DISTINCTION BETWEEN MALNUTRITION AND POVERTY AND ITS IMPLICATION FOR SOCIAL POLICY*

BY

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There are two beliefs which have influenced national policy of eradicating poverty in our country. The first is that food is the most stark element in the deprivation of the people so much so that even today according to the Planning Commission some 48% of of the people of India do not get enough of what they eat to meet minimum energy needs for a healthy active life. The second belief is that because the people are undernourished in such large number, they are small in body stature, slow and lazy in their work, liable to fall ill, their work performance is low and it just does not pay to employ them. In brief they are unemployable. I plan to show today that both the beliefs are founded on the wrong interpretation of statistics almost reminiscent of the quotation ascribed to Disreali, "there are three kinds of lies—lies, damn lies and statistics."

The assessment that 40% of the rural and 50% of the urban population were below the poverty line during the year 1961-62 and that even today nearly half the total population find themselves in much the same position is based on the method pioneered by Dandekar and Rath. A person who cannot afford a diet which meets his minimum energy needs for a healthy active life is certainly both poor and malnourished. However, in using this criterion, Dandekar and Rath have used the figure for average energy requirement of an individual in place of the minimum, ignoring the fact that dietary allowances for energy are defined as average per caput based on measurement of intakes in healthy active individuals within each age-sex category and that about half of these individuals have their needs below the tabulated average and half above. When therefore Dandekar and Rath report that 40% of the rural population and 50% of the urban population in India are below the level

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of expenditure corresponding to the average energy requirement, it is more an indication that the people of India are for the most part healthy and active than undernourished. Their evaluation reminds me of the assessment for Great Britain carried out by the late Sir Arthur Bowley which in the words of late Sir Norman Wright, Scientific Adviser of the Ministry of Food and Agriculture in the United Kingdom (1967) ran as follows:

> "I well remember the occasion when that distinguished statistician Sir Arthur Bowley, noting that the mean level of calorie consumed by the British population in the spartan period of the early post-war years, coincided exactly with the accepted calorie requirement concluded (to the consteration of officials in the Ministry concerned) that some 50% of the population must be undernourished."

In reproducing the quotation above, it is not my intention to criticise the late Sir Arthur Bowley for a pronouncement which he may have made but which to the best of knowledge, he never published. There is nothing surprising either if the officials of the Ministry concerned were taken aback by his assessment. The suggestion that half the people of the United Kingdom were either losing body weight or were forced to reduce their physical activity for want of adequate food or both would always have serious policy implication which no Government would accept without having factual data to support it. This was 50 years ago when the concept of requirement had hardly developed to a point to grasp its full implications. But to adopt the same method today for comparing intake with requirement, when it was discarded as inapplicable to the conditions in the United Kingdom is to ignore the knowledge we have gained in understanding the concept of requirement.

Even a priori the use of average energy requirement as a criterion for classifying a person as undernourished cannot be justified. For to consider that any one eating below the average need is undernourished is equivalent to considering that a person eating above the average need is over-nourished. Such a classification amounts to assuming that the average requirement is both a desirable minimum and optimum at the same time. To do so will be to deny the existence of variation altogether. I am reminded of an old publication by the Food and Agricultural Organisation of the United Nations which states that "if a man eats below the level of average requirement he becomes thin and wastes away and if eats above the average requirement, he becomes fat and is exposed to the hazard of obesity." Dandekar and Rath follow the first half of the definition to the world but conveniently ignore the latter. The fact that 40% eating below the average are considered to suffer from energy deficit implies that 60% suffer from excess energy intake and are, therefore, exposed to the risk of obesity. If the dividing line between the undernourished and overnourished is the average requirement, then one cannot but conclude that the more serious problem for India is over-nutrition than undernutrition! One is bound to reach such an absurd conclusion if onedoes not allow for inter and intra-individual variation in estimating the incidence of under-nutrition.

How does one take into account the variation in estimating the incidence of under-nutrition ? How does one separate individuals whose requirements are lower than the average requirement and yet who are healthy from those whose intakes are low but who are malnourished ? Briefly, what is the meaning of requirement for health and when can a person be said to be undernourished? The question looks difficult for one who does not have an insight into the nature of variation but in reality is simple because the requirement of an individual is not fixed as implied in posing this question and as assumed on current theory in nutrition literature.

