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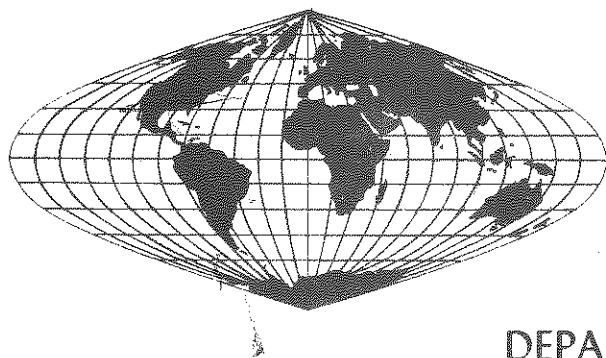
May 1982
Reissued January 1984

A.E. Research 82-17
Revised

CORNELL/INTERNATIONAL AGRICULTURAL ECONOMICS STUDY

WORLD HUNGER: EXTENT, CAUSES, AND CURES

Thomas T. Poleman



DEPARTMENT OF AGRICULTURAL ECONOMICS

New York State College of Agriculture and Life Sciences

A Statutory College of the State University

Cornell University, Ithaca, New York 14853

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DEPARTMENT OF
AGRICULTURAL ECONOMICS
WARREN HALL

Thomas T. Poleman
Professor of
International Food Economics

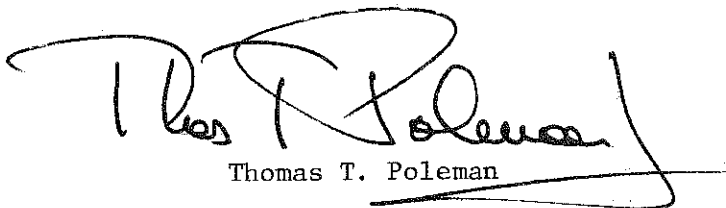
January 1984

Since 1972 I have published an article each year on the world food and agriculture situation. Now, as the supply of the most recent, "World Hunger: Extent, Causes, and Cures," nears exhaustion, I find little new to say. So instead of moving a few paragraphs around and pretending originality, I will simply reissue it.

Were I to do it over again, however, several modifications would be in order:

- The behavioral threshold approach to hunger quantification would be presented more forcefully. Neville Edirisinghe's recent study^{1/} clearly demonstrates its efficacy, and also confirms the skill with which poor people the world over manage to allocate their resources so as to get by on very little. It also suggests that the intake levels at which people begin to substitute quality for quantity is lower than previously thought--further confirmation that the international minimum dietary standards are still too high.
- That the so-called vulnerable groups--young children and pregnant and lactating mothers--are the most subject to nutritional deprivation is now generally accepted. The usual method for estimating their numbers has been anthropometry. That this method employs extremely arbitrary criteria and is subject to serious limitations was highlighted in Seneka Abeyratne's study^{2/} of child malnutrition in Sri Lanka. He demonstrates that protein-energy malnutrition among the young there is not nearly so pervasive as was once believed; that it is as much a function of health status as income; and that means are at hand--chiefly in the form of weaning food programs and oral rehydration therapy--for rectification that can be both immediate and cheap.
- The latter conclusion is consistent with my suggestion--insufficiently stressed in the present paper--that governments in the developing world rethink their approach to hunger alleviation. Traditionally this has involved some sort of price manipulation. Such intervention invariably becomes politicized and counterproductive to efforts to stimulate food production. Instead, I am convinced that governments should leave the market alone and focus investment on public health clinics and on works of water supply and sanitation.

- Finally, there is the problem of sub-Saharan Africa, the only part of the world where things may be getting worse rather than better. I tried to put this delicately, but would no longer do so. Governmental incompetence and corruption in Africa should be held up to the world's contempt and the food debacle there not be excused, as FAO seems to be trying, in terms of drought or as a legacy of the (ever more distant) days of colonialism.



Thomas T. Poleman

1/ Neville Edirisinghe and Thomas T. Poleman, "Behavioral Thresholds as Indicators of Perceived Dietary Adequacy or Inadequacy" (Cornell/International Agricultural Economics Study, A. E. Res. 83-24, July 1983).

2/ Seneka Abeyratne and Thomas T. Poleman, "Socioeconomic Determinants of Child Malnutrition in Sri Lanka: The Evidence from Galle and Kalutara Districts" (Cornell/International Agricultural Economics Study, A. E. Res. 83-25, July 1983).

WORLD HUNGER: EXTENT, CAUSES, AND CURES*

by

Thomas T. Poleman **

Let me make clear at the outset that there is no way to specify with certainty the extent of world hunger. To do so would require much more information than is presently at hand about the actual availability of food, the exact amount of food people need for proper nourishment, and how access to food varies among different income groups within a country. These limitations notwithstanding, I would hazard the guess that at no time in history has the world been as well fed as it is today. To argue otherwise would be to deny a basis for the increase--from about 40 years to 55 years--that has occurred during the past 30 years in life expectancy in the poorer countries. I would also guess that the principal nutrition problem in the world today is not hunger among the poor, but the result of overeating and underexercising by the affluent in the industrialized countries.

By so saying I do not want to suggest that hunger and its consequences have all but disappeared. Rather it is to suggest that the problem is a manageable one and given proper governmental will and direction could be resolved in almost all parts of the world during the remaining years of the century.

Why then does the conventional wisdom come down so heavily on the other side? Ask the man in the street for his impression of what life is like in the developing countries and he will invariably reply "hungry." This perception finds extensive support in the literature. We were, after all, assured 30 years ago by Lord Boyd-Orr, the First Director General of the United Nations Food and Agriculture Organization (FAO), that "a lifetime of malnutrition and actual hunger is the lot of at least two-thirds of mankind," by one of the many alarmist books which captured the public's attention in the mid-1960s that widespread famine would overtake us by 1975, and just two years ago by the Carter administration's Presidential Commission on World Hunger that the "world hunger problem is getting worse rather than better. There are more hungry people than ever before."

*Prepared for presentation at the University of Chicago/University of Minnesota/Cargill, Incorporated conference on "The Role of Markets in the World Food Economy," Minneapolis, 14-16 October 1982.

**Professor of International Food Economics.

I. MEASURING HUNGER: THE EARLY ASSESSMENTS

The notion that the world is no longer able to feed itself and teeters uncontrollably on the brink of mass starvation may be traced to the formative years of the FAO and its early attempts to assess the extent of world hunger. These studies, and their methodological underpinnings, are worth reviewing because, although they are now discredited, their message has remained remarkably durable. This is because few of those who have seen fit to pronounce on world hunger--and this includes the recent Presidential Commission--have troubled to undertake original research of their own.

The findings of the early FAO studies and those of more recent work by FAO, the U.S. Department of Agriculture (USDA), and the World Bank are shown in Figure 1. The extent of disagreement among them is extraordinary. Boyd-Orr's conclusion that two-thirds of mankind were hungry came from FAO's Second World Food Survey. An earlier survey suggested a lower figure. The USDA's two World Food Budgets concluded that almost the entire population of the developing world lived in "diet deficit" countries. FAO's Third World Food Survey put the afflicted in such countries at about 60 percent and identified a shortage of protein as the principal problem. The World Bank saw a problem of roughly the same magnitude--involving about 1.2 billion people--but suggested the prime cause was shortfall of calories. In its two most recent studies the FAO also identified calories as the culprit, but put the total afflicted at something over 400 million.

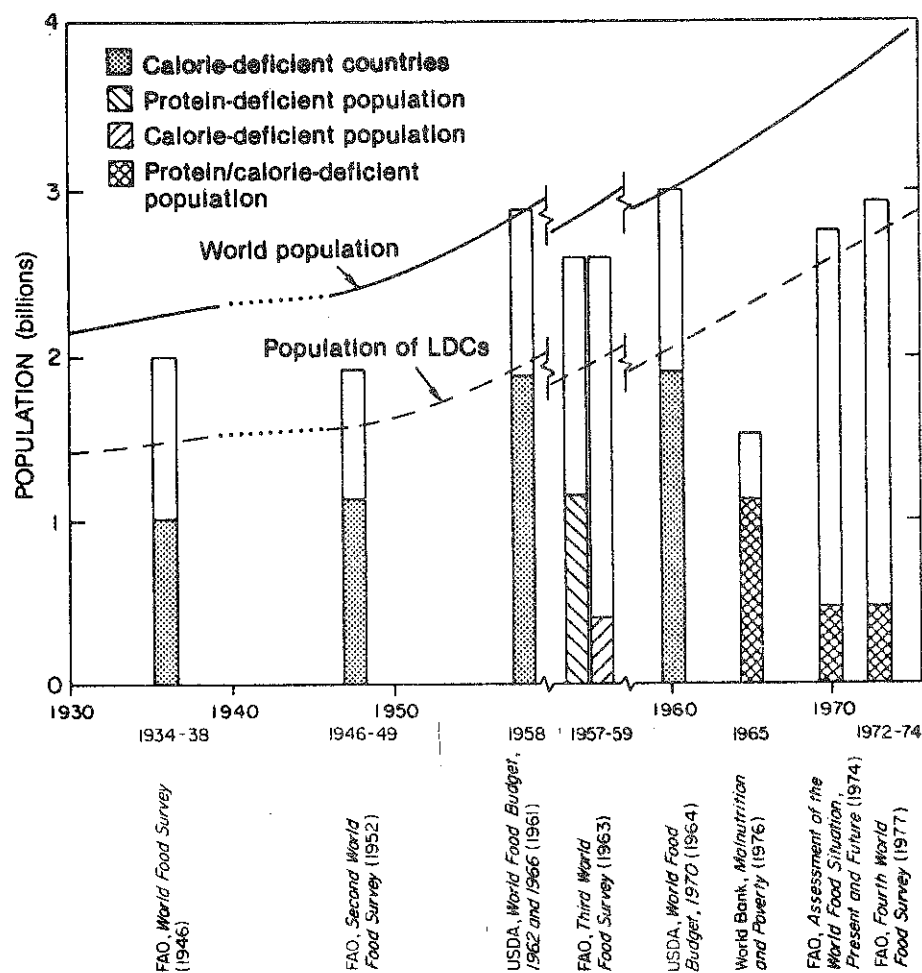
The analytical approach followed in FAO's first two World Food Surveys and the two World Food Budgets prepared by USDA was simple in the extreme and may be summarized by the following equation:

$$\frac{\text{Food available for human consumption}}{365 \times \text{population}} - \text{Loss allowance} \approx \text{Average daily recommended nutrient allowances}$$

To determine whether or not a country was experiencing a food problem, apparent per capita food availabilities, minus an allowance for wastage between the so-called retail level and actual ingestion, were set against estimates of per capita nutrient needs. Where and when availabilities exceeded requirements, all was presumed well; where they did not, the country or region's entire population was considered to be inadequately nourished.

