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NUTRITION AND DEVELOPMENT:

THE VIEW OF THE PLANNER[#]

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NUTRITION AND DEVELOPMENT: THE VIEW OF THE PLANNER

Alan Berg and Robert Muscat

In recent years we have heard much about the magnitude and implications of malnutrition and the need to attack the problem with a new sense of urgency. Yet when looking at the development plans of most countries in the developing world, one seldom finds nutrition getting more than passing mention. Even where better nutrition is cited and discussed as an objective of a plan, its relative priority -- measured by allocation of resource, or specific policy proposals -- is low.

One is therefore tempted to ask: Have we demonstrated a convincing case that malnutrition should warrant more funds, given the competing demands on scarce resources?

In a paper in 1969 (1), we examined a series of policy issues relating to this question and concluded then that from the planner's view, an acceptable case for nutrition had not been made. It was also said that until a sufficiently strong case is presented, the impact of the extensive research of the scientific community would not reach beyond the periphery of the malnutrition problem. Since then, a rich dialogue has developed among many of those sharing these concerns. Issues have been more sharply defined, new rationale has been examined, and new conceptual approaches have evolved. In short, we believe the case can now be advanced for nutrition's role in the mainstream of development. This paper is an attempt to explore that case, looking at nutrition from the viewpoint of the development planner.*

At the outset we should state an important caveat to be borne in mind throughout this paper. We do not mean to imply either that malnutrition can be treated or overcome in isolation from other elements of the socio-economic framework, or that better nutrition alone is a panacea for underdevelopment. On the contrary, nutrition is one of the many interrelated determinants of human performance requiring advancement. We do question whether the relative importance of nutrition, its role among the many factors, has been given the attention it deserves. We also suggest that under certain circumstances nutrition may be a precondition to the advancement of these other factors.

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* Some nutrition proponents may take issue with this approach. It is commonly argued that the very fact of widespread malnutrition is itself grounds for large programs; that children should not have to justify their sustenance on societal economic grounds. With clear appreciation of the human tragedy implied in malnutrition, we point to the evidence that over the years the case for nutrition as a moral imperative has proved insufficient to claim more than a token portion of development resources.

SIZE OF THE PROBLEM

In examining the relationship of malnutrition to national development, the planner's first interest is the magnitude of the problem. This need be discussed only briefly to set the problem in its broad context. We will consider child mortality, the relationship of malnutrition to that mortality, and malnutrition of the survivors.

By any measure, child mortality in developing countries is of staggering proportions.*

- Children under 5 in Pakistan and Brazil consitute under one-fifth of the population, but account for four-fifths of all deaths; in India, for 65% of the deaths, in the U.A.R ,68%. (In industrialized countries, deaths at this age are significantly smaller than their age proportion in the population, e.g., in Sweden, young children account for 7.4% of the population, but only 2.2% of deaths.)
- The percentage of children ages 1 to 4 who die in Pakistan is 40 times higher than in Japan; and 80 times higher than in Sweden.
- Of children between the critical ages of 1 and 2, the proportion of deaths in rural Punjab (one of India's strongest and healthiest areas), is 72 times higher than in Sweden; in the U.A.R. it is 107 times higher and in Gambia, 111 times higher.

Although it is difficult to isolate a single cause for these death rates -- a number of obviously related environmental factors are involved -- there is little dispute to FAO's contention that "malnutrition is the biggest single contributor to child mortality in the developing countries." (2) Studies currently being conducted in 8 Latin American areas report malnutrition to be the underlying or an associated cause of 52% of all deaths of 1 to 4 year olds (3). In Monterrey it is 65%; in San Salvador 67%; in Recife 70%.** Even in the early months of life (1 to 5 months), malnutrition was related to 58% of the Recife deaths. The same Latin American study shows that immaturity -- often nutritionally related -- caused 47 to 74% of deaths in the first month of life. A recent study from Jamaica (4) reports that 65% of deaths in the 6 to 36 month old children had malnutrition as either the primary or a contributing factor.

The 5 principal causes of childhood death account for 50% of all preschool deaths in a sampling of developing countries.*** Deaths due to all 5 causes are often nutrition-related. For example, the Latin American study estimates that among children under 5, malnutrition is an associated cause in 55% of the deaths attributed to infective or parasitic diseases.****

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*See Appendix, Tables I and II.
**See Appendix, Table III.
***See Appendix, Table IV.
****See Appendix, Table V.

Deaths are measurable. Less dramatic and less visible is the toll among the survivors. How widespread, the planner then wants to know, is malnutrition? How severe is it and what does it mean? FAO recently reported that of the 800 million children now growing up in developing countries, more than two-thirds will "encounter sickness or disabling diseases either brought on or aggravated by protein-calorie malnutrition" (5). Children who do survive will be plagued by illness that might not occur or be as serious were it not for their reduced resistance caused by malnourishment. Recent studies in Latin America, South Africa and India show that 20 to 30% of the time, the young child is experiencing acute infection (6). A sense of the severity within this group is suggested by a summary of 16 of the most recent nutrition surveys (7). This shows a range of severe malnutrition, (i.e., third degree: below 60% of standard body weight per age), from 0.5 to 4.5%. An additional 25% of the children are commonly found to be suffering from moderate malnutrition, (second degree: 60 to 75% of norm). Thus, in some areas, such as rural Mexico, almost 1 out of 3 children fall below 75% of the accepted standard. It has often been reported elsewhere that an additional 40 to 45% of the children have mild malnutrition (first degree: 75 to 90% of norm).

Three standard techniques have been used to measure the extent of malnutrition: food-balance sheets, consumer expenditure surveys, and direct nutrition surveys. Each has its drawbacks,* but taken together, the different methods

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* A method developed in great statistical detail by FAO is the food-balance sheet. This estimates supplies of different foods available within a country (or region), and translates these supplies into calories and nutrients to compute per capita availabilities. (Both supplies, population and food demand can be projected forward to form an estimate of how the demand-supply situation might look, say ten years ahead, under a given set of assumptions.) Per capita availabilities can then be compared with recommended standards for that country to arrive at an estimate of the aggregate nutritional gap. There are several problems associated with this method, chief of which is that all aggregate measures conceal the features of the complex reality they describe. The approach does not take account of income differences within the population, regional variations, or intra-family food distribution mores. Thus, it does not yield an estimate of how many actually are suffering from malnutrition, or a profile of who they are. Since even countries with apparent large surpluses of nutrients, as shown in the balance sheets, still have malnutrition problems due to the wide variations around average intake, (and associated health problems that show a higher incidence in the poorer groups), this approach does not indicate absense of a problem where an aggregate surplus exists, but it does guarantee that a serious problem exists where a country has anything less than a moderate surplus.

A second technique uses a combination of income distribution data and consumer expenditure surveys. The latter often tell us how much of what foods are purchased, by what levels of income or expenditure. This information can then be paired with

income distribution data to derive estimates of the numbers of people consuming different levels of calories and nutrients. Two recent studies illustrate this method. One by P. D. Ojha (8) estimates that at least 60% of the Indian population in 1960/61 (about 200 million people), was consuming less than the minimum recommended daily calories. A study of Korean consumer income and expenditure data estimated protein deficiencies by broad occupational categories, concluding (for example) that 90% of the households of urban "daily workers" were in a critical deficiency range (9). Depending on the reliability and detail of the data, these surveys can give a good picture of the overall magnitude of nutritional deficits, the distribution of the deficits among areas and groups of the population defined according to different characteristics, and the apparent consumption levels of different nutrients. Although these methods provide a closer look than the balance-sheet approach, they still omit many important characteristics of the nutrition problem, such as cooking habits and their impact on the nutrient content of food, intra-family distribution habits and incidence of parasites or other factors affecting absorption.

A third technique is the direct nutrition survey, involving a field examination of the nutritional status of a sample of the population. For the specific group studied, this is the most accurate of the three determinations, but also the most costly, the most time-consuming and the most difficult. By necessity, the sample is small and question may be raised as to how representative it is of the whole population. Virtually all national populations are nutritionally heterogenous. Thus, any sample for identifying specific nutritional problems is less useful the larger is the proportion of the population that the sample is meant to describe. In making necessary comparisons among various surveys to project a broader picture, one often runs into a lack of standardization of clinical definitions, uneven representativeness of the materials, and methodological problems such as failure to make allowances for seasonal variations.

present a consistent and reasonably reliable picture of a problem of major magnitude. Information available from studies employing the three techniques demonstrates the presence of an enormous mass of subclinical malnutrition in the developing countries, i.e., malnutrition that does not show up in conventional medical statistics. This mass amounts to something on the order of a billion persons (10).

ECONOMIC IMPACT ON THE INDIVIDUAL

Having obtained some idea of the magnitude of the problem, the planner next may ask: What does malnutrition mean to the individual as economic man and thus, in a composite sense, to society and to national development? The planner hears that malnutrition affects mental development, physical development, and productivity. He wants to know to what extent this is so and in what ways and to what degree this affects national development.

