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RECENT TRENDS IN FOOD AVAILABILITY AND NUTRITIONAL WELL-BEING

by

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Let me make clear at the outset that there is no way to specify the global food and nutrition situation with precision. 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 over 60 years--that has occurred since mid-century in life expectancy in the poorer countries. In the rare instances where outright famine has occurred recently--in Ethiopia and Sudan, for example--the problem has been localized and attributable to political conflict.

Yet ask the man in the street what life is like in the poorer countries--wherein resides about three-fourths of the world's population--and he will invariably reply "hungry." The popular literature is replete with pronouncements to this effect. We were, after all, assured as early as 1950 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" (*2*, p. 11); by one of the many alarmist articles induced by the mis-named "World Food Crisis" of the early 1970s that "the world is teetering on the brink of mass starvation" (*4*, p. 152); by the Carter administration's Presidential Commission on World Hunger a decade ago that the "world hunger problem is getting worse rather than better" (*15*, p. 182); and just last year by the UN's World Food Council that "hunger and malnutrition are growing and will continue to grow" (*5*, p. iv).

An essay on trends in food availability and nutritional well-being must therefore begin by defining the state of an imperfect art and cleanse the reader's mind of what is not before attempting to grapple with reality.

I. Global Hunger: The Methodologies Underlying the Myth

Although pronouncements on global nutrition are legion, few have pretended to rest on original analysis. Rather most have had recourse for their statistical support to a small number of studies carried out by the FAO, the U.S. Department of Agriculture (USDA), and the World Bank. These have had as their aim the *measurement of hunger* and although all pretended to objectivity, it would be naive to presume that this was always foremost in the minds of those who caused them to be carried out.

The findings of principal FAO, USDA, and World Bank studies are shown in Figure 1. Boyd-Orr's conclusion that two-thirds of mankind were hungry came from FAO's *Second World Food Survey* (*8*). An earlier survey suggested a lower figure (*7*). The USDA's two *World Food Budgets* (*25*; *26*) concluded that almost the

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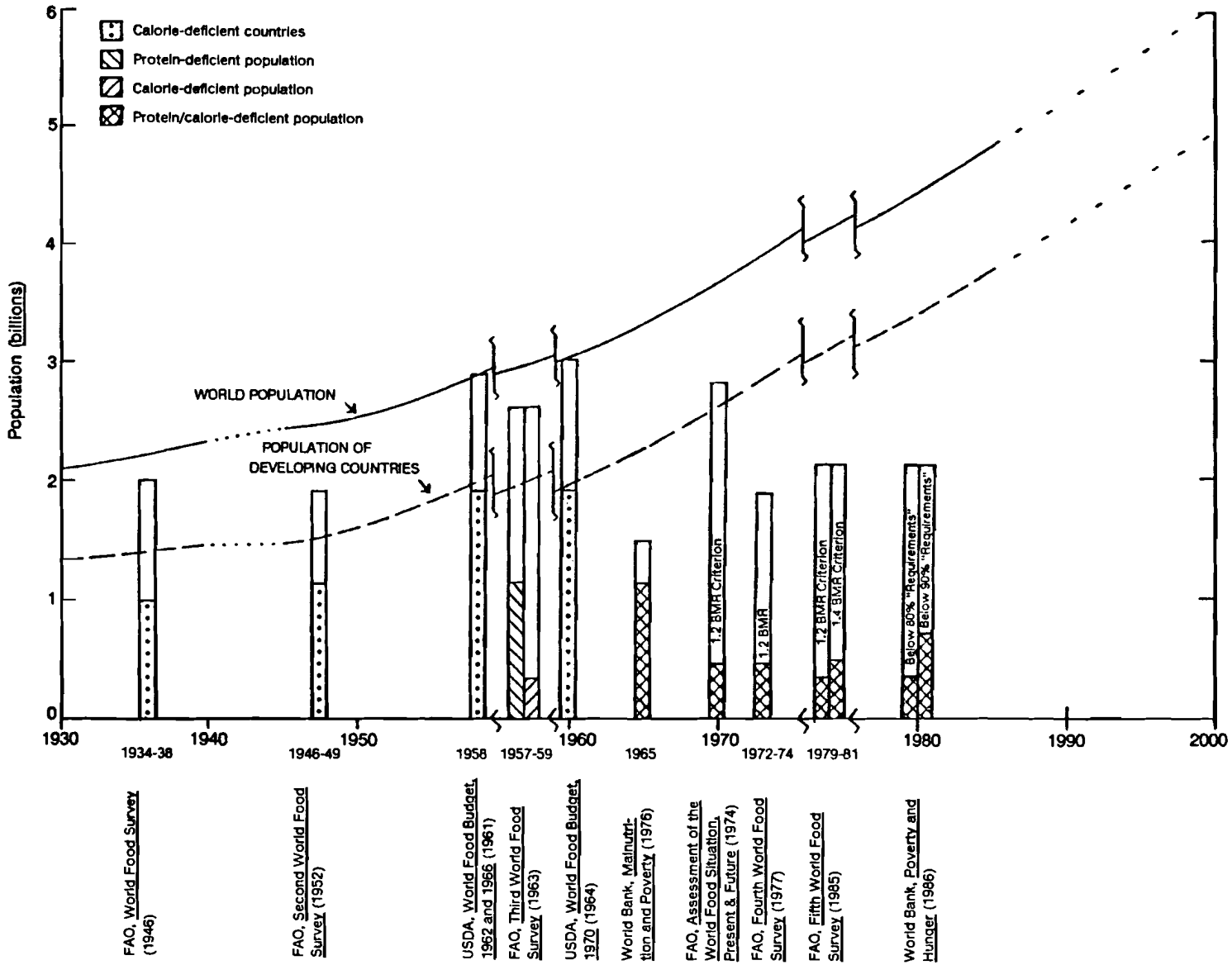
FIGURE 1. PERSONS IDENTIFIED AS NUTRITIONALLY DEFICIENT IN SELECTED WORLD FOOD ASSESSMENTS



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

entire population of the developing world lived in "diet deficit" countries. FAO's *Third World Food Survey* (*9*) put the afflicted in such countries at about 60 percent and identified a shortage of protein as the principal problem. The World Bank's first attempt saw a problem of roughly the same magnitude--involving about 1.2 billion people--but indicated the prime cause was a shortfall of calories (*20*, p. 2). The Bank's most recent study has the figure ranging from 340 to 730 million (*19*, p. 17). The last three FAO efforts put the number of afflicted at between 330 and 500 million (*11*, p.26).

