

# National Food Review

United States  
Department of  
Agriculture

Economic  
Research  
Service

April-June 1990  
Volume 13  
Issue 2



**Feeding the World:  
the 1990's and Beyond**



# Contents

The *National Food Review* is published quarterly by the Commodity Economics Division, Economic Research Service, U.S. Department of Agriculture.

The Secretary of Agriculture has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Funds for printing this publication have been approved by the Director of the Office of Management and Budget.

Contents of the *National Food Review* may be reprinted without permission. The use of commercial or trade names does not imply approval or constitute endorsement by USDA or ERS.

Subscriptions are \$11.00 a year to U.S. addresses (\$13.75 foreign). Multi-year subscriptions are also available. For fast service, call toll free 1-800-999-6779 (8:30 am to 5:00 pm ET) and charge your order to Visa or MasterCard. To order by mail, send your check or money order payable to ERS-NASS to: ERS-NASS, Box 1608, Rockville, MD 20849-1608. Please include your complete address and daytime telephone. Refunds cannot be issued.

**Economics Editors:**  
Lewrene Kay Glaser  
Kathryn L. Lipton  
(202) 786-3313

**Managing Editor:**  
Wendy Pinchas  
(202) 786-1494

**Art Director:**  
Joan A. Van Chantfort

**Editorial Staff:**  
Judith Foulke  
Martha R. Evans  
Cliola Peterson

**Composition:**  
Joyce Bailey

## Feeding the World: the 1990's and Beyond



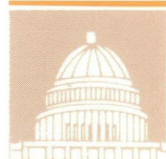
- |    |  |
|----|--|
| 1  | <b>Is the World Facing a Food Crisis?</b><br>Governments and public institutions will be influential in determining how adequate the world's food supply will be in coming years.  |
| 6  | <b>Trends in World Food Consumption</b><br>Food consumption has increased steadily throughout the world, but the amount, variety, and quality differ greatly among nations.  |
| 13 | <b>The Changing Nature of World Agriculture</b><br>Long-term trends of production, use, and trade are better predictors of the future of world agriculture than current supply and demand conditions.  |
| 18 | <b>Government Policies Influence Agricultural Competition Among Less Developed Countries</b><br>Policy reforms in recent years have increased the level of support, or reduced the level of taxation, for producers in less developed countries. |

## Food Research and Policy



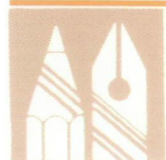
- |    |   |
|----|---|
| 24 | <b>The Market for Fat Substitutes</b><br>Consumers and food processors are excited over the prospects for improved fat substitutes, like recently approved Simplesse. |
|----|---|

## The Federal Front



- |    |  |
|----|--|
| 31 | <b>Recent Trends in Domestic Food Programs</b> |
| 34 | <b>Food and Nutrition Legislation</b>          |
| 37 | <b>USDA Actions</b>                            |

## Information Updates



- |    |                            |
|----|----------------------------|
| 39 | <b>In the News</b>         |
| 42 | <b>Reports of Interest</b> |



# Is the World Facing a Food Crisis?

Ray W. Nightingale  
(202) 786-1705

In 1985, at the height of the African famine, only a few people voiced concern about the adequacy of the world's food supply. Now, without a major crisis, many—including environmentalists, economists, and policymakers—believe a world food shortage is looming.

Some developing countries are unable to maintain adequate food supplies through either production or commercial imports. Therefore, they need aid from overseas to meet their food deficits. (A food deficit exists if a country's total food use is greater than its domestic production and capacity to commercially import food.)

Why are these countries short of food? Do the current disturbances in world food markets foretell a crisis in world agriculture in the next few decades? Recent ERS analyses yield some disquieting observations:

• In many developing nations, food deficits have grown despite improving food production. Use of cereal grains in 54 less-developed countries grew 34 million metric tons (mt) between marketing years 1984/85 and 1988/89 to 351 million (table 1). Cereal import requirements—food use less domestic production—rose less than 5 million mt during the period, attesting to success in increasing agricultural production. Nevertheless, the cereal deficit in 1988/89 was 17 million mt, compared to 12 million in 1984/85, at the height of the African famine.

Some countries achieved solid gains in production in the 1980's. In India, cereal output in 1987/88-1988/89 averaged 135 million mt, compared to 120 million early in the decade. Similarly, Indonesia moved from 26 million to 31 million mt of cereal production.

The author is an agricultural economist with the Agricultural and Trade Indicators Branch, Agriculture and Trade Analysis Division.

**Table 1. Cereal Use Has Outstripped Production in Many Developing Countries**

| Region  | Cereal situation                               |         |
|---|--|---------|
|   | 1984/85  | 1988/89 |
|   | <i>Thousand metric tons, cereal equivalent</i> |         |
| <b>North Africa</b>                           |  |         |
| Cereal use                                    | 25,016   | 27,956  |
| Cereal production                             | 13,075   | 15,705  |
| Import requirements                           | 11,941   | 12,251  |
| Import capacity                               | 8,626  | 7,771   |
| Cereal deficit                                | 3,315  | 4,480   |
| <b>Sub-Saharan Africa</b>                     |  |         |
| Cereal use                                    | 55,334   | 59,497  |
| Cereal production                             | 48,241   | 54,116  |
| Import requirements                           | 7,093  | 5,381   |
| Import capacity                               | 1,943  | 2,386   |
| Cereal deficit                                | 5,150  | 2,995   |
| <b>Asia</b>                                   |  |         |
| Cereal use                                    | 225,968  | 252,917 |
| Cereal production                             | 221,256  | 241,772 |
| Import requirements                           | 4,712  | 11,145  |
| Import capacity                               | 2,249  | 4,255   |
| Cereal deficit                                | 2,463  | 6,890   |
| <b>Latin America</b>                          |  |         |
| Cereal use                                    | 10,840   | 10,928  |
| Cereal production                             | 7,032  | 7,338   |
| Import requirements                           | 3,808  | 3,590   |
| Import capacity                               | 2,582  | 1,207   |
| Cereal deficit                                | 1,226  | 2,383   |
| <b>All food-deficit countries<sup>1</sup></b> |  |         |
| Cereal use                                    | 317,158  | 351,298 |
| Cereal production                             | 289,604  | 318,931 |
| Import requirements                           | 27,554   | 32,367  |
| Import capacity                               | 15,400   | 15,619  |
| Cereal deficit                                | 12,154   | 16,748  |

<sup>1</sup>Fifty-four developing countries in Africa, Asia, and Latin America.

Source: *World Food Needs and Availabilities*, ERS, USDA, various issues; and supporting data.

But for many nations, production growth has been far too slow, and recent high output is just the product of favorable weather.

• The ability of developing countries to import food commercially has dropped.

The 1980's were a major economic disappointment for most developing nations. Economic growth slowed dramatically, and countries piled up debt. In many food-aid-dependent countries, the economy declined sharply. Poor export earnings and the increasing cost of debt servicing curtailed the amount of foreign exchange available to buy food imports, raising the food deficit in many regions.

In Asia, import requirements rose from 4.7 million to 11.1 million mt during 1984/85-1988/89, while import capacity grew by only 2 million mt. This caused the food deficit to expand from 2.5 million to 6.9 million mt.

Bangladesh's cereal output in 1988/89 was 16.6 million mt, the same as in 1984/85. But total use rose and import requirements increased from 1.1 million to 3.2 million mt, outstripping commercial import capacity. The country's food deficit grew threefold to 1.6 million mt.

Although import requirements declined in Latin America, the region's food deficit increased from 1.2 million to 2.4 million mt as commercial import capacity was more than halved by diminished foreign exchange availability and higher cereal prices.

In Sub-Saharan Africa, both production and import capacity have grown. However, food deficits are still large in countries such as Ethiopia, Somalia, and Mozambique. In Mozambique, total food use and import requirements went up. Production in 1988/89 was only slightly greater than in 1984/85. Because commercial import capacity was only one-third of 1984/85's level, the cereal deficit climbed from 480,000 to 637,000 mt.

• Developing-country cereal import bills and the cost of food aid are greatly influenced by world cereal stocks, particularly wheat, the principal food aid commodity. In the last few years, wheat output has declined and surplus stocks have shrunk to barely adequate levels in





The amount of international food aid has dwindled in the last few years.

major food producing and supplying nations. Better weather and larger plantings meant a record 1989 crop for most wheat exporting countries, but in the United States, unfavorable weather dam-

aged the winter wheat crop and total wheat production rose only slightly.

In marketing year 1988/89, lower beginning stocks nearly balanced the larger wheat harvest in exporting nations,

so total supplies showed little change. However, the world consumed more wheat than it produced, and stocks continued to decline. Fortunately, initial estimates of 1990 wheat production in major exporting countries suggest the rundown in stocks may finally be ending.

- Exceptionally low world cereal stocks, especially wheat, have caused international prices to rise sharply. U.S. wheat prices for 1988/89 were 45 percent above 1987/88. The world price for wheat in 1988/89 was \$165 per metric ton, close to the levels of the early 1980's. Higher cereal prices have eroded countries' import capacities, already depressed by deteriorating financial conditions.

Low prices in 1986/87 and 1987/88 had provided considerable relief to financially strapped countries purchasing wheat on the world market. (Foreign exchange earnings and the price of cereal imports determine how much food a country can import commercially.) However, these lower world prices—averaging only \$115 per mt during the 2 years—were the temporary result of large stocks and aggressive competition among exporting nations.

- Countries' food deficits translate into food crises when assistance fails to arrive, and the amount of international food aid has dwindled in the last few years. The Food and Agriculture Organization (FAO) estimates that world cereal aid shipments in marketing year 1988/89 were less than 9.8 million mt, the lowest level since 1983/84. Projected 1989/90 aid from all donors is 8.3 million mt.

Tight government budgets and high market prices have contributed to the declines. For example, in the United States, higher costs reduced the tonnage donated under Public Law 480 by about 20 percent even though the fiscal 1989 food aid budget of \$1.5 billion was similar to 1988. Government commodities shipped overseas under the Section



416(b) donation program also declined from nearly 1.8 million tons in fiscal 1988 to approximately 1 million tons.

Are diminished food aid budgets a sign that donors, such as the United States, Canada, and the European Community, are unwilling to pay the cost of keeping the wolf from the door of hungry nations? Probably not. What they signal is an unwillingness by donors, who have economic problems themselves, to provide food security to countries that are only financially troubled. The reappearance of famine would quickly prompt additional food assistance.

### Will Food Shortages Last?

Over the years, people have used current conditions to predict the future behavior of world agriculture. For instance, the development and rapid spread of high-yielding cereal varieties in the 1970's inspired predictions of the end of famine. Then, the global scarcity of cereals in the early 1980's led to predictions of ever-growing markets for U.S. agricultural exports. (*See The Changing Nature of World Agriculture for more information on the public's perceptions of agricultural conditions.*) Should people interpret the present stresses in world agriculture to mean that food crises are imminent? What are the causes of current food deficits, and how enduring are they?

Weather greatly influences cereal production, but its effects on individual countries are temporary. In a reversal of recent events, weather could improve production in the United States and diminish output in developing countries.

Low cereal stocks are largely the consequence of decreasing Canadian and, more predominantly, U.S. holdings. Both countries experienced major crop shortfalls in 1988 because of drought. Aggressive export competition among major grain producers, particularly the

United States and the European Community, also helped draw stocks down.

As cereal production increases in the major exporting countries, so will stocks. Had favorable weather accompanied the larger acreage planted in 1988/89, stocks would have already turned up. How swiftly they recover, and to what levels, will depend in part upon the multilateral negotiations on agriculture now taking place under the auspices of the General Agreement on Tariffs and Trade (GATT). (*See National Food Review, October-December 1989, for information on the GATT negotiations.*)

There is little doubt that major food exporting nations will continue to produce more than domestic requirements. Thus, other countries can rely on these exporters for both commercial imports and emergency supplies. Cereal stocks in these countries have an impact around the world.

Stock levels are the principal determinant of world cereal prices. For example, in the 1970's and late 1980's when the ratio of wheat stocks to total use was low, real prices rose (*figure 1*). (Real prices have been adjusted for inflation.) In marketing year 1989/90, the world wheat stocks-to-use ratio is expected to be the lowest in 30 years. The projected ratio for total cereals is the smallest since 1974/75. As stocks in major exporting nations increase relative to world use, the downward trend in real cereal prices that slowed in the mid-1980's may resume.

None of the events underlying U.S. production shortfalls or food shortages abroad are enduring, except for economic stagnation in food-deficit countries. Poor economic policies coupled with a downturn in the global economy have taken their toll.

The national insolvency of some developing countries has its roots in OPEC's fourfold boost in petroleum prices during the mid-1970's. Petroleum-importing nations borrowed money from

banks in developed countries to finance oil imports and did not maintain capital investment for industrialization. With the second major jump in oil prices in 1979-80, lending nations tightened their monetary policies to counter anticipated inflation. Developing nations faced larger loan repayments and stagnant export markets. The economic growth of the 1970's vanished. Although food-deficit countries exhibited some financial improvement in the late 1980's, they remain decidedly poor.

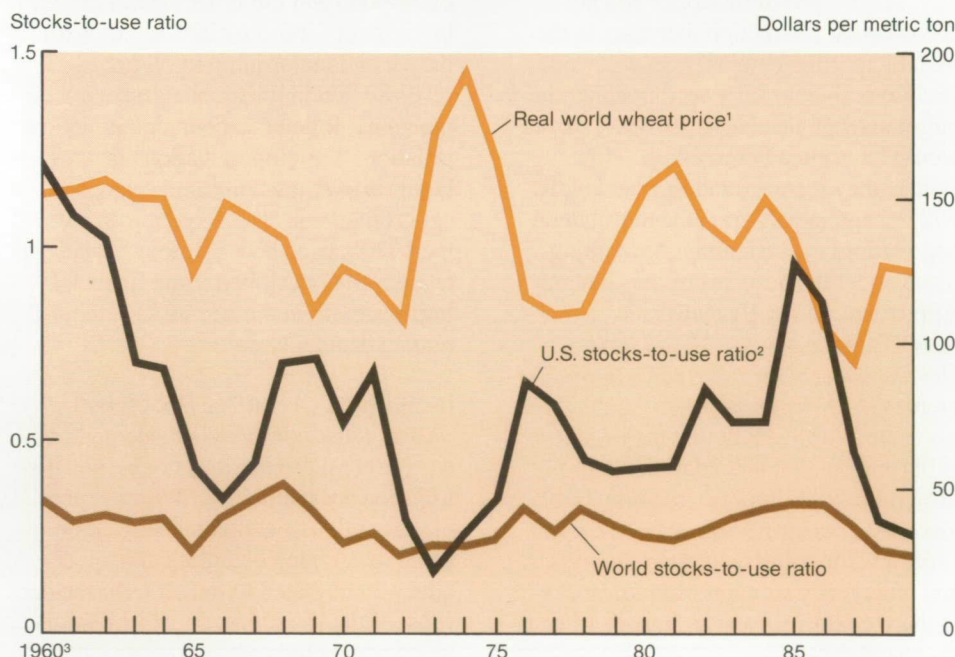
### Indicators of Future Problems

The causes of today's inadequate world cereal production, stocks, and distribution are temporary. With the possible exception of economic stagnation in some developing countries, this inadequacy is unrelated to longer term factors. Most of the long-term threats are familiar. They include:

- A slowdown in technological change in agriculture.
- High population growth.
- Limited availability of agricultural resources.
- Environmental degradation and adverse climate change.
- The inability of policies and institutions to influence these other factors.

One of the most worrisome assertions made by those studying the world food situation is that agricultural technology is running out of steam. This comes from observing that yields of specially developed wheat and rice varieties are not increasing as fast as they once did. These high-yielding varieties were responsible for most of the growth in the world's food supply during the "Green Revolution" of the 1960's and 1970's. However, the news is not all bad. Yields of other crops have been increasing, and many countries, such as Bangladesh, have yet to achieve the full production potential of the improved rice and wheat varieties.



**Figure 1. Stock Levels Are a Principal Determinant of World Wheat Prices**

<sup>1</sup>Hard red winter wheat, U.S. gulf ports, deflated by International Monetary Fund Commodity Price Index, 1989 estimated.

<sup>2</sup>Exports included in total use. <sup>3</sup>Marketing years.

The plant breeding techniques that developed these high-yielding varieties may soon be supplemented with recombinant-DNA bioengineering methods. How soon these new procedures will be employed to improve cereal varieties is impossible to predict. They are most likely to have their initial impact on plant and animal disease control because microorganisms are easier to manipulate genetically.

Eventually, bioengineering will be able to significantly transform plants themselves. Once a plant's genetic code is known, it can be directly altered to change plant characteristics such as height, drought tolerance, and disease resistance. This will allow much more rapid progress in adapting a greater variety of plants to new environments.

The prospects for greater agricultural production are accompanied by the pros-

pect of having greater numbers of people to feed. Expectations for lower population growth that emerged in the 1980's have recently been dashed by the United Nations Population Fund, which projects world population growth in the 1990's of 921 million, compared with 843 million in the 1980's.

Population growth rates in food-deficit Sub-Saharan Africa are among the highest in the world, and population growth continues high in Egypt, long a major recipient of food aid. Neither India nor China, both of which sustain large annual population increases, has recently had to appeal for food aid. In a period of rapid social and political change, even small shifts in population growth rates in these countries would greatly change world population.

Population growth compounds the stress on natural resources, which leads

to environmental degradation and climate change. More land, including marginal grasslands and cleared forests, must be used to feed evergrowing populations. This puts stress on the environment, and when adverse conditions occur—like drought or flood—the land can lose its productive capacity altogether.

These large-scale changes can also alter climate. For example, the African Sahel lost much agricultural land when drought hit overgrazed areas. The disappearance of forests and grasslands alters temperatures and the wind patterns that govern precipitation. The recent desertification in the Sahel was preceded centuries earlier by overcutting and overgrazing in North Africa. While arid lands can be cultivated successfully, as in Jordan, Morocco, and Tunisia, production is highly irregular, adding to global food instability.

The loss of agricultural land is not confined to Africa. In the last couple of decades, overcutting of forests for fuel in Nepal has devastated agriculture. Topsoil that washed from the steep Himalayan hillsides into rivers and streams has permanently ruined the land's productivity.

The clearing of tropical forests in Brazil is harmful because of the atmospheric changes it induces. Also, Amazon forests harbor unique plant and animal life, the loss of which would reduce the genetic resources available to agricultural science.

Some experts, seeing the climatic changes and loss of genetic materials as irreversible, anticipate a bleak future for world agriculture. Others point out the negative impact that policies and institutions can have on agricultural production, but say this can change. For example, government mismanagement in the Soviet Union, China, and Eastern Europe curtailed agricultural output for decades, but recent policy changes bode well for their farming sectors.



Governments and public institutions will be influential in determining the adequacy of the world's food supply in coming years. Recent ERS analysis has indicated that none of the long-term threats—slower technological change, population growth, limited agricultural resources, or environmental degradation—are certain causes of a global food crisis in the next two or three decades, but avoidance of a crisis depends heavily on national institutions and public policy.