Mental Development: It is now clear that malnutrition during the fetal period and in infancy is associated with intellectual impairment. Severe malnutrition reduces the size of the brain, decreases the number of brain cells and is responsible for abnormalities of behavior (11). Some beginnings of functional quantification have been attempted, and the results are not pleasant to contemplate (12).

Recent research also suggests these changes may be irreversible and that severe malnutrition* could be responsible for a permanent impairment in brain development and ultimate function (13, 14).

Those directly working on this question, such as Winick, generally contend "the evidence is becoming more and more weighty that malnutrition in infancy permanently affects the minds of the children who have been afflicted." (15) Others, such as Frisch, although appreciating the difficulties of such investigations, find shortcomings in the existing studies and thus conclude that "surmises should not be treated as facts." (16) Unfortunately, the question whether damage brought on by malnutrition is reversible has dominated our thinking and our work, and has tended to direct attention away from the more significant public policy considerations. This is understandable; the mention of irreversibility suggests a dramatic difference in kind, a difference infinitely less tolerable.

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*Perhaps because of the difficulty in isolating the nutrition variable, almost no work has been conducted to measure the effect on brain function of mild or moderate malnutrition. Although there is observational reporting suggesting a lag in mental performance, clearly more quantification is desirable.

This has been reflected in discussions we have had with public officials who imply that "if malnutrition is irretrievably limiting, we must quickly do something about it; if it isn't, it is a matter of lesser importance and poses a lesser sense of urgency."

Such posture is dangerously misleading. Two points need to be made to place the matter in policy perspective.

First, malnutrition clearly interferes with a child's ability to learn, whatever its ultimate effect on the condition of the brain itself. Learning time is lost during the most critical periods of learning. A malnourished child is listless, lacking in curiosity, and unresponsive to stimulation. Even if he were less passive, the maternal stimulation a small child requires for proper development frequently is unavailable; the mother herself often a victim of nutrition lethargy.*

Whether a child's apathy results from his own or his mother's nutritional deprivation, he is late in reaching the standard development milestones. He slides from the norms, and by the time he enters school he already is behind his adequately nourished classmates. This child is less aware of his world than are his well-nourished counterparts. Much passes him by. He is mentally and physically fatigued and thus has difficulty being attentive in class. Frequently he seems detached from the life around him.

If this were not a sufficient competitive disadvantage, the malnourished youngster falls further behind because of his frequent bouts with nutrition-related illnesses. In the United States an estimated 8 school days a year are lost because of sickness (18). It has been computed in four Latin American countries that more than fifty days of school are missed a year because of illness (19). In some instances this constitutes one-third of the available school days.

The malnourished child thus falls still further behind, often until he is unable to cope with the school situation.** Obviously, other factors are also at work, but there is little doubt that malnutrition contributes to the poor performance, to the low aspiration to higher education levels, and to the

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*Rosenzweig reports that stimulation may affect brain size (17).

**To the extent the duller children fail to advance in grades, they occupy seats that others might fill. The level of a teacher's instruction to all students must be lowered to accommodate the scope of comprehension of the dull children. Thus, the returns to education expenditure where the dull child is present are reduced by malnutrition.

substantial student drop-out rate often found among the poorly fed portions of the population.

Thus, whatever may or may not happen to his brain development at some future date, the malnourished child is permanently handicapped. He has suffered an irreversible loss of opportunity.

A second and perhaps more compelling policy consideration concerns the uncertainty of the relationship between malnutrition and permanent mental retardation. Discussion of reversing mental deficiency assumes that the nutrients now in short supply will be available at some future date. We have attempted in earlier papers (20, 21), to demonstrate that this is an assumption of questionable validity. For a substantial portion of people in developing countries, that 'future date' will not fall within their lifetimes, given their present low incomes and likely rates of income growth. For example, for a third of the families in India at least twice the current incomes are required to meet even the minimum acceptable diets. Unless a new nutrition strategy is evolved to shortcut the traditional means of providing nutrition, it will be well into the next century before more than 150 million Indians will afford even a minimum adequate diet. And it has been suggested that these projections were overly optimistic, being based on a 5.5% annual national growth rate, compared to a 3.5% trend over the past 13 years.

All this questions the policy relevance of the discussion about reversibility or irreversibility of mental retardation. It also emphasizes the need for solutions other than conventional income solutions to meet the nutrition problem.

Physical Development: Next we come to the relationship of nutrition to physical growth. Heredity is the key to the ultimate size a youngster can attain, but it is nutrition which largely determines how close he will get to his genetic potential. It is now clear that large parts of the populations of the developing countries are falling significantly short of their genetic potential because of inadequate nutrition* (22). In fact, low income populations have an almost universally smaller body size. According to FAO, more than 300 million children from these groups suffer "grossly retarded physical growth." (24) It is not uncommon to mistake these youngsters for healthy

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* Bengoa has written that "Despite genetic differences and other disease factors ...short stature in a population is now regarded as an indication that malnutrition exists, and plays an important role in physical development in many developing countries," (23) i.e., a person small for his age may well have been malnourished during some important period of his development.

children, though their growth may be retarded 20 to 30%. This means that by the time the child reaches the age of 12, he has the physical development of a normal 8 year old.

Other than for certain kinds of jobs requiring more than average physical prowess, physical size in itself generally is not economically significant. More important is the possibility that the shortfall in size may be related to a shortfall in performance. It is now clear that small stature often reflects the disabilities of stunted mental growth. A study of presumably healthy Arab children (25) showed that alertness, good proportions, and good physical condition camouflage dwarfing to such an extent that "without knowledge of their exact age they could have been taken for healthy children." In fact, 70% were short for their ages and their accomplishments and behavior were more in keeping with their size than their age. Similar observations were noted in Mexico (26).

Other Productivity Considerations: The above concerns result primarily from inadequate quality of diet, especially childhood diet. The relationship of nutrition to productivity also poses what is largely, (although not solely) a quantitative consideration. Man is subject to the laws of thermodynamics; he must absorb energy to produce an energy output (27). Classic work studies during and following World War II (28), as well as the numerous studies of output before and after the introduction of factory feeding programs (29), show a direct relation between dietary improvements from clearly inadequate starting levels, and subsequent increases in work output. Those who would apply the usual caveat that the observed correlations do not prove a direct causal relation may be justifiably skeptical in cases where other motivational factors are at work and where the diet outside the institutional feeding has not been properly observed. But it would be too fastidious to quarrel with the general conclusion that these studies corroborate, under closely observed conditions, the commonly observed fact that inadequate food intake leads men to make compensating adjustments in energy output to preserve their internal processes.

The adult worker with an inadequate diet compensates for this intake shortfall by living, in effect, a less than average life as a less than average man. His adjustment falls short of putting him into a clinically defined state of undernutrition or malnutrition. It comprises a mixture of slowly paced work, savings on muscular exertion, opportunities for innovation or extra effort foregone, low body weight, and a moderate departure from

a condition of general well-being -- in short, a mix of work performance below a man's potential and a chronic condition of ill-being. As indicated earlier, the picture is further complicated by the interaction of malnutrition and other sources of illness.

Most of the concerns reflected in the foregoing discussion are a consequence of protein and/or calorie malnutrition. These are the most severe and widespread of nutritional deficiencies, especially among children in the formative years. Additional problems are induced by inadequacies of other nutrients, either directly or in combination with protein and/or calorie shortages. Although there exists a profusion of medical studies of the diseases emanating from these deficiencies, data on their prevalence is sparse. One comes away from a search of the literature sensing that the generous space nutrition textbooks devote to these once serious problems may no longer be a valid reflection of their importance in today's world. This is not to suggest that such classic nutritional deficiency diseases as rickets, scurvy, beriberi and pellagra no longer exist. Rather, for policy purposes, as a general rule they are of only secondary importance.* There are two reasons for this: first, where such nutrient deficiencies have been identified, and where a feasible method of distributing a dietary supplement exists, the cost of corrective programs are likely to be relatively modest. They pose for the planner no major resource problem of a size approaching the problems of protein/caloric deficiencies. As such, an effective plan to eradicate such deficiencies would not be likely to prompt serious resistance. Second is the matter of numbers. The cases of such diseases probably are relatively few, at least when compared with protein deficiencies that can be measured in the hundreds of millions.

There are two prominent exceptions. Among some adult populations, nutritional anemia is a widespread deficiency. The resulting sickness and sluggishness is a condition so common in poorer societies, it is often accepted as the norm. Nutritional anemia is particularly severe in pregnant women -- 56% of expectant mothers studied in South India are anemic; 80% in North India (30) -- and is responsible for a considerable portion of maternal deaths (31).** Nutritional anemias in mothers are also responsible for the

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* A rule that does not hold in certain areas under certain sets of unusual circumstances.

** It should be noted in this connection that maternal death rates of developing countries are many-fold those of more affluent societies. India's maternal death rate is 17 times that of Denmark's. (32)

precarious health of the newborn. Premature births are much more common among anemic mothers, and premature children are much more likely to die. 70% of the deaths in the perinatal period were in infants weighing less than 2.5 kg. at birth (33). Anemias are also common among children; 50% of those studied in a recent large Indian survey were anemic (34).