As long back as 1947, Prof. Widdowson observed that healthy active individuals even when they belong to the same age-sex category and are engaged in similar work vary enormously in their daily intake. The large variation is found to persist even when the intake is averaged over a week. In particular, she observed that there are two individuals to be found in every 40 of each age-sex group of healthy active population one of whom has a mean weekly intake twice as large as that of the other. This implies a coefficient of variation for mean weekly intake of some 16%. A part of this variation is undoubtedly due to variation in body weight. However, the correlation between body weight and intake is small. Even after correcting for variation in body weight, intake is found to vary from 12 to 15% within each age-sex category. The assumption in nutrition literature that energy requirement of individuals similar in age, sex and body weight and engaged in similar activity with the same mode of life is similar or same is thus not borne out by Widdowson's data.

Several studies have been reported in recent years combining simultaneous measurements of intake and expenditure confirming the observation of Widdowson that intake varies much more widely than expenditure in individuals engaged in similar work. More important was the conclusion that intra-individual variation persists even if the balance is averaged over a week. This meant that, the habitual intake did not equal expenditure in man maintaining body weight thus undermining the whole basis of determining energy requirement of man. Leading English Physiologists in a communication to Nature in 1973 interpreted these results to mean that either errors in measurement of intake and expenditure are too large to permit any useful statement on the balance of intake over expenditure in the same individual or man's requirement for energy must be considered as not known in the present state of knowledge.

The expectation that man's weekly intake must equal the corresponding expenditure in man maintaining body weight is based on the assumption that errors in their measurements are primarily chance errors and successive observations are independent. But available data do not support this expectation. They show that the mean square between weeks for intake is significantly larger than mean square between days within weeks, implying that even when the daily intake is averaged over several days, the differences from week to week in the same individual continue to be large. In particular the coefficient of variation of man's weekly intake is found to be of the order of 15%. If day-to-day variations were random, the coefficient of variation between weeks over time in the same individual would be much smaller. Rather, the data must be taken to indicate that successive observations of intake in man maintaining body-weight are correlated.

Clearly, then part of the variation in intake reported by Widdowson and ascribed to differences in energetic efficiency between individuals must be due to variation in intake in the same individual even after the intake is averaged over several days. That is to say, the assumption that a week's intake or balance in an individual maintaining bodyweight and engaged in similar activity from day to day is constant and equal to individual's habitual intake has no support in the data reported in literature. This is equivalent to saying that an individual ceases to be the same individual as he advances in time, which of course is true. There is thus a suggestion in the data reported in literature that the body regulates its energy stores by adjusting either intake or expenditure or both and that in consequence the requirement of an individual cannot be considered as fixed and equal to habitual intake, as assumed in nutrition literature.

The data situation in the problem under consideration is clearly very different from one commonly assumed, namely that there is a set of pairs of numbers (x_i, y_i) i going from 1 to n, and that when an observation is made on i^{th} unit whether for determining height, weight, intake and/or expenditure, it would be a unique number (x_i, y_i) in the sense that the error of measurement of x (or y) is negligible relative to the magnitude of the true values X (or Y). In other words, the model commonly assumed is represented by

$$X_t = X + e_t \qquad ...(1)$$

where X_t represents the value observed on the t^{th} day, X is the true unknown value and e_t is the error of measurement assumed to be negligible relative to X. With characteristics like height or body weight, it is not difficult to demonstrate the validity of this model. All we need to do is to repeat the observation on successive days to convince ourselves that the variance of the mean weekly height or weight in an individual over time is negligible relative to the absolute magnitude of body weight or height. However, there are no data to warrant such assumptions in the case of intake and expenditure. Even in the most controlled studies determining intake, and especially expenditure, for any day is difficult and involves measurement errors which are too large to be made negligible relative to the true differences between successive days. For this reason, the problem needs to be approached as one of separating out regulatory messages, if any from the underlying errors, using the theory of stochastic processes.