The overall trend is thus downward with time and a reasonable presumption would be that the studies confirm that the extraordinary economic change experienced in most parts of the globe since the end of World War II has been accompanied by sharp declines in the incidence of hunger. In fact, the changing estimates reflect nothing more than modifications in analytical technique.

The Early Analytical Approach

The analytical approach followed in the FAO's first two *World Food Surveys* and the two *World Food Budgets* prepared by the USDA was simple in the extreme. To determine whether or not a country was experiencing a food problem, apparent per capita food availabilities 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's 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. 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.

To estimate food availabilities one must construct a food 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 United States 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 (*27*, p. 260). In Mexico, the extent of understatement for maize during 1925-34, the *Direccion General de Economia Rural*'s first decade, was over 50 percent (*17*, pp. 16, 19).

To generalize about the extent to which food availabilities in the developing countries 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* (*7*). 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 Sri Lanka carried out by my students in the 1960s suggested that energy availabilities in both were officially understated by between 10 and 15 percent (*18*; *13*). 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.

Compounding this tendency to undercount food availabilities have been the difficulties associated with estimating food needs. Conceptually, knowing such things as body size, activity patterns, and health status, 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 dietary 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.

In response to criticism that the energy allowances used in its early *World Food Surveys* were unrealistic surrogates for minimum needs, the FAO employed a different approach to establishing floor criteria in its report to the 1974 World Food Conference (*23*) and continued this in its *Fourth* and *Fifth World Food Surveys* (*10*; *11*). This was to estimate 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 X 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 energy 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 developing world 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 (*6*, p. 2).

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 global food assessments painted a gloomy picture of world hunger. The picture conveyed was one of hungry countries and of a world unable to feed its rapidly growing population. Insufficient production was seen as *the* problem.

We now know that such conclusions seriously distort reality. The record of agricultural productivity in the less-developed countries has not been all that bad. Indeed, according to such generally used indices of global food output such as that published by the USDA (Figure 2) the less-developed countries have expanded production rather more rapidly--significantly so during the 1980s, when saturated markets constrained farmers in the United States--than the developed ones. Population growth, to be sure, has absorbed most of the gains, but with the exception of sub-Saharan Africa modest per capita improvements have occurred.

Twice, however, the rate of progress seemed to falter, and as this gave rise to a spate of pessimistic pronouncements about the world's ability to feed itself, it is worth examining the causes. The first pause came in the mid-1960s and resulted almost exclusively from two successive droughts in India. Indian production bulks so large in the less-developed aggregate that major fluctuations in its output influence visibly the index for all developing countries. Looking at the figures 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--the man in the street was receptive to forecasts of universal global starvation. One author went so far as to specify 1975 as the year in which this would take place (*16*).

The factors underlying the second pause--the "World Food Crisis" of the early 1970s--had little to do with the developing world. In brief, it resulted from an unfortunate coincidence of several influences affecting the major trading countries: an intentional running down of stocks and holding down of production in the United States; unprecedented prosperity and rising demand for imports in Japan and Europe; and unfavorable weather in the Soviet Union. The role of Russia was particularly destabilizing. The failure of its 1972 harvest triggered a run on world supplies--it no longer being politically feasible for the Soviets to mask their agricultural failings behind belt tightening--and large imports of feedstuffs by the Soviet Union have been a regular feature of the world food economy ever since.

Save for continuing difficulties in the Soviet Union and sub-Saharan Africa, and intentional cutbacks and drought in the United States,[1] the trend in production has been ever upward almost everywhere since the mid-1970s. The extension of the irrigated area in India seems to have insulated that country from vagaries in the weather.[2] Although some have perceived the upturn in the quantity of grain moving from North America to the developing world as a sign that the latter continues to be in trouble, this interpretation is incorrect. The great bulk of the increase is not going as food to the poorest countries, but as feed to those middle-income countries whose populations are becoming sufficiently affluent 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 and the possibility of a recurrence taking place. There have, after all, been few changes

