

WORLD FOOD: A PERSPECTIVE

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

July 1975

WITH modern methods of travel and communication shrinking the world almost day by day, a progressive university must extend its campus to the four corners of the world. The New York State College of Agriculture and Life Sciences at Cornell University welcomes the privilege of participating in international development — an important role for modern agriculture. Much attention is being given to efforts that will help establish effective agricultural teaching, research, and extension programs in other parts of the world. Scientific agricultural knowledge is exportable.

A strong agriculture will provide not only more food for rapidly growing populations in less-developed countries, but also a firmer base upon which an industrial economy can be built. Such progress is of increasing importance to the goal of world peace.

This is one in a series of publications designed to disseminate information concerned with international agricultural development.

Single Copy Free
Additional Copies 25¢ each

Reprinted from
9 May 1975, Volume 188, pp. 510-518

SCIENCE

World Food: A Perspective

Thomas T. Poleman

World Food: A Perspective

Thomas T. Coleman

One's view of the historical sweep of things is inevitably colored by the events of the day. In times of boom we tend to accept growth and change as the natural order of man, just as the occasional recession will bring forth dire prophecies of endless doom and gloom. And so it is that the escalation in food prices during the past couple of years has been accompanied by a revival of the fear, periodic in its emergence, that the world is running out of food and that some cataclysmic Malthusian solution will shortly be upon us.

Whether or not such fears are justified—and I think they are not—there is no question that the recent concern over agriculture has come as a rather surprising ending to a most extraordinary quarter century. We sometimes forget how great has been the change of the past 25 years. The real product of the world perhaps trebled, so that on a per capita basis we are on the average twice as well off as we were in 1950. Change, to be sure, has been concentrated in the developed countries, but not exclusively. The explosion in education and literacy has been worldwide. The Indian born today has a life expectancy of half again what it would have been at mid-century. Famine, if not entirely eliminated, has come to be localized and to reflect political failings more than anything else. The only year in which global indicators of food production turned down was 1972.

Despite this positive record, an overtone of Malthusian pessimism pervades the majority of assessments of the food situation since World War II. It has never been entirely clear why this should be the case. In part, I suppose, to prophesy catastrophes is a time-honored means for selling books. And the tidiness of the Malthusian apocalypse has a certain fundamentalist appeal. But in part also it finds support in all

tion (FAO) of the United Nations. Indeed the rise of latter-day Malthusianism is so closely associated with the FAO that any appreciation of the current food situation should begin with an overview of that organization's attitude and its many pronouncements.

But first let us summarize Malthus, who is rightly described as being more talked about than read. Since he was also an accomplished writer, it is only proper that we quote his words. In the first of six editions of his *Essay on the Principle of Population*, published in 1798, he wrote (1):

I think I may fairly make two postulates. First, That food is necessary to the existence of man.

Second, That the passion between the sexes is necessary, and will remain nearly in its present state . . .

Assuming then, my postulate as granted, I say, that the power of population is indefinitely greater than the power in the earth to produce subsistence for man.

Population, when unchecked, increases in a geometrical ratio. Subsistence increases only in an arithmetical ratio. A slight acquaintance with numbers will show the immensity of the first power as compared with the second.

By that law of our nature which makes food necessary to the life of man, the effects of these two unequal powers must be kept equal.

This implies a strong and constantly operating check on population from the difficulty of subsistence. . . . The race of plants, and the race of animals shrink under this great restrictive law. And the race of man cannot, by any efforts of reason, escape from it. Among plants and animals its effects are waste of seed, sickness, and premature death. Among mankind, misery and vice. The former, misery, is an absolutely necessary consequence of it. Vice is a highly probable consequence . . . I see no way by which man can escape from the weight of this law which pervades all animated nature. . . .

That such misery and vice have so far been held at bay is of course not due to control of population—man's numbers have increased roughly four-

century witnessed great agricultural change. Vast new acreages were brought under the plow in the United States and Canada, and in much of South America, Australia, Africa, and Asia as well. Improved irrigation facilities opened the Indian subcontinent's great granary, the Punjab, to cultivation, and the surplus rice-producing areas of Southeast Asia began to be fully exploited.

Immediately after this period of expansion in the geographical sense came a series of technological breakthroughs, the precursors of today's Green Revolution. Building on improved plant varieties and increased use of fertilizers, pesticides, mechanization, and other technical advances, they laid the foundation for ever-increasing yields per unit of land.

By the 1930's, Malthus and his gloomy forecasts had been pretty well forgotten. Advanced countries were concerned not so much with overpopulation as with underpopulation. European governments in particular pursued programs of population encouragement in order to enhance their political and military power. On the agricultural side, superabundance, not shortage, seemed the key problem, with most industrial states adopting tariffs and other restrictive measures in an effort to drive prices up to levels "equitable" to the farmer.

FAO and Latter-Day Malthusianism

From this picture of apparent plenty to the one portrayed by the FAO after World War II there is a gulf all out of proportion to the number of years which lapsed. History will surely view that war as one of its major watershed. With the decline of Europe there emerged a new set of superpowers and a Third World of former colonies harboring the bulk of the world's people. Emergence of the latter took a number of forms: political independence; the introduction of public health measures that enabled them to rapidly reduce death rates; and a more humane attitude on the part of the industrialized nations toward them. We could, for the first time in history, afford a collective conscience.

Within a year of its creation in October 1945, the FAO issued its first *World*

Food Survey (2). This survey is important on two counts: it had a weighty influence on popular thinking for the subsequent two decades, and it established procedures for evaluating the world food situation which could come up with very misleading results.

In the early FAO studies the terms "undernourishment" and "malnourishment" are widely used. Undernourishment is generally taken to mean a shortfall in total caloric intake such that a person cannot maintain normal bodily activity without losing weight. Malnourishment, on the other hand, is used to describe the lack or deficiency of one or more of the so-called protective nutrients—protein, the vitamins, and minerals. Although the two are now seen as going together, and referred to as "protein-calorie malnutrition," this is a comparatively recent modification.

FAO's method of determining whether and where either undernourishment or malnourishment existed was to set against estimates of per capita food availabilities other estimates of per capita nutrient requirements. If and when average per capita availabilities fell below the estimated per capita requirements, the people of the country or region were presumed to be inadequately nourished.

A key limitation of this approach is that it presupposes a wealth of statistical evidence about individual agricultural economies. To estimate food availabilities, one must construct what is called a food balance sheet, incorporating quantifications of output, trade, and stocks changes on the supply side, and of such items as seed, feed, and wastage on the utilization side. Food availabilities are derived as a residual. Because underdeveloped statistical systems go hand in hand with economic underdevelopment, the evidence on most of the balance sheet components is sketchy in the Third World. The tendency is to understate on the supply side and overstate on the utilization side. Actual food availabilities will thus typically be underreported—by from 10 to 15 percent if our work at Cornell on Asian economies is any guide (3).

