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Global Agricultural Supply and Demand: Factors Contributing to the Recent Increase in Food Commodity Prices

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Abstract

World market prices for major food commodities such as grains and vegetable oils have risen sharply to historic highs of more than 60 percent above levels just 2 years ago. Many factors have contributed to the runup in food commodity prices. Some factors reflect trends of slower growth in production and more rapid growth in demand that have contributed to a tightening of world balances of grains and oilseeds over the last decade. Recent factors that have further tightened world markets include increased global demand for biofuels feedstocks and adverse weather conditions in 2006 and 2007 in some major grain- and oilseed-producing areas. Other factors that have added to global food commodity price inflation include the declining value of the U.S. dollar, rising energy prices, increasing agricultural costs of production, growing foreign exchange holdings by major food-importing countries, and policies adopted recently by some exporting and importing countries to mitigate their own food price inflation. This report discusses these factors and illustrates how they have contributed to food commodity price increases.

Keywords: Agricultural prices, food prices, prices, supply, demand, global supply, global demand, food inflation, energy prices

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Approved by USDA's
World Agricultural
Outlook Board

Introduction

World market prices for major food commodities such as grains and vegetable oils have risen sharply to historic highs—more than 60 percent above levels just 2 years ago. Retail food prices in many countries have also risen in the last 2 years, raising concerns around the world.

No one factor has been the cause of the price runup in food commodity prices. Some factors reflect underlying trends in supply and demand for agricultural commodities that began more than a decade ago. Other developments that have contributed to the price increase have occurred more recently. Some factors reflect significant structural changes in supply and demand relationships; others can be interpreted as short-term shocks to global supply and demand for agricultural products.

Figure 1 shows an index of monthly prices for food commodities, e.g., grains, vegetable oils, meats, seafood, sugar, bananas, and various other commodities that are the basis for human consumption of staple foods. Although prices, measured in nominal dollars, trended slightly downward between 1980 and 2002, there were several short periods (1980, 1983, 1988, and 1996) when prices did rise from the previous year. After 2001, prices began to rise slowly and by 2004 reached the level that they had been in the mid-1980s. In early 2006, commodity food prices began to rise more quickly. During the last 2 years, prices of these commodities rose sharply to a new high, more than 60 percent above what they were 2 years ago.

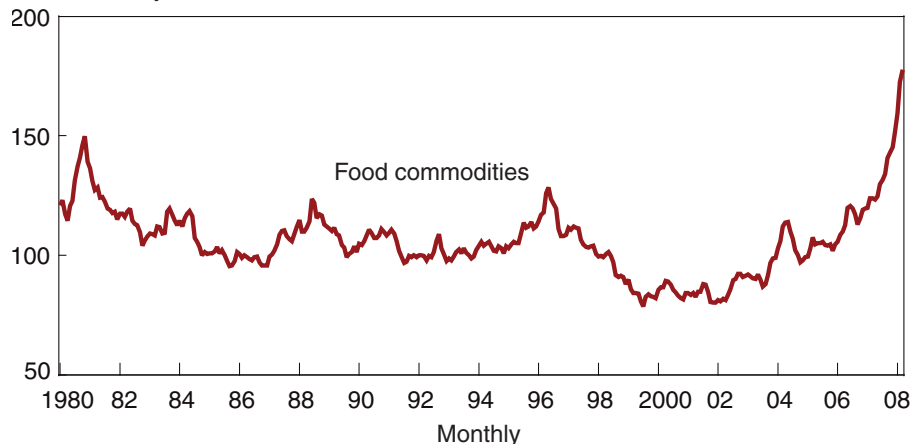
Figure 2 puts the evolution of the food commodity price index into broader perspective. Monthly price indices for wheat, rice, corn, and soybeans back to 1970 have been added to the index for food commodity prices. Wheat and rice account for much of the world food consumption of grains. Corn is used for both food and animal feed. Soybeans provide vegetable oil for human

This revised report adds a timeline of factors behind rising food prices (see: “A Mix of Short- and Long Term Factors Are Contributing to Higher Food Prices” on page 6), and new information and data on land use associated with the production of biofuels (see: “Update on Global Land Use in Biofuel Feedstock Production” on page 19). The new information on biofuel land use replaces figure 22 in the original report. Several typographical and formatting errors have also been corrected.

Figure 1

Food commodity prices rose more than 60 percent in the last 2 years

Index: January 1992 = 100

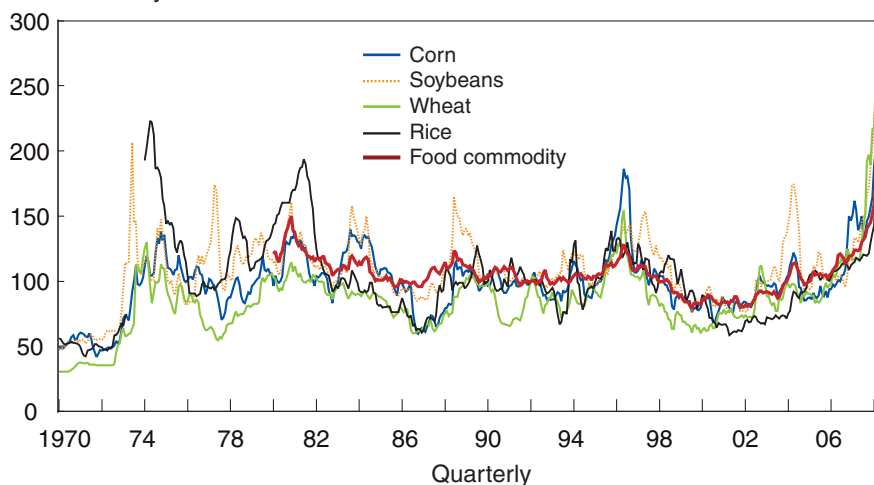


Source: International Monetary Fund: International Financial Statistics.

Figure 2

Food commodity price spikes since 1970

Index: January 1992 = 100



Source: International Monetary Fund: International Financial Statistics.

consumption and protein feed for animals. Combined, the four crops account for a large share of the staple foods that are consumed globally.

