Ethiopian Journal of Development Research Vol. 22, No. 1, April 2000

Calorie Demand in Rural Ethiopia

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ABSTRACT:

The paper investigated the extent of responsiveness of nutritional status of rural Ethiopian households to changes in their economic status. Daily calorie per capita intake and expenditure per capita per day were taken as a proxy for nutritional status and economic status respectively. Using OLS and Local Regression Smoothers, calorie intake elasticity of expenditure was estimated. The 95% Confidence interval for the elasticity is 0.222 - 0.254. The estimate indicated that the contemporary approach (improving food entitlement to solve under nutrition problem) is not an adequate means of tackling nutritional deficiency in rural Ethiopia since the responsiveness of calorie intake to change in expenditure is very small.

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• *The author also thanks the Economics department of Addis Ababa University for the Ethiopian Rural Household Survey data on which this study is based.*

INTRODUCTION

Ethiopia is characterised by extreme poverty, continuing high population growth, high and possible increase of food insecurity and nutritional problem (Ezra, 1997). The country is one of the four poorest countries in the world. Stunting has reached 64% among all children while approximately 47% of the children are reported to be underweight (World Bank, 1992). Considering the same issue from a time series perspective, nutritional intake declined from 82% of the standard (2300 calorie per person per day) to 75% in the eighties. The Inter-governmental Authority for Draught and Development, IGADD (1990) estimated that from 38 million Ethiopians having food problems in terms of nutritional deficiency, 67% are the rural poor. So, tackling food problem in the area under study requires searching and investigating the precise causes and possible effects of the problem among the rural poor.

Undernutrition, being responsible for a lot of adverse effects like disease, death, lowering capacity to work, lower mental ability, recently became one of the basic focal points of poverty studies. It became an economic issue, specially, because on one hand it affects human welfare by itself and on the other, through its adverse effects mentioned above, it influences human capital formation which has got a significant role in achieving a planned economic growth.

On pointing out the main causes of under nutrition, the literature survey indicates a major shift of focal area since early eighties. In 1970s and earlier time, researchers and policy makers held the view, sometimes refereed to as conventional view, that the main cause of nutrition lies in the food supply side. The approach aims at equating food availability to food requirement at national level, through measures like food production and increasing its rate of growth, food import and food aids (Elliss, 1992: 300). But later on strong pieces of evidence were seen that a country might have equal aggregate supply and aggregate requirement with many households starving or facing nutritional deficiency problem. As a result, a contrasting method refereed to as *Contemporary Approach* was developed to supply shortage. This approach is centred on lack of enough food entitlement as the main cause of undernutrition. Holders of this view emphasise the fact that lack of enough command over food can lead to under nutrition even if food supply increases in aggregate level. Ever since the development of this view, food shortage remains only one among several causes of under nutrition (Ellis, 1992: 302). Moreover the concept shifted the focus away from tackling the problem at aggregate economic level towards households and individuals level. Besides, it became a direct link between poverty and under nutrition since purchasing power is one of the basic components of food entitlement.

In the Ethiopian case, too, recent studies indicate the existence of strong undernutrition problems in food surplus producing regions. Pelletier et al. (1995) indicated the existence of malnutrition in both food deficit and food surplus region. The finding leads one to conclude that the cause of under nutrition in rural Ethiopia is not only supply shortage but may also be food

entitlement problems. Thus, in searching the causes and means of tackling it among rural people, this issue leads one to focus on economic variables like purchasing power, budget allocation cases and some other related issues which can be analysed through responsiveness of nutritional status to economic status.

Ever since the emergence of food entitlement view, the relationship between income and food intake at household level became one of the major focal points. Indeed, there is little agreement on the responsiveness of the latter variable to changes in the former one. Conventional wisdom held the view that hunger and undernutrition would be eliminated by economic growth (Reutlinger and Selowsky, 1976). In contrast, some recent studies like that of Behrman and Deolalikar (1987), Bouis and Haddad (1992), and Bouis (1994) assert that substantial nutritional improvement don't *automatically* accompany increase in income in the process of development. As an intermediary view the World Bank (1981: 59) says the most efficient *long-term* policies are those that raise the income of the poor. Indeed, the base of these conflicting views is the level of nutrient intake-expenditure or income elasticity. Findings, in favour of conventional wisdom include Strauss (1982) who estimated the elasticity to be 0.9 for rural Sierra Leone; Subramanian and Deaton (1996) who estimated it to be 0.3 - 0.5 for rural India. In contrast, findings of Strauss and Thomas (1990), who estimated the elasticity for Brazil to be 0.03-0.26, Wolfe and Behrman (1983), who estimated it for Managua, Nicaragua to be 0.0-0.1, and others are against the conventional wisdom.