A second limitation of the early FAO approach was its implicit assumption that societies are sufficiently homogeneous in their food habits for average data to have meaning. This certainly is not the case in developing economies where differences in income, locality,

effects on food patterns. Recent work has suggested that the presumption of homogeneity is even less valid for the developing world (4).

But these drawbacks are only part of the problem. Equal or even greater difficulties attend the estimation of food requirements against which the results of the balance sheet computations were judged. Nutrition is still a young science; and these requirements, more properly "recommended allowances," are not nearly so precise as we would like them to be. In fact, the history of the FAO, the World Health Organization (WHO), and the Food and Nutrition Board of the U.S. National Research Council in estimating nutrient needs has been one of constant (downward) change. The blunt truth is that we still do not know the nutritional requirements for various populations under various environmental conditions. The organizations charged with preparing estimates, therefore, have consciously erred on the side of caution.

Now to the first *World Food Survey*, which, as I said, shaped the thinking of so many people about the world food problem immediately after the war. Though prepared in great haste, the survey covered 70 countries with something like 90 percent of the world's population. Most of tropical Africa was omitted, as were a number of Asian countries; still, on the basis of prewar evidence, the survey implied that well over half the world's population was inadequately nourished. A figure of 2600 kilocalories per person per day was used as the criterion of caloric adequacy. This figure is only 100 kilocalories below the one at present established for the Food and Nutrition Board's U.S. "reference man"—a moderately active, adult male weighing 70 kilograms—and accordingly would be an overstatement for almost any conceivable population group (5).

FAO's *Second World Food Survey* (6) published in 1952, incorporated a greater measure of caution and scholarship. A number of countries with particularly dubious statistics were dropped from consideration. The FAO also convened a team of experts to specify human energy needs more closely, and they drew up a sliding scale that sought to allow for regional differences in such variables as body size and a population's age-sex structure. Though few nutritionists would now argue that the new figures were not overstatements,

direction. Still, when compared with the results of the balance sheets, the picture that emerged remained depressing. About two-thirds of the world's population, the survey concluded, suffered from undernutrition. Indeed—and the evidence for this was especially sketchy—average caloric availabilities in the less developed countries (LDC's) had fallen after the war from the already low levels that prevailed prior to it.

The theme of deterioration was amplified 10 years later in the next major analysis of the food situation, the U.S. Department of Agriculture's (USDA) *World Food Budget, 1962 and 1966*. This study employed an analytical approach identical to FAO's, except that the USDA ventured into a few areas where even the FAO had feared to tread: included were most of the countries of Africa and Asia, among them, despite a total lack of evidence, China. The data were for 1958. The report concluded that (7):

Diets are nutritionally adequate in the 30 industrialized nations in the temperate Northern Area which account for a third of mankind—more than 900 million people. Their production of food and things they can trade for food assures their food supply, now and for the foreseeable future.

For most of the 70 less-developed countries in the semitropical and tropical Southern Area, diets are nutritionally inadequate, with shortages in proteins, fat, and calories. These [diet deficit] countries contain over 1.9 billion people. In most of them, population is expanding rapidly, malnutrition is widespread and persistent, and there is no likelihood that the food problem soon will be solved.

"Diet deficit" countries were considered to be all those in which average caloric or protective nutrient availability did not meet standards similar to those established by FAO.

Three years later the USDA repeated the exercise. The map on the cover of the second report, *World Food Budget, 1970 (8)*, revealed few new diet-deficit countries. But it is difficult not to believe that an important political angle had been discovered. Exaggeration of the extent of hunger in the developing world was clearly good politics for the USDA, faced as it was at this time with increasingly bothersome surpluses. Sales or gifts to the LDC's under Public Law 480 could postpone the day of more stringent controls or lower prices (or both) to American farmers.

At about the same time as the USDA released this second report, the FAO published its third and most recent

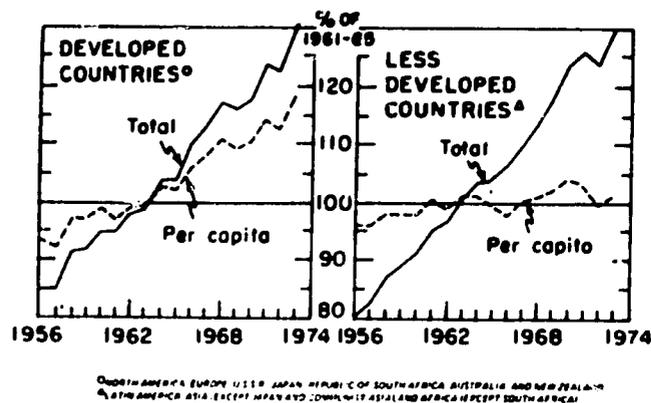


Fig. 1. World agricultural production, 1956 to 1973. [The data are from (32)]

in preparation.) Largely the work of P. V. Sukhatme, director of FAO's Statistics Division, the study represented a first attempt to break away from reliance on national average dietaries and to substitute for them estimates of dispersions about the means. In practice the data base of most LDC's still precludes this being done and neither Sukhatme's evidence nor his methodology is easy to follow. Still, "as a very conservative estimate," he concluded (9):

. . . 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. . . . 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.

In other words, if the earlier studies were misleading, it was not so much that they had overstated but that they had seen a shortage of energy sources, instead of protein, as the key problem.

If at this juncture the USDA could be faulted for exaggerating for political reasons, the FAO gave every appearance of living up to the billing given it by *The Economist*: "a permanent institution . . . devoted to proving that there is not enough food in the world to go round" (10).

The Wisdom of the 1950's

During the decade and a half in which the five surveys held sway, a rash of publications on food and population appeared in both the popular and scientific press. Most proclaimed that a new Malthusian debacle was upon us. Drawing heavily on the statistics presented in the three FAO and two USDA reports and on population projections for the LDC's, a majority

would shortly be unable to feed itself. Certainly starvation would be upon us by the year 2000 when global population was expected to reach 6 billion people. One went so far as to forecast widespread famine by 1975 (11).

A few voices were heard on the opposite side. In the early 1950's, M. K. Bennett, in many respects the first student of world food economics, detailed the drawbacks of the methodology followed in the *World Food Survey* and argued persuasively (to a limited professional audience) that the FAO was almost certainly overstating the magnitude of the world food problem (12). In amplifying this theme, some, Colin Clark being the most vocal, carried it almost to an opposite extreme, suggesting that the world could feed vastly greater numbers and that population growth was in certain instances probably a good rather than a bad thing (13). But few saw reason to listen. Continued population growth could only bring about a worsening of an already bad situation.