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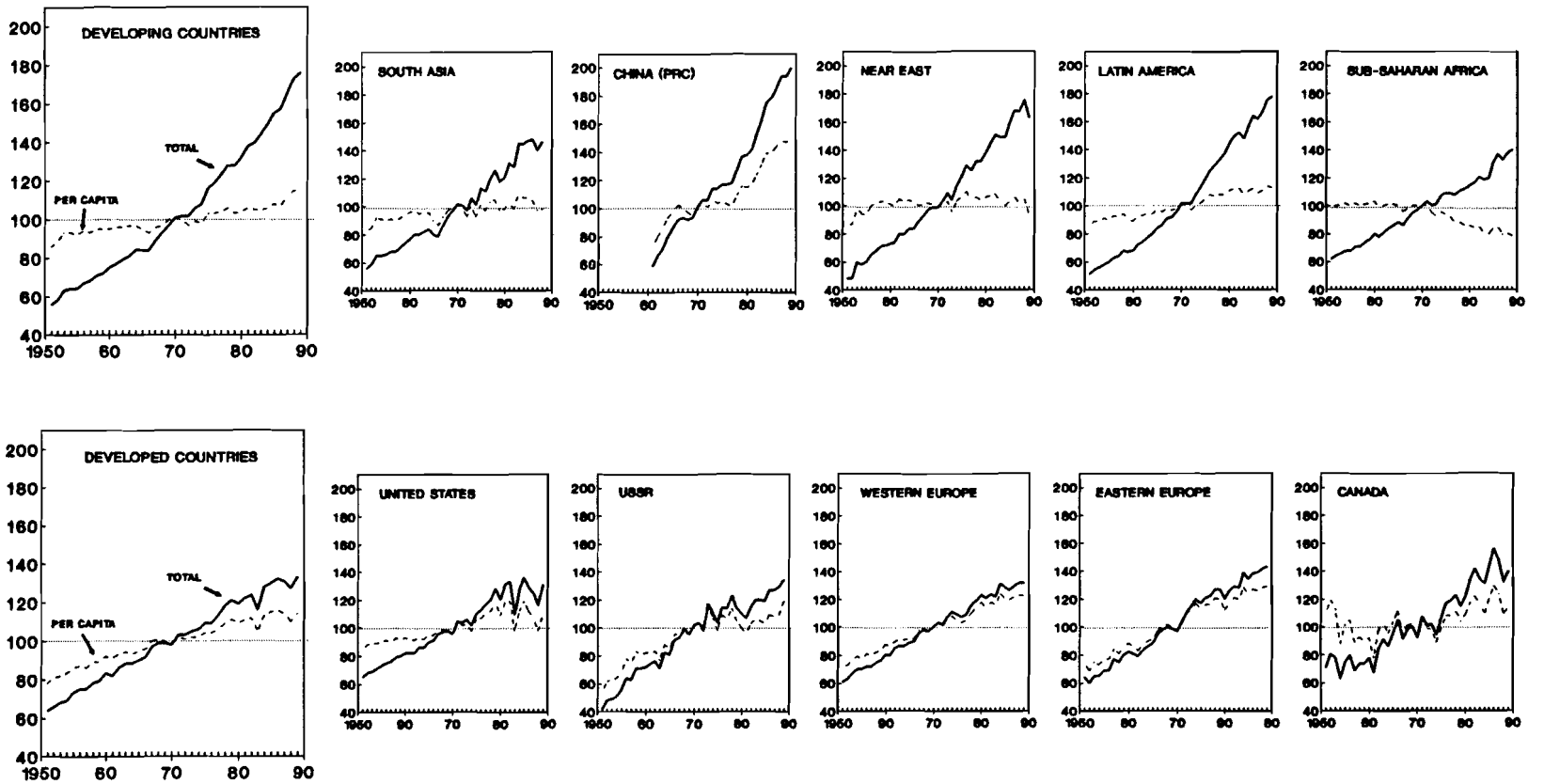
[1] The 1983 drop in the developed country index reflected implementation in the United States of the Payment-in-Kind (PIK) program; effective, but expensive, it reduced grain output by a third, or by over 100 million metric tons. The 1988 drop was caused by drought in North America.

[2] Failure of the monsoon in 1987 resulted in only a marginal (five percent) drop in Indian grain production; accumulated reserves were more than adequate to tide over the shortfall, which was more than made up for by gains in the 1988 harvest.

FIGURE 2. INDICES OF TOTAL AND PER CAPITA FOOD PRODUCTION, 1951-1989*

(1969-71 = 100)



* Data from U.S. Dept. Agr., Econ. Res. Ser., *World Indices of Agricultural and Food Production* (various issues); *ibid.*, *World Agricultural Trends and Indicators* (various issues); FAO, *Quarterly Bulletin of Statistics* (various issues); and *ibid.*, *Production Yearbook* (various issues).

in the policies of the major trading nations which would mitigate against a recurrence--as almost happened in 1987 and 1988--following a year or two of below-trend production.

If this story of steady progress in the less-developed countries does not tally with the pessimism of the early hunger assessments, it does not follow that the post-war years have witnessed a reduction in the number of people nutritionally distressed. For the suggestion that increased production alone could eliminate hunger was only one of the misconceptions conveyed by early studies.

A second unfortunate legacy was the notion that *countries* could be classified as hungry or well fed. It is individuals, not countries, who experience nutritional deprivation, and since the early 1970s it has become a commonplace in 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. Access to food is a function of income. Those with adequately paying jobs are easily able to afford an acceptable diet; their less fortunate neighbors sometimes cannot.

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 (*9*). Largely the work of the eminent Indian statistician, P. V. Sukhatme, then Director of FAO's Statistics Division, the study was spotty in its description of methodology. This was 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 three decades ago.

Nonetheless, on the basis of evidence from Maharashtra State in India and elsewhere, Dr. Sukhatme concluded (*9*, p. 51):

> . . . 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 (*23*), 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 the developing world's population whose estimated intake fell below it actually increased (*23*, p. 66).

The FAO offered no explanation as to how this increase came about, but the evidence strongly suggests the figures were derived less through research than through a political decision imposed from on high. The findings would appear to contain a suspicious element of arbitrariness. Between April 1974, when the preliminary documentation was released, and the conference itself in November, the estimated number of persons with intakes falling below 1.2 BMR was raised from 360 million to 434 million--or from exactly 20 percent of the population of the developing countries to exactly 25 percent (*24*, p. 29; *23*, p. 66).

I confess to similar skepticism regarding the findings of the four most recent attempts to measure the impact of income. Although they employed broadly similar analytical techniques, the two studies published in the mid-1970s--the FAO's *Fourth World Food Survey* (*10*) and the World Bank's *Malnutrition and Poverty* (*20*)--came to wildly different conclusions. The FAO report concluded that about 450 million people were suffering from protein-calorie malnutrition (*10*, p. 58); the World Bank put the number at almost 1.2 billion (*20*, p. 2). Shortly after the two studies appeared, President Carter appointed his Commission on World Hunger. Not knowing what to do about this discrepancy in the magnitude of the problem it was supposed to investigate, the Commission mentioned both figures in its report.