Coming back to Ethiopia, sufficient information on the elasticity for the rural part is not available so far. But the basic question demanding due attention is

'do the rural Ethiopian households behave like Sierra Leoneans or do they behave like Nicaraguans?' In policy context, is it possible or not to eliminate under nutrition through income growth in short term? Findings of Strauss and Thomas (1990) have got still another implication. The size of the elasticity among the community was not the same for the rich and the poor, implying nutritional value of food has no similar weight among the mentioned classes. On the contrary, the rural Indian study mentioned above imply that the nutritional attribute of food is nearly equally important for both types of the economic classes. In this regard, how do rural Ethiopians behave? This will be another question that this paper attempts to look at.

METHODOLOGY

The common approach to estimate elasticity of calorie intake with respect to expenditure (here after refereed to as elasticity) can be grouped as direct approach - that is estimating demand function for nutrient and indirect approach - estimating food demand function[1]. In fact the latter approach was found to exaggerate the elasticity for poor countries (Wolfe, 1988). Within the first approach estimation technique also vary. Some researchers use OLS and others use Non parametric techniques[2] such as smooth local regression technique[3]. Strauss and Thomas (1990 :1902) assert that non-parametric regression provides a powerful set of tools that can be extremely useful for data analysis when there is little a priori knowledge of the shape of the function to be estimated. This can be the case when the shape varies over the distribution of the covariate. That is, it allows one to sec very clearly the variations of the elasticity among different economic classes[4]. An equivalent technique that

contains this advantage is running OLS for different economic classes separately. Here, to approach the accurate result, both estimation techniques were employed.

Most often the elasticity estimates are biased as a result of failing to measure per capita calorie intakes and expenditures properly. There are different approaches for such calculation. The first is, assuming food is shared equally among family members, dividing the variable by family or household size. This method, certainly, leads to biased estimate. Another approach is to assume individual consumption is proportional to approximate calorie requirement (Strauss, 1986), and calculate the per capita consumption based on this assumption[5].

Still another approach is using an adult equivalent scale that gives lesser weights to children and female as compared to adult males. To limit the bias of the estimate the first and the last approach was compared to calorie share-ratio approach, which is to be illustrated in the latter section.

DESCRIPTION OF THE DATA

The data used for this study came from the first round of Ethiopian Rural Household Survey conducted in 1993. Data collection was made by the Economics Department of Addis Ababa University in collaboration with the Centre for the Studies of African Economies, Oxford University. In the survey 1,477 households were interviewed over varieties of their economic and social characteristics from 15 Woredas (districts) and 6 regions,

stretching across the country. In selecting the sites attempts were made to provide an outcome that reflects a balanced picture of the Ethiopian rural poor economic behaviour (Department of Economics, 1995).

To collect the required data on food consumption respondents were asked to recall how much, in physical measurements, they had consumed from each of the more than 45 food items over a period of seven days. Together with the food items, the sources of these food items were asked by categorizing the items as food bought from market, from own harvest and stock, from own field, gifts and loans, and purchase of prepared foods. The reported physical quantities were converted to calorie using calorie conversion factor of Agren and Gibson (1968).

The full detail of reported food consumption, of course, represents food availability to household rather than food intake. That is, it requires the adjustment of the former to the latter. This was done using food given out in the form of meals to visitors, guests of ceremonies and daily farm workers or employees. The respondents were also asked about their expenditure on food and non-food items. They reported it in Birr as well as in physical measurements where appropriate. The final seven days and the last four months were used as demarcation points in time, for the former and the later expenditure titles respectively.

From the surveyed households, only those who reported both their consumption and expenditure were included in this study. The descriptive statistics for the sample of 1320 households are shown in table 1.