Two general patterns are especially significant in figure 2. First, the index of average food commodity prices (data only available back to January of 1980) closely tracks the prices of the four major crops (wheat, rice, corn, and soybeans), although in a somewhat dampened manner. Second, there have been periodic spikes in the prices of the four crops during the last 38 years. Although some of the price spikes focused on only one of the crops, in general the prices of all four crops rise and recede in a similar pattern. This occurs because buyers can substitute among these or other commodities, whether for food use or animal feed use, and purchase whichever is cheaper. With the exception of the early 1970s, each period of rapidly rising prices was followed by a retreat back to their pre-spike level.

The question on the minds of many consumers around the world is, “Will food prices drop again this time?” Or, stated another way, “Is the current price spike any different from those of the past, and if so, why?”

Before we begin to explore the factors contributing to the most recent rise in food commodity prices, two more additions to the graph provide an even broader perspective on the current increase in food commodity prices.

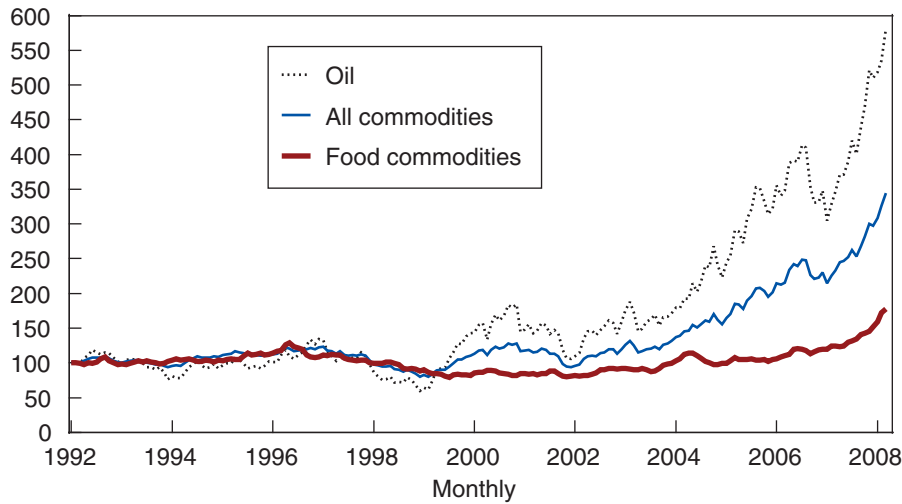
Figure 3 charts the price index for food commodities along with an index for the average of all commodities and an index for crude oil. Although the food commodity index has risen more than 60 percent in the last 2 years, the index for all commodities has also risen 60 percent and the index for crude oil has risen even more.

Since mid-1999, when all three indices were at about the same level (and were about where they had been 10 years earlier), food commodity prices have risen 98 percent (as of March 2008); the index for all commodities has

Figure 3

Prices of many commodities rose

Index: January 1992 = 100



Source: International Monetary Fund: International Financial Statistics.

risen 286 percent; and the index for crude oil has risen 547 percent. In this perspective, the recent rise in food commodity prices might not seem so severe after all. However, because an increase in the price of food—a basic necessity—causes hardships for many lower income consumers around the world, food-price inflation is socially and politically sensitive. That is why much of the world’s attention is now focused on the increase in food prices more so than on the more rapid increase in prices of other commodities.

Long-Term Trends

A number of long-term, slowly evolving trends have affected the global supply and demand for food commodities. The impact of these trends has been to slow growth in production and to strengthen demand. The resulting tightening of the global supply and demand balance has gradually put upward pressure on agricultural prices. Many of these long-term trends have been exacerbated by the more recent developments that have put additional upward pressure on world prices by further reducing supplies and increasing demand.

The annual growth rate in the production of aggregate grains and oilseeds has been slowing. Between 1970 and 1990, production rose an average 2.2 percent per year. Since 1990, the growth rate has declined to about 1.3 percent. USDA's 10-year agricultural projections for U.S. and world agriculture see the rate declining to 1.2 percent per year between 2009 and 2017.¹

Growth in productivity, measured in terms of average aggregate yield, has contributed much more to the growth in production globally than has expansion in the area planted to grains and oilseeds. Global aggregate yield growth averaged 2.0 percent per year between 1970-1990, but declined to 1.1 percent between 1990 and 2007. Yield growth is projected to continue declining over the next 10 years to less than 1.0 percent per year.

The growth rate for area harvested has averaged only about 0.15 percent per year during the last 38 years. In USDA's agricultural projections, crop prices do not decline much over the next decade. The continued higher prices provide the incentive for producers to respond by increasing the area allocated to crops during the coming decade. Some of this expanded area planted will come from land converted to cropland from non-cropland uses, such as pasture and forest. Area harvested will also increase as a result of more intensive use of existing cropland, generally from double-cropping and reduced fallow area.

Reduced agricultural research and development by governmental and international institutions may have contributed to the slowing growth in crop yields. Stable food prices during the last two decades have led to some complacency about global food concerns and to a reduction in R&D funding levels. Although private sector funding of research has grown, private sector research has generally focused on innovations that private companies could sell to producers. These have often been cost-reducing rather than yield-enhancing technological developments. Publicly-funded research might be more likely to focus on innovations that would increase yields and production, particularly in parts of the world where farmers are unable to pay royalties for new varieties of seeds.

¹USDA's 10-year agricultural projections are a Departmental consensus on a longrun scenario for the agricultural sector. The projections are not a USDA forecast of what the future will be, but instead are a description of what would be expected to happen with a continuation of current farm legislation and under very specific assumptions regarding the macro-economy, trade policies, weather, and international developments. The projections provide a neutral backdrop, reference scenario that provides a point of departure for discussion of alternative farm sector outcomes that could result under different domestic or international assumptions. The projections referred to in this report were prepared in October through December 2007 and reflect a composite of model results and judgment-based analyses. See the documentation of the baseline process at <http://www.ers.usda.gov/Briefing/Baseline/>.