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 (*20*, p. 2):

> . . . 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 unlike the FAO, which used the 1.2 BMR benchmark, they continued to employ recommended dietary allowances as surrogates for minimal needs. The latter error was corrected in the Bank's most recent study, *Poverty and Hunger*, published in 1986, with the result that it now puts the number of nutritionally deprived at between 340 and 730 million (*19*, p. 17). FAO's *Fifth World Food Survey*, which appeared a year earlier, has the range between 335 and 494 million (*11*, p. 26).

What of these figures? After almost 50 years at the task, is the international bureaucracy finally in a position to give us a reasonable estimate of extent of global hunger? Unfortunately, no. Even if we accept that food production is now quantified with a fair degree of accuracy in much of the developing world and the 1.2 BMR figure is not unreasonable as an approximation of minimal energy needs, serious problems remain with the measuremunt of income distribution and the concept of calorie-income elasticity. The latter misleads by suggesting that the relationship between income changes and changes in energy intake is a simple one, reducible to one tidy figure, which is clearly not the case, and even if it were, reliable information on income distribution remains wanting for most developing countries.

II. Plotting Trends in Nutritional Well-Being

Despite our continuing inability to quantify the extent of global hunger, several points regarding postwar trends in food availability and nutritional well-being can be made with confidence:

- There is a global sufficiency of food and despite poverty most people in developing countries behave as if they manage to eat adequate, if not especially tasty, diets. The "quality" of such diets as measured by the starchy staple ratio has improved since at least 1965 and most probably throughout the entire postwar period.

- Nutritional deprivation, where it exists, is likely to be most acute among the young and the incidence of infant malnourishment is declining.

- Where this decline is least evident--in sub-Saharan Africa and among the very poorest in South Asia--corrective action lies in political reform (Africa) and more and better jobs (Asia).

Behavioral Evidence of Perceived Dietary Adequacy

Some years ago, while serving as a consultant to the USDA on matters relating to the hunger question, it occurred to me that since the approach of comparing food availabilities with minimal nutritional needs was so littered with pitfalls, we should abandon it altogether as a methodology for measuring hunger and search instead for signs of behavior pointing to perceived dietary adequacy or inadequacy.

Essential to identifying such behavior 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.[3] 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 two 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 125 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; and the starchy staple ratio has dropped to 21 percent. We pay more for such a diet and presumably enjoy it more. But it does not follow that it is a better diet. Indeed, current thinking among nutritionists is that because of its high sugar and fat content it may well be a poorer one.

Would not Bennett's progression of dietary change provide a suitable framework for our analysis, and would not the point where households begin to purchase quality instead of quantity represent the onset of behavior indicative of perceived dietary adequacy?

Evidence of such behavior must come from household budget surveys, and carefully conducted surveys of broadly representative samples are still few for the developing countries. However, analysis 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 (rice) is all pervasive (*3*). This is because initial substitution will take place among the starchy staples; and where one food dominates, the substitution will be between grades of that commodity, shifts which are extremely difficult to monitor. Figure 3, based on data collected in Brazil in 1974/75, indicates what happens 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 energy 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.

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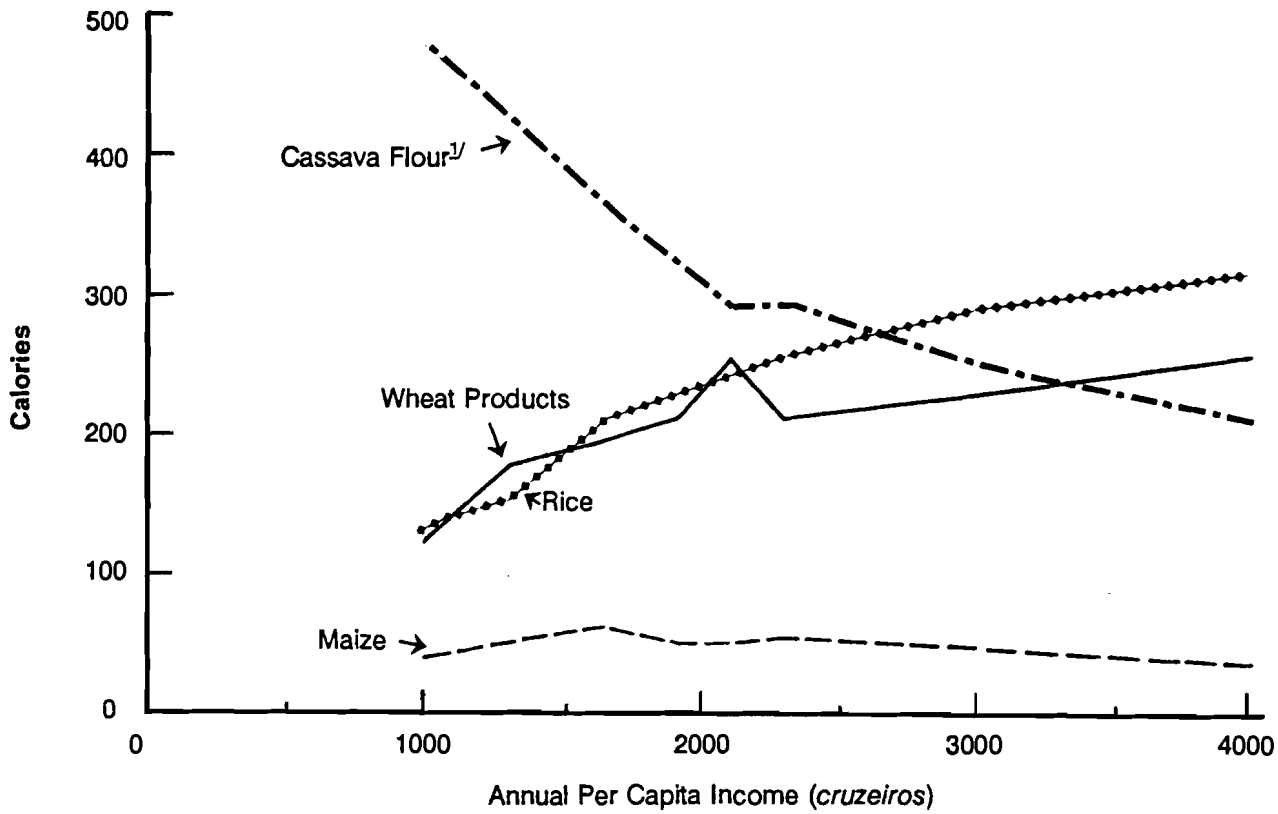
[3] Bennett's work is best summarized in *1*.

