S10 Poverty and Inequality

Are Income-Calorie Elasticity's Really High in Developing Countries?: Some Implications for Nutrition and Income*

Abstract

In the last few years there has been an intense debate on the response of nutrition intake to rising incomes. This paper is about this relationship which has some far reaching policy implications for the developing countries on how best to reduce malnutrition. On the one hand some studies show that the Income elasticity of calorie intake was quite low, and not significantly different from zero in statistical terms. Critics on the other hand have concentrated their firepower on the finding that the income elasticity of calorie intake is low and one study based on the Indian National Sample Survey show that the elasticity is in the range of 0.3-0.5 and in any case statistically different from zero. This increase in calorie consumption with increase in income comes largely from the increase in cereals. In this paper, we relook at the evidence for India to study this important relationship using two different sets of data from NCAER surveys. Our estimates of the total expenditure (income) elasticity of cereals are low and the cereal consumption declines with increase in income. This shows that calorie income elasticity cannot be as high as in the literature, given that cereals are the cheapest and the highest source of calories. Following this we conclude that the underconsumption of calories among the poorest households is unlikely to disappear in the normal course of economic development. Increasing incomes may not be effective in reducing malnutrition (in the sense currently defined). It should, however, be recognised that low calorie-income elasticity is not because the overall quality of the diet is unchanged with income, but because calorie-intake is a poor summary statistic for diet quality. A more comprehensive measure of diet quality or nutritional adequacy would have to include both calorie intake and the intake of other nutrients, several of which may be highly income elastic.

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Are Income-Calorie Elasticity's Really High in Developing Countries?: Some Implications for Nutrition and Income

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I. Introduction

In the last few years there has been an intense debate on the relationship between nutrition and income. More specifically on the response of nutrition intake to rising incomes. This paper is about this relationship which has some far reaching policy implications for the developing countries on how best to reduce malnutrition. If the income elasticity is close to zero (Behrman and Deolalikar (1987)), the implication is that improvement in the income of the poor will have little impact on the extent of malnutrition. Then the developmental policies intended to improve nutrition will have to use policy instruments which attack malnutrition directly rather than relying simply on rising income. This debate was apparently triggered by the pioneering study of Behrman and Deolalikar (1987), who showed that, in the (six) ICRISAT villages of South India, the Income elasticity of calorie intake was quite low, and not significantly different from zero in statistical terms. Even among the very poor, as incomes rise households mostly purchase additional taste.

Critics on the other hand have concentrated their firepower on the finding that the income elasticity of calorie intake is low (Strauss and Thomas (1989), Ravallion (1990). Bouis and Haddad (1992), Deaton and Subramanian (1996)). Subramanian and Deaton (1996), for instance, questions the validity of the Behrman and Deolalikar (1987) initial findings, and based on the National Sample Survey data estimate the expenditure elasticity of calorie intake in rural Maharashtra. They find this to be in the range of 0.3-0.5 and in any case statistically different from zero. The debate appears to focus on the size of the calorie-income elasticity, especially at low incomes. See table 1 for a summary of various estimates from the literature.

The view that calorie-income elasticity is low is itself challenged by growing evidence that the size of the estimate is a function of the method of data collection. Low estimates are typically based on samples drawn from surveys designed to monitor nutrition. Higher calorie-income elasticity typically come from household expenditure surveys which are designed to elicit information on household consumption including food, along with other economic and social information. Not all surveys distinguish between the consumption of household members and that of visitors or hired help. Here two methodological issues, as pointed out in the debate are relevant. First, income and expenditure may be measured with random error. Second, it is possible that the error in measurement is correlated with the set of potential instruments. In general, data from household expenditure surveys are particularly susceptible to these problems.

However, some studies use instrumental variable techniques (e.g. Strauss and Thomas (1989), Bouis and Hadded (1992), Subramanian and Deaton (1996)) to get away from these errors.
Using instrumental variables, Subramanian and Deaton (1996) show the calorie-expenditure to lie in the range of 0.3-0.5, a range close to the conventional wisdom. And hence does not support the notion that nutrition will not increase with higher standards of living. The increase in calorie consumption with increase in income comes largely from the increase in cereals. We would therefore expect cereal consumption to grow over time. However, the empirical evidence is quite contrary to this popular claim. The official journal of the National Sample Survey Organisation (NSSO) - Sarvekshana states that:
"It was observed that per capita cereal consumption has registered an overall decline of about 1kg per month in rural India and about 600 gm per month in urban India between the 43rd and 50th rounds of NSS (GOI, 1996)".

"The findings of different NSS rounds from the 43rd (1987-88) to the 51st (1994-95) on quantity and value of all-India per capita consumption of important cereals _ _ _. It is observed that per capita cereal consumption in rural India is declining gradually, the decline being mainly spread over wheat and jowar (GOI, 1998)".

However, the NSSO's own estimates of cereal consumption in rural areas suggest that it has fallen over time. Thus, the estimates of Subramanian and Deaton, which are also based on the same data source, but confined to one state - rural Maharashtra, are seriously misleading.

The high elasticity estimate by Subramanian and Deaton (1996) is a result of applying the conversion factors to the broad groups as previously stated in the literature by Behrman and Deolalikar (1987). The total calories calculated by applying the conversion factor is higher for the top 10% than the bottom 10%. This is something, which is against the perceived evidence from the same data source.

In this paper, we relook at the evidence from India, so as Behrman and Deolalikar (1987), Subramanian and Deaton (1996) and Ullah and Roy (1998) to study this important relationship using two different sets of data. We use two data sets from the National Council of Applied Economic Research (NCAER) household surveys - HDI (1993-94) and MIMAP (1994-95) for reasons stated in the next section. Our focus is only on the rural samples but spread over all the 16 states in India, unlike that of Behrman and Deolalikar (1987) and Subramanian and Deaton (1993), which is confined to rural Maharashtra.[1] We have 2712 rural households and are subject to similar criticism as Subramanian and Deaton (1993) of ignoring individual heterogeneity.

Our estimates of the total expenditure (income) elasticity of cereals are low (see table 1) and the cereal consumption declines with increase in income unlike that

[1] For Behrman and Deolalikar one of the three villages is from Maharashtra.

of Subramanian and Deaton (1996). This is not because the overall quality of the diet is unchanged with income but because calorie intake is a poor summary statistic for diet quality. A more comprehensive measure of diet quality or nutritional adequacy would have to include both calorie intake and the intake of other micro nutrients.[2] We expect some of these micro nutrients to be potentially income elastic, which clearly deserves further attention.[3]

The rest of the paper is structured as follows: section II questions the high elasticity of calorie-income relationship using examples from India. Further section III presents the definitions and data sources. Section IV presents the parametric evidence from HDI and MIMAP survey on the expenditure/income and cereal consumption relationship. We then present the nonparametric estimates of this important relationship in section V followed by policy implication and conclusion in the last section.