The 1960's: Pessimism, Then Optimism

Since the *Third World Food Survey* and the second *World Food Budget* were released in the early 1960's, there have been three sharp swings in popular thinking about global food problems. According to such generally used series of "world" production as that of the USDA plotted in Fig. 1, the LDC's seemed to be making fair, though hardly spectacular, progress from the mid-1950's to 1964. Then suddenly, 1965 and 1966 witnessed a leveling off of output and a marked deterioration in per capita supplies. cursory disaggregation indicates that this change resulted almost exclusively from two successive droughts in India. Indian production bulks so large in the LDC's

output visibly influence the index for all developing countries. This fact, however, was lost on many commentators. Looking at the figures and hearing of massive Public Law 480 shipments abroad—of the 30 million tons of grain shipped during the 2 years ending in June 1967, 15 million went to India—many people concluded that we were faced with a truly global problem and that starvation was just around the corner.

A reaction began to set in only a year later 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 that the index of production for all low-income countries rose steeply, as did per capita availabilities. The assessment was as extreme in the opposite direction as it had been in 1965 and 1966. This was when we first began to hear of the Green Revolution. The situation in Northwest India, together with the introduction, as a consequence of work at the International Rice Research Institute and elsewhere, of high-yielding, stiff-strawed, fertilizer-responsive rice in wetter portions of Asia, led many to believe the situation had been fundamentally altered and that feeding the world's rapidly increasing population no longer posed problems. So pervasive was the optimism that the FAO even suggested 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 (14).

Lending statistical comfort to this more cheerful view was FAO's 1971 evaluation of the global food picture. In response to criticism that its protein and energy allowances were excessively cautious, FAO in 1971 convened a new

side were recommended, but the protein figures were slashed by a third. Although this reduction was accompanied by the warning that a portion of dietary protein could be used to meet energy needs if energy intakes were insufficient and that protein malnutrition could therefore occur even when supplies were apparently adequate, the effect was to convert the list of "protein deficit" countries to ones of sufficiency. If the protein problem did not disappear overnight, its statistical underpinnings seemed to (15).

1972 and All That: Aberration or Permanent Turnaround?

The events leading to the latest turnabout in the food situation and to renewed popular concern for the adequacy of world supplies involve more than the shortfall in the 1972 grain crop and the subsequent running down of U.S. stocks. Simultaneously at work have been longer-term forces acting at home to hold down U.S. production and in importing countries to heighten the demand for American grain.

The agricultural capabilities of North America are vast; and, if U.S. farm policy over the past half century can be thought of as having a theme, it has been to prevent this productivity from driving down prices to the point where income to farmers could be maintained only by a massive exodus from the land. Whether or not the exodus has been slowed is debatable, but the tinkering with the 'market' mechanism has been on a scale befitting the world's wealthiest nation. From Soil Bank to Public Law 480 to drowning baby pigs, little that might elevate prices has not been tried.

The Kennedy and early Johnson years saw the introduction of policies that were more costly to the government but more effective in limiting production. Support prices were lowered, and, to compensate for this, direct payments were made to farmers who agreed to keep a portion of their cropland idle. The effect by the late 1960's was to stabilize production and to make U.S. grain more competitive on the world market. This competitiveness was reinforced by devaluations of the dollar, totaling almost 20 percent, between 1971 and 1973.

At the same time that American exports were becoming cheaper to consumers abroad, forces were in motion

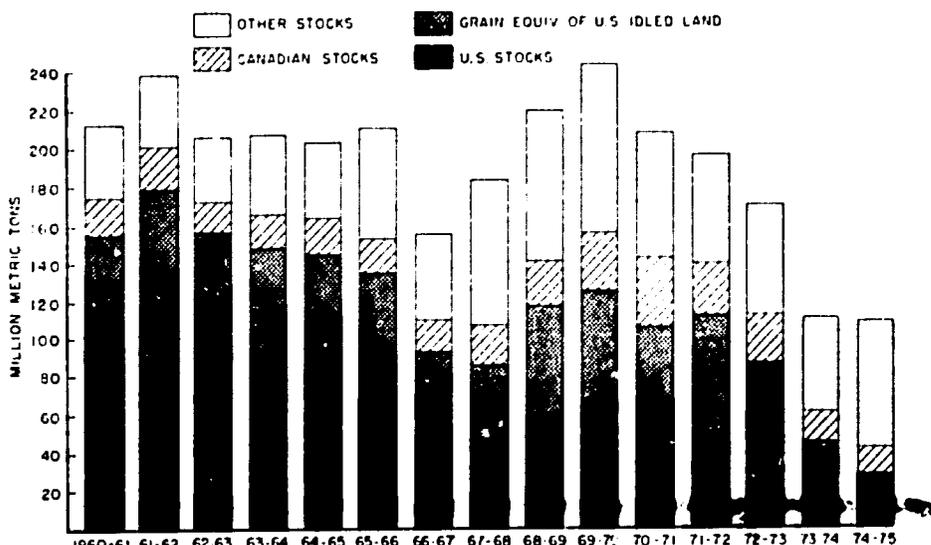
(Fig. 2). In the developed countries, the LDC's, and the communist countries, recent imports of grain have been at levels well above those that prevailed a decade and a half ago. The factors underlying this movement are important; on their permanence or lack of it hinges our assessment of whether 1972 marks the beginning of a new era on the world food front.

First the developed importers of foodstuffs: Europe and Japan. We tend to think of diets, particularly national diets, as being rigid and subject to little change. In the short run this may be true, but over the long run the dietaries of a people are subject to great

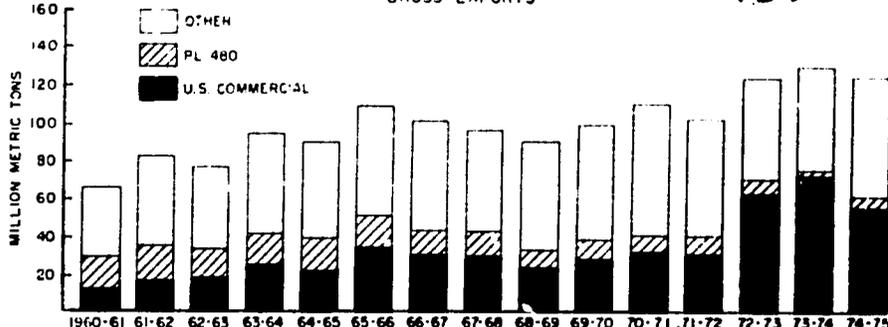
changes. These changes above all reflect the level of economic prosperity.

