, we solved the linear programming problem described above under three different scenarios. Under scenario I, we imposed only the constraint that the consumption of any food item must be non-negative, i.e. ($fi \geq 0$). Under scenario II, in addition to the constraint in scenario I, we imposed the constraint that the consumption of coconut, *jowar, bajra, ragi* and millets equals zero. The main justification for this assumption is that coarse grains such as *jowar, bajra, ragi* and millets are increasingly vanishing from the average Indian diet, as is their production. For example, the area under *jowar* cultivation in India has gone down from approximately 9% in the early 1980s to less than 6% in the late 1990s, with the value of production falling from 1.64% to 0.71% during the same period. Similarly, the area under cultivation and the value of production of *bajra, ragi* and small millets have declined considerably over the years **(Table 2)**.

Table 2

Area under cultivation and production of jowar, bajra, ragi and small millets during the 1980s and 1990s

Crop	Years (Triennium average)		
	1981-82	1991-92	1998-99
Cultivated Area as a Share of Total Cultivated Area (%)			
Jowar	9.01	7.55	5.69
Bajra	6.35	5.71	5.08
Ragi	1.39	1.21	0.92
Small millets	2.08	1.32	0.83
Share in Total Agricultural Production (%)			
Jowar	1.64	1.16	0.71
Bajra	0.75	0.66	0.49
Ragi	0.36	0.21	0.15
Small millets	0.19	0.08	0.06

Source: Government of India, 2000.

There are two main reasons for imposing the requirement that the consumption of coconut is zero. First, in many parts of India, coconut is consumed in limited amounts. Second, including the possibility of coconut consumption in the linear programming exercise leads to unrealistic solutions where large amounts of coconut are consumed, and items commonly observed in the consumption basket are excluded. Under scenario III, we impose the further requirement that at least 200 g rice is consumed. This requirement was imposed because rice did not figure in the optimum consumption basket in any of the State except three States viz. Andhra Pradesh, Assam and Tamil Nadu. However, a long-term consumption pattern of different food items in India shows that, on an average, 200 g per capita per day of rice is consumed in almost all the States. (For consumption trends of different cereals *see* Mahendradev *et al.* 2004.)

We estimated the FPL by solving for the least cost combination of foods separately for rural and urban areas in all states. For illustrative purposes, however, we present in **Tables 3 and 4**, the solution that would obtain if one was interested in an FPL at the all India level, separately for rural and urban areas.

In **Table 3**, scenario I describes the solution to the linear programming problem without imposing any constraint other than the RDA requirement and non-negativity of the consumption of food items. Here the optimum consumption basket is 214 grams of Jowar, 361 grams of Bajra, 48 grams of Ragi, 32 grams of Spinach, 40 grams of coconut and 14 grams of guava per person per day in rural areas. Similarly, in urban areas the optimum quantity of consumption is 213 grams of Jowar 361 grams of Bajra, 48 grams of Ragi, 32 grams of

Table 3

Three scenarios of optimum consumption basket and minimum expenditure required for recommended nutritional intakes in rural and urban areas in India, 1993-94

Region and food items		Scenario I		Scenario II		Scenario III	
	Price in Rs per 100g	Amount (x 100 g)	Total expenditure (Rs)	Amount (x 100 g)	Total expenditure (Rs)	Amount (x 100 g)	Total expenditure (Rs)
RURAL							
Rice	0.51	0.00	0.00	0.00	0.00	2.00	1.03
Khoi, lawa						0.30	0.27
Wheat/Atta	0.47	0.00	0.00	7.44	3.50	5.00	2.35
Jowar and products	0.32	2.14	0.68				
Bajra and products	0.34	3.61	1.23				
Ragi and products	0.39	0.48	0.19				
Milk						0.49	0.33
Other milk products	1.70	0.00	0.00	0.02	0.04	0.16	0.27
Mustard oil	3.24	0.00	0.00	0.24	0.78	0.18	0.60
Spinach/other leafy vegetables	0.32	0.32	0.10	0.38	0.12	1.38	0.44
Coconut	0.42	0.40	0.17				
Guava	0.44	0.14	0.06	0.14	0.06	0.13	0.06
Per capita per day total expenditure required			2.43		4.50		5.35
Per capita per month total expenditure required			72.90		135.00		160.50
URBAN							
Rice	0.54	0.00	0.00	0.00	0.00	2.00	1.07
Khoi, lawa						0.34	0.34
Wheat/Atta	0.55	0.00	0.00	7.44	4.09	4.66	2.56
Jowar and products	0.40	2.13	0.86				
Bajra and products	0.42	3.61	1.51				
Ragi and products	0.46	0.48	0.22				
Milk						0.49	0.40
Other milk products	0.80	0.00	0.00	0.06	0.05	0.16	0.50
Mustard oil	3.26	0.00	0.00	0.24	0.79	0.19	0.63
Spinach/other leafy vegetables	0.43	0.32	0.14	0.38	0.16	1.39	0.60
Coconut	0.45	0.40	0.18				
Guava	0.56	0.14	0.08	0.14	0.08	0.13	0.07
Per capita per day total expenditure required			2.99		5.17		6.17
Per capita per month total expenditure required			89.70		155.10		185.10

Note: Scenario I: Food items consumed must be greater than or equal to zero. Scenario II requires the constraint that not only are food items consumed greater than zero, but also that no ragi, jowar, bajra, millets, and coconut are consumed. Scenario III incorporates, in addition to the constraints under scenarios I and II, that at least 200 g of rice per capita per person is consumed.
Source: Authors' Estimates.