The failings of this approach are several and, when probed, obvious. First, it assumes that societies are sufficiently homogeneous in their food habits for average data to have meaning. This is certainly not the case in developed economies, where differences in income, locality, ethnic background, and place within the household have long been known to have marked effects on food behavior; and it is now recognized to be no less invalid for the developing world.

FIGURE 1. PERSONS IDENTIFIED AS NUTRITIONALLY DEFICIENT IN
IN MAJOR WORLD FOOD ASSESSMENTS



The size of the populations to which the assessments apply is indicated by the total height of bars.

A further drawback of the approach is that it presupposed an ability to specify average food availabilities and needs with a fair degree of precision.

Problems of Estimating Food Availabilities

To estimate food availabilities one must construct a balance sheet, incorporating on the supply side measurements of production, trade, and stocks changes, and on the utilization side such items as seed and feed use and losses in storage. Availabilities for human consumption are derived as a residual and thus reflect the totality of error.

The error so introduced will almost invariably be in the direction of understatement. Understatement of production is a characteristic of most newly developed agricultural reporting systems. Wheat production in the USA is now recognized to have been 30 to 40 percent above that officially reported during the first decade (1866-1875) of USDA's statistical efforts. In Mexico, the extent of understatement for maize during 1925-34, the Direccion General de Economia Rural's first decade, was over 50 percent.

To this understandable tendency further complications can be added:

- The statistical officer in developing countries is frequently (and not irrationally) equated with the tax collector by the farmer, whose response will be to minimize.
- Output which is not seen is not counted and where communications are poor a great deal is not seen.
- Much food production is for on-farm consumption and does not pass through commercial channels where it might be monitored.
- In tropical areas especially, many food crops are not grown in pure stands but mix-planted in fields of bewildering complexity.

To generalize about the extent to which food availabilities in LDCs have been and are now understated is not easy. A reasonable assumption is that the accuracy of production estimates has improved with time and that the extent of understatement is now less than it was when FAO published its first World Food Survey. An exception may be sub-Saharan Africa, where independence has frequently been accompanied by a deterioration in the reporting systems established by colonial administrators. When perfection may be anticipated is anybody's guess. It was not until 1902, 36 years after the effort began, that USDA began reporting wheat output with an acceptable margin of error; and not until the mid-1950s, with 30 years of experience in hand, was Mexico able to confidently measure its maize harvest.

Detailed studies of the food economies of Malaysia and Ceylon carried out by my students in the 1960s suggested that caloric availabilities in both were officially understated by between 10 and 15 percent. As the staple in both countries is rice grown under irrigated conditions, and thus relatively simple to quantify and as both countries have by the standards of the developing world an admirable statistical tradition, this

10-15 percent is probably something of a minimum understatement. Elsewhere the amount of food actually available may be undercounted by rather more.

Problems of Estimating Food Requirements

Compounding this tendency to undercount food availabilities have been the difficulties associated with estimating food needs. Until recently these have been overstated. Nutrition is still a young science and our ability to establish minimal or desirable levels of intake is not nearly as precise as we would like it to be.

A person's nutritional needs are a function of many things: age, sex, body size, activity patterns, health status, and individual make-up to mention the more important. Conceptually, knowing these variables, it should be possible to set minimum levels of intake for protein, energy, vitamins, and other nutrients sufficient to preclude overt deficiency disease in most of a population. As a practical matter it is not, and what were used as surrogates for such minimal criteria in the early food evaluations were the recommended allowances prepared as guidelines for dietitians and other nutritional workers. These allowances consciously err on the side of caution, both to incorporate a comfortable safety margin and to ensure that the substantial variations in food needs among individuals will be covered.

The recommended allowances are periodically modified and from the direction and magnitude of change it is possible to infer something of the probable extent by which minimum needs were overstated in the past. With respect to energy allowances, the history of the FAO, the United States Food and Nutrition Board, and other responsible organizations has been one of continued downward modification. The energy allowance for the United States "reference man"--in his twenties, weighing 70 kilograms, and not very active--now stands at 2,700 calories, 500 calories less than the 1953 recommendation.

Apart from undue initial conservatism, the principal cause of this reduction is the increasingly inactive character of life in industrial societies. Physical effort is less and less demanded on the job and the body moves from place to place less on its feet than on its seat. It is not unlikely that the energy allowances suggested for the developed countries are now quite reasonable. Little remains to be understood of how urban man divides his day--it has become after all depressingly routinized--and, thanks to studies carried out in association with war-time rationing programs in the United Kingdom and Germany, the energy costs of most activities are well known.

The same is not true for developing countries. Very few energy expenditure/activity studies have been conducted among rural or urban people in these regions and useful common denominators continue to be wanting. A key reason for this shortcoming is the difficulty of obtaining reliable information on energy expenditure. The traditional method for doing this is to record the energy costs of specific tasks with a respirometer and then multiply the resulting factors by appropriate time spans. The problems are many. The respirometer is a clumsy instrument; it can be kept on a subject for only a few minutes and its presence is

hardly conducive to normal behavior. Moreover, time-span recording must be meticulously accurate in order to be useful. To obtain such information under primitive conditions without an impetus similar to wartime rationing is probably asking too much of the research priorities of most LDCs.

In response to criticism that the energy allowances used in its early World Food Surveys were unrealistic surrogates for minimum needs, the FAO, lacking actual evidence from the LDCs, employed a different approach to establishing floor criteria beginning with its report to the 1974 World Food Conference. This was to estimate the minimal energy requirements of the average nonfasting person at 1.5 X his Basal Metabolic Rate and to assume that some individuals might have a BMR as much as 20 percent below the norm.

It is difficult to fault this modification. Certainly the 1.2 BMR factor which results-- $.8 \times 1.5$ (BMR)--yields values which bear a clearer hallmark of reality. If anything, it errs on the side of being too low. Applied to Asia it suggests minimum per capita requirements of the order of 1,500 calories, as opposed to the criteria of 2,600 and 2,230-2,300 calories, respectively, used in the first two World Food Surveys.

In the early FAO and USDA studies, the terms "undernourishment" ("undernutrition") and "malnourishment" ("malnutrition") were widely used. Undernourishment is generally taken to mean a shortfall in caloric intake such that a person cannot maintain normal bodily activity without losing weight. Malnourishment, on the other hand, describes the lack or deficiency of one or more of the so-called protective nutrients--protein, the vitamins, and minerals.

The first two World Food Surveys defined the nutritional problems of the LDCs largely in terms of energy shortfalls and undernourishment. In the Third World Food Survey insufficient protein availabilities and malnourishment were highlighted. Today most nutritionists concerned with the developing countries speak of protein-calorie (or protein-energy) malnutrition. This sees a shortage of energy again as the prime problem and takes into account that an apparent adequacy of protein can be converted into a deficit should a portion of it be metabolized to compensate for insufficient energy intake. This major change in problem perception and terminology coincided with a drastic reduction in the recommended minimum allowances for protein.

As with energy allowances, the early FAO protein recommendation contained a comfortable safety factor as well as an allowance to take individual variation into account. In 1971 an expert panel concluded that these had been excessive and reduced the daily per capita recommendation for adults by a third: from 61 grams of reference protein to 40.

The effect of this change was dramatic. Prior to the revision, simple comparisons of average availabilities and needs suggested that almost all the world's developing countries were deficient in protein; after it, hardly any of them. If the "protein gap" did not disappear overnight, its statistical underpinnings seemed to.

Misleading Conclusions

Since they used food availability estimates that understated to compare against food requirement figures that overstated, it is not surprising that the early FAO and USDA global food assessments painted a gloomy picture of world hunger. Though the numbers varied, the picture was one of hungry countries and of a world unable to feed its rapidly growing population. Insufficient production was seen as the problem. As the second of the USDA's World Food Budgets put it:

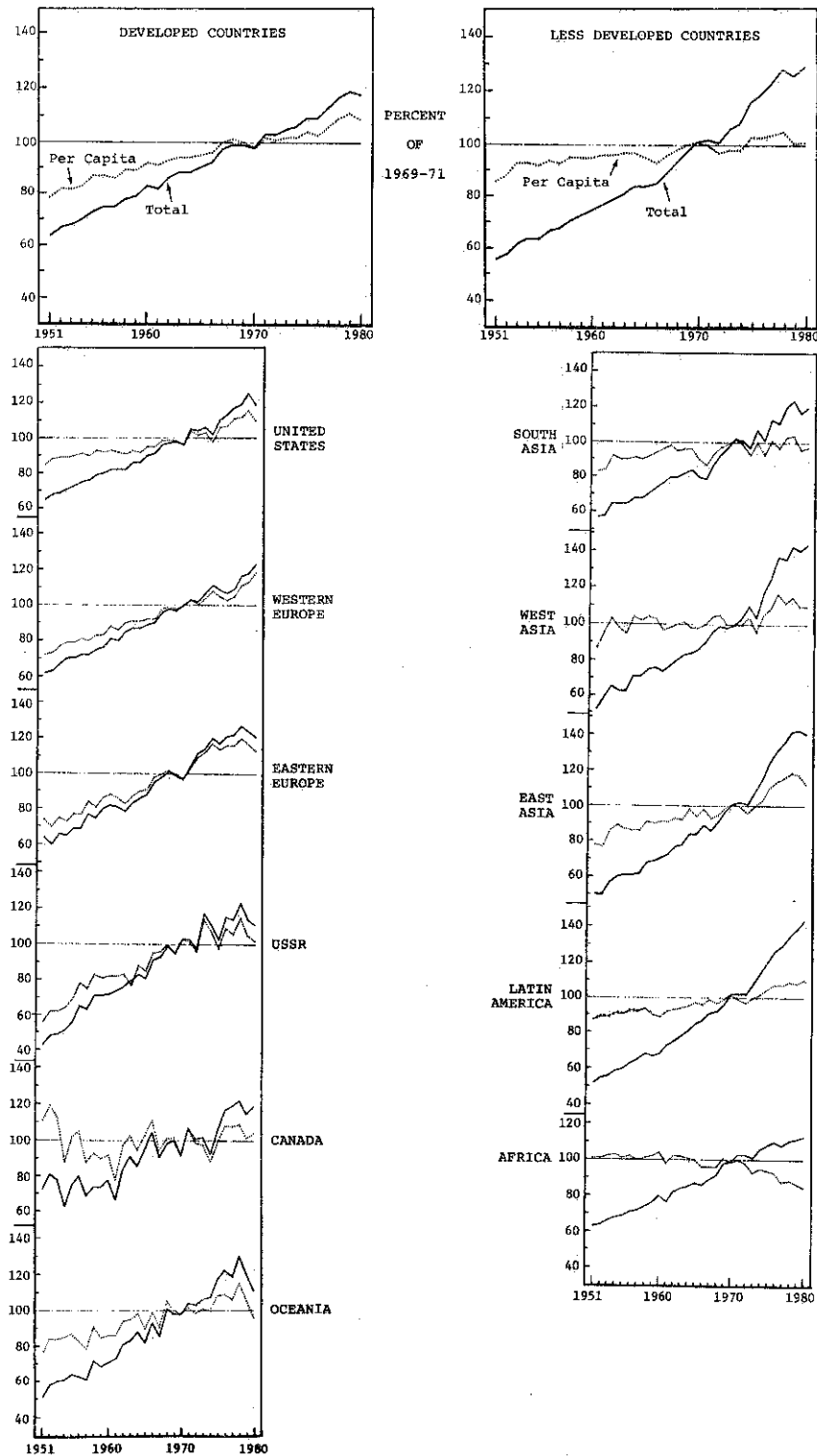
Two-thirds of the world's people live in countries with nutritionally inadequate national average diets. . . The diet-deficit countries are poor and food deficiencies merely reflect the low level of income in general. . . The basic problem of the diet-deficit countries is one of productivity. The people cannot produce enough food to feed themselves or produce enough other products to buy the food they require. Food production has barely been able to keep ahead of population growth, much less provide for the expanded demand resulting from some improvement in per capita income, most of which goes for food.