Table 1: Some elasticity estimates from the literature

Authors	Income elasticity of food expenditure	Income elasticity of micro nutrients	Income elasticity of calorie intake	Income elasticity of cereal intake
Conventional			Large	Large
Behrman and Deolalkar (1987)			Low	
Ravallion (1990)[a]			Low	
Strauss and Thomas (1990)			Low	
Bouis and Haddad (1992)			Low	
Bouis (1994)			Low	
Subramanian and Deaton (1996)			Large	Large[b]
Ullah and Roy (1998)			Low	
Own estimate	Large	Positive, Large	Positive, Low	Low

[a] Ravallion (1990) find low calorie elasiticities at the mean points but argues that it is in general plausible that the elasticities are large for the poor.
[b] This is implied in their paper though they do not estimate the expenditure elasticities of cereal consumption.

[2] Taken together, micronutrient deficiencies (of iron, Vitamin A, and iodine) affect a far greater number of people in the world than protein-energy malnutrition (quoted in Graham and Welch (1996)).

[3] In a later paper Behrman (1995) mention that as income increases, people purchase more expensive foods that are richer in micronutrients than the basic staples that are the primary source of calories. Though the empirical evidence is not conclusive and the evidence in either way is also infected with the estimation problem, choice of income indicator, etc. as in the calorie-income relationship debate.

II. Can the Calorie-Income Elasticity be High?: Some Stylised Facts From India

It was conventionally believed that as income rises households switch to higher valued foods not necessarily with higher calorie content. However, this effect is likely to operate more strongly at higher income levels, so that at low incomes we expect calorie consumption to respond positively to income. This view has been challenged suggesting that even among the very poor, as incomes rise households mostly purchase additional taste (Behrman and Deolalikar (1987), Behrman et. al. (1988)). Consequently, the calorie-income curve is very flat. In fact, Behrman and Deolalikar (1987) find they cannot reject the hypothesis that there is no relationship between calorie intake (or the intake of all but one other nutrient) and household expenditure in their sample from rural India. They conclude that optimism about the nutrient improvements to be expected with income gains in communities such as the ones under examination seeks fundamentally misleading. However, subsequent work, which has mainly concentrated on the relationship between calories and income, does not corroborate their finding.

The relationship between calories and income (or expenditure) is found to be significant (Strauss and Thomas (1909), Ravallion (1990), Bouis and Haddad (1992), Subramanian and Deaton (1996)). Instead the debate appears to focus on the size of the calorie-income elasticity, especially at low incomes. One view, which has come to be termed as revisionist is that calorie-income elasticity's are low or moderate, typically below 0.15. The conclusions drawn are similar to Behrman and Deolalikar, that income growth cannot be expected to result in substantial improvements in nutrition. Since average incomes and intake levels vary considerably even among developing countries this view deserves clarification. Clearly, the size of the calorie-income elasticities both at the mean and at low incomes will depend on average income and intake levels in the chosen sample. In countries or samples where there is clinical or other evidence of under-nutrition, it would come as a surprise if calorie-income elasticity were below 0.15 at low levels of income. Elasticity below 0.15 may, however, not be especially low for the population average. In fact, Strauss and Thomas (1990) find their estimate of the calorie-expenditure elasticity, which takes a value of 0.11 (0.006) at the median of their sample from urban Brazil, varies from 0.26 (0.02) to 0.02(0.01) between the lowest and highest deciles of per capita expenditure. Another obvious complication in evaluating estimates is the lack of information in most samples about levels of physical activity performed by households. If physical activity falls with income, low elasticity may simply reflect falling requirements.

The view that calorie-income elasticity is low is itself challenged by growing evidence that the size of the estimate is a function of the method of data collection. Low estimates are typically based on samples drawn from surveys designed to monitor nutrition. Enumerators observe the actual consumption of a household on the survey day, often weighing raw or prepared foods. If household members eat some meals outside the house, they are asked to provide an estimate of food consumed elsewhere. Alternatively, and less intrusively, enumerators may ask respondents to recall the previous day's meals including quantities consumed, recipe and preparation technique. Information on household income is obtained independently of the nutrition monitoring survey. Higher calorie-income elasticity typically come from household expenditure surveys which are designed to elicit information on household consumption including food, along with other economic and social information. If information on food is based on recall of the previous day's or three day's consumption the household is typically visited more than once, and an average taken. Some surveys use longer recall periods, but for food consumption this rarely extends beyond a month. The household's representative may sometimes be encouraged to maintain a record of food consumed to aid recall. Not all surveys distinguish between the consumption of household members and that of visitors or hired help, but there are a fair many that do. The same holds for meals consumed by household members outside the house. Although survey data may contain information on the number of meals eaten elsewhere, it rarely, if at all, records the contents of these meals.

Two methodological points made elsewhere (Bouis and Hadded (1992)) bear repeating. First, income may be measured with random error. In a linear model, this will lead to a downward bias in the OLS estimates of the coefficient on income, or the calorie-income elasticity. In principle, the estimate can be purged of bias provided a set of instruments can be found which is uncorrelated with the measurement error. An additional problem arises when both calorie intake and total expenditure are constructed from the same information on household food consumption as when calorie-expenditure elasticity are estimated from households expenditure survey data. Errors in the measurement of food consumption are passed on to both food and hence total expenditure, and calorie intake. The common measurement error will, in a linear model with no errors in non-food expenditure, lead to upward bias in the estimate of the expenditure coefficient. Again, provided the error in the measurement of food consumption is purely random. The resulting bias can be purged through the use of instruments.

Second, it is possible that the error in measurement is correlated with the set of potential instruments. Examples of this are errors arising from meals provided to servants of hired help, or gifts of food. Since richer households tend to have more hired help and give away more food, the failure to take account of this error will lead to systematic overstatement of nutrient intake in high-income households. This is to the extent that meals provided to hired field workers are not a part of household consumption, the systematic overestimation of their expenditure. Income, too, may be systematically overstated if meals to field employees are not subtracted from gross income. The formal structure of this problem is very similar to the case of random measurement error, and it's analysis fairly straightforward (Bouis and Haddad (1992)). The relevant point is that the ordinary least squares estimates of the income coefficient will not only be biased and inconsistent, it is extremely difficult (if not impossible) to obtain consistent estimates using instruments since variables which are correlated with income are unlikely to be uncorrelated with the error in measurement.