Spinach, 40 grams of coconut, and 14 grams of guava. Taking their respective unit prices in rural and urban areas separately, the total expenditure comes to be Rs. 2.44 per person per day, i.e. Rs. 73.14 per person per month in rural areas and Rs. 2.99 per person per day, i.e. Rs. 89.66 per person per month in urban areas. These figures indicate the minimum required expenditure by households per capita per month in order to secure the minimum level of nutrition.

However, it is likely that the optimum consumption basket is so uninteresting that no one can be expected to accept that as a balanced diet. In particular, the coconut consumption seems quite a bit excessive and the absence of rice and wheat from the diet appears unrealistic, given that the consumption of coarse grains such as jowar and bajra is low in India at the present time. Hence, scenario II requires that the consumption of coarse grains such as jowar, bajra, and ragi and of coconut to be equal to zero in the linear programming problem. In the revised solution, the optimal consumption basket includes wheat, milk and oil in different proportions both in rural as well as urban areas. This solution gives a more diversified consumption basket relative to that under scenario I, but with the imposition of additional constraints the cost is a bit higher. Now the minimum food expenditure required by an individual is Rs 135 and Rs 155.10 in rural and urban areas per person per month, respectively. **Figure 1** summarizes the estimates of the food poverty line under the three scenarios at the all India level for 1993-94 and 1999-2000, and for rural and urban areas separately.

Scenario III introduced the additional constraint of a minimum consumption of 200 grams of rice (or related prod-

Table 4

Three different scenarios of optimum consumption basket and minimum expenditure required for recommended nutritional intakes in rural and urban areas in 1999-2000.

Region and food items		Scenario I		Scenario II		Scenario III	
	Price in Rs per 100g	Amount (x 100 g)	Total expenditure (Rs)	Amount (x 100 g)	Total expenditure (Rs)	Amount (x 100 g)	Total expenditure (Rs)
RURAL							
Rice	1.09	0.00	0.00	0.00	0.00	2	2.19
Khoi, lawa		0.00	0.00	0.00	0.00	0.00	0.00
Wheat/atta	0.82	0.00	0.00	7.44	6.08	4.90	4.00
Bajra and products	0.68	5.99	4.06				
Ragi and products	0.64	0.34	0.22				
Milk: liquid	1.06	0.00	0.00	0.00	0.00	0.63	0.67
Other milk products	3.19	0.00	0.00	0.02	0.07	0.13	0.42
Vanaspati, margarine	4.10	0.00	0.00	0.06	0.24		
Mustard oil	4.26	0.00	0.00	0.00	0.00	0.23	0.99
Groundnut oil	4.14	0.00	0.00	0.18	0.75		
Spinach/other leafy vegetables	0.59	0.29	0.17	0.38	0.22	0.81	0.48
Coconut	0.86	0.15	0.13				
Guava	0.73	0.15	0.11	0.14	0.10	0.08	0.06
Groundnut	2.99	0.08	0.23	0.00	0.00		
Per capita per day total expenditure required			4.92		7.46		8.81
Per capita per month total expenditure required			147.6		223.8		264.3
URBAN							
Rice	1.33	0.00	0.00	0.00	0.00	2	2.66
Khoi, lawa		0.00	0.00	0.00	0.00	0.02	0.05
Wheat/atta	0.94	2.47	2.33	7.44	7.01	4.87	4.59
Bajra and products	1.69	0.00	0.00				
Ragi and products	0.78	4.09	3.19				
Milk: liquid	1.24	0.00	0.00	0.07	0.09	1.20	1.49
Other milk products	6.09	0.00	0.00	0.00	0.00	0.00	0.00
Vanaspati, margarine	4.18	0.00	0.00	0.13	0.56	0.00	0.00
Mustard oil	4.24	0.00	0.00	0.11	0.46	0.24	1.03
Groundnut oil	4.27	0.00	0.00	0.00	0.00	0.00	0.00
Spinach/other leafy vegetables	0.81	0.49	0.39	0.37	0.30	0.83	0.67
Coconut	0.91	0.73	0.66			0.00	0.00
Guava	0.89	0.12	0.11	0.14	0.12	0.08	0.07
Per capita per day total expenditure required			6.68		8.54		10.56
Per capita per month total expenditure required			200.40		256.20		316.80

Scenario I: Food items consumed must be greater than or equal to zero. Scenario II requires the constraint that not only are food items consumed greater than zero, but also that no ragi, jowar, bajra, millets, and coconut are consumed. Scenario III incorporates, in addition to the constraints under scenarios I and II, that at least 200 g of rice per capita per person is consumed.
Source: Authors' Estimates.