In many instances, environmental damage can be minimized by using agricultural production methods that are less abusive, but they are often more costly and may raise the cost of food. Many nations, including the United States, are faced with the choice of low food prices in the short term or long-term maintenance of their agricultural resource base. Public policy will also affect the development of bioengineering technology. Agriculture competes with other sectors for research funds. The level of funding for agriculture is influenced by public acceptance of the products made with modern bioengineering.

There is no doubt that major food exporting nations can increase output to serve expanding export markets. However, there is no reason to assume that current production advances in many African countries are driven by anything other than a fortunate turn in the weather. Food needs will climb as populations grow rapidly in Africa, Asia, and Latin America. Reducing indebtedness and

replenishing budget coffers require broad-based economic growth. Meanwhile, food aid from developed nations can free foreign exchange for imports of needed capital goods. In the past, some developing countries have used too much of their foreign exchange to fund current consumption instead of investing in factories and equipment.

Today's concern about a world food crisis could be replaced by an optimistic assessment with the return of favorable weather, rebuilding of cereal stocks, or less rapid population growth. The introduction of existing crop varieties and production practices to new areas of the world and development of new production technologies through bioengineering are also cause for hope. Now that major world institutions are concerned about the debt of poor countries, the financial front also looks brighter.

But in coming decades, as in the past, decisions could be made and policies implemented that would inhibit rather than promote agriculture. Thus, sounding the alarm from time to time may be beneficial. ■

## References

"Are We Approaching a World Food Crisis Again?" *World Agriculture Situation and Outlook Report*, WAS-55. ERS, USDA, June 1989.

Avery, Dennis T. "The Green Revolution is Real Food Security." Testimony before the Subcommittee on Wheat, Soybeans, and Feed Grains of the House Committee on Agriculture, Washington, DC, September 26, 1989.

"Feeding Six Billion." *World Watch*, September/October 1989, pp. 32-40.

*Food Outlook*, No. 9. Global Information and Early Warning System, Food and Agriculture Organization, United Nations, September 1989.

*Food Projections for the Decade of the 1990's*. Board on Science and Technology for International Development, Office of International Affairs, National Research Council, Washington, DC, September 1989.

"Higher Prices Strain Food Aid Budgets." *Agricultural Outlook*. ERS, USDA, September 1989.

Johnson, D. Gale. Lecture on technological advance and agricultural productivity. ERS-Farm Foundation Conference on Public Policy, Emerging Technologies in Agriculture, and Agricultural Productivity Growth, Washington, DC, October 17, 1989.

Shane, Mathew D. and David Stallings.

"Country Insolvency, Government Policies and Resolving the Third World Debt Crises." Unpublished briefing paper. ERS, USDA, May 1989.

\_\_\_\_\_. *Debt Crisis in Developing Countries Hurts U.S. Agriculture*, AIB-546. ERS, USDA, July 1988.

*World Food Needs and Availabilities*. ERS, USDA, various issues.



# Trends in World Food Consumption

C.E. Overton  
(202) 786-1705

Food consumption throughout the world has increased steadily since 1960. Yet the amount, variety, and quality of food people eat differs greatly among nations. Today, a typical North American consumes an assortment of foods, including lots of animal products. Many Africans, whose diet looks virtually the same as it did 25 years ago, struggle to find a meager meal of cereal grains or starchy root crops, like cassava and taro, and a little meat.

The composition of people's diets has changed in the last quarter century, mostly in developed and centrally planned economies. For instance, Europe and the USSR have significantly expanded their consumption of animal products, while reducing use of cereals, roots, and tubers. On the other hand, many developing nations, especially in Africa, still consume large amounts of starchy foods.

## Levels of Consumption

In 1986, developed countries in North America (*see box*) had the highest level of food consumption in the world, over 2,218 pounds per capita per year. The more than 3,600 calories consumed per person per day greatly exceeded the minimum daily requirement of about 2,700 calories. Oceania (Australia and New Zealand) and Western Europe were close behind with 2,152 and 2,150 pounds and 3,350 and 3,418 calories, respectively. Japan consumed only 1,459 pounds and 2,600 calories per capita in 1986. Under-reporting of imported processed food and omission of high fructose corn syrup from consumption data account for part of the disparity. Two other developed

nations, Israel and South Africa, consumed 1,998 and 1,212 pounds, respectively.

The USSR and Eastern Europe's food consumption in 1986 averaged 1,903 pounds per capita, and the daily caloric intake was 3,415 calories. Thus, in spite of the recent publicity about food shortages in Eastern Europe, people are relatively well fed. The major food problems in the region are quality, diversity, and distribution. In contrast, China had the lowest level of consumption among the centrally planned economies in 1986, only 1,011 pounds and 2,630 calories.

As a group, developing countries consumed less than half the amount of developed nations, only 1,031 pounds per capita (*table 1*). But consumption varied widely within the group. The Near East and Latin America led with 1,382 and 1,288 pounds, respectively. Developing countries in the Far East and Africa had the lowest levels of consumption in 1986 at 878 and 1,072 pounds, respectively. On average, a resident of central Africa consumed only 2,072 calories per day, about 12 percent below the minimum recommended for most countries in that region.

## Growth in Food Consumption

Not only do people around the world eat different amounts of food, the rate at which their consumption has increased since the 1960's has varied. Food consumption among developed countries grew slightly between 1961 and 1986, about 0.5 percent per year. During the 1960's, food consumption in North America, Western Europe, and Oceania increased at nearly identical rates. During the early 1970's, Oceania, with Western Europe trailing close behind, led the world in per capita consumption. But in the late 1970's and 1980's, growth in both Oceania and Western Europe began to stagnate, while North American con-

**Table 1. Food Consumption in Developed Countries in 1986 Was Almost Twice That of Developing Nations**

| Region                             | 1961-86 consumption |                       |                   |
|------------------------------------|---------------------|-----------------------|-------------------|
|                                    | Annual growth rate  | Annual average change | 1986 level        |
|                                    | Percent             | Pounds per capita     | Pounds per capita |
| <b>Developed countries</b>         | 0.53                | 10.16                 | 2,031             |
| <b>Centrally planned countries</b> | 0.67                | 7.67                  | 1,243             |
| USSR and Eastern Europe            | 0.49                | 8.97                  | 1,903             |
| China                              | 1.17                | 10.14                 | 1,011             |
| <b>Developing countries</b>        | 0.64                | 6.15                  | 1,031             |
| Africa                             | 0.12                | 1.33                  | 1,072             |
| Latin America                      | 0.40                | 4.85                  | 1,288             |
| Near East                          | 1.35                | 16.31                 | 1,382             |
| Far East                           | 0.73                | 5.73                  | 878               |

Source: Computed from Food and Agriculture Organization data.

sumption continued to rise. In fact, the 2,152 pounds per capita consumed by Australians and New Zealanders in 1986 barely exceeded the 1975 level. This suggests that both Oceania and Western Europe may be approaching their maximum levels of consumption.

Although the rate of growth in consumption was lower in developed countries than in centrally planned or developing economies between 1961 and 1986, the average change in volume per year was higher, 10.2 pounds versus 7.7 and 6.2 pounds, respectively. This disparity indicates that the differences in food consumption levels around the world have increased.

The author is Chief of the Agricultural and Trade Indicators Branch, Agriculture and Trade Analysis Division.

Among centrally planned economies, China had the highest rate of food consumption growth, about 1.2 percent. Compared with other regions, China's rate of increase was second only to that of the Near East. In the 1980's, economic reforms in China that stimulated production received considerable publicity, even though the country has maintained relatively steady growth throughout the 25-year period. Despite the gains in consumption, however, the Chinese remain one of the poorest fed peoples on earth.

Food consumption in the developing countries of the Near East grew at an annual rate of 1.35 percent (16.3 pounds per capita) from 1961 through 1986. At 1,382 pounds in 1986, the Near East led all developing regions in food consumption. These gains were encouraged first by the "Green Revolution"—a program of improved crop varieties and cultural practices introduced in the 1960's and 1970's that dramatically increased yields, especially of wheat and rice—and then by economic growth in countries such as South Korea, Hong Kong, and Thailand.

Agricultural production, which grew dramatically throughout the Near East, helped fuel the high rate of consumption growth. Since 1970, production climbed by over 70 percent in Burma, Indonesia, South Korea, Pakistan, and Thailand. Output in India, Malaysia, and the Philippines increased over 50 percent. In contrast, U.S. production expanded by 34 percent between 1970 and 1986. India, once a nation highly dependent on food aid, has become an occasional wheat exporter, and Thailand is now the world's largest supplier of rice to the international market.

Consumption in other developing regions grew modestly during 1961-86. However, the modest growth combined with low levels of consumption at the beginning of the period caused the gap in per capita food consumption between

developed and developing regions to expand. Even in the Far East, where the annual growth rate of 0.73 percent was higher than in developed countries, the 5.7-pounds-per-year gain was only about half the increase of the developed world.

Latin American food consumption grew at a stable rate through most of the period, but fell beginning in 1981. The drop was due to the effects of a world recession in the early 1980's. The recession forced many African and Latin American countries to adopt austere economic programs to meet repayment obligations on large amounts of debt the countries owed overseas banks. Nevertheless, both regions fared well compared with the Far East, where per capita food consumption in 1986 was the lowest in the world, only 40 percent of North America's level.

Rapid population growth is a major constraint to improving food consumption in developing countries. Population increases in these areas have far exceeded those occurring in the rest of the world (*table 2*). Unlike China, which successfully reduced population growth in the 1970's and 1980's, other develop-

ing nations have been unable to check their growth. High rates in Africa and the Near East appear to have escalated since 1970. As a consequence, in developing countries in Africa, food consumption grew at only 0.12 percent (1.33 pounds) per year between 1961 and 1986. Population growth in both regions threatens to overwhelm their capacity to maintain even meager levels of food consumption. For example, food production in Nigeria expanded by 37 percent between 1970 and 1986, yet population climbed by 60 percent. Similarly, Egypt increased production by 32 percent, but saw population rise by 50 percent.

### Composition of People's Diets

Changes have occurred not only in the amounts of food consumed but also in the composition of people's diets. Typically, as incomes rise from a subsistence level, people spend a large share of the increase on food. They start consuming more grains, replacing what are regarded as inferior foods, such as starchy roots and tubers—potatoes, cassava, and taro, for example. As incomes rise further, people eat more animal products and

**Table 2. Populations in Developing Countries Have Grown Faster Than in the Rest of the World**

| Region                             | Population |       | Growth Rate |         |
|------------------------------------|------------|-------|-------------|---------|
|                                    | 1961       | 1986  | 1961-86     | 1970-86 |
|                                    | Millions   |       | Percent     |         |
| <b>Developed countries</b>         | 660        | 823   | 0.87        | 0.77    |
| <b>Centrally planned countries</b> | 1,030      | 1,539 | 1.61        | 1.37    |
| USSR and Eastern Europe            | 317        | 395   | 0.85        | 0.79    |
| China                              | 660        | 1,053 | 1.88        | 1.53    |
| <b>Developing countries</b>        | 1,372      | 2,522 | 2.43        | 2.40    |
| Africa                             | 228        | 464   | 2.84        | 2.97    |
| Latin America                      | 220        | 410   | 2.45        | 2.36    |
| Near East                          | 125        | 245   | 2.67        | 2.69    |
| Far East                           | 795        | 1,398 | 2.26        | 2.19    |

Source: Food and Agriculture Organization, United Nations.





## World Economic Regions

*The Food and Agriculture Organization of the United Nations classifies the nations of the world into economic regions. The categories are:*

### Developed Countries

#### North America

Canada  
United States

#### Western Europe

|               |                  |
|---------------|------------------|
| Andorra       | Luxembourg       |
| Austria       | Malta            |
| Belgium       | Monaco           |
| Denmark       | Netherlands      |
| Finland       | Norway           |
| France        | Portugal         |
| Gibraltar     | San Marino       |
| Greece        | Spain            |
| Holy See      | Svalbard Islands |
| Iceland       | Sweden           |
| Ireland       | Switzerland      |
| Italy         | United Kingdom   |
| Liechtenstein | West Germany     |
|               | Yugoslavia       |

#### Oceania

Australia  
New Zealand

#### Other

Israel  
Japan  
South Africa

### Developing Countries

#### Far East

Bangladesh  
Bhutan  
Brunei  
Burma  
East Timor  
Hong Kong  
India  
Indonesia  
Laos

Macau  
Malaysia  
Maldives  
Nepal  
Pakistan  
Philippines  
Singapore  
South Korea  
Sri Lanka  
Thailand





### **Near East**

|             |              |
|-------------|--------------|
| Afghanistan | Libya        |
| Bahrain     | Oman         |
| Cyprus      | Qatar        |
| Egypt       | Saudi Arabia |
| Gaza Strip  | South Yemen  |
| Iran        | Sudan        |
| Iraq        | Syria        |
| Jordan      | Turkey       |
| Kuwait      | United Arab  |
| Lebanon     | Emirates     |
|             | Yemen        |

### **Africa**

All countries except Egypt, Libya, South Africa, and Sudan

### **Latin America**

South America, the Caribbean including Cuba, and Central America, including Mexico

### **Centrally Planned Countries**

#### **Eastern Europe and USSR**

|                |         |
|----------------|---------|
| Albania        | Hungary |
| Bulgaria       | Poland  |
| Czechoslovakia | Romania |
| East Germany   | USSR    |

#### **Asia**

|           |             |
|-----------|-------------|
| China     | North Korea |
| Kampuchea | Vietnam     |
| Mongolia  |             |



fruits and vegetables—not only to improve the quality of their diets but also to show status. The diet becomes more nutritionally balanced because a greater diversity of foods are consumed.

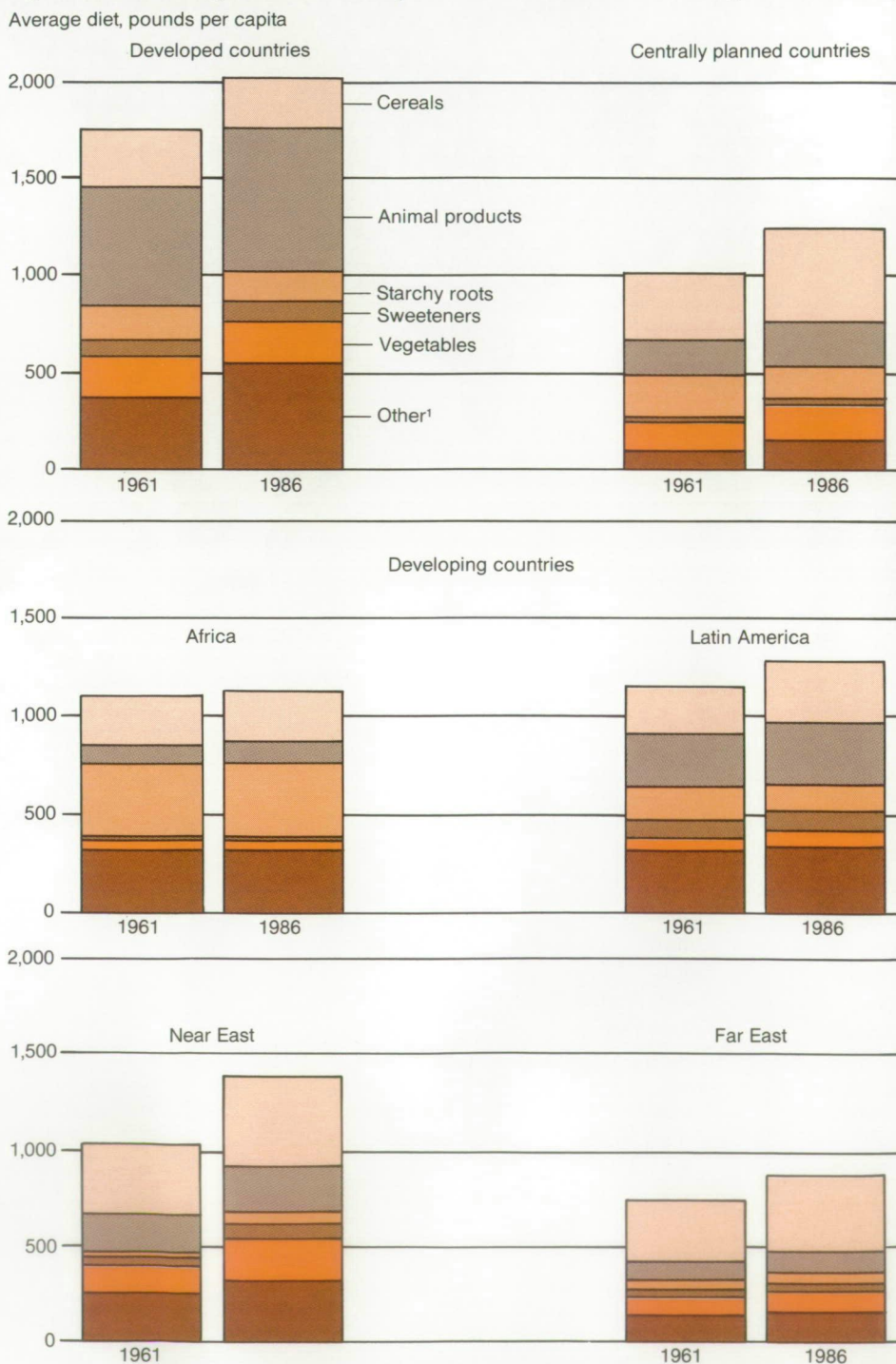
Between 1961 and 1986, consumption of animal products, vegetables, and other foods continued to rise in developed countries, while use of cereals and starchy roots gradually declined. Western Europe was largely responsible for these shifts, since consumption patterns among food groups in North America and Oceania were remarkably stable.

The most dramatic changes in diet composition have taken place in centrally planned economies (*figure 1*). China's consumption of cereals climbed dramatically to 512 pounds per capita in 1986 from 280 pounds in 1961, echoing major gains in production. Consumption of animal products and vegetables also rose significantly, but they remain a small share of the total diet.

People in the USSR and Eastern Europe ate more animal products in the 1960's and early 1970's, but consumption stagnated in the mid- and late 1970's. Following a policy decision to import grain for livestock production, consumption resumed growing in the 1980's. Use of cereals and starchy roots declined during the 25-year period, while intake of sweeteners, vegetables, and other foods increased. Consequently, despite the need for food assistance in some Eastern European countries, the composition of their diets in 1986 was similar to those in developed nations.

Among developing countries, diets varied by region. In 1986, the main components of the diet in Latin America were animal products, cereals, and other foods. During 1961-86, consumption of animal products increased the most, followed by cereals. However, the economic woes of the 1980's—slower economic growth and large overseas debt—will likely constrain further

**Figure 1. The Average Diet in Centrally Planned Economies Has Changed Dramatically**





growth in livestock consumption, which is closely linked with high per capita incomes.

In Africa, the composition of the diet was virtually unchanged between 1961 and 1986. Cereals and starchy roots and tubers remained the leading food items. Vegetables and sweeteners played only a minor role.