Table - 1. Descriptive Statistics

	CALORIE Intake/ person/day	EXP. in Birr Per capita/day	LOG-CAL.	LOG-EXP.
MEAN	1333.618	2.778	3.092	0.293
STD	509.484	2.548	0.174	0.361
MAXIMUM	2916.63	15.33	3.46	1.19
MINIMUM	391.00	0.24	2.59	-0.62
SKEWNESS	0.551	2.953	-0.339	0.131
STD.-SKEW.	0.067	0.067	0.067	0.067
T - RATIO	8.17*	43.806*	-5.03*	1.944
KURTOSIS	-0.165	4.136	-0.290	-0.150
STD.-KUR.	0.135	2.500	0.500	0.135
T – RATIO	-1.225	1.654	-0.579	-1.116

Most of the statistics presented in table 1 conform to the aggregate of national statistics. The average per capita per day consumption of calorie was given by Ezra (1997) to be 1,518 for the year 1992, while the average estimate of this study is also closer to this estimate but lesser. The difference is, mainly, due to adjustment of calorie availability to calorie in take.

Per capita expenditure for the rural areas at aggregate level was estimated to be Birr 2.43 in 1995/96 by CSA (1997), which is slightly below the estimate of

this study, i.e., Birr 2.77. Table 1 also indicates the distribution of the variables. Both variables were found to be strongly positively skewed and lepto kurtic[6]. This non-normality will not allow application of OLS to estimate the relationship between the two variables. Kmenta (1971: 204) indicates that in such circumstances the random terms will not be normally distributed too. That is, the enormity of the sample size could not overcome the non-normality problem here. This requires some sort of data transformation.

Table - 2 Coefficient Of Variation For Calorie And Expenditure

DECILES	CALORIE MEAN	CALORIE STD	CALORIE COEF.VAR	EXP. MEAN	EXP. STD	EXP. COEF.VAR
1st Decile	2031.98	387.61	0.19	7.72	3.11	0.40
2nd Decile	1741.54	445.58	0.26	4.91	2.03	0.41
3rd Decile	1465.89	443.08	0.30	3.70	1.96	0.53
4th Decile	1395.07	386.43	0.28	2.62	1.24	0.47
5th Decile	1278.42	409.53	0.32	2.18	1.20	0.55
6th Decile	1183.79	371.31	0.31	1.84	0.95	0.51
7th Decile	1123.67	338.84	0.30	1.52	0.84	0.55
8th Decile	1059.20	347.96	0.33	1.31	0.79	0.60
9th Decile	1069.64	395.30	0.37	1.09	0.68	0.63
10th Decile	986.98	439.86	0.45	0.88	0.58	0.66

With respect to choosing suitable transformation, Snedecor and Cochran (1967: 329) suggest that if the standard deviation in the original scale varies directly with the mean; that is, if the coefficient of the variation is constant, logarithmic transformation is more appropriate. Table 2 shows the coefficient of variation for consecutive deciles after arranging the data in decreasing expenditure order. The coefficient of variation for calorie intake is around 0.32 and that of expenditure is about 0.5. In the case of Calorie intake the coefficient of variations is not seen increasing with the mean. But in the case of the expenditure, the C.V. is somewhat related to the mean but not strongly. Hence logarithmic transformation was believed to be suitable for the data.

PERCAPITA CALORIE AND PERCAPITA EXPENDITURE ESTIMATE

It is hardly acceptable to estimate the relationship between the two variables of percapita calorie and percapita expenditure using household calorie intake and expenditure data since it is affected by household size, age - sex composition of the household and activity of members of household. Moreover, data on individual basis are also hardly available. These conditions necessitate percapita calculations. In this calculation some researchers use family size ignoring the above complexities, which leads to an upward-biased estimate of the elasticity[7]. Even if such approach may lead to a biased-estimate, for comparison purpose, it was employed here. Other researchers use the basic calorie requirement in adjusting age and calorie consumption variations. Such approaches may also become erratic if the consumption pattern or share of

individuals in the community under study do not follow such proportion. A relatively better way and more common approach is using adult or household equivalent scales.