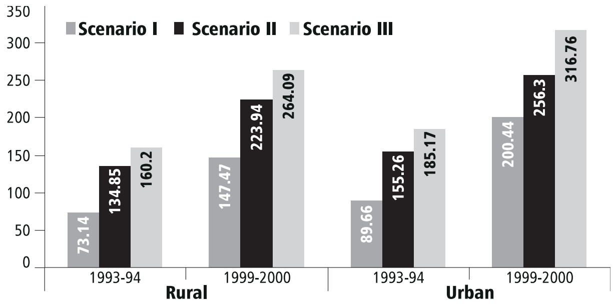
ucts) per person per day. The resulting solution for the consumption basket included rice, wheat, oil, milk, and guava (fruits) and is indicated in the last two columns of **Tables 3 and 4.** The total expenditure required to command this food basket came to be Rs 160 per person per month in rural areas and Rs 185 per person per month in urban areas for 1993-94. The solution under scenario III was taken to be the FPL for 1993-94 in **Table 2.** Similarly, the solution under scenario III for the FPL during 1999-2000 was Rs 264 per person per month in rural areas and Rs 317 per person per month in urban areas.

It is interesting to note that in the solution of the linear programming exercise under scenario 1 (i.e. without imposing any additional constraint other than the RDA itself) in 1999-2000 gives exactly the same composition of the consumption basket as in 1993-94, with the sole difference being that jowar in 1993-94 is replaced by groundnut in rural and by wheat in urban areas in 1999-2000. Under scenarios II and III, milk and milk products figure in the 1999-2000 consumption basket prominently indicating that the relative prices of milk and milk products may have declined between 1993-94 and 1999-2000. In addition to milk, the optimal 1999-2000 basket contains vanaspati, gram and other edible oils.

In general, a comparison of the least cost consumption basket of 1993-94 with that of 1999-2000 (scenario III in both cases) indicates that the latter has a higher proportion of expenditures allocated to cereals. This occurs presumably because of the comparatively slower price increase of cereals between 1993-94 and 1999-2000, relative to non-cereal food item prices during the same period. However, since the consumption of cereals does not suffice for a balanced diet, the least cost expenditure required for achieving nutritional requirements in 1999-2000 consumption basket may be much more (in real terms) than the basket of 1993-94.

Fig 1

Estimates of food poverty line (in Rs) under three scenarios at the all India level in rural and urban areas for 1993-94 and 1999-2000



Source: Authors' Estimates.

State-specific poverty lines and poverty ratios

To derive State-, rural- and urban-specific PLs, FPLs, estimated on the basis of methods discussed earlier are scaled up by using non-food expenditure ratios for the year 1993-94.

Poverty line estimates for the three scenarios outlined above at the all-India level are given in **Table 5**, for 1993-94 and 1999-2000. Each of the FPL and PL in **Table 5** refers to a specific 'cultural' constraint (reflecting the three scenarios).

The three FPLs (FPL1, FPL2 and FPL3) indicate three different levels of cut-off of the minimum expenditure required for a nutritionally balanced food basket for the three different sets of cultural constraints. The three PL (PL1, PL2 and PL3) on the other hand, indicate the corresponding minimum expenditure required to cover both the nutritional minimum, as well as the minimum non-food allowance.

We prefer to use PL3 for subsequent analyses, although PL1 or PL2 may also be used. Using the standardized RDA and the added constraints for scenario III, we estimated State-, rural- and urban-specific FPLs. Then, using State-, rural- and urban-specific non-food expenditure ratios of the marginally poor, we arrived at the corresponding PLs. The PLs and the head-count poverty ratios for 17 major States in rural and urban areas for two years (1993-94 and 1999-2000) are given in **Tables 6 and 7**. These estimates were also used to derive the all India level poverty ratios for rural and urban populations and the overall poverty ratio. Corresponding official estimates for poverty ratios produced by the Planning Commission are given in **Table 8**.

The national level poverty ratios under both approaches produced by aggregating the population living in poverty at the State level (nutrition and the Planning Commission) are further brought together in **Table 9**.

On comparing the two methods (i.e. 'nutritionally balanced' and that of the Planning Commission) we find that the PLs as well as the poverty ratios are much higher under the 'nutritionally balanced' approach than the Planning Commission approach. During 1993-94 and 1999-2000, the all-India poverty ratio declined from 37.3% to 27.1% in the rural population; and from 32.4% to 23.6% in the urban population.[2] The head-count ratio of nutrition-based poverty also shows a decline in 1999-2000, compared to 1993-94. However, the head-count ratio of nutritional poverty was 38.8% in rural populations and 27.5% in urban populations in 1999-2000 as against the official poverty ratios 27.1% and 23.6% among rural and urban populations, respectively in the same period. The ratios of nutritional poverty are higher than those of official poverty both in 1993-94 and 1999-2000.

