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# Minnesota AGRICULTURAL ECONOMIST



## Another Look at the World Food Problem

John H. Sanders and Vernon W. Ruttan

From mid-1965 until mid-1967, U.S. agricultural policy discussion was dominated by the specter of world food shortage. The conclusion frequently was drawn that American agriculture was entering a new "golden age" in which the world would demand all that American agriculture was capable of producing and at higher prices.

The pendulum of public opinion has now swung to the opposite extreme. There have been frequent dramatic reports of a "green revolution" and of the development and rapid adoption of "miracle" rice and wheat varieties by peasant farmers in the underdeveloped, grain deficient countries. In the United States, stocks of wheat, feed grains, and soybeans have risen above the levels achieved in mid-1967.

The outlook for commercial and non-commercial exports of American agricultural commodities depends upon a correct assessment of agricultural production trends and potentials in the rest of the world. These trends will strongly condition the agricultural policy proposals that will be considered by the new administration and debated in Congress.

This article considers the population-food problem from an historical perspective and evaluates the results of four studies of future food demand and supply in the developing countries. Then the implications for American agriculture of several different rates of agricultural output growth in the developing countries are considered.

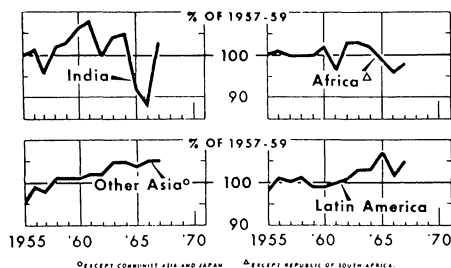
### THE HISTORICAL PERSPECTIVE

The tendency to view the prospects for meeting world food needs with alarm is not new. In 1798, Thomas Malthus stated that population grows at a geometric rate, while food output increases

only arithmetically. So food shortages are inevitable. He further argued that disease, famine, or wars are necessary periodically to reduce the excess population. This ominous prediction was not accurate for the present developed countries due to increased agricultural production and reduced birth rates. In the mid-sixties, however, Malthus' concept was revived and applied to the developing countries, especially those with high population densities, high birth rates, and apparently stagnant agricultural sectors. India is one such country. Since 1798, India has had nine major famines and millions of its people have died of starvation and associated diseases. From 1876 to 1878, 5 million died in Bombay, Madras, and Mysore, and in 1943, approximately 1,500,000 died in Bengal.

For the developing countries as a group from 1935-39 to 1959, population increased at a faster rate than cereal production, resulting in a per capita cereal production decline. Since the mid-1950's, per capita food production in most of the developing world has risen (see the figure). Some countries, such as India, have experienced wide fluctuations in annual food production. Other regions, such as tropical Africa, have experienced a decline in per capita food production.

Even though per capita food produc-



Food production per person in less developed areas.

Source: Economic Research Service, USDA

tion generally did increase in the developing countries from 1955 to 1967, the demand for food increased even faster than supply due to economic growth and the high proportion of increased incomes spent on food in those countries. Thus, in the early 1960's, many of the developing countries, especially those in Asia, were faced with the dual problems of inadequate nutritional levels in the low income sectors of their populations and rising food imports that either drained their foreign exchanges or made them dependent upon food aid.

### THE FUTURE

This chronic problem of food demand increasing faster than food supply in the developing countries became acute with the virtual depletion of the world grain surplus in the 1966-67 crop year, due primarily to the Indian drought from 1965 to 1967. At that point, both developed and developing countries began to reevaluate their agricultural and trade policies. To facilitate this reevaluation, four studies of the future world food supply were made by various international and national agencies and published in 1967.

The agency projections of the future relationship between population and food production growth in the developing countries are summarized in table 1.

Table 1. Agency projections of population, food production growth, and food demand growth in the developing countries, 1965-80\*

Agency	Rate of population growth	Rate of food production growth	Rate of food demand growth
FAO . . .	2.5	3.2	3.2
OECD . .	2.6	2.9	3.3
USDA . .	2.6	2.9	3.2
PSAC . .	2.6	3.8	4.3

\* These projections generally were given as ranges. The midpoints of the ranges were used in this table.

