The Changing Nature of World Agriculture

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Rising agricultural productivity and changing diets are transforming commercial agriculture throughout the world. One of the major changes in farming is the growing emphasis on grain-fed livestock and the resulting increase in feed grain production.

This transformation, however, is sometimes masked or exaggerated by large swings in production and consumption due to weather. For example, world grain stocks as a percentage of consumption are at a 20-year low because use has exceeded production for 3 years. Is this a fundamental reversal in the rising per capita availability of grain over the past four decades? No, present conditions are no more indicative of long-term trends than 4 years ago when stocks were high.

Changing economic conditions can also cause fluctuations in production and consumption. For example, the worldwide economic recession of the early 1980's greatly slowed the growing international grain trade.

These swings, however, attract much attention and tend to color our perceptions of world agriculture.

Fluctuating Grain Supplies

Changes in supply and demand caused by short-term events, such as drought or economic cycles, sometimes lower and raise the world's stockpiles of food. Over the past 40 years, some agricultural experts and ordinary citizens have mistakenly used current circumstances as an indication of long-term conditions *(table 1)*.

At the end of World War II, food supplies in Europe and Asia were dangerously low. Because U.S. stocks were also down, there was concern about whether the United States could provide the grain needed to avert starvation. As agriculture in Europe and Asia recovered, the apprehension passed.

Through the 1950's and early 1960's, U.S. grain stocks were growing because Government price supports, in combination with higher productivity, allowed production to exceed demand. Grain surpluses and low farm income burdened American agriculture. The Federal Government responded by reducing surpluses through land-idling programs. At their peak in 1962, almost 65 million acres were taken out of production. The Government also cut stocks by shipping commodities overseas through Public Law (P.L.) 480, a food donation and economic development program for countries unable to afford commercial imports.

Following major droughts in India and the USSR in the mid-1960's, P.L. 480 and commercial exports to these countries reduced U.S. grain stocks. This caused concern about the ability of the United States to continue supplying food if the droughts persisted. With the return of normal weather, however, stocks recovered and pessimism eased.

In the late 1960's, hope about the prospects for developing nations to increase grain output rose as several nations, including India, greatly expanded wheat production with new varieties and heavy fertilizer use. The food supply grew

Table 1. Opinions on the World's Ability To Feed Its Evergrowing Population Have Differed Over Time

Time period	Public mood	Examples of events
Late 1940's and early 1950's	pessimism	Reduced production in Europe after World War II when U.S. stocks were low.
1950's and early 1960's	optimism	Large surpluses in the United States provided food security for other countries.
Mid-1960's	pessimism	Crop failures in the USSR (1963 and 1965) and India (1965 and 1966) reduced world stocks and raised doubts about long-term prospects.
Late 1960's	optimism	Normal weather returned to major producing areas. Improved wheat and rice production in some developing countries reduced concern that population in the Third World would outstrip production.
Early 1970's	pessimism	Large imports by the USSR after bad weather greatly reduced North American and world stocks.
Late 1970's and early 1980's	optimism	Output increased to supply the trade boom of the 1970's. When the world economy slowed in the 1980's, surpluses appeared.
Late 1980's	apparent pessimism	Idled cropland and drought reduced U.S. production and stocks. Drought also decreased output in Asia. These events have led to record low world stocks.

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faster than population, leading many to believe that food shortages were a thing of the past.