Apart from the fact that the nutritional poverty is much

Table 5

Food poverty lines, non-food expenditure ratios and poverty lines under different scenarios for rural and urban India, 1993-94 and 1999-2000

	FPL1	FPL2	FPL3	NFE ratio	PL1	PL2	PL3
1993-94							
Rural	73.14	134.85	160.20	0.27	100.19	184.73	219.45
Urban	89.66	155.26	185.17	0.33	133.82	231.73	276.37
1999-2000							
Rural	147.47	223.94	264.09	0.27	202.01	306.77	361.77
Urban	200.44	256.30	316.76	0.33	299.16	382.54	472.78

NOTE: 1, 2 and 3 indicate scenario I, II and III, respectively. Scenario I: Food items consumed must be greater than or equal to zero. Scenario II requires the constraint that not only are food items consumed greater than zero, but also that no ragi, jowar, bajra, millets, and coconut are consumed. Scenario III incorporates, in addition to the constraints under scenarios I and II, that at least 200 g of rice per capita per person is consumed.
FPL: food poverty line; NFE: ratio: non-food expenditure; PL: poverty line.
Source: Authors' Estimates.

Table 6

Food (nutrition-based) poverty line, non-food expenditure ratios and poverty line for 17 major States, and rural and urban areas in India for 1993-94 and 1999-2000

State	Food poverty line				NF expenditure ratio		Poverty line			
	1993-1994		1999-2000		1993-94		1993-1994		1999-2000	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
Andhra Pradesh	156.23	175.57	260.69	302.77	0.28	0.34	216.99	266.01	362.00	458.59
Assam	179.81	193.88	269.85	288.29	0.25	0.22	239.75	248.57	360.37	365.21
Bihar	164.84	172.09	264.40	271.58	0.25	0.28	219.78	239.01	354.38	376.39
Gujarat	159.25	195.31	232.46	258.94	0.26	0.30	215.20	279.02	369.24	461.76
Haryana	164.56	171.85	283.37	309.01	0.31	0.36	238.49	268.51	409.65	482.82
Himachal Pradesh	172.08	178.19	293.06	332.63	0.29	0.35	242.36	274.14	413.48	512.21
Jammu and Kashmir	173.23	202.05	294.76	325.53	0.26	0.23	234.10	262.40	398.53	422.81
Karnataka	141.25	213.25	254.70	342.84	0.31	0.34	204.71	323.10	369.19	520.62
Kerala	178.68	212.21	303.08	358.96	0.29	0.28	251.66	294.74	428.13	499.85
Madhya Pradesh	151.34	205.43	239.42	326.83	0.29	0.35	213.15	316.05	336.68	505.23
Maharashtra	154.98	213.69	246.11	349.88	0.31	0.35	224.61	328.75	356.76	537.91
Orissa	154.10	209.62	264.07	318.74	0.24	0.30	202.76	299.45	348.55	461.93
Punjab	168.25	179.92	294.12	296.31	0.30	0.31	240.36	260.76	423.87	425.33
Rajasthan	158.22	183.40	268.08	328.16	0.32	0.34	232.67	277.88	395.02	497.11
Tamil Nadu	152.14	203.25	275.68	368.20	0.26	0.32	205.59	298.90	372.69	532.82
Uttar Pradesh	160.85	178.60	266.99	302.41	0.29	0.32	226.55	262.65	369.29	444.98
West Bengal	175.14	178.90	283.35	301.30	0.24	0.29	230.45	251.97	372.40	425.21
All India	160.20	185.17	264.09	316.76	0.27	0.33	219.45	276.37	359.45	466.28

Source: Authors' Estimates.

higher in comparison to the official poverty in both rural and urban areas, the decline in the nutritional poverty has been much lower than the official poverty between 1993-94 and 1999-2000. As against a decline of approximately 10 percentage points in official poverty estimates over the period 1993-94 and 1999-2000, the decline in nutritional poverty has been approximately 6% during the same period (Fig. 2).

As in the case of the all-India average, the decline in the nutrition poverty ratios

Table 7

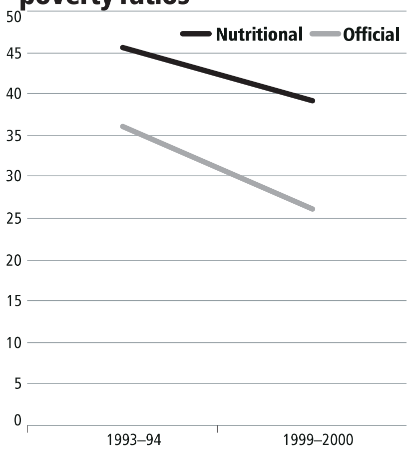
Poverty ratios using the nutrition poverty line in India, 1993-94 and 1999-2000

State	1993-94		1999-2000	
	Rural	Urban	Rural	Urban
Andhra Pradesh	42.24	35.08	38.36	27.61
Assam	49.23	15.26	38.31	9.58
Bihar	60.51	35.08	51.52	34.59
Gujarat	27.61	23.87	22.49	12.71
Haryana	29.63	18.99	14.04	15.75
Himachal Pradesh	33.01	11.49	15.48	7.71
Jammu and Kashmir	18.33	6.72	12.15	3.37
Karnataka	38.59	44.80	32.22	25.75
Kerala	27.89	27.50	16.58	22.62
Madhya Pradesh	49.82	47.81	44.13	44.34
Maharashtra	49.89	35.13	32.44	26.49
Orissa	55.19	41.25	54.97	40.48
Punjab	13.32	12.78	12.95	8.25
Rajasthan	33.34	30.20	23.51	24.38
Tamil Nadu	36.98	40.39	37.29	29.19
Uttar Pradesh	47.53	36.58	40.23	35.11
West Bengal	45.51	23.81	37.00	16.84
All India	45.28	33.83	38.27	27.54

Source: Authors' Estimates.