FIGURE 3. NORTHEAST BRAZIL: APPARENT PER CAPITA DAILY CONSUMPTION OF MAJOR STARCHY STAPLES AMONG LOW-INCOME CLASSES, 1974-75*



* Data from Neville Edirisinghe and T. T. Poleman, *Behavioral Thresholds as Indicators of Perceived Dietary Adequacy or Inadequacy* (Cornell/Int'l. Agric. Econ. Study 18, Ithaca, N.Y., 1983), p. 28.

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

This type of behavior, which is also evident in the data for the other countries examined, is less suggestive of widespread hunger in the developing countries 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 was suppressed by the government because of the social inequality it reveals.

Although reliable budget survey material is still available for only a handful of countries, other less sensitive evidence suggests that the behavior they reveal obtains throughout the developing world, and further that the quality of the average diet as monitored by the starchy staple ratio has improved with time. Figure 4 indicates that between 1964-66 and 1979-81, the earliest and most recent periods for which FAO has published food balance sheets for a large number of countries, even in the poorest countries the starchy staple ratio dropped.[4] The sole exceptions are India, where the slight rise may be a statistical aberration, and sub-Saharan Africa. The quality of African data is such that for most countries meaningful starchy staple ratios cannot be calculated.

The Nutritionally Vulnerable Within the Household

If we do not know how many among the poor in the developing countries suffer nutritional deprivation, there is agreement that the preschool child and the pregnant and lactating mother are those most likely to be adversely effected. There are several reasons for this. The early growth and reproduction phases are nutritionally the most demanding in the life cycle. 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.

Estimating the extent of malnutrition among young children and their mothers is not easy. It involves the new science of nutritional anthropometry and a debate of some virulence attends the standards for healthy children it should employ, the measurements--whether weight for age, height for age, or weight for height--it should involve, and where the cut-off criteria should be established.[5] If the number of those at risk is to be estimated, therefore we have no alternative but to do so rather arbitrarily.

Table 1 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 children 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 non-African developing countries, while a 50-percent figure would seem an absolute maximum. The resulting range of those at risk runs from 77 million to 385 million persons.

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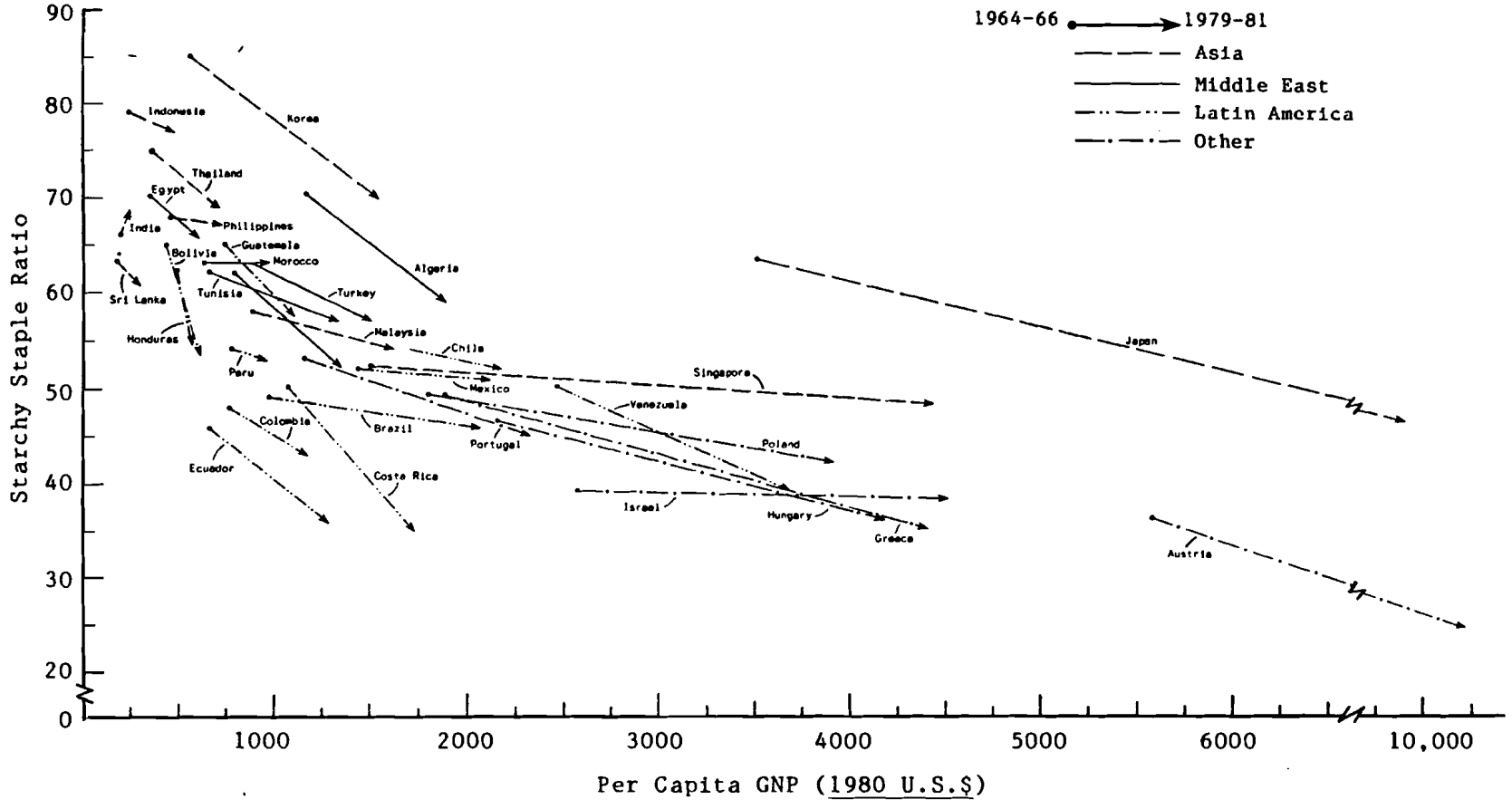
[4] Although the starchy staple ratio is everywhere related inversely to income, in countries where rice is the dominant staple the ratios at a given income level are higher than elsewhere. Thus the seemingly anomalous behavior of Japan, Korea, and Singapore in Figure 4.