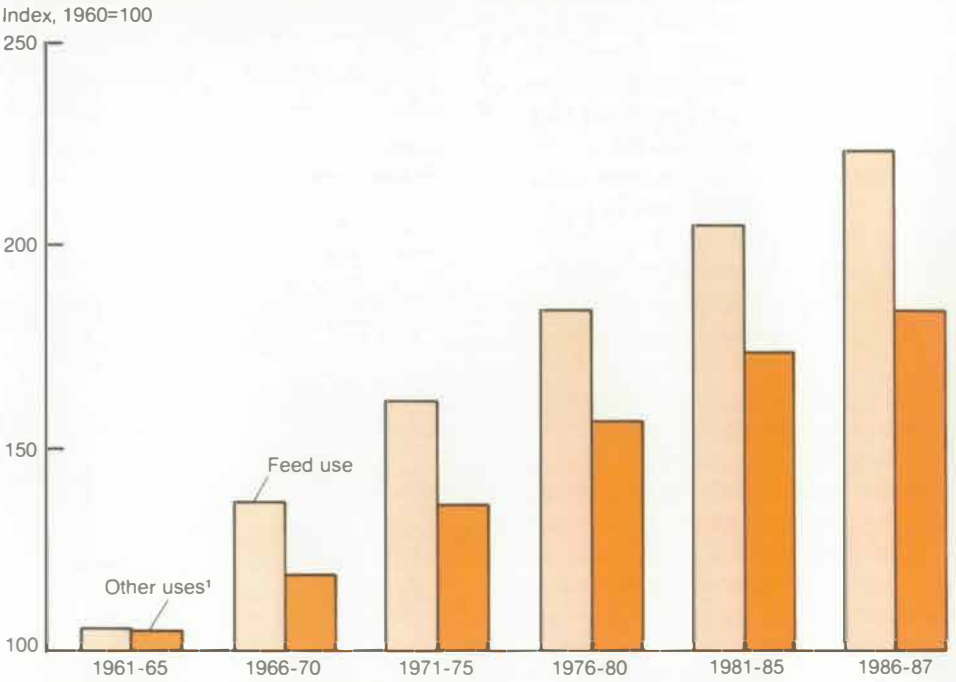
In 1972, world grain production dropped for the first time since World War II. North American stocks were quickly drawn down, and prices soared as the USSR bought large quantities of grain. Several developing nations had problems buying the higher priced grain. Poor people within these countries were seriously affected, especially since richer nations were cutting back on food aid donations during the same period. Then, in 1974, a drought in the United States reduced corn yields by 15 percent. There was a real threat of worldwide grain shortages.

In response, the United States ended land-idling programs, and farmers brought more than 60 million acres back into production within 2 years. By 1976, the period of high prices was over and world food output was up again. Grain demand in the more prosperous developing countries continued to grow, particularly among oil exporters, who benefited from rising petroleum prices. As a result, agricultural trade boomed in the mid- and late 1970's, and U.S. farmers gained a large share of the world grain market.

The worldwide recession of the early 1980's cut demand. As the value of the dollar rose and U.S. grain prices were held at high levels by Government support programs, U.S. grains lost their competitiveness in world markets. Because of these changes in demand and supply, U.S. production expanded and surpluses began to build. As stocks grew, the Government idled large areas of cropland, almost 70 million acres in 1987 and 1988.

In 1988, major droughts occurred in North America and Asia. The U.S. drought was the worst in 50 years. World production dropped below consumption, and grain stocks declined.

Figure 1. Feeding Grain to Livestock Has Grown More Than Other Uses Since 1960



¹Total use minus feed use, includes food and industrial uses.

Although consumption still exceeded production in 1989, the shortfall was less than the previous 2 years.

Weather and policy do have a transitory effect on carryover stocks. In particular, whenever a major drought occurs while governments are reducing stocks, they fall further than expected. Concern about feeding the world's growing population rises. But with the return of normal weather, stocks build and concern eases.

Technology and Income Transform Agriculture

During the last four decades, world grain output has been growing faster than population, 2.9 percent annually compared with 1.9 percent. Along with this rising availability, grain use has also changed. More and more grain is fed to livestock, not consumed directly by humans *(figure 1)*. As people's incomes rise, they demand a higher quality diet, often including animal products. The transition from food grain-based systems to those focused on feed grain production and raising livestock is a major long-term trend underlying world agriculture. This change is driving agricultural development and is an indicator of the world's ability to feed itself in the future, not short-term shifts in world grain stocks.

When incomes rise enough for people to be able to afford meat, the technology for raising poultry and swine under environmentally controlled conditions, often called confinement production, can readily be purchased and transferred to that country. People are usually willing to pay more for fresh meat than frozen, imported meat.

The spread of modern broiler production shows the transferability of confinement technology. Broiler production—raising chickens for their meat—is a rela-

tively new industry. Sixty years ago chickens were raised primarily for eggs, and meat was a byproduct. Chickens were often scavengers, consuming feed that would not otherwise have been used. Chicken meat was not plentiful and was expensive compared with pork and beef.