Sources: *Agricultural Commodities — Projections for 1975 and 1985*, Food and Agriculture Organization of the United Nations (FAO), Vol. I, Rome, Italy, 1967, pp. 7, 10, 48.

Thorik Kristensen, *The Food Problem of Developing Countries*, Organization for Economic Cooperation and Development (OECD), Paris, France, Dec. 1967, p. 23.

Martin E. Abel and Anthony S. Rojko, *World Food Situation: Prospects for World Grain Production, Consumption, and Trade*, Agr. Econ. Rept. 35, U.S. Department of Agriculture (USDA), Sept. 1967, pp. 9, 12, 20, 29.

The growth rate for food production from 1965 to 1980 was calculated from the base year totals and the projected totals.

*The World Food Problem*, A Report of the President's Science Advisory Committee (PSAC), Vol. II, The White House, May 1967, pp. 649, 655, 657.

These projections were estimated from past trends and evaluation of the future impact of present policies.

The four studies anticipate slightly higher population growth rates compared to the 2.4 percent annual rate in the developing countries from 1955 to 1965. From 1953 to 1965, food production increased at a rate of 2.85 percent in the developing countries. The OECD and the USDA studies project a continuation of historic food production growth rates, whereas the FAO and PSAC reports anticipate that food production growth will exceed present trends.

In all four studies, future food production growth exceeded population growth, even though population was expected to continue increasing at a high rate. However, food supply also must be compared with food demand to ascertain the ability of the developing countries to satisfy their own growing domestic consumption aspirations. Food demand in a country depends primarily upon the size of its population, the purchasing power of its inhabitants, and their preferences for food purchases rather than other purchases. The growth rate of the demand for food then is the sum of population growth plus income growth adjusted by the proportion of increased income that is spent on food.

*In algebraic terms, the population-income growth determination of demand can be specified as  $C = P + \partial N$  where:*

*C is the rate of growth of demand for food.*

*P is the rate of population growth.*

*$\partial$  is the income elasticity for food or the percentage increase in food expenditures with a 1 percent increase in per capita income.*

*N is per capita income growth.*

*For example, with a 2.6 percent population growth, a 0.5 income elasticity for food, and a 2.4 percent annual growth in per capita income, a 3.8 percent growth in demand for food would result.*

Since food production increased 2.85 percent annually from 1953 to 1965, all four demand projections would result in an increasing food deficit unless food production increases more rapidly than in the recent past. Three of the four studies anticipated that food demand would increase at around 3.2-3.3 percent annually. The PSAC report focused its attention on closing present nutritional deficits and producing the maximum food output that is technologically feasible. Consequently, it is not surprising that its demand projection was higher than that of the other studies.

The projections of the four studies are very similar for some growth rates. These consensus growth rates are indicated in table 2.

**Table 2. Probable growth rates in the developing countries, 1968-80**

	percent
Population growth .....	2.6
Percentage of income spent for food with 1 percent income growth ...	0.5
Per capita income growth .....	2.4
Food demand growth .....	3.8

The four studies generally agreed on the approximate levels of population growth and the percentage of increased per capita income spent on food. In our projections, a conservative estimate of income growth, 2.4 percent, is used. This estimate is below the average projected income growth rate of the four reports, but represents a 20 percent increase from the 2 percent rate of income growth from 1955 to 1965 in the developing countries. It is not unreasonable to believe that the developing countries can increase their income growth rates: Concern with economic development in these countries continues, and a reservoir of technological change is potentially available to them in many industries. The low level of the base from which growth is to take place and the success of certain developing countries such as Mexico and Taiwan also indicate the possibility of an increase in the rate of income growth in developing countries.

The probable growth rate of food demand, 3.8 percent, results from accepting the other three values, since food demand growth equals population growth plus the growth in food consumption resulting from higher incomes (see the italicized explanation at left). This figure represents a high level of food demand growth. If food production and imports increase rapidly enough to satisfy this rate of demand growth, most of the present nutritional inadequacies in the developing countries could be eradicated in 20 years.