We now know that such conclusions seriously distort reality. The record of agricultural productivity in the LDCs has not been all that bad. According to such generally used series of "world" food output as that currently issued by the USDA (Figure 2), the LDCs over the past 30 years have expanded production rather more rapidly than the developed countries, a remarkable achievement in view of the minimum priority given to agriculture in their development programs. Population growth, to be sure, absorbed most of the gains, but with the exception of sub-Saharan Africa modest per capita improvement occurred.

There have, of course, been year-to-year fluctuations in this trend--fluctuations whose import has tended to be magnified by those who would influence public opinion. The first apparent faltering came in the mid-1960s and resulted almost exclusively from two successive droughts in India. Indian production bulks so large in the LDC aggregate that major fluctuations in her harvest influence visibly the index for all developing countries. This fact, however, was lost on many commentators. Conditioned by the early FAO and USDA findings to think of all LDCs as "hungry" and hearing of massive food aid shipments--of the 30 million tons of grain shipped by the United States under Public Law 480 during the two years ending in June 1967 half went to India--not a few were inclined to predict imminent global starvation. The Paddock brothers went so far as to specify 1975 as the year in which this would take place.

A reaction set in almost immediately and again closely mirrored the Indian situation. A sequence of favorable years in terms of weather was accompanied by introduction into the Punjab of high-yielding varieties of Mexican wheat. The result was the index for all low-income countries rose steeply, as did per capita availabilities. The assessment was as extreme in the opposite direction as it has been in 1965 and 1966.

FIGURE 2. INDICES OF TOTAL AND PER CAPITA
FOOD PRODUCTION, 1951-1980*



*Data from: U.S. Department of Agriculture. World Indices of Agricultural and Food Production. Washington, D.C.: ERS Statistical Bulletin 669, July 1981, pp. 12-17. Developed countries: North America, Europe, USSR, Japan, South Africa, Australia, and New Zealand; less developed countries: Latin America, Asia (except Japan and Communist countries), and Africa (except South Africa).

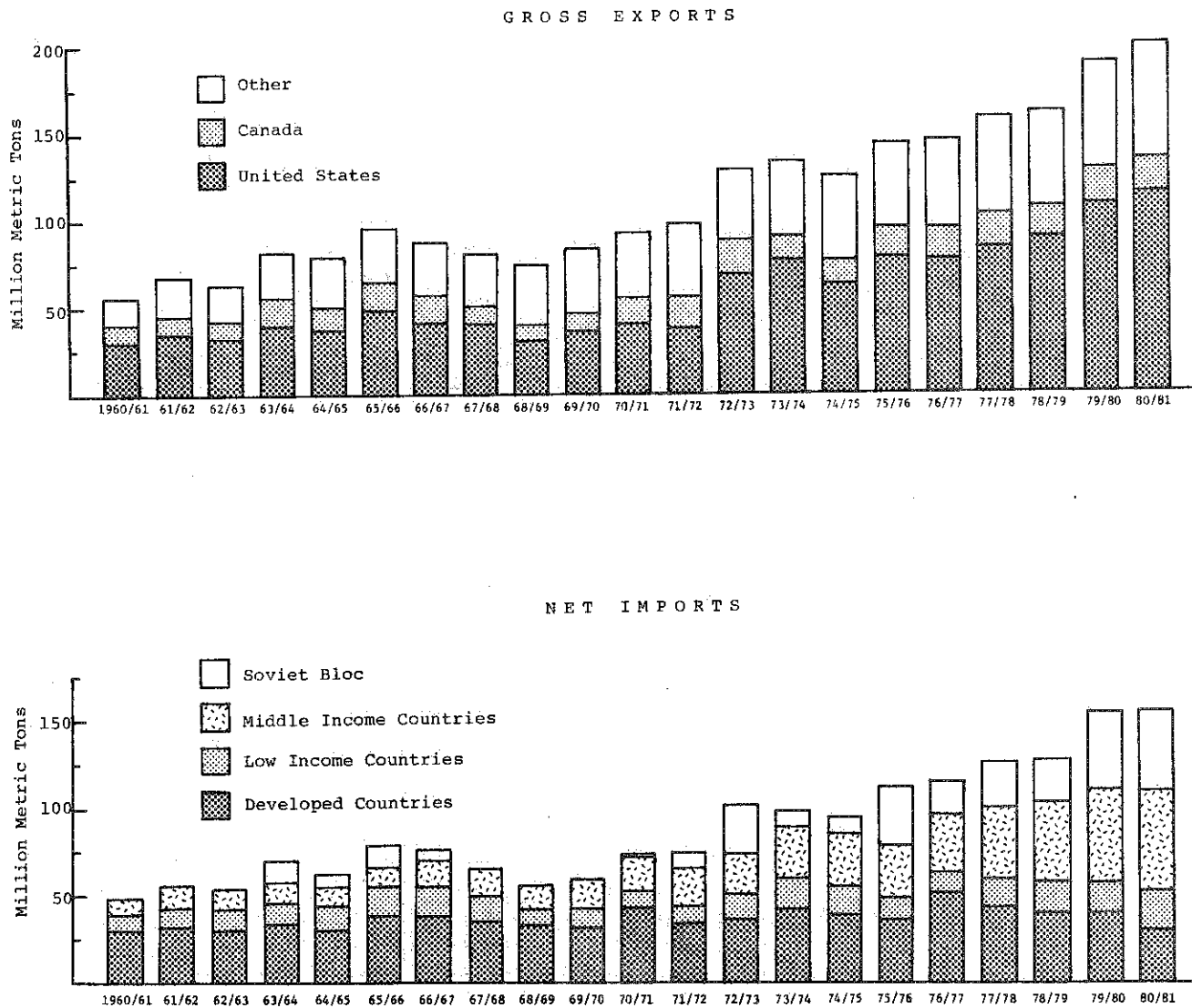
These were the years when the Green Revolution began to be talked of. The situation in Northwest India, together with the introduction of high-yielding, fertilizer-responsive rice in the wetter portions of Asia, led many to believe that a fundamental change had taken place and that feeding the world's rapidly increasing population no longer posed problems. So pervasive was this optimism that the FAO went so far as to suggest, in its State of Food and Agriculture for 1969, that the food problems of the future might well be ones of surplus rather than shortage.

The factors underlying the second pause--the "food crisis" of the early 1970s--were more complex and primarily involved the developed rather than the developing countries. In brief, it resulted from an unhappy coincidence of four main influences: an intentional running down of stocks and a holding down of production in the United States; unprecedented prosperity and rising demand in Europe and Japan, which led to rapid increases in the use of grain for livestock feed; a general relaxation of attention to agriculture in the LDCs; and unfavorable weather in India, the African Sahel, and the Soviet Union. The role of the Soviet Union was particularly destabilizing. The failure of its 1972 harvest triggered the run on world supplies and the short crop of 1975 prolonged it. Nonetheless, the crisis was truly global in that the price rises were general and in that it exposed the weaknesses of the international agricultural order. "International" is the operative word: most affected were the countries trading in the world market. Least involved were the largely self-reliant LDC economies.

More recently the pendulum of assessment has again swung. Save in the Soviet Union, harvests almost everywhere were favorable during the latter half of the 1970s. Although some perceive in the upturn in the quantity of grain moving from North America to the developing world a sign that the latter is increasingly unable to feed itself, this interpretation is incorrect. As Figure 3 shows, the bulk of increase is going not as food to the poorest countries, but as feed to those middle-income countries whose populations are beginning to experience sufficient affluence to effectively demand more meat in their diet. To the extent there is talk among knowledgeable observers of potential crisis, it is usually in the context of the events of the early 1970s repeating themselves sometime during the next decade. There have, after all, been few changes in policies that would mitigate against such a recurrence following a year or two of below trend production.

This story of modest progress in the LDCs clearly does not tally with the pessimism of the early FAO and USDA studies. It does not follow, however, that the postwar years have witnessed a reduction in the actual number of people nutritionally distressed. For the suggestion that increased production alone could eliminate hunger was only one of the misconceptions conveyed by the early studies.

FIGURE 3. WORLD GRAIN TRADE, 1960/61-1980/81*



*Data from: U.S. Department of Agriculture, Foreign Agricultural Service. Years are July-June marketing years. Low income countries are defined as those with a 1979 per capita GNP of US\$670 or less.

A second unfortunate legacy was the notion that countries could be classified as hungry or well fed. It is now clear that, to the extent that this notion has validity, the early studies misrepresented reality. With food availability estimates that understated set against requirement figures that overstated, the cards were so stacked that almost all LDCs could be classified as "diet deficit." Redone with truly accurate information, it is probable that few countries would be so classified. Much as the protein gap proved a statistical illusion, the list of diet-deficit countries would be whittled away.

But such a computation would perpetuate the most important failing of the early methodology. It is individuals, not countries, who experience nutritional deprivation, and average country data tell us little about the individual. It is now a commonplace among serious pronouncements on the food situation that, equitably distributed, global supplies are sufficient to feed all. The problem is that all within a country do not have equal access to existing supplies, and it is to consideration of the impact of this inequality that I now turn.

II. MEASURING THE IMPACT OF INCOME

The first study which attempted to take account of the income effect was FAO's Third World Food Survey, published in 1963. Largely the work of the eminent Indian statistician, P. V. Sukhatme, then Director of FAO's Statistics Division, the study is spotty in its description of methodology. This is understandable. Our insights into the effect of income rest largely on household budget surveys, and if there are few of these today of acceptable quality, there were even fewer two decades ago.

Nonetheless, on the basis of evidence from Maharashtra State in India and elsewhere, Dr. Sukhatme concluded:

. . . as a very conservative estimate some 20 percent of the people in the underdeveloped areas are undernourished and 60 percent are malnourished. Experience shows that the majority of the undernourished are also malnourished. It is believed therefore . . . some 60 percent of the people in the underdeveloped areas comprising some two thirds of the world's population suffer from undernutrition or malnutrition or both.