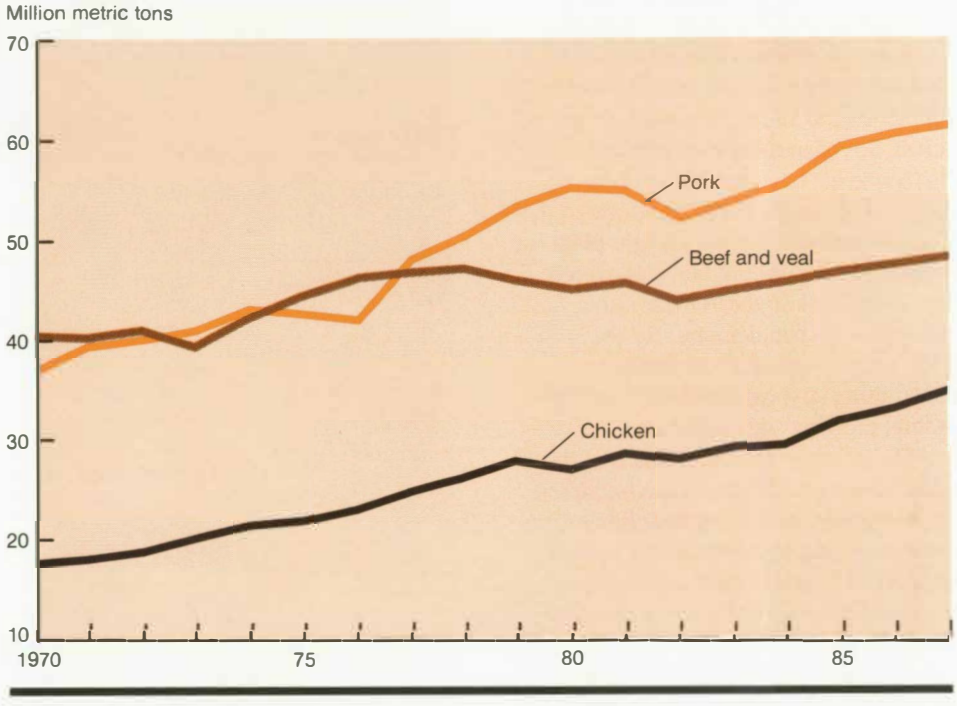
U.S. researchers and entrepreneurs transformed broiler production, greatly lowering the cost of poultry to consumers. Balanced, high-energy rations and hybrid birds improved the conversion of grain into meat. Drugs reduced disease losses, making confinement feasible. Company control of all production stages, from feed preparation to slaughter, further reduced costs. The price of chicken (adjusted for inflation) has declined by two-thirds from the mid-1950's, helping popularize poultry compared with beef and pork.

This new industry spread to Western Europe after World War II, then to Japan and other developed nations, and now to newly industrializing countries of the Third World, such as Taiwan, Brazil, and Mexico.

Confinement raising of swine has also been increasing. Crossbred pigs and better rations have improved feed conversion. As with broilers, medicines to control disease have made confinement possible. World pork production now surpasses beef, and chicken is gaining rapidly *(figure 2)*.

Raising livestock under confinement breaks traditional ties to land and climate. But while producers are no longer dependent on pastures, they now have to grow or purchase feed. In many countries, the demand for meat is so strong that the need for feed outstrips production and feed ingredients have to be imported. For example, as the broiler industry spread during the past 20 years, the international demand for feed rose and large import markets for feed grains and soybeans developed. Almost 40 percent of world grain production is now fed to livestock.

Figure 2. Growth in World Pork and Poultry Production Has Outpaced Growth in Beef Production During the Last 20 Years



Because of the need for livestock feed, a country's demand for grain can quickly reach 1,500 to 2,000 pounds per person per year. In contrast, a poor country—whose population exists on a subsistence grain diet—might require only 400 to 500 pounds per person because almost none goes to livestock.

The trade implications of this growing demand for feed vary. If a nation lacks cropland or suitable high-yielding crop varieties, feedstuffs are imported, a common practice. A few countries have abundant resources for growing crops. With the development of a grain-fed livestock industry, the locally produced livestock eat surplus grain and less feed is exported.

Improved Crop Production Provides Low-Cost Feed

The rapid increase in grain-fed livestock is due, in part, to low-cost feedstuffs. The development of feed grains, in turn, resulted from crop breeding advances and the use of inputs needed to raise yields, such as fertilizer and pesticides.