In the Far East, cereals were by far the main component of the diet in 1986, and accounted for nearly half the gain in consumption during the period. Use of vegetables and animal products also increased, but they remained a minor part of the diet.

Cereals were also the leading food group in the Near East in 1986. However, diets were more nutritionally balanced because people were able to eat significant amounts of animal products, vegetables, and other foods. Between 1961 and 1986, cereals had the smallest relative increase in use and contributed just 20 percent to the region's gain in food consumption.

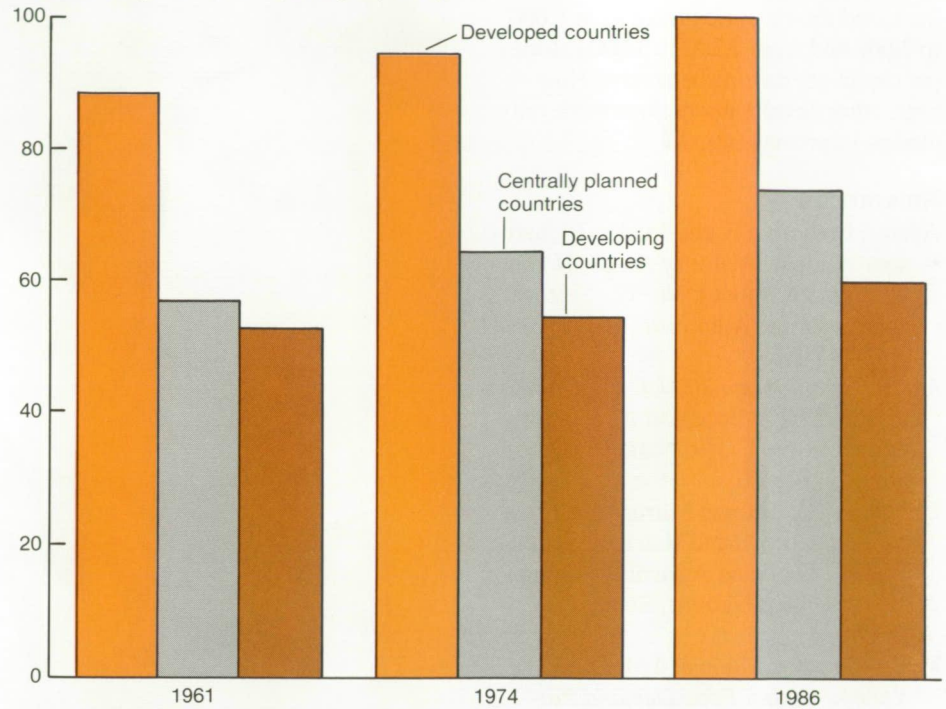
### Quality of the Diet

In addition to the quantity and composition of food consumed, nutritional content is important for developing and maintaining a healthy population. Protein and energy content are widely used to measure the quality of people's diets.

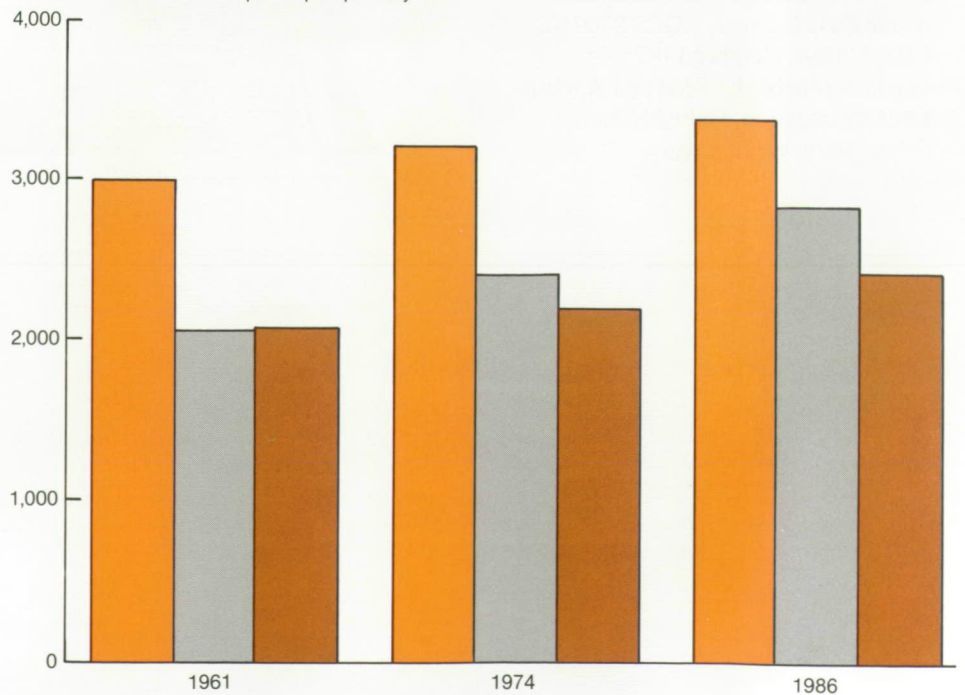
Protein consumption in developed nations during 1961-86 remained well above that in centrally planned and developing countries (figure 2). Among centrally planned economies, Eastern Europe and the USSR were on a par with developed countries over the period. China dramatically increased protein intake from 39 to 62 grams per day. Developing countries have made only marginal improvements since 1961. Protein consumption rose from 64 to 82 grams per capita per day in the Near East, but stayed the same in Africa, at just over 50 grams.

**Figure 2. Protein and Energy Consumption Were Highest in Developed Countries**

Protein consumption -- Grams per capita per day



Caloric intake -- Calories per capita per day



Source: Food and Agriculture Organization, United Nations.



The energy situation is similar. Between 1961 and 1986, China and the developing countries of the Near East increased their caloric intake from 1,600 to 2,600 and from 2,200 to 3,000 calories per capita per day, respectively. However, other developing regions made only modest improvements. ■

### References

- Adams, Catherine F. and Martha Richardson. *Nutritive Value of Foods*, Home and Garden Bulletin No. 72. Science and Education Administration, USDA, 1981.
- Agriculture: Toward 2000*, Conference paper C87/27. Food and Agriculture Organization, United Nations, Rome, Italy, July 1987.
- Latham, M.C. *Human Nutrition in Tropical Africa*, Food and Nutrition Series No. 11. Food and Agriculture Organization, United Nations, Rome, Italy, 1979.
- Marks, Suzanne Marie and Mervin J. Yetley. *Global Food Demand Patterns Over Changing Levels of Economic Development*, AGES 870910. ERS, USDA, October 1987.
- Production Yearbook*. Food and Agriculture Organization, United Nations, Rome, Italy, various years.



Developing countries have made only marginal improvements in protein consumption since 1961.

# The Changing Nature of World Agriculture

Gary Vocke  
(202) 786-1718

**R**ising 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 world-wide 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

**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.   |

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

The author is an agricultural economist with the Agricultural and Trade Indicators Branch, Agriculture and Trade Analysis Division.



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

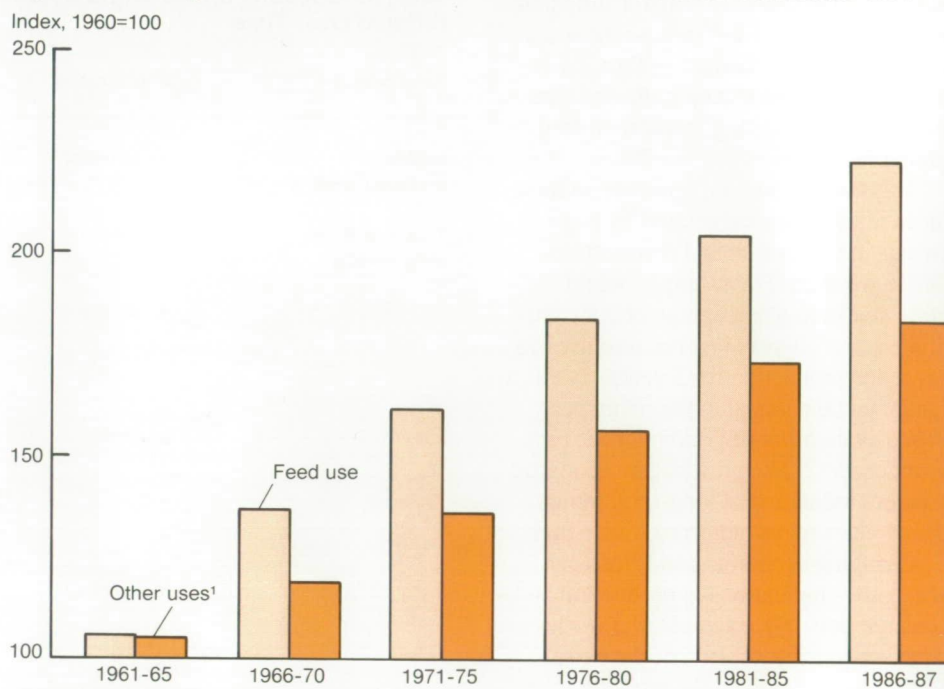
In 1972, world grain production dropped for the first time since World War II. North American stocks were quickly drawn down, and prices soared as the USSR bought large quantities of grain. Several developing nations had problems buying the higher priced grain. Poor people within these countries were 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**



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.

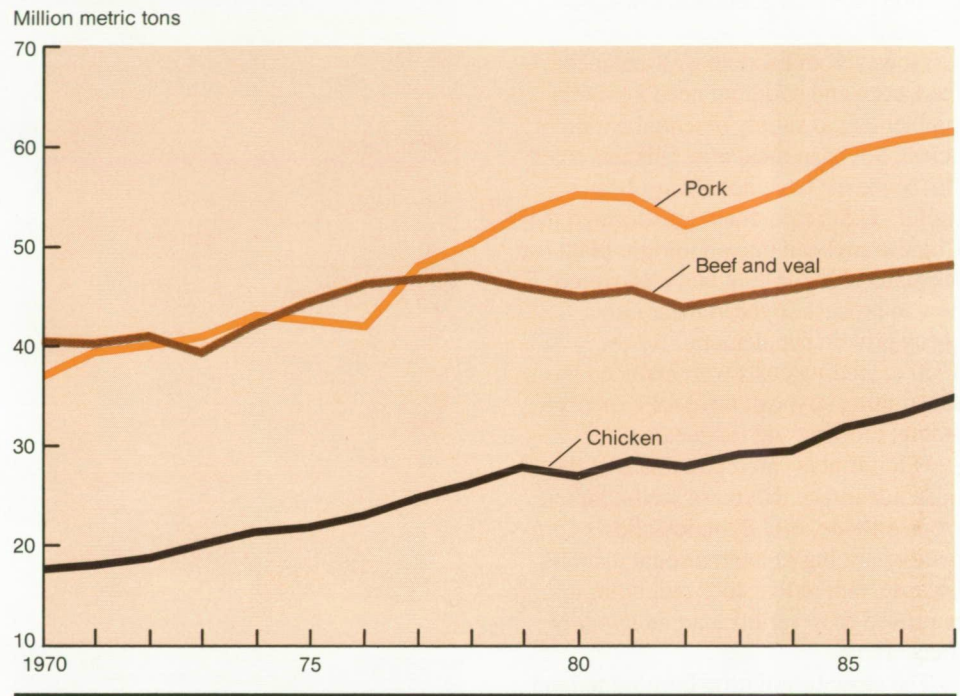
U.S. researchers and entrepreneurs transformed broiler production, greatly lowering the cost of poultry to consumers. Balanced, high-energy rations and hybrid birds improved the conversion of grain into meat. Drugs reduced disease losses, making confinement feasible. Company control of all production 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 per-

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



cent of world grain production is now fed to livestock.

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,



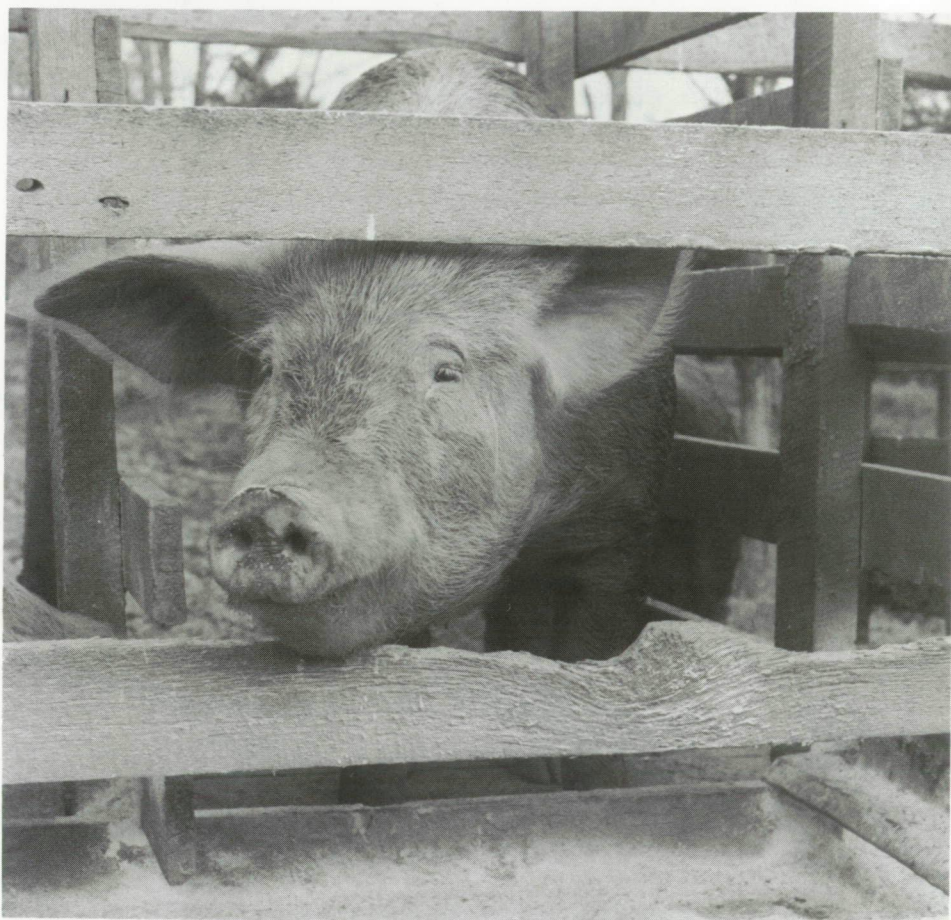
hybrid sorghum was available, and with higher input use, yields climbed. The rapid growth in corn and sorghum production provided abundant, low-cost feedstuffs.

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.

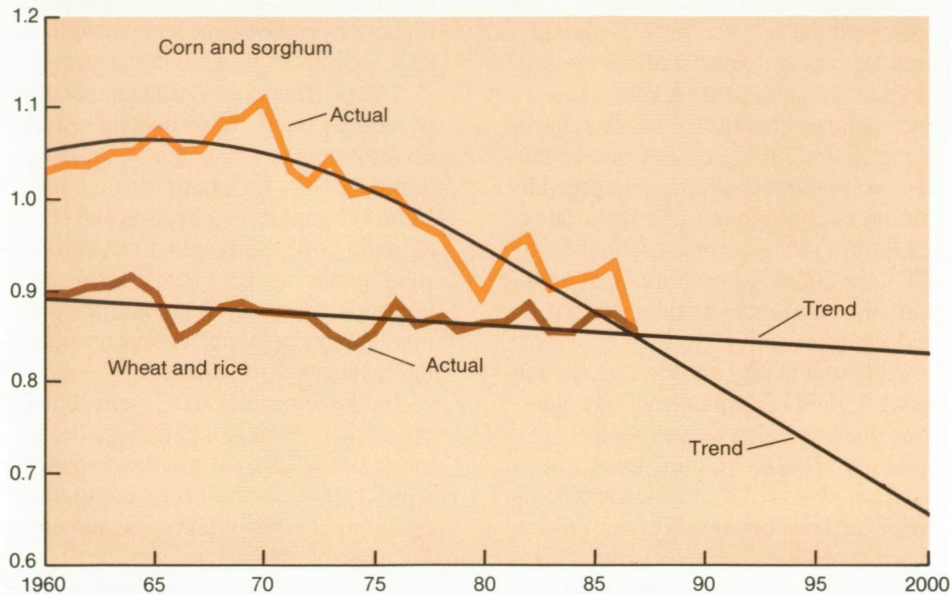
As incomes rise in developing countries, the shift to more animal products in the diet will likely lead to an even greater dependency on commercial grain imports. This is especially true for feed grains. Imports of corn and sorghum have outpaced domestic production, leading developing countries to a 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**

Self-sufficiency ratio<sup>1</sup>



<sup>1</sup>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

- Poleman, Thomas T. "World Food: A Perspective." *Food: Politics, Economics, Nutrition, and Research*, Philip H. Abelson (editor). American Association for the Advancement of Science, Washington, DC, 1976.
- Walters, Harry. "Difficult Issues Underlying Food Problems." *Food: Politics, Economics, Nutrition, and Research*, Philip H. Abelson (editor). American Association for the Advancement of Science, Washington, DC, 1976.



## Government Policies Influence Agricultural Competition Among Less Developed Countries

Carl C. Mabbs-Zeno  
(202) 786-1636

Throughout the world, countries of different income levels and political systems are moving toward a consensus on the likely direction of agricultural policy reform. The variety of government programs that influence production, consumption, and trade are facing vigorous challenges that are reducing the role of government regardless of the effect on agricultural producers.

China, the Soviet Union, several Eastern European nations, a majority of African States, and many South American countries have already dramatically reduced government intervention in their agricultural sectors. Western economies are key players in multilateral negotiations to liberalize trade by reducing government involvement in agriculture. These negotiations are being conducted under the auspices of the General Agreement on Tariffs and Trade (GATT).

The United States is pinning its hopes for expanding agricultural exports on our ability to compete in international markets that are relatively free from government intervention. At the GATT negotiations, the United States has offered to substantially reduce trade-distorting farm support if competing nations do likewise. It would be difficult for the United States alone to scale back agricultural programs because such an action would lessen the U.S. competitiveness in world markets. With smaller subsidies, American farmers would have less incentive to produce than their counterparts in other exporting nations. (See *National Food Review*, October-December 1989, for more information on the U.S. proposal and GATT agricultural negotiations.)

International markets that are relatively free from government intervention could mean expanded U.S. agricultural exports as domestic prices move more in line with world levels. However, another impetus for policy reform in the United States comes from the burden on Government budgets imposed by current farm programs. Agricultural policy reform in the European Community (EC), the United States' principal trading partner, is also motivated by internal budgetary pressures.

Although many countries are encountering budget constraints, not all countries share the other incentives for agricultural policy reform. Less developed countries (LDCs) are experiencing pressures from external sources, particularly international lenders, to reduce government intervention in agriculture. The lenders regard many current policies as

constraints on the ability of borrowers to pay their debts, and these lenders place a higher priority on debt repayment than LDC governments have in the past.

The production and trade implications of reduced intervention depend heavily on the nature of existing government programs. LDCs, for example, often burden farmers by inhibiting exports and encouraging imports. Some programs enforce rigid quotas that completely insulate domestic decisions from international market developments. Others are specifically tied to world prices.