Studies on energy balance using this approach show that successive values are correlated in a manner represented by the Markoff process, comprising two components—one a short term component arising from the current value of the process at the previous time point and the other a long term component in the form of error of measurement given by

$$w_t = p w_{t-1} + e_t \qquad ...(2)$$

where w_t is the balance on the t^{th} day, p is the serial correlation of order one between w_t and w_{t-1} and e_t is a random variable distributed around zero with variance σ_e^2. The meaning of this process is that if it were possible to repeat the circumstances which give rise to the observed value of balance on any day, t, then the balance will be distributed around zero within limits which we call homeostasis, which are independent of t, given by

$$\frac{\pm\sigma_e}{\sqrt{1-p^2}}$$

This is described as stochastic stationary distribution. Data on energy balance must, therefore, be interpreted to mean that although intake may not be equal to expenditure even when averaged over a week man is in balance every day in a probabilistic sense with varying intervals between peaks and troughs and varying amplitudes in daily balance. For this reason, the data cannot be expected to show a fixed period that English physiologists have been looking for.

This does not mean that the laws of thermodynamics have been violated, as suggested in the statement of British physiologists. Laws of thermodynamics do not mandate that intake must equal expenditure every day or even after fixed periods of 3, 5 or 7 days. In living biological systems we must expect a time lag in balancing intake with expenditure. Periods of stress or strain may modify the time lag but there is always a movement towards balance through built-in auto-regulatory mechanisms. The fact that the distribution of energy balance is stochastic ensures that the expected value of the daily balance is zero and the standard deviation is independent of time.

The finding that energy balance is regulated is consistent with the evidence that humans possess a physiological regulatory mechanism for controlling appetite and energy expenditure. Regulation implies adaptation ; the magnitude of autocorrelation p is an index of the power with which regulation at any given level of intake is controlled. The value of p decreases as intake departs from the normal. Outside the limits of homeostasis p is zero and indicates that the organism is under stress.

The model shown in equation (2) described above is autoregressive (AR) model of order 1. It is given here more to bring out the regulatory homeostatic character of the energy balance than as an exact description of the phenomenon. Long term series under controlled conditions to permit further refinement of homeostatic models are unavailable.

Apparently, the specialized environment in which an individual is brought up interacts with the genetic component to keep the variance constant. It would appear that some physiological system plays a role in carrying information from the environment to activate or suppress genes, thus ensuring homeostasis.

When intra-individual variation in energy balance is the fundamental source of variation and the successive values can be generated by an auto-regressive process such as Markoff, it also means that there is no absolute energy requirement for any day or period. It simply means that the individual is in homeostasis and that his requirement is controlled by a regulated system, the nature of which we do not presently understand. Viewed this way, intra-individual variation would appear to reflect a man's capacity to adapt (or regulate) his intake and expenditure in such a way that the expected value of daily energy balance is zero and the co-variance between daily energy balance k days apart is constant over time. The possibility that there is some mechanism, involving a kind of thermostat, which operates to measure energy intake of food consumed and tells an individual to stop eating, is remote since balance is maintained in a probabilistic and not absolute sense. On the other hand, metabolic pathways which lead to variation in energy utilization are known and it seems more likely that the body regulates its energy balance by varying the efficiency of energy utilization.

The important concept to remember in discussing variable efficiency of energy utilization is that when the body needs energy for any of its functions it takes it from that part of the energy consumed which is mediated through ATP or other high energy bonds, and not directly from the energy in the food consumed. In this process, like all systems which convert energy, the human body dissipates heat; that is to say it is less than 100% efficient. Thus the metabolic pathways for glucose and fat show that the maximum amount of energy they contain which can be mediated through ATP is uncertain, but of the magnitude of about 35% and the rest is wasted as heat. For protein, the maximum yield is smaller. These values represent the maximum because numerous further opportunities exist for inefficient utilization of ATP in various metabolic processes. Thus, because a man eats only intermittently, he is forced to store much of the energy in adipose tissue to insure that a continuous supply of energy is available to the body. It is estimated that in the process of converting glucose to triglycerides and mobilizing the latter when needed, there is a loss of about 10 to 15 percent. Again, energy needs are known to be modified in the processes involved in protein synthesis. Thus man is forced to convert excess amino acids in the food consumed into a relatively harmless product like urea, thereby increasing the pool before excreting it. This entails wastage of ATP, the magnitude of which depends upon the composition of man's diet and the quantity he consumes. Changes in enzyme levels likewise contribute to inefficiencies in the overall utilization of the energy available. Because of this wastage, a healthy individual varies his intake, increasing it when the wastage is large and decreasing it when it is lower but without altering his body weight and level of physical activity, thus enabling him to maintain himself within limits of homeostasis. Outside of these limits he may adapt at a different level, or he may not be able to adapt at all. By calculating resting metabolic rate (RM) every hour to estimate daily expenditure, Margen and Schultz have confirmed that the cost of maintenance cannot be constant as assumed *in* the literature but that it is regulated. Their work on thermogenic yield at different intakes and Applebaum's work confirm that within the range of intra-individual variation RM increases as intake increases and Vice versa without changing body weight or physical activity. It is apparently the auto-regressive mechanism in daily expenditure in maintaining body weight which enables a man to adapt his requirements to intake without affecting the net energy needed for maintenance and physical activity. All this confirms that the energy requirement of man or the efficiency with which he uses energy consumed varies greatly over the range of intra-individual variation as illustrated in the Figure 1. The figure shows that of the energy released from a given amount of food, only about 35% is available for essential anabolic processes and physical activity; the rest is lost as heat. Eventually of course, even the energy used in essential processes appears as heat because no energy can be lost without a trace.