#### AGRICULTURAL PRODUCTION GROWTH IN THE DEVELOPING COUNTRIES

Given the 3.8 percent rate of food demand growth, what are the implications of various agricultural production growth rates in the developing countries? If historic trends continue, agricultural output will continue to increase at a 2.85 percent annual rate in the developing countries. The higher and more probable agricultural production growth rate, 3.5 percent, assumes an increasing commitment to agricultural development, particularly to technical change in agriculture through changes in the economic policies of these countries. Advances in seed breeding and the development of cost reducing technology in the production of agricultural chemicals, especially nitrogen fertilizer,

make possible significant agricultural output growth through yield increases. This process of increased agricultural output growth already has occurred with dramatic results in some developing countries and is expected to be increasingly obvious in even those countries with high population densities and chronic food production shortages. For example, Mexico increased its agricultural output by over 7 percent per year from 1952 to 1959 and Pakistan obtained similar results in the sixties.

The technologically feasible agricultural production level of 4 percent assumes two things. First, it assumes that developing countries begin to rapidly develop, adapt, and exploit agricultural technology, including new varieties and agricultural chemicals. From 1964-65 to 1967-68, the estimated acreage in high yielding, fertilizer responsive varieties in 10 selected Asian countries increased from 200 to 20 million acres.<sup>1</sup>

The second prerequisite is substantial public and private investment in the agribusiness network as well as in the public services supporting agriculture. Whereas there already is evidence that technological change is now taking place, there is little evidence that sufficient private and public investment in agriculture for a sustained growth of 4 percent is as yet occurring in many developing countries.

Table 3 indicates the levels of food demand and supply in 1980 using all three production growth rates. The base year is 1968 and the probable growth rates from table 2 are used.

Obviously, if food production expands at the historic rate, food demand will exceed output in 1980. When food demand is greater than food supply, prices increase. If farmers in the developing countries cannot increase output in response to these increased prices and food is not imported, food shortages result in inflationary pressures. In this case, food imports can close the food deficit and help prevent inflation. In the second case

<sup>1</sup>D. G. Dalrymple, *Estimated Acreage in High-Yielding Varieties of Grains in Ten Asian Nations*, International Agricultural Development Service, U.S. Department of Agriculture, Nov. 1968.

**Table 3. Estimated levels of population, income, food demand, and food output in the developing countries, 1980 (1968 = 100)**

Population .....	136
Per capita income .....	133
Food demand .....	157
Historic food production .....	140
Probable food production .....	151
Technologically feasible food production .....	160

(with the probable food production growth rate of 3.5 percent), the food demand level again exceeds the food supply level, so again there would be rising food prices. But there would be less upward pressure on food prices and less excess demand for food than if the historic trend of food production continues.

In both cases, food imports would have to be closely regulated to minimize the downward price pressure on agricultural products, since substantial agricultural price declines in recipient countries probably would reduce farmers' incentives to produce and would stifle agricultural development. If production expands at the technologically feasible rate of 4 percent per year, growth of food output will slightly exceed growth of food demand. This situation would lead to falling food prices in the developing country unless the government supported food prices and stored the surplus for emergency use or unless exports of food products increased. Modest declines in food prices would have a favorable effect on development in some countries for two reasons. First, lower prices make food more available to low income consumers through the marketplace. Secondly, lower cereal prices could increase the utilization of feed grains, thus facilitating the development of livestock industries. Sharp declines in grain prices in any large developing country could have the undesirable effect of contributing to the disruption of international commodity trading patterns.

If agricultural output continues to increase at the historic growth rate of 2.85 percent, the developing countries will require substantial food imports. Many of these imports could be on commercial terms, since economic growth is expected to contribute to rising purchasing power in many developing countries. If, as expected, the rate of agricultural output growth increases to approximately 3.5 percent, food imports still will be needed by some developing countries. However, the demand for U.S. grain exports would grow at a much slower rate than it has in the sixties. Finally, if the developing countries attain the technologically feasible 4 percent annual growth in agricultural output, shifts in price policy and international trading patterns would be expected.

From a 1969 perspective, the advances in agricultural technology make a continuation of past trends in agricultural production unlikely. However, a 4 percent rate of increase in agricultural production, though technologically possible, is dependent upon substantial investment in agriculturally related factories and public services in the developing coun-

tries. And this type of commitment to agriculture appears unlikely in those countries. Consequently, an agricultural production growth rate around 3.5 percent appears to represent a reasonable projection of the growth rate of agricultural output for the developing countries.