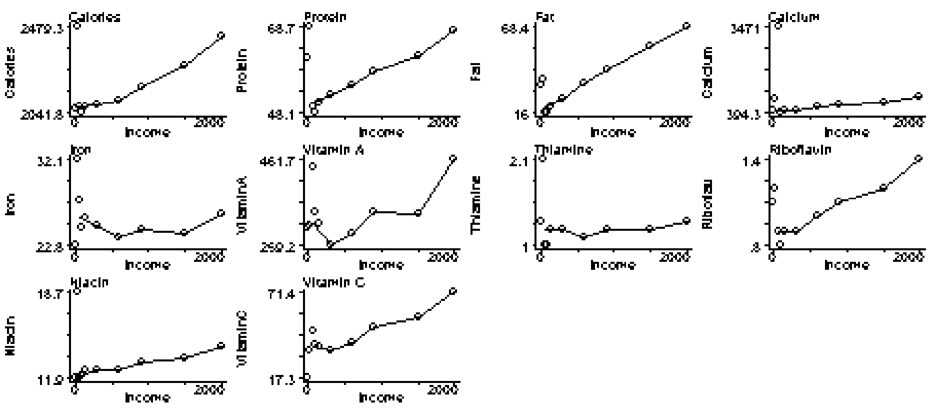
In general, data from household expenditure surveys are particularly susceptible to the problem described in the preceding paragraph because households are often asked to report food purchased by the household, including both actual purchases and imputed purchases from self-production, rather than food consumed by household members. The former would exclude from household consumption gifts received and meals eaten elsewhere, and include in its consumption gifts given and meals provided. However, there is sufficient evidence from surveys that make the distinction between the consumption of members and non-members, or where it can be inferred (e.g. Strauss and Thomas (1989), Bouis and Haddad (`1992), Subramanian and Deaton (1993)), to ask the question: why do nutrition monitoring surveys yield lower estimates of calorie-income elasticities than household expenditure surveys? It should be emphasised that all three cited studies use instrumental variable technique so their results cannot be attributed to the bias arising from common random measurement error. In fact, Bouis and Hadded (1992) estimates calorie-income elasticities using data obtained from the same households using the two survey methods, and find the estimates based on the nutrition monitoring survey to be substantially lower.

Two interpretations have been offered for the difference in estimates. Bouis et. al. (1991) and Bouis and Hadded (1992) attribute the difference to meals to guests and workers and other 'leakage's' from food consumption such as plate wastage which go unrecorded in household expenditure surveys. Since we have discussed this argument earlier, we will confine ourselves to brief remark. While it is certainly the case that many expenditure surveys do not distinguish sufficiently between household purchases and household consumption, the argument holds less force in the context of studies (such as Bouis and Haddad's own) which are based on surveys that do. Nor does it seem plausible that plate wastage is of sufficient magnitude to account for the scale difference between estimates based on the two methods.

Another interpretation is that 24-hour recall data leads to an overestimation of nutrient intake at low incomes, and hence compresses the calorie-income elasticity, because it allows the poor to overstate their true consumption, or "talk a good diet" (Lipton (1983)). While a certain degree of overestimation of the consumption of the poor is unavoidable, it is not clear to what extent this may explain differences between estimates. This is for two reasons. First, overstatement of consumption at low levels of income is not confined to nutrition monitoring surveys conducted by 24-hour recall. It may also affect data from household expenditure surveys, though perhaps not to the same degree. Second, not all nutrition-monitoring surveys rely on 24-hour recall to obtain information on food intake. In some surveys food consumption is determined by measuring raw or prepared foods intended for consumption. Differences with household expenditure survey data persist even though this method is open to less bias than 24-hour recall.

One such survey is conducted in India by the National Nutrition Monitoring Bureau (NNMB) to collect state level information on diet and nutrition situation on an annual basis. The data is collected for the representative population groups on ten Indian states surveying approximately 500 rural households every year. In eighty per cent of the households, food consumption levels are assessed by the 'weighment' method in which the enumerator weighs all the raw foods used in cooking for the day. In the remaining twenty per cent of households, the survey is conducted through 24-hour recall of food consumption. The nutrients content of various foods are converted to per capita equivalents on the basis of the number of people present at meals including non-household members. Households are also questioned about the content of meals consumed outside (Krishnaswamy, Vijayaghavan, sastry, Rao, Brahman, Radhiah, Kashinath and Rao (1997)).

Figure 1: Average Intake of Nutrients (CU/day) By Per capita Income



Source: National Nutrition Monitoring Bureau (1999)

In f igure 1 we present the nonparametric plots of income-nutrition relationship (group averages) for different income groups from the survey. The first plot in figure 1 presents the calorie-income relationship which shows an increase in calorie consumption over the income distribution but is not as fast as that suggested by Subramanian and Deaton (1996). The difference between the average calorie intake between any income class is observed to be at the most 20 per cent, including the difference between the highest and the lowest income classes. Admittedly, the estimates of household income made by the NNMB are rather simple (NNMB, various issues), which would result in a downward bias to the calorie-income elasticity, or an understatement of the difference in calorie consumption between extreme income classes. However, the NNMB-NSSO Linked Survey (1983-84), in which households from four states of the NSS central sample of the 38th round were subsequently assessed for diet and nutritional status by the NNMB. The results from this survey is also of the order of 25 per cent of the calorie intake gaps between the extreme expenditure classes, except for the state of Orissa where the difference is around 52 per cent.

It is instructive to compare this finding with that of Subramanian and Deaton (1993) whose data are from the same round but relate to a different state. In their sample the calorie-intake of the top ten percent of households is over 100 per cent more than the bottom 10 per cent. Admittedly, such a comparison may overstate the 'true' difference between the rich and poor because of common measurement error in calorie intake and household expenditure. However, Subramanian and Deaton using instrumental variables estimate the 'true' calorie-expenditure elasticity to lie in the range of 0.3-0.5. Given this range of the household expenditure and the non-parametric evidence that the calorie-expenditure elasticity is practically constant, implies a difference in calorie intake of 60-100 per cent which is substantially greater than what is found in the NNMB-NSSO samples.