The second exception is vitamin A deficiency, which in its most severe form of deprivation can lead to blindness.* Estimates have been made that in India alone there are more than 4 million cases of blindness, a million of which are of nutritional origin and thus preventable (36). But these numbers in themselves are a bit misleading, since children blinded from diseases brought on by inadequate vitamin A often will not survive. In Indonesia, for every survivor, one child dies. And the survivor then has a lower chance for further survival than his age partners (37). For every Indian case of total or near-total blindness, another three Indians are said to be suffering from mild to moderate degrees of visual handicap (38). For example, 10 to 15% of children in India are said to suffer from night blindness and more severe ocular manifestations of vitamin A deficiency (39). Further, the severity of protein deficiency cases is intensified when accompanied by vitamin A deficiency. Usually, good hospital treatment can lead to recovery of half of the cases of severe protein deficiency. When vitamin A deficiency is also present, the fatality rate rises to 80% (40).

IMPACT ON NATIONAL ECONOMY

What effect do these individual disabilities of malnutrition have on economic development?

Human Capital: Malnutrition is a disease. Expenditures to overcome or avoid disease have commonly been regarded as a form of consumption, and consumption is often an unwelcome word in the halls of national planning agencies. This has not always been the case. Earlier developers of economic thought recognized that wealth flows from some kinds of expenditures on people, which were tantamount to investment in human capital, as well as from investment in non-human capital. Their view implies that expenditures to prepare a person to enter the labor force, or subsequently to increase or maintain

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* Although compilations have been made of available studies (35), it is still difficult to assess the magnitude of this problem. Comprehensive statistics of quality are rarely available, and when they are, they often differ as to what constitutes blindness. It is even more difficult to assess the numbers who are blind because of malnutrition. Also, the % of malnourished children who show clinical signs of eye impairment varies considerably from region to region.

his productivity eventually will produce a flow of income. However this train of thought was eclipsed by the more mathematically precise economic growth models that came into vogue in the 1940s.

The planning models in general use do not take explicit account of the notion of investment in human beings. The models develop a view of the growth process which sees increases in tomorrow's income as resulting primarily from today's additions to material capital (or investment). The nature and productivity of the investment then determines the extent of the increase of future income.

Obviously, the more one consumes today, the less is available for investment -- and thus, for generating future income tomorrow. Viewed in this light, consumption becomes an enemy of growth, not a handmaiden. Investment in steel plants, large dams, and other modern temples thus attained a new kind of sanctity. Consumption in the form of educational and health services, clothing, and eating -- and even more flippant forms of consumption such as entertainment which can affect a person's motivation -- is recognized as having an instrumental impact on productivity. But since the effects are so difficult to identify, all growth in income is imputed to those measurable factors included in the model.*

Expenditures on health have suffered from this stigma. In the national accounts they fall in the category of consumption. They contribute to the current sense of well being and are consumed immediately, as is food or a visit to the cinema.

In recent years, however, a new school of economic thought has begun to advance beyond the confines of the models. A body of literature has developed the theory of human capital, measuring returns to investment in people. Guided by the techniques applied to measuring material capital and the returns to investment, several writers have attempted to develop similarly rigorous approaches to human capital. The impetus to extend the concept of capital to human beings, developed from the observation that the theory previously used could not explain all of the increases in national output that had been achieved in several countries. As Professor T. W. Schultz,

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* The planner's personal vision may transcend the confines of his model -- or at least the inherent bias against consumption, but his plans are constructed around the model nonetheless.

a leading proponent of the development of human capital theory, wrote in 1961:

> Although it is obvious that people acquire useful skills and knowledge, it is not obvious that these skills and knowledge are a form of capital, that this capital is in substantial part a product of deliberate investment, that is has grown in Western societies at a much faster rate than conventional (non-human) capital, and that its growth may well be the most distinctive feature of the economic system. It has been widely observed that increases in national output have been large compared with the increases of land, man-hours, and physical reproducible capital. Investment in human capital is probably the major explanation for this difference (41).

Elaborate work by Denison (42) and others (43) has shown that a significant part of economic growth in the United States and Western Europe has been attributable to education, but that even after taking education into account, there remains an unexplained residual growth. Denison attributes this to "knowledge". To examine these efforts and their limitations further would exceed the scope of this paper. For our purposes, it is enough to note here these authors reflect a breakthrough in economic thought -- a recognition that the quality of the labor force is an important factor in economic growth.

Inspired by this development in the theory of education, economists have attempted to develop a parallel approach to the economics of health. Several methods have been devised to measure the economic returns and they show substantial returns to health investment in the United States. The most common technique is to compare the costs of preventing a death with the worker's future income, had he lived (44).* Another measurement is the investment in human capital that is lost through death any time prior to retirement. This second approach yields an estimate of the health "capital" that has been invested in a member of the labor force, along with food, clothing, housing, education and other expenditures necessary to enable a person to develop his particular skills. A variation in this approach measures the economic cost of debility, where death is not a factor (45).

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* The ratio of the income benefit to the costs of preventing its loss, is a ratio that is comparable to benefit-cost measurements of more standard project analysis. It is sometimes objected that the individual's future consumption should be deducted from his income in calculating the net benefits. This is an error, since the objective of growth (and of economic activity generally) is future consumption, not merely the residual after personal consumption. The benefit consists both of a life saved and the consumption enjoyed by that person; if he also turns out to generate for future investment, so much the better.

Whether an illness results in temporary loss of work days, or some temporary or permanent reduction in work capacity, the loss in output can be estimated in various ways and added to the cost of medical care. This can then be compared with proposed expenditures for preventing the occurrence of the illness in the first place.

Similar techniques are applicable in measuring returns to expenditures on better nutrition. From the earlier discussion of the impact of malnutrition on the individual, an improvement in nutrition (or an avoidance of undernutrition or malnutrition) can be economically equivalent to curing (or preventing) any other disease. Improved nutrition that returns an absent worker to the active labor force, or that overcomes a debility that is reducing a worker's productive capacity, or that enables a child to return to school or to improve his understanding or retention of things taught, or that enables an adult to absorb more effectively in-service training or the advice of agriculture extension, clearly increases the flow of earnings above what it would have been in the absence of the improvement in well-being.

Once a person is restored to well-being, adequate nutrition (e.g., sufficient iron supply), is a maintenance expenditure. From then onward it contributes to present income only in the sense that in its absense, the person would lose some of the income-generating capacity he or she has when nutrition is adequate. And it contributes to future income in the sense that its absence would interrupt current learning, or otherwise dilute activities that are necessary or contributory to future income generation.* Increments of nutrition lead to diminishing increments in potential productivity and then only up to a certain point. Beyond that point, in either quantity or quality, further increases in ingestion at any one time do not contribute to productivity, and in fact can reduce it.

In sum, an improvement in nutrition can have a continuing, current or maintenance effect on the productivity of an active member of the labor force, or it can take the form of an investment, enabling a person to earn a higher future income stream.

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* All distinction between consumption and investment would be destroyed if the expenditures on eating by all people who were adequately fed were labelled investment by extension of the idea that they were a necessary condition for maintaining a flow of income.

Returns in a Developing Country: Let us assume that our planner accepts the notion of human investment and the logic of the methods for calculating the benefits from avoiding death or restoring (or increasing) productivity through reducing or eliminating malnutrition.* These analyses of the developmental importance of nutrition and well-being have been worked out for economies already highly developed. Before the conclusions can be aggregated and applied to the poorer countries, the planner faces another set of problems arising from important differences between developed and developing economies.

We might start with a benefit that is often central to discussions of health economics, the savings of medical costs where adequate nutrition would reduce the number of clinical admissions into the medical system. As long as there is an unsatisfied demand, i.e., as long as the potential case load exceed the treatment capacity of the medical system, the elimination of a kwashiorkor case frees up a bed (and other medical resources) for some other sick person who was otherwise unable to gain entry into the system. Since this is the typical situation, reduction of malnutrition is not likely to bring about a reduction in current medical expenditures, or a slowing of the rate of growth in medical system investment, given the inadequacies of these systems. However, the adequate nutrition would enable the system to increase the welfare and restore the productivity of all those persons on the queue who would then be able to gain entry.**, ***

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* The reader should be reminded of our initial caveat. Reduction of malnutrition and consequent realization of benefits may require joint attacks on other related problems, particularly synergistically-related diseases.

** The childhood morbidity data referred to earlier indicates the contributory role of malnutrition to some of the major prevailing childhood diseases. Examination of medical system statistics in any country would show the extent to which these diseases claim medical resources, and would give an indication of the numbers of people on the queue who might gain access as a result of reductions in malnutrition-related morbidities.

*** A benefit that has been cited but does not seem appropriate to transfer to a developing country is the saving in additional nutrients that a sick person otherwise consumes if his illness involves a loss in the efficiency of absorption. In such situations, the person must offset the malabsorption by eating more during the period of recovery (46). Where malnutrition is widespread, and food supply and income levels place severe limits on the consumption available to low-income families, the malnourished either do not have access to these medically-recommended high intakes (if they did, the malnourishment would not have arisen in the first place), or the extra needs of the clinically ill must be met by reducing the intake (and increasing the malnourishment) of those suffering less severe deprivation. In short, it cannot be said there would be a saving of cost when no cost is actually being incurred.