### FOOD PRICES: WELFARE VS. INCENTIVE OBJECTIVES

For many developing countries, a fundamental aspect of the food problem is finding a method of channeling an increased food supply to the low income sector of the population. With economic growth, this sector spends most of its increased income on food. If cheap food prices are maintained to make adequate diets more accessible, then the farmer in the developing countries has little incentive to increase production. Farmers may have more incentive with higher food prices, but how does the low income sector pay for the food?

Another income distribution problem lies within the agricultural sector itself. Usually the largest producers are able to obtain most of the benefits from technological change through their greater access to information and credit and their ability to produce in quantity. If small farmers can leave agriculture through the rapid development of the nonfarm sector, such as has occurred in the United States, this may not cause acute social problems. However, in many developing countries the nonfarm sector is not developing rapidly and income distribution already is a social problem. In these countries, an acceleration of income redistribution to the large landholders could precipitate substantial rural unrest or even revolutionary movements. Development planners may need to take special measures to avoid duplicating the U.S. experience of transferring income to large producers through a farm policy geared to accelerate technological change in agriculture.

### CONCLUSIONS

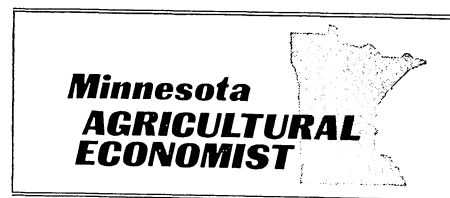
Projections of the ability of the world to feed itself over the next several decades have become more optimistic. Developing countries are expected to emphasize agricultural development, placing increased investment into the production of technical inputs. The availability of these inputs, especially improved seeds and chemical fertilizer, to developing countries makes more rapid rates of agricultural output growth probable. Some developing countries may increase their commercial imports of American food

products, as Japan has done during the last decade, if American commodities remain competitive in international trade. However, a gradually increasing commercial trade in American food products represents a much less optimistic outlook than the recent projections that have been based on an assumed obligation to meet ever rising food deficits in the developing countries.

However, just as the Indian drought helped precipitate excessive pessimism about the world food supply from 1965 to 1967, new varieties of wheat, rice, corn, millet, and sorghum combined with favorable weather in many of the key developing countries in 1968 could stimulate excessive optimism in 1968-69. Even with the availability of new agricultural technology, changing the production patterns or finding alternative employment for millions of subsistence farmers in the developing countries will not be easy. Bad weather and bottlenecks in the production of inputs for agriculture will continue to create regional crises in food production. Consequently, during the period 1968-80, some of the developing countries will continue to require food aid. However, it is increasingly clear that rapid agricultural development is possible in these countries, even in those with high population densities and presently large nutritional deficits.

Hence, during the seventies, American agriculture will have to develop policies that will facilitate internal adjustment to deal with surplus capacity rather than depending upon increasing foreign demand from developing countries to absorb ever larger quantities of surplus commodities.

For further discussion of the impact of world agricultural development upon American agricultural policy for wheat, feed grains, and soybeans, see V. W. Ruttan and J. H. Sanders, *Surplus Capacity in American Agriculture*, Special Report 28, Agricultural Extension Service, University of Minnesota, 1968. ■



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# IN PERSPECTIVE



## Agricultural Trade and the Minnesota Farmer

Arley D. Waldo

Farmers have an important stake in foreign markets for agricultural products. The United States is the world's leading exporter of farm commodities, accounting for nearly one-fifth of total world agricultural exports. Currently, around \$1 out of every \$6 that U.S. farmers receive from farm marketings comes from an overseas customer.

Largely because of price declines, the total value of U.S. agricultural exports dipped to \$6.3 billion in the year ending June 30, 1968. This was a drop of 7 percent from the previous year, when farm exports reached a record level of nearly \$6.8 billion. However, U.S. farm exports have risen sharply since the fifties. Total annual farm exports, which averaged \$3.2 billion in 1950-54 and \$4 billion in 1955-59, climbed to \$5.3 billion in 1960-64 and to \$6.5 billion in 1965-67. In recent years, farmers in Minnesota and the other 11 North Central states have produced close to half of these exports.