There are substantive differences in calorie intakes as measured by the two survey methods, which cannot easily be ascribed to unmeasured meals to guests and workers or respondent bias. These differences underlie the differences in estimated calorie-income elasticity. More significantly, however, they go to the heart of our understanding of nutrition and its variation with economic status.

Table 2: Consumption of Cereals in Calories between Groups of per capita Household Expenditure

Calories	Bottom 10 %	Top 10%	Increase Between Deciles	Percent Increase
From Cereals (unadjusted)	1071	1938	867	43*
From Cereals (adjusted)	1105	1815	710	41*
Total Calories (unadjusted)	1385	3382	1997	144
Total Calories (adjusted)	1429	3167	1738	122

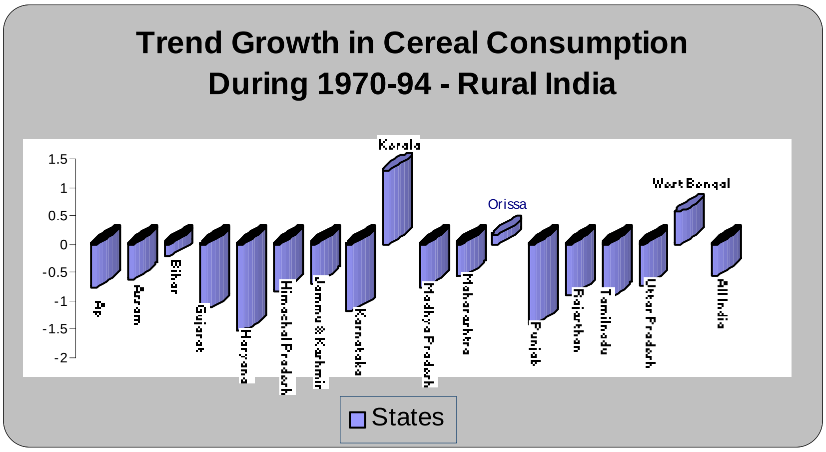
Note: * Percentage increases in calories from cereals to total calories.
Source: Subramanian & Deaton (1996)

If the calorie-expenditure elasticity is indeed as high as Subramanian and Deaton suggest, then the calorie consumption of the poor is substantially lower than that of the rich. This conforms to the conventional view that poverty is characterised by a low absolute intake of calories. Concomitant with this view is the idea that increases in calorie consumption are largely achieved through the increased consumption of cereals. This is borne out by Subramanian and Deaton's sample, where the cereal consumption of households in the highest decile and over 40 per cent of the increase in calorie consumption between the deciles comes from increased cereal consumption (see Table 2).

The cereal elasticity implied by the two views (Subramanian and Deaton (1996) and NNMB) are, however, quite different. According to the first, the expenditure elasticity of cereal consumption is quite high. We would, therefore, expect cereal consumption to grow over time with income. But what does the empirical evidence show. Table 3 gives the per capita per month consumption of cereals over time for the NSSO years from 1970-71 to 1993-94 in rural India.

Table 3: Per capita per month Consumption of Cereals (Kgs) in Rural India

Year	**Rural**
1970-71	15.35
1972-73	15.26
1973-74	15.09
1977-78	15.25
1983	14.80
1986-87	14.20
1987-88	14.47
1989-90	14.00
1990-91	14.06
1991-92	13.50
1993-94	13.40



Source: Chelliah and Sudarshan (1999) using NSSO Data.

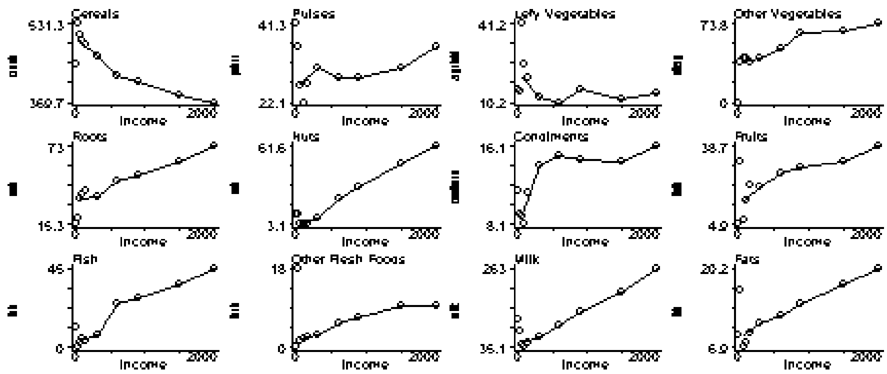
Quit Contrary to the expectations of Subramanian and Deaton (1996), the consumption has declined over the period**.** Between 1970-71 and 1993-94, the per capita cereal consumption declined by 0.55 percent per annum in the rural areas. The average all-India rural per capita consumption fell from 15.25 kg per capita per month in 1977-78 to 13.40 kg in 1993-94. What is much more interesting is the decline over the cross section at the level of state including Maharasthra - Subramanian and Deaton' s state of study, with the exception of Orissa, Kerala and West Bengal (See Figure 3). The decline is very prominent in the prosperous states of Punjab and Haryana with diversification in favour of non-cereal food particularly milk, meat, eggs, fish, etc.[4] While poor states such as Orissa have positive but low consumption. Further evidence on the per capita cereal intake over the NSSO periods from 1972-73 to 1993-94 shows a declining trend (0.8 per cent) while per capita total expenditure in real terms increased by

[4] See Chelliah and Sudershan (1999).

1.2 per cent per annum for rural areas (see table 4). Even among expenditure groups the per capita consumption of cereals shown by the compound annual growth rates declined while their total expenditure increased in each of the groups.

The pooled data for all the ten states from the NNMB repeat survey - rural (1996-97) also indicate that the intake of cereals and millets declined from 505 g in 1975-79 to 450 g/CU/day in 1996-97 with the reduction of cereal intake among better socio-economic states, as also observed from the NSSO. An improvement in the intakes of protective foods also occurs simultaneously. Concomitant with this is the increase in per capita income of Rs. 33 per cent per month over the two decades.