This, of course, was before the recommended allowances for protein were lowered; with revision, the 60 percent malnourished presumably disappeared. On the other hand, Dr. Sukhatme's 20 percent undernourished is not too much different from FAO's current estimate of persons suffering protein-calorie deprivation.

In its documentation prepared for discussion at the World Food Conference of November 1974, the FAO took due account of the 1971 reduction in protein allowances and also employed the 1.2 BMR criterion for minimum

energy needs for the first time. Though this yielded floor values well below the energy requirement figures used by Dr. Sukhatme--1,500 as opposed to 2,300 calories for the Far East--the proportion of LDC population whose estimated intake fell below it actually increased: from 20 percent to 25 percent.

It is difficult to imagine how this increase came about, and the FAO offered no explanation. My suspicion is that the figures were derived less through research than through a political decision imposed from on high. Few bureaucrats wish to admit that the problem they are relieving is a modest one, and international bureaucrats are no exception. As Table 1 shows, the figures almost certainly contain an element of arbitrariness. Between April 1974, when the preliminary documentation was released, and the conference itself in November, the estimated LDC population with intakes falling below 1.2 BMR was raised from 360 million to 434 million--or from exactly 20 percent to exactly 25 percent.

I confess to similar skepticism about the findings of the two most recent studies which attempted to measure the impact of income--the World Bank study carried out in 1976 and FAO's Fourth World Food Survey, published a year later. Although they used broadly similar techniques for estimating the effect of income--the main difference was that the 1.2 BMR floor criterion was used by FAO; the old recommended dietary allowances by the World Bank--their conclusions differed wildly. As Figure 1 indicates, the FAO concluded that about 450 million people were suffering from protein-calorie malnutrition; the World Bank put the number at almost 1.2 billion. Not knowing what to do about this discrepancy, the recent Presidential Commission on World Hunger mentioned both figures.

Central to the analysis in both studies was the concept of calorie-income elasticity; that is, of the increment in caloric intake associated with an increment in income. The elasticity or elasticities used by the FAO were not stated; the World Bank study postulated a range of from .10 to .30 for people just meeting their minimal food needs. Although the reasons for its selection were not specified, a calorie-income elasticity of .15 was deemed most appropriate, and on the basis of it and some heroic assumptions about income distribution in Asia, Latin America, Africa, and the Middle East, the study concluded:

. . . that 56 percent of the population in developing countries (some 840 million people) had calorie-deficient diets in excess of 250 calories a day. Another 19 percent (some 290 million people) had deficits of less than 250 calories a day.

There are a number of reasons for giving minimal credence to the resulting figure of almost 1.2 billion hungry people. The World Bank analysts were apparently unaware of the tendency for food production in developing countries to be underreported; and their use of the old recommended dietary allowances as surrogates for minimal needs was surprising to say the least. Further, there are serious problems with the concept of calorie-income elasticity. It misleads by suggesting that the relationship between income changes and changes in energy intake is a simple one, reducible to one tidy figure. This is not the case. Figure 4, prepared ten years ago to summarize the effect income has on nutrient intake in Sri Lanka, is suggestive of the real world. The

TABLE 1. WORLD FOOD CONFERENCE: PRELIMINARY AND FINAL ESTIMATE
OF NUMBER OF PEOPLE THOUGHT TO HAVE HAD AN INSUFFICIENT
PROTEIN-CALORIE SUPPLY IN 1970, BY REGION^{a/}

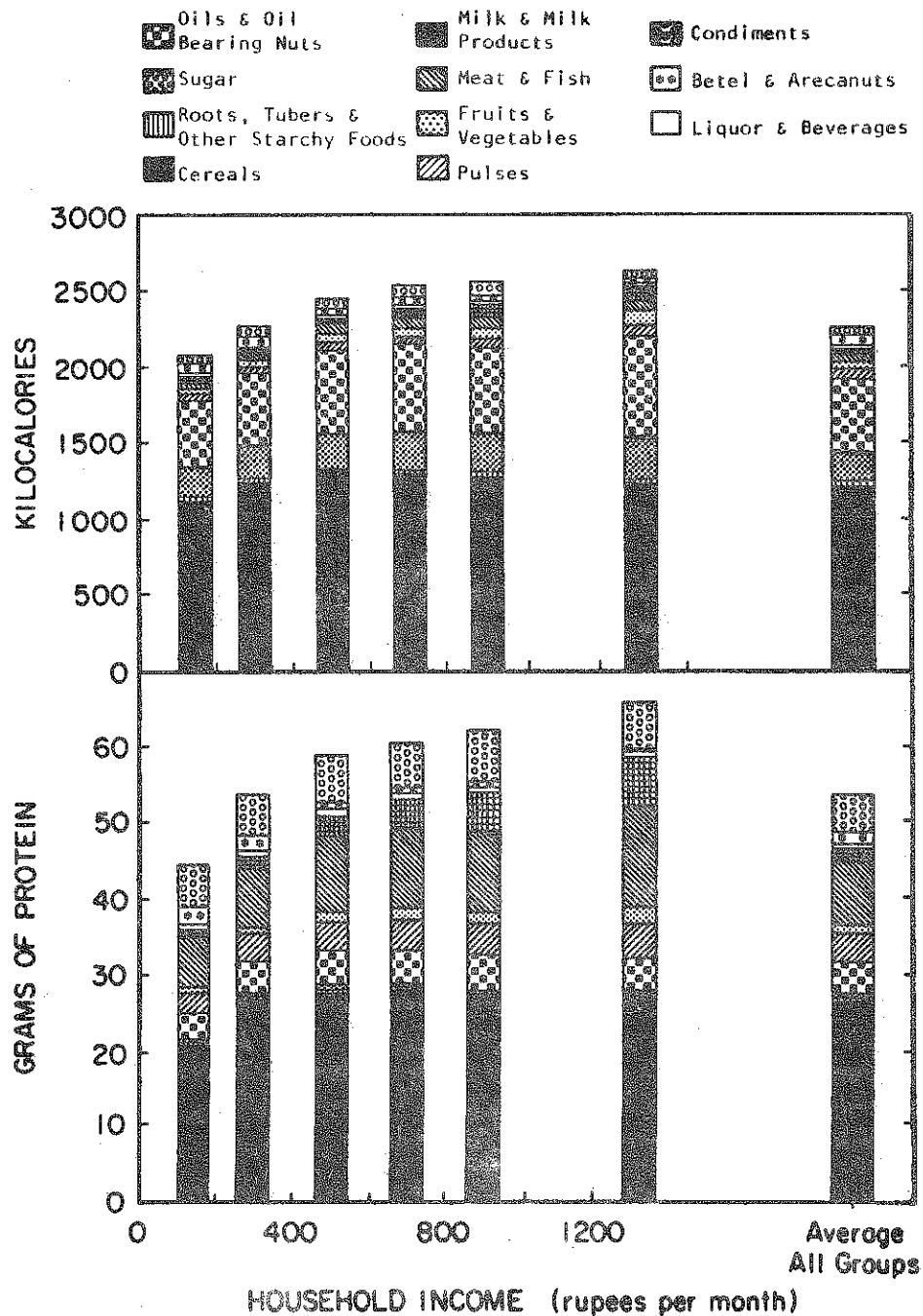
Region	Population (millions)	Percentage Below 1.2 BMR		Number Below 1.2 BMR	
		Preliminary Estimate	Final Estimate	Preliminary Estimate	Final Estimate
Developed	1,074	3	3	28	28
Developing ^{b/}	1,751	20	25	360	434
Far East ^{b/}	1,020	22	30	221	301
Latin America	283	13	13	37	36
Africa	273	25	25	68	67
Near East	171	20	18	34	30
World ^{b/}	2,825	14	16	388	462

*Preliminary estimates from United Nations, World Food Conference. Preliminary Assessment of the World Food Situation, Present and Future. Rome, April 1974, p. 39. Final estimates from United Nations, World Food Conference. Assessment of the World Food Situation, Present and Future. Item 8 of the Provisional Agenda. November 1974, p. 66.

^{a/} Principal modifications shown in italics.

^{b/} Excluding Asian centrally planned economies.

FIGURE 4. APPARENT PER CAPITA DAILY ENERGY AND PROTEIN AVAILABILITIES IN SRI LANKA, 1969-70, BY INCOME CLASS*



*Reproduced from: Poleman, Thomas T. Income and Consumption: Report to the Government of Sri Lanka. Food and Agriculture Organization, Nutrition Division and United Nations Development Program Report No. TA-3198. Rome, 1973, pp. 18-19. Based on data from: Sri Lanka, Department of Census and Statistics. Socio-Economic Survey of Sri Lanka, 1969/70, Special Report on Food and Nutrition Levels in Sri Lanka. 1972.

household budget survey on which it is based was then almost unique. It covered almost 10,000 households representative of the entire country and was conducted and analyzed with uncommon integrity.

Yet, even with this survey, one can infer little with confidence about the extent of protein-calorie malnutrition in Sri Lanka. The most important dietary adjustment historically associated with rising income is a decline in the importance of the starchy staple foods--read rice in Asia--as sources of energy and a shift to the more expensive, flavorful foods such as meat, fish, and vegetables. In Sri Lanka this tendency is observable among only the four uppermost income classes (20 percent of the population), and then, because of egalitarian measures imposed by the government, only weakly so. Between the lowest class (43 percent of the people) and the next lowest (37 percent), the sole change is quantitative. There is a difference in apparent per capita daily availabilities of 200 calories and 10 grams of protein, but none in diet composition.

What are we to infer from this? Because increased quantity not quality was purchased with increased income, the jump from 2,050 to 2,250 calories could be interpreted as implying behavior consistent with enforced reduced activity among the very poor (or actual physical deterioration) and that the 1.2 BMR energy floor of 1,500 calories is an unrealistically low figure for minimum needs in Sri Lanka. But just as reasonably, one might postulate caloric adequacy among that element of society which is too poor to waste anything and which, given the very high rate of unemployment in Sri Lanka, leads a less active life and therefore has lower energy needs. Thus it is possible to have it either way: depending on your assumptions, you can prove beyond a statistical doubt that 43 percent of Ceylonese suffer protein-calorie malnutrition or none do.

Income, then, is clearly crucial, but hasty evaluations of its impact are out of place. If its effect is to be properly understood, the evidence at hand must be subjected to painstaking scrutiny.

An essential backdrop to such scrutiny is an understanding of how poor people over the centuries have contrived to feed themselves and the sorts of changes their diets undergo as they become more wealthy. This was the subject of some truly pioneering research carried out during the 1930s and 1940s by Merrill K. Bennett. He noted that the very poor everywhere would seek to maximize the nutritional return per outlay for food by building their diets around foods composed principally of starch: wheat, rice, potatoes, cassava, and the like. This is so because of the cheapness of these starchy staples, whether expressed as market price or production cost. Far less land and far less labor are needed to produce a thousand calories of energy value in the form of the starchy staples than in the form of any other foodstuff. Meat producers by comparison are inefficient converters; an animal must be fed between three and ten pounds of grain for it to produce a pound of meat. But most people enjoy meat, and they turn away from the starchy staples as they become wealthier.