For Ethiopians, Ostby and Gulilat (1969) used 0.7, and 0.6 for males and less than 15 for females respectively, and 1 and 0.9 for males and greater than 15 for females respectively. This scale assumes the equality of males above 15, and also for the females which may not be the case in reality. Hence, assuming Indian consumption behaviour is similar to Ethiopian in this regard, Indian scale was used as a second option of household equivalent calculation. However, a close look into this issue may reveal the fact that the scales vary from community to community and from time to time. A community which is childcare-oriented will not have identical scale with a community that has contrary orientation. Due to cultural change, economic growth and education the scales are also time-dependent. A community with a culture that oppresses females in terms of food consumption will not have a similar scale with a community that is not. Consequently, it seems reasonable to seek a solution for such an obstacle. Therefore, average calorie-share ratio was estimated to tackle this problem as follows.

Conceptually, daily household calorie-intake is shared among its members in accordance with the community's consumption behaviour (whether or not childcare oriented, whether female suppressing or not etc.).

On this ground, a model is specified as:

$$C_i^H = \alpha + \sum \beta_j n_{ij} + \varepsilon_i \ldots\ldots\ldots (1)$$

Where C^H_i is calorie intake of household i=1...1320;
J = 1...10; age-sex groups are as listed in table3; α, β_j are parameters to be estimated. β_j being calorie per capita share of an individual falling in Age -Sex group j; n_{ij} is the number of household i members falling in j^{th} group.

Next, the share of each group was divided by the share of the adult male aged 18 - 55 to arrive at Share-Ratio. The results of the estimates are presented in table 3. the Table reports that the parameter estimates are all significant and 60% of the variation in household calorie-intake was explained by equation 1. Moreover, the pattern of shares is consistent with the usual expectation.

Adult males falling in age group 18-55 are having the largest share while females older than 55 years are having the least share.

Table - 3. Calorie Intake Share Ratio Estimation

Age-Sex Group	Estimate of β_j	Std. Of β_j	t – ratio	Share-Ratio
Female <5 Years	704.560	122.673	5.743	0.529
5 ≤ Female < 10	1024.587	102.831	9.964	0.769
10 ≤ Female < 18	1271.099	91.22	13.933	0.954
18 ≤ Female < 55	855.029	86.817	9.849	0.642
Female ≥ 55	508.437	142.122	3.577	0.381
Male <5	654.881	114.284	5.730	0.491
5 ≤ Male < 10	919.201	105.213	8.737	0.690
10 ≤ Male < 18	1172.783	85.375	13.737	0.880
18 ≤ Male < 55	1332.821	80.113	16.637	1.000
Male ≥ 55 Years	910.856	151.293	6.020	0.683
		$r^2 = 0.60684$		

As a third alternative, these share-ratios were considered as a substitute for Obsty and Gulilat (1969) scale.

ESTIMATION OF CALORIE-EXPENDITURE RELATIONSHIP

In this section, a close look is made into the relationship of per capita calorie and per capita expenditure mentioned in the preceding section. The distribution of the variables demands transformation of the original scale. Moreover, also the model to be estimated has to be able to indicate the possible inequalities of the elasticity among the different economic groups. In some countries, for example Brazil, the elasticity was found to vary inversely with income. In other countries, like India, it was found not to vary with economic group. Thus the model has to be flexible enough to comprise both situations. Simple linear regression equation cannot allow such flexibility as it yields only one elasticity estimate for the whole sample. Hence, application of OLS to different quartiles may serve the purpose better. In general, the expected type of the relation between the two variables is

$$LnC_i^p = \alpha + \beta\, LnX_i + \varepsilon_i \ldots\ldots\ldots (2)$$

Where i = 1 ... 1320 stands for household index; C_i, X_i are percapita calorie intake and per capita expenditure α, β are parameters, the latter being elasticity of calorie with respect to expenditure and ε_i the error term. The sample estimates of the model using OLS are given in table 4, where method 1 means percapita calculation based on unadjusted family size, Method 2 indicates Household size adjustment using Indian adult equivalent scale and

Table-4. Calorie-Expenditure Relationship Estimation

	β - est.	β -std	t -ratio	r - sqd
METHOD-1	0.366732	0.008824	41.55929	0.567184
METHOD –2	0.359694	0.008545	42.09304	0.573439
METHOD –3	***0.239771***	***0.009157***	***26.18302***	***0.342168***
1st – QUARTILE*	0.269533	0.029184	9.235517	0.206378
2nd – QUARTILE*	0.354094	0.097926	3.615944	0.038335
3rd – QUARTILE*	0.170423	0.096898	1.758792	0.009343
4th – QUARTILE*	0.131727	0.046132	2.855462	0.024256