Figure 2: Average Intake of Foodstuffs (g/CU/day) By Per capita Income



Source: National Nutrition Monitoring Bureau (1999)

The alternative, suggested by the nutrition monitoring surveys of the NNMB, is that the difference in calorie consumption between the rich and the poor is not substantial. This should not be taken to imply that the difference in consumption relative to requirements is insubstantial, simply that in absolute terms, the difference in calorie intake is small. Further, it appears that increases in calorie consumption with income are not associated with an increase in cereal consumption except at very low income levels. After an initial rise, cereal consumption levels off or falls with income. The most marked feature of the rise in income is the diversification of the diet, with increased consumption of pulses, vegetables, fruit, milk and diary products, fish and flesh foods, sugar and fats (see Figure 2 and also various issues of NNMB). This suggests that calorie intake on its own is a poor proxy for changes in dietary quality with income, and the focus on calories to the exclusion of both requirements, or other nutrients, yields a limited picture of changes in nutrition with income.

It would be tempting to reconcile the two views by treating the first as descriptive of changes in calorie intake at low levels of income and the second as representative of moderate or high income levels. However, the NSSO collects large, random samples, which are fairly representative of the distribution of expenditure. There is no evidence from rural samples of a fall in the calorie-expenditure or cereal-expenditure elasticity at high expenditures. Although the sample of the NNMB are not as large as that of the NSSO, nor is their sampling technique as sophisticated, when the NNMB adopted the sampling structure of the NSSO (the NNMB-NSSO Linked Survey), their findings were unaltered. It would, therefore, be difficult to reconcile the two views with reference to the distribution of income.

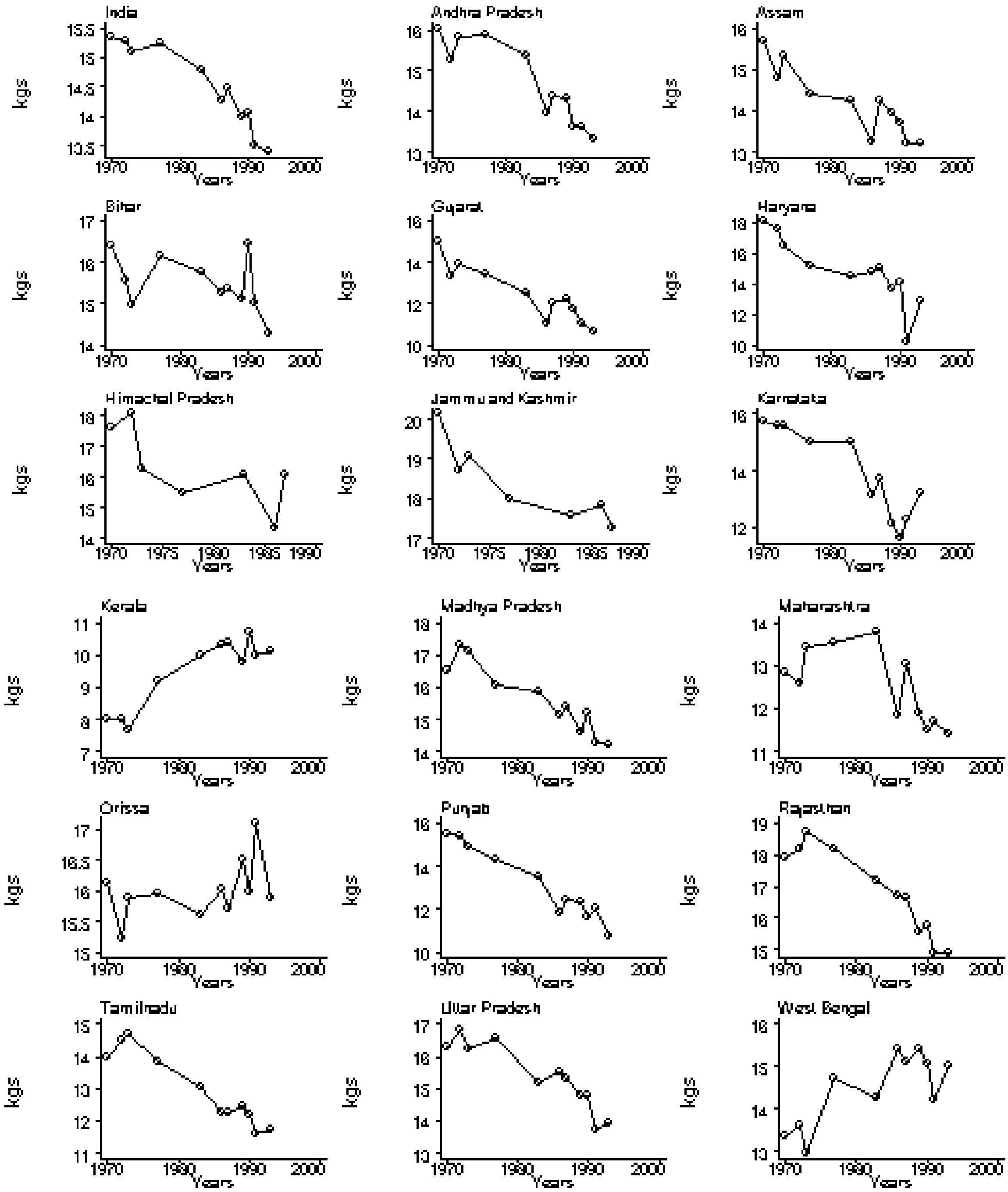
Table 4: Compound Annual Growth Rates Computed From NSSO data

	Lowest 30%	Middle 40%	Top 30%	All
Cereals (Kg/month)				
1972-78	0.6	0	-0.7	-0.1
1977-83	-0.3	-1	-1.1	-0.9
1983-88	0.4	-0.4	-1.5	-0.6
1988-94	-0.8	-1.3	-2	-1.4
1972-94	-0.1	-0.7	-1.4	-0.8
Total Expenditure (per month)				
1972-78	1.7	0.9	3.5	2.4
1977-83	2	2.6	0	1.1
1983-88	1.4	-0.1	0	0.2
1988-94	1.1	1.1	0.7	0.9
1972-94	1.5	1.2	1	1.2

Notes: Class specific price deflators have been used for estimating real expenditure.
Source: Rao and Radhakrishna (1997)

Hence all the evidences both cross section and time series from NNMB and also NSSO themselves show results which does not collate the findings of Subramanian and Deaton (1997) that consumption elasticity of cereals can be large. In the rest of this paper we present results from another all India sample survey which are in tune with the above mentioned stylised representation from India.