Policy reforms in LDCs will contribute to changes in global trade patterns, particularly since several developing nations have already become important agricultural competitors or customers. For example, Thailand increased its share of world agricultural trade by over 50 percent from 1970 to 1985. Argen-



Producers of temperate commodities in exporting LDCs generally have less support from their governments than farmers in developed countries.

The author is an agricultural economist with the Agriculture and Trade Policy Branch, Agriculture and Trade Analysis Division.

tina was an important grain exporter despite export taxes through the early 1980's.

### Less Developed Countries Are Diverse

LDCs are a diverse group, defined by their lack of infrastructure, like schools and factories, and by their lack of capital to invest in such facilities. They range in per capita income from the rich, oil-producing States, such as Saudi Arabia, Libya, and Brunei, to the newly industrialized, middle-income countries of eastern Asia and Latin America, like Argentina, Brazil, and South Korea. In Africa, the perennial food aid recipients of Burkina Faso, Ethiopia, and Mozambique are also classified as LDCs. More than three-fourths of the world's people now live in developing countries.

The poorest LDCs, those with annual per capita incomes under \$500, contain half the world's population. China and India together had 37 percent of the world's 5 billion people in 1988.

Poor LDCs provide the United States with little agricultural competition, except in cotton, sugar, and tobacco. Their importance to the United States derives from two sources. First, when development does occur in these nations, income levels will rise, providing the United States with more overseas customers. Second, some of these developing nations supply the United States with tropical products.

Some middle-income LDCs export commodities that compete directly with U.S. exports, such as temperate-climate crops like wheat, corn, and soybeans. These nations also export rice, cane sugar, oilseeds, and other tropical commodities that compete with temperate crops. Such countries—including Argentina, Brazil, Malaysia, and Thailand—pose a conspicuous challenge to U.S. farm exports.

Higher income LDCs that import temperate products are already a significant source of demand for U.S. agricultural products. For example, U.S. agricultural exports to Mexico and South Korea more than doubled between 1975 and 1980 and now each exceeds \$1 billion annually. However, agricultural production in some of these high-income LDCs is heavily subsidized, which increases their output and thus reduces the demand for imports. Farmers in South Korea and Saudi Arabia are among the most heavily subsidized in the world.

### Types of Government Intervention

Individual LDCs rarely have as many agricultural programs as the United States. But as a group, developing countries display considerable variety in the types of agricultural policies and programs they use. Government intervention among LDCs can be categorized on the basis of two characteristics:

- *Program target*, which can be either commodity specific or economywide. Commodity-specific programs focus on the producers or consumers of a specified commodity or group of commodities. Examples include agricultural price supports and tariffs. These programs tend to shift resources toward or away from targeted sectors. For instance, the cocoa marketing board in Ghana pays domestic farmers less than the international price for the cocoa it exports, reducing production below competitive market levels. U.S. taxes on cigarettes have a similar effect on our tobacco output.

Economywide programs do not focus on any particular sector but apply equally to all productive activity. Examples include income taxes or requirements that profits be kept in the country where they were earned. Nonetheless, these general policies may affect some sectors more than others due to underlying economic conditions. A tariff on all imports does not specify any particular commod-

ity, so it appears to be economywide, but in a country that imports mainly cereals, an across-the-board tariff functions in a commodity-specific way.

- *Program method*, which can be either domestic or a border measure. Domestic programs are limited to direct involvement in transactions among citizens or institutions of the country that formulated the policy. Sale of cheap fertilizer from government shops scattered through the countryside constitutes a domestic policy. Increased production due to low fertilizer costs only indirectly affects the country's trade balance in that commodity.

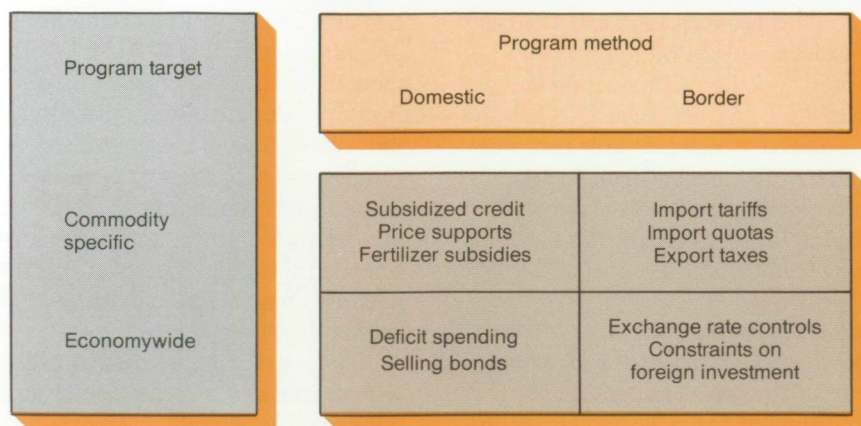
Border measures involve exchanges with or constraints on citizens or institutions of other countries. An export tax, for example, might be paid by the exporter, but it is a border policy because it directly lowers the price received from outside the country.

The two intervention characteristics overlap. A commodity-specific policy is also either a domestic or border measure (*figure 1*). Price supports and tariffs are both commodity specific, but a price support is a domestic measure, while a tariff is a border measure. In the same way, a border policy can apply to specific commodities or the whole economy. Import quotas and exchange rate controls are both border policies, but quotas apply to particular commodities, while exchange controls are economywide.

Domestic, commodity-specific programs typically take a different form in LDCs compared with developed countries. For example, marketing boards that are exclusive or major purchasers of farm output were common in LDCs until the late 1980's, particularly for exported commodities. Nigeria, for example, had marketing boards covering virtually every agricultural commodity that was traded commercially within the country or across its borders until 1986. Using various techniques, marketing boards are



Figure 1. LDC Policies Can Be Categorized on the Basis of Two Overlapping Characteristics



able to set the prices received by producers. Sometimes these prices are lower than what a private market would have offered. For example, if a marketing board is the only legal exporter and the market is dominated by foreign demand, as it is for cocoa in West Africa, the board can hold prices down. Because LDCs often have few reliable sources of government revenue, such techniques have been used to generate funds.

Many LDC governments assist their farmers in purchasing farm inputs, such as machinery, fertilizer, and credit. However, the value of these domestic, commodity-specific services is usually relatively low.

In LDCs, commodity-specific border policies often include tariffs and quotas. South Africa, for example, places large tariffs on most manufactured goods. Tariffs and quotas are a more frequent phenomenon in LDCs than in industrialized countries, possibly because LDCs are less constrained by GATT rules on these measures. GATT allows greater latitude on border measures if justified by balance-of-payments difficulties or the need

to develop an infant industry. In practice, both justifications are limited to LDCs.

The principal economywide border measure affecting agricultural trade is control of foreign exchange—mainly the rates at which national currencies are traded for one another. Differences between official and market exchange rates can be found in some LDCs. Of the 125 LDCs whose policies were examined by the International Monetary Fund in 1988, only 35 followed a policy of flexible exchange rates. In most cases, exchange controls raised the value of local currency when used in exchanges authorized by the State. (See *National Food Review*, October-December 1989, for an explanation of exchange rates.)

Until the mid-1980's, large currency overvaluations were common among developing nations. This had the effect of discouraging domestic production of internationally traded commodities, such as most agricultural goods, since imports were relatively cheap. Among the most overvalued currencies were those of Ecuador and Nigeria where official exchange

rates were three to six times what an open market would have supported.

### Levels of Intervention

As governments reform their policies they have a new interest in measuring their levels of intervention. GATT members are comparing themselves to their trade competitors. Lenders are comparing observed levels following reform to planned levels. Industries within an economy are comparing the effects of government policies on themselves with those in other sectors.

Numerous methods of measuring the effect of government involvement have been devised, but each suffers from theory and data problems that inevitably arise when trying to estimate such complex interactions around the globe. GATT negotiators have explored the producer subsidy equivalent (PSE) as an estimate of government intervention because it incorporates the effects of both domestic and border policies. Considerable analytical effort has gone into measuring PSEs for many countries.

Some effects of various LDC government policies and programs may be compared by using PSEs. This measure reduces all the effects of government intervention into one value—indicating the net transfer to or from farmers. When a PSE is positive, producers are being supported by government programs, and they are better able to compete with foreign production, such as that from the United States. On the other hand, if the policy costs producers money, such as an export tax, the PSE is negative.

Using PSEs, ERS economists examined government intervention in agriculture in 19 of the most important agricultural trading LDCs during 1982-87 (table 1). In contrast to the widespread pattern of support found in developed countries, LDC policies often taxed their farmers, generally by paying

**Table 1. Less Developed Countries Often Tax Their Agricultural Producers**

| Country <sup>2</sup> | Annual average value of subsidies<br>to producers during 1982-87 <sup>1</sup> |                         |         | Subsidies<br>as a percent<br>of producer<br>revenue |
|----------------------|---|-------------------------|---------|---|
|                      | Commodity-<br>specific<br>policies  | Economywide<br>policies | Total   |   |
|                      |   |                         |         |   |
|                      | Million dollars   |                         |         | Percent   |
| Taiwan               | 30,783  | nm                      | 30,783  | 24.0  |
| South Korea          | 5,083   | nm                      | 5,083   | 60.2  |
| Argentina            | -1,044  | 558                     | -486    | -19.4   |
| Brazil               | 2,321   | 73                      | 2,394   | 24.5  |
| South Africa         | 271   | -159                    | 112     | 6.8   |
| Mexico               | 1,441   | 543                     | 1,984   | 44.7  |
| Chile                | 136   | -210                    | -75     | -12.1   |
| Colombia             | -501  | -224                    | -725    | -34.2   |
| Turkey               | -110  | 163                     | 53      | 2.1   |
| Thailand             | -89   | nm                      | -89     | -4.5  |
| Egypt                | 769   | -1,066                  | -297    | -9.4  |
| Senegal              | 27  | nm                      | 27      | 16.0  |
| Indonesia            | 2,347   | nm                      | 2,347   | 10.2  |
| Nigeria              | 832   | -1,151                  | -319    | -15.0   |
| Pakistan             | -347  | -1,091                  | -1,439  | -22.0   |
| Kenya                | 82  | -165                    | -83     | -8.6  |
| India                | -363  | nm                      | -363    | -1.4  |
| China                | -23,193   | nm                      | -23,193 | -27.4   |
| Bangladesh           | -817  | nm                      | -817    | -19.0   |

nm = none measured. Among the countries not measured, probably only China had a large effect from these policies. <sup>1</sup>Negative subsidies are taxes. The commodities studied varied among countries. <sup>2</sup>Countries are listed from richest to poorest based on income per person.

low prices for state-controlled exports. These farmers' losses sometimes benefited the government budget and sometimes benefited consumers. In 8 of the 19 countries studied, agricultural commodity-specific policies reduced producer revenue.

In 7 of the 11 cases in which economywide effects were measured, they were detrimental to producer revenue. The economywide policies measured here were foreign exchange controls. Pakistan was a typical case. The government overvalued the exchange rate during 1982-87 so that imports were cheaper than they would have been without the controls. Pakistani farmers had to com-

pete with lower priced imports or sell on the international market at cheap local currency prices.

Overall, commodity-specific and economywide policies supported producers in about half the 19 LDCs. The richer LDCs tended to support their farmers at a higher rate. For instance, South Korea—the second richest LDC studied—gave its producers the highest rate of support.

During the study, 15 of the countries raised their rate of support or reduced their rate of taxation. For example, in early years of the period, Nigeria and Chile each taxed their producers by more than half the value of the commodities

under study, but in 1986 their policies provided more than 20 percent of producer revenue. Only China and Egypt significantly increased their rates of taxation during 1982-87.

These results are consistent with research conducted by the World Bank on the effect of LDC government intervention on agricultural competitiveness. For example, producers of temperate commodities in exporting LDCs generally have less support from their governments than farmers in developed countries. Nations that import temperate commodities frequently support producers of these crops at much higher levels. Japan, for example, attempts to limit its food imports by supporting its own farmers. Countries that grow tropical products tend to tax their producers. Coffee, which accounts for the highest trade value among tropical commodities, is an important example. In the mid-1980's, all of the largest 15 coffee-exporting nations paid their producers less than the international price.

### Reducing Government Intervention

ERS economists have evaluated how much government involvement in agriculture affects international trade by simulating the removal of government intervention based on agricultural trade patterns and government policies in 1986.

The starting point for the analysis considers the case of removing agricultural support for temperate products in developed nations. Without subsidies in the major trading nations of the developed world, production of temperate commodities would have fallen and international prices would have risen compared to 1986. The most heavily subsidized commodities, such as sugar and dairy products, would have experienced the greatest production declines. International sugar prices would have increased as much as 30 to 40 percent above actual 1986 lev-



els, while the price of dairy products would have climbed 40 to 80 percent, depending on the item and how much it was subsidized at the time. However, the average price of all temperate agricultural commodities would likely have risen by only 15 percent.

Any additional impact on international prices if LDCs completely liberalize agricultural trade would be fairly small unless foreign exchange constraints were lifted along with commodity-specific policies. With all policies in all countries eliminated, average prices for temperate crops in international markets would have risen about 8 percent above 1986 levels.

Although aggregate prices would have increased, some individual commodity prices would have declined. Cotton, tobacco, and some oilseed prices would have fallen with full global liberalization. This is because major suppliers of these commodities—Egypt, Sudan, and Pakistan—taxed their producers. Once these policies are removed, production would rise and the international prices would fall.

Similarly, prices of many tropical products, notably coffee, would also have fallen. For these commodities, the dominant exporters are LDCs that tax agricultural exports. Without these policies, world production would have risen, placing downward pressure on international prices.

The production and price effects of any scenario liberalizing temperate agriculture would generally improve the trade balance of LDCs. Agricultural exporting LDCs, like Argentina, Chile, and Thailand, would face less competition from developed countries whose policies were liberalized. Higher world food prices would probably lead India, Indonesia, and Bangladesh to produce and export more rice. Changes in the market caused by these large supplies

would be offset by increased Japanese rice imports.

The trade balance, however, would fall in some of the richer LDCs, such as Taiwan, South Korea, and the Middle Eastern oil exporters, in addition to the poorest LDCs. With higher prices, food imports would fall. Domestic production would likely improve but not enough to compensate for the import decline. Poor countries, such as Egypt and Peru, would require additional aid to assure their food security.

Liberalizing the trade of tropical products would tend to reduce the trade balance of several very vulnerable exporting economies. Lower international prices would mean less revenue for the economy from exports of tropical products, but individual producers would receive higher prices as domestic taxing policies were lifted. Coffee and cocoa would account for most of the loss in revenue to exporting nations. These tropical beverages are critically important to many small countries.

The largest revenue losses from global liberalization would occur in Brazil, Colombia, and Kenya. Banana prices would not change much on international markets, although production would shift as special arrangements between traditional trading partners were eliminated. The French islands of Martinique and Guadeloupe, for example, would face much lower prices with liberalization.

Trade liberalization would put agricultural production on a more commercial basis. Market signals would be more important in guiding production and distribution of agricultural goods, while other government goals would lose influence. Liberalization would also favor production of export commodities over food crops.

In the long run, poor countries would likely improve national income, but at the cost of greater dependence on international markets and, in many cases,

greater dependence on one or two export commodities. Without a ban on grain imports, for example, Nigerian consumers will turn to foreign sources for nearly all their wheat and rice. Increasing the relative return of export crops compared with food crops also tends to foster large farms. Thus, small farms might find it harder to compete in the market, either going out of business or returning to subsistence production. In rural areas, these problems would be offset by improved opportunities for jobs and better wages.

### **Implications of Trade Liberalization**

The diversity of LDC policies and economies complicates our understanding of how competitive their agriculture would be in a more liberal trading environment. Policy reforms in recent years have increased the level of support, or reduced the level of taxation, for LDC producers. Despite a few exceptional LDCs, like South Korea, where producers are supported at relatively high rates, they generally receive less support even now than farmers in developed countries. Further multilateral trade liberalization is likely to make LDCs even more competitive as traders of temperate products.

LDCs are particularly burdened by support in developed countries for producers of cotton and sugar. Production of both these commodities could shift strongly toward LDCs if policies in developed nations change.

In contrast, developed country policies on tropical products are less important. Since developed nations are seldom important producers, their policies affect only demand. Without a production interest, they did not institute policies as influential as those for temperate products. However, developed countries process tropical products, such as cocoa into chocolate, and they have structured their border measures to protect their processors. Thus, processing of these and other



Liberalizing trade in tropical products would tend to reduce the trade balance of several vulnerable exporting economies.

agricultural goods does offer potential for raising LDC employment following trade liberalization.

The heaviest support for agricultural producers in LDCs is in commodities that are imported. Egypt, for example, supports its wheat and corn producers in an attempt to substitute domestic production for imports, while it taxes its main agricultural export, cotton. Worldwide trade liberalization would benefit exporters in developed countries by making LDCs better customers. Without support for farmers substituting domestic produc-

tion for imports, LDCs like Egypt would buy more from the international market.

That U.S. farmers can successfully compete in a world with less government intervention in agriculture and trade is supported by the recent history of the richer LDCs. As countries like Mexico and South Korea developed, they became better customers for U.S. farm products, even when part of their development was based on domestic agricultural growth. Thus, the question of what LDC policies to promote in the interests of U.S. producers boils down to the question of what policies will help LDC economies. ■

## References

- Bibliography of Research Supporting the Uruguay Round of the GATT*, AGES 89-64. ERS, USDA, December 1989.
- Exchange Arrangements and Exchange Restrictions: Annual Report 1988*. International Monetary Fund, Washington, DC, 1988.
- GATT and Agriculture: The Concepts of PSE's and CSE's*, Misc. 1468. ERS, USDA, April 1989.
- Krissoff, Barry, John Sullivan, and John Wainio. "Opening Agricultural Markets: Implications for Developing Countries." Paper presented at Annual Conference of the Agricultural Institute of Canada, Montreal, July 9-12, 1989.
- Mabbs-Zeno, Carl and Barry Krissoff. "When Does Trade Liberalization in Tropical Beverages Improve Export Revenues?" *World Agriculture Situation and Outlook Report*, WAS-57. ERS, USDA, December 1989, pp. 27-30.
- Roninger, Vernon and Praveen Dixit. *Economic Implications of Agricultural Policy Reforms in Industrial Market Economies*, AGES 89-36. ERS, USDA, August 1989.
- World Development Report, 1986*. World Bank, Washington, DC, 1987.



# The Market for Fat Substitutes

Rosanna Mentzer Morrison  
(202) 786-1864

**H**ealth officials are urging Americans to eat less fat. While it plays an important dietary role, too much fat has been linked with higher risk of coronary heart disease and certain cancers.

The 1988 *Surgeon General's Report on Nutrition and Health* urges Americans to reduce their consumption of fat, especially saturated fat, and cholesterol. The American Cancer Society and the American Heart Association recommend that fat compose no more than 30 percent of the total calories an individual consumes. Currently, dietary fat accounts for about 37 percent of Americans' total energy intake. Lowering fat consumption can also help reduce obesity because fat is the most concentrated source of calories in our food. Fat provides 9 calories of energy per gram versus 4 calories each for protein and carbohydrates.