* - quartiles are formed on Exp/Person/Day.

method 3 means percapita calculated based on the calorie-intake share-ratio estimated in the preceding section. One may be tempted to compare the methods with R^2 and t-ratio, but since differences can be due to the measurement of the variables such comparison is misleading. The comparison should be done among the adult equivalent scales used by the three methods. The elasticity estimate of method 1 and method 2 are very close to each other, implying usage of Indian adult equivalent scale yields a close result as using unadjusted family size. But rural poor Ethiopians are having a high number of children to household ratio, which makes the adjustment more compulsory. As a result, ignoring the adjustment may lead to a biased estimate.

According to method 3 the elasticity estimate is lower than the other methods. The point estimate is 0.2397 with 95% confidence interval of (0.222 - 0.257). With this method and logarithmic model given by equation 2 above, more than 34.2% of the variation in calorie percapita intake is explained by expenditure percapita. Indeed the elasticity estimate is significant (t-Ratio = 26.18, $p < 0.01$). In addition to OLS estimation technique, the elasticity was estimated with the application of smooth local regression estimation technique at the sample mean to check whether or not the estimation of the elasticity with OLS is reliable. The technique requires running a weighted linear regression. Here quartic kernel weights were used. The weights $W_i(x)$ are determined as

$$W_i(X) = \frac{15}{16}[1-(\frac{X - X_i}{h})^2]^2 \quad \text{.....if } -h \leq X - X_i \leq h$$

$$= 0 \qquad \text{otherwise}$$

where h is a bandwidth. For quartic kernel weights the optimal value of bandwidth was given by Deaton (1997: 175) as $h = 2.42 \min (S, 0.75 \text{ IQR}) N^{-0.5}$, where IQR is interquartile range and S is standard deviation.

This estimation technique gives slightly lesser elasticity estimate at the sample mean with a bandwidth of h = 0.6. It gives a point estimate of the elasticity to be 0.236 at the sample mean. However, it lies in the 95% C.I. of OLS estimate. The difference may arise from omission of some households from the higher expenditure group by this estimation technique[8]. The result was given in table 5. The elasticity estimate obtained here is slightly higher than that of Nicaragua (0.0 - 0.1), (Wolfe and Behrman, 1983) and that of Brazil (0.03 - 0.26),

(Strauss and Thomas, 1990), but by far below that of Sierra Leone (0.9) (Strauss, 1982). Thus, the result implies that in the short run, the possibility of improving nutritional status of rural Ethiopian households through improvement of the economic status is very unlikely. This is because change in economic status brings a change in nutritional status with a proportion that is much less than unity.

Table-5 Elasticity Curve Estimate Based On Local Regression Smoothers

Exp./p/d	log-exp*	β - est.	β-std
5.29	1.6659	0.4326	0.0086
4.56	1.5184	0.3900	0.0088
3.96	1.3752	0.3477	0.0089
3.54	1.2644	0.3142	0.0091
3.27	1.1834	0.2893	0.0092
3.05	1.1149	0.2680	0.0092
2.85	1.0488	0.2471	0.0086
2.66	0.9781	0.2243	0.0088
2.45	0.8981	0.1982	0.0089
2.29	0.8279	0.1748	0.0091
2.11	0.7459	0.1470	0.0092
1.91	0.6496	0.1135	0.0092
1.71	0.5358	0.0727	0.0086
1.47	0.3880	0.0175	0.0088
2.77	1.0164+	0.2367+	0.009368+

* - at every 88th-household = .6 + - estimate at sample mean

The slow responsiveness obtained above is likely to occur when households allocate higher budget share to relatively less nutritious food items[9]. The main factors that lead to such allocation are taste, habit, and simplicity of processing. Some studies found out that even at low levels of income, considerable weight is given by households and individuals to such attributes of food, (Shah, 1983). Similarly the misallocation of the budget among food item leading to lower elasticity can be seen from accustomed production system in a given locality. In case the produced food grain in the locality is less nutritious due to unavailability of nutritious food items in their vicinity, households may be obliged to give higher budget share to the available less nutritious food items. Obviously, the elasticity is directly proportional with the correlation between calorie unit price and budget share allocated to the food items. The stronger the correlation the higher the elasticity.