Over the last four decades, grain yields in developed countries have soared. On average, developed-country yields are now more than 170 percent higher than in developing nations. In the 1930's, before crop production became intensified, yields around the world were much the same.

In the United States, corn yields began to rise sharply in the 1930's. Hybrid varieties allowed yields to increase with fertilizer and pesticide use. By the 1950's,

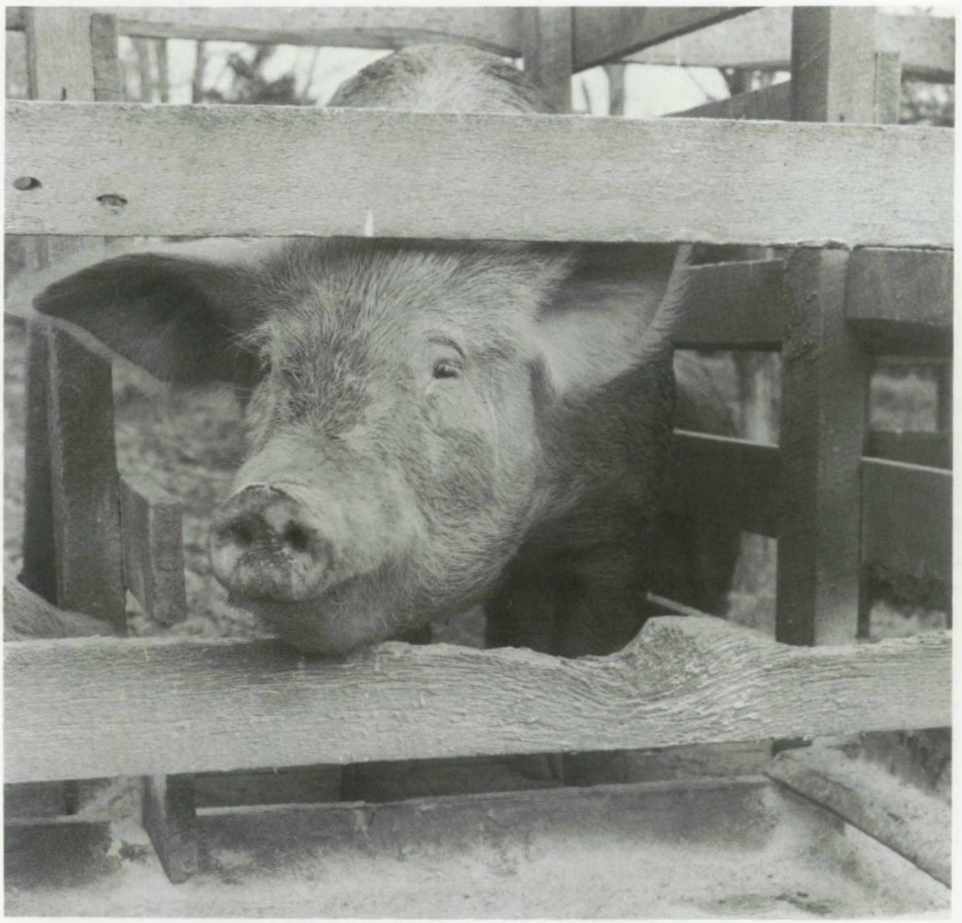
hybrid sorghum was available, and with higher input use, yields climbed. The rapid growth in corn and sorghum production provided abundant, low-cost feedstuffs.

However, to become well-balanced feed, corn and sorghum need a protein supplement to supply essential amino acids. Soybean meal now fills this role. But soybeans have not always been so useful. U.S. researchers transformed the Chinese soybean into an upright plant for mechanical harvesting and discovered how to process soybean meal into a cheap protein supplement. By the 1950's, feeding costs were reduced by substituting soybean meal for expensive animal proteins and fishmeal.

U.S. farmers can retain much of the trade advantage that these well-adapted crops provide, if U.S. policy allows competitive pricing in international markets because, unlike livestock technology, improved crop varieties are not widely transferable.

The close ties of crop farming to land and climate limit the transferability of crop improvements and the expansion of production around the world. For example, corn, the world's principal feed grain, can be grown in climates ranging from tropical to temperate. Each country, however, usually has to develop its own varieties. When varieties developed for one environment are transferred to another, yields normally fall.