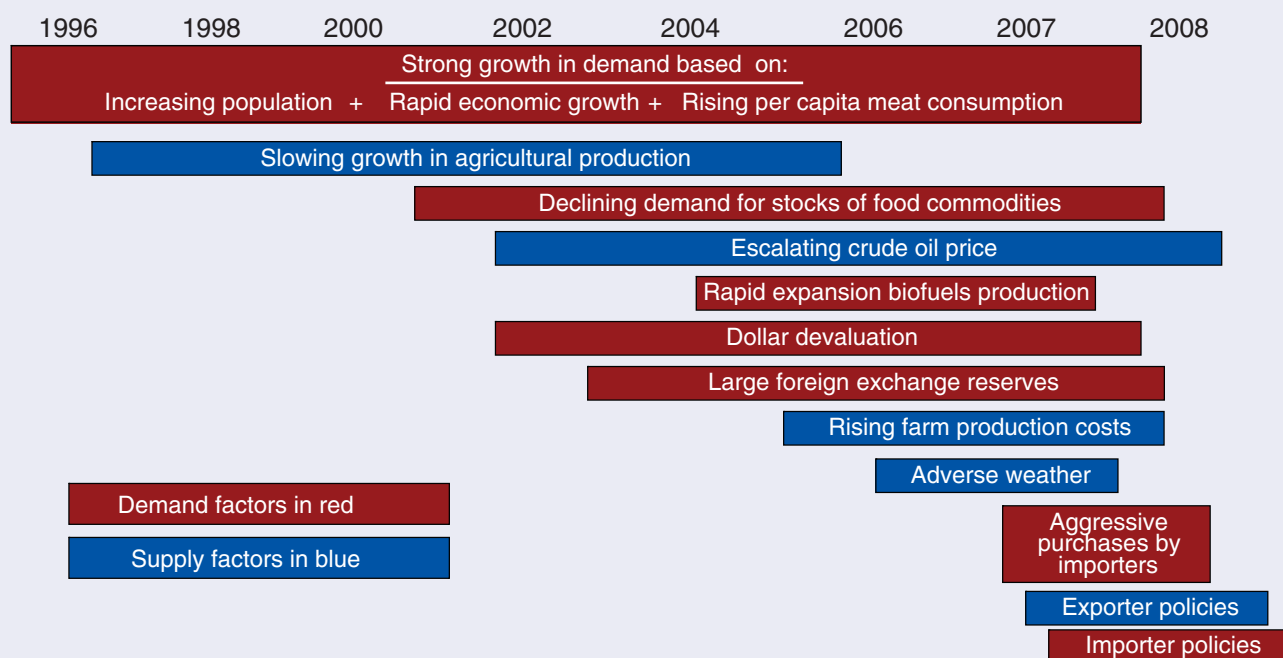
A Mix of Short- and Long-Term Factors Are Contributing to Higher Food Prices

A number of factors have contributed to the tight market conditions that set the stage for the sharp increase in food commodity prices since 2002. Some factors reflect underlying trends in supply and demand for agricultural commodities that began more than a decade ago. Trends of more rapid expansion in demand and slower growth in production began in the 1990s, and contributed to declining global demand for stocks of grains and oilseeds since 2000. Then, rising crude oil prices and changing biofuel policies provided incentives to expand biofuel production in some countries. Also, since the early 2000s, the declining value of the dollar and the foreign accumulation of foreign exchange reserves (U.S. dollars) enabled some countries to increase food commodity imports, even as world prices denominated in dollars reached record highs. On the supply side, largely due to rising energy prices, production costs for most of the world's farmers

were increasing and, in 2006 and 2007 adverse weather in a number of countries reduced global production of grains and oilseeds.

Together, these factors resulted in declining global stock-to-use ratios for aggregate grains and oilseeds which, by 2007, fell to the lowest levels since 1970. Importers faced declining market supplies and many countries experienced politically sensitive increases in domestic food prices, leading some to contract aggressively for future imports, even at world record prices. Finally, in late 2007 and early 2008, various exporters of food commodities imposed restrictions on exports in an attempt to moderate domestic food price inflation. These actions, combined with the already tight market conditions, set the stage for the further rapid increases in food prices in late 2007 and early 2008.

Factors contributing to higher food commodity prices



Other trends show an even longer history of gradually slowing production growth.

- For decades, each year a small percentage of the world's agricultural land has been converted to nonagricultural uses.
- The ability to obtain more water for agricultural uses has gradually become more difficult, either because gravity-flow irrigation systems are

more difficult and expensive to develop, or because irrigation wells have to be dug deeper as water tables decline.

These factors are changing slowly and likely played a negligible role in the recent increase in world prices. Additionally, although climate change has increasingly become a concern, its impact on crop production is unclear.

The demand for agricultural commodities has also been affected by some long-term trends. Over the last decade, strong global growth in average income combined with rising population to increase the demand for food, particularly in developing countries. As per capita incomes rose, consumers in developing countries not only increased per capita consumption of staple foods, they also diversified their diets to include more meat, dairy products, and vegetable oils, which in turn, amplified the demand for grains and oilseeds.

Global economic growth has been strong since the late 1990s (fig.5). For developing countries, growth has been quite strong since the early 1990s. Growth in Asia has been exceptionally strong for more than a decade. Unusually rapid economic growth in China and India, with nearly 40 percent of the world's population, has provided a powerful and sustained stimulus to the demand for agricultural products.

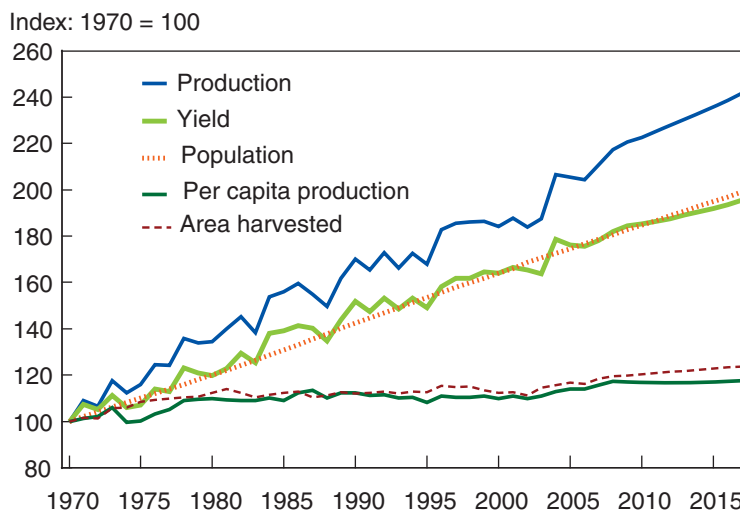
Rapid economic growth in developing countries has also resulted in very rapid growth in the demand for energy for electricity and industrial uses, as well as for transportation fuel. The associated increase in petroleum use in developing countries has contributed to rapidly rising oil prices since 1999. The oil imports of China alone grew more than 21 percent per year from 194 million barrels in 1996 to 1.37 billion barrels in 2006.