A simple way to rank diets is according to the percentage of total calories supplied by the starchy staples and an easy way to record change is to monitor shifts in this starchy staple ratio. In the United States the ratio stood at 55 percent a hundred years ago, when our great-great-grandparents consumed large amounts of bread and potatoes. Today our diets are dominated by meat, fats and oils, sugar,

vegetables, and dairy products. We pay more for such a diet and presumably enjoy it more. But it does not follow that it is a better diet.

Faced with so much conflicting material about the extent of world hunger, the USDA a few years ago asked me to look into the basis for the confusion. Among my conclusions was one which could be anticipated at the outset. This is that there still is not enough evidence about the effect of income on food behavior for us to generalize with confidence. Such evidence must come from household budget surveys, and carefully conducted surveys of broadly representative samples are still few for the developing countries.

About halfway through my research for USDA, it occurred to me that since it was not likely that the next few years would see more accurate estimates of either food availabilities or minimal nutritional needs in the developing countries, we should consider abandoning altogether the approach of comparing availabilities with needs, and search instead for behavior indicative of perceived dietary adequacy or inadequacy. Would not Bennett's progression of dietary change provide the necessary framework for such a search and would not the point where households began to purchase quality instead of quantity be the threshold we sought?

Preliminary analysis by my students of five recent surveys, conducted in Sri Lanka, Indonesia, Bangladesh, Peru, and Brazil, indicates the idea has merit--but that it will be of less value in countries where, as in Sri Lanka, one staple is all pervasive. This is because initial substitution will take place among the starchy staples; and where one food dominates, the substitution will be between quality grades of that commodity, shifts which are extremely difficult to monitor. Figure 5, based on data collected in Brazil in 1974/75, is suggestive of what we are finding where more than one staple and a clear preference hierarchy prevail. It is apparent that the diet at the lower end of the income range is that of poor people: the four starchy staples (cassava, maize, rice, and wheat) supply over half of total caloric availability. But it would not appear to be the diet of people who perceive themselves threatened with hunger. Additional calories are not purchased as income increases. Instead, consumption of cassava, the least preferred staple, falls off sharply, its place taken by rice and wheat bread.

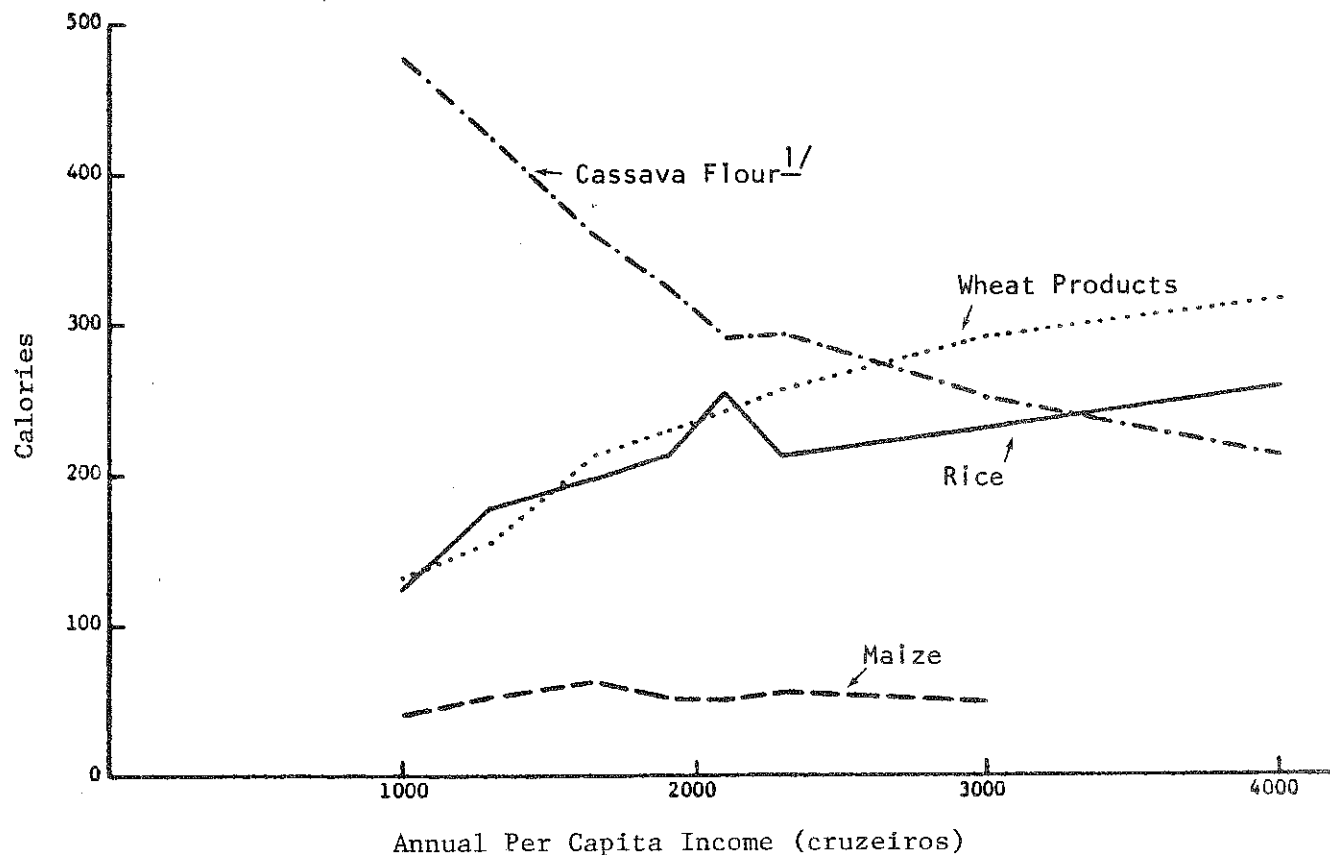
This type of behavior, which is also evident in the data for the other countries examined, is less suggestive of widespread hunger in the LDCs than it is of the ability of the people there to shrewdly allocate their limited resources so as to get by on what by the standards of the industrialized world is very little. And lest it be thought that the poor were excluded from the surveys, be assured that they were not. The Brazilian data are for the north-eastern part of the country, Brazil's poorest region, and the survey has been suppressed by the government because of the social inequality it reveals.

III. REMEDIAL APPROACHES

I am sure that it has occurred to a number of you that while feeling free to criticize the work of the FAO, USDA, and the World Bank, I have cleverly avoided offering any numbers of my own. Be assured that I will. But before doing this, I would like to discuss in a general way the various strategies which have been put forth for eliminating hunger. Since the nutritional problems of the developing countries are less a reflection of insufficient production than of the poor's inability to effectively

FIGURE 5. NORTHEAST BRAZIL: APPARENT PER CAPITA DAILY CONSUMPTION OF MAJOR STARCHY STAPLES AMONG LOW-INCOME CLASSES, 1974-75

(calories)



^{1/} Plus other roots and tubers (5 percent of total).

*Data from: Neville Edirisinghe, "Behavioral Thresholds as Indicators of Perceived Dietary Adequacy or Inadequacy" (unpublished Ph.D. dissertation, 1983).

demand a satisfactory diet, these strategies must take into account the extent to which the normal course of development can be expected to raise income.

The Income/Employment Backdrop

Increased levels of food production will, of course, continue to be required, but the evidence for most areas points to this being forthcoming. I have noted that the record of LDC agriculture over the past quarter century has not been unimpressive; that despite the minimal attention given agriculture in most LDCs, output has expanded no less rapidly than in the industrialized countries and, save in Africa, more than kept pace with population growth.

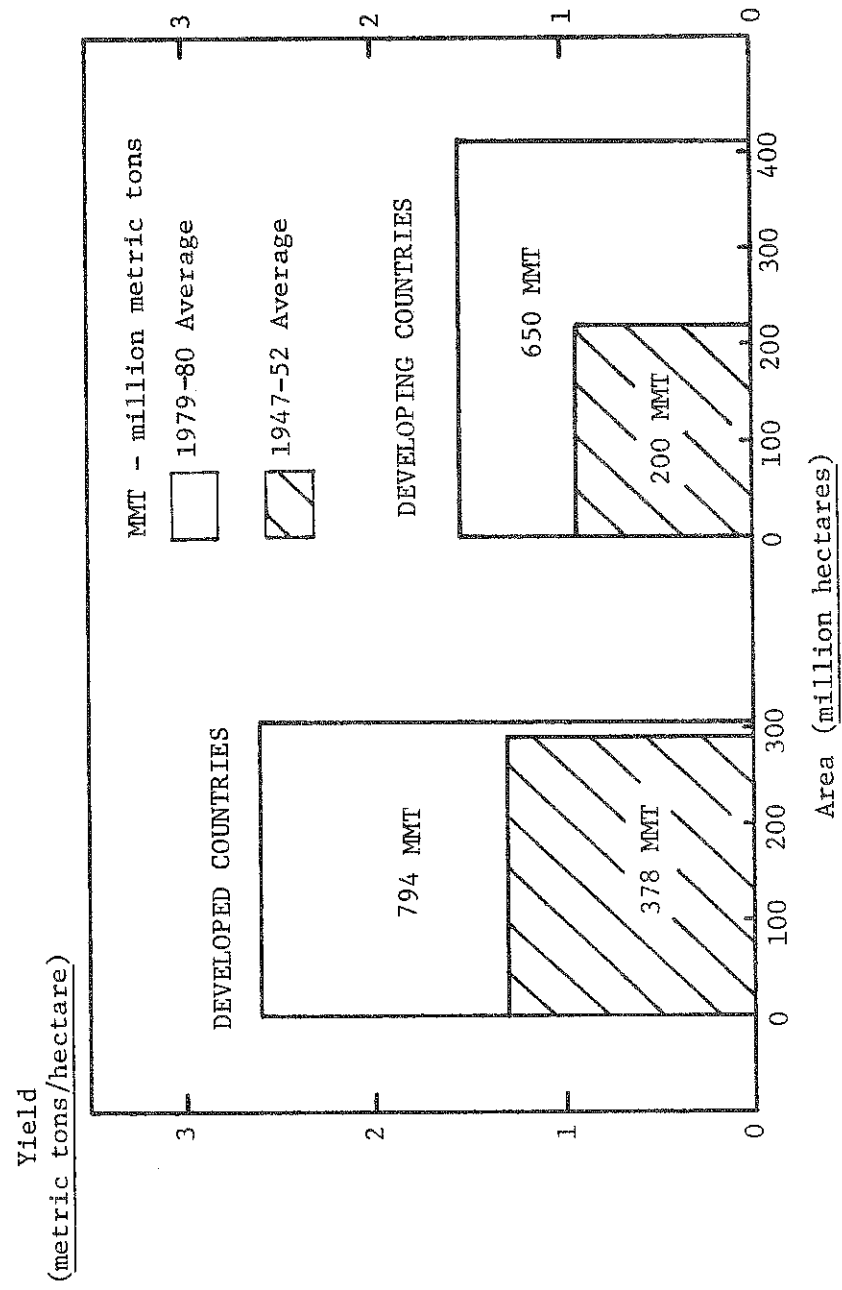
What is all the more remarkable about this is that it has taken place without the huge upsurge in yields which has so transformed agriculture in the developed countries. Figure 6, in which are compared the production, area, and yield of all grains immediately after the war and recently, offers some perspective. Prior to the war, grain yields everywhere averaged in the neighborhood of one ton per hectare. By 1980, as the result of greater use of fertilizer, improved seed varieties, and better cultivation practices, yields had more than doubled in the developed countries. In the LDCs, on the other hand, the gains have been comparatively modest. Despite the publicity given the Green Revolution and certain spectacular accomplishments, LDC average yields have increased to only a bit above where they were in the developed countries at the beginning of the postwar upsurge.