Midwest producers of wheat, soybeans, and feed grains have a particularly large stake in foreign trade. These three commodities account for more than half of all U.S. agricultural exports, and each is an important cash crop in the Midwest and in Minnesota. In 1967, farmers in the North Central region produced about 55 percent of the wheat, 75 percent of the soybeans, and 80 percent of the feed grains that were exported to other countries.

Minnesota now ranks 10th among the 50 states in the dollar value of the export commodities produced by its farm industry. Minnesota's share of total U.S. farm exports amounted to about \$226.3 million for the year ending June 30, 1968. This figure was down from \$240.5 million in the previous year, reflecting the decline in total U.S. farm exports. However, the cash receipts of Minnesota farmers from agricultural exports still were substantially above the amounts received in earlier years, and Minnesota's share of total farm exports has been growing.

Estimates of the value of agricultural commodities produced for export by Minnesota farmers are shown in the table. Three major commodity groups — soybeans, feed grains, and wheat — account for a little over two-thirds of Minnesota's share of total U.S. agricultural exports. Soybeans, including soybean oil and meal, account for one-third of all Minnesota farm exports. The largest share of these exports, \$53.3 million worth, was unprocessed soybeans.

Of the \$6.3 billion in U.S. agricultural exports last year, \$4.7 billion were commercial sales for dollars. Shipments under government food aid programs amounted to \$1.6 billion. Among the major export commodities produced in Minnesota, only wheat and dairy products are heavily dependent upon government programs. More than three-fourths of Minnesota's farm exports are commercial sales for dollars. Thus, Minnesota farmers have a direct interest in the success of public and private efforts to gain and maintain access to commercial foreign markets for agricultural commodities.

The importance of foreign trade to farmers who market cash crops is obvious. But other Minnesota farmers also have an interest in protecting overseas sales. For example, suppose that several of the countries that are major importers

### Value of export shares of agricultural commodities produced in Minnesota for the year ending June 30, 1968

Commodity	Value	
	Amount (million dollars)	Percentage distribution
Soybeans and soybean products	75.9	33.5
Feed grains	49.9	22.1
Wheat and wheat flour	31.5	13.9
Meat and livestock products	21.7	9.6
Dairy products	19.6	8.7
Flaxseed	3.0	1.3
Vegetables and preparations	3.0	1.3
Poultry products	1.5	.7
Other	20.2	8.9
Total	226.3	100.0

Source: Dewain H. Rahe and Isaac E. Lemon, "U.S. Agricultural Export Shares by Region and State, Fiscal Year 1968," *Foreign Agricultural Trade of the United States*, USDA, Nov. 1968, pp. 7-19.

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of feed grains produced in the United States were to erect new trade barriers that reduced our exports of feed grains. This action would tend not only to reduce the market prices received by Minnesota feed grain producers but also to reduce the prices received by livestock producers as lower feed prices acted as an incentive to expand livestock production. Furthermore, firms supplying farm inputs and those engaged in the marketing, handling, and storage of farm products also would be affected by any reduction in U.S. agricultural trade.

Most U.S. farmers and businessmen would agree that we should work toward the elimination of trade restrictions that limit our access to foreign markets. But, if we want to increase sales abroad, we must be willing to allow foreign producers equally free access to U.S. markets.

For more than 30 years, the United States has been a world leader in working toward reductions in tariffs, import quotas, and other barriers to world trade. We have benefited significantly from a relaxation of trade barriers, but American sentiment favoring freer world trade has not been universal. And new demands now are being made for government action to restrict the flow of foreign agricultural and industrial goods into the United States. A new mood of protectionism and isolationism has appeared on the policy scene. These attitudes were apparent as Congress debated and failed to approve the 1968 Trade Expansion Act.

Opposition to freer world trade is strong in certain segments of U.S. agriculture and industry where foreign imports are thought to threaten the economic well-being of American producers. Stemming from this belief, pressure for import restrictions is understandable. But if new or additional protection is granted, both agriculture and industry in the United States may find their foreign markets curtailed by retaliatory trade barriers imposed by other nations. Any reversal of our long-standing policy in support of freer world trade must be evaluated carefully in terms of probable international economic and political repercussions.