Figure 4

Total world grain & oilseeds¹

Production, yield, area harvested, population & per capita production

Exponential trend growth rates:			
	1970-90	90-07	2009-17
Production	2.2	1.3	1.2
Yields	2.0	1.1	0.8
Area	0.15	0.14	0.39
Population	1.7	1.4	1.1
Per capita production	0.56	0.11	0.02

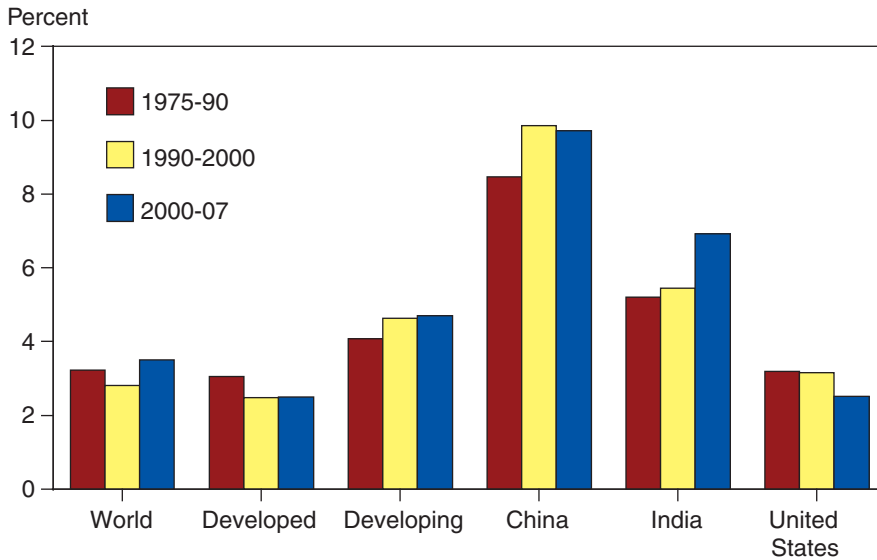


¹Total oilseeds = soybeans + rapeseed + sunflowers.

Source: USDA Agricultural Projections to 2017.

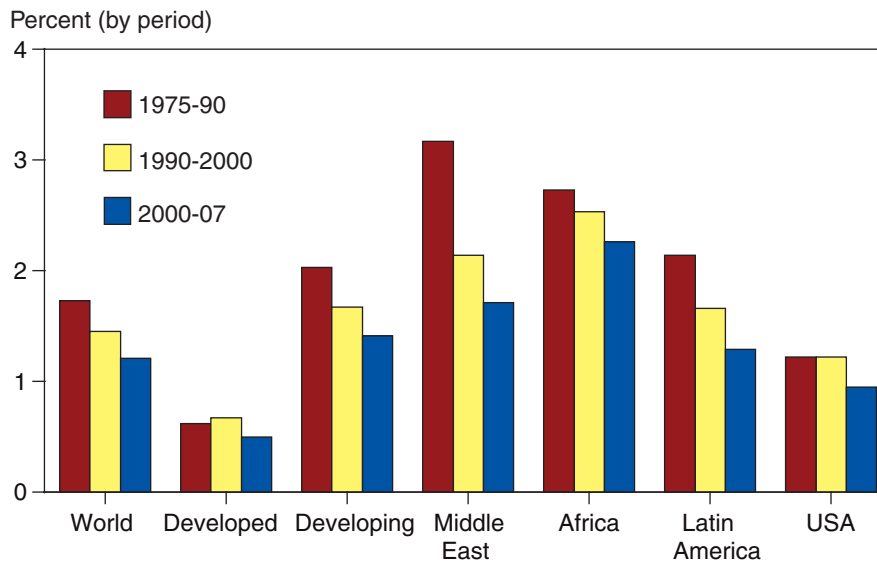
The world's population growth rate has been trending down since before the 1970s (fig. 6). This declining trend applies to nearly all countries and regions of the world. However, the number of people on earth is still rising by about 75 million (1.1 percent) per year. This rising population adds to the global demand for agricultural products and energy. The impact on demand is amplified because the most rapid population growth rates tend to be in devel-

Figure 5
Strong economic growth
Average real GDP growth rates



Source: USDA Agricultural Projections to 2017.

Figure 6
Population growth rates decline
But still high in developing countries

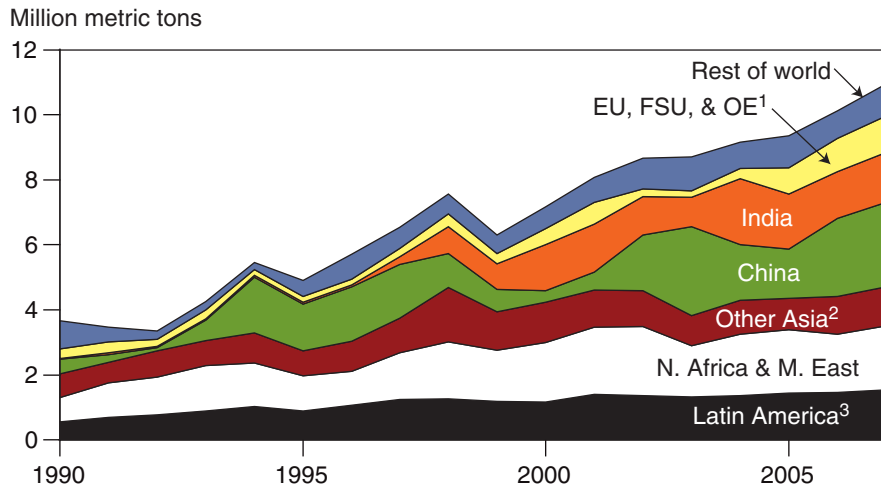


Source: USDA Agricultural Projections to 2017.

oping countries. Many of these have rapidly rising incomes, again particularly important for agricultural demand due to diet-diversification.

Figures 7-12 illustrate how the rapid increase in global demand for agricultural products is facilitated by growth in imports. Note that much of the demand growth comes from developing countries.