Fig 3: Per Capita Per Month Consumption of Cereals (Kgs) in Rural India



Source: Chelliah and Sudarshan (1999)

III. Definition and Data Sources

The data used in this paper comes from two all-India surveys, both collected by the National Council of Applied Economic Research (NCAER). The first survey, widely known as the HDI survey, was conducted during 1994 with 33,000 rural households' spread over 1765 villages and 195 districts in 16 states.[5] The second survey which is a sub-sample of the HDI survey (only for the rural sample), know as the MIMAP survey, was undertaken for 3364 rural and 1492 urban households. The details of the survey are provided in Pradhan and Subramanian (1999) and MIMAP report (1998).

Both HDI and MIMAP surveys collected consumption and income data from the sample households. We have the advantage of using both income and consumption from the same survey. Hence, we combined both the surveys taking household income and expenditure from the MIMAP survey and only the quantity (in Kgs) of cereals and its components consumed from the HDI survey. The compulsion of combining the two data sets were determined by the unavailability of the consumption data of cereals (only in quantity) from the MIMAP survey. Hence, we take this data from the HDI for the same sample households.[6] For rest of the data we depend on the MIMAP for various reasons. In HDI, the net agricultural income for rural households were computed by estimating the gross cultivated area under various crops and by applying the various village level norms of output per hectare at the prevailing harvest prices and deducting the input cost norms per hectare at the village level. Thus the variations in the output and input at the household level were not captured. Hence we do not take the income data from HDI.

As for the income data, it is widely known that in any income-expenditure survey, there would be an inherent understatement of income. Generally people tend to suppress their income, particularly when questions relating to its disposition are not asked. To counter this hindrance for proper estimation of income, a cash flow statement at the household level was prepared in the MIMAP survey to check whether cash inflows during the year compare with cash outflows. Similarly, details of all sources of funds and their uses were also prepared at the household level to check inconsistencies, if any, in the data. It was decided to allow 8 per cent differences between the sources and uses of funds due to the fact of memory lapses of the respondent. The questionnaire was resurveyed for households with differences exceeding this limit. Despite the second visit to the households, some of the respondents were unable to express the details of the sources of funds and their uses, especially where the respondents were illiterate or at the highest level of income. Such questionnaires were excluded.[7]

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[5] The details of the design and implementation of the survey are provided in Shariff (1999).
[6] But the consumption of cereals in values are reported in MIMAP and there was no way the value could be converted to quantity.
[7] For details see MIMAP report (1998).

Similarly the respondents were asked to recall how much they had consumed of each of the 70 items over the last 30 days and to report expenditures in rupees and quantities, were appropriate. The questionnaire does not record separate information on the quantity of meals given or taken in the form of wage or rent but excludes the expenditure on ceremonies conducted in the house and also other irregular expenses including gifts given on special occasions. The consumption of food articles recorded from the HDI survey for one month includes only 18 items, not exhaustive. The consumption expenditure from the HDI survey hardly includes non-food items. Hence we take total consumption expenditure from the MIMAP survey which is fairly detailed.

In this paper we limit ourselves to households in the rural areas for two reasons. One, the main focus of the ongoing debate is on the nutritional issues among rural samples, which also makes comparisons easier. Second, the HDI data is available only for the rural samples.

The total rural households combined from both the surveys were 2712 with 652 households excluded due to mismatch. The mismatch was basically due to two reasons: (a) differences in household codes and (b) differences in the household size between the surveys. The second component was larger. Hence we excluded those households for which the changes in the household size between the survey years was greater (lesser) than 2. This in no way was arbitrary, as the guiding principle was to arrive at a correlation as high as .9 between the years for household size. Previously with the full sample, the correlation was .6 but after the exclusion the correlation improved to more than .9.

Table 3 presents the means, standard deviations and coefficient of variation from both the surveys for the expenditure on food, income and expenditure.

Table 4: Mean, Standard Deviation and Coefficient of Variation for various Expenditures and also total Income from both HDI and MIMAP surveys

Per capita Consumption of Food	HDI Survey			MIMAP Survey		
	Mean	Standard Deviation	Coefficient of Variation	Mean	Standard Deviation	Coefficient of Variation
Cereals (value)	73.04	34.19	.47	72.59	35.21	.48
Cereals (quantity)	13.50	5.37	.40	-	-	-
Rice (value)	43.07	38.98	.90	-	-	-
Rice (quantity)	6.46	5.57	.86	-	-	-
Wheat (value)	20.94	24.15	1.15	-	-	-
Wheat (quantity)	4.72	5.37	1.14	-	-	-
Other Cereals (value)	9.03	15.59	1.73	-	-	-
Other Cereals (quantity)	2.32	4.07	1.75	-	-	-
Total Expenditure	-	-	-	326.95	182.00	.56
Total Income	371.22	464.32	1.25	453.81	404.67	.89

Notes: Values are in Rs. and quantities are in Kg.

It would have been better if information on further disaggregation of other cereals, consumption of different varieties of rice, wheat were available. Since the survey does not provide information on such disaggregation the analysis here is constrained by the data limitations. This table presents ready comparison of some of the summary statistics from both HDI and MIMAP data. The mean consumption of cereals from both the surveys are closer to each other while mean total income is higher in the MIMAP survey. The coefficient of variation from the HDI survey shows substantial fluctuations in total income across households compared to MIMAP survey. While there is not much variation for cereal consumption in value terms between the surveys.

IV. Expenditure/Income and Cereal Consumption: The Survey Evidence

In this section we estimate the elasticity's of cereal consumption to total expenditure/income. But first we look at the consumption of cereals between the bottom 10 per cent and the top 10 per cent. For the rural poor cereal consumption accounts for 31.6 per cent of their budget share on food while a substantial portion (28.5 per cent) is also spent on 'other food' such as milk. meat, fruits, etc. So a substantial portion of the poor's income is also spent on acquiring food with not only high calorie content but also on other nutrients.

Does the evidence from this survey corroborate the results presented in Subramanian and Deaton or the NSSO and NNMB? The results presented in Table 5 shows how the poorest and the richest 10 per cent consume cereals by both expenditure and income classification. The results presented here are in contrast to the evidence provided by Subramanian and Deaton (1996). In Subramanian and Deaton (1996) cereals provide cheap calories and so they bulk much larger in the calorie share - 71 per cent and the increase between the lowest and the highest 10 per cent is close to 100 per cent for the unadjusted and 122 per cent for the adjusted. However the survey results show that consumption of cereals declined between the lowest 10 per cent and the highest 10 per cent. This is, however, in tune with the secondary information from the NSSO data presented previously. The time-profile of cereal consumption is more consistent with the fairly low elasticity's implied by the NNMB cross-sections.