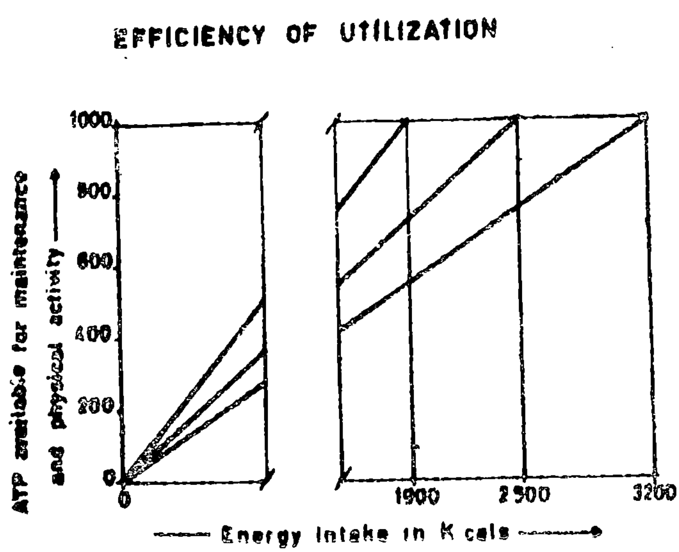

Fig. 1

As explained in the preceding paragraph, 'requirement' is thus a dynamic and not static concept because in a healthy active individual engaged in specified tasks, balance in found to vary as a matter of course around zero, with stationary variance without implying under or-over-nutrition. It follows that a person must be considered in balance whenever his intake falls within homeostatic limits determined by the stationary distribution for balance. It is only when the balance exceeds the homeostatic mechanism that he is under stress from inadequate or excessive intake. It seems that below the lower level of homeostasis the body diverts a part of ATP in favour of the more vital function of maintaining body temperature, losing energy stores and level of activity in the process, while the opposite happens at the upper end with the body accumulating excess stores to gain weight. Fig. 2 shows the distribution of energy intake in the population under study compared with that of requirement in normal healthy adults of the 'reference' type. The shaded area in the Figure to the left shows the proportion of individuals with intake less than the lower limit of homeostasis, $m-2s$, where m stands for the average requirement of individuals of the 'reference' type and s stands for the intra-individual standard deviation. The proportion represents the estimate of the incidences of undernutrition. The shaded area to the right shows the proportion of over-nourished with intake exceeding $m+2s$. The unshaded area in the middle represents normal healthy individuals with intake varying within limits of homeostasis.