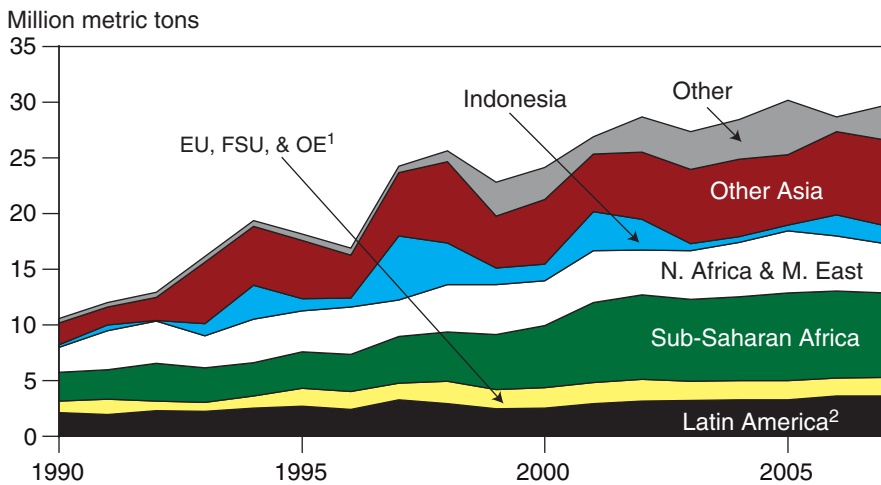
Figure 7
Global soybean oil imports



¹European Union, former Soviet Union, and other Europe.
²Asia excluding India and China.
³Includes Mexico.

Source: USDA Agricultural Projections to 2017.

Figure 8
Global rice imports

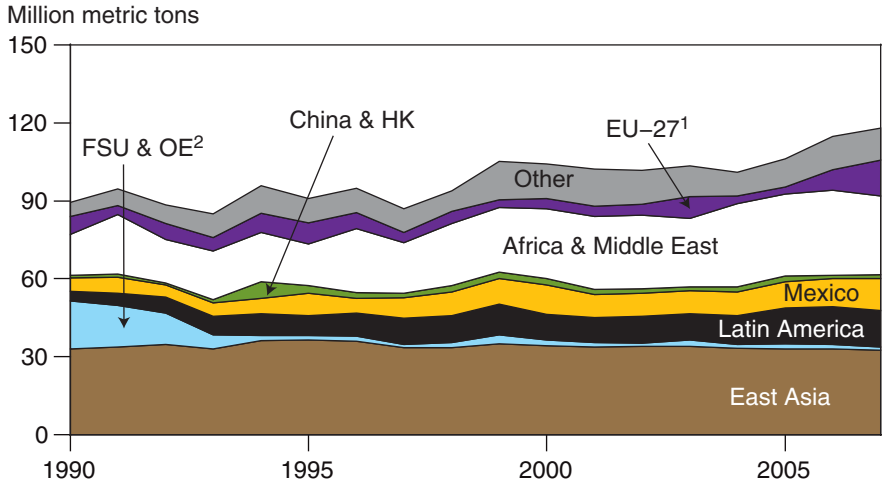


¹European Union, former Soviet Union, and other Europe.
²Includes Mexico.

Source: USDA Agricultural Projections to 2017.

Figure 9

Global coarse grain imports



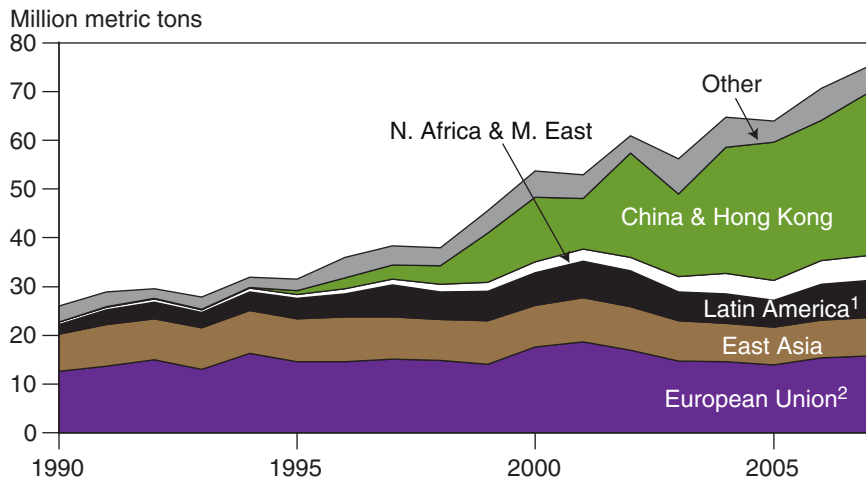
¹EU-27 excludes intra-trade after 2002, EU-15 intra-trade before 2003, Slovenia before 1992.

²Former Soviet Union and other Europe; prior to 1999, includes Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, and Slovenia.

Source: USDA Agricultural Projections to 2017.

Figure 10

Global soybean imports



¹Includes Mexico.

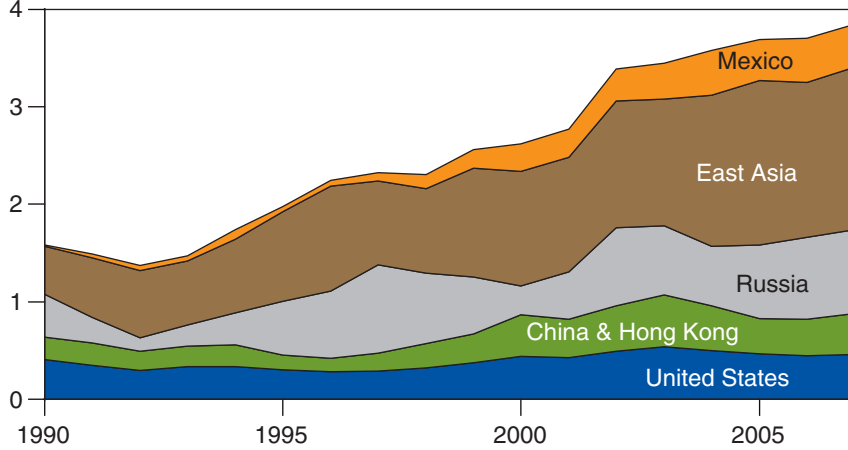
²EU-27 excludes intra-trade after 2002, EU-15 intra-trade before 2003, Slovenia before 1992.

Source: USDA Agricultural Projections to 2017.