A category of benefits that appears to be potentially very large for a developing country* is the reduction in productivity losses caused by the debility of a substantial portion of the labor force. Calculation of these losses, using the standard methods of health economics in the developed countries, would be extremely difficult. Medical data of the kind needed for such calculations are not available for most developing countries. The excess demand on the medical system also means that many of the sick never enter the statistics. The data that are available often reflect cursory diagnoses by paramedical personnel or by doctors whose need to work their way through long queues prevents careful examinations. Moreover, the synergistic character of much prevailing illness makes it difficult to pin down the exact contribution of malnutrition to illness or death. Beyond these problems is the overriding fact that most malnutrition does not show obvious signs and it rarely puts the suffered into the queues. Thus, the methods used to measure returns to health in the developed countries** are, with some exceptions, usually not very helpful in the developing countries. This is especially true for the added step of determining the malnutrition component.

An alternative approach is to use aggregative data on food supply and the occupational distribution of the labor force. An interesting example is the work of Correa (47). He starts with an estimate of daily caloric need in different occupations which was worked out by Lehmann and others in Germany in 1949 (48). The German study calculated the % shortfalls in work capacity resulting from different levels of shortfall in caloric intake. Correa works out the average caloric need for a country by dividing its labor force into occupational groups comparable to Lehmann's and then calculating a weighted average caloric requirement for 100% physical capacity (with adjustments for temperature and other factors). By comparing this average with the average national caloric consumption derived from food balance calculations, Correa arrives at national working capacity

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* But much smaller for a developed country, especially where the prevailing social philosophy calls for relatively equal income distribution.

** In the developed countries, the fact that a very large fraction of the labor force is registered under institutional arrangements of some kind means that days lost due to illness, and even the nature of the illness can be derived from non-medical statistical sources outside the medical system itself, such as employment data, or medical insurance records. In the developing countries the coverage of medical insurance is normally small, and the large fraction of the labor force that works outside formal institutionalized employment, especially in agriculture, precludes generation of such data.

shortfalls, which for developing countries are almost always very substantial, many being as high as 50% or more.*

The Problem of Surplus Labor: In attempting to apply to a developing country any of these methods of calculating the cost of ill-being for present output (or for future output, in the case of a death prevented or a worker brought up to and kept at "par"), one must reckon with the implicit assumption behind all such studies, that the labor force -- or more precisely, the occupational groups in which the relevant individuals fall -- is fully employed. Restoring a person to good health adds nothing to national production if he has no meaningful job. In our discussion with development economists, this is perhaps the most frequent and basic objection raised to all claims for economic benefits to better nutrition.

Developing countries are usually assumed to have a substantial labor surplus resulting from a combination of open unemployment and underemployment. This appears at first glance to weaken the case for seeking productivity benefits from better nutrition, especially for the masses of the unskilled. Although it would take us far afield in this paper to examine the employment problem in any detail, it will be useful to touch on a few aspects that have emerged from recent studies. These are changing our

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* As Correa recognizes, this method poses the same problems that limit the usefulness of the aggregative methods for estimating the incidence of malnutrition. Data limitations necessitate numerous heroic assumptions. The model equates productivity with human energy capacity, a weakness of all static "caloric gap" calculations that cannot take into account the impact of malnutrition on physical and mental capacity during the growth period of those now included in the labor force. A high level of aggregation (e.g., agricultural labor would include everything from chicken keepers to lumberjacks) and lack of regional or ecological differentiation (e.g., the differences in nutrients based on soil quality) can easily lead to large errors, and to the overlooking of the detailed features of the malnutrition problem that would enable one to understand its characteristics and draw relevant programmatic and policy conclusions. Still, the approach is imaginative and conceptually useful. It lays out for the first time, step by step, some of the links between impact on the individual worker and final aggregation into potential impact on the national economy. For a single country, a more refined model could be developed using finer breakdowns of the labor force, adjustment of Lehmann's factors for local conditions, estimates of caloric requirements more carefully adjusted by occupation and local conditions (including seasonal factors) and estimated daily intake by income level. While this more elaborate approach would take one closer to an estimate of a potentially significant economic shortfall for occupations heavily reliant on human energy, it would stop short of taking account of important additional factors such as early childhood diet, intra-family food distribution, the impact of cooking habits on nutrient content, and the problems of efficiency of absorption.

previously oversimplified picture and thereby are weakening the implication that health expenditures in developing countries are essentially welfare improvements with no productive economic payoff.

First, in rural areas it is often more common for labor to be in short supply than in surplus during harvest and other periods of intense activity (49).* Do these workers try to feed themselves seasonally to higher capacity, like draft animals, then recede back to undernourishment and apathy during the slack periods? What happens to productivity when a person undergoes a chronic regime of alternating periods of malnourhishment? Can wage labor feed itself up to par in the weeks preceding harvest, when its cash income is at the lowest annual point and grain prices are at their pre-harvest peak?** It is commonly said that in some countries a significant portion of the workers could be taken off the land without affecting production. Perhaps during certain months this may be so; on an annual basis with present technology it clearly is not so in most cases, and in the future it will be even less valid. With the spread of irrigation, now spurred by the development of the higher yielding and faster maturing varieties, slack time during the agricultural year is diminishing.***

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* This short labor supply condition may be reflected in labor-saving arrangements such as have been common in Thailand's rice delta, where there would not be enough people to harvest the rice if it all matured at the same time. Accordingly, farmers plant paddy fields on different days during planting season to be able to form groups that harvest each member's fields in succession as the rice matures on a staggered schedule. Or short supply may be reflected in market conditions -- that is, seasonal increases in wages -- where harvesting and other activities are usually carried on with the help of wage labor. This has been dramatically illustrated in India's wheat areas with the substantial increases in the size of crops to be handled that have resulted from the spread of the new high yielding varieties.

** Labor which is dependent on seasonal employment and market wages but has some mobility, is in a different position from labor which traditionally makes annual contracts with a farmer under which compensation takes the form of partial wages in kind and the labor resides on or near the farm. In the latter case, there may be no seasonal fluctuation in the availability of foodgrain to the worker, and he has no geographic mobility in slack periods.

*** The impact of these developments on the demand for agricultural labor will vary by crop and by changes in technology, particularly the opportunities for and economies of mechanization. The eventual impact of the new agricultural technology within the context of overall economic expansion, on the demand for labor raises issues beyond the scope of this paper (50).

Second, even where open unemployment exists, many functions impaired by a worker's malnourishment cannot be satisfactorily fulfilled by hiring additional workers. In such cases the existence of a surplus does not argue against returns to better nutrition. In other words, quantity cannot substitute for quality. If a job is strictly machine paced -- that is, the machine has an independent rhythm, perhaps in a sequence of timed operations on an assembly line -- a chronically malnourished worker would have narrow scope for reducing his performance below the machine's automatic demand on its operator. In such a situation, malnutrition might be reflected in shoddy output. This is of special significance when the worker's manual precision or strength figures in the operation, the quality of the work being dependent on the quality of the worker. Malnutrition also is reflected in accident rates and absenteeism. The literature contains numerous examples of factories where feeding programs were introduced and lower accident and absenteeism rates were subsequently observed (51).*

Third, it is worth recalling that many areas of the developing world have relatively low man-land ratios and do not appear to have a substantial underemployment problem. Much of Southeast Asia was historically a textbook case of what Adam Smith called a "vent for surplus" economy. This is an economy in which only an increase in export demand was needed to motivate farmers to extend their area of cultivation, trading leisure for additional work to take advantage of a vent for exporting the potential surplus. Many parts of Africa today would seem to fit this description, which is becoming less apt for Southeast Asia as increasing population pushes into marginal lands.

Fourth, on closer examination, the pool of unemployment in many urban centers is not the commonly perceived homogeneous army of mere surplus human energy. Although considerable numbers of unskilled laborers are included in

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*While a reduction in accidents brings about both a welfare and an economic gain, the impact of reduced absenteeism is less clear in an employment market characterized by open unemployment and where employers make a practice of hiring apparently redundant labor, a common industrial practice in some countries. If two men are in effect sharing one place at a machine or work bench, the absenteeism of one is covered by the presence of the other, the employer (and the employees) sharing the wage for one work place between two men. If one of them were fed enough (and diet was sufficient alone) to eliminate his absenteeism, the result would be an increase in unemployment (unless union rules barred firings for mere--real--redundancy).

the pool, recent studies show there is also a large amount of unemployment among the educated. The rate of urban unemployment is greater among skilled and educated young people than among manual laborers.* The young remain unemployed for a while by choice preferring to wait for the job that will gain them entry into the professional field for which they are trained, and in which they will earn the largest future stream of income. This portion of the pool is conspicuous, often volatile, and therefore a problem; but it reflects what economists call frictional unemployment.