Another possible cause might be lack of information or unawareness about nutrient. Wolfe et al. (1988) argue that the poor do not increase their nutrition much with income because they do not understand the relation between nutrient and other food attributes. If they were well informed, they would weigh nutrient content more heavily.

Be it deliberately (attracted by other food attributes) or unknowingly (due to lack of information), the higher the weight given to other food attributes the lesser the calorie elasticity will be and vice versa[10]. Thus, the attempts made to improve the nutritional status has to include the strategy that influences consumption behavior in such a way that the elasticity (responsiveness) of nutritional status to improvement in economic status will be higher.

Otherwise, the consumers will continue buying more of other food attributes instead of nutrients as their economic status improve. Such consumption behavior, of course, makes the contemporary approach ineffective.

Comparison of the elasticity among different expenditure groups, i.e., among quartiles presented in table 4 shows that the first and second quartile, i.e., relatively richer ones, are having higher elasticity than the poorer quartiles - three and four - implying that the relatively better economic group at better position improve their nutritional status when there is improvement in their economic status. Indeed, on this issue too, there is little agreement among researchers. Timmer and Alderman (1979), and Murty and Radhaknishna (1981) assert the existence of inverse relationship between income or expenditure and nutrient elasticities. On the other hand Sabramanian and Deaton (1996) report the absence of such relationship in their rural Indian study. The result obtained here differs from both groups in that the relationship obtained is positive. The elasticity was found to decline with declining expenditure group. Actually this behaviour requires further study before it is accepted as a general truth. In order to check whether such relationship came from the actual behaviour of households or from estimation problem, local regression smoothers was employed and the result of estimation is presented in table 5.

Table 5 also reports a clear positive association of the elasticity with expenditure, in contrast to many research results of other countries. This type of relationship can be viewed as follows. In rural Ethiopian households, the relatively economically better ones are more conscious or well-informed

about the nutritional attributes of food and tend to allocate their budget in a better way to optimise nutrient intake than the extremely poor groups. Clearly, the non-positive relation, in other countries, between the elasticity and the expenditure appears after some higher level of calorie intake. The fact was attested by a Brazilian study after 2400 calorie/person/day and an Indian study after 2100 calorie/person/day, (Strauss and Thomas, 1990: 1903). If that is the case, one may not expect the inverse relationship between the elasticity and expenditure as the community understudy is generally undernourished. So, the relatively better groups are not in a position to pay much for non-nutrient attributes of food. Besides, according to Wolfe and et al. (1988), elasticity close to zero in poor classes may be the result of the existence of a Nutrient Subsistence Constraint. In this case, too, the poorer group might have been influenced by such behaviour than the better economic group.

CONCLUSION

Undernutrition is responsible for a lot of adverse effects like disease, death, and lowering working capacity. As a result, it became one of the focal points of development endeavours. It calls attention not only for its impacts on human welfare, but also for its influence, through its adverse effects like lowering mental ability, on human capital formation which plays a significant role in an attempt to achieve a planned economic growth.

The question, which this article has sought to address, is whether or not the contemporary approach (attempt to overcome undernutrition through economic

growth) is effective in short runt. The data used to address the issue was taken from first round Ethiopian Household Survey conducted in 1993 by the Economics Department of Addis Ababa University in collaboration with the Centre for Studies of African Economies, Oxford University. The analysis of the data gave a compelling evidence for non-responsiveness of nutritional status of the rural people to the improvement of their economic status. It was observed that for a 1% improvement in economic status there would be only about 0.235% increment in nutritional status, taking expenditure/person/day and calorie in take/person/day as proxy variables respectively. This change is, obviously, very small when compared to some countries' elasticities, which is estimated to be about unity.

Moreover, it was observed that those households existing in a relatively better economic class are found to have better elasticity or responsiveness than the poorer ones. This result is in contradiction with the usual argument. Even if the reasons for this result demand further investigation, it is believed that the contradiction might have arisen from the fact that the relatively higher income group are well informed about nutritional content of food items and are attempting to improve their nutrition by the help of the information, when compared to the poorer classes.