Figure 11

Pork imports¹

Million metric tons



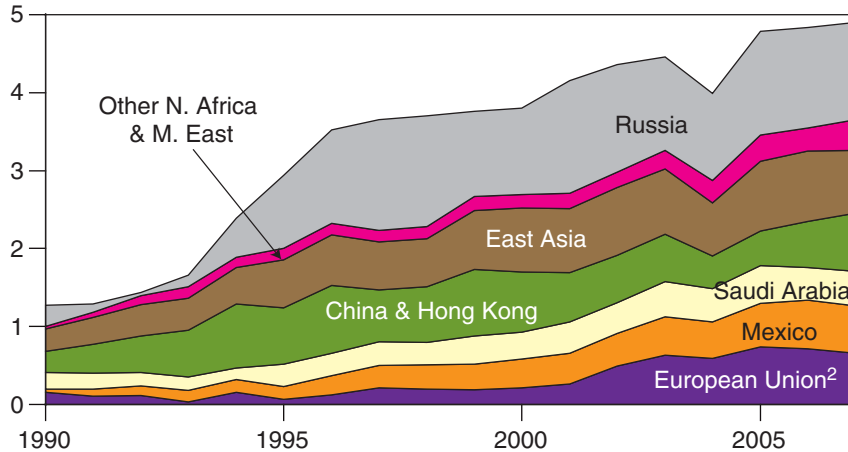
¹Selected importers.

Source: USDA Agricultural Projections to 2017.

Figure 12

Poultry imports¹

Million metric tons



¹Selected importers.

²EU-27 excludes intra-trade after 2002, EU-15 intra-trade before 2003, Slovenia before 1992.

Source: USDA Agricultural Projections to 2017.

Increased Meat Consumption Means Increased Demand for Grain and Protein Feeds

Global consumption of meat has been growing much more rapidly than consumption of grains and oilseeds. Between 1985 and 1990, production of meat (beef, pork, chicken, and turkey) rose more than 3 percent per year. Since this was well above the world's population growth rate of 1.7 percent per year, per capita consumption was able to climb by 1.4 percent per year. Although the average growth rates in production and per capita consumption of meat have declined somewhat since 1990, they are still well above the growth rates for aggregate use of grains and oilseeds.

As the demand for meat rises, the demand for grain and protein feeds used to produce the meat grows proportionally more quickly. Feed-to-meat conversion rates vary widely depending on the class of animal and the production practices used to produce the meat. The feed-to-product conversion factors below show an upper bound of how much the demand for feed increases for every 1-pound increase in meat consumed using the typical U.S. production system.

Feed-to-meat conversion rates

Class of animal	Pounds of feed needed to produce 1 pound of meat
Chicken	2.6
Pork	6.5
Beef	7.0

Source: Ephraim Leibtag, "Corn Prices Near Record High, But What About Food Costs?" In *Amber Waves*, February 2008.

<http://www.ers.usda.gov/AmberWaves/February08/Features/CornPrices.htm>

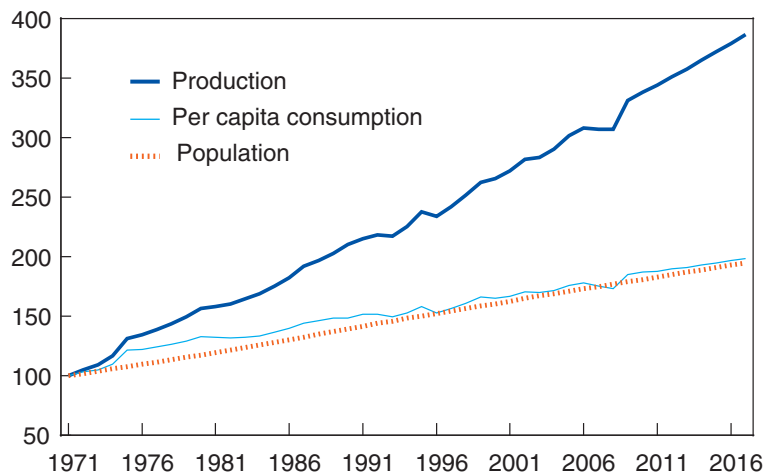
Figure 13

Global meat¹

Production, per capita consumption, and population

Exponential trend growth rates:			
	1975-90	90-07	2009-17
Production	2.2	2.5	2.1
Population	1.7	1.4	1.1
Percapita use	1.4	1.1	1.0

Index: 1971 = 100



¹Total meat = beef + pork + chickens & turkeys.

Source: USDA Agricultural Projections to 2017.

Developments Since 2000

As the new century began, the trends discussed above resulted in slowing growth in production and increasing growth in demand. At the same time, policy decisions in China led to a reduction of its grain stocks. And elsewhere, there were incentives for governments and the private sector to reduce stocks. Government-held buffer stocks were deemed to be less important after nearly two decades of low and stable food prices. For the private sector, the cost of holding stocks, use of “just-in-time” inventory management, and years of readily available global supplies provided incentives to reduce stock holding. Over the last decade, the shift toward more liberalized trade reduced trade barriers and facilitated trade, which in turn reduced the need for individual countries to hold stocks.

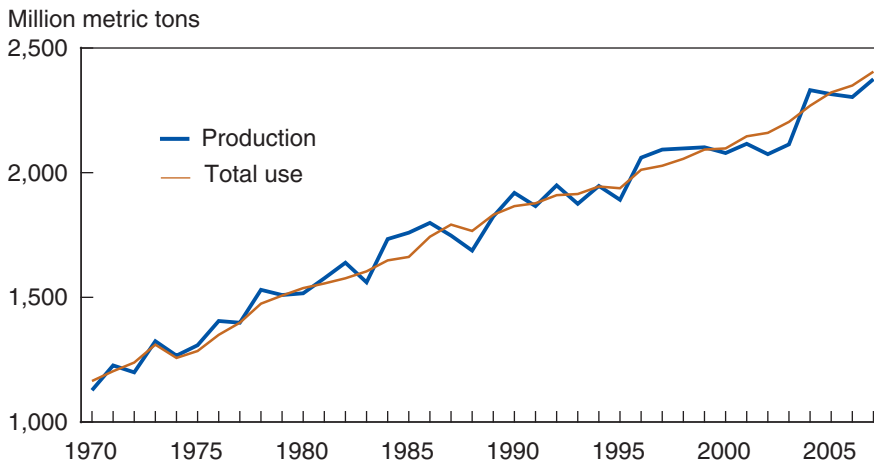
As a result of these factors, global consumption of aggregate grains and oilseeds exceeded production in 7 of the 8 years since 2000 (fig. 14). And since 1999, the global stocks-to-use ratio for the aggregate of grains and oilseeds declined from about 30 percent to less than 15 percent currently—the lowest level on record since 1970 (fig. 15). The resulting low level of world stocks in 2007 has caused importing countries to become anxious about being able to obtain their future food needs.