The area planted to soybeans expanded very rapidly over the past three decades, first in the United States. Then, high world prices in the 1970's stimulated production in South America. Varieties developed for the Southern United States were grown in Brazil and Argentina. Because the climates are similar, these varieties grew well. U.S. high-yielding soybean varieties are not well suited to the tropics, however, because the length of days is different.



Almost 40 percent of world grain production is now fed to livestock.

Crops grow best where they are well adapted, in contrast to intensive livestock production, which can be located near consumers. Nevertheless, there are enough countries with abundant land suitable for producing grains to keep trade competitive. Attempts by any country to hold its prices above international levels will result in loss of its market share.

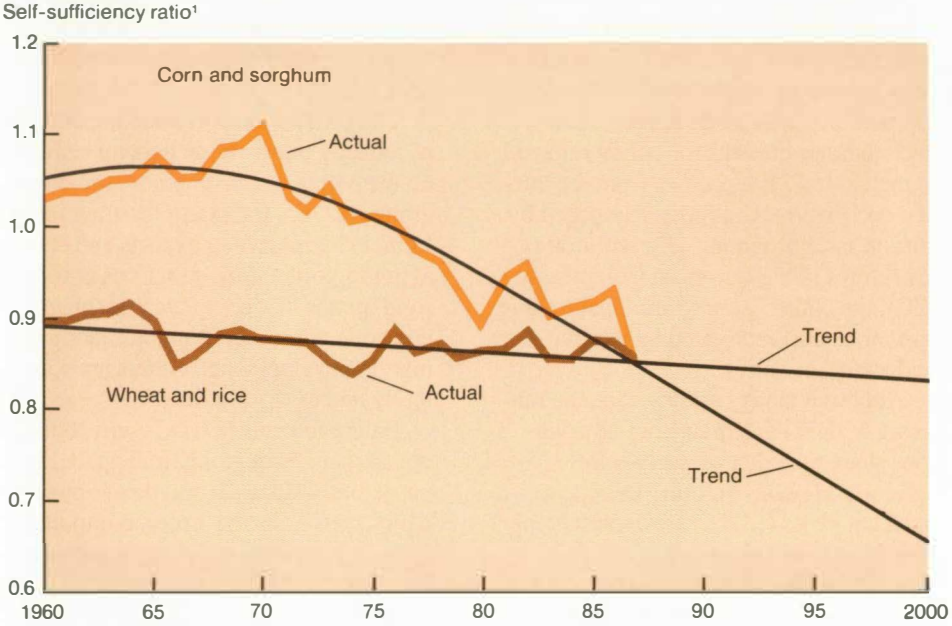
Implications for Developing Countries

Many developing countries, led by the newly industrializing nations, buy significant amounts of grain from overseas. As a group, they have been net importers of food grains since World War II and net importers of feed grains since the mid-1970's. Only two developing nations—Argentina and Thailand—consistently export grain.

As incomes rise in developing countries, the shift to more animal products in the diet will likely lead to an even greater dependency on commercial grain imports. This is especially true for feed grains. Imports of corn and sorghum have outpaced domestic production, leading developing countries to a lower level of self-sufficiency—a trend that will accelerate as livestock feeding expands in the next 10 years *(figure 3)*.

The change in self-sufficiency for wheat and rice is much less dramatic. Higher domestic production in some countries has partially offset the growing

Figure 3. As the Need for Grain Imports Increases Among Developing Nations, Self-Sufficiency Will Decline



[1]Grain production divided by the sum of grain production and net imports. A value less than one indicates that developing countries are importing grain to meet domestic needs.

imports of others. Most of the loss in self-sufficiency is because of higher wheat imports. Unlike rice, wheat is not a suitable crop for tropical climates.

Although part of the explanation for the steeper trend for corn and sorghum lies with the slower development of local varieties compared with wheat and rice, most of the decline in grain self-sufficiency is due to the growing demand for animal products.

To understand the future of world agriculture, we need to look at the long-term trends of production, use, and trade instead of current supply and demand conditions. The short periods of weather-induced surplus and scarcity provide little information about long-term changes because they result from the interaction of government policy with weather. ■

References

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