Among poor people, be they individuals or nations, diets tend to be dominated by 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 3 and 10 pounds of grain

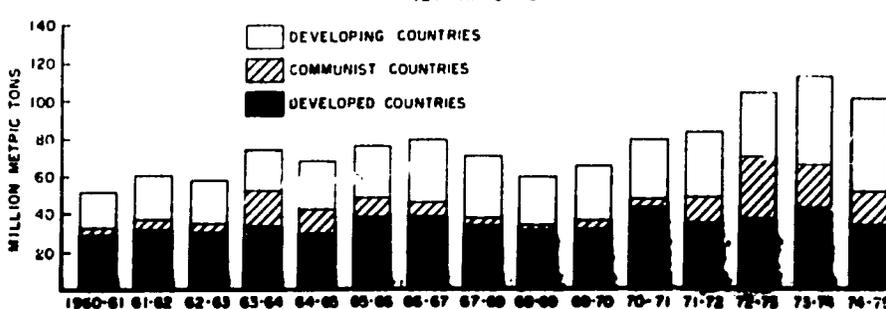
INITIAL STOCKS, INCLUDING GRAIN EQUIVALENT OF U.S. IDLED LAND



GROSS EXPORTS



NET IMPORTS



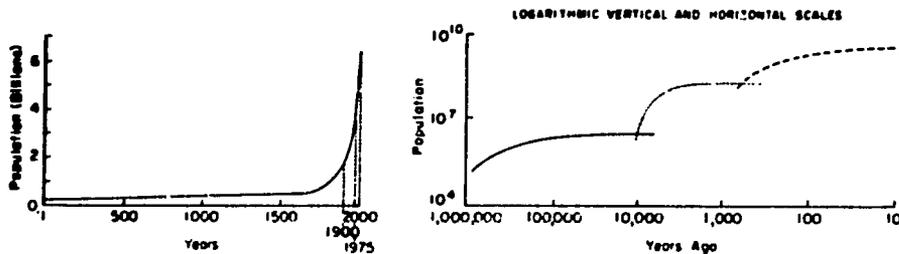


Fig. 3. Two views of world population growth. [The data are from (20); courtesy of *Scientific American*]

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-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 just over 20 percent. Yet per capita grain disappearance has risen to 1800 pounds per person per year. Of this amount less than 100 pounds are directly consumed; the bulk of the remainder is fed to animals (16).

Precisely this sort of dietary shift underlies the growing imports of grain by Europe and Japan, a shift accelerated by the boom years of the early 1970's. A similar shift to a less efficient, meatier diet is taking place in the U.S.S.R., where over the last 15 years impressive gains have been recorded in the agricultural sector. Prior to the reforms initiated by Khrushchev, farming was the weak sister of the Soviet economy. Little was given it and little expected.

What is remarkable about Khrushchev's reforms is the speed with which they have altered the Soviet diet. In 1950 the starchy staple ratio stood at 72 percent. By 1960 it had dropped to 59 percent and is now of the order of 50 percent. The Soviet consumer still accounts each year for several hundred pounds of grain consumed more or less directly, but total per capita disappearance has risen to 1600 pounds (17).

Not even the most totalitarian government would attempt to reverse such a trend of dietary improvement, and the Russian leaders obviously have no intention of doing so. Their problem

Russia's wheat land lies to the north of the 50th parallel, and damaging drought is the rule in the New Lands of western Siberia and Kazakhstan in one year out of three. Great variability in yields is the consequence, and the evidence of the last decade is that the Soviets would be prepared to purchase massively from the West in times of occasional shortage rather than cut into their animal population.

The issue then begins to clarify itself, and for American agriculture it is not so much whether it can respond to periodic Soviet demands, coming as they will on top of substantially enhanced sales to Japan and Western Europe. Assuredly it can, although probably at permanently higher prices at home and abroad (18). Rather, the issues relate to how stocks in the future will be carried—certainly the U.S. taxpayer would be ill-advised to underwrite the cost of a storage operation geared to occasional sales to the U.S.S.R.—and to whether the abundance of America is being spread too widely. Has the world come to rely excessively on North America to feed it in good years as well as bad? To deal with this question, we must cut short our respite in the realm of trustworthy fact and reliable figure and return to the Third World. Does the steep increase in LDC grain imports shown in Fig. 2 mean a turn for the worse there in the race between food and population? Has the Green Revolution fizzled out?

Prognosis for the Third World:

Population Control

The quandary faced by most countries of the Third World can be viewed more instructively not as a race between food and population, but as one between population and employment on the one hand and employment and food on the other.

3, indicating that the world's population remained essentially stable from biblical times to about 1750. Such charts are valid in that they drive home the magnitude of the current explosion in population, some 80 percent of which is taking place in the LDC's, but they mislead in several important respects. The current upturn in population growth is not unique, and growth (and contraction) prior to 1750 took place not gradually but in bursts.

This is of fundamental importance and is perhaps most readily understood when visualized in terms of the right-hand chart of Fig. 3, a deceptively simple graphing first conceived by E. S. Deevey. This chart, which is plotted on logarithmic scales to make both time and numbers more manageable, strikes at the heart of Malthusian thinking. The present upsurge in numbers is not the first but the third in a sequence of bursts that have been associated with major breakthroughs in man's ability to cope with his environment. The first occurred several million years ago—Deevey plotted it at 1 million, although today he would no doubt move it back—and attended man's emergence from the primate line into a maker of tools able to hunt and gather over a range of conditions. The second marked his domestication of plants and animals some 10,000 years ago and the beginnings of agriculture, the "Neolithic Revolution."

These breakthroughs, of course, did not take place simultaneously around the world, but were staggered in their impact. Just as the industrial and scientific revolution occurred first in Europe, food gatherers and hunters first became agriculturists in the Fertile Crescent and Southeast Asia. Still the effect in a particular locality was rapid and profound. For example (19),

Twenty thousand people would probably be an extreme estimate of the population of hunter-gatherers the Egyptian section of the Nile valley could have supported at the end of palaeolithic times. The population of the Old Kingdom two thousand years later has been variously estimated at from three to six millions.

That such epochal technological breakthroughs would be accompanied by rapid population rises seems obvious. What is less obvious is the nature of the forces that ultimately acted to force a leveling off. Malthus' food supply, together with such other essentials as space, water, and air, clearly set an upper limit, but one wonders how far

term population equilibria of the past would seem to have been at levels below those associated with marginal starvation. Thus, "a Paleolithic man who stuck to business should have found enough food on two square kilometers, instead of [the] 20 or 200" believed to have been available per capita, respectively, in the Upper and Lower Paleolithic ages (20). And it is not weather but changed political circumstances that are most clearly linked to the great swings in China's population over the last two millennia.