In 2000, the price of crude oil began to rise—slowly at first (see fig. 3). The underlying trends of rapid economic growth and demand for energy led to rapidly rising use of crude oil in developing countries.

Beginning in 2002, the U.S. dollar began to depreciate, first against OECD country currencies, and later against many developing countries’ currencies. As the dollar lost value relative to the currency of an importing country, it reduced that country’s cost of importing. Since the United States is a major source of many agricultural commodities, foreign countries’ imports of commodities from the United States began to rise. This put upward pressure

Figure 14

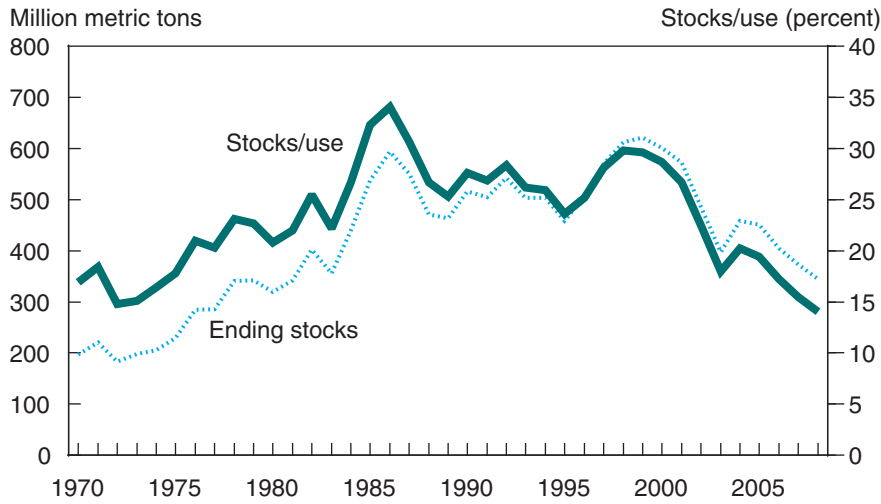
Total world grain & oilseeds Production and total use



Source: USDA PS&D Database.

Figure 15

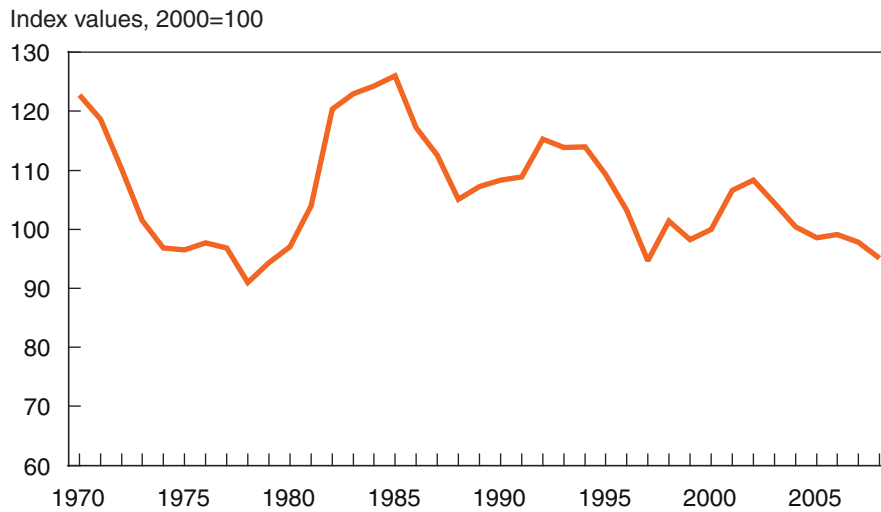
Total world grain & oilseeds
Stocks and stocks-to-use ratio



Source: USDA PS&D Database.

Figure 16

Value of U.S. dollar declines after 2002¹



¹Real U.S. agricultural trade-weighted dollar exchange rate, using U.S. agricultural export weights, based on 192 countries.

Source: ERS International Macroeconomics Dataset.

on U.S. prices for those commodities. Further, since the world price of major crops are typically denominated in U.S. dollars, the depreciation of the dollar also raises prices (measured in dollars).

Crude oil is also denominated in U.S. dollars, and the declining value of the dollar enabled importing countries to increase their oil imports. This increase in global demand for oil (in addition to the underlying trend resulting from rapid economic growth in developing countries) put additional upward pressure on the world price of crude oil, and in 2004 oil prices began to rise more rapidly than in prior years.

The Role of Biofuels

Biofuels have been produced and used in small amounts in several countries in recent decades. Production generally grew slowly until after the turn of the century. U.S. ethanol production began to rise more rapidly in 2003; EU biodiesel production began to increase more rapidly in 2005.

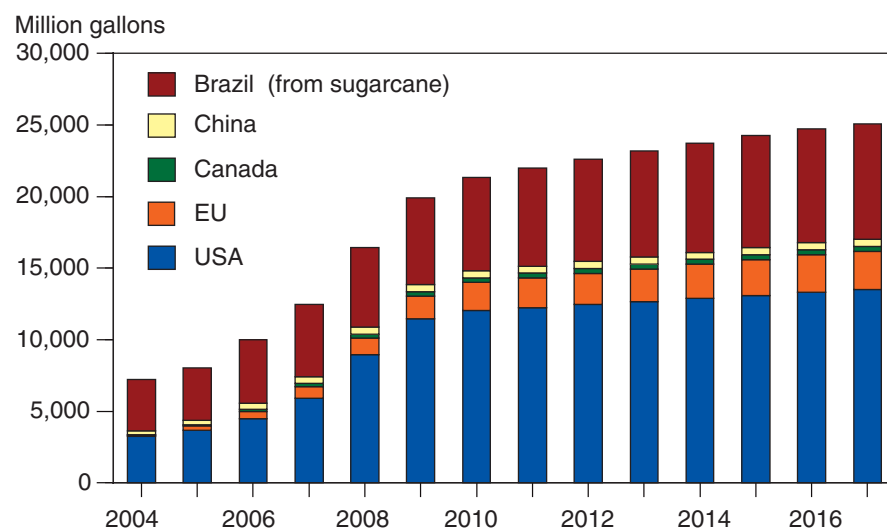
Brazil and the United States account for most of the world's ethanol production. Brazil uses sugarcane as a feedstock, while the United States uses nearly all corn. A number of other countries have policy initiatives designed to increase ethanol production, but so far the total augmentation in production capacity has been small relative to the combined capacity of Brazil and the United States. In 2006, China reversed its decision to invest in facilities to produce more ethanol from grain. Given its food policies, China is now focusing on using cassava and sweet potatoes as feedstocks for future increases in ethanol production.