What are the major implications of the low calorie-expenditure elasticity estimate? The overall smallness of the elasticity indicates that the contemporary approach is not so effective in tackling the undernutrition problem in the short run. The attempt to tackle the problem, in addition to the conventional approach (increasing food supply), the contemporary approach

has to include measures that improve the responsiveness of nutritional status to change in economic status. The people do not increase their nutrition much with the improvement of their economic status, possibly because they do not understand the relationship between nutrients and other food attributes. If so, it may be desirable for the government and concerned bodies to improve the dissemination of nutritional information. Moreover, the marginal nutrient choices may be choices based on full information about nutrients, but the misallocation of budget is dictated by factors like food habits and the production system in the locality. In such cases, measures like developing programs that induce substitution among food items both at production and consumption levels are very basic. Clearly, these measures are not the end by themselves; but they will make the contemporary approach effective in tackling the problem.

Some studies[11] observe the fact that programs aimed at bringing food substitution, among the poor are more effective in improving nutritional status than an imaginable income changes.

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END NOTE

[1] For detailed comparison of both approaches see Beherman and Deolalikar (1987).

[2] Also known as distribution-free methods are methods that do not require specific assumptions about the distribution of the population from which the samples were obtained. Most often, to conduct parametric statistical tests and to construct confidence interval, we need to assume the distribution of the population to be normal besides the usual classical OLS assumptions.

[3] Fan .(1992,1993) demonstrated the superiority of Local Regression Smoothers over other methods, and the procedure works as follows. At a given point x_i, of X_i, independent variable, a weighted linear regression of Y_i , dependent variable on X_i is run. The weights are chosen to be very large for the observations close to x_i and to diminish with distance from this point; they are also set so that as the sample size increase, the weights given to the immediate neighborhood of x_i, is increased, hence in the limit, only x_i, is represented.

[4] In the literature, it is often argued that poor people, whose income is insufficient to buy sufficient food, should have an elasticity calories to expenditure that is much higher than that for those who have enough to eat. For example, Wolfe et al. (1988) found that as per capita income grows, preference curve change from about a Cobb-Douglas form (that is relatively price-responsive for a per capita income of $500 to significantly

closer to the L-shaped case (that is relatively unresponsive to price and showing strong preference for variety) for per capita annual income of $2,800. OLS estimation techniques can not reflect such tendency.

[5] For example see Srauss(1986).

[6] In a given distribution of a variable, if extreme values exist at the higher values of the variate than at the lower values, the distribution is referred to as positively skewed; In this case the mean value is greater than the median value. On the other hand, if a large number of the observations have identical values, the distribution is referred to as lepto kurtic. When both properties co-exist in a distribution like the case in this study, it indicates that most of the observations are having values less than the mean values.

[7] For further examination of the approach see Strauss and Thomas (1995).

[8] In the data description, it was observed that there are extreme values above the central values for both calorie and expenditure. The smooth local regression estimation technique punished such values by giving them lesser weight or omitting them, so that their impact on the estimate is kept at minimum.

[9] To show the effect of preference made for other food attributes(like taste, color, simplicity of processing) on the elasticity of calorie with respect to expenditure, let β be the elasticity of food consumed in physical measurement(Q) with respect to expenditure (X) i.e.

$$\beta = (\Sigma xq)/\Sigma x^2$$

where the lower cases represent the deviations from means of logs of their respective variables. Assuming multiplicative behavior of food nutrients (Y) and other attributes (Z) and the lower cases representation as above,
$\beta = (\sum x(y+z)/\sum x^2 = \sum(xy+xz)/\sum x^2; \quad \beta = \sum xy/\sum x^2 + \sum xz/\sum x^2; \quad \beta = \gamma + \delta$
where γ and δ are the elasticity of calorie and other food attributes respectively, with respect to expenditure. That is $\gamma = \beta - \delta$ (*).
(*) indicates that the higher the elasticity of other food attributes the lower the elasticity of calorie and vice versa, keeping β unchanging. The constancy of β is plausible on the ground that relative-boundedness of the quantity (not quality) to consume.

[10] See note number 9 above.

[11] For example, in a rural Bangladesh study Pitt (1983), after finding very small elasticity, found that the food substitution program had about three-fold effect in improving nutrition.

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