If the parameters of the demographic transition associated with the Neolithic remain to be satisfactorily generalized, those associated with the third of the great upheavals, the industrial and scientific revolution, would seem fairly clear cut (Fig. 4). Initial population stability is characterized by high birth and death rates. Then, as public health measures are introduced, the death rate drops. Birth rates, however, remain at their old level, and a period of population "explosion" sets in. Then birth rates in their turn fall, and the population again approaches stability, but at a much higher level.

Most of the industrialized states have passed through this transition and have reached, if not precisely zero population growth, the condition immediately preceding it. For them the transition averaged between 50 and 100 years. Virtually all of the LDC's have passed through the stage of declining death rates and are in the interval of maximum population growth. For them, as Dudley Kirk is fond of pointing out, the "population problem is essentially whether or not [they] will follow Europe and North America in reducing birth rates . . ." (21).

The evidence from some of the smaller, more prosperous LDC's (notably Singapore, Taiwan, Mauritius, and Sri Lanka) is that they can reduce birth rates and probably much more quickly—within 20 or 30 years (22). Contraceptives are becoming available

Table 1. Number of people estimated by the FAO to have had an insufficient protein-energy supply in 1970, by region. [Data from (25)]

Region	Population (millions)	Percentage below lower limit	Number below lower limit (millions)
Developed	1074	3	28
Developing*	1751	25	434
Latin America	283	13	36
Far East*	1020	30	301
Near East	171	18	30
Africa	273	25	67
World*	2825	16	462

* excluding Asian centrally planned economies.

at little or no cost to users in the Third World, and birth control information is widespread. However, for family planning to be rapidly introduced, people must consciously want fewer children and for this to happen there are certain preconditions. These include a reduction in the economic attractiveness of children and an end to the need for parents to plan on two live births in order to feel reasonably assured that one child will reach maturity. Expressed more positively, the preconditions imply growing access to health facilities, social security, and education—all of which fall under the heading of "improved living levels" or "development." Hence the race between population and employment. From all these desirable things, he who is without gainful work tends to be excluded; and thus it is on the outlook for new jobs in the huge, impoverished LDC's (such as India, Bangladesh, and Indonesia) that the prognosis for population control in the Third World must rest.

Prognosis for the Third World: Food Consumption

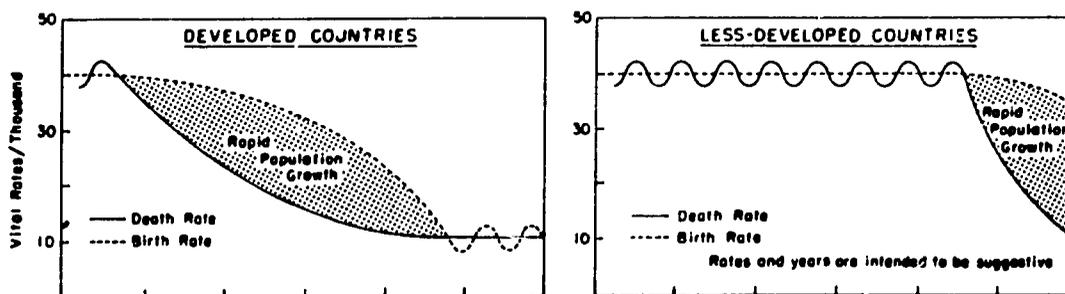
It is gratifying to record that in its most recent assessment of the world food situation, prepared for the World Food Conference, the FAO was able to present its findings in a way which at

last avoided suggesting that some countries are well fed and others not, and in its place substituted what FAO's analysts have known all along—that those with money eat well wherever they may be, while the poor, be they in Bangladesh or Boston, suffer (23). The number of people suffering (according to FAO deductions) has been widely quoted: "over 400 million" as of 1970, including almost 25 percent of the population of the Third World (excluding China). Although this figure rises when compared with the 60 percent Sukhatme found in the *Third World Food Survey*, it represents an unconscionable segment of mankind.

The breakdown by region is shown in Table 1 and indicates the problem to be largely an Asian one. Just as Sukhatme's earlier attempt to quantify the dispersion of diets about national means required us to take much on faith, so the origin of the data in Table 1 is clouded by ambiguity. This is understandable. The survey data from which inferences as to the impact of income on feeding habits might reasonably be drawn do not exist for a majority of the LDC's, and even if they did they would reveal little about eating patterns within the household (24).

Figure 5, a summary of the effect of income on diets and nutrient intake in Sri Lanka (Ceylon), illustrates some of the difficulties. The survey on which it is based was broad in coverage and was carried out with great integrity. Nothing of comparable quality exists for India, Bangladesh, or Pakistan, or, for that matter, any country of Africa south of the Sahara. Yet, even with this survey, one can tell very little about the extent of protein-calorie malnutrition in Sri Lanka. We have noted that the starchy staple ratio falls as income goes up. In Sri Lanka this tendency is observable among only the four uppermost income classes (20 percent of the population), and then only weakly so. Between the lowest class (43 percent of

Fig. 4. The demographic transition schematized.



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 kilocalories and 10 grams of protein, but none in diet composition.

What does this mean? Because the FAO now (quite reasonably) reckons energy needs in South Asia average about 1900 kilocalories daily and protein adequacy to be a function of energy adequacy (25), it could mean either of two things. If the standard factor of 15 percent is applied to account for wastage between purchase and actual ingestion, the 200-kilocalorie gap could be interpreted as implying enforced reduced activity among the poor or ac-

tual physical deterioration (or both). Alternatively, one might postulate caloric adequacy among that element of society which is too poor to waste anything and which, because of the high rate of unemployment in Sri Lanka, leads a less active life and thus has lower energy needs. Thus you can have it either way: depending on your assumptions, you can prove beyond a statistical doubt that 43 percent of Ceylonese suffer protein-calorie malnourishment or none do.