In sum, to dismiss the value of nutrition as a factor in increasing productivity is to assume that underemployed labor is available** in the vicinity of an activity, at the right time, that it possesses required skills, and that the work is technically capable of being divided among more workers than are currently employed. Conversely, however, provision of adequate nutrition to an adult now in the labor force does not necessarily lead to higher output and may not be the most efficient route to higher output. Better health may be a necessary condition to a worker raising his productivity, but it is not a sufficient condition if health is only one of a number of obstructions, such as lack of cooperant factors, or limitations of technology, that have the effect of limiting the possibilities of additional returns to additional labor input. The conditions just spelled out may well exist to a significant extent in some rural areas. Whether an economically relevant labor surplus really exists at a given time and place, and what factors bar that surplus from productive employment, are empirical questions to which no general answers can be given apart from empirical examination. The key economic question, however, is not merely whether positive returns are possible, and under what circumstances, but rather how these returns compare with costs and with alternative resource uses. Before commenting

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* For instance in Malaya (1965), the urban unemployment rate among males 15 to 24 with secondary education was 30.9% and among those with primary education 19.5% compared to 10.4% among male illiterates of the same age. In urban areas of Venezuela (1969) the rate among laborers with secondary education was 10.2%; with primary education 7%, and among illiterate laborers, 4.3% (52).

** Or can be made available at a transfer cost lower than the incremental nutrition cost of providing equivalent work from the labor already in the vicinity.

on this, we should touch on two other aspects of the nutrition/productivity relationship.

Quality of Human Labor: Implicit in both the surplus labor model and in the attempts made thus far to measure the national production "cost" of malnutrition is the assumption that productivity is exclusively a function of human energy -- of numbers of workers. Although energy loss no doubt is substantial, it is a limited basis for calculating the effect of malnutrition on national production. As development proceeds, human quality becomes more important than sheer physical capacity. Human energy gradually is replaced by machine energy (combined with more refined human skills) in many occupations traditionally reliant on human (and animal) strength. The proportion of the work force in agriculture declines, thus reducing demands on human physical energy output. Although this may sound like a longrun description of the development process, it is in fact already happening in many parts of Asia.

Timely initiative, physical dexterity and comprehension of increasingly sophisticated techniques all become critical to the successful exploitation of the new technologies. It has been commonly observed, for example, that large numbers of farmers fall short of maximizing net returns because they fall short, in varying degree, from full application of the recommended practices for cultivating the new high yielding varities. To some extent this failure reflects constraints beyond the farmers' control,(e.g., in accessibility or high cost of credit). Other shortfalls like planting depth error are not economic, but reflect factors such as education, mental performance level, dexterity and attention.*

Probably the most important example of how poor quality cannot be compensated for by quantity is the small farmer. His decision-making on the use of his own resources is not divisible. If protein malnutrition during his childhood has impaired his mental development, and undernourishment as an adult is compounding his disadvantages, his efficiency as a farm entrepreneur is not increased by the presence of unemployed labor in the neighborhood.

Although many of these notions are new in the context of development planning, it is of interest to note that for some years they have been endorsed

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*To our knowledge no effort has been made to sort out the factors in a systematic attempt to identify the limiting ones. Thus, at this stage, one can only point to the potential impact that malnutrition could now be exerting on adult farmers.

and commonly incorporated into the planning of military establishments (53). Special nutrition units have been established and special nutritious products developed. In some developing countries a sizeable portion of the total nutrition research budget is directed to the relationship of nutrition to the effectiveness of the fighting man.

Other Economic Benefits: There also will be additional economic benefits of a nutrition program besides the direct productivity benefits as measured by the previously discussed techniques:

- Activities of housewives which do not get measured in the national accounts because they do not enter the market economy, are economically important for many reasons, not least of which is the quality of care for the young.
- The increased income of the well nourished worker (or well nourished child when he enters the labor force) will improve the living standards of his dependents, thereby raising both their current consumption and their future productivity.
- The lower incidence of communicable diseases among the adequately nourished will, in turn, reduce the exposure to these diseases of others not participating in a nutritional program.
- Improved nutrition will raise the returns to other investments closely related to human well-being, such as education where the malnourished child often is unable to cope with the school expectations.

Comparison of Benefits with Costs: Finally, even where significant opportunities exist for returns to better nutrition, one needs to weigh the costs in relation to benefits. Will the increase in production achieved by the proposed expenditure be greater than the input or resource cost of achieving that increase and how will it compare with returns to alternative investments? The answer to this question will depend on whose malnourishment is to be corrected, what increments in productivity can be expected from these target people, how much the program of extra nutrition will cost, whether the productivity effect is immediate or delayed, and in the latter case, what discount rate is applied to obtain the present values of the benefits and costs that are to be compared.

Even in a labor-surplus market, there are several groups from whom a current or fairly short-run productivity payoff from nutrition investment could be obtained: workers employed in machine-paced occupations in modern manufacturing sectors; students for whom malnutrition limits the potential joint returns from education and health expenditures; and small farmers

facing the more exacting demands of new agricultural technologies. The most lasting and numerically widespread impact, however, probably would derive from providing adequate nutrition to mothers in the last trimester of pregnancy and to children from 6 months up through 3 years of age. Even if the children's diets are fully adequate only during these critical months, but return to the average levels of their family income thereafter, they will have been brought much closer to their growth potential, particularly their intellectual potential. Even if their energy intake level remains inadequate by some desirable norm during adulthood, their productivity nevertheless will have been ratcheted up to a higher level that is more relevant to a modern economy than a level measured by sheer caloric output capacity.

We might illustrate the arithmetic of an investment in child nutrition with the following example:

Suppose a program designed to meet all nutritional deficiencies costs $8.00 per child per year,* and provides a nutritional supplement from 6 months through the third year to meet existing deficiencies. Let us also suppose that as a result of this program, a disability in a child's performance potential is avoided, and the child-turned-breadwinner produces $8.00 more income per year in his years 15 through 50, than he would have otherwise. If his income otherwise would have been $200 per year, productivity would be raised to a 4% higher level (or $208 per year), for the 41 year earning period, and our nutrition investment of about $20.00 would appear to be yielding an annual return of approximately 40%. Of course, returns beginning only 12 years after the investment is made, and stretching so far into the future, are remote compared with more immediate returns available from other investment opportunities. Thus, the notion ofour annual 40% return is deceptive and needs to be corrected to take account of the long waiting period for this type of investment.

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*The $8.00 estimate is based on meeting deficiencies of a diet which currently satisfies three-fourths of a child's protein need and two-thirds of his caloric need. The calculations were based on actual productive and distribution costs of Bal Ahar, an Indian-produced blended food currently provided in institutional child feeding programs. (It should be noted that the child feeding program is being used here only for illustrative purposes, and is not being suggested as the lowest cost means of achieving a pre-determined nutrition goal.) The Bal Ahar commodity cost per child per year is $5.60; administration cost is 65¢. The remaining $1.75 of the $8.00 estimate has been included for what are often non-measured costs such as fuel, cooking equipment and the time that teachers and health center officials devote to the program at the expense of their other duties.

The standard method of comparing different future streams of costs and benefits is to reduce these streams to a single amount representing their present values. The standard set of compound interest tables used for this purpose show that even if we discount our 35 year $8.00 stream to its present value at a discount rate of 10%,* our $20.00 investment still "breaks even." Put another way, if we discount the future returns at 10%, the amount of annual productivity increase needed to break even is about the same as the annual cost of the feeding.

Our illustrative increase in future productivity of 4% looks modest as a minimum result from higher levels of intelligence. What in fact, the actual rate of return will be depends on a large number of factors. The higher the initial income, the smaller proportionately need be the break even increase in productivity. The larger the potential mental shortfall due to malnutrition, the greater might be the increase in potential performance from better nutrition. Whether the range of mental shortfall is relevant to future productivity depends on what occupational difference the performance improvement can lead to. In addition, the idea of increased productivity used in the example should be broadened to include the values of the side benefits and enhanced returns to other investments, mentioned above.

There are many links in the chains between diet, performance potential and economic returns which are better understood now than just a few years ago, but which require further research before our understanding is satisfactory. However, a broad increase in the intelligence of a substantial fraction of the future labor force is certain to have significant implications for economic growth and modernization. While work proceeds to define these implications more clearly, economic judgment recommends that the search for effective low-cost nutrition delivery systems should be pressed, that development plans be shaped to take account of nutrition objectives, and that investment in child nutrition be significantly increased above present levels. The question, "How much does better nutrition cost?",

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*A discount rate of 10% is often used in project analysis in the developing countries, based more on a hunch consensus than an accepted body of theory and empirical underpinning.

is obviously just as important as the question of benefits. Space precludes an extended discussion of alternative programs and their costs.

Suffice to note that revolutions in both agriculture and food technology are now underway which may now provide answers to old problems at lower costs than was previously possible. A broad multi-policy approach to a nutrition strategy and nutrition problems viewed as socio-economic problems - rather than strictly medical or dietary problems - might yield interesting new directions for attacking malnutrition.