The systematic application of the scientific method to food farming in the developing world is very recent, dating no further back than the mid-1940s. It is not surprising, then, that the scope for improving yields has been only superficially exploited. Moreover, breeding work until just this decade ignored the root crops and concentrated on wheat, rice, and maize; and even for these crops yields have risen to only a fraction of the potential. A substantial share of the rice produced in Bangladesh and Thailand is of the floating variety, able to grow up to a foot per day if flooding demands it. It is hardly an exaggeration to say that work is only beginning on this unusual crop. That the payoff is likely to be great goes without saying.

If the LDCs are potentially capable of enormous increases in food production, it is not possible to be equally sanguine about the outlook for providing productive employment for their populations. In part this pessimism recognizes the selective nature of all economic change--some are caught up in the process, others left out--but above all it mirrors the number of people who will be entering the labor force between now and the year 2000.

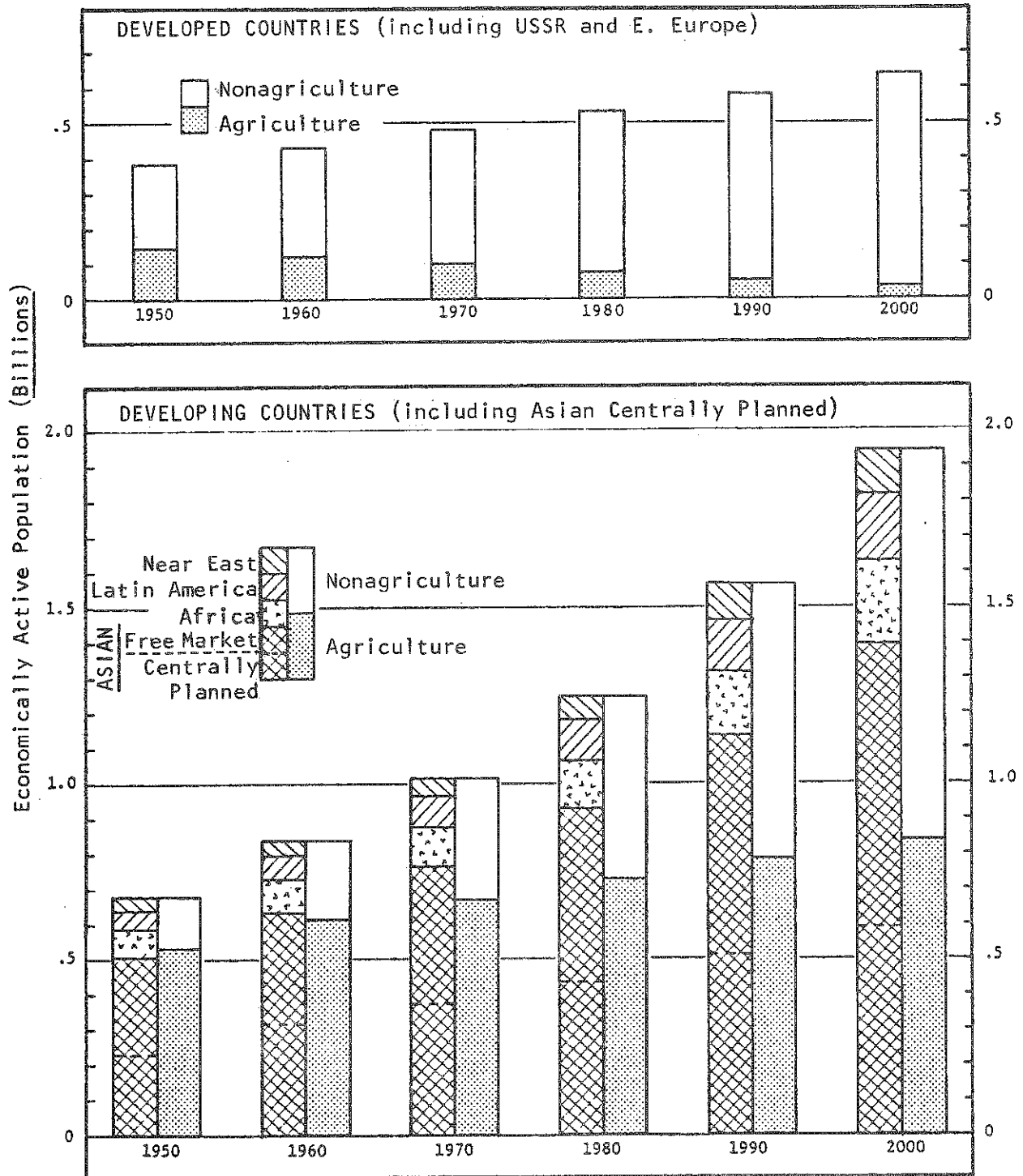
Their number is truly staggering. Figure 7 illustrates a projection prepared a few years ago by the International Labor Office. Between 1970 and 2000 it is expected that the LDC labor force will double--from about one to two billion people. The billion new jobs that must be found are roughly twice the number presently existing in the industrialized countries and mean that the LDCs will be called on to transform themselves at a rate and on a scale unprecedented in history. In terms of

FIGURE 6. WORLD PRODUCTION, AREA AND YIELD OF GRAINS, AVERAGE
1947-52 AND 1979-80



Data from: U.S. Department of Agriculture, Foreign Agricultural Service.

FIGURE 7. ECONOMICALLY ACTIVE POPULATION, RECENT YEARS AND PROJECTIONS TO 2000*



*Data from: International Labour Organization. Labor Force Projections. Geneva, 1971. United Nations, Food and Agriculture Organization. The State of Food and Agriculture--1973. Rome, 1973, pp. 131, 138.

just one country, it means that during the remainder of the century Mexico will add to its labor force each year about the same number of new entrants as the USA and Canada together were able to absorb during the boom years of the 1950s and 1960s.

The ILO projection sees few of the new entrants being absorbed into agriculture, and one must ask whether this need be so. The basis for it is the selectivity of the various technical breakthroughs that have so far characterized the Green Revolution. To the layman the term Green Revolution conjures up visions of miracle seeds which offer all farmers the same potential for dramatic increases in yield. In fact, the high-yielding varieties have not been designed to be introduced alone, but as one component of a package involving a host of complementary inputs: fertilizers, adequate water, and effective control of disease, insects, and weeds to mention the more obvious. Thus the miracle rices are highly responsive to fertilizer and yield well only under irrigated conditions. Simply to provide the conditions under which they can be introduced can be time-consuming and expensive. To the extent that the new systems are specific to particular ecological conditions, benefits will clearly be restricted. Equally obvious is that those best able to command the new inputs--the larger and wealthier farmers--will reap the lion's share of the benefits.

The experience of Mexico is a case in point. Mexico was the site of the first "agricultural miracle" of the postwar period, thanks to the Rockefeller-funded Office of Special Studies (now CIMMYT). The achievements were impressive. The output of maize increased from about 3.5 million tons during the late 1940s to nine million tons in 1968. Average yields per hectare almost doubled: from 700 to 1300 kilograms. The performance of wheat was even more spectacular: from 300,000 tons to over 2.5 million tons in just 20 years, with yields quadrupling to 3.2 tons per hectare. Cotton and other crops for export fared almost as well.

But, as every Mexican knows, this extraordinary achievement was localized both geographically and with respect to its impact on the rural population. Change has largely been confined to the north and the north-west, where the program of government sponsored irrigation opened up expanses of highly productive land, and the Gulf coastal strip, the one portion of the country receiving abundant rainfall. Though lip service throughout the period was paid to continued agrarian reform, the great majority of the rural population was bypassed. Today less than 5 percent of the holdings occupy almost two-thirds of the irrigated area and account for over half the value of production. In contrast, 85 percent of farms have access to only 4 percent of irrigated land and contribute a mere 20 percent of output by value.

While the selective impact of their breakthroughs came as a shock to the Rockefeller scientists and their Mexican colleagues, it should not have. A similar selectivity characterized the innovations which transformed agriculture in Europe and North America during the 19th

century. But here the historical parallel begins to break down. There is a great difference between the cities of last century's developing countries and those of today's. A hundred years ago the bypassed or displaced farmer could look to the city for opportunity. Industry was growing, and as industry then had high labor requirements, virtually all who left the land found jobs. Today the movement to town rests on less solid foundations. Though urbanization in the LDCs is proceeding at a breakneck pace, most of such industrialization as is taking place is capital-, not labor-demanding. To a depressing extent most urban centers continue as administrative and trading centers. Suitable jobs are far fewer than people in search of them.

The prospect, then, is for two groups of persons to be excluded from the course of development: those bypassed by progress in the countryside and the underemployed of the towns. The proportion of the population presently falling within the two groups is anybody's guess. Governments in the developing world do not collect data on unemployment and underemployment, and if they were to the findings would be too distasteful politically to permit release. The World Bank and other international agencies speak of the "lower 40 percent," and even if this figure is a very rough estimate, it is probably a fair one. Somewhere between a quarter and a half of the population of the developing world is being bypassed by the forward march of economic change.

Recognition that the income effect cannot be relied on to eliminate all nutritional deficiencies within the lifetime of many of those most seriously afflicted has given rise to a host of alternative proposals, their number, in the words of one observer, being indicative "of how much of a growth industry human nutrition and world hunger activity has become." They divide in two broad groupings: those which would look to correcting the causes of economic inequality and those which would aim at affording a measure of short-term relief.

Proposals falling within the first category range from the hopelessly naive to the outright revolutionary, but include a broad center setting forth conditions for "growth with equity." These include:

- An emphasis on developing the rural sector and on the immediate implementation of land reform.
- The retargeting of production toward meeting the minimum needs of all.
- The use of "appropriate"---by which is meant labor-intensive---technology.
- A willingness to view the Chinese and Cuban experiences with tolerance.