Similar guidelines on fat consumption were issued recently by the National Research Council's Committee on Diet and Health. The Committee suggests people reduce their fat intake by:

- Eating lean meats, poultry with the skin removed, fish, and low-fat or nonfat dairy products.
- Limiting consumption of fried foods, baked goods with large amounts of fat, and spreads and dressings high in fats and oils.

Many Americans, however, enjoy the taste of high-fat foods and may not want to give them up. Thus, food companies have been devoting considerable time and resources to developing products that taste like traditional high-fat foods but have less fat.

In existing reduced-fat foods, mixtures of water and starch or protein often replace some of the fat. However, these foods tend not to have the taste and creaminess of their traditional coun-

terparts, nor can they be used in cooking because the mixtures break down when heated. Therefore, the thrust of current research is to develop fat substitutes that create the same taste and texture as fat and have the same functional properties.

Consumers and food processors are understandably excited over the prospects for improved fat substitutes. At the same time, food safety regulators, nutritionists, and others are concerned about the substitutes' safety and nutritional impacts, as well as the potential effects on dietary patterns, demand for traditional fats and oils, and ingredient manufacturers.

## Sources of Fat in the Diet

Fat is a principal and essential component of our diets, along with protein and carbohydrates. Fat is a major source of energy, and it carries the fat-soluble vitamins A, D, E, and K throughout the body. Fatty acids, the chemical components of fat, help regulate many body functions, such as blood pressure, and are components of cell membranes and hormones. Fatty acids are classified as saturated, monounsaturated, or polyunsaturated, depending on their chemical composition.

Saturated fats are thought to increase the amount of cholesterol in the blood and may be partly responsible for coronary artery disease. The National Research Council's Committee on Diet and Health recommends limiting saturated fats to 10 percent of the calories we consume.

Fats that are solid at room temperature generally contain more saturated fat than those that are liquid. (Fats that are liquid at room temperature are called oils.) However, coconut and palm oil are more saturated than some solid fats, such as butter and beef fat.

Fat occurs in varying amounts in many foods (*table 1*). In 1985, fats and oils accounted for almost half of the fat

**Table 1. In 1985, Fats and Oils Accounted for Almost Half of the Fat in the U.S. Food Supply**

| Food groups                           | Total fat | Saturated fat |
|---------------------------------------|-----------|---------------|
|                                       | Percent   |               |
| <b>Fats and oils</b>                  | 44.3      | 29.0          |
| Salad, cooking, and other edible oils | 18.4      | 8.1           |
| Shortening                            | 16.8      | 14.2          |
| Margarine                             | 6.4       | 3.4           |
| Lard and beef tallow                  | 2.7       | 3.3           |
| <b>Meat and fish</b>                  | 31.3      | 39.3          |
| Red meats                             | 25.6      | 34.9          |
| Poultry                               | 5.0       | 3.9           |
| Fish                                  | 0.7       | 0.5           |
| <b>Dairy products</b>                 | 14.5      | 24.6          |
| Cheese                                | 4.7       | 8.2           |
| Fluid milk                            | 4.2       | 7.2           |
| Butter                                | 2.9       | 5.0           |
| Other                                 | 2.7       | 4.2           |
| <b>Nuts, legumes, and soy protein</b> | 3.8       | 1.8           |
| Eggs                                  | 2.3       | 1.9           |
| <b>Miscellaneous<sup>1</sup></b>      | 1.6       | 2.4           |
| <b>Grain products</b>                 | 1.3       | 0.6           |
| <b>Fruits</b>                         | 0.5       | 0.3           |
| <b>Vegetables</b>                     | 0.4       | 0.2           |
| <b>Total<sup>2</sup></b>              | 100.0     | 100.0         |

<sup>1</sup>Includes coffee, tea, cocoa, and spices. <sup>2</sup>May not add due to rounding.

Source: N. Raper and R. Marston, Nutrient Content of the U.S. Food Supply, Adm. Rep. No. 229-21, Human Nutrition Information Service, USDA, August 1988. Values for butter and margarine obtained directly from N. Raper.

in the U.S. food supply. Red meat, poultry, and fish were responsible for 31 percent of fat and 39 percent of the saturated fat in our diets. Overall, dairy products accounted for 14.5 percent of total fat consumed. However, the fat content of individual dairy products varied from 1 percent for nonfat dry milk to 10 to 15

The author is an economist with the Food Marketing and Consumption Economics Branch, Commodity Economics Division.

percent for ice cream and 30 percent or more for certain cheeses.

The fat present in foods such as milk, meats, eggs, and nuts occurs naturally, but may be altered through breeding or feeding practices. Other fats and oils are added to foods, either directly, such as dressings on salads or butter on bread, or as ingredients, such as shortening or cooking oils, in bakery products and other processed items. Processed foods—like cheeses, shortenings, and salad dressings—are the candidates for fat substitutes because food processors control the fat content.

### Types of Fat Substitutes

In addition to their nutritional roles, fats and oils add flavor and palatability to food. They also provide an essential

lubricating action in baked goods that contributes to the products' characteristic form and texture. In frying foods, fats and oils transmit heat rapidly and uniformly to the food's surface. Thus, a successful fat substitute must mimic the taste, texture, and functions of the fat it is replacing. The desired function of the fat—flavor, lubrication, or heat transfer—determines what properties the developers of fat substitutes try to achieve.

Replacing fat with water or air is one method manufacturers use to reduce the fat content of processed foods. In low-calorie dressings that have less oil and more water, xanthan gum is used to increase viscosity and shelf life. Mixtures of starch and water and proteins and water are also used to lower fat in many food items, such as yogurt, salad dress-

ing, and imitation margarine. Chocolate manufacturers have reduced fat in their products by using soybean and nut protein to replace some of the cocoa butter. Many of these replacements have limited applications or do not replicate the taste and creaminess of fat. Some imitation margarines, for example, separate at room temperature and when heated.

Below are examples of current fat substitutes, as well as substitutes made with enhanced technologies and new improved compounds.

- **Starch-based substitutes.** Mixtures of starch derivatives and water are used to produce a variety of reduced-fat foods. The mixtures do not have all the taste and functional properties of fat, so they can replace only part of the fats and oils without a loss in quality.

One such product, N-OIL, a tapioca dextrin marketed by National Starch and Chemical Corporation of Bridgewater, New Jersey, is used to reduce the fat content of salad dressings and ice cream. The company claims that N-OIL can replace 30 to 50 percent of the oil in salad dressings. National Starch and Chemical also sells a replacement for shortening in cake mixes. The substitute consists of emulsifiers, modified food starch, guar gum, and nonfat dry milk. A cake made with the shortening-free mix has 33 percent fewer calories than traditional cake, and the fat content drops from 10 to 3 grams per serving.

Maltodextrins made from corn starch can partially replace fat in salad dressings, margarines, and frozen desserts and cut calories in these products by a third. Maltrin M040, a maltodextrin made by Grain Processing Corporation of Muscatine, Iowa, is used in salad dressings, dips, diet margarines, and frozen desserts. However, it cannot be used by itself for frying or baking because it thins out and loses its creaminess when heated.



Milk and egg proteins are used in some fat substitutes. Photo: The NutraSweet Company



○ *Protein-based substitutes.* Mixtures of protein and water are also used as partial fat substitutes.

Thomas J. Lipton, Inc., a subsidiary of Unilever located in Englewood Cliffs, New Jersey, has developed a technology that uses either gelatin or milk proteins to halve the number of calories in margarine. The company is already using this fat substitute in two of its European margarines. In the United States, Lipton has test-marketed a low-fat "butter" made with the fat substitute and is evaluating the results. The product can withstand some heat, so it can be used for baking and light frying and sauteing.

Another protein-based substitute, which has received a lot of publicity, is Simplese, developed by the NutraSweet Company of Deerfield, Illinois. The company, a subsidiary of the Monsanto Company, also manufactures the low-calorie sweetener aspartame.

Simplese is made from egg whites or milk proteins. Through a process called microparticulation, the egg and milk proteins are heated and blended into round protein particles so tiny that they create the taste and texture of a creamy, rich fat. Simplese can be added to dairy products—like ice cream, yogurt, cheese, sour cream, and dips—and oil-based foods—like salad dressing and mayonnaise. However, the compound cannot be used to cook foods because heat causes the protein to gel and lose its creamy quality.

In September 1988, the NutraSweet Company filed a petition with the Food and Drug Administration (FDA) to have Simplese affirmed as a GRAS (generally recognized as safe) substance and allow its use in frozen desserts. FDA approved the use of Simplese in frozen desserts in February 1990.

Substituting Simplese for most of the fat in leading premium (high fat) products reduces calories by 50 to 80 percent and fat content by 85 to 97 percent. The

declines are so dramatic because one gram of fat has 9 calories, while Simplese has only 1 to 2 calories per gram.

In May 1989, Kraft General Foods, based in Glenview, Illinois, petitioned FDA for GRAS affirmation of its new fat substitute in frozen dessert products. Kraft's "modified protein texturizer" is a mixture of dried egg whites and whey-protein concentrate or skim milk combined with 5 to 15 percent xanthan gum and 1 to 2 percent food grade acid.

According to the company's petition, a frozen dessert with this new fat substitute will have less than two-thirds the calories and 5 to 10 percent of the cholesterol of an average ice cream product. Because the vitamin A normally present in milkfat will be lost when the fat is removed, Kraft plans to enrich its new "ice cream" with vitamin A.

○ *Fatty acid-based substitutes.* Other fat substitutes use fatty acids that have been chemically altered to provide fewer or no calories. Many of these are still under development.

Polyglycerol esters have 6 to 6.5 calories per gram, about one-third less than a gram of fat. They are used in low-calorie versions of ice cream, other frozen desserts, margarines, shortenings, peanut butter, whipped toppings, and bakery items.

Another type of fatty acid-based substitute functions and tastes like fat but passes through the body unabsorbed because the molecules are too large for the body's enzymes to break down. The most important of these undigestible fatty acid-sugars is olestra, a mixture composed of sucrose and six, seven, or eight fatty acid esters. The Procter & Gamble Company, headquartered in Cincinnati, Ohio, has been developing olestra since the 1960's.

In 1987, Procter & Gamble petitioned FDA for permission to use olestra in shortenings and oils for home and com-

mercial use. Specifically, the company proposed including up to 35 percent olestra in shortenings and oils used at home and by foodservice personnel for grilling and seasoning vegetables, meats, and fish and for donuts, sauces, and salad oils.

Olestra would replace up to 75 percent of traditional shortenings and oils for deep fat frying in restaurants and other foodservice outlets and preparation of commercial snack foods, like potato chips. FDA is reviewing the petition. Although olestra can also be substituted for some fat in ice cream, margarine, salad dressing, and processed meats, Procter & Gamble has not petitioned FDA for these uses.

The ARCO Chemical Company of Newtown Square, Pennsylvania, is working on a fat substitute called esterified propoxylated glycerol (EPG). Like olestra, EPG is undigestible. The company is testing it in a wide variety of foods including frying oils, ice cream, baked goods, and dressings. ARCO Chemical estimates that EPG faces about 4 years of safety tests before the company will be ready to petition FDA, but ARCO Chemical has already applied for patents.

Other food companies are also developing their own fatty acid-based substitutes for a variety of foods. Unilever; Frito-Lay, Inc., of Plano, Texas; and CPC International, Inc., headquartered in Englewood Cliffs, New Jersey; are among those involved in the research.

## Market Potential

The potential market for fat substitutes is determined by two factors:

○ *The size of the markets for products in which fat substitutes can be used.* The largest of these markets is fats and oils. In 1988, the fats and oils market totaled about 14 billion pounds (table 2). Baking and frying fats, salad and cooking oils, and margarine accounted for about

**Table 2. Food Processors Are Large Users of Baking and Frying Fats and Salad and Cooking Oils**

| Item  | Annual<br>production      | Market share |                |              |
|---|---------------------------|--------------|----------------|--------------|
|   |                           | Processing   | Retail         | Foodservice  |
|   | <i>Million<br/>pounds</i> |              | <i>Percent</i> |              |
| <b>Fats and oils</b>                                | 14,089                    |              |                |              |
| Baking and frying fats <sup>1</sup>                 | 5,377                     | 54           | 10             | 36           |
| Salad and cooking oils <sup>1</sup>                 | 6,499                     | 71           | 22             | 7            |
| Mayonnaise <sup>2</sup>                             | 1,706                     | <sup>3</sup> | 45             | <sup>3</sup> |
| Salad dressing and<br>sandwich spreads <sup>2</sup> | 914                       | <sup>3</sup> | 45             | <sup>3</sup> |
| Pourable dressings <sup>2</sup>                     | 1,155                     | 0            | 45             | 55           |
| Margarine <sup>1</sup>                              | 1,895                     | 6            | 76             | 18           |
| Specialty items                                     | 318                       | na           | na             | na           |
| <b>Selected dairy products</b>                      | 12,066                    |              |                |              |
| Butter <sup>4</sup>                                 | 903                       | 31           | 25             | 44           |
| Ice cream and products <sup>5</sup>                 | 4,471                     | 0            | 83             | 17           |
| Processed cheese <sup>4,6</sup>                     | 1,270                     | 29           | 33             | 38           |
| Natural cheese <sup>4,6</sup>                       | 3,589                     | 29           | 33             | 38           |
| Yogurt <sup>4</sup>                                 | 1,124                     | na           | na             | na           |
| Specialty creams <sup>4</sup>                       | 709                       | na           | na             | na           |

na = not available. <sup>1</sup>1988 ERS data. Distribution between markets from the Institute of Shortening and Edible Oils and the National Association of Margarine Manufacturers. <sup>2</sup>1986 data from the Association for Dressings and Sauces. Categories are a subset of salad and cooking oils and do not add to total. <sup>3</sup>Combined market share is 55 percent. <sup>4</sup>1987 ERS data. Allocations among the three markets from the National Dairy Board. <sup>5</sup>1987 ERS data, except for foodservice data, which are from Foodservice Research & Marketing. <sup>6</sup>Total food disappearance minus USDA donations.

Sources: J.J. Putnam, Food Consumption, Prices, And Expenditures, 1966-87, SB-773, ERS, USDA, January 1989; Oil Crops Situation and Outlook Yearbook, OCS-22, ERS, USDA, July 1989; and Dairy Products Study, Wave 2-1987, Foodservice Research & Marketing, New York, New York, April 1988.

13.8 billion pounds. Another 318 million pounds of fats and oils were used in specialty food applications, such as nondairy toppings, coffee whiteners, and confectionery coatings.

Food processing is the largest market segment for baking and frying fats and salad and cooking oils. About 54 percent of baking and frying fats produced annually are used by cookiemakers, snack food companies, and other food processors. The foodservice industry—restaurants, fast-food outlets, school cafeterias, and other facilities serving food—accounts for about 2 billion pounds, or 36 percent, of these fats. With a 71-per-

cent market share, food processors are also big consumers of salad and cooking oils, which they use to make products like mayonnaise and dressings. In contrast, three-fourths of the margarine is sold in retail foodstores.

Some dairy products are also possible candidates for fat substitutes. Annual production of butter, ice cream, natural and processed cheeses, yogurt, and specialty creams equaled 12.1 billion pounds in 1987.

○ *The fat content of the products.* The amount of fat a food contains determines how much of a fat substitute can be used in the product. For example, baking and

frying fats and salad and cooking oils are 100 percent fat. Thus, a fat substitute that has all the properties of traditional fats could potentially replace the 11.9-billion-pound market for these items (table 3). Mayonnaise, on the other hand, is 80 percent fat so the potential market for a fat substitute is 1.4 billion pounds.

Dairy products that are candidates for fat substitutes also vary in their fat content, from 81 percent for butter down to only 3 percent for yogurt. The potential use of fat substitutes in these items totals 2.8 billion pounds. Natural cheeses and butter are the two largest markets.

The processing, retail, and foodservice sectors may differ in their interest in fat substitutes. Processors may be the most eager group to capitalize on the calorie- and fat-reducing properties of these substitutes to gain an edge over their competitors. The foodservice industry may be less interested in these attributes because most consumers do not seek out such alternatives as diligently when dining out. In a 1988 survey conducted by the Food Marketing Institute, 72 percent of respondents said that nutrition was a very important factor when they shop for food, while only 29 percent reported being very concerned about food ingredients when eating out.

However, the foodservice industry may be able to more readily absorb the higher price of a low-fat product because food costs are a smaller share of menu prices than of grocery prices. According to industry studies, food costs accounted for 74 cents of each dollar the consumer spent in the supermarket in 1987 but only 30 percent of the restaurant bill.

### Factors Affecting Marketability

Existing low-fat and low-calorie items vary in their popularity with consumers. For example, according to scanner check-out data, diet soft drinks account for about 30 percent of foodstore soft drink sales, and reduced-calorie liquid salad



**Table 3. The Market for Fat Substitutes Could Reach 16.2 Billion Pounds**

| Item                                 | Average fat content <sup>2</sup> | Potential market for fat substitutes <sup>1</sup> |        |              |        |
|--------------------------------------|----------------------------------|---|--------|--------------|--------|
|                                      |                                  | Processing  | Retail | Food-service | Total  |
|                                      | Percent                          | Million pounds                                    |        |              |        |
| <b>Fats and oils</b>                 |                                  | 7,610   | 3,134  | 2,667        | 13,411 |
| Baking and frying fats               | 100                              | 2,904   | 538    | 1,936        | 5,378  |
| Salad and cooking oils               | 100                              | 4,614   | 1,430  | 455          | 6,499  |
| Mayonnaise                           | 80                               | <sup>3</sup>                                      | 614    | <sup>3</sup> | 1,365  |
| Salad dressings and sandwich spreads | 42                               | <sup>4</sup>                                      | 173    | <sup>4</sup> | 384    |
| Pourable dressings                   | 36                               | 0   | 187    | 229          | 416    |
| Margarine                            | 81                               | 92  | 1,166  | 276          | 1,534  |
| <b>Dairy products</b>                |                                  | na  | na     | na           | 2,806  |
| Butter                               | 81                               | 227   | 183    | 322          | 732    |
| Ice cream and novelties              | 11                               | 0   | 408    | 84           | 492    |
| Processed cheese                     | 31                               | 114   | 130    | 150          | 394    |
| Natural cheese                       | 28                               | 291   | 332    | 382          | 1,005  |
| Yogurt                               | 3                                | na  | na     | na           | 34     |
| Specialty creams                     | 21                               | na  | na     | na           | 149    |

na = not available. <sup>1</sup>Computed from table 2. <sup>2</sup>Product-weight basis. <sup>3</sup>Combined potential market is 751 million pounds. <sup>4</sup>Combined potential market is 211 million pounds.

dressings make up about 23 percent of their market. On the other hand, consumers do not view ice milk and sherbet as good substitutes for ice cream. These products have captured only about 11 percent of the ice cream/ice milk market.

Whether products containing new fat substitutes will replace existing low-fat items on supermarket shelves or even expand the popularity of low-fat foods depends on several factors—FDA approval, the substitutes' quality and versatility, strength of consumer demand and willingness to pay for reduced-fat products, and marketing strategies.