Table 5: Consumption of Cereals in Quantity (Kgs.) by Expenditure and Income Class

		By Expenditure Class	
	Mean	Bottom 10%	Top 10%
Rice	6.46	6.12	6.43
Wheat	4.72	4.99	5.39
Other Cereals	2.32	3.02	1.72
Total Cereals	13.50	14.13	13.54
		By Income Class	
	Mean	Bottom 10%	Top 10%
Rice	6.46	6.62	5.86
Wheat	4.72	4.20	5.72
Other Cereals	2.32	2.96	1.53
Total Cereals	13.50	13.78	13.12

By both criterions, expenditure and income classification of households, the consumption of cereals in Kgs between the classes declined by 4 per cent and 4.8 per cent, respectively. Looking at the components of cereals we see that by expenditure classification the consumption of rice and wheat increased by 5 and 8 per cent, respectively. And by income classification, the increase in consumption is only for wheat while both rice and "other cereals" declined between the classes. The highest decline between the classes is in "other cereals" by 43 per cent for expenditure classification. For the income classification, it is 48.3 per cent. However, the point to note from this table is that the consumption of cereals declined between the groups irrespective of whether the households are classified according to their level of income or expenditure.

We next present both the variants of elasticity's - income and expenditure for cereal consumption using OLS and also instrumental variables. We also present the elasticity's for cereal components in Table 6. The elasticity's using OLS gives a negative elasticity of 0.08 at the mean for cereals. The elasticity's for its components are also negative but are higher in absolute terms both for expenditure and income except for wheat. The Income elasticity of wheat consumption is considerably low in absolute terms and is not significant even at 5 per cent level. For rest of the variables the elasticity's are highly significant. In the same table we also present the elasticity's using instrumental variables. The results from this method show no considerable difference rather the elasticity's are much lower than what is suggested by Subramanian and Deaton (1996). In order to refine these estimates we present the elasticity's using nonparametric methods in the next section.

Table 6: Income and Expenditure Elasticity for Cereal and Cereal Components based on both OLS and Instrumental Variables Methods

	Ordinary Least Squares				**Instrumental Variables**	
	Coefficient	t statistics	R^2	F-Ratio	Coefficient	t Statistics
Expenditure						
Cereals	-0.08	-5.2	0.02	40.00	-0.13	-2.7
Rice	-0.24	-4.9	0.02	30.86	-0.25	-1.9
Wheat	-0.22	-4.4	0.01	9.98	-0.10	-1.6
Other Cereals	-0.45	-7.3	0.05	37.39	-0.31	-1.9
Income						
Cereals	-0.05	-4.2	0.03	49.84	-0.12	-5.0
Rice	-0.29	-7.4	0.03	46.61	-0.29	-1.9
Wheat	-0.001	-0.04	0.00	0.02	-0.01	-0.1
Other Cereals	-0.37	-7.36	0.06	37.85	-0.27	-2.0

Notes: (a) The only independent variables in these regressions are household size and total income/expenditure. But various experiments were done using other independent variables such as land size holdings, level of education and primary occupation of the head of the households. With the inclusion of these variables in the equation, the size and sign of both income and expenditure elasticity's did not change much. For reasons of brevity we do not report the coefficients with the above mentioned experiments.
(b) The instruments used are household size, total expenditure, total income from HDI data, farm size of both irrigated and unirrigated land owned, level of education and also primary occupation of the head of the household, etc..

V. Some Nonparametric Estimates of the Expenditure Elasticities

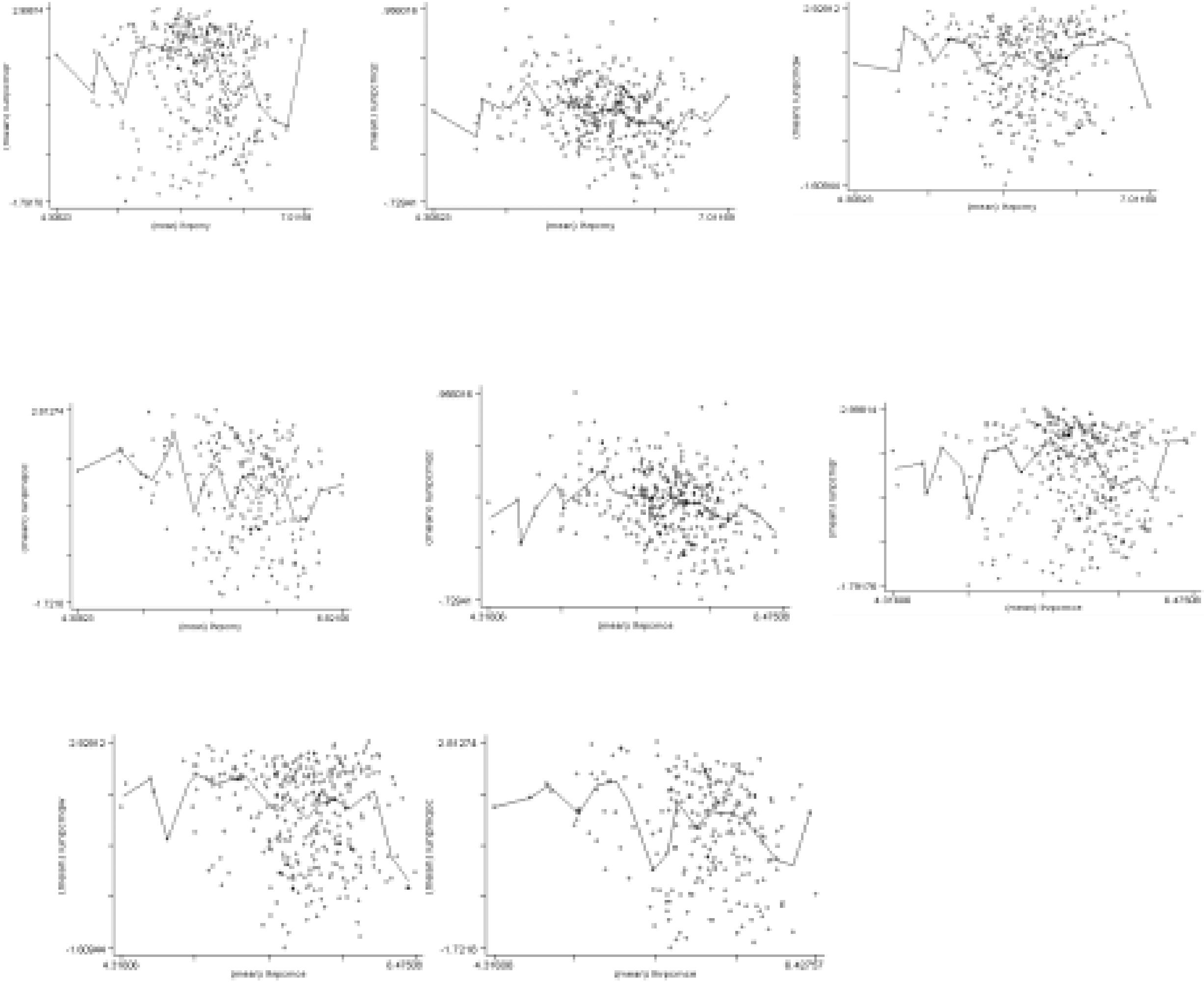
In this section we look at the relationship between cereal consumption and income/expenditure. The elasticity estimates presented in the previous section does not differentiate between the rich and poor or rather does not allow for the possibility of differential elasticity's across income groups, more generally between the highest and the lowest income deciles. This being the crux of the debate with elasticity's substantially high for the poor and declines with income as shown by Strauss and Thomas (1990) for Brazil - 0.26 for the lowest decile and falls to 0.03 for the highest decile. While Subramanian and Deaton (1996) show that the elasticities for the poorest households are 0.55 and falls to 0.40 over the incomes. To allow for such possibilities in the estimation of elasticity's we use nonparametric methods of regression analysis to obtain the range.