BEYOND STANDARD ECONOMIC BENEFITS

Leadership: The discussion thus far has concentrated on the costs to society from malnutrition among the working masses. Another consideration, even more difficult to quantify but no less real, is the loss to society of potentially outstanding individuals. Since the origin of so many superior people in the middle and upper class is a result of opportunity rather than genetic potential, it seems appropriate to ask how many superior minds have been and are being lost or repressed because of malnutrition? If nutritional risk is as high as studies now indicate -- affecting perhaps half of some populations -- a substantial number of superior people will never come forward. This refers not just to the priceless contributions of the Tagores and the Gnandis, but also to the one-in-a-thousand or one-in-ten-thousand who can organize large resources, who can innovate, who can move men. Considering how very thin is the leadership elite in most countries on whom rests the burden of the nation's success or failure, such loss would seem to inhibit the chances for economic development.

Equality: A related economic consideration has social and political overtones. For societies whose prevailing philosophy places a premium on egalitarianism, it can be said that the intellectual loss caused by malnutrition is the strongest obstacle to attaining this social goal. This is not to state the case for nutrition as a panacea; educational barriers, for example, are immense. However, a malnourished child's chances for social mobility are greatly restricted no matter what else is offered in education or other avenues designed by policy makers to facilitate upward movement within a society. Adequate mental development, hence adequate nutrition, would seem to be a necessary precondition to validate other programs for mobility that are being developed as a matter of social policy. In short, if a child lacks curiosity and mental energy -- to say nothing of the possibility of mental capacity -- the other opportunities are not significant.

Human Well-Being: Most planners today appear to view malnutrition as a welfare issue, and programs designed to alleviate it are budgeted accordingly. To move beyond this stage of token resources, many of us have assumed the need to justify the relationship of nutrition to development in traditional economic terms. In such terms, the life of the agricultural laborer and his family usually would be categorized as "very poor" or "destitute." Yet, for all their economic privation, they have the potential for enjoying a wide range of non-economic consumption. We speak, of course, of man's appreciation of nature, of love, of friends, of good talk at the tea stall, and of the joy of children. These enjoyments may be viewed as independent of one's economic status. They include some of the major sources of satisfaction in life, satisfactions which by their nature are not marketable services, neither quantifiable nor measurable in the national accounts when the economist totes up the per capita availability of goods and services for personal "consumption." But the person who is apathetic and physically drained by nutritional anemia or debilitated by the seemingly constant bouts with nutritionally related diarrheas, cannot really savor these satisfactions. It is well-being, not income, that primarily determines whether or not a man, rich or poor, has the capacity to enjoy these most fundamental sources of human satisfaction. Well-being is the primary requisite, the sine qua non that determines the utility men derive from all other forms of consumption, whether measurable or not. The developing economies are not likely in the near future, to provide a very much wider range of material goods at the lower income levels. But it may be within the power of public policy to improve the level of nutrition, which in turn can increase the capability for a substantial portion of the population to enjoy whatever sources of consumption are available.

Objectives of Development: The purpose of development -- of foregoing consumption today in favor of more investment -- is to generate a higher level of human well-being tomorrow for more people. To most people in developing countries, that higher level of well-being substantially means a better diet. Food is a major, perhaps the major problem of their lives. It is central to both their consumption and their production activities. For a person living at the income level that characterizes the malnourished, typically 65 to 80% of income goes for food. As his income rises, the proportion devoted to buying more food declines; but throughout the income range of the problem, the proportion remains high. The inadequacy and

uncertain availability of food from year to year represents the condition of underdevelopment at its most immediate and palpable and dangerous.

Thus nutrition cum food represents the thin margin between mere survival and adequate growth and well-being. To be concerned with food as a commodity but not with nutrition -- which is food analyzed into its nutritional constituents -- reflects a double vision. The economic distinction between food and nutrition -- ranking food "high," nutrition "low"; or food "essential," nutrition "welfare" -- is a false distinction. Food has obvious tangibility features that nutrition lacks. Food costs and supplies can be measured and subjected to economic analysis. Food is unmistakable to the consumer and commands a price that allows measurement for entry into the national accounts. Nutrition in contrast is invisible, dimly understood by most consumers, and seldom commands a price. In fact, despite the essentiality of nutrition for life, the individual's effective demand for nutrients is in many ways inefficient for meeting his needs. Eating is a complex activity that satisfies several wants besides nutrition -- alleviation of hunger, esthetic preferences, religious prescriptions, social customs. Some of these demands may be mutually inconsistent (e.g., esthetics vs. nutrition). As the consumer tries to maximize his satisfaction of these several wants, the nutritional demand may be the one most prone to distortion. The consumer is least capable of evaluating the nutritional component and of recognizing the degree to which meeting the other objectives, within his sharp income constraint, is depriving him of the health he assumes he is acquiring. Such considerations argue strongly for government intervention to compensate for consumer inefficiency.

Although one cannot make a valid economic distinction between food and nutrition, one can make a physiological distinction between food quantity and food quality. Both are important; both are inadequate. To propose in 1971 a broad attack on the quantitative or caloric side of malnutrition would coincide with agriculture objectives to which most developing nations already are pledged. Certain countries have attained or soon will attain self sufficiency in cereals. The qualitative side of the food problem is a different story. Many countries, including the United States, are demonstrating that caloric sufficiency of itself is no answer to malnutrition, but finding solutions to other debilitating nutritional deficiencies has not received the same policy attention. This is not to quarrel with the existing emphasis on quantity, especially when recalling the bleak projections

of just a few years ago. Yet, one can now envision a time in the near future when caloric inadequacies shall have been much reduced while serious nutritional deficiencies remain. Knowing what is now known, planners would be derelict in their responsibilities if they awaited the day of cereal adequacy before awakening to the additional needs and the program preparation time implied in meeting such needs. As indicated earlier, new nutrition-related technologies may now provide more direct shortcuts and enable people to achieve substantially better nutrition and well-being at a much lower income, and much earlier in time than previously was possible.

NUTRITION AND POPULATION

No discussion of nutrition and development would be complete without mention of certain aspects of the population problem.* Better nutrition would appear to have the initial effect of increasing population growth by reducing mortality, especially infant mortality. If this were all there were to say on the nutrition-population relationship, nutrition programs would appear to be affecting per capita income in opposite directions at the same time. On the one hand, productivity increases would raise income per capita. On the other, reduced mortality would accelerate the growth in population, tending to lower income per person. What would be the upshot? At this stage of knowledge, we think the answer would take the following form:

In the short run the net effect would depend on whose nutrition is being improved. For example, factory feeding programs for adults could have immediate impact on output with marginal impact on mortality; with infant and child feeding, the impact is the reverse; mortality reduction is immediate, while the income effect is delayed. Indeed, a Malthusian might argue that the increase in real income experienced by the poor who are (or whose children are) getting a nutrition supplement, would merely allow population to increase until the higher number had cancelled with mortality rising back to its former level.

We know, however, that in the modern era, declining mortality has been followed by a decline in fertility, with per capita incomes rising to high levels and population growth rates falling and even nearing total stability in some countries. The fertility declines have resulted from a variety of

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*For a more comprehensive discussion of the subject, see reference 54.

profound ~~rural~~ and economic changes that separate the modern era from man's previous history. High fertility has usually been perceived as desirable and beneficial where children were an economic asset, where security in old age vitally depended on surviving sons in the face of high mortality rates, and where religious and ~~racial~~ customs favored large families. The value and satisfaction of each successive child begins to decline as incomes rise, as the costs of child education increase, as compulsory education postpones the time when a child begins to add to, rather than draw on, family income, as the convenience of contraception improves, and as opportunities increase for female education and higher paying female employment, to mention a few among many factors. One of the most powerful factors inducing smaller family size appear to be declining mortality. As parent's confidence in the survival chances of their earlier children rises, their need for additional children to ensure achievement of desired family size declines. Thus, better nutrition which lowers child mortality can favorably affect one of the most important of the variables determining fertility rates. In addition, nutrition programs may add a significant incentive to family planning programs by directly linking services for contraception with measures to raise the well-being of existing children, and thereby their chances of survival.

Population stability in the past was maintained by higher rates of both births and deaths. With mortality declining in the developing countries, clearly the only acceptable route to reestablishment of stability (or much slower growth), is a regime of low rates of both births and deaths. Although further lowering of child mortality is not sufficient by itself, fertility is unlikely to come down to acceptable levels without it.

Thus, paradoxically, an important contribution to lower population growth may be to keep children alive. Because of malnutrition's enormous role in today's high child mortality rates, a planner who accepts this hypothesis would look to nutrition programs for an important contribution toward attaining family planning objectives.

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A FINAL NOTE: As the planner begins to probe for answers, he finds that the nutrition professions have built an impressive body of literature on the effects of malnutrition. Extensive laboratory investigations describe animals systematically deprived of calories and of specific nutrients, and considerable

related clinical work has been done among severely malnourished children. As the planner looks for studies of human beings subjected to mild nutritional stress -- those who are the majority of the malnourished -- he finds a body of knowledge less comprehensive and less exact. This reflects the relative youth of the field (e.g., the notion of a relationship of malnutrition to mental development is primarily a product of the 1960's), and the enormous complexity of measuring human growth and performance.