[5] For two very different opinions see *14* and *21*.

FIGURE 4. RELATIONSHIP BETWEEN STARCHY STAPLE RATIO[1/] AND PER CAPITA GNP, 1964-66 AND 1979-81*



* Data from World Bank, *World Development Report, 1982* (Oxford University Press, 1982); FAO, *Food Balance Sheets, 1964-66 Average* (Rome, 1971); and FAO, *Food Balance Sheets, 1979-81 Average* (Rome, 1984).

1/ Percent of total calories derived from cereals and roots and tubers.

TABLE 1. NUMBER OF WOMEN AND CHILDREN AT RISK NUTRITIONALLY ACCORDING TO TWO ASSUMPTIONS, 1985, BY REGION*

(millions)

Region[a/]	Total Population	Children Under Age 5	Pregnant/ Lactating Mothers[b/]	At Risk[c/]	
				10 Percent Assumption	50 Percent Assumption
Far East (ex-China)	1,434	236.6	97.5	33.4	167.0
China	1,041	124.9	39.6	16.4	82.3
Africa	448	82.0	41.2	12.3	61.6
Latin America	397	62.7	25.4	8.8	44.0
Near East	245	41.6	18.1	6.0	29.9
TOTAL	3,565	547.8	221.8	76.9	384.8

* Population data from: United Nations, *1985 Demographic Yearbook* (New York, 1987).

a/ Regional breakdown follows current FAO usage and includes only those countries classified as "developing." See FAO, *The Fifth World Food Survey* (Rome, 1985), pp. 84-87.

b/ The number of pregnant and lactating mothers is taken as being twice the birth rate.

c/ Assumptions are that 10 percent and 50 percent of the vulnerable groups (children up to five years of age and pregnant and lactating mothers) can be considered malnourished.

A second method is to use the infant mortality rate--the number of infants who die before reaching one year of age, per 1,000 live births in a given year--as an indicator of maternal and child nutrition. Since low birth weights and feeding problems are associated with higher infant mortality rates, this is a reasonable linkage. But again, debate attends the conditions which should be equated with particular rates. Is, for instance, anything below 50/1,000 indicative, as some would argue, of a population in which most children are reasonably well-nourished?[6] Or would some other figure be more appropriate?

It is clear from Figure 5, which includes countries containing over 75 percent of the population of the developing world, that infant mortality has fallen dramatically during the past quarter century. Rising income levels and improved access to food have presumably contributed to this, but it is impossible to say whether this has been of greater or lesser importance than the spread of education or enhanced public health and medical facilities (*22*; *12*).[7] Whatever the case, much of Latin America is now in comparatively good shape, as are the more prosperous countries of Asia, plus--impressively--China. The principal exceptions are India, Pakistan, and Bangladesh and virtually all of sub-Saharan Africa. Here, despite declines, infant mortality remains above 100/1,000.

Any attempt to use these infant mortality rates to refine the numbers in Table 1 must be highly subjective, but is nonetheless a revealing exercise. If the 50-percent figure is applied to populations experiencing infant mortality in excess of 100/1,000, graduated down to 10 percent for under 50/1,000, a picture of world hunger emerges which is rather less foreboding than that conjured up by FAO's *Fifth World Food Survey* and the World Bank's *Poverty and Hunger* (*11*, p. 26; *19*, p. 17):

	Insufficient Protein-Energy Supply		*Vulnerable People at Risk*	
	Fifth Survey (1978-81)	*World Bank (1980)*	*Infant-Mortality Adjusted Guess Within 10-50% Range (1985)*	
	(millions)			
Far East (ex-China)	210-313	220-510	134	(40%)
China	-	-	16	(10%)
Africa	70- 99	90-150	62	(50%)
Latin America	38- 56	20- 50	12	(14%)
Near East	16- 25	10- 20	16	(27%)
	334-494	340-730	240	

Although Table 1 includes China, which the two studies did not, the estimate of 240 million children and mothers at risk is roughly half as great as the midpoint of the ranges calculated by the FAO and World Bank. The 240 million represent less than five percent of the people living in 1985, and their number lends support to the contention that the world is now better fed than at any time in history.

The Special Problems of Africa and the Impoverished of South Asia

To the generalizations that overall diet quality and infant nutrition have improved during the past half century, two groups must be excepted: those living in that portion of Africa which lies south of the Sahara and north of South Africa, and the impoverished of the three countries of the Indian sub-continent.