A rudimentary nonparametric plots - cubic splines, for consumption of cereals, rice, wheat and other cereals are presented in Figure 2.
We plot these against both expenditure and income to see if there lies any difference in both the plots. It is generally known that total expenditure is better got from household surveys than total income in developing countries.

The plots below show that the consumption of cereals rises initially for the poorest households and then declines over the higher income/expenditure levels across cereals and its components. These rudimentary non-parametric plots show that the elasticity's cannot be as high as that suggested by Subramanian and Deaton over the ascending order of income. This is so because the consumption of cereals declines as income increases unlike that shown by them. They showed that the consumption of cereals increases with income and cereals being the major contributor of calories results in a higher expenditure elasticity.

Below we present the results from the nonparametric regression analysis to examine the relationship between cereal consumption and total expenditure and income (to be inserted).

Figure 2: Nonparametric plots of cereal consumption and income/expenditure



Note: (a) The plots are based on village means.
(b) lhrpcmy and lhrpcmce refer to log of per capita monthly income and log of per capita monthly consumption expenditure, respectively from MIMAP data. lunpcmqc, lunpcmqr, lunpcmqw and lunpmqoc refers to log of per capita monthly quantity of cereals, rice, wheat and other cereals, respectively from HDI data.

VI. Policy Implications

In this final section, we put together all the evidences provided in the previous sections to draw some important lessons with reference to the broader literature on this issue.

The purpose of this paper was to demonstrate the relationship between calorie-income relationship given the consumption of cereal-income relationship in the paper by Subramanian and Deaton (1996) using two data sets from India, namely HDI and MIMAP. The estimates presented here show that the elasticities of cereal consumption are not as high as that implied by Subramanian and Deaton (1996) and infact, the consumption of cereals declines as the income increases. Cereal is the cheapest and the highest source of calorie. As the income increases households diversify with increased consumption of pulses, other vegetables, fruits, milk and diary products, fish and flesh foods, sugar and fats. If these views of fairly low cereal-income and calorie-income elasticity's are taken on board, then we have to reconsider the terms in which we discuss nutrition and its change with income.

First underconsumption of calories in the poorest households is unlikely to disappear in the normal course of economic development. Increasing incomes may not be effective in reducing malnutrition (in the sense currently defined). It should be recognised that low calorie-income elasticity is not because the overall quality of the diet is unchanged with income, but because calorie-intake is a poor summary statistic for diet quality. A more comprehensive measure of diet quality or nutritional adequacy would have to include both calorie intake and the intake of other nutrients, several of which are highly income elastic. However some micronutrients which are supposedly income inelastic such as vitamin A and iron requires direct policy intervention. There are evidences from rural Pakistan which suggest that education of women is the key factor in achieving better nutrition by determining household food acquisition patterns (Alderman and Garcia (1996)). Hence public intervention such as this will have higher payoff.

Second, the emphasis on dietary quality is given greater impetus by the realisation that calorie-sufficient diets are not sufficient in all other nutrients. While it may be true that calorie-sufficient diets are sufficient in proteins (Osmani (1982), NNMB reports), the same does not hold for some other nutrients, notably vitamin A, certain vitamins in the B-complex group, iron and folate (Lipton (1983) NNMB Reports, successive issues).[8] Thus, vitamin and micro-nutrient deficiency can exist as a condition independent of calorie or protein adequacy.

Third, we will have to discard rather simple notions of what the nutrition of the poor consists of. We have for too long thought that the poor do not 'eat enough'. However, in terms of nutrient shortfalls, or the difference between average intake and recommended dietary allowances, the shortfall in calorie intake appears to

[8] It is interesting to note that the protein adequacy of calorie-sufficient diets is not universally valid. Exceptions are provided by the Yam- and cassava- based diets of certain parts of Africa.

be the smallest of all nutrients. The diets of the poor is dominated by cereals which are the cheapest source of calories, so much so that the average consumption of cereals by the poor in rural India is higher than that of the ICMR's recommended dietary allowance (NNMB, various issues).

As income increases, there is an increase in the consumption of "protective" foods such as pulses, fruits, milk and diary products, which, while adding to calories, contribute significantly to the increase in other nutrients whose intake, is particularly lacking in the diet of the poor. Throughout the developing world high incidence of disease is associated with inadequate intake or absorption of micronutrients (Levin etal. (1991)). While the intake of nutrients such as fat, calcium, riboflavin, vitamin C etc. appear to be rising steadily with income, the intake of vitamin A and iron are poorly correlated with income. Since the incidence of blindness resulting from vitamin A deficiency is high in rural India, and the deficiency in the vitamin is believed to lead to metabolic inefficiency long before it affects eye-sight, this is something that clearly deserves further investigation.

Fourth, it is advantages to move away from the discussion of dietary quality in terms of simple nutrition intake, such as required minimum calorie intake, to food based strategies to address the problem of malnutrition. One important advantage of food based strategies is that foods provide several essential micronutrients, simultaneously addressing a combination of deficiency problem.

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