Proposals of this type have taken on a certain air of dogma among nutrition planners at the World Bank and the United States Agency for International Development, but one wonders to what end. Since so many of the changes visualized fly in the face of the interests of established elites, they are not likely to be implemented without protracted struggle. Furthermore, there is the very real danger---as El Salvador demonstrates---

that any such struggle would come to be seen in terms of the East-West conflict.

Treating the Symptoms

Given these political problems and the magnitude of the employment dilemma, my suspicion is that both the West and a majority of LDCs will not attempt to resolve the causes of poverty in a generation, but will seek instead to treat the symptoms. Are there means whereby those excluded from the development process can be helped to command a minimally acceptable diet? The answer is yes, but bringing this about will not be easy.

Measures for easing the plight of the nutritionally deprived without transforming the social structure include those designed to increase food consumption without a corresponding rise in food expenditures and those that improve the nutritive value of given foods.

Fortification of traditional foodstuffs with special nutrients is the most attractive means of accomplishing the latter. Iodization of salt is a classic example, as is the admixture to milled cereals of niacin, iron, thiamin, riboflavin, and calcium. The impact of such measures can be widespread and immediate. Beriberi, for instance, was endemic on the famed Bataan Peninsula of the Philippines immediately after the second world war. With the introduction of thiamin enrichment of rice, it virtually disappeared. The problem with this approach, of course, is that enrichment is only possible when foods are centrally processed; and in the very poor countries few are.

Similarly flawed are most of the schemes designed to permit greater consumption of food for a given level of expenditure. These usually involve some form of price manipulation by government, whether through direct procurement in the countryside, by subsidizing aspects of production or consumption, or by controlling the price paid by consumers.

Virtually all developing countries have one or more programs of this type, and as their effect is to transfer income, the motivation for them has been more political than nutritional. Nonetheless their nutritional impact can be appreciable. In Sri Lanka, for instance, rice was from the second world war to a year or two ago "rationed;" that is, virtually the entire population was entitled to a weekly quantity either free or at a subsidized price. Throughout most of the period this amounted to two pounds per head per week, or the equivalent of about 475 calories per day. Most observers credit this program with having contributed to the well-being of Sri Lankan people, as they do the Egyptian program of subsidizing the retail prices of staple foods in Cairo and Alexandria. The cost, however, of such schemes can be high. The rationing program in Sri Lanka regularly absorbed between 15 and 20 percent of the government's budget, and was abandoned by the current leadership as being incompatible with rapid economic growth. One estimate of the cost of the Egyptian food subsidy put it at a twelfth of the country's GNP. Neither program would have been possible without concessional food from abroad.

In addition to their expense, the problems with programs of this type are several and severe:

- They tend to be restricted to the urban centers--the Egyptian and Bangladesh cases being the most prominent--and thus have minimal impact on the very poor, most of whom still live in the countryside. In Bangladesh, proof of employment is a prerequisite for being issued a ration card.
- If not political from their inception, they quickly become politicized, with the result that modification is difficult. An attempt to reduce the consumer food subsidy triggered such severe riots in Cairo in January 1977 that the plan was immediately rescinded. The price and wage distortions they engender thus tend to become permanent.
- Where not dependent on food aid from abroad, the schemes tend to rely on low procurement prices to keep costs down. In either case the effect is to discourage the growth of domestic agriculture.

This disincentive effect is probably the most telling of the objections to both food aid and the various distribution and subsidy schemes as vehicles for combating malnutrition. To get around it a number of two-price systems and other devices have been proposed. By far the simplest and--when it is remembered that hunger is not all pervasive--the most appealing of these is to channel assistance in kind directly to those at greatest risk through maternal and child health clinics.

To some, this suggestion no doubt will seem a step in the wrong direction. For it is precisely this type of targeted intervention which was for long central to the (modest) activities of the more traditional nutritionists working in developing countries and which has been downgraded by the new wave of nutrition planners in the World Bank, FAO and the US Agency for International Development. Yet there are, I believe, compelling reasons for its use.

IV. ASSISTING THE NUTRITIONALLY VULNERABLE

If we do not know how many among the poor in the LDCs suffer nutritional deprivation, nutritionists are agreed that the preschool child and the pregnant and lactating mother are those most likely to be adversely effected by protein-calorie malnutrition (PCM). There are several reasons for this. The early growth and reproduction phases are nutritionally the most demanding in the life cycle:

- The total energy cost of a pregnancy is estimated to average between 40,000 and 80,000 calories.
- To produce 850 milliliters of milk daily during lactation, a mother's energy needs will be about 600 calories above normal.
- Because they are growing so rapidly, the infant and young child require more than twice the number of calories per unit of body weight as do adults and half again as much as adolescents.

Yet it is precisely the mother and young child whose needs can be reflected least in the choice of foods purchased by the household and who may be the residual claimants on that which has been prepared for all to eat.

Discrimination against mothers and the young in feeding habits reflects educational as well as income deficiencies. It is not just that undesirable food taboos relate particularly to the mother and her young; where households do not eat together, the father and elders will typically satisfy themselves first, and the women and children get what is left. Adult tastes, rather than those of the infant, will be the usual criteria of dietary excellence, with the result that much of the animal protein a meal contains can be impossible for the very young to swallow. The younger the child, moreover, the less well he is able to fend for himself at the table. And in times of shortage the mother is likely to defer to her children, not realizing that it is not only she, but her unborn child, who will suffer the consequences.

In its extreme form, PCM among the young occurs either as kwashiorkor or marasmus or sometimes combination of the two. Kwashiorkor is generally the result of an inadequate intake of protein relative to calories. It typically affects children who, after a period of breast feeding, are weaned onto starchy staples low in protein--such as the tropical roots and tubers--or sugary foods. It is most common in those parts of tropical Africa where roots, tubers, and bananas are the dominant starchy staples; indeed kwashiorkor comes from the Ga and means "disease that occurs when displaced from the breast by another child."

Marasmus, on the other hand, arises from an insufficiency of both energy intake and protein. The condition usually occurs in the first year of life and among the children of undernourished women. They are commonly of low birthweight and even in their first few months will show large weight-for-age deficits. Marasmus by definition is chronic, whereas kwashiorkor is an acute condition amenable to rapid reversal.

Cases of purekwashiorkor or marasmus seem to be the exception rather than the rule. Instead, most severely malnourished children will present signs and symptoms of both conditions and perhaps even alternate between the two. In addition to low weight for age and other overt physical signs, symptoms are apathy, instability, and poorly developed motor skills.

Although marasmic children may be at risk of outright starvation, the main danger to the severely malnourished lies in their diminished resistance to other disease. Should they survive these, they may well go through life permanently impaired, both mentally and in the height and weight they will ultimately attain. Although the linkages between severe PCM and brain growth and development are by no means understood, they give rise to particular concern.

Compared with its impact on pregnant and lactating mothers and the very young, the adverse effects of PCM on the other elements of a population are likely to be moderate. (Exceptions, of course, are the aged and the

infirm; on them the impact can be devastating.) This is because these elements are either not growing so rapidly or have stopped growing altogether and can adapt to reduced energy intake by either taking off body weight or by curtailing activity.

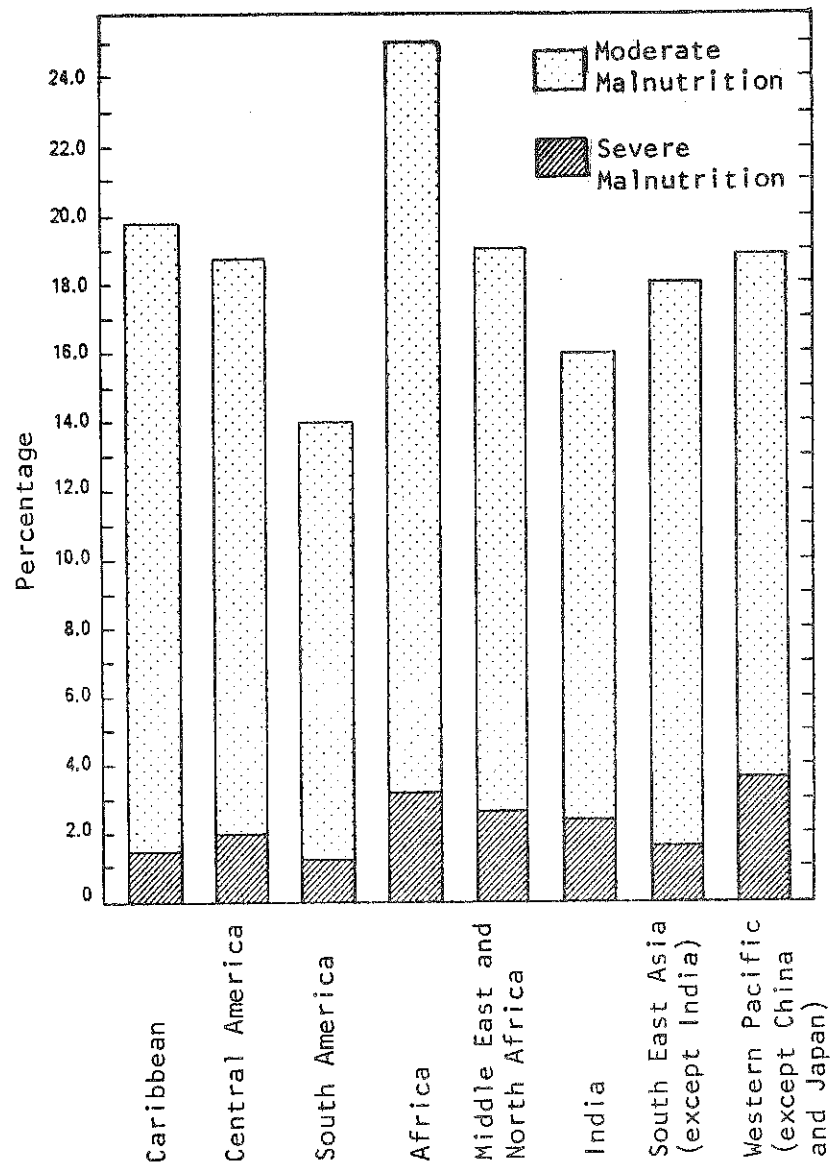
The human body is remarkably adaptive to reduced levels of food intake. Controlled studies among adults have shown that if caloric intake is cut to 50 percent of normal, body weight will drop within a few months by about a quarter. Thereafter a reduced level of activity can be maintained for many months before additional weight loss sets in and the incidence of nutrition-related disease rises. Thus the after-effects among adults of war-induced privation in the Netherlands in 1944-45 and in Biafra in 1968-69 are not thought to have been lasting; and certain groups in Africa may experience with no apparent impairment significant changes in body weight in association with the preharvest hunger phenomenon. This is not to suggest that the lethargy often observed among the poor in developing countries is not an adjustment to inadequate dietaries; only that it is reversible and need only be temporary.