One suspects that FAO's response to this opportunity for "bias in, quantification out" has not been to minimize the number of people suffering protein-calorie malnourishment. Although Af-

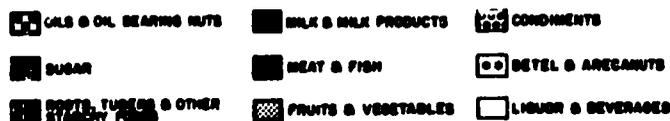
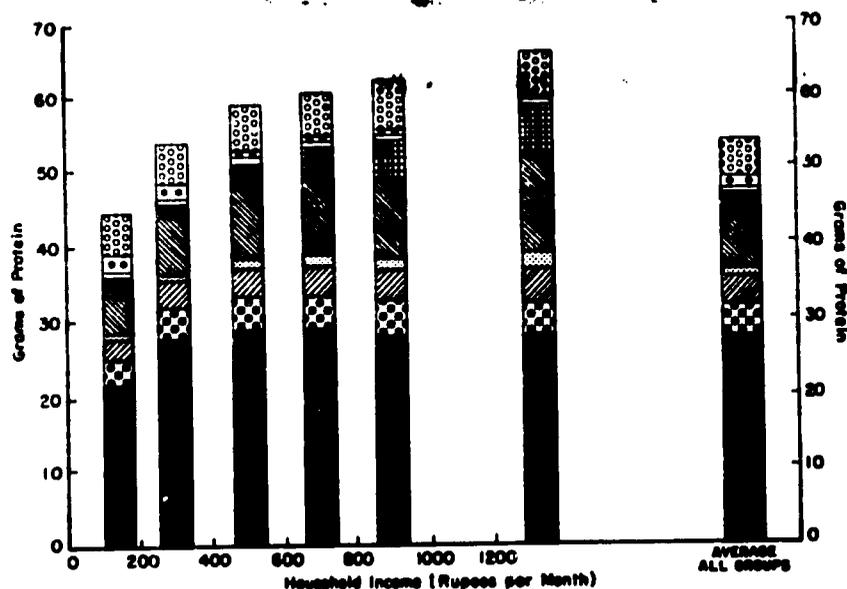
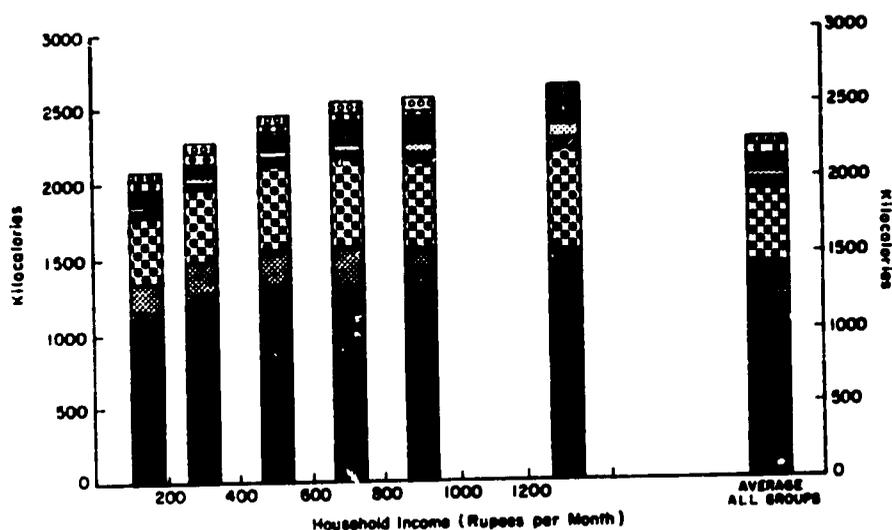
rica remains pretty much a statistical vacuum, it is not easy for anyone who has spent time there to accept the notion that a quarter of its population is underfed. None of the materials I have worked with suggests anything like so severe a problem, nor does ocular inspection. The same applies to the Near East. The 13 percent estimate for Latin America may not be too wide of the mark; at least it checks out with an evaluation we recently completed using some fairly trustworthy data for Lima (26). The Far East—and what is referred to is really South and Southeast Asia—is the big question mark. The 30 percent estimate is no doubt too high for the region as a whole, but may well be pathetically accurate for parts of India and Bangladesh.

Exaggeration or not, Table 1 and the changes at FAO that it implies are long overdue and welcomed. What we once thought to be a global food problem is, in fact, largely an Asian problem, and rising incomes hold the key to its resolution.

Prognosis for the Third World: Food Production and Jobs

If rising incomes lie at the heart of controlling population growth in the LDC's and improving nutritional intake, the goal should obviously be to carry out development in such a way that its benefits will be widely shared. So far this has rarely happened. The new agricultural systems have tended to effect only a segment of the rural population while, pronouncements about intermediate technology notwithstanding, industry in the Third World is as capital-intensive as elsewhere. Two groups of excluded persons have consequently arisen: those bypassed by progress in the countryside and the unemployed of the towns. Their plight, in that it interlocks with the need to produce more food in ways that are at once complementary and conflicting, may prove the most intractable of the problems confronting the Third World.

The equity problem in agriculture has its roots in the selectivity of the various breakthroughs of the Green Revolution. The high-yielding varieties in particular are not designed to be introduced alone, but demand a host of complementary inputs: fertilizers, adequate water, and effective control over disease insects and weeds to men-



sive to fertilizer—as the *Indica* varieties they are meant to replace are not—and yield well only under irrigated conditions. Simply to provide the conditions under which they can be introduced can be very time-consuming and expensive. To the degree that any of the new systems are suited to specific ecological conditions, benefits will obviously be restricted. Equally obvious is that the benefits will accrue primarily to those classes best able to command the new inputs: the larger farmers and landowners (27).

None of this is new. A similar selectivity characterized the innovations which transformed agriculture in Europe and North America during the 19th century. The difference lies in the cities and the opportunities they offer the displaced countryman. A hundred and fifty years ago our ancestors were greeted with promise; industry was growing and, since industry then had high labor requirements, virtually all who left the land found new jobs. Today the movement to town rests on less solid foundations. Though urbanization in the LDC's is proceeding at a breakneck pace—major centers are probably doubling in size every 8 or 10 years—most of the cities are “cities that came too soon” (28). To a remarkable degree they remain administrative and trading centers, built up to dispatch raw materials to the developed countries and to receive and distribute manufactures in exchange. That the bulk of what little industrialization is occurring is capital- not labor-intensive is apparently a necessity if foreign competition is to be warded off. Jobs are far fewer than the bodies in search of them.

The proportion of the population that falls within the two groups of disadvantaged is anybody's guess. Governments in the Third World do not collect data on unemployment and underemployment, and if they did the findings would be too distasteful politically to permit release. World Bank officials speak of the “lower 40 percent,” and even if this figure is a very rough estimate, it is still a fair one. Somewhere between a quarter and a half of the population is being bypassed by the forward march of development.

The instability of this situation is now recognized; and with the World Bank and the U.S. Agency for International Development (USAID) in the van, the search has begun for investments that will benefit the poorest classes. “Growth

number of schemes for labor-intensive development have been launched. These focus on the rural disadvantaged, and though one sometimes suspects the true aim goes no further than keeping them down on the farm, the targets expressed are lofty. It is on “eight-acre man,” Barbara Ward writes, that “the hopes of feeding most of mankind in the longer term depend” (29).