Before a novel substitute can be marketed, the manufacturer must obtain FDA's permission for each food use. At this time, FDA has granted the NutraSweet Company permission to use its new substitute only in frozen desserts. Expanded usage would require companies to file additional petitions. Because fat is an essential nutrient, FDA will carefully consider what foods to allow the

substitutes in and at what levels, so that people do not risk eliminating fat from their diets.

For new fat substitutes to catch on with manufacturers and consumers and expand the low-fat market, they must be technically superior to existing substitutes and offer better taste or more versatility. Unlike today's fat replacements, true fat substitutes must mimic the taste, texture, and functions of fat. Substitutes may face the greatest difficulty competing with highly flavored fats, such as milk fat and olive oil.

The strength of demand for low-fat foods will strongly influence manufacturers' decisions to develop and market foods containing fat substitutes. Demand is expected to continue to increase as more health professionals extol the virtues of a low-fat diet. In an April 1989 survey for the Calorie Control Council, "staying in better overall health" was the number one reason respondents gave for using low-calorie

foods and beverages. Among the low-calorie consumers in the survey, 52 percent said they would like to see more low-calorie alternatives available, especially cakes and pies, cookies, and ice cream. When asked about fat substitutes, 57 percent of the total sample and 69 percent of low-calorie consumers expressed a need for new fat substitutes.

But will people pay more for low-fat items? According to scanner checkout data, reduced-calorie liquid salad dressings sold in foodstores average about 10 cents more per pound than regular salad dressings. How manufacturers will price products containing new fat substitutes is unclear, in part because the costs of producing the substitutes will not be precisely known until they are made on a commercial scale.

Dr. Norman Sonntag, a fats and oils industry analyst, classified the cost of existing and proposed fat substitutes by assessing their raw material and processing costs (excluding expenses for research and development). He placed the existing starch-based substitutes, N-OIL and Maltrin M040, in the low-cost group at \$1 per pound or less. The undigestible fats, olestra and ARCO Chemical's EPG, were in the average group projected to cost \$1.01 to \$2 per pound. He placed Simplese in the third group with estimated production costs of \$2.01 to \$3. (The NutraSweet Company expects production costs to equal \$1 to \$2 per pound.) In comparison, refined soybean oil sells at between 20 and 35 cents per pound and milk fat costs about \$1.35.

Whether companies developing the new substitutes and obtaining FDA approval will use them only in their own products or sell them as ingredients to other manufacturers is also a factor influencing marketability. A food company that develops a fat substitute may wish to restrict its use to its own brands. On the other hand, an ingredient manufacturer

will likely make its substitute available to any food processor willing to purchase it. This approach expands the potential market for a fat substitute from one brand's share to the entire market for that low-fat food.

### Issues and Concerns

The likelihood of a plethora of reduced-fat products raises several nutritional and food safety concerns. Many nutritionists are wary of fat substitutes. They have been trying for years to get Americans to substitute nutrient-rich fruits, vegetables, and grain products for high-fat foods. Their message has been to eat raw carrot sticks, not low-fat potato chips. Once the new low-fat products are on the market, people might eat more of these foods, instead of consuming healthful, nutrient-dense items.

Nutritionists also fear that fatty foods could follow the same consumption pattern shown by sweeteners during the last decade. Despite the growing array of foods and beverages containing artificial sweeteners, annual consumption of sugar and corn syrups rose from 125 to 131 pounds per capita between 1977 and 1987.

In addition to a fat substitute's nutritional implications, its toxicological safety is a major concern. Demonstrating the safety of a new food ingredient and securing FDA approval will have a significant impact on the length of the time required to commercially develop a new fat substitute. Consumers' perceptions of safety are also important. Negative consumer reaction could jeopardize sales of new reduced-fat products and other items made by the company.

Labeling issues will also emerge. Many of the target foods for fat substitutes, such as margarine, mayonnaise, and ice cream, are covered by FDA-enforced standards of identity. Standards of identity specify what ingredients and quantities these products must con-



The Food and Drug Administration recently approved the use of Simplese in frozen dairy desserts.  
Photo: The NutraSweet Company

tain to be called by their traditional names. For example, a frozen dairy product containing less than 10 percent milk fat cannot be called ice cream. Margarine must have at least 80 percent fat to be labeled "margarine." Products containing less fat would need to be called by another name.

The National Renderers Association has raised objections to some of the undigestible fat substitutes. Renderers buy scrap bones and fat trimmings from slaughterhouses and supermarkets and collect the deep fat frying grease discarded by foodservice establishments. These byproducts are used in animal feeds and pet foods. According to a 1989 SRI International study, renderers collect

2.3 to 2.4 billion pounds of waste grease yearly from the U.S. foodservice industry.

The renderers believe that if the throw-away grease has fewer calories and less nutritional value, farmers and pet food manufacturers would pay a lower price or no longer buy the recycled grease. This could make it uneconomical for renderers to pick up the waste grease and could lead to a serious disposal problem.

Another set of issues would involve the intercommodity effects of fat substitutes. A growing market for fat substitutes would increase the demand for the ingredients used in their manufacture and displace demand for traditional fats and oils. Compounds, such as olestra, made from traditional vegetable oils would have a smaller economic impact on the



oils industry than those made from other ingredients.

Vegetable oil-based substitutes would also raise demand for other ingredients used to make the substitutes. In the case of olestra, this would be sugar. If such a fat substitute caused demand for fat-containing foods to increase substantially, sales of vegetable oils would rise.

On the other hand, if a protein-based substitute, such as Simplesse, is used in oil-based products, demand for traditional vegetable oils would fall and demand for the ingredients used to make the substitute would grow. For example, if Simplesse were used in retail low-calorie salad dressings, it would displace about 9.5 million pounds of vegetable oil. If 10 percent of regular salad dressings, which contain more than five times as much oil, also switched to Simplesse, another 17.6 million pounds of vegetable oil would be displaced.

Simplesse uses either whey protein or egg whites as raw ingredients. In the above example, about 9 million pounds of milk or egg protein would be used in place of the 27.1 million pounds of oil. The source of the protein would depend on price and availability. In 1989, more than 200 million pounds of whey protein were an unused byproduct of cheese manufacturing, so the 9 million pounds of whey protein needed could come from this source and the dairy industry would not need to produce additional milk.

The egg market is a different situation. Demand for egg whites is very strong. The price of frozen liquid egg whites doubled during 1989. To produce 9 million additional pounds of egg whites, annual production would have to increase by 2.3 percent from the 1989 level of 390 million pounds.

Simplesse's use in ice cream would not affect the vegetable oil market but would displace milkfat. For example, if Simplesse were used in 25 percent of U.S. ice cream, about 123 million pounds of milkfat would be displaced by 40 million pounds of milk or egg protein, adding to the current surplus of milkfat.

The potential for fat substitutes is promising. Health professionals continue to advise consumers to reduce their fat consumption, and food manufacturers perceive a growing and lucrative market for fat substitutes. Consumers are likely to support research and development efforts because they want to follow the health guidelines without changing their eating habits. ■

## References

- Borgeson, N.S. et al. *U.S. Production and Uses of Yellow Grease*, SRI Project No. 6225. SRI International, Menlo Park, California, January 1989.
- Bunch, K. and J. Hazera. "Fats and Oils: Consumers Use More, But Different Kinds." *National Food Review*, NFR-26. ERS, USDA, 1984, pp. 18-21.
- GRAS Affirmation Petition for Modified Protein Texturizers in Frozen Dessert. Petition submitted to the U.S. Food and Drug Administration, Kraft General Foods, May 22, 1989.
- Haumann, B.F. "Getting the Fat Out." *Journal of American Oil Chemists' Society*, Vol. 63, No. 3, March 1986, pp. 278-288.
- Key Costs in the Supermarket Industry*. Food Marketing Institute, Washington, DC, 1988.
- "Majority of Americans Prefer a 'Low-Cal' Lifestyle." *Calorie Control Council News*, June 29, 1989.
- National Research Council. *Diet and Health Implications for Reducing Chronic Disease Risk*. National Academy Press, Washington, DC, 1989.
- Restaurant Industry Operations Report*. National Restaurant Association, Washington, DC, 1988.
- Sonntag, N.O.V. "Fat Substitutes—One Option to Low-Calorie Foods." Paper presented at the American Oil Chemists' Society annual meeting, Cincinnati, Ohio, May 6, 1989.
- The Surgeon General's Report on Nutrition and Health*. DHHS No. 88-50211. Dept. of Health and Human Services, 1988.
- Trends—Consumer Attitudes and the Supermarket 1988 Update*. Research Department, Food Marketing Institute, Washington, DC, 1988.
- Waring, S. "Shortening Replacement in Cakes." *Food Technology*, Vol. 42, No. 3, March 1988, pp. 114-117.



# Recent Trends in Domestic Food Programs

Masao Matsumoto  
(202) 786-1864

*Participation and costs discussed in this article compare the fourth quarter of fiscal year 1989 (July-September) with the same period in 1988. Recent data are reported as of January and are subject to revision.*

Federal expenditures on domestic food assistance reached \$4.59 billion in the fourth quarter of fiscal 1989, up slightly from the \$4.42 billion spent during the same period in 1988 (table 1). Individual program expenditures, with the exception of the food distribution programs, remained at the previous year's level or increased. Due to depleted government stocks, commodities distributed to charitable institutions, the National School Lunch Program, and through the Temporary Emergency Food Assistance Program were significantly less than a year earlier.

## Food Stamp Program

Average participation in the Food Stamp Program increased from 18.65 million in 1988 to 18.77 million in 1989. Average monthly benefits rose 4 percent to \$51.90 per person during the same period. The Federal share of State administrative expenses grew to an average \$88.39 million per month in 1989, while other Federal costs dropped to \$4.96 million. Due to the rise in participation and average benefits, total program costs for the fourth quarter increased from \$3.04 billion to \$3.21 billion, a 5.6-percent rise.

## Child Nutrition Programs

In September 1989, average daily participation in the National School Lunch Program totaled 23.55 million, 1.5 percent less than in 1988. Participation fell because the number of students paying full price dropped from 13.3 million to



Average daily attendance at facilities offering the Child Care Food Program dropped 1.5 percent to 1.28 million in 1989.

12.4 million. The number of participants getting reduced-price meals increased from 1.32 to 1.55 million, and those receiving free meals grew from 9.27 million to 9.59 million.

Federal expenditures for the program, which include cash payments and commodities, totaled \$369.3 million in September 1989, 0.4 percent less than the amount spent in 1988. Cash payments rose from \$328.4 million to \$335.6 million, while entitlement commodities dropped from \$42.3 million to \$33.7 million. Schools also receive bonus commodities as part of the National School Lunch Program. In September 1989, they got \$18.9 million in bonus commodities. Bonus commodities declined 16 percent between fiscal years 1988 and 1989.

Approximately 40,000 schools offer the School Breakfast Program, which provides free and reduced-price breakfasts to children whose families meet certain eli-

gibility criteria. During September 1989, a daily average of 3.56 million students participated in the program, up from 3.47 million served in September 1988. In 1989, 81 percent of the participants received free meals, 5 percent paid a reduced price, and 14 percent paid full price. Federal expenditures for the School Breakfast Program increased 11.5 percent to \$55.4 million in September 1989.

Average daily attendance at facilities offering the Child Care Food Program dropped 1.5 percent to 1.28 million in 1989. The number of outlets climbed from 125,204 to 136,344 over the same period. Total meals served in the Child Care Food Program, including the newly instituted adult care food program, rose 11 percent to 203.7 million. Federal costs for the program reached \$169.2 million in the last quarter of 1989, a 17.9-percent increase over 1988.

The author is an agricultural economist with the Food Marketing and Consumption Economics Branch, Commodity Economics Division.



**Table 1. Benefit Costs of USDA Food Assistance Programs Rose Slightly in 1989<sup>1</sup>**

| Program                      | 1988   | 1989   | Fiscal 1988 quarters |       |       |       | Fiscal 1989 quarters² |       |       |       |
|------------------------------|--------|--------|----------------------|-------|-------|-------|-----------------------|-------|-------|-------|
|                              |        |        | I                    | II    | III   | IV    | I                     | II    | III   | IV    |
| Million dollars              |        |        |                      |       |       |       |                       |       |       |       |
| Family food                  |        |        |                      |       |       |       |                       |       |       |       |
| Food stamps                  | 11,149 | 11,682 | 2,781                | 2,842 | 2,790 | 2,736 | 2,902                 | 2,955 | 2,925 | 2,900 |
| Puerto Rico³                 | 883    | 912    | 221                  | 221   | 221   | 221   | 228                   | 228   | 228   | 228   |
| Food distribution            |        |        |                      |       |       |       |                       |       |       |       |
| Indian reservations          | 47     | 52     | 12                   | 12    | 12    | 12    | 12                    | 14    | 13    | 13    |
| Schools⁴                     | 830    | 783    | 255                  | 285   | 139   | 151   | 272                   | 298   | 120   | 82    |
| Other⁵                       | 220    | 209    | 58                   | 62    | 48    | 51    | 58                    | 56    | 52    | 45    |
| TEFAP⁶                       | 593    | 219    | 189                  | 185   | 142   | 77    | 44                    | 61    | 74    | 60    |
| Cash in lieu of commodities⁷ | 152    | 150    | 38                   | 38    | 39    | 38    | 37                    | 38    | 39    | 38    |
| Child nutrition⁸             |        |        |                      |       |       |       |                       |       |       |       |
| School lunch                 | 2,908  | 3,005  | 874                  | 929   | 724   | 382   | 904                   | 932   | 772   | 398   |
| School breakfast             | 474    | 512    | 141                  | 147   | 121   | 65    | 151                   | 155   | 134   | 72    |
| Child care and summer food   | 648    | 745    | 131                  | 140   | 161   | 216   | 148                   | 157   | 187   | 253   |
| Special milk                 | 19     | 19     | 5                    | 5     | 4     | 4     | 5                     | 5     | 5     | 4     |
| WIC⁹                         | 1,798  | 1,910  | 425                  | 444   | 460   | 467   | 459                   | 466   | 472   | 509   |
| Total¹⁰                      | 19,721 | 20,198 | 5,129                | 5,311 | 4,860 | 4,418 | 5,219                 | 5,364 | 5,021 | 4,601 |

<sup>1</sup>Fiscal years. Administrative costs are excluded unless noted. <sup>2</sup>Preliminary. Quarterly data may not add to annual total due to rounding. <sup>3</sup>Represents annual appropriations. Includes grant for Northern Marianas. <sup>4</sup>Includes National School Lunch, Child Care Food, and Summer Food Service Programs, and schools receiving only commodities.

<sup>5</sup>Includes Commodity Supplemental Food Program, Nutrition Program for the Elderly, and donations to charitable institutions. <sup>6</sup>Temporary Emergency Food Assistance Program. <sup>7</sup>Includes child nutrition programs and Nutrition Program for Elderly. <sup>8</sup>Cash expenditures. <sup>9</sup>Special Supplemental Food Program for Women, Infants, and Children. Includes administrative costs. <sup>10</sup>May not add due to rounding.

Source: Food and Nutrition Service.

The number of half pints of milk served under the Special Milk Program dropped 3.9 percent; 18.3 million half pints were served last September, compared with 19.0 million in 1988. Program costs for the quarter rose 4.1 percent from \$4.0 million to \$4.2 million.

To reflect changes in the costs of preparing and serving meals in schools, the Federal Government each year adjusts the meal reimbursement rates, the amount that schools may receive for each meal served (*table 2*). School lunch reimbursement rates rose an average of 5.6 percent, while entitlement commodities

for each meal rose by 8.2 percent. Breakfast reimbursement rates increased by significantly greater percentages, reflecting a change in the authorizing legislation to increase program subsidies in order to improve the meal pattern and encourage more schools to participate.

### Supplemental Food Programs

Participation in the Special Supplemental Food Program for Women, Infants, and Children (WIC) continued to grow to a record 4.4 million in 1989, a 19-percent increase from 1988. Women accounted for 23.2 percent of partici-

pants in 1989; infants, 30.3 percent; and children, 46.5 percent.

Federal costs for the WIC program in the fourth quarter of fiscal 1989 equaled \$498.3 million, 6.8 percent more than in 1988. Food costs went up 7.4 percent to \$388.0 million. However, average monthly food costs for the quarter fell from \$32.60 to \$29.52 per person, reflecting the effect of rebates from infant formula manufacturers.

Monthly participation in the Commodity Supplemental Food Program increased 27 percent to 271,146 in 1989. Participation rose for women, infants, and children, but the greatest percentage

increase was in the number of elderly persons who participated in the program. Total fourth quarter costs for the program grew 27 percent, reaching \$14.2 million in 1989.

### Food Distribution Programs

The average number of participants in the Food Distribution Program on Indian Reservations rose from 136,349 in the fourth quarter of fiscal 1988 to 145,777 during the same period in 1989. The number of projects distributing food expanded from 108 to 109. Food costs were \$10.2 million in 1989, 9.7 percent higher than in 1988. Bonus commodity donations continued at the 1988 level of \$2.3 million.

An average of 911,300 meals per day were served under the Nutrition Program for the Elderly, compared with 934,000 a year earlier. USDA provides cash and

**Table 2. Meal Reimbursement Rates for Child Nutrition Programs Have Increased<sup>1</sup>**

| Program and meal type        | July 1, 1988 thru June 30, 1989 | July 1, 1989 thru June 30, 1990 |
|------------------------------|---------------------------------|---------------------------------|
| <i>Cents per meal</i>        |                                 |                                 |
| <b>National School Lunch</b> |                                 |                                 |
| Paid                         | 14.00                           | 14.75                           |
| Reduced price                | 106.25                          | 113.25                          |
| Free                         | 146.25                          | 153.25                          |
| Commodities <sup>2</sup>     | 12.25                           | 13.25                           |
| <b>School Breakfast</b>      |                                 |                                 |
| Paid                         | 14.00                           | 17.50                           |
| Reduced price                | 49.25                           | 56.00                           |
| Reduced price, severe need   | 64.75                           | 72.00                           |
| Free                         | 79.25                           | 86.00                           |
| Free, severe need            | 94.75                           | 102.00                          |
| <b>Special Milk</b>          |                                 |                                 |
| Paid                         | 9.50                            | 10.25                           |
| Free                         | Actual cost                     | Actual cost                     |

<sup>1</sup>Basic rates are higher in Alaska and Hawaii.

<sup>2</sup>Entitlement commodities.

commodities to this program, which serves meals to senior citizens. Federal expenditures for food and cash in lieu of commodities totaled \$34.4 million in 1989, down slightly from \$35 million in 1988. The amount of bonus commodities donated to the program fell substantially from \$1.8 million to \$0.8 million.