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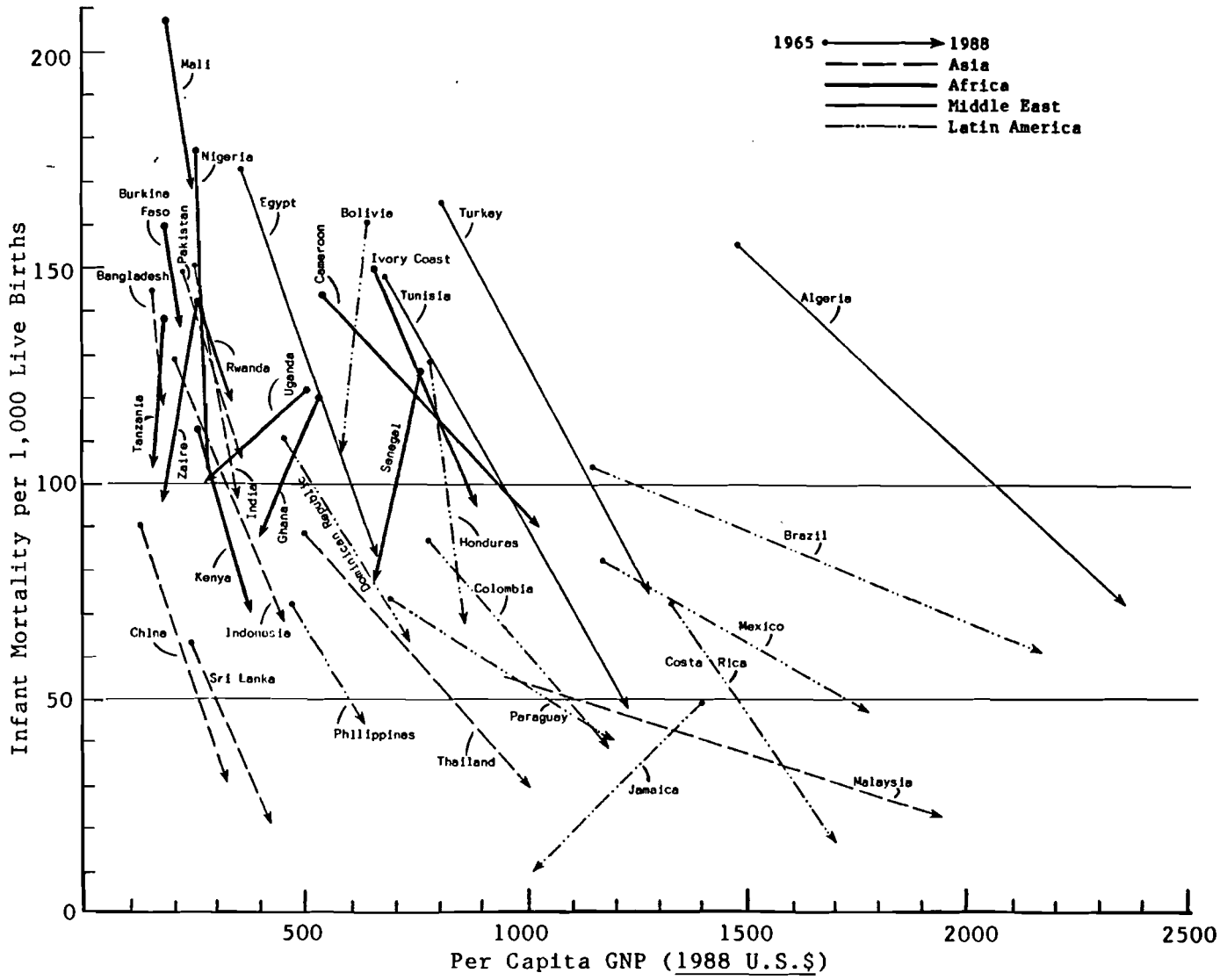
[6] Infant mortality in the United States is slightly below 10/1,000, down from 25/1,000 in 1965. Among black children the current figure is just under 19/1,000.

[7] China and Sri Lanka are oft-cited examples of the role that noneconomic factors can play in reducing infant mortality.

FIGURE 5. RELATIONSHIP BETWEEN INFANT MORTALITY RATE AND PER CAPITA GNP, 1965 AND 1988*



* Data from World Bank, *World Development Report, 1990* (Oxford University Press, 1990).

The problem in India, Pakistan, and Bangladesh is entirely one of poverty and insufficient effect demand. The sub-continent is one of the homes of the Green Revolution and food production in all three countries during the past several decades has increased rather faster than population growth. Were it equitably distributed, the supply of food would be adequate to feed all. But none of the countries has been able to implement an effective program to provide food to the poor, and continued high population growth has frustrated the incorporation of all within the process of economic growth. The outlook for those unfortunate enough to be left out is not encouraging.

Even less promising is the situation in Africa. Population growth continues there unabated and it is the only region for which the data in Figure 2 suggest per capita food availability has not increased in recent years, but actually declined. The extent to which this fall-off--of roughly 20 percent, if the data are to be believed--reflects reality and not merely the deterioration of the crop reporting system defies measurement. Sub-Saharan Africa is a statistician's nightmare. The reason data for it are not included in Figure 4 is that the food balance sheets for most countries show declines in both energy availabilities and starchy staple ratios--a course of dietary evolution inconsistent with any logical explanation.

The sorry story of agriculture in the newly independent states of Africa reflects many things, not the least of which has been the breakdown of law and order in a depressingly large number of countries. More important, however, has been the fact that almost every African government has for political reasons implemented measures which have acted to reduce incentives to commercial farming, including artificially low producer prices and overvalued exchange rates. A few years ago the World Bank concluded from a country-by-country study of Africa that the involvement of government in food-policy related matters was almost everywhere counterproductive and that new lending should be tied to a freeing up of the marketplace (*28*). The turnaround in the last couple of years in the food situation in Ghana is testimony to the efficacy of such steps.