Isolation of the nutritional variable from the constellation of other factors can never match the kind of scientific elegance that is possible, for example, in studying the effects of an alloy that result from varying slightly the proportion of chemical inputs, or -- a better example -- the effects of the yield of a particular cereal strain caused by a slight variation in the quantity or composition of fertilizer applied. The human condition reflects physiological and psychological dimensions of vastly greater complexity.

It is not surprising, therefore, that a planner reacts with uncertainty to the suggestive, but at times, imprecise nutritional data before him. In his uneasiness, the planner should recall that he has been making decisions on the allocation of substantial resources in many areas where the returns were long-run and difficult to calculate with anything approaching precision (such as in education), or where projects had an engineering and economic precision that proved to be illusory (with benefits below expectations because of real-life complexities such as make the study of malnutrition's impact so difficult). One might point again to the example of cereal varieties. In the case of rice, the differences between controlled research conditions and conditions on the farm have turned out to be substanti l from one area to another, resulting in costly mistakes along the road generally recognized as the right one to higher rice production.

In short, the planner should not insist on greater exactness in measuring the impact of malnutrition than he does in other fields where he is accustomed to allocating large sums. However, he should insist that a new claimant for scarce resources provide a reasonable description and measurement of the problem to be addressed and offer program choices that promise to yield benefits significant in relation to the size of the problem and the cost of the programs. As indicated at the outset, knowledge of nutrition is at a stage where this can be done. Although a great deal more investigation clearly is needed to reduce the ranges of uncertainty, this should not detract from the

significance of what already is known. The contention here is that enough knowledge is available to justify substantial resource allocations to nutrition-oriented programs.

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APPENDIX

TABLE I

PERSPECTIVES ON CHILD MORTALITY, 1970 [1]

COUNTRY	Percent of children who die each year				% children born live that die before 5th birthday	Approx. age in years at which comparable % die in	
	Of all infants [2] under 1	Of all children 1 - 2	Of all children 1 - 4	Of all children under 5		Taiwan	U.S.A.
India	13.9	2.6 [3] 7.2 [4]	4.4	8.7	28.1	61	63
Pakistan	14.2	N.A.	5.3	9.0	31.0	63	66
Gambia	8.3 [5]	11.1 [6]	N.A.	N.A.	N.A.	N.A.	N.A.
UAR	11.7	10.7 [7]	3.9	5.8	24.8	60	61
Zambia	25.9	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Guinea	21.6	6.8 [8]	5.2	9.3	36.7	66	68
Cameroon	13.7	N.A.	3.9	6.3	26.5	61	62
Brazil	17.0	4.9 [9]	1.6	5.2	22.2	58	61
Guatemala	8.9	6.2 [10] 5.2 [11]	2.8	4.3	18.5	55	57
Taiwan	2.0	1.9 [12]	0.4	0.8	3.6	5	20
Portugal	5.9	1.6 [13]	0.5	1.7	7.6	32	46
Japan	1.5	0.3 [12]	0.1	0.4	1.9	1	1
U.S.A.	2.1	0.2 [12]	0.1	0.5	2.5	2	5
Sweden	1.3	0.1 [12]	0.1	0.3	1.7	1	1

N.A. = Not Available

Computations based on data found in: "1970 World Population Data Sheet," Population Reference Bureau, Inc., Washington, D. C., April 1970;

Demographic Yearbook, United Nations, New York, various issues;

Gordon, John E. et al., "The Second Year Death Rate in Less Developed Countries," The American Journal of Medical Sciences, 254, Sept. 1967, 357-80;

"Progress Report of the Inter-American Investigation of Mortality in Childhood," Report presented to the Ninth Meeting of the Advisory Committee on Medical Research, Pan American Health Organization, Washington, D.C., June 15, 1970, Table 2.

CONTINUED.....

TABLE I (cont'd.)

Legend:
1. 1970 data unless indicated otherwise.
2. Live births.
3. 1961 Bombay only.
4. 1957-59 rural Punjab.
5. Bathurst, 1967.
6. Bathurst, 1949-53.
7. 1961.
8. 1955.
9. Sao Paulo only, provisional 1970.
10. National figure 1963.
11. Rural 1958-64.
12. 1963.
13. 1960.

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APPENDIX

TABLE II

WHAT CHILDHOOD MORTALITY RATES MEAN IN ABSOLUTE NUMBERS:

Number of deaths by age group at existing rate compared to number if rates of India, Taiwan, Japan and Sweden were applied [1/]

COUNTRY	Infants Under 1 [2/]					Children 1 to 4					Children Under 5				
	1000's deaths at current rate	1000's deaths difference if one applies rate of...				1000's deaths at current rate	1000's deaths difference if one applies rate of...				1000's deaths at current rate	1000's deaths difference if one applies rate of...			
		India	Taiwan	Japan	Sweden		India	Taiwan	Japan	Sweden		India	Taiwan	Japan	Sweden
India	3239		-2772 [3]	-2888	-3151	[illegible]		-2543	-2841	-2851	[illegible]		[illegible]	[illegible]	-5925
Pakistan	972	+ 21	- 835	- 962	- 884	1059	- 150	- 973	-1033	-1045	2031	- 75	-1951	-1932	-1954
Gambia	4/	4/	4/	4/	4/	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
UAR	171	- 32	- 53	- 156	- 152	173	+ 21	- 154	- 167	- 170	344	- 166	- 277	- 313	- 324
Zambia	57	+ 26	- 52	- 54	- 54	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Guinea	41	- 14	- 38	- 38	- 39	29	- 4	- 27	- 28	- 29	70	- 5	- 64	- 67	- 67
Cameroon	40	0	- 34	- 35	- 36	36	+ 4	- 32	- 35	- 35	76	+ 28	- 66	- 71	- 72
Brazil	617	+112	- 544	- 562	- 570	193	+ 336	- 142	- 192	- 193	810	+ 540	- 686	- 742	- 757
Guatemala	21	- 12	- 16	- 17	- 18	20	+ 12	- 17	- 19	- 19	41	+ 41	- 33	- 37	- 38
Taiwan	9	+ 48		- 2	- 3	7	+ 63		- 5	- 6	16	+ 158		- 7	- 9
Portugal	12	+ 16	- 8	- 9	- 9	4	+ 30	- 1	- 3	- 3	16	+ 66	- 9	- 12	- 13
Japan	30	+244	+ 10		- 4	9	+ 292	+ 20		- 4	39	+ 726	+ 31		- 9
USA	77	+425	+ 5	- 22	- 30	15	+ 627	+ 48	+ 4	- 4	92	+1488	+ 53	- 12	- 30
Sweden	2	+ 14	+ 1	5/		6/	+ 21	+ 2	+ 1		2	+ 50	+ 3	+ 1	

NA = Not Available

Computations based or data found in:

Demographic Yearbook, 1969, United Nations, New York, 1970 and "1970 World Population Data Sheet," Population Reference Bureau, Inc., Washington, D. C., April 1971.

CONTINUED....

TABLE II (cont'd.)

Legend:
1. 1970 estimates of population and mortality rates. Figures rounded to nearest 1000; if less than 1000, figure appears in footnotes.
2. Live births.
3. Minus sign (-) indicates number of lives that would be saved at projected rate.
4. 130 infants die at current rate. 88 more would die if India's rate applied; applying the rates of Taiwan, Japan and Sweden would reduce the number of deaths by 98, 106 and 109 respectively.
5. + 200 deaths.
6. 300 deaths.

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APPENDIX

TABLE III

MALNUTRITION AS THE UNDERLYING OR AN ASSOCIATED CAUSE OF DEATH IN CHILDREN AGE 1 - 4

AREA [1]	% of deaths in which malnutrition is the underlying cause (A)	% of deaths in which malnutrition is an associated cause: Contributory [2] (B)	Consequence [3] (C)	% of all deaths in which malnutrition is the underlying or an associated cause [4] (D)
Kingston, Jamaica [5]	8	24	11	43
Monterrey, Mexico	11	29	25	65
San Salvador, El Salvador [6]	26	25	16	67
La Paz, Bolivia	4	34	14	52
Santiago, Chile [7]	5	24	8	37
Recife, Brazil [8]	8	51	11	70
Sao Paulo, Brazil	10	21	12	43
San Juan, Argentina [9]	4	29	8	41
Average of the Above	10	30	13	52

Calculations based on provisional data found in:

"Progress Report of the Inter-American Investigation of Mortality in Childhood," presented to the Ninth Meeting of the Advisory Committee on Medical Research, Pan American Health Organization, Washington, D.C., June 15, 1970, Tables 1, 2, 9 & 10.

Legend:
1. Not limited to city cited but includes surrounding rural areas.
2. i.e., malnutrition pre-exists the underlying cause of death.
3. i.e., malnutrition results from recurring episodes of diarrheal disease.
4. Excludes two deaths in Kingston Area, two in San Salvador Area, two in Sao Paulo Area and one in Santiago Area with nutritional deficiency as an associated cause as well as an underlying cause and one death in Monterrey with two types of nutritional deficiency as a consequence of measles. Failure of columns (A) + (B) + (C) to equal (D) due to rounding.
5. Including St. Andrew parish.
6. Including 3 neighboring communities: Apopa, Nejapa, Quezaltepeque.
7. Including 4 neighboring communities: Colina, Lampa, Quilicura, Til-til.
8. 3 districts.
9. San Juan Province.