Fig 2

Relative decline in the nutritional and official poverty ratios



Source: Authors' Estimates.

Table 8

Poverty line and head-count ratio of poverty by the Planning Commission estimates

State	Poverty Line (in Rs)				Poverty ratio (%)			
	1993-94		1999-2000		1993-94		1999-2000	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
Andhra Pradesh	163.02	278.14	262.94	457.4	15.92	38.33	11.05	26.63
Assam	232.05	212.42	365.43	343.99	45.01	7.73	40.04	7.47
Bihar	212.16	238.49	333.07	379.78	58.21	34.5	44.3	32.9
Gujarat	202.11	297.22	318.94	474.41	22.18	27.89	13.17	15.59
Haryana	233.79	258.23	362.81	420.20	28.02	16.38	8.27	9.99
Jammu and Kashmir	233.79	253.61	367.45	420.20	30.34	9.18	3.97	1.98
Karnataka	186.63	302.89	309.59	511.44	29.88	40.14	17.38	25.25
Kerala	243.84	280.54	374.79	477.06	25.76	24.55	9.38	20.27
Madhya Pradesh	193.1	317.16	311.34	481.65	40.64	48.38	37.06	38.44
Maharashtra	194.94	328.56	318.63	539.71	37.93	35.15	23.72	26.81
Orissa	194.03	298.22	323.92	473.12	49.72	41.64	48.01	42.83
Punjab	233.79	253.61	362.68	388.15	11.95	11.35	6.35	5.75
Rajasthan	215.89	280.85	344.03	465.92	26.46	30.49	13.74	19.85
Tamil Nadu	196.53	296.63	307.64	475.6	32.48	39.77	20.55	22.11
Uttar Pradesh	213.01	258.65	336.88	416.29	42.28	35.39	31.22	30.89
West Bengal	220.74	247.53	350.17	409.22	40.8	22.41	31.85	14.86
All India	205.84	281.35	327.56	454.11	37.27	32.36	27.09	23.62

SOURCE: Planning Commission

across most of the major States has been much slower in comparison with the official poverty ratios **(Table 10)**. A comparison of changes in the two poverty ratios across States shows that in 10 of the 16 major States (viz. Andhra Pradesh, Bihar, Gujarat, Haryana, Jammu and Kashmir, Punjab, Rajasthan,

Table 9

Head-count ratios of nutritional and official poverty among rural and urban populations in India, 1993-94 and 1999-00

Region	Nutritional poverty ratio(%)		Official poverty ratio(%)	
	1993-94	1999-2000	1993-94	1999-2000
Rural	45.28	38.77	37.27	27.09
Urban	33.83	27.51	32.36	23.62
Combined	42.27	35.65	35.97	26.10

Source: Authors' Estimates and Planning Commission.

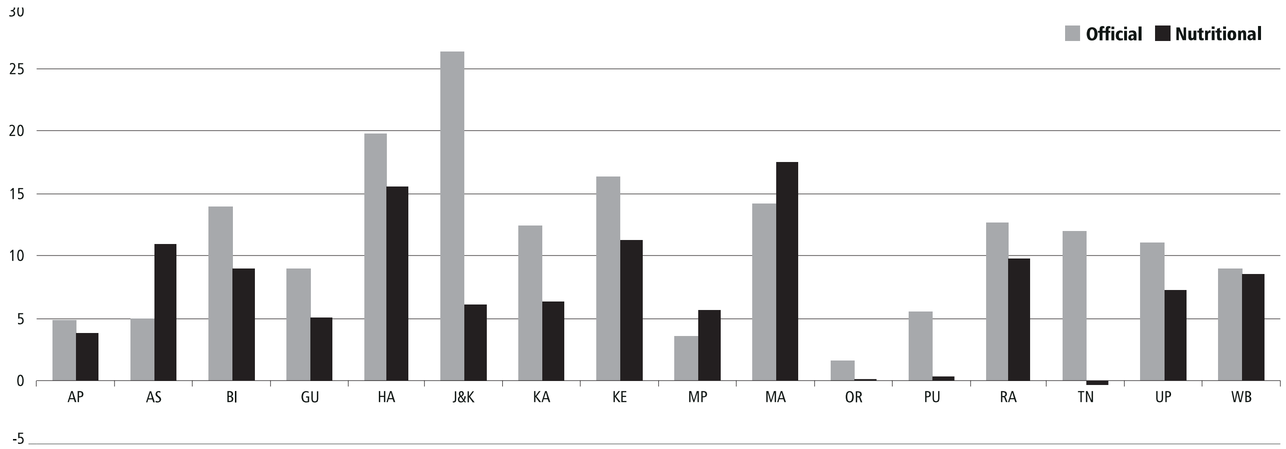
Tamil Nadu, Uttar Pradesh and West Bengal), the nutrition poverty ratios have declined at a slower rate in both rural and urban areas. Further, in 3 states (viz. Karnataka, Kerala and Orissa) rural nutritional poverty has declined at a rate slower than officially estimated rural poverty ratios. In Madhya Pradesh, the nutritional poverty ratio has declined at a faster rate in rural areas but at a slower rate in urban areas. Assam is the only State that shows a faster decline in the nutritional poverty ratio in comparison with the official poverty ratio, both in rural as well as urban areas. A comparison of decline in nutritional and official poverty ratios in rural areas of 16 major States between 1993-94 and 1999-2000 is presented in **Fig. 3**.