The European Union is the largest biodiesel producer, and rapeseed oil is its main feedstock. The EU has mandated that biofuels account for 10 percent of transportation fuel use by 2020. The EU cannot produce sufficient rapeseed to fill the mandate and will have to import either some feedstocks for producing biodiesel, or some biodiesel. Russia and the Ukraine are increasing rapeseed production destined for export to the EU as rapeseed, rapeseed oil, and perhaps as biodiesel. Brazil and Argentina are using soybean oil as a feedstock to expand biodiesel production. Brazil's biodiesel will mostly be produced in the Center West part of the country and will replace petrol-diesel traditionally trucked in from the coast. Most of Argentina's biodiesel production is destined for the export market. Canada is expanding biodiesel production in the Prairie Provinces using rapeseed as the feedstock.

Figure 17

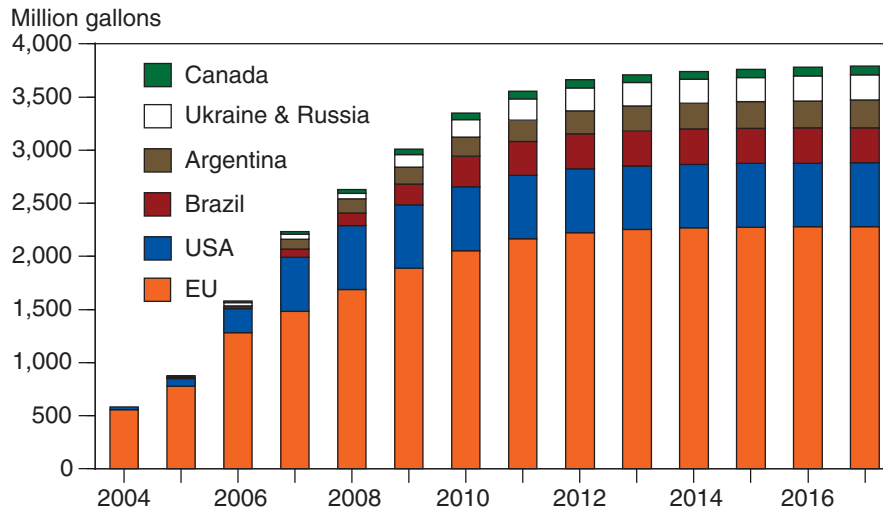
Ethanol production

Mostly from grain feedstocks except for Brazil



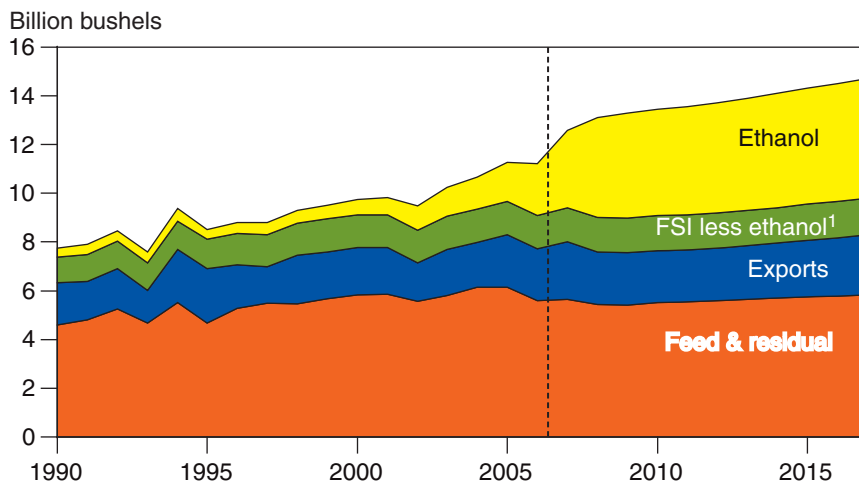
Source: USDA Agricultural Projections to 2017.

Figure 18
Biodiesel production



Source: USDA Agricultural Projections to 2017.

Figure 19
U.S. corn use



¹Food, seed, and industrial less ethanol.

Source: USDA Agricultural Projections to 2017.

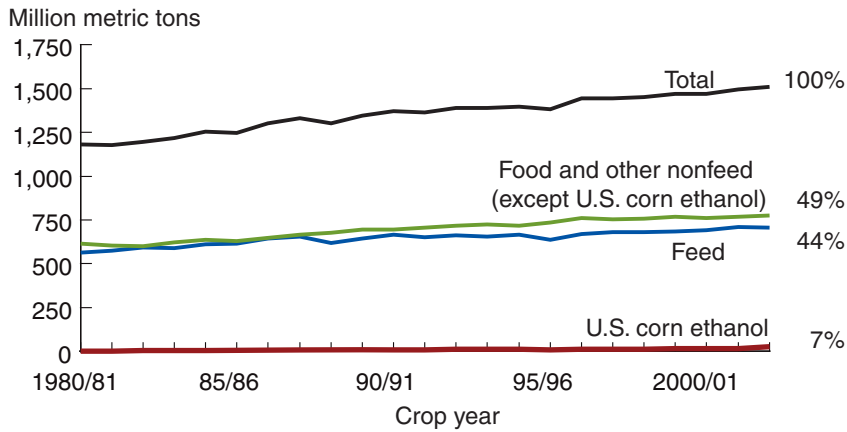
U.S. ethanol production began to expand rapidly in 2003. There were several incentives for expanding ethanol production: the increasing price of petroleum; concerