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# THE GAP BETWEEN AGRICULTURAL TECHNOLOGY AND THE DEMAND FOR FOOD

Quentin M. West

ERS-628



## THE GAP BETWEEN AGRICULTURAL TECHNOLOGY AND THE DEMAND FOR FOOD

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We are currently in a period of great international anxiety about the world's ability to feed an expanding, more affluent population. In the past few years the world food situation has changed from one of surpluses and low prices to one of tight supplies and high prices. This rapid reversal has raised another wave of widespread food-population pessimism similar to that which has swept the world several times since Thomas Malthus wrote his influential essay in 1798.

As would be expected, judgments differ widely about the causes of the sudden reversal in the food situation and about its likely course in the future. One judgment is that we have entered a period of chronic food scarcity spurred by population growth and rising affluence--a period in which demand has begun to outrun the production capacity of the world's farmers and fishermen. At its extreme, this view of the future foresees the arrival of the Malthusian apocalypse as early as the 1980's.

On the other hand are the more sanguine, deterministic views of some observers who point out that man has managed to avoid the Malthusian specter on a global basis until now, and he will surely have the ingenuity, foresight, or luck to continue to do so--except, of course, for the occasional national or regional famine. That Malthus' predictions of widespread famine have so far been held at bay is not due to control of population--man's numbers have increased roughly 4-1/2 times since 1798--but to expansion of food supplies. A series of "technological fixes" will surely carry us well into the 21st century in meeting world food needs, according to these observers.

Both views are overdrawn. The former seems to have been extrapolated from current or very recent events without careful diagnosis of the cause of these events and without careful examination of the world's food production potential. The latter view is naive, even dangerous, in assuming that we will somehow "muddle through." The most casual reflections upon prospects for food production in the developing countries during the next few decades lead one to conclude that they face formidable problems in simply keeping pace with their projected population growth, even if long range plans are formulated and implemented now.

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1/ Dr. West is Administrator, Economic Research Service, U.S. Department of Agriculture. This report is based on remarks made at the Bicentennial Symposium Series on Contemporary Problems held at the NASA-Goddard Space Flight Center, Greenbelt, Maryland, on April 29, 1976.

A third hypothesis, one which underlies the remainder of my discussion, is that in the long run the earth can feed its people only if population growth is curtailed.

Efforts to increase food production will buy time for population adjustments. But the central food problem facing the world is the growing gap between food production and demand in the developing countries.

However, before discussing what it's going to take to narrow this gap between agricultural technology and the demand for food, let me review some developments in the the world food situation that have brought us to where we are now.

The Past in Perspective

In appraising the current world food situation and the prospects for the future, it is important to differentiate between the random, essentially nonrecurring events and the longer run, evolutionary changes.

World food output has been rising fairly steadily over the past several decades (chart 1). In fact, production in developing countries has grown at about the same rate as in the developed countries--around 3 percent a year.

Many people might assume that the green revolution they have heard so much about is responsible for this gain in farm output in developing countries. Actually, the introduction of improved grain varieties deserves only partial credit. The truth is that a large number of the developing world's farmers are getting their production gains the hard way--by breaking new ground (chart 2).

Grain acreage in the less developed countries has expanded at an annual rate of about 1.3 percent. In contrast, developed countries farmed less area in grain in the 1970's than they did back in 1950.

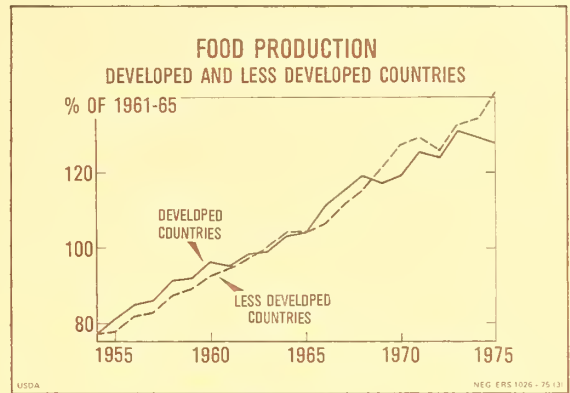


chart 1

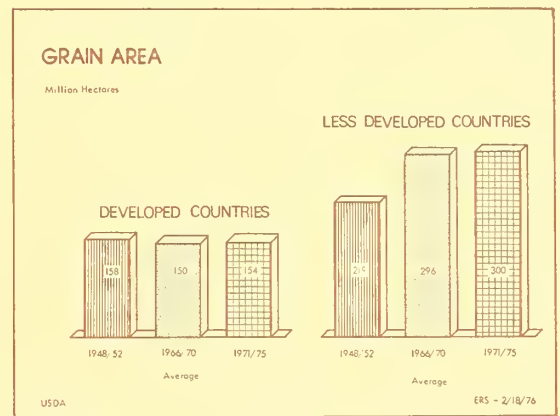


chart 2

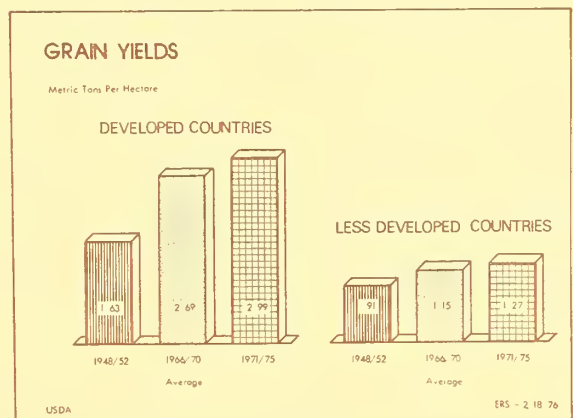


chart 3

The real green revolution of this era took place in the developed countries, where grain yields posted spectacular gains of over 2.5 percent per year. Yield increases in the developing countries averaged only 1.4 percent a year--in part, because large increases in acreage limited per acre gains. By 1975, the developing countries' yields had not reached the level the developed nations achieved 20 years before (chart 3). While their rate of increase in grain production about matched that of the richer nations, their total grain output today only approximates that of the developed countries a decade ago (chart 4).

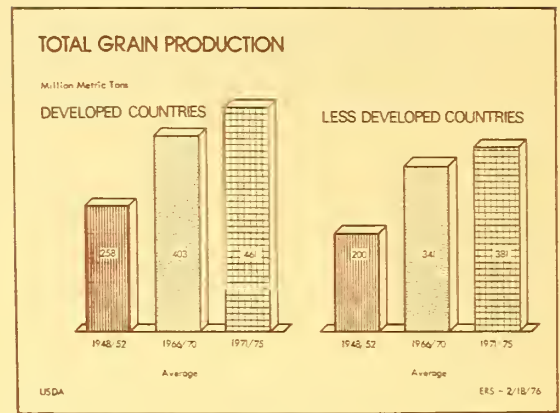


chart 4

As farm production has been on the rise, so too has population (chart 5). Americans may be approaching zero population growth. But population control has not taken significant hold in most of the less developed nations, where growth rates average close to 2.7 percent a year. Over 65 million people are added each year to the populations of developing countries already hard pressed to feed themselves adequately. And while over half the world's people now live in these developing countries, over seven-eighths of the world's annual population increases are concentrated here.

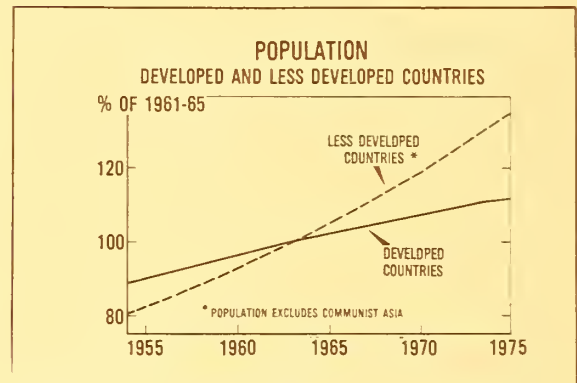


chart 5

Population growth eats up a large part of the food production gains in the developing world. In fact, per capita food output in the developing countries has been rising at an annual rate of only 0.4 percent and now is just slightly above that of the base period (chart 6). Last year the situation temporarily changed with the developing nations registering a sharp recovery in per capita food output, returning to the high achieved in 1970. Per capita food output in the developed countries had been rising at a more rapid rate until recently, when it leveled off (chart 7).

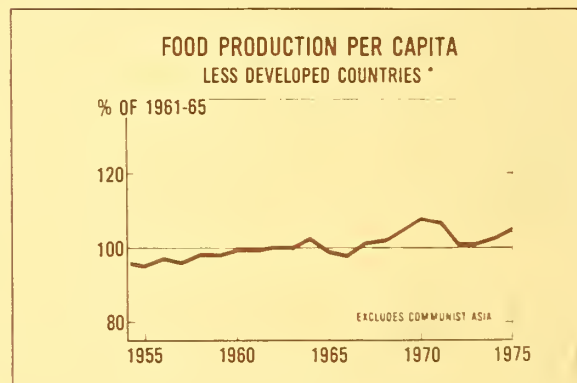


chart 6

Other fundamental changes in the world food situation also occurred during the 1950's and 1960's. Economic progress put

greater buying power in the wallets of foreign customers, particularly in the richer countries. These individuals, often anxious to eat better, developed tastes for such U.S. staples as convenience foods and meat. Their desire for improved diets with substantially larger livestock product components created a whole new market for feed-stuffs (chart 8). Each new increment in the demand for livestock products meant that a little less grain was consumed directly, but a lot more was used indirectly in raising livestock for the table. The more than ample grain supplies at low prices also helped stimulate the trend toward growth in meat production and consumption.

A more modest dietary revolution also was underway in poorer countries, where efforts to modernize and industrialize were usually concentrated in urban areas. As people left rural villages attracted by the promise of a better life in the cities, they became dependent on purchased grains, often of a higher quality, which replaced root crops and other home-grown staples.

The World Food Problem Unmasked

Increased affluence and upgraded diets both had the same outcome: They increased the world's dependence on imported grain (chart 9). This was not a problem during the 1950's and 1960's, when it appeared the big grain-exporting nations in North America and elsewhere faced chronic problems of excess productive capacity. In the late 1960's, these countries held stocks of up to a year's wheat production and a fourth of a year's coarse grain production. Farm programs to reduce grain acreage in the United States and Canada withheld as much as 55 million acres from production in the late 1960's and early 1970's.

However, these trends--in food production, population growth, dietary habits, and basic food policies--set the stage for the dramatic developments of recent years.

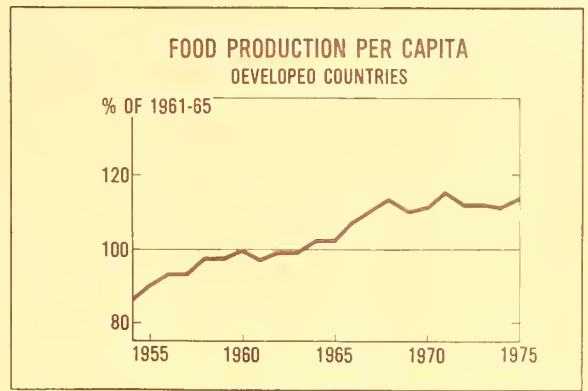


chart 7

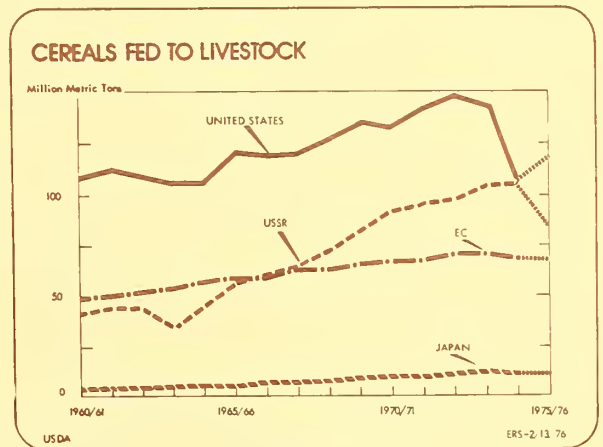


chart 8

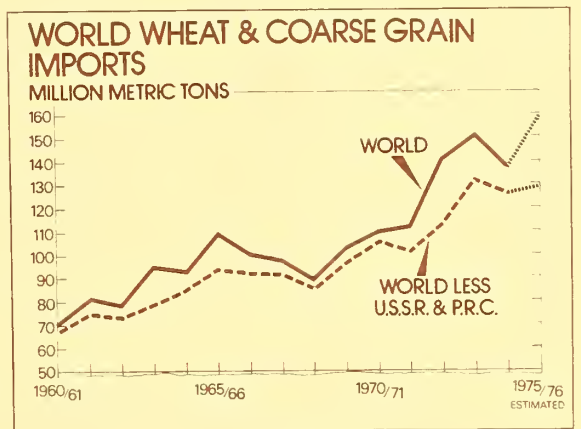


chart 9



Sharp deviations in weather, and consequently in harvests, reduced world grain production a cumulative 75 million tons below trend between 1972/73 and 1974/75, even though the 1973/74 crop broke all previous production records (chart 10). There were also the massive imports by the Soviet Union, then by the People's Republic of China, and sharp increases in exports to other developed countries, which were enjoying a run of unprecedented affluence. These events were accompanied by soaring food prices and rampant speculation.

By 1974, the prices of many important agricultural commodities were double or triple their 1972 levels (chart 11). These high prices and spot shortages of food were the signs of a world food market seriously out of adjustment. Events had masked the fact that between 1969 and 1974 the world consumed more food than was being produced and that to meet these needs grain stockpiles were being drawn down. Demand was being stimulated while supply was being restrained. The unmasking came in 1972, and producers could not adjust immediately.

As late as 1974/75, although farmers tried to boost production, poor weather in some leading exporting countries continued to frustrate efforts to increase grain stocks. And grain production in 1975/76 is substantially below estimates made last spring and summer because of weather, and is less than 1 percent above 1974/75. Production increases in the United States, in the People's Republic of China, and in nearly all developing countries just barely overcame declines in the Soviet Union and Western and Eastern Europe. Fortunately, the developing countries in general harvested a record 1975/76 crop, which largely relieved the pressure generated by poor 1974/75 crops.

Continued growth in grain consumption at anywhere near the rates of the last 15 years will keep ending 1975/76 stocks at

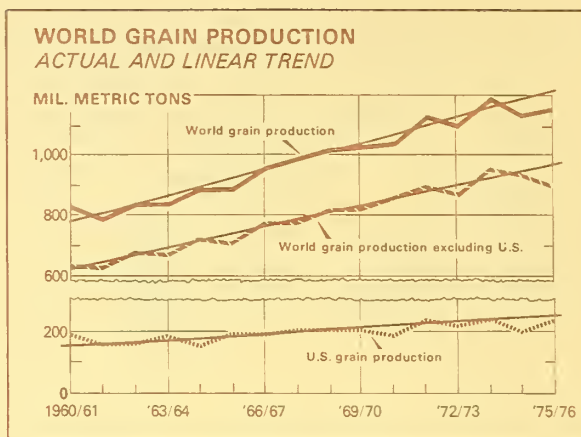


chart 10

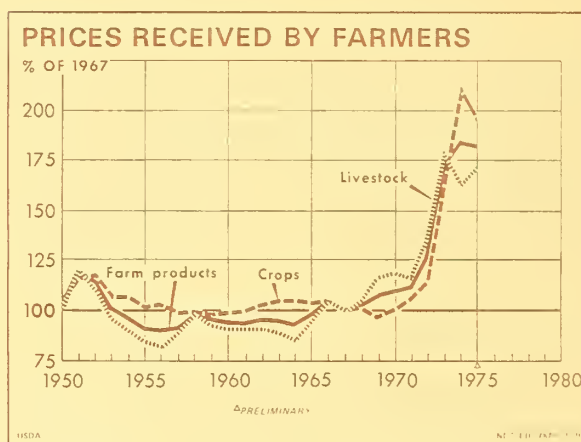


chart 11

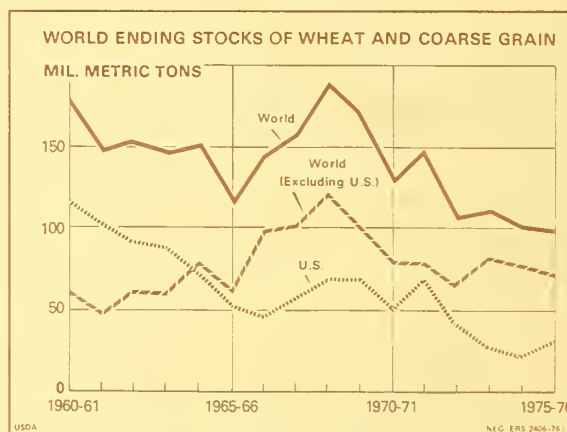


chart 12

about minimum working levels (chart 12). Stocks--particularly of coarse grains and wheat--are becoming more concentrated in the United States. Wheat and coarse grain stocks have grown in the United States while declining elsewhere.

Quite obviously, the "world food problem" is far from solved. The problems of high food prices and uncertain food supplies arose out of a combination of long-term trends, policy changes, and random weather-related events. The basic imbalances in world food production and consumption still exist. Correction of these imbalances will require a serious reevaluation of agricultural, food, and trade policies in many parts of the world.

### Resources for Future Food Production

What are the sources from which increased food production might be derived in the next few decades? How limited are the traditional factors of land, labor, capital, and management likely to be in various parts of the world, and particularly in the developing nations? Can resources used in agricultural production continue to be made more productive by infusion of new technology? What types of such new technology might be brought on stream?

Recent food developments have been seen by some as indications that the world is running out of land on which to produce food; that crucial yield-raising inputs, especially fertilizer, are becoming scarce; that future increases in yields will come more slowly and at greater cost; and that the world's weather is changing--becoming more erratic and less favorable for food production. They have speculated that food will be more difficult to produce in the future, prices higher, and supplies less stable than in the past.

Running out of land on which to produce more food has been a concern from time to time since Malthus put forth the idea of a limited quantity of land and the unlimited growth of population, and drew his dismal inferences about the future of mankind. However, several recent studies on land availability have come to essentially one conclusion: At least twice as much land is physically suitable for crop production as is currently being used.

The U.N. Food and Agriculture Organization (FAO) estimates that about 1.4 billion hectares (3.4 billion acres) presently are being cultivated to grow food crops or to feed livestock. This is less than one-half of the 3.2 billion hectares (7.8 billion acres) which could be used, according to a recent study by Iowa State University. Information on potentially arable land is far from complete, but we think that this is a conservative estimate.

But while the world as a whole is clearly not running out of land, most of the additional land lies outside the densely populated countries--and is likely to be increasingly more costly to bring under cultivation. Thus, a good part of future food production gains will have to come from yield-increasing inputs and techniques--more fertilizer, improved seed varieties, better cultural practices, improved water management, and so on.

We expect the largest share of future growth in food production to come from technologically induced higher yields. Most of the recent increases in grain yields in the developing countries have been brought about by the adoption of high-yielding varieties of grain--especially wheat and rice--and an associated package of inputs. The package includes fertilizer, insecticides, pesticides, water control, and improved farm management.

The countries that have adopted the essential elements of this technological process have as yet obtained only a fraction of their potential. South and Southeast Asia, especially India, Indonesia, Pakistan, and the Philippines, have all made important progress. Turkey, as well as Morocco, Tunisia, Mexico, and Algeria have also introduced the high-yielding wheat varieties (chart 13). Though the area planted to the new varieties has increased rapidly in some of these countries, plantings haven't approached full potential. Inappropriate farm size, lack of credit, and inhibiting tenure patterns have stopped some farmers, while uncertainty and risk in respect to both economic and agronomic factors have stopped others. Removal of such barriers and further perfection of technology for the particular needs of the developing nations is crucial to expanding food production.

### New Technology

No discussion of the potential role of agricultural technology in bridging the food gap would be complete without some speculation as to the new technology which might become available. The following are cited as examples of technology which might come on stream, economic conditions warranting:

- Upgraded protein-rich cereals and other crops similar to high lysine corn.
- Hybridization of additional crops, including wide crosses such as triticale.
- Soil management techniques which would permit the agricultural use of the fragile soils of the tropical rain forest.
- Biological rather than chemical control of harmful insects and diseases.
- Control of the tsetse fly, the vector for sleeping sickness in Africa, thereby opening for farm use vast areas of that continent which are now idle.
- Successful long-range weather prediction and possibly weather modification.
- The use of satellites for worldwide crop reporting.
- Extension of the principle of nitrogen fixation to new groups of plants in addition to legumes, thus cutting down the need for commercial fertilizer.
- The desalination of sea water, permitting human habitation and agricultural production in lands now desolate.
- Solution of the fuel problem, probably by the use of nuclear energy.
- Greater environmental control for both plants and animals, providing more

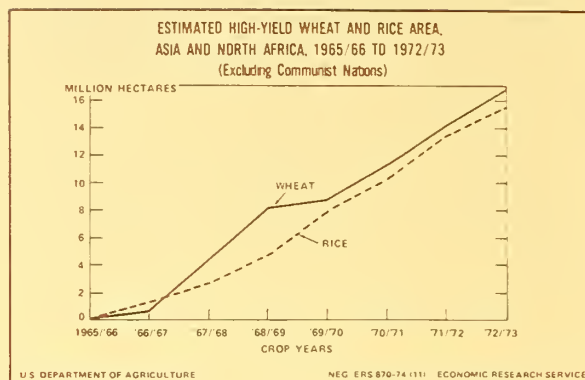


chart 13

economical production and high, more standardized quality.

--Advances in food technology, particularly the modification of plant protein to provide meat analogues to the many millions who cannot afford palatable and nutritious meat, milk, and eggs.

--The use of microbial action on various feedstocks (such as organic wastes or fossil fuels) for direct production of feed and food.

--Better systems of distribution to minimize the obverse problems of overeating and poverty-related malnutrition.

### Demand and Production in the Developing Countries

As we have indicated, resources are physically available to insure world food production. How great the economic pressure on these resources will be depends heavily on future growth in world food demand.

In our report, The World Food Situation and Prospects to 1985, we examined several possible demand levels under several alternative assumptions. Our projections focused on grain (wheat, coarse grains, and milled rice) since it is the single most important component of the world's food supply. We assumed world population growth to 1985 at the rate of 2.7 percent in the developing countries and 0.9 percent in the developed countries. Several different rates of income growth were assumed.

Under these alternatives, the developing countries would continue to face larger net deficits in cereals. Output would fail to keep up with the demand generated by both rising incomes and rapid population growth. If the world economy were to resume the trend pace of growth before the current slowdown, alternative I, the net import deficit in the developing countries could reach 48 million tons of cereals (chart 14). Under alternative III, the deficit would be reduced only slightly at slower rates of economic growth, but would increase to 68 million tons under alternative II if economic growth rates accelerate and stimulate nascent demand for grain-fed livestock products. In comparison, the developing nations' net imports of grain averaged 21 million tons from 1969/70 to 1971/72 and 30 million tons from 1972/73 to 1974/75.

At current grain export prices, it would cost over \$10 billion annually by 1985 to finance the high 68-million-ton deficit. I doubt that the developing countries could finance that level of imports from increased export earnings alone.

Two crucial points emerge from these projections:

(1) If the developing countries merely maintain the growth rates in food production of the 1960's and early 1970's (approximately 2.6 percent), they face the prospect of sharply increased food imports.

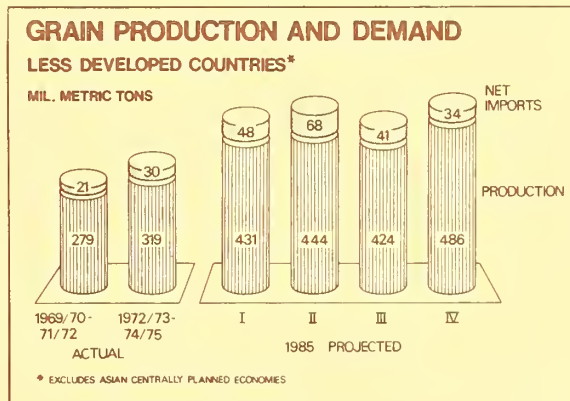


chart 14

(2) Although the developed countries might have the production capacity to meet those deficits, it is doubtful that the poorer nations could allocate sufficient foreign exchange to finance all their import needs on purely commercial trade terms. And they surely couldn't without impairing overall economic development, thus increasing their food problems in the longer run.

The alternatives are: (1) to meet such import deficits with large-scale food aid programs by the developed countries; or (2) to reduce deficits by getting the developing nations themselves to increase their food production. In our judgment, the latter is clearly the preferred course of action.

In terms of productive capacity, the developed countries, and particularly the United States, would be able to meet the maximum projected deficits of the less developed countries as well as their own domestic requirements. U.S. capacity, shown here for wheat, feed grains, and soybeans, is far greater than our potential utilization through 1985 (charts 15,16,17).

However, the potential benefit of increasing the productivity of the developing nations can be measured by our fourth alternative projection. In it, we estimated the effect in the developing countries of increasing fertilizer use by 1-1/2 to 2 percent over the 1960-72 annual growth in combination with similar increases in an associated bundle of other inputs such as irrigation, pesticides, and hybrid seed. Under this alternative, the grain deficit of the developing market countries in 1985 might be only slightly higher than the import levels of the last few years.

Solving the world food problem in this manner would be costly, and the costs would be too heavy for the developing countries to bear alone. Still, the cost would be much less than financing the closure of the gap each year with increasing grain imports.

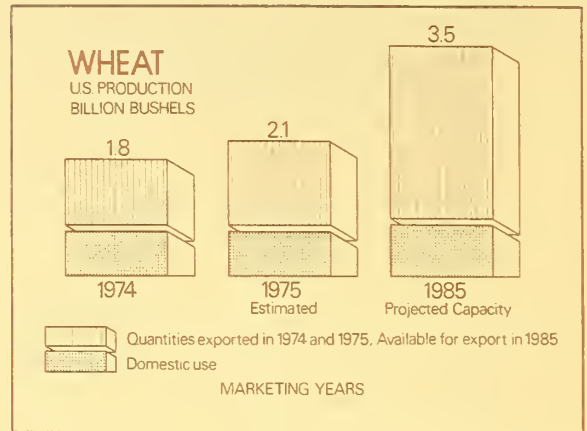


chart 15

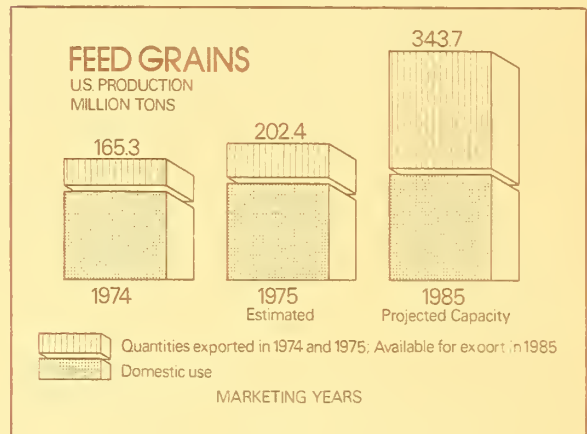


chart 16

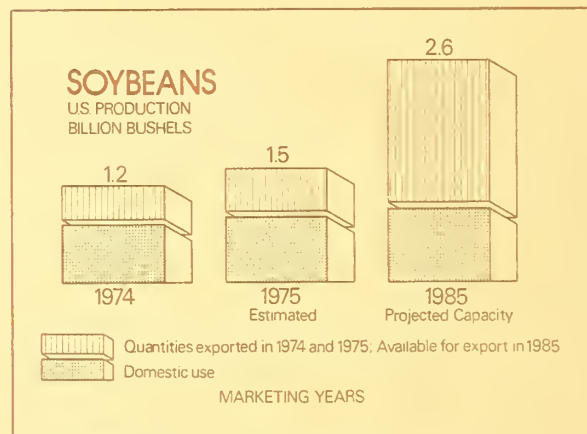


chart 17

## Some Policy Issues and Options

It is apparent that the developed nations will need to provide assistance --capital, managerial, technological--if the developing countries' food deficit is to be lowered by increased indigenous output. But the developing nations must first commit themselves to the complementary goals of increasing output and limiting population growth. A beginning should be made by reassessing their food and agricultural policies.

However, for the developed countries, there are also myriad policy issues associated with efforts to improve the world food situation. They include questions about price instability in domestic markets, about grain reserves necessary to provide famine relief and to stabilize foreign and domestic markets, about food aid to the vulnerable and malnourished, and particularly about the promotion of agricultural production in the developing countries.

Price Instability: During the decades when we were maintaining large grain stockpiles, the United States was able to moderate price swings, nationally and internationally. Availability of U.S. stocks dampened price changes in the international market while discouraging increases in domestic prices. But the days of our large stockpiles--and their protective price cushion--are gone. U.S. farm prices now are directly influenced by international markets, and vice versa. And as the domestic U.S. market and the international market have moved together, U.S. farm prices have become more unstable. This instability will increase as weather conditions around the world change from year to year, producing changes in import needs and export supplies.

Trade Control: This price instability may force several different types of adjustments on our agricultural sector. For example, various export control devices could be used to try to stabilize domestic U.S. prices. The state-trading nations and some other developed countries have controlled trade and insulated their domestic price structures from international price changes.

U.S. export embargoes--such as those for soybeans a few years ago and those for grain to the Soviet Union last summer--have produced a sufficiently loud outcry, at least from farmers, that any effort to spell out a U.S. control program may be doomed in today's environment. The encouragement given to farmers to plant "all-out" presupposes no marketing restrictions.

The United States does perform some screening of part of our exports--shipments of food under Public Law 480. If such an approach were expanded to commercial sales, the review process in the U.S. Government could be focused primarily on supply availability. Commercial exports are already being monitored through an export reporting program.

Food Reserves: Adjustment to year-to-year fluctuations around the world may also take the form of establishing food reserve stocks nationally, by importers or exporters or both, or conceivably on an international basis. The

mechanics and policy framework for acquiring and managing these stocks are not easily established, due to the multiple and sometimes conflicting objectives of a stocks program. Such programs can operate in a host of ways: they can stabilize prices or--by withdrawing supplies from the market--actually increase prices; they can be used to stimulate production, or as a set-aside to meet acute shortages (which, however, reduces their usefulness in stabilizing prices); and they may or may not be earmarked for lower income countries.

There are other questions, such as where should stocks be held and by whom. Stocks need to be held throughout the world to avoid overdependence on a small number of countries in times of shortage. U.S. stocks alone are not an adequate answer. Moreover, significant buildups of U.S. stocks would surely operate, as in the past, to depress farm prices in the United States while lulling others into believing that they need not build their own reserves.

An especially crucial question for the United States is: Should we depend on private trade or government to carry stocks? Private traders will limit the stocks they carry if large stocks are carried by the U.S. Government. How much they will accumulate and carry otherwise is not known. Farmers and traders already are carrying more stocks. Wheat stocks in private hands are now about 3-1/2 million metric tons larger than ever before (chart 18).