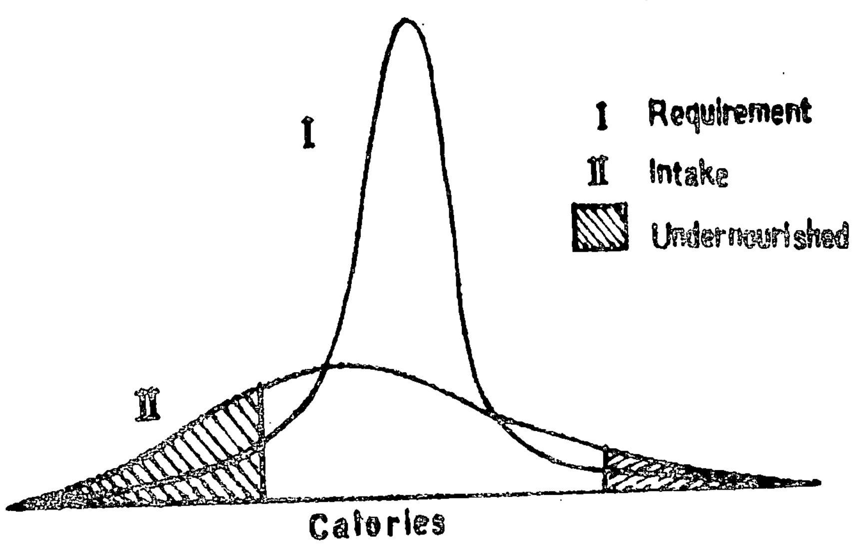

Fig. 2. Distribution of calories intake compared with requirement.

I have examined available data and find that nearly two-thirds of the individuals with intake below the average requirement belong to the category of normal healthy — individuals of the 'reference' type. These individuals have an average income smaller than the income corresponding to the average energy requirement, that is to say, they are poor but there is no evidence that they are undernourished and their health (morbidity and mortality) and work capacity are different from those of the normally nourished individuals of the 'reference' type. It is the individuals below the lower critical limit constituting roughly 15 to 20% of the total population which can be considered to be under stress and hence liable to develop calorie deficiency.

I may refer the readers to my papers on the subject, particularly Lal Bahadur Shastri Memorial Lecture of 1977 and the paper on the Incidence of Undernutrition published in the Journal of Agricultural Economics in 1978. I should add that studies on intake of individuals in small scale surveys show that the incidence of clinical undernutrition is even smaller. As an example, a nutritional survey of some 1000—children in New Guinea has shown that a high proportion of nutritionally inadequate diets assessed using FAO standards for average requirements do not match the physical and clinical symptoms of under nutrition and malnutrition. In this particular survey the authors report that not even 3% of the total childern examined were found to be clinically malnourished against the estimated incidence of some 50% based on the comparison of intake with energy requirement. I have similar experience in the small scale but intensive longitudinal survey carried out on school children belonging to age group 13-17 in rural areas around Uralikanchan. Although some 15% of these children had an intake less than the lower critical limit for their age group, none showed signs of clinical malnutrition.

You may ask me that if the needy and undernourished form so small a proportion of the total, then how does one explain the small stature in children and people of India. Is not poor growth a cardinal sign of malnutrition which shows up like the tip of an iceberg in the form of Marasmus and Kwashiorker when the growth is severely retarded but is present in sub-clinical form when growth retardation is moderate and mild ?

While not refuting that dietary intakes of children in India are much smaller than those in USA, it needs to be mentioned that small stature is not caused by small intake alone, but is also the result of chronically high morbidity rates to which the population is exposed. Morbidity rates are known to be particularly high among poor communities living in slum and rural areas. Surveys show that children, particularly infants spend some 15 to 20% of their time suffering from morbidity caused by gastroenteric and infectious diseases, which have their origin principally in the miserable living conditions. Thus water is the most important of all nutrients but the majority of villages do not have easy access to a protected supply of drinking water. Water supply for washing and maintenance of hygiene, particularly during summer, is known to be inadequate. Even where wells are bored and water is potable, the area immediately surrounding the wells continues to be misused with repeated lowering of utensils to fetch water for washing and bathing. There is also absence of community latrines and sanitation. Housing is grossly inadequate and hygiene and health consciousness are hardly developed among the people. Conditions in the slum areas of the cities are no better. As a result much of the energy of children is spent on combating infections and in the process they are forced to lose body wight, both tissue and water. As much as 1% of the body weight is reported to be lost daily during these episodes, especially in diarrhoea and fevers. Besides, the majority of children carry worm-loads. It is not, therefore, surprising to find that by the time a child is two or three years old, he has already lagged behind in growth on average upto 10 cm in height and 3 kgs in body weight compared to his counterparts in USA. No amount of food can correct the diarrhoeal disease or even significantly decrease its incidence. By contrast observations on children of Indian origin born and brought up in USA show that they grow well even though they continue to take much the same diet as in India. Conversely, whenever these children return to India they suffer set-backs to their health and growth because of the high incidence of diarrhoea and other infections.