In the fourth quarter of fiscal 1989, USDA donated \$23.9 million in surplus and bonus commodities to charitable institutions, 32 percent less than the \$35.0 million distributed the previous year. The Temporary Emergency Food Assistance Program distributed \$50.7 million worth of commodities to needy persons in the fourth quarter of fiscal 1989, 34 percent less than in 1988. The Federal Government also provided \$40 million worth of commodities to soup kitchens and food banks in fiscal 1989. ■



# Food and Nutrition Legislation

Susan L. Pollack  
(202) 786-1696

*Numerous food and nutrition bills have been introduced in the 101st Congress since August 1989. One new law and several bills are described below.*

## Food Assistance

### P.L. 101-147

This law reauthorizes the Special Supplemental Food Program for Women, Infants, and Children (WIC), and the Commodity Distribution, School Breakfast, and Nutrition Education and Training Programs through fiscal 1994. It also permits private, nonprofit organizations to sponsor the Summer Food Service Program in areas where no public sponsor operates such a program. Private sponsors can serve no more than 2,500 children and have no more than 5 sites in urban areas or 20 sites in rural areas. Other provisions of the law include:

- Establishing demonstration projects under the Child Care Food Program to provide year-round foodservice for homeless children under age 6 in emergency shelters.
- Setting up statewide demonstration programs to permit private, for-profit child-care centers to participate in the Child Care Food Program if at least 25 percent of the children in the facility are from families with incomes at or below 185 percent of the Federal poverty line.
- Requiring State education agencies to provide information to school boards and officials about the benefits and availability of the School Breakfast Program.
- Requiring that people at nutritional risk who are eligible for food stamps, Aid to Families with Dependent Children, or Medicaid be automatically eligible to meet the income test to qualify for WIC.

The author is an agricultural economist with the U.S. Agricultural Policy Branch, Agriculture and Trade Analysis Division.

- Requiring State WIC offices to promote breast-feeding.

## Nutrition

### S. 1739—Sen. Tom Harkin (IA)

The Nutrition and Health Act would establish a permanent Federal Council on Nutrition and Health in the Department of Health and Human Services (HHS). The council would serve as a clearinghouse and focal point for current scientific information on the connection between nutrition and health. It would not have authority to make policy, nor would it take enforcement or policymaking authority in nutrition and health from any existing Federal agency.

## Food Safety and Quality

### H.R. 3071—Rep. Timothy Penny (MN)

The Comprehensive Food Safety Act of 1989 would consolidate HHS and Interior Department agencies responsible for food safety with USDA's Food Safety Inspection Service. The new agency would be located in USDA.

### H.R. 3084—Rep. Charles Rangel (NY)

The Nutritional Information Labeling Act of 1989 would require that food labels list information on oils or fats according to their common names. It would also require that the labels include the amount of each oil or fat; the amounts of saturated, polyunsaturated, and monounsaturated fats; and the amounts of sodium and potassium in the food.

### H.R. 3292—Rep. E. (Kika) de la Garza (TX)

The Food Safety Assurance Act of 1989 would amend the Delaney clause of the Federal Food, Drug, and Cosmetic Act and the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).

The Delaney clause would be modified to allow for negligible risk with respect to traces of carcinogenic pesticides in food rather than the present zero tolerance to determine a food's safety. It would amend FIFRA by streamlining the procedure for removing pesticides determined to be hazardous from the marketplace. The present system requires a regulatory review that can be very lengthy and a formal judicial hearing. This two-stage process can take up to 5 or 6 years to remove a dangerous pesticide from use. Under the proposed changes, a single-stage process of an informal ruling would enable the Environmental Protection Agency to take quick action to remove harmful pesticides from the market.

Other provisions of the bill would provide additional resources to increase the Food and Drug Administration's program to monitor violations of food safety regulations, provide additional resources for gathering information on pesticide use to help create sound regulations, and direct USDA to research and disseminate information to farmers about integrated pest management and other techniques to minimize chemical pesticide use.

### H.R. 3369 and H.R. 3481—Rep. Dan Glickman (KS)

The Consumer Seafood Safety Act of 1989 would prohibit the sale or processing of fish or fishery products which have been adulterated or come from vessels or establishments that do not cooperate with inspection; that have altered, destroyed, or copied official stamps, certificates, or records; or that have not been certified by USDA. It would also prohibit the sale of imported fish and fishery products from countries that do not meet U.S. standards and regulations. Violators would be fined \$10,000 for the first offense, with a 5-percent increase for each additional offense. The offenders'



Several bills have been introduced into the 101st Congress that would regulate the fish and seafood industry.

names would be published in the *Federal Register*.

Also, USDA would be able to halt inspections of vessels or establishments for any period necessary to protect the public health, curb persistent violations, or enforce other provisions of the bill. An individual who purposely adulterates products would face up to 2 years in prison. The bill authorizes \$75 million to carry out the program for each fiscal year from 1990 through 1993. H.R. 3481 supersedes H.R. 3369, making minor technical changes to the original bill.

Adulterated fish and fish products would be defined as those containing hazardous substances, such as chemicals, parasitic organisms—like bacteria and viruses, and natural microbiological toxins; products failing to meet sanitation, processing, storage, and handling regulations; products derived from shellfish harvested in areas containing hazardous substances; and products imported from countries that do not have a comparable fish and fish products safety program.

#### **H.R. 3508—Rep. E. (Kika) de la Garza (TX)**

The Federal Inspection for Seafood Healthfulness Act of 1989 would amend the Agricultural Marketing Act of 1946 to promote seafood and seafood products and provide a comprehensive seafood inspection system including fresh catch and aquaculture-grown seafood. The bill would also help develop new markets for domestic seafood both within the United States and abroad.

H.R. 3508 would establish a Federal inspection program designed for the specific characteristics of seafood and its processing and would require periodic registration and inspection of seafood establishments and vessels. It would also require registration of establishments and vessels that process seafood, compliance of their labels and packaging with standards approved by USDA, and maintenance of accurate records of receipts, deliveries, sales, movements, or dispositions of seafood or seafood products.

The bill would authorize inspectors to enter vessels and establishments at any

time to sample and inspect the products, their labels and packaging, and equipment and records. It would also establish and maintain a system for sampling and testing of seafood to identify and designate geographical areas from where seafood may be harvested. The bill also establishes criteria for importing and exporting seafood and seafood products.

#### **H.R. 3386—Rep. William Clinger Jr. (PA) and S. 1751—Sen. John Heinz (PA)**

The Safe Transportation of Food Act would prohibit hauling solid wastes, including medical and hazardous wastes, in refrigerated vehicles and would ban cargo tanks used to haul loads of hazardous materials or wastes from carrying liquid foodstuffs, such as fruit juices and cooking oils. The bills would also direct the Secretary of Transportation to conduct a study to determine if additional regulations are necessary to ensure the safety of food products hauled in other types of vehicles.

#### **H.R. 3430—Rep. Christopher Smith (NJ)**

The Food Contamination Prevention Act would amend the Solid Waste Disposal Act to make it illegal to transport solid waste in vehicles used for carrying food, drugs, or cosmetics. All refrigerated vehicles specially designed to carry fresh meat and other foods would be banned from transporting garbage. The bill also establishes three new subclasses of solid waste for empty beverage bottles, recyclable materials, such as newspapers and aluminum, and baled garbage destined for landfills. The bill would require regulations to be established for transporting the first two subclasses of waste on food-designated vehicles.

#### **S. 1904—Sen. Albert Gore, Jr. (TN)**

The Clean Food Transportation Act would prohibit refrigerated vehicles used



to transport food from hauling solid waste, forbid cargo tanks used to transport food from carrying nonfood products, and require labeling cargo trucks as food or nonfood carriers. The bill would also require the Secretary of Transportation to issue regulations establishing methods, operations, and procedures to be used in cleaning cargo tanks between shipments and would require sufficient training for inspectors.

**S. 1896—Sen. Patrick Leahy (VT)**

The Organic Foods Act of 1989 would set national standards for production of organically produced foods and provide for the labeling of these products. It would mandate inspections, periodic residue testing, and civil penalties for those who violate the regulations. Also, the bill would establish a national promotion board to serve as a

policymaking body for the industry, recommend production standards, and conduct promotional and research activities for organic farming using voluntary assessments. A pilot program would be established to explore the implications of a low-input label for farmers using low-input sustainable agriculture production methods.

**Other**

**H.R. 3387—Rep. Charles Hatcher (GA)**

The Pecan Promotion and Research Act of 1989 would establish a promotion and research program designed to strengthen the position of the pecan industry in the marketplace and to maintain and expand domestic and foreign markets and uses for domestic pecans and pecan products.

**H.R. 3664—Rep. Charles Hatcher (GA)**

The Omnibus Agricultural Commodity Promotion and Research Act of 1989 incorporates the earlier agricultural promotion bills introduced into the House of Representatives during the first session of the 101st Congress. The bill would include programs for pecans, mushrooms, potatoes, and limes.

**S. 1838—Sen. Wyche Fowler (GA)**

The Agricultural Promotion Programs Act of 1989 incorporates the earlier agricultural promotion bills introduced into the Senate during the first session of the 101st Congress. The bill would include programs for soybeans, cotton, pecans, mushrooms, limes, potatoes, honey, and Vidalia onions. ■

## USDA Actions

Lori Lynch  
(202) 786-1696

*USDA regularly implements operational and regulatory changes that affect the status of food and nutrition in the United States. Here are some recent actions.*

### Food Stamp Benefits Increased

USDA increased monthly food stamp benefits by about 10 percent, effective October 1, 1989. The maximum net income food stamp recipients may earn and still remain eligible was raised about 4 percent. The amount of deductions from gross income to determine net income also rose, which may further boost the number of eligible recipients.

### Food Stamp Demonstration Project Launched

Nearly 4,000 low-income households in the Park Circle suburb of Baltimore, Maryland, can now buy food with plastic magnetic strip cards instead of food stamps, under a 5-year pilot project launched by USDA. Recipients are issued a plastic card for use at a computer terminal at the grocery check-out counter instead of receiving a check or food stamp coupons in the mail. The cost of the food is automatically subtracted from the household's total monthly food stamp allotment. For the first time, recipients are also able to use the plastic card to receive benefits from other programs, such as Aid to Families with Dependent Children and the Child Support Enforcement Program. Evaluation of this project will help determine the potential of electronic systems for nationwide use.

### USDA Eliminates Nitrate In Specialty Bacon

USDA prohibited the use of nitrates and limited the amounts of nitrite that



USDA raised food stamp benefits by about 10 percent.

can be used in two curing methods for specialty bacon. The two specialty curing methods account for about 2 percent of the bacon made in the United States. Nitrites offer protection against microbiological contamination and give bacon a distinctive color and taste. FSIS took the action because nitrites can combine with amines to form nitrosamines, some of which are carcinogenic. "The new regulation will help avoid any health risk from nitrosamine formation when these types of bacon are fried," said Dr. Lester M. Crawford, administrator of USDA's Food Safety and Inspection Service (FSIS).

### California Quarantines Continue

Efforts continue to combat the Mediterranean fruit fly, a destructive pest of fruits and vegetables. USDA quarantined a 60-square-mile area of Santa Clara County, California, in September 1989, following the discovery of more than 20 Medfly adults and one larva in the Mountain View area. In November, 12 square miles in the Sylmar area of Los Angeles County were added, bringing the number of quarantined areas to five.

Federal, State, and county officials have begun an intensive program to eradicate the Medfly with traps, malathion bait spray, and release of sexually sterile Medflies. James W. Glosser, administra-

The author is an agricultural economist with the U.S. Agricultural Policy Branch, Agriculture and Trade Analysis Division.



tor of USDA's Animal and Plant Health Inspection Service, anticipates that additional quarantine areas will be established in the future due to recent Medfly catches in the Alhambra and Rosemead areas.

USDA shifted the quarantine on the Oriental fruit fly to different areas of Los Angeles County and a new part of Orange County. The Oriental fruit fly can damage over 200 varieties of citrus, vegetables, nuts, and berries.

### **New Aflatoxin Testing Procedures in Use**

USDA's Federal Grain Inspection Service (FGIS) began using newly approved commercial aflatoxin testing kits in place of current methods. However, during an interim period, FGIS will use the current methods—Holaday-Velasco minicolumn and thin-layer chromatography—to determine aflatoxin in corn while replacing these methods with the new kits at all field locations. Besides being highly specific, the new tests are considered safer for the inspection staff.

In another recent action, FGIS added the Agri-Screen test to the list of aflatoxin test kits. EZ-Screen, Aflatest, Afla-20-Cup, OXOID, and SAM-A have already been approved. These kits determine the presence of aflatoxin by indicating the quantity of aflatoxin in the corn or by indicating when the aflatoxin threshold of 20 parts per billion has been exceeded.

### **USDA Ends Intensified Heptachlor Testing**

USDA ended a 4-month intensive surveillance program in which poultry and swine in 10 States were tested for traces of heptachlor, a pesticide banned for all agricultural uses by the Environmental Protection Agency. Heptachlor builds up in the fat tissues of animals and humans and induces tumors in mice. Thus, when

violative levels were detected in chickens in May 1989, FSIS set up intensive testing programs in Arkansas and nine surrounding States to determine if the problem was widespread. The tests found no contamination problem. Therefore, USDA has resumed routine monitoring.

### **New Requirements Announced for Livestock Exported to Mexico**

As a result of bilateral negotiations, Mexico has revised its import requirements for livestock, lifting restrictions imposed in 1989 on animals shipped for slaughter. According to the new rules, male animals need not be castrated when exported for slaughter, but breeding animals must be tested for vibriosis. These changes give U.S. livestock producers greater access to Mexico's market.

### **Patents Take USDA Research Into Marketplace**

In the last fiscal year, USDA's Agricultural Research Service has patented 35 inventions including frozen concentrated milk, a high calcium and protein flan pudding, and a bacteria injection method to prevent *salmonella* contamination in eggs and poultry.

### **USDA Boosts Processed Fruit and Vegetable Fees**

The basic hourly rate charged users for certain services provided by USDA's Agricultural Marketing Service increased due to a 15-percent rise in program costs in the last 3 years. The services include industry-requested inspection, grading, and certification of processed fruits and vegetables. For those with contracts for yearly in-plant full-time services, the hourly charge climbed from \$22 to \$25; for those contracts for in-plant full-time services that last for more than 4 weeks but less than a year, the rate went from \$27 to \$28. For those with intermittent contracts, the hourly charge increased

from \$29 to \$31. The overtime basic hourly fee rose from \$5.50 to \$7.00.

### **United States and USSR Agree on Agricultural Team Exchanges**

The U.S. and USSR Joint Committee on Cooperation in Agriculture signed a protocol to carry out exchanges of teams on agricultural economics, agricultural science, forestry, and food processing in 1990-91. These exchanges will allow research and technical experts from both countries to share agricultural information and establish and strengthen working relationships. One issue on which the exchanges will focus is the market potential for processed packaged foods and other high-value products through direct contact with USSR trade agencies and firms.

### **USDA Changes Dairy Price Support**

The price support for milk was reduced from \$10.60 to \$10.10 per hundredweight (cwt) on January 1, 1990, for milk with a milkfat content of 3.67 percent. According to provisions of the Omnibus Budget Reconciliation Act of 1989, the milk support price can be lowered if purchases of surplus dairy products are estimated to exceed 5 billion pounds milk equivalent during 1990.

The price support program is carried out through Commodity Credit Corporation (CCC) purchases of butter, cheese, and nonfat dry milk. To better reflect current market conditions, all of the decrease in the support price for milk used in manufacturing butter and nonfat dry milk was allocated to the purchase price of butter—which dropped 11.25 cents to \$1.0925 per pound. The nonfat dry milk price remains unchanged. The CCC purchase price for block Cheddar and barrel cheese was reduced by 4.5 cents to \$1.11 and \$1.07 per pound, respectively. ■

## In the News

### Oat Bran Is Still Good for You

Consumers would be wise to keep buying oat bran products that are low in fat, despite recent findings downplaying the effectiveness of oat bran in reducing cholesterol.

A recent study claimed national attention by reporting that oat bran failed to reduce cholesterol in subjects whose levels were already in the desirable range. However, these results aren't so surprising considering how the body functions, says Gerald Combs of USDA's Agricultural Research Service (ARS).

When cholesterol levels are too high, the liver normally stops producing cholesterol and converts the excess into bile acids, which are either eliminated by the body or made available to be converted back into cholesterol. But when cholesterol levels are in a desirable range—and scientists don't know what the body considers desirable—the liver probably does not cut cholesterol production but maintains the status quo, says Combs, who is Assistant to the Deputy Administrator for Human Nutrition.

What remains healthy about oat bran is that it contains soluble fiber, more than most grains, which is thought to reduce cholesterol by removing the bile acids before they can be recycled into cholesterol.

There's no reason to think that oat bran's soluble fiber isn't as effective at reducing elevated cholesterol as the pectins and gums in fruits and vegetables, Combs says. Even if soluble fiber doesn't prove to be a panacea for high cholesterol sufferers, it still helps us control our weight by slowing the absorption of glucose after meals and by smoothing out blood sugar and insulin levels between meals. And it helps prevent diabetes.

So don't toss out the oat bran products if they're low in fat. At the very least, they can help lower cholesterol by replacing fat in the diet. According to the oat bran study mentioned earlier, the amount



Microbiologist James Smith examines growth medium for evidence of harmful bacteria.

of fat we eat is the strongest determinant of cholesterol levels in people who have not inherited high cholesterol.

For more information, contact Gerald Combs, ARS Program Staff/Human Nutrition, Beltsville, Maryland, (301) 344-3216.

### Helping Food Processors Check for Bacteria

Food processors sometimes get an inaccurate reading when they check for potentially harmful bacteria in their products. Tests are under way at an ARS lab in Pennsylvania to see that processors get more accurate counts. *Listeria* and *Shigella* species of bacteria are under study.

The problem stems from the nature of processors' testing material—called bacterial growth medium. This material is designed to be selective, that is, to allow only the target bacteria to show up and to inhibit others. However, when food is

underprocessed, the bacteria may just be injured. But the selectivity that additives can give to a bacterial medium to inhibit undesired bacteria usually also prevents the growth of injured cells. So processors get a low bacterial count.

ARS microbiologist James L. Smith has achieved more accurate counts for the bacteria *Listeria monocytogenes* by using a special medium developed by his ARS lab. Smith also is testing media that will allow microbiologists to count injured *Shigella flexneri* bacteria, which causes severe diarrhea and is the second largest killer of children in the Third World.

For more information, contact James L. Smith, Microbial Food Safety Research, Eastern Regional Research Center, Philadelphia, Pennsylvania, (215) 233-6520.



## Older Women May Need More Vitamin D

Older women may need more vitamin D in the winter than recommended in order to prevent loss of bone calcium, reports USDA's Human Nutrition Research Center on Aging at Tufts University.

Vitamin D helps the body absorb calcium. During the winter, the skin produces little or no vitamin D, which can mean less calcium for the bones. As vitamin D levels dip, another hormone rises to help maintain a constant blood calcium level, probably by taking calcium from the bones, says principal investigator Elizabeth Krall.

The study of 333 post-menopausal women found that those who consumed at least 10 percent more vitamin D than recommended did not have this seasonal see-saw of hormones. The Recommended Dietary Allowance (RDA) for vitamin D is 200 international units (IU) daily after age 21.