The high costs of stocks also argue that not just major exporters should be involved in a food reserve scheme. Food stocks are expensive to purchase and they are costly to store. Rough estimates of monthly costs of storing grain stocks in the United States are 60 cents per ton, exclusive of the interest costs of money invested in the commodities or any allowance for physical deterioration or losses. If interest costs are added at 8 percent on an assumed value of 75 percent of the current U.S. market prices for grain, the annual carrying cost of 1 ton of wheat would be \$16, or for 1 ton of corn, \$14. The current market values are about \$140 and \$105 per ton, respectively.

Estimates of the amount of stocks "needed" vary. One way to estimate the need is to consider the fluctuation of production in past years. Based on 1960-73 world production changes, 25 to 40 million tons of grain would be required to meet two-thirds of the annual shortfalls.

For the United States, there are important trade-offs. As long as the U.S. balance of payments is in doubt, the benefit from high export sales of agricultural products is bound to weigh heavily. On the other hand, the long term growth in exports might be greater if foreign customers were assured of

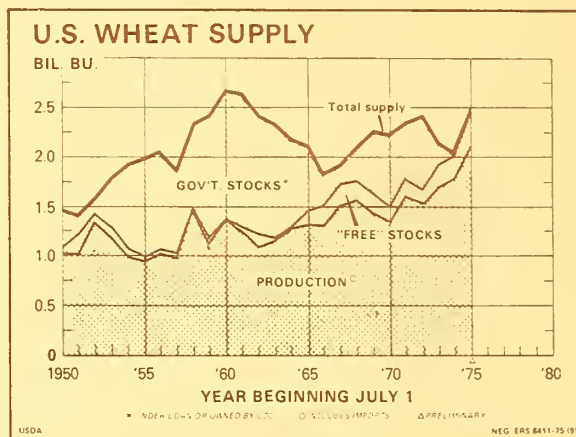


chart 18

relatively stable supplies from year to year at relatively stable prices.

On the domestic front, unstable food prices concern consumers and labor unions. Farm interests, too, may become frustrated with effects of instability. Major groups of U.S. farmers have benefited from high prices; for others, benefits have been more limited or none at all. Some have even been hurt--as were U.S. livestock producers faced with recent hikes in grain prices.

### U.S. Food Aid Programs

The nature and magnitude of the world's food needs raise a number of questions about our food aid programs: most importantly, the extent of our commitment to an ongoing program now that our surpluses are gone; the wider sharing of food aid efforts; and the final objectives of food aid.

U.S. food aid programs--specifically P.L. 480--depended heavily on surpluses, especially of grains, which built up during the late 1950's and the 1960's (chart 19). For many years, P.L. 480 was consistent with our commercial objectives of expanding our agricultural exports. It permitted us to charge lower prices to poor countries without undercutting our prices to others. Through adjusting terms--use of the local currency, credit, and commercial sales--effective prices were tailored to the customer's financial and security status. Thus, our overseas food aid programs played a part in boosting agricultural exports.

However, with strong demand, negligible stocks, and high prices, it is not now advantageous to move as much food under P.L. 480. Therefore, political support for food aid has waned somewhat, although new Congressional efforts are underway to revitalize the program. But considering the growing import bill for our petroleum supplies and the potential of farm exports to ease the burden, U.S. concessional sales and food aid grant programs will probably not reach the volumes of the mid-1960's (chart 20).

On a value basis, the proposed 1977 U.S. budget would authorize nearly \$1.3 billion for commodities and transportation under P.L. 480 programs, slightly

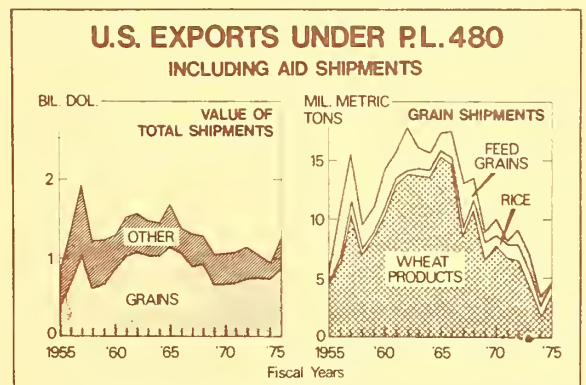


chart 19

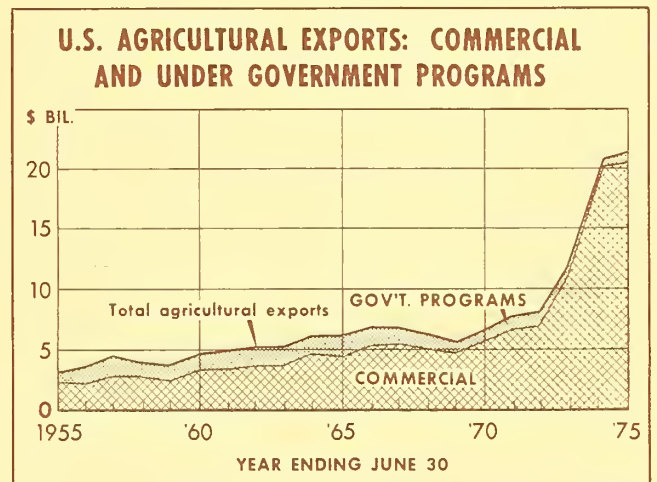


chart 20



more than last year. The dollar increase comes at a time when we are planning a cut of more than \$1 billion in our domestic food aid programs. I think this increase clearly demonstrates that the United States has a strong commitment to bridging the food gap in the developing world. But as the events of 1972-74 clearly demonstrated, we cannot always be the main residual supplier of the world's food needs. There must be a wider sharing of food aid efforts.