Most children in India are indeed smaller than their counterparts in the West. However, smallness need not be understood to mean that they are malnourished for lack of adequate nutrient intake to develop their genetic potential for growth as currently assumed in nutrition literature. If this was true, we would not have observed that intakes of healthy individuals of the same age-sex group engaged in similar activities could differ as much as two-fold as pointed out by Widdowson and confirmed by others. Small size cannot therefore be considered as an attempt on the part of an individual to adapt to inadequate intake unless there was evidence of an associated impairment of physical function and of increase in morbidity and mortality.

I have reviewed the evidence and find that functions which are thought to be affected in malnutrition such as intestinal absorptions and immune response are not altered in children unless their body weight for age is so low as to be below 60% of the Harward median standard. In other words, the so-called mild and moderate forms of malnutrition which are thought to be present in subclinical forms have little functional significance.

Perhaps, the most convincing and comprehensive evidence on the significance of small size for malnutrition comes from the work of Chen. He carried out a longitudinal survey on 2017 children under 23 months residing in rural areas of Bangladesh over a period of one year. He classified them as normal, mild, moderate and severely malnourished following Gomez classification for body weight and other anthropometric indices and found that the mortality was the same in normal, mild and moderately malnourished children.

There is clear evidence in his data of a threshold phenomenon characteristic of homeostatic limits below which risk of mortality is seen to increase sharply. Chen does not give data for morbidity but I infer from our data in villages near Pune that morbidity from diarrhoea and gastro-intestinal diseases are governed by a like phenomenon. Chen's data confirm the addition of a new dimension to nutritional studies by incorporating in them the relevant ecological component in environment such as personal hygiene and public sanitation, particularly in respect of air and water-borne and other pathogens and also pollutants. I cannot, therefore, accept the anthropometric evidence such as cited by Gopalan for India and by Bengoa and Donoso for different countries of the world, as proof of the existence of widespread protein-calorie malnutrition in mild and moderate forms. There is no evidence that those between 75 and 90% are mildly malnourished. To call them as protein-calorie malnourished is to assume that nutrient intake and macro-environments do not interact with the genetic component for growth to keep the energy balance within homeostatic limits; that is to say that intra-individual variation for energy balance around the trend for growth is zero for which as we already saw there is no evidence whatsoever. Children in India and in the developing countries of the Far East may be small for age but must be regarded as healthy above the threshold value for body weight which on current evidence appears to be 60% of the Harvard standard. The situation is much like the data on calorie deficit discussed in the previous paragraphs. Gomez classification for body size which nutritionists use for estimating the incidence of malnutrition ceases to have a functional significance for estimating the incidence of malnutrition when the phenomenon controlling the manifestation of malnutrition is the threshold phenomenon resulting from the break down of self-regulatory mechanism governing energy and nitrogen balance in man. I should add that a threshold value does not imply that there is a discontinuity in the distribution of the risk function. It means that the risk increases sharply and the risk function is analogus to u form of distribution.

Seckler has interpreted these findings on the impairment of body function and morbidity associated with variation in body weight for age to mean that the children can be 'small but healthy'. Seckler has enlarged on this concept using Mckigney data to say that a child who is small for age need not be small for his height and analysed data for the developing countries, using appropriate cut off points for 'height for age' and 'weight for height' to find that some 90% of these children belong to the moderate and mild categories in the Gomez classification. In other words, children in the developing countries are small in height relative to the Harvard median standard but they have the appropriate body weight for their height.

It is, of course, another matter altogether to enquire how children in the developing countries came to be small. As already stated, there is no difference in the height or weight growth curves of children in the developing countries and those in the West during the first six months of child's life. Apparently, breast-feeding protects a child from infection and ensures a growth curve almost similar to the reference Harvard child. However, at about its weaning time, the growth curve deviates and the gap in stature widens with age. It is during this period that the child suffers from very high rate of morbidity and loses body weight. However, at about the age of 3, the gap in growth curves stabilises, the child adapts itself to the local ecology and the growth curve becomes almost parallel to that in the West. Seckler ascribes the small but healthy size to adaptive process resulting from an array of alternative growth paths emanating from the homeostatic nature of growth postulated for energy and nitrogen balance. Having adapted to living in social surroundings as they exist, nutrition intervention can do little to make up for the lost gains, particularly in height. It is not, therefore, surprising that school meal programs in India have made no impact on the height and weight of children to reduce the incidence of so-called mild and moderate forms of malnutrition. The truth appears to be that malnutrition of this form is non-existant. It is the wasted or severely malnourished such as those in the Gomez category III, who stand to gain from nutrition intervention but their proportion is small, of the order of 15 to 20% in children. The conclusion is consistent with the one reached in the last section.