The comparison of the two PLs across States also indicates that the difference between the two estimates has been highest in Andhra Pradesh followed by Maharashtra, Madhya Pradesh and Rajasthan, particularly in rural areas. The case of Andhra Pradesh needs special mention. Official estimates of the rural poverty ratio in Andhra Pradesh have been a subject of controversy because the Planning Commission estimates much lower poverty in rural than in urban Andhra Pradesh. However, the nutritional poverty ratio in Andhra Pradesh is not only much higher than the official poverty ratio but also rural Andhra shows higher poverty ratio than the urban Andhra Pradesh. Similarly, in rural Jammu and Kashmir, the official poverty ratio shows a drastic decline between 1993-94 and 1999-2000 from more than 30% in 1993-94 to less than 4% in 1999-2000. The nutritional poverty ratio, on the other hand shows a systematic decline in rural poverty in Jammu and Kashmir from 18% in 1993-94 to 12% in 1999-2000.

2• The official estimates of poverty ratios in 1999-2000 have been a subject of intense discussion on account of their different methodology of recall period. Most of these discussions have centred on the magnitude of and intensity of decline in poverty as reported by the Planning Commission (2001) based on the 55th round of the National Sample Survey (NSS). For a review of this literature see Visaria 2000; Deaton 2001; Deaton and Dreze 2002; Kozel and Parker 2002, Sen and Himanshu 2004; and Sundaram 2003

Fig 3

Decline in nutritional and official poverty ratios (rural) between 1993-94 and 1999-2000 in various States in India



AP: Andhra Pradesh, AS: Assam, BI: Bihar, GU: Gujarat, HA: Haryana, HP: Himachal Pradesh, J&K: Jammu and Kashmir, KA: Karnataka, KE: Kerala, MA: Maharashtra, MP: Madhya Pradesh, OR: Orissa, PU: Punjab, RA: Rajasthan, TN: Tamil Nadu, UP: Uttar Pradesh, WB: West Bengal
Source: Authors' Estimates and Planning Commission.

Table 10

Decline in the poverty ratios between 1993-94 and 1999-2000 in rural and urban areas in the States of India

State	Nutritional		Official	
	Rural	Urban	Rural	Urban
Andhra Pradesh	3.68	7.26	4.87	11.7
Assam	10.91	5.68	4.97	0.26
Bihar	8.79	0.48	13.91	1.6
Gujarat	5.12	11.16	9.01	12.3
Haryana	15.59	3.24	19.75	6.39
Jammu and Kashmir	6.18	3.35	26.37	7.2
Karnataka	6.37	19.05	12.5	14.89
Kerala	11.31	4.88	16.38	4.28
Madhya Pradesh	5.69	3.47	3.58	9.94
Maharashtra	17.45	8.64	14.21	8.34
Orissa	0.22	0.77	1.71	-1.19
Punjab	0.37	4.53	5.6	5.6
Rajasthan	9.83	5.82	12.72	10.64
Tamil Nadu	-0.31	11.2	11.93	17.66
Uttar Pradesh	7.3	1.47	11.06	4.5
West Bengal	8.51	6.97	8.95	7.55

Source: Authors' Estimates and Planning Commission.

A slower decline in the nutritional poverty ratio in comparison to the official poverty ratio suggests at least prima facie, the need for examining carefully the potential role that relative prices might play in influencing the nutritional well-being of people. This is particularly so in India, where the State has long subsidized, on the one hand, cereal production (wheat and rice) through various price support schemes while simultaneously subsidizing prices at which consumers are able to purchase these commodities. Theoretically, this ought to lead to a setting where a much smaller cultivable area is devoted to food commodities that are relatively richer (relative to cereals) in other nutrients that are components of the RDA, with obvious implications for affordability.

Conclusions

The main aim of this paper is to present the case for and to develop an indicator of poverty for India that highlights the need to achieve a balanced diet-in terms of a minimum set of required nutrients. Such an indicator is valuable both to take account of our increasing knowledge about the role of micro-nutrient consumption in influencing health outcomes; as well as to begin the process of examining the question of how the policies of the government on agricultural prices may have affected the health of Indians in general and of the poor, in particular.