Would that this were true, for it would offer a tidy solution to the population problem as well as to the problems of food production and consumption. However, any dependence on smallholder agriculture will more probably prove fleeting. The labor-intensive schemes so far initiated, such as the Ujamaa villages in Tanzania and the Puebla Project in Mexico, have not met with great success, and they are not likely to. This is fundamental and I will return to it. But accepting it as so, it is crucial that the equity question not become confused in the official mind with the overriding need for continued agricultural expansion. For if the Green Revolution has seemed to flag during the last few years, it is from lack of sustained attention rather than exhaustion of opportunities for increasing food production.

The systematic application of the scientific method of food farming in the Third World is very recent—it dates no farther back than the mid-1940's—and the scope for improvement that remains is great (Fig. 6). Breeding work until just a year or two ago ignored the root crops and concentrated on wheat, rice, and maize; and

even for these crops yields have risen to only a fraction of what they can. 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.

The question is not solely one of greater inputs into agriculture. If food production in the LDC's is to be forthcoming in anything like the quantity the remaining years of population explosion will require, there will have to be a restructuring of attitudes and linkages between town and countryside. When, last spring, I had an opportunity to spend a month in the drought area of the western Sahel in Africa, what was more shocking than the poverty was the extent to which the wetter lands to the south were going untapped because of pricing policies. Among the things the Sahelian states inherited from the French was a policy of assuring jobs for all secondary school graduates. At one time this policy may have been the logical one to promote education, but as school enrollments have burgeoned and economies have stagnated, it has served to swell the unproductive ranks of the civil service. Budgetary crises have ensued and civil service salaries have been held down by controlling the price of food. But by pegging the millet price at about half what it otherwise might have been, it has been made unprofitable for farmers to grow more than they and their families require.

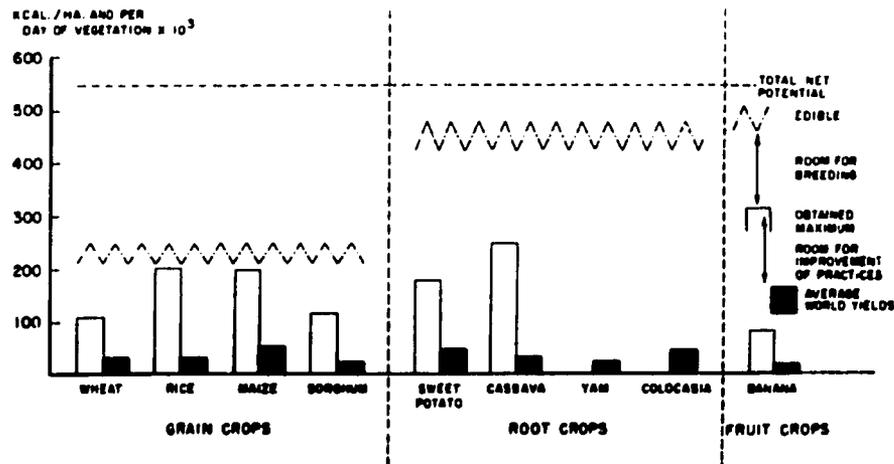


Fig. 6. Average world yields, maximum yields obtained in selected tropical experiment stations, and estimated potential yields to be reached through breeding and research. Yields are given as 10³ kilocalories per hectare per day of vegetative growth. As is shown on the extreme right of the graph the distance between the average yields and the maximum obtained indicates the scope for improved cultural practices. The distance between the obtained maximum and the edible yields indicates the scope for improvement in breeding. [The data are from (35); courtesy of the *Netherlands Journal of*

This is an extreme example, but in just about every developing country—the situations in Thailand, Egypt, Indonesia, and Nigeria come readily to mind—the politically articulate of the cities stand unwittingly in the path of agricultural progress. To reverse such a relationship will be very painful politically; and a constructive result of the current increase in fertilizer prices and the reduced availability of Public Law 480 grain is that they are giving governments the political stiffening needed to shift the terms of trade more to agriculture's favor. But the prognosis is clear. Either greater attention is paid to agriculture or production will fall short of needs.

The employment-equity-income problem is another matter. How it will ultimately resolve itself remains a source of debate and speculation. Most observers seem prepared to follow the lead of the World Bank and USAID and accept that the solution has to lie in an increasingly labor-intensive agriculture (30). This view has taken on added respectability since the rediscovery of China.

Those who are not so certain—and I am among them—base their skepticism on a fear that reliance on eight-acre man will lead to equity without growth. It is not just that technical change in the countryside is more capital- than labor-demanding. The noble peasant is a rich man's delusion. People infected with rising expectations prefer almost anything to farming, and history equates progress with a decline, not a rise in agricultural employment. Over the long pull it would seem more promising not to flaunt such basic tendencies and to look instead to a revamping of the development process that will bring its benefits, particularly those having an effect on fertility behavior, to all. This may well imply consumption planning, massive welfare schemes for the generation of employment, and other things with which we are little experienced (31). It almost certainly also implies substantial social and political change.

That fundamentally altered economic circumstances will engender major adjustments in the social and political order should not come as a surprise. It happened first when the Neolithic gave rise to the great Classical civilizations and again 200 years ago when enclosure and the Industrial Revolution brought on the emergence of Western democracy. What remains to be seen

today need experience their own Age of Revolution, just as Europe and America did two centuries ago, or whether the institutions left by the departing colonial powers will be amenable to peaceful modification. Should evolution prove possible, the ultimate colonial reckoning may well be a positive one. Should it not, civil strife on an unprecedented scale may be difficult to avoid. For reasons Malinowski could have hardly foreseen, the misery and vice about which he brooded may yet be visited on much of the world.