Why then are the developing countries so preoccupied with the organisation of feeding programs and that too at the wrong point of time in child's life? Why cannot they give an equally high priority to public health measures to reduce the load of diarrhoea and other infections through provision of drinking water and improving environmental hygiene and sanitation? The answer in part is to be found is the lack of resources but more because the developing countries are led into believing that reduction in marbidity and mortality and improvement in work capacity can be achieved by improving nutrition and health services for immunisation and treatment as suggested by the evidence from field studies of village community reported from Gautemala and Narangwal India.

The limitations of these studies need to be pointed out. The study reported from Gautemala has obvious flaws in design and organisation. Its major weakness is that those who participated in the program were found to be self-selected groups and secondyl nutritional program brought with it increased, though unintended, medical attention thereby partially confounding the very efforts the study sought to evaluate. The Narangwal study is more thorough in design and analysis. However, the inference that nutrition intervention effectively reduces morbidity and mortality is based on inadequate statistical analysis. In fact, the report hardly attempts any critical analysis of the relationship between growth retardation and morbidity on the ground that morbidity data is essentially unreliable. The only analysis it attempts is to calculated prevalence rates for morbidity and show that it is staggering and tended to be highest between 7 and 15 months *i.e.* when the child is nutritionally most vulnerable. It adds that since immune capacity is known to be significantly lower in sub-clinical malnutrition, nutrition programs can be expected to help in reducing morbidity and influencing height and weight of children as a result, but does not give any supporting analysis to carry conviction. On mortality it observes that children, who are severely malnourished, that is, with body weight below 60% of the Harvard standard, experience a risk 5 times as high as the rest of the children. But it does not elaborate on the significance of this observation. I would be inclined to interpret this observation as demonstration of the threshold phenomenon governing body growth in its relation to mortality. With regard to gains in height and weight made by children receiving nutrition care, the report points out that they are statistically significant but they are small in absolute terms relative to the difference of upto 10 cm and 3 kg in height and wieght that are observed between Indian and Harvard children at age 3. The report recognises this and points out that caste differences are also important and suggests by implication that unless nutrition programs are accompanied by social change implied in the caste differences, they will not be fully effective. The fact that the proportion of children whose weight is below 60% of the Harvard body weight decreased somewhat is in keeping with the gains reported in the study. But the fact that the proportion of children beetween 60 and 70% has shown enormous variation confirms that the changes brought about by nutrition intervention are small. On the other hand, height and weight changes larger than what are reported in the study could not have possibly occurred because the design of the study omits the provision of drinking water on the ground that most homes in the Narangwal area have installed handpumps which provide relatively safe drinking water. Likewise the design of the study also omits sanitation and latrines as input variables on the ground that apart from being expensive their utilisation show a considerable time lag. It is precisely these omissions and the reasoning accompanying them which limit the utility of Narangwal study for policy decisions. It is wrong to assume that availability of water will automatically play its part in cutting down the load of diarrhoea and other infections. Social changes imply influencing attitudes and habits in using public health facilities and it is only when they become integrated into the motion of man's system for regulating energy balance and growth through self-regulatory mechanism of the type represented by autoregressive series that man is able to achieve homeostasis.

The analysis given in the preceding sections reveals that there are two kinds of problems the country is confronted with. The first is the problem of those who are under stress for lack of purchasing capacity of developing energy deficiency and its adverse consequences for health; some of these, particularly childern are even functionally malnourished. These people, amounting to roughly 15 to 20% of the total, mostly come from—

(*a*) The landless labour and marginal farmers in the drought prone areas,

(*b*) The tribal areas where people are known to live for generations together on inadequate diets, and

(*c*) Those living in the slums.

Among them, the sectors of the population who are particularly affected are infants, young children and pregnant mothers.