Some nutritionists have suggested that cases of frank marasmus and kwashiorkor among the very young are but the tip of an enormous iceberg of PCM in the developing world and that for every child demonstrating symptoms of clinical PCM there may be 99 others who are inadequately nourished, grow poorly, and are highly susceptible to disease infection. The iceberg analogy may indeed be appropriate, but should be treated with skepticism. Certainly attempts to quantify the submerged portion--where no demonstrable harm is being done--do not yet warrant scientific credence.

Estimating the extent of PCM among young children involves the incipient science of nutritional anthropometry and debate attends the standards for healthy children it should employ, the measurements it should involve--whether weight for age, height for age, or weight for height--and where the cut-off criteria should be established. The reference standards usually employed are those of the US National Academy of Sciences and are defended on the grounds that within the 6-71 month age group possible distortions resulting from individual or racial differences will be minimal.

Very few follow-up studies of the health experience of children displaying specific anthropometric deficiencies have been carried out, and until such evidence is in hand and country-specific benchmarks have been determined, anthropometric evaluations should be interpreted with caution. Nevertheless, it has become common practice to define severe PCM as being evidenced by a weight-for-age of less than 60 percent of standard and the moderate form as being reflected by weights in the 60-80 percent range. Following (more or less) these definitions, the findings of the hundred or so anthropometric surveys available a decade ago have been summarized in Figure 8. It is apparent that only a small fraction of children--in most of the surveys just one or two percent--suffered from severe PCM and perhaps for each one of these, 10 or 15 were moderately afflicted. But beyond this, generalization is impossible. Most of the surveys covered small samples of questionable typicality, and the range in findings is too extreme to permit extrapolation. If the number of

FIGURE 8. PREVALENCE OF SEVERE AND MODERATE PROTEIN-CALORIE MALNUTRITION, BY REGION, 1963-73*



Reproduced from: Bengoa, J. M. and G. Donoso. "Prevalence of Protein-Calorie Malnutrition, 1963 to 1973." PAG Bulletin, vol. IV, no. 1 (1974), p. 31.

those at greatest risk is to be estimated, therefore, we have no alternative but to do so rather arbitrarily.

Table 2 offers one method for doing this. In it the number of pregnant and lactating women is approximated by doubling the birth rate. To this figure is added the number of infants below five years of age. Arbitrary percentage estimates of those likely to be at risk nutritionally are then applied. A 10 percent assumption is not an unreasonable minimum for most developing countries, while a 50 percent figure would seem an absolute maximum. The resulting range of those at risk--62 million to 309 million persons--defines a world hunger problem of vastly different dimensions than that conjured up by the World Bank study and The Fourth World Food Survey:

	Insufficient Protein-Energy Supply		Vulnerable People at Risk	
	Fourth Survey	World Bank	10 Percent Assumption	50 Percent Assumption
		(millions)		
Far East (ex-China)	297	736	26	131
China	-	-	14	71
Africa	83	190	9	46
Latin America	46	113	7	37
Near East	29	91	5	24
	455	1,130	62	309

Although Table 2 includes China, which the two studies did not, even the 50 percent assumption yields figures well below the number of those considered to have an insufficient protein-calorie supply in The Fourth World Food Survey and about a quarter the number arrived at by the World Bank study.

About a year ago I was quoted in a front-page article in The New York Times to the effect that "food aid of only three million tons of grain a year, if it could be channeled to the truly needy, would enable 100 million malnourished people to have an adequate diet." Whence came this statistic? It was a guess, worked out during a telephone interview, that perhaps 100 million mothers and young children are seriously malnourished and their average deficiency is in the neighborhood of 300 calories per day. I cannot defend it. The truth could be 400 calories for 150 million people or 200 calories for 200 million. If the former, the deficit would be 6 million tons; if the latter, 4 million tons. The point is that the deficits are trivial for a world which produces about 1.5 billion tons of grain and in which about 200 million tons move annually in international trade. There is no doubt in my mind that such quantities would be immediately forthcoming--as FAO's unexplained target of 10 million tons of food aid has not been--if the donors could be assured that the recipient countries would pass them on to those in true need.

Herein lies the rub. Few developing countries have so far shown themselves able to muster the medical expertise and administrative competence to organize a nationwide system of maternal and child health clinics. In Sri Lanka, for instance, it is reckoned that at best perhaps only two-thirds of the children needing it are benefitted by the country's Thriplosa weaning food program; and Sri Lanka is recognized to have one of the best public health systems in the developing world.

TABLE 2. NUMBER OF WOMEN AND CHILDREN AT RISK NUTRITIONALLY
ACCORDING TO TWO ASSUMPTIONS, 1975, BY REGION*

(millions)

Region ^{a/}	Total Population	Infants (Age 0-4)	Births	At Risk ^{b/}	
				10 Percent Assumption	50 Percent Assumption
Far East (ex-China)	1,057	174.3	43.5	26.1	130.6
China	823	98.6	22.1	14.3	71.4
Africa	331	60.6	15.8	9.2	46.1
Latin America	319	50.4	11.7	7.4	36.9
Near East	188	31.9	8.1	4.8	24.0
TOTAL	2,718	415.8	101.2	61.8	309.0

*Population data from: World Bank. World Atlas of the Child. Washington, D.C., 1979.

^{a/} Regional breakdown follows current FAO usage and includes only those countries classified as "developing." See: United Nations, Food and Agriculture Organization. The Fourth World Food Survey. Statistical Series 11, 1977.

^{b/} Assumptions are that 10 percent and 50 percent of the vulnerable groups (infants up to five years of age and pregnant and lactating mothers) can be considered malnourished. The number of pregnant and lactating mothers is taken as being twice the birth rate.

Yet establishing such public health systems should be a priority matter everywhere, if only to help bring the birth rate under control. It is now clear that rapid population growth can be contained rather quickly once certain preconditions have been achieved. Among the most important of these preconditions is a reduction in infant mortality, so that parents need no longer plan on two live births in order to feel reasonably assured that one child will reach maturity. To this end there are no more effective means than systems which provide supplemental food as well as medical services to mother and child.

Happily, there is a growing body of evidence which suggests these public health systems need not be as sophisticated as was once thought. This is certainly a lesson of the Chinese "barefoot doctor" program. If life expectancy in China is indeed half again what it was in 1949, the potential of relatively simple paramedical services should not be underestimated.

Similarly, new simplified methods of treatment of disease would seem to hold great promise. A case in point is the use of oral rehydration therapy in the treatment of diarrhea. Diarrhea and its consequences are among the major causes of infant mortality, there being perhaps 500 million episodes annually among preschool children worldwide.

Since the immediate causes of death from diarrhea are a loss of water and electrolytes, the essence of therapy is the replacement of these substances. The traditional form of doing so has been intravenously--a form of treatment that requires the child be brought to a hospital or health care center. In the past few years, however, it has been found that oral administration of a mixture of water, electrolytes, and glucose in the home can have the same beneficial effects. A recent trial of the technique in rural India resulted in a reduction in fatalities to one-fifth their previous level.

There are no doubt other innovations whose impact could be equally dramatic.

V. THE SPECIAL PROBLEM OF AFRICA

I indicated in the introduction that I felt the hunger problem was now manageable and could be eliminated in virtually all parts of the world before the year 2000 given proper governmental resolve. That this will come to pass in Latin America and Asia I am reasonably certain. Whether it will also in sub-Saharan Africa is very much in doubt.

It is customary to think of hunger as being primarily a problem of Asia, and so it once probably was. But today the incidence of serious malnutrition is highest in Africa. Black Africa is the only region of the developing world where, if the statistics are to be believed, per capita food production has not risen, but declined during the past two decades. It is also the only region where life expectancy is still under 50 years and where the birth rate has not begun to decline. And finally (if we exclude Cambodia) it is the only region to have experienced outright famine since the second world war.

Why this dismal performance? It certainly does not stem from a shortage of resources. The amount of arable land per cultivator in Africa is more than double that in Asia. And the infrastructure left by the departing colonial administrators was not all that inappropriate for sustained economic growth.

The answer, of course, lies in political instability and the incompetence and corruption which have characterized so many African governments since independence.

The two countries which I know best--Ghana and Uganda--are depressing cases in point. I spent some months in the early 1960s studying the system through which Ghana's cities were fed, and was mightily impressed with its efficiency. Commodities moved smoothly into Accra from up to 300 miles away and there was rational substitution in the availability of staple foods from one season to the next. At independence Ghana was the wealthiest country in tropical Africa. Today, 20 years and five coups later, it is no longer. The cause is human folly. Ghana's once thriving cocoa industry is producing at a level 50 percent below that of the 1960s not because there is no demand for the product, but because the government, in an effort to enhance its revenues, compels growers to accept a price rather less than half that prevailing on the world market. And a chicken sells in Accra today for the equivalent of about a tenth of a senior civil servant's monthly salary--and fish, the poor man's protein, for about three days labor per pound--not because the market women have lost their enterprise, but because fuel has become so expensive--and vehicles and roads have so deteriorated--that they can no longer exercise it.

The Uganda story is even sadder. Makerere University, where my family and I spent a delightful year in the late 1960s, had an excellent academic tradition and was home to first-rate medical and agricultural faculties. Again because I was studying the marketing system I was impressed with the liveliness and efficiency of producers and traders, and the wealth of the country. I suppose the less that is said of conditions today the better. Famine apparently is common among the Karamojong in the northeast, with armed helicopters needed last year to ride shotgun on relief shipments. The gentleman with whom I studied Kampala's food supply subsequently rose to become Dean of Makerere's Faculty of Agriculture and Pro-Vice-Chancellor of the University. Subsequent to that he had to disguise himself as a peasant and flee for his life from Idi Amin's goon squads. Makerere is in a shambles.

What happened in Uganda is an extreme instance of the collapse of law and order in Africa. But it affords little satisfaction that the Ghanaian experience is more typical. A recent World Bank review concluded that just about every African country enforced for the same political reasons as in Ghana pricing policies which discourage the production of food. Once in place such policies are extremely difficult to reverse.

The history of hunger and famine is not easy to trace. But to the extent that it is, it is evident that causality has laid more with man-made than with natural events. If the 21st century witnesses the persistence of hunger in Africa or elsewhere, we will only have ourselves to blame.

BIBLIOGRAPHICAL NOTE

I have for many years been interested in questions relating to world hunger and have, with my students, written extensively on the subject. The ideas summarized in this paper have been drawn freely from the following overviews, in which may be found the detailed citations to the literature omitted here:

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My work, in turn, builds on that of my mentors a generation ago at Stanford's Food Research Institute, most notably Merrill K. Bennett and Helen C. Farnsworth. Although now somewhat dated, Bennett's The World's Food (New York: Harper and Brothers, 1954) remains the classic analysis

of the linkages between income and diet; as does Farnsworth's "Defects, Uses, and Abuses of National Food Supply and Consumption Data" (Food Research Institute Studies, II,3(1961):179-201) on our inability to adequately quantify the food economies of developing countries.

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They have improved with time and provide the student with a basis for understanding the evolving conventional wisdom. A Fifth Survey is scheduled for 1984.

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