Which leads us to the question: What are, or should be, the objectives of food aid?

The Role of Food Aid in Developmental Assistance: There is broad consensus among the developed countries that food aid should be made available in the event of natural disasters or other emergencies. Also, it is widely agreed that special assistance may be required in the short run by developing countries hard hit by rising food and oil prices. But there is less agreement on the use of food aid on a medium or long-term basis for development assistance. In the absence of surpluses, food aid should be considered as an alternative to other forms of aid. Thus, it should be evaluated in terms of its contribution to development efforts in relation to other forms of aid. The disincentive effect that long-term food aid might have on agricultural production in the recipient country must be considered.

We're at the point where the world will need to evaluate trade-offs between food aid and other economic assistance. Most developed countries and international assistance agencies have limited but still significant resources for assisting lower income countries. However, they have never had to closely evaluate trade-offs until recently because the United States, with its large surpluses, was willing to finance and implement a program of world food assistance as a major adjunct to U.S. agricultural programs. Thus, except for the relatively small World Food Program, resources for international assistance could be used for items other than food.

It is time for international agencies such as the World Bank to ask: Should not food aid be made an integral part of economic assistance programs? Food assistance can be a form of investment. As with P.L. 480, proceeds from the sale of food provided on a concessional basis can be used for investment in irrigation facilities, locally made machines, and production facilities, much as hard currency loans can be used to permit the purchase of foreign-made machines. Used in this way, such aid can have material employment and productivity effects. These choices have not been faced simply because through P.L. 480, food was "priced" low, and the money, once appropriated for food aid, could not be switched to other assistance activities. Now the higher prices will require more difficult and complex choices.

### Productivity in the Developing World

The developing countries--with help from the developed countries--must increase their own agricultural productivity if growth in per capita food consumption is to be maintained or accelerated. The supply of land and

agricultural inputs need not be a critical impediment to future increases in food production. Most future growth in food production is expected to come from higher yields and other improvements in technology. The adoption of agricultural policies by the developing countries which give adequate incentives to their producers is of prime importance.

The developed countries can make a critical contribution to the development, transfer, and adaptation of both new and existing technologies to the developing countries. Greater investment flows into agriculture--both within the developing countries and from the developed countries--will be needed.

The U.S. agricultural community--with its vast technical know-how--will undoubtedly play a crucial role in the transfer of this know-how to the developing world. Our universities, the Department of Agriculture, and private industry have already contributed to the productivity of world agriculture. The widely acclaimed international research centers have been staffed almost exclusively by U.S. trained personnel. Further, the U.S. agricultural community has generated much of the basic knowledge on which these centers and other research organizations rely.

Because of our size and expertise, I expect there will be a continuing heavy demand on the U.S. agricultural and scientific community to participate in technical cooperation programs. To assist in this knowledge transfer, Title XII of the 1975 International Development and Food Assistance Act (which became effective in December 1975) will provide funding to encourage land grant colleges and other universities to become more involved in increasing agricultural production in developing countries, in "institution building" to develop national and regional agricultural research capacity, in work with the international research centers, and in contract research and research program grants. The program seems to be getting off to a good start with a number of colleges already expressing interest.

### Conclusions and Implications

Several conclusions may be drawn from the foregoing discussion.

--At current population and food production growth rates, the developing countries of the world as a whole face growing food import deficits in the remainder of this century. Even within the 10 years to 1985, those countries must expect grain deficits possibly double their current (1975/76) net import level of 31 million tons if present trends continue unchanged.

--The reduction of potential food import deficits in the developing countries must come through some combination of major increases in the rate of growth in their food production and reduced rates of population growth. A failure to adopt such a strategy means increased dependence upon food aid from developed countries or reduced levels of per capita consumption.

--There is, in fact, a large potential for increased food production in both

the developing and developed nations during the next quarter century, from cultivation of additional acreage, but primarily from application of existing and potentially new production technologies. To exploit these potentials requires, first and foremost, a commitment from the developing nations to step up agricultural productivity and to reassess food, agricultural, and economic policies to offer greater incentives for indigenous investment and production.

--Even with commitment of the developing countries to increased agricultural productivity and output, they will require massive assistance from the developed nations, including the private sector. The FAO estimates that agricultural investment in the developing countries will need to be increased from the current level of \$8-\$10 billion annually to about \$16-\$18 billion, of which perhaps one-third will have to come from outside.

--Technical assistance and training, the transfer and adaptation of technology, and the development of new technology designed for the particular conditions of developing nations are but a few examples of where the private sector in developed countries can make substantial contributions toward expanding food production.

--In closing, let me quote from the World Food Conference of 1974:

Every man, woman, and child has the inalienable right to be free from hunger and malnutrition in order to develop fully and maintain their physical and mental facilities. Society today already possesses sufficient resources, organizational ability, and technology and hence the competence to achieve this objective. Accordingly, the eradication of hunger is a common objective of all the countries of the international community, especially of the developed countries and others in a position to help.

The achievement of this goal will require the harnessing and coordination of massive human energy and talent. It will not be easy, but substantial progress can be made in the next quarter-century.

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