People in the drought prone areas not only live under threat of abrupt reduction in their levels of consumption during drought years but also experience large seasonal variations. The plight of landless labour is more miserable; they constantly seek an opportunity to migrate to the cities. People in the tribal areas have adapted themselves to condition of life which by any standard must be considered as totally unsatisfying. Much the same is true of people living in the slums. These people need food and an assured supply of income and wages from employment, besides needing health and medical services to look after the functionally malnourished members of their households. Food for work together with the primary health agencies in the different areas would appear to be an ideal instrument to deal with their problem, because while meeting the immediate needs of their household members it offers the possibility of planning their work in a way so as to create community assets with which to remove or at least reduce the intensity of the basic cause of their hunger and malnutrition, namely, lack of water. They need water for drinking, for maintaining hygiene and sanitation and for farming. Without water and appropriate social action to prevent its contamination, appropriate education to use it for maintaining hygiene and appropriate social and economic action to store and use it for farming, there can be no hope of helping them, Nutrition intervention Programme will at best help to treat symptoms-not the cause of hunger and malnutrition.

There are many examples reported from different parts of India involving communities as a whole into successful economic and social action using food in part payment of the work done. Indira community kitchen, Pune, serving some 10,000 meals a day at prices only half the market prices is an example in point. It is replicable and can go a long way in assisting in the solution of the problem in urban areas. The village project in Kirkatwadi in which community action for improving living conditions is being developed around and with active cooperation of children in the school provides another example of involving population into successful social and economic action. Collection of rain water in reservoirs and its channelling, storing and distribution as in villages like Naigaon around Purandar under the direction of Shri Salunke is another example of this effort where food for work can be an effective instrument. But all this means that co-operative measures of a social character will need to be undertaken. In stressing community and co-operative character of the work, it needs to be pointed out that future advances in agriculture in areas prone to drought and in hilly areas with poor soil cannot come easily. Dr. M.S. Swaminathan, Member, Planning Commision has repeatedly made this point. Agrnomic and other factors will each have a part to play, with *none* contributing spectacularly and yet collectively producing a sizeable increase in production adequate to warrant a risk on the part of the poor farmer and wage earner to borrow and invest. Only then the less privileged will benefit and their dependence on food aid will decrease. Failing this, the inequalities will persist. And there will of course have to be nutrition intervention programmes but coveing only infants and preschool children possibly in the form of creches and Balwadis going hand in hand with the efforts described above.

The second problem we are confronted with is the problem of poverty as distinct from that of malnutrition linked with poverty. Small stature in children is the direct result of this poverty and low socio-economic statusex pressing itself in miserable conditions of living. Intervention to deal with this problem need not be focussed on food and water; nor addressed at the individual level; its purpose is to improve environmental conditions through public health and education measures. As overall economic growth increases environmental conditions are expected to improve. This will necessarily be a slow process but this aspect need not disturb us unduly because these people will normally be in energy homeostasis and although looking small in stature for their age, cannot be considered as under risk of developing malnutrition.

On the other hand, the longer it takes to stabilise population growth in balance with resources, the larger will be the number of new entrants to the labour force and more difficult it will be to absorb them in employment which of necessity in the present stage of development must be found in the rural sector. It is for this reason that we will need to accelerate overall economic growth. At the same time, we will need to be vigilant to prune expenditure on nutrition and social programs to ensure that no wastage occurs on humanitarian programmes in the name of feeding the hungry, only to find that most funds have been unproductive. And at all costs, we will need to ensure that by resorting to such programmes we do not create a sense of dependency for food, thus striking at the very root of the value of dignity so characteristic of human life. In any programmes, we choose to have, the aim must be to develop self-reliance in the needy as in Indira community kitchen and other projects described above.

And lastly, even at the cost of repetition, it needs to be said that it is fallacious to assume that the more food one consumes the better is the nutrition status. It needs to be recalled that a man is a homeostat; he functions as one whole; anything that disturbs state of homeostasis sets in motion a series of reactions that overcome the disturbing factor. This in the meaning when we say that nitrogen and energy balance in man in health, engaged in specified level of activity is auto-regulated. This behaviour needs profound understanding by social scientists and planners before they set out to evolve a comprehensive approach to combat poverty related malnutrition. The very fact that the production levels in India are low and that the problem of malnutrition is confined to lower 20% of the people are evidence enough of the scope they offer in meeting the challenge ahead of us.