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APPENDIX

TABLE IV

PERCENT OF DEATHS BY AGE GROUP FOR SELECTED COUNTRIES [1] DUE TO THE FIVE PRINCIPAL NUTRITION-RELATED CAUSES OF DEATH

COUNTRY	% of deaths caused by gastritis, enteritis, etc. [2]			% of deaths caused by pneumonia, influenza [3]			% of deaths caused by measles [4]			% of deaths caused by rachitis [5]			% of deaths caused by whooping cough [6]			% of deaths from these 5 causes		
	Under 1 yr.	1 - 4 years	Under 5 yrs.	Under 1 yr.	1 - 4 years	Under 5 yrs.	Under 1 yr.	1 - 4 years	Under 5 yrs.	Under 1 yr.	1 - 4 years	Under 5 yrs.	Under 1 yr.	1 - 4 years	Under 5 yrs.	Under 1 yr.	1 - 4 yrs.	Under 5 yrs.
Chile	14.9	11.4	14.5	26.2	30.3	26.[illegible]	[illegible].2	11.[illegible]	3.5	negl	negl	negl	negl	negl	negl	43.3	53.3	44.8
Colombia	20.2	26.4	22.6	10.2	12.1	10.9	0.[illegible]	4.7	2.3	10.1	9.7	9.[illegible]	negl	negl	negl	41.4	52.[illegible]	45.7
Costa Rica	23.2	23.9	23.4	9.0	11.[illegible]	9.[illegible]	1.7	11.7	4.2	6.0	5.0	5.[illegible]	negl	negl	negl	39.9	52.5	43.2
Dominican Republic	24.3	26.1	24.9	2.6	4.1	3.1	negl	negl	negl	2.7	3.9	3.1	negl	negl	negl	29.6	34.1	31.1
Ecuador	14.9	19.8	15.0	7.5	8.6	7.[illegible]	1.7	7.8	4.0	16.7	13.9	15.5	8.4	11.7	9.4	45.[illegible]	56.8	51.8
El Salvador	8.3	9.6	8.9	4.5	4.5	4.5	1.6	7.8	3.8	4.7	4.9	4.7	negl	negl	negl	19.1	26.8	21.8
Guatemala	13.2	20.8	17.0	18.0	21.0	19.5	2.7	9.5	6.1	negl	negl	negl	6.8	10.4	8.6	40.7	61.7	51.2
Mexico	18.1	19.2	18.[illegible]	19.8	20.8	20.1	0.9	6.9	2.[illegible]	5.6	3.8	5.1	1.3	5.3	2.6	45.7	56.0	49.1
Nicaragua	29.4	19.4	23.4	5.6	6.4	5.9	0.6	3.3	1.4	negl	negl	negl	1.3	3.8	2.1	32.9	32.9	32.9
Paraguay	15.5	27.9	19.4	11.9	13.2	12.3	0.4	4.3	1.6	3.3	3.2	3.3	negl	negl	negl	31.[illegible]	48.6	36.6
Peru	11.0	13.7	11.9	20.5	22.0	21.0	negl	negl	negl	9.6	8.4	9.2	7.4	10.3	8.4	48.5	54.4	50.5
UAR	53.1	62.2	57.1	2.8	5.0	3.7	0.6	3.0	1.7	10.7	17.9	13.9	negl	negl	negl	67.2	88.1	76.4
Angola	21.5	23.2	22.2	8.3	11.[illegible]	9.8	negl	negl	negl	negl	negl	negl	negl	negl	negl	29.8	35.0	32.0
Nigeria	11.3	5.6	7.6	23.8	11.6	15.9	4.5	4.9	4.[illegible]	negl	negl	negl	negl	negl	negl	39.6	22.1	28.3
Mauritius	31.5	44.9	35.6	5.3	5.9	5.4	negl	negl	negl	4.0	5.6	4.5	negl	negl	negl	40.8	56.4	45.5
Philippines	8.0	15.3	10.9	17.6	33.1	24.8	1.0	4.2	2.3	6.9	11.4	8.7	0.1	0.1	0.1	33.6	64.1	46.8
Average of above LDCs	18.6	22.8	20.8	12.1	13.9	12.6	1.2	5.[illegible]	2.4	5.0	5.5	5.2	1.6	2.6	2.0	39.5	49.7	43.0

negl = negligible

Continued.....

TABLE IV (cont'd.)

COUNTRY	% of deaths caused by gastritis, enteritis, etc. 2/			% of deaths caused by pneumonia, influenza 3/			% of deaths caused by measles 4/			% of deaths caused by bronchitis 5/			% of deaths caused by whooping cough 6/			% of deaths from these 5 causes		
	Under 1 yr.	1 - 4 years	Under 5 yrs.	Under 1 yr.	1 - 4 years	Under 5 yrs.	Under 1 year	1 - 4 years	Under 5 yrs	Under 1 yr.	1 - 4 years	Under 5 yrs.	Under 1 yr.	1 - 4 years	Under 5 yrs.	Under 1 yr.	1 - 4 years	Under 5 yrs.
Japan	4.0	4.8	4.1	9.3	11.2	9.7	0.3	1.2	0.5	0.8	1.3	0.9	negl	negl	negl	14.4	18.5	15.2
U.S.A.	1.3	2.2	1.4	7.2	10.7	7.7	negl	negl	negl	negl	negl	negl	negl	negl	negl	8.5	12.9	9.1
Canada	1.3	2.2	1.5	8.2	9.4	8.4	negl	negl	negl	negl	0.8	0.1	negl	negl	negl	9.5	11.6	9.9
Sweden	0.6	1.2	0.7	2.2	7.6	2.9	0.8	3.2	1.1	negl	negl	negl	negl	negl	negl	3.6	12.0	4.7

negl = negligible

Computations based on data found in:

Health Conditions in the Americas 1965-1968, Pan American Health Organization, Scientific Publication No. 207, Washington, D. C., September 1970, Table XII; Demographic Yearbook, 1967, United Nations, New York, 1968, Table 25; World Health Statistics, 1967, World Health Organization, Geneva, 1970, Tables 2, 4.1, 5.1.

Most data are for 1967; exceptions being Nigeria (1963), UAR (1964), Angola (1965), Guatemala and Nicaragua (1966) and Canada (1968).

Legend: 1. LDCs are defined as those countries in which the infant mortality is equal to or exceeds 5% and the GNP per capita is less than US $500 and are selected on the basis of availability of data. Developed countries are selected for comparison

According to various standard international classification systems:

2. 543, 571-72 or A101 and 104 or B36.
3. 480-83, 490-93 or A89-91 or B30-31.
4. 085 or A32 or B14.
5. 500-02 or A92-93 or B32.
6. 056 or A22 or B9.

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TABLE V

MALNUTRITION AS THE UNDERLYING OR AN ASSOCIATED CAUSE OF DEATHS OF CHILDREN UNDER 5 [1]

AREA [2]	% of deaths in which malnutrition is the underlying cause (A)	% of deaths due to infective & parasitic diseases [3] (B)	% of deaths in column B with malnutrition as associated cause (C)	% of deaths due to measles [4] (D)	% of deaths in column D with malnutrition as associated cause (E)	% of deaths due to other causes [5] (F)	% of deaths in column F with malnutrition as associated cause (G)	% of all deaths in which malnutrition is underlying or associated cause (H)
Kingston, Jamaica [6]	7	41	44	1	NA	52	34	43
Monterrey, Mexico	7	56	69	10	75	37	27	56
San Salvador, El Salvador [7]	13	53	48	8	62	34	33	50
La Paz, Bolivia	4	58	62	25	56	35	19	47
Santiago, Chile [8]	6	35	50	1	NA	59	36	45
Recife, Brazil [9]	6	66	69	29	72	28	47	65
Sao Paulo, Brazil	6	45	57	7	41	50	37	49
San Juan, Argentina [10]	8	53	40	18	34	39	33	46
* * * Average of the Above	7	51	55	12	57	42	33	50

NA = Not Available

Computations based on provisional data found in:

"Progress Report of the Inter-American Investigation of Mortality in Childhood," presented to the 9th Meeting of the Advisory Committee on Medical Research, Pan American Health Organization, Washington, D. C., June 15, 1970, Tables 3, 4 and 6.

CONTINUED.....

TABLE V (cont'd.)

Legend:
1. Excludes neonatal deaths, i.e., in first 28 days of life.
2. Not limited to city cited but includes surrounding areas.
3. i.e., classifications 000-136 including measles, diarrhea and other intestinal infectious diseases; whooping cough; tetnus; diphtheria; tuberculosis.
4. Deaths from measles included in percentages appearing in column (B).
5. i.e., not covered in columns (A), (C), and (D), such as diseases of nervous system, and sense organs, diseases of the digestive system, of the respiratory system, etc.
6. Including St. Andrew parish.
7. Including 3 neighboring communities: Apopa, Nejapa, Quezaltepeque.
8. Including 4 neighboring communities: Colina, Lampa, Quilicura, Til-til.
9. 3 districts.
10. San Juan Province.

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