Our main findings are the following. First, estimates of PLs that focus on the expenditures needed to achieve a nutritionally balanced diet are readily constructed and typically are higher than the official PL. Thus, poverty ratios based on the nutrition-adjusted PL exceed official estimates of head-count poverty. Second, trends over the period 1993-94 to 1999-2000 suggest that poverty ratios based on the nutrition-adjusted PL declined more slowly than poverty ratios based on the official PL given by the Planning Commission.

Third, there were considerable inter-State and regional (urban versus rural) differences in the poverty ratios in the 1990s. The incidence of nutritionally poor population is highest in Orissa and Bihar, followed by Madhya Pradesh, Uttar Pradesh and Andhra Pradesh. The official estimates show a higher poverty ratio (and also the absolute number of poor) in urban Andhra Pradesh compared to rural Andhra Pradesh. Similarly, the poverty ratio in Jammu and Kashmir is as low as approximately 3% in the official estimates registering a decline of more than 25 percentage points during 1993-94 to 1999-2000. Our estimates of the least cost balanced diet-based poverty ratio show more consistent results in these two States. Kerala shows much lower incidence of nutritional poverty compared to that of Karnataka and Tamil Nadu.

These trends and estimates raise obvious policy issues that need further examination and lie well beyond the scope of this exploratory paper. In particular, the paper strengthens arguments of those who state that increases in incomes alone are not enough to eliminate poverty and malnutrition quickly; that relative prices of essential nutrients may also need policy attention. This, in turn, may require additional attention to government policies with respect to the prices of cereals such as rice and wheat.

Although our paper focuses on using a PL approach to estimate the lack of affordability of nutrients, other authors have taken an alternative route that equates inadequate nutrition with poverty. We have shown that, in the context of a balanced diet of macro- and micronutrients, the two approaches give rise to markedly different results, even if their general direction is the same. We conclude that a lack of purchasing power (and not simply choice) offers much in terms of developing an understanding of the roots of inadequate nutrient intake in India.

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Appendix I

Nutrient composition of food items (Nutrient content per 100 grams of different food items)

Food item	Calories	Protein	Fat	Iron	Calcium	Carotene	Riboflavin	Thiamin	Niacin	Vitamin C
Rice	345	7	1	1	10	9	0.12	0.06	2.5	0
Chira	346	7	1	20	20	0	0.05	0.21	4	0
Muri	325	14	16	35	67	0	0.01	0.21	4.1	0
Other rice products	346	6	1	1	9	2	0.05	0.21	3.8	0
Wheat/atta	290	12	2	5	48	29	0.17	0.49	4.3	0
Maida	348	11	1	3	23	25	0.07	0.12	2.4	0
Suji, rawa	348	10	1	2	16	0.15	0.03	0.12	1.6	0
Sewai, noodles	352	9	0	2	22	0.12	0.05	0.19	1.8	0
Bread (bakery)	244	9	1	2	18	0	0.17	0.49	4.3	0
Other wheat products	245	8	1	1	11	0	0.17	0.49	4.3	0
Arhar (tur)	335	22	2	3	73	132	0.19	0.45	2.9	0
Gram (whole)	372	21	6	5	56	129	0.18	0.48	2.4	1
Gram (split)	360	17	5	5	202	189	0.15	0.3	2.9	3
Moong	348	25	1	4	75	49	0.21	0.47	2.4	0
Masur	323	24	1	9	77	12	0.2	0.51	1.3	0
Urad	347	24	1	4	154	38	0.2	0.42	2	0
Peas	315	20	1	7	75	39	0.19	0.47	3.4	0
Soya bean	432	43	20	10	240	426	0.39	0.73	3.2	0
Kesari	345	28	1	6	90	120	0.17	0.39	0.17	0
Gram products	369	23	5	10	58	113	0	0.2	1.3	0
Besan	372	21	6	5	56	129	0.18	0.48	2.4	1
Other pulse products	336	23	4	6	101	12	0.2	0.51	1.3	0
Milk: liquid (litre)	117	4	7	0	210	48	0.1	0.04	0.1	1
Baby food	67	3	4	0	120	420	1.36	0.31	0.8	2
Milk: condensed/ powder	357	38	0	1	1370	0	1.64	0.45	1	5
Curd	60	3	4	0	149	31	0.16	0.05	0.1	1
Ghee	850	0	100	0	0	600	0	0	0	0
Butter	729	0	81	0	0	960	0	0	0	0
Other milk products	421	15	31	6	650	500	0.41	0.23	0.4	6
Vanaspati, margarine	900	0	100	0	0	750	0	0	0	0
Mustard oil	900	0	100	0	0	162	0.26	0.65	0.4	0
Groundnut oil	900	0	100	0	0	37	0.13	0.9	0	0
Coconut oil	900	0	100	0	0	0	0.01	0.08	3	0
Fish, prawn	219	43.5	5	2.5	500	0	0.1	0	2.1	15
Goat meat/mutton	156	20	8.5	1.5	81	9	0.14	0.18	0	0
Beef/ buffalo meat	86	19	1	0.8	3	18	0.04	0.15	5.8	0
Pork	114	19	4	2	30	0	0.09	0.54	2.8	2
Chicken	109	26	1	0	25	0	0.14	0	0	0
Others (birds, crab, oyster, tortoise, etc.)	130.7	17	5.7	0	542	425	0.4	0.1	0.1	0
Potato	97	1.6	0.1	0.5	10	24	0.01	0.1	1.2	17
Onion	50	1	0	1	47	15	0.01	0.08	0.4	11
Radish	32	1	0	0	50	3	0.02	0.06	0.4	17
Carrot	48	1	0	1	80	6460	0.02	0.04	0.6	3
Turnip	29	1	0	0	30	0	0.04	0.04	0.5	43
Beet	43	2	0	1	18	0	0.09	0.04	0.4	10
Sweet potato	120	1	0	0	46	1810	0.04	0.08	0.7	24
Arum	120	1	0	0	46	6	0.04	0.08	0.7	24
Pumpkin	25	1	0	0	10	1160	0.04	0.06	0.5	2
Gourd	12	0	0	0	20	0	0.01	0.03	0.2	0
Bitter gourd	25	2	0	1	20	126	0.09	0.07	0.5	88