Krall says older women probably need at least 220 IU of vitamin D, although further studies on specific amounts are needed. Older people, or those with kidney or absorption problems, probably need even more, she says. Many women don't even come close to this amount. The average intake in the study was only 112 IU.

For more information, contact Elizabeth Krall, Human Nutrition Research Center on Aging, Tufts University, Boston, Massachusetts, (617) 556-3069.

## Using "Good" Bacteria To Fight *Salmonella*

ARS scientists are studying ways to use rod-shaped bacteria known as *Bdellovibrio* to control *Salmonella* and other harmful bacteria during food processing and packaging. These "good" bacteria are *B. bacteriovorus*, *B. Starrii*, and *B. Stolpii*.

"This is the first time anyone has tried to use a predatory bacterium for ensuring food safety," says Richard Whiting, ARS food technologist. The three bacteria—harmless to humans—were discovered in the 1960's and are common in soil and water. They are parasites of only Gram-negative bacteria, which include *Salmonella* and *Escherichia coli*.

Studies will determine whether the bacteria can be commercially adapted as a spray for use against *Salmonella* and other bacteria in the processing of meats, eggs, and powdered milk, Whiting says. The bacteria also might be added to packaged meats sold in grocery stores.

For more information, contact Richard Whiting, Microbial Food Safety Research, Eastern Regional Research Center, Philadelphia, Pennsylvania, (215) 233-6437.

## "Eat Your Greens!" Is Sound Advice

The greener the vegetable, the higher its level of chlorophyll, which means higher levels of carotenoids, says ARS

scientist Frederick Khachik. Carotenoids are the red and yellow pigments thought to protect against cancer.

Khachik and colleagues analyzed carotenoid levels in six green vegetables eaten in the United States and in nine common in the Cook Islands of the South Pacific where the relationship of diet to cancer is under study.

"All green vegetables have the same carotenoids but in varying concentrations. You can actually see the difference by the intensity of the color," Khachik reports.

U.S. kale had the highest concentrations of important carotenoids, about twice those in U.S. spinach and in Chinese cabbage from the Cook Islands. But levels in domestic green beans and broccoli were not as high as in popular Cook Island greens.

Researchers also found that the method of cooking had no impact on the amount of carotenoids found in three domestic vegetables tested—broccoli, green beans, and spinach.

The carotenoids in question are those detectable in human blood—alpha and beta carotene and lutein.

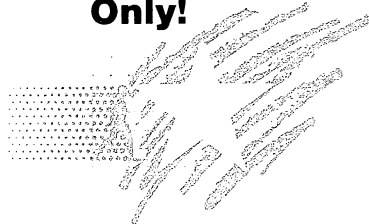
For more information, contact Frederick Khachik, Nutrient Composition Laboratory, Beltsville, Maryland, (301) 344-2930 or 344-2356.

## Nation's Ag Colleges Report Second Year of Growth

Deans of agriculture across the country are reporting increasing enrollments, greater demand for graduates, and higher starting salaries in the last 2 years. Agricultural enrollments, which peaked in 1977 at most colleges, had steadily eroded until 1987.

Demand for graduates of agriculture is strong, from the traditional options such as agronomy, agricultural economics, horticulture, and animal sciences, to the newer programs in food science, turf grass management, and landscape

## For Movers and Shakers Only!



You already know the right moves when it comes to planning health education programs that work. The National Heart, Lung, and Blood Institute has prepared an outstanding collection of research, resources, and easily reproducible brochures that can be just the information you need to make a good education/awareness program great. Interested in moving and shaking? Send a \$5.00 check (for handling, made out to NHLBI Kit '90) to

**NHLBI Information Center**  
4733 Bethesda Avenue, Suite 530  
Bethesda, MD  
20814-4820

design. Many colleges report great demand for students of food processing, food science, biotechnology, and agribusiness.

The Nation's deans expect these enrollment and placement trends to continue. Many forecast increased demand and rising salaries for graduates.

For more information, contact Jane Coulter or Patrick Casula, Higher Education Program, Cooperative State Research Service, Washington, DC, (202) 447-7854.

### **Foul-Tasting Fish? Algae Are the Culprit**

Two natural chemicals in algae give freshwater fish—both sport and farm-raised—a musty and muddy taste. The off-flavor is caused by the chemicals geosmin and 2-methylisoborneol, which also can taint drinking water. ARS scientists have confirmed the presence of the two compounds in off-flavor catfish, says ARS research physiologist Peter Johnsen.

ARS is developing test kits to monitor levels of the two chemicals in drinking water and fish so that fish farmers and water utilities can eliminate the chemicals when their presence is first detected. However, controlling off-flavor production is still several years away. "We're looking for the key to turn off the chemicals in algae that cause off-flavor," Johnsen says.

For more information, contact Peter Johnsen, Food Flavor Quality Research Laboratory, New Orleans, Louisiana, (504) 286-4421.

### **Developing the Ultimate Raisin**

The ultimate raisin will be as plump and juicy as the Thompson Seedless but will be developed from a raisin-grape that is ready to harvest 10 to 21 days earlier. The Thompson Seedless is the mainstay of California's \$600-million-a-year raisin industry, but it cannot be harvested until late summer, when rains can rot the crop.

To perfect the new raisin, ARS is using embryo rescue, a seedsaving technique that makes it possible to grow experimental grape vines that produce seedless raisins. So far, researchers have developed seven types of vines that bear fruit about 14 days before Thompson Seedless.

For more information, contact David W. Ramming, Horticultural Crops Research Laboratory, Fresno, California, (209) 453-3061.

### **Cutting Calories and Weight Loss**

The only sure-fire method of losing weight is to cut calories, assuming the dieter has a normal metabolism. Contrary to popular belief, a person's metabolism does not slow down in response to fewer calories, according to recent ARS weight-loss studies.

If people lose 10 percent of their body weight, they need about 10 percent fewer calories to maintain the new weight. To lose more, they have to continue reducing their calorie intake, physiologist William V. Rumpler says.

Weight-loss slows down or stops after the first week or so probably because people eat more than they realize, Rumpler says. For instance, the 28 volunteers who participated in one of the ARS studies substantially underestimated the number of calories they consumed.

For more information, contact William V. Rumpler, Human Nutrition Research Center, Beltsville, Maryland, (301) 344-4360.

### **More News**

**Natural Chemical in Strawberries May be a Cancer Fighter...** Researchers are working to increase organic ellagic acid in strawberries that medical studies show inhibits the start of cancer caused by some chemicals. For more information, contact plant pathologist John L. Maas, ARS Fruit Laboratory, Beltsville, Maryland, (301) 344-3572.

**A Long-Grain Rice that Smells of Jasmine Is Being Harvested...** Called Jasmine 85, the new rice could be a domestic substitute for the 100,000 tons of specialty aromatic rices now imported each year at premium prices. For more information, contact agronomist Charles N. Bollich, ARS Rice Research Station, Beaumont, Texas, (409) 752-2741.

**Cattle Can Provide Life-Saving Blood for Humans...** Cattle blood is a good source of hemoglobin that can be used for emergency transfusions in humans. For more information, contact biochemist John R. DeLoach, ARS Veterinary Toxicology and Entomology Research Laboratory, College Station, Texas, (409) 260-9484. ■



## Reports of Interest

*The Economic Research Service recently issued the following reports of interest to the food industry. To order copies, call toll free 1-800-999-6779 (8:30-5:00 weekdays ET).*

### Understanding Supermarket Prices

Retail food prices vary among supermarkets both within and between cities, but for different reasons. A nationwide survey of supermarket prices in 28 cities selected at random shows that within cities, big supermarkets with large sales volumes have lower prices. Stores with high occupancy costs, such as rental and utility rates, tend to have higher prices. Prices are also higher among stores with more services, but differences in employee wages and fringe benefits do not significantly affect prices.

Between cities, prices are higher where population growth rates are greater, but population density does not affect prices significantly. Cities where stores have strong market rivalry, turnover, and changing sales shares have lower prices. Where stores are newly established, prices are higher.

Supermarkets, which represent only 10 percent of all foodstores, account for more than 70 percent of foodstore sales and have the greatest effect on the structure and performance of the food retailing industry. This report is based on data collected in 1982 from 616 supermarkets representing 321 firms operating in 28 cities. More than 300,000 food and non-food prices were surveyed. Separate surveys collected detailed data on grocery item prices, labor compensation, and store characteristics and services. The detailed store-level data and survey designs account for much of the differences in findings compared with some earlier studies of retail food prices.

*Supermarket Prices and Price Differences: City, Firm, and Store-Level Determinants*, TB-1776. By Phillip R. Kaufman and Charles R. Handy. December 1989. \$8.00.



Retail food prices vary among supermarkets both within and between cities, but for different reasons. Photo: Giant Food, Inc.

### Domestic Food Assistance Programs: What Have We Learned?

U.S. food assistance programs are designed to improve the nutrition of low-income and other target groups and to provide an outlet for surplus agricultural commodities. In 1987, nearly 40 million people, over 16 percent of the population, received food assistance, costing the Federal Government about \$21.2 billion. Although the programs have benefited many people, they have created indirect and sometimes unintended economic effects on food production and marketing, the gross national product, and income distribution. Some programs displace commercial sales, while others increase retail prices.

This bulletin describes current domestic food assistance programs, their relationships to each other, their effectiveness, their impact on the food

production and marketing sectors, and their costs. It also suggests food assistance reforms that could be included in discussions of farm policy for the 1990's.

*U.S. Domestic Food Assistance Programs: Lessons From the Past*, AIB-570. By J. William Levedahl and Masao Matsumoto. January 1990. \$4.00.

### Industry Handles Increasing Flour Consumption

U.S. flour consumption reached 128 pounds per capita in 1987, 4 pounds higher than in 1986 and the highest it has been since 1950 when it was 135 pounds. The milling and baking industries have met the strong demand with larger outputs per plant and improved production and distribution. In addition, the industry has concentrated its operations by allowing a relatively large amount of its capacity to be held by fewer firms. Out-

put among the top four wheat flour and durum milling firms alone increased from 34 percent of the industry total in 1973 to 52 percent in 1987.

The number of U.S. wholesale bakers in 1982 was about 2,700, 10 times greater than the number of milling plants because bakery products are perishable. Although a few baking companies are quite large, many employ fewer than 20 workers. The number of in-store bakeries and specialty retail outlets jumped 37 percent between 1982 and 1987, challenging traditional wholesale bakers who sell their packaged products through supermarkets and grocery stores. Many wholesalers are investing in promotional activities to develop greater consumer loyalty and to increase their competitiveness with each other and with in-store bakeries. Wholesalers introduced more than 550 new bakery products in 1986, mainly to attract and hold consumers.

This report examines the structure, conduct, and performance of the U.S. milling and baking industries in the 1980's. It shows changes in plant numbers and gives information on capacities, concentration ratios, margins, and buying and selling practices. The publication is well documented with over 80 tables and graphs and a glossary.

*The U.S. Milling and Baking Industries*, AER-611. By Joy L. Harwood, Mack N. Leath, and Walter G. Heid, Jr. December 1989. \$8.00.

### **Biotechnology and the Consumer**

Biotechnology is not a product. It is a set of techniques for enhancing existing products and production practices. Most

people are unaware that products they consume have a biotechnology component. The technology can reduce food costs, improve food quality, and enhance food safety.

Biotechnology research has moved from university laboratories and small companies to large industrial firms that are using the new techniques to improve their production methods and expand their product lines. But the new techniques raise some complex and sensitive regulatory issues. For example, although biotechnology safeguards are designed to protect the public against unintended environmental effects, genetically engineered organisms could become pathogenic or toxic to humans, could multiply in the environment leading to widespread human exposure, and could be difficult or impossible to control or eradicate. These types of effects are difficult to guard against because it is hard to predict a new organism's survival characteristics.

This report discusses the use of biotechnology in pest resistance and crop quality, veterinary and livestock products, and food processing, as well as its economic effects on agriculture and consumers.

*Consumer Effects of Biotechnology*, AIB-581. By John M. Reilly. December 1989. \$3.00.

### **Harmony Between Foreign Aid and Farm Trade**

Is technical assistance to agriculture in developing countries helping or hurting

U.S. farm exports? The authors of this report maintain that both outcomes are possible, but neither is inevitable. The results of their study show that the kind of development project and the characteristics of the recipient country determine whether agricultural aid to developing countries is more likely to result in expanded U.S. markets or greater competition for U.S. farm commodities.

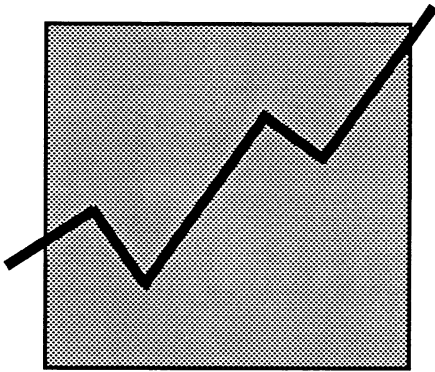
Agricultural aid is more likely to create demand for farm imports when it is combined with general development aid that promotes balanced economic growth. Higher agricultural incomes have a ripple effect, causing the general economy of the recipient country to grow rapidly, resulting in increased demand for farm imports. The ripple effect, however, depends on balanced development in all sectors, strong links between sectors, and government policy that refrains from interfering with these links. While aid is most likely to compete with food imports in the short run, it increases import demand in the long run.

The authors support their assertions with case studies of aid and trade with Taiwan and South Korea. They identify conditions that promote harmony between aid and trade, and evaluate alternative aid policies to developing countries at different stages of development.

*Foreign Aid's Effect on U.S. Farm Exports: Benefits or Penalties?*, FAER-238. By Alain De Janvry, Elisabeth Sadoulet, and T. Kelley White. November 1989. \$5.50. ■



# OUTLOOK '90 CHARTS



Order a special book of the charts presented at USDA's 66th Agricultural Outlook Conference held in Washington, D.C., November 1989.

This publication carries the approximately 180 charts and tables used by Conference speakers. Each chart, measuring 6 x 4 inches, is printed in black and white for easy reproduction or use in overhead transparencies.

Order the ***All New***  
**OUTLOOK '90 CHARTS**  
**\$8.00 (\$10.00 foreign, includes Canada)**  
**for each copy**

Yes! Send me \_\_\_\_\_ copies of *Outlook '90 Charts* (AGES 9001)

**Mail to:** ERS-NASS  
P.O. Box 1608  
Rockville, MD  
20849-1608

Name \_\_\_\_\_

Organization \_\_\_\_\_

Address \_\_\_\_\_

City, State, Zip Code \_\_\_\_\_

Daytime telephone number \_\_\_\_\_

- Use purchase orders, checks drawn on U.S. banks, cashier's checks, or international money orders.

- **Make payable to ERS-NASS.**

☐ Bill me. ☐ Enclosed is \$\_\_\_\_\_. **Credit card:** ☐ MasterCard ☐ VISA Total charges \$\_\_\_\_\_.

Credit card  
number:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|

Expiration date:

|  |  |
|--|--|
|  |  |
|--|--|

Month/Year

**For *fastest* service, call toll free, 1-800-999-6779**  
**(8:30-5:00 ET, in U.S. and Canada;**  
**all other areas, please call 301-725-7937)**

These periodicals bring you the latest information on food, the farm, and rural America to help you keep your expertise up-to-date. Order these periodicals today to get the latest facts, figures, trends, and issues from ERS.

**Agricultural Outlook.** Presents USDA's farm income and food price forecasts. Emphasizes the short-term outlook, but also presents long-term analyses of issues ranging from international trade to U.S. land use and availability. 11 issues annually. 1 year, \$26; 2 years, \$51; 3 years, \$75.

**Farmline.** Concise, fact-filled articles focus on economic conditions facing farmers, how the agricultural environment is changing, and the causes and consequences of those changes for farm and rural people. 11 issues annually. 1 year, \$12; 2 years, \$23; 3 years, \$33.

**National Food Review.** Offers the latest developments in food prices, product safety, nutrition programs, consumption patterns, and marketing. 4 issues annually. 1 year, \$11; 2 years, \$21 3 years, \$30.

**Economic Indicators of the Farm Sector.** Updates economic trends in U.S. agriculture. Each issue explores a different aspect of income and expenses: national and State financial summaries, production and efficiency statistics, and costs of production for major field crops and for livestock and dairy. 5 issues annually. 1 year, \$14; 2 years, \$27; 3 years, \$39.

**Rural Development Perspectives.** Crisp, nontechnical articles on the results of new rural research and what those results mean. 3 issues annually. 1 year, \$9; 2 years, \$17; 3 years, \$24.

**The Journal of Agricultural Economics Research.** Technical research in agricultural economics, including econometric models and statistics focusing on methods employed and results of USDA economic research. 4 issues annually. 1 year, \$8; 2 years, \$15; 3 years, \$21.

**Foreign Agricultural Trade of the United States.** Updates the quantity and value of U.S. farm exports and imports, plus price trends. 8 issues annually. 1 year, \$25; 2 years, \$49; 3 years, \$72.

**Situation and Outlook Reports.** These reports provide timely analyses and forecasts of all major agricultural commodities and related topics such as finance, farm inputs, land values, and world and regional developments. Each *Situation and Outlook* title costs 1 year, \$12; 2 years, \$23; 3 years, \$33. Titles include:

|  |                            |                             |                                    |
|--|----------------------------|-----------------------------|------------------------------------|
| <i>Agricultural Exports</i>            | <i>Cotton and Wool</i>     | <i>Oil Crops</i>            | <i>Vegetables and Specialties</i>  |
| <i>Agricultural Income and Finance</i> | <i>Dairy</i>               | <i>Rice</i>                 | <i>Wheat</i>                       |
| <i>Agricultural Resources</i>          | <i>Feed</i>                | <i>Sugar and Sweeteners</i> | <i>World Agriculture</i>           |
| <i>Aquaculture</i>                     | <i>Fruit and Tree Nuts</i> | <i>Tobacco</i>              | <i>World Agriculture Regionals</i> |

Also available: *Livestock and Poultry*: 1 year, \$17; 2 years, \$33; 3 years, \$48.

*Livestock & Poultry Update (monthly)*: 1 year, \$15; 2 years, \$29; 3 years, \$42.

*U.S. Agricultural Trade Update (monthly)*: 1 year, \$15; 2 years, \$29; 3 years, \$42.

**Add 25 percent for shipments to foreign addresses (includes Canada).**

**To subscribe to these periodicals, or for more information,  
call toll free, 1-800-999-6779 (8:30-5:00 ET in the United States  
and Canada; other areas please call 301-725-7937), or write to:**

ERS-NASS  
P.O. Box 1608  
Rockville, MD 20849-1608



United States  
Department of Agriculture

Washington, D.C.  
20005-4789

OFFICIAL BUSINESS  
Penalty for Private Use, \$300

April-June 1990

BULK RATE  
POSTAGE & FEES PAID  
U.S. Dept. of Agriculture  
Permit No. G-145

**Moving?** To change your address, send mailing label on this page and your new address to: National Food Review, USDA, Room 228, 1301 New York Avenue NW, Washington, D.C. 20005-4789