But even with the right policies, there are reasons for believing that the rapid gains which characterized the Green Revolution in Asia are not likely to be repeated in Africa. In Asia the rural population is concentrated in great alluvial floodplains; these lend themselves ideally to introduction of the package of new inputs, especially irrigation, associated with rapid technical change. Not so in Africa. The only floodplain of consequence south of the Sahara is the inland delta of the Niger; and Mali and Burkina Faso, within whose borders it falls, rank among the half dozen poorest countries in the world. Further, apart from the West African coast and the Congo basin, sub-Saharan Africa is comparatively dry. So the fact that it has more than twice the amount of arable land per person as Asia is not too meaningful. Where rainfall is plentiful, moreover, the principal starchy staples are not the cereals, around which the Green Revolution elsewhere has been based, but roots and tubers, which have received comparatively little scientific attention. Finally, the expense and limited availability in Africa of the various components of the Green Revolution package will doubtless temper their introduction. Transportation costs are very high. There are hardly any railroads and those that there are were located for the export of minerals, not the movement of agricultural inputs. Outside of the Congo and Niger, river transport is negligible. So transportation is heavily dependent on roads and trucks, the maintenance of which is difficult and expensive. My introduction to Africa 35 years ago was through a series of studies of how its cities were supplied with food. To me one of the saddest changes which has subsequently taken place has been the degree to which this system and the road network which supported it have broken down. Small wonder that such fertilizers and pesticides which find their way into the countryside fall far short of needs and are priced beyond the means of most farmers.

Even assuming political stability, then, the combination of very rapid population growth and slow agricultural progress does not augur well for Africa. Whether, as some suggest, the next several decades are likely to witness a rise in the death rate and perhaps even the local fulfillment of the Malthusian nightmare is an open question. Certainly without an improvement in the political scene it should not be ruled out. It is a blot on a picture which almost everywhere else is colored with accomplishment.

CITATIONS

1. Bennett, M. K., *The World's Food* (Harper, 1954).

2. Boyd-Orr, Lord John, "The Food Problem," *Scientific American*, Vol. 183, No. 2, August 1950.

3. Edirisinghe, Neville and T. T. Poleman, *Behavioral Thresholds as Indicators of Perceived Dietary Adequacy or Inadequacy* (Cornell/Int'l. Agric. Econ. Study 18, Ithaca, N.Y., 1983).

4. Ehrlich, Anne and Paul Ehrlich, "Starvation: 1975," *Penthouse*, July 1975.

5. *Ending Hunger: The Cypress Initiative* (World Food Council, 15th Ministerial Session,Cairo, 22-25 May 1989).

6. "Food and Nutrition: A New View of an Old Problem," *(FAO) Nutritional Newsletter* (Rome), Vol. 11, No. 4, 1973.

7. FAO, *World Food Survey* (Washington, D.C., 1946).

8. FAO, *Second World Food Survey* (Rome, 1952).

9. FAO, *Third World Food Survey* (Freedom from Hunger Basic Study 11, Rome, 1963).

10. FAO, *The Fourth World Food Survey* (Statistics Series 11, Rome, 1977).

11. FAO, *The Fifth World Food Survey* (Rome, 1985).

12. Hobcraft, J. N., J. W. McDonald and S. O. Rutstein, "Socio-economic Factors in Infant and Child Morality: A Cross-national Comparison," *Population Studies*, Vol. XXXVIII, No. 2, 1984.

13. Jogaratnam, Thambapillai and T. T. Poleman, *Food in the Economy of Ceylon* (Cornell Int'l. Agric. Dev. Bulletin 11, Ithaca, N.Y., 1969).

14. Mason, J. B., *et al.*, *Nutritional Surveillance* (World Health Organization, Geneva, 1984).

15. *Overcoming World Hunger: The Challenge Ahead* (Report of the Presidential Commission on World Hunger, Washington, D.C., March 1980).

16. Paddock, William and Paul Paddock, *Famine - 1975!* (Little, Brown, 1967).

17. Poleman, T. T., "Mexican Agricultural Production, 1896-1953: An Appraisal of Official Statistics" (Cornell Agric. Econ. Staff Paper No. 77-30, Ithaca, N.Y., 1977).

18. Purvis, M. J., "Evaluation and Use of Underdeveloped Agricultural Statistics: The Food Economy of Malaysia" (unpublished PhD dissertation, Cornell Univ., Ithaca, N.Y., 1966).

19. Reutlinger, Shlomo and J. V. Pellekan, *Poverty and Hunger* (World Bank Policy Study, Washington, D.C., 1986).

20. Reutlinger, Shlomo and Marcelo Selowsky, *Malnutrition and Poverty* (World Bank Staff Occasional aper 23, Washington, D.C., 1976).

21. Sukhatme, P. V., ed., *Newer Concepts in Nutrition and Their Implications for Policy* (Pune, India, 1982).

22. United Nations, Dept. Int'l. Econ. and Social Affairs, *Socio-Economic Differentials in Child Mortality in Developing Nations* (New York, 1985).

23. United Nations, World Food Conference, *An Assessment of the World Food Situation, Present and Future* (Item 8 of the Provisional Agenda, Rome, 1974).

24. United Nations, World Food Conference, *Preliminary Assessment of the World Food Situation, Present and Future* (Rome, 1974).

25. U.S. Dept. Agr., Econ. Res. Ser., *The World Food Budget, 1962 and 1966* (For. Agr. Econ. Report 4, 1961).

26. U.S. Dept. Agr., Econ. Res. Ser., *The World Food Budget, 1970* (For. Agr. Econ. Report 19, 1964).

27. Working, Holbrook, "Wheat Acreage and Production in the United States Since 1866: A Revision of the Official Estimates," *Wheat Studies of the Food Research Institute*, Vol. II, No. 7, June 1926.

28. World Bank, *World Development Report, 1986* (Oxford University Press, 1986).

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