Appendix I

Food item	Calories	Protein	Fat	Iron	Calcium	Carotene	Riboflavin	Thiamin	Niacin	Vitamin C
Cucumber	13	0	0	1	10	0	0	0.03	0.2	7
Parwal/patal	20	2	0	2	30	153	0.06	0.05	0.5	29
Jhinga/torai	17	1	0	0	18	33	0.01	0	0.2	5
Snake gourd	18	1	0	2	26	96	0.06	0.04	0.3	0
Cauliflower	30	3	0	1	33	30	0.1	0.04	1	56
Cabbage	27	2	0	1	39	120	0.09	0.06	0.4	124
Brinjal	24	1	0	0	18	74	0.11	0.04	0.9	12
Lady's finger	35	2	0	0	66	52	0.1	0.07	0.6	13
Spinach/other leafy vegetables	26	2	1	1	73	5580	0.26	0.03	0.5	28
French beans and barbati	26	2	0	1	50	132	0.06	0.08	0.3	24
Tomato	21	1.3	0	1.3	38.7	351	0.06	0.12	0.4	27
Peas	93	7	0	2	20	83	0.01	0.25	0.8	9
Chillies (green)	29	3	1	4	30	1007	0.39	0.19	0.9	111
Capsicum	24	1	0	1	10	427	0.05	0.55	0.1	137
Plantain (green)	64	1	0	6	10	30	0.02	0.05	0.3	24
Jackfruit (green)	51	3	0	2	30	175	0.13	0.03	0.4	7
Other vegetables	25	2	0	1	34	325.3	0.06	0.08	0.46	30.55
Jackfruit	88	2	0	1	20	130	0.13	0.03	0.4	7
Watermelon	16	0	0	8	11	0	0.04	0.02	0.1	1
Pineapple	46	0	0	2	20	18	0.12	0.2	0.1	39
Guava	51	1	0	0	10	0	0.03	0.03	0.4	212
Orange, Mausambi	48	1	0	0	26	1104	0	0	0	30
Mango	74	1	0	1	14	1990	0.09	0.08	0.9	16
Watermelon	17	0	0	1	32	169	0.08	0.11	0.3	26
Pear (Naspati)	52	1	0	1	8	28	0.03	0.06	0.2	0
Berries	49.7	1	0.3	2	46.7	1248	0.13	0.04	0.5	30
Apple	59	0	1	1	10	0	0	0	0	1
Grapes	51.5	1	0	0.5	22.5	3	0.03	0.12	0.2	31
Coconut (Kopra)	662	7	62	8	400	0	0.01	0.08	3	7
Groundnut	567	25	40	3	90	37	0.13	0.9	19.9	0
Dates	317	3	0	7	120	26	0.02	0.01	0.9	3
Cashewnut	596	21	47	6	50	60	0.19	0.63	1.2	0
Walnut	687	16	65	3	100	6	0.4	0.45	1	0
Raisin (kishmish, monacca etc.)	308	2	0	8	87	2.4	0.19	0.07	0.7	1
Other dry fruits	687	16	65	3	100	0	0	0	0	0
Sugar	398	0	0	0	12	0	0	0	0	0
Gur	383	0	0	3	80	0	0	0	0	0
Candy (misri)	398	0	0	0	12	0	0	0	0	0
Honey	319	0	0	1	5	0	0	0	0	0
Turmeric (gm)	349	6	5	68	150	30	0	0.03	2.3	0
Black pepper (gm)	304	12	7	12	460	1080	0.14	0.09	1.4	0
Dry chillies (gm)	246	16	6	2	160	345	0.43	0.93	9.5	50
Garlic (gm)	145	6	0	1	30	0	0.23	0.06	0.4	13
Tamarind (gm)	283	3	0	17	170	60	0.07	0	0.7	3
Ginger (gm)	67	2	1	4	20	40	0.03	0.06	0.6	6
Curry powder (gm)	108	6	1	1	830	7560	0.21	0.08	2.3	4
Other spices (gm)	250	8	7	25	120	304	0.19	0.22	1.2	50

SOURCE: Adapted from Gopalan et al. 1998