References and Notes

1. T. R. Malthus, *An Essay on the Principle of Population* . . . (London, 1798; reprinted Macmillan, London, 1906), pp. 6-8.
2. FAO, *World Food Survey* (Washington, D.C., 5 July 1946).
3. Two studies showing this result are: T. Jagaratnam and T. T. Poleman, "Food in the economy of Ceylon," *Cornell Int. Agric. Dev. Bull. No. 11* (October 1969); M. J. Purvis and T. T. Poleman, "Food policy planning for Malaysia: The evaluation and use of underdeveloped agricultural statistics," *Cornell Int. Agric. Bull.*, in press.
4. E. B. Simons and T. T. Poleman, "The food balance sheet as a parameter of tropical food economies: The case of Mauritius," *Cornell Int. Agric. Bull. No. 29* (June 1974).
5. Food and Nutrition Board, National Research Council, *Recommended Dietary Allowances* (National Academy of Sciences, Washington, D.C., ed. 9, rev., 1974), pp. 26-29.
6. FAO, *Second World Food Survey* (Rome, November 1952).
7. USDA, Economic Research Service, *The World Food Budget, 1962 and 1966* (Foreign Agricultural Economic Report 4, October 1961), p. 5.
8. ———, *The World Food Budget, 1970* (Foreign Agricultural Economic Report 19, October 1964).
9. FAO, *Third World Food Survey* (Freedom from Hunger Campaign Basic Study 11, Rome, 1963), p. 51.
10. *The Economist*, 23 August 1952, p. 456.
11. Lord Boyd-Orr's pronouncement in *Scientific American* for August 1950 that "a lifetime of malnutrition and actual hunger is the lot of at least two-thirds of mankind" set the tone for a majority of the early writings. Among the more responsible extensions of this theme were: W. Vogt, *Road to Survival* (Sloane, New York, 1948); Josué de Castro, *The Geography of Hunger* (Little, Brown, Boston, 1952); and Sir John Russell, *World Population and World Food Supplies* (Allen and Unwin, London, 1954). The Cornell libraries' holdings suggest that the volume of writing was greatest in the mid-1960's. Alarmism predominated. The forecast for 1975 was given in W. Paddock and P. Paddock, *Famine—1975* (Little, Brown, Boston, 1967).
12. M. K. Bennett, *The World's Food* (Harper, New York, 1954).
13. C. Clark's argument is most fully presented in his *Population Growth and Land Use* (Macmillan, London, 1967).
14. FAO, *The State of Food and Agriculture, 1969* (Rome, 1970), pp. 1-3.
15. ———, *Agricultural Commodity Projections, 1970-1990* (Rome, 1971), vol. I, pp. 43-48.
16. USDA, Economic Research Service, *Food Consumption, Prices, and Expenditures* (Agricultural Economic Report 138, July 1968); and supplements.
17. D. Bronson and B. Severin, "Soviet consumer welfare: The Brezhnev era," in *Soviet Economic Prospects for the Seventies* (U.S. Congress, Joint Economic Committee, Washington, D.C., 27 June 1973).
18. An excellent summary of the current food situation and likely things to come is USDA, Economic Research Service, *The World Food Situation and Prospects to 1985* (Foreign Agricultural Economic Report 138, July 1968); and supplements.
19. ———, *The World Food Situation and Prospects to 1985* (Foreign Agricultural Economic Report 138, July 1968); and supplements.
20. E. S. Deevey, Jr., "The human population," *Sci. Am.* (September 1960), p. 198.
21. D. Kirk, in *Fertility and Family Planning—A World View*, S. J. Behrman, Y. Cora, Z. Freedman, Eds. (Univ. of Michigan Press, Ann Arbor, 1969), p. 76.
22. This is demonstrated by Kirk in (21) and in his "A new demographic transition?" in *National Academy of Sciences, Rapid Population Growth—Consequences and Policy Implications* (Johns Hopkins Press, Baltimore, 1971).
23. The rich suffer as well—from overnutrition. If we could really measure these things, it would not be surprising to discover that the world's overfed nearly equaled the underfed.
24. Because hardly any survey data can be disaggregated below the household level, the fact that the nutritional problems of the Third World center on the preschool child tends to be obscured when the sums are done. A priority role for the FAO should be development of studies which take the child as the starting point and work outward to his social and economic environment.
25. U.N., World Food Conference, "Assessment of the world food situation" (Rome, 5-16 November 1974), p. 66.
26. M. A. Ferroni, "The impact of urbanization on nutrition in Latin America: The Peruvian experience," thesis, Cornell University (1974).
27. My treatment of the Green Revolution and its consequences is obviously simplified. For an expanded view, see N. Wade, *Green Revolution* (1974); also the articles by F. Franke and D. K. Freeston, W. Paddock, *Population, and Employment*, T. T. Poleman and D. K. Freeston, Eds. (Praeger, New York, 1973); and K. Griffin, *The Political Economy of Agrarian Change—An Essay on the Green Revolution* (Harvard Univ. Press, Cambridge, Mass., 1974).
28. B. Ward's special section, "The poor world's cities," in *The Economist*, 6 December 1969, is instructive. The quote is from p. 36.
29. Again B. Ward has taken on a complex problem in "Food," a special section of *The Economist*, 2 November 1974. The quote is from pp. 24-25.
30. More accurately, the World Bank and AID have followed the lead of S. Barracough, "Employment problems affecting Latin American agricultural development," (FAO) *Mon. Bull. Agric. Econ. Stat.*, July-August 1969, and B. F. Johnston and J. Cowrie, "The seed-fertilizer revolution and labor force absorption," *Am. Econ. Rev.*, September 1969.
31. An excellent piece on the new economics of the Third World is Mahbub ul Haq, "A new perspective on development" in *International Development, 1971*, A. E. Rice, Ed. (Proceedings of 12th World Conference of the Society for International Development, Dobbs Ferry, N.Y., 1972).
32. USDA, *Handbook of Agricultural Charts, 1974* (Agriculture Handbook 477, Government Printing Office, Washington, D.C., October 1974), p. 50.
33. Data are from USDA, Foreign Agricultural Service, *Foreign Agriculture Circular: Grains* (various issues); *ibid.*, *World Grain Trade Statistics, 1950-1951/1972-1973* (FAS M-258, September 1974); USDA, Economic Research Service, *U.S. Agricultural Exports Under Public Law 480* (Foreign 395, October 1974); USDA, *Agricultural Statistics 1973 and 1974*; FAO, *Trade Yearbook 1972*; and *ibid.*, *World Grain Trade Statistics, 1972/1973*. Years are (July-June) marketing years. Idle land was converted to grain equivalent at 1 metric ton per acre. Data for 1974-1975 are USDA projections. Although designated "world grain" by the USDA, the figures exclude rice and the stocks of most LDC's.
34. T. T. Poleman, "Income and food consumption: Report to the government of Sri Lanka" (FAO/UNDP, No. TA 3198, Rome, 1973), pp. 18-19.
35. C. A. de Vries, J. D. Ferrerda, M. Flach, *Neth. J. Agric. Sci.* (November 1967), p. 246.
36. This paper summarizes elements of my course, "Food, population, and employment." I thank at Cornell, K. L. Robinson, R. S. Morison, D. I. Padberg, D. K. Freeston, and D. G. Sider and in Washington, W. R. Gasser, W. M. Beahm, O. M. West, and B. Conner for

of Africa (Penguin Books, London, ed. 2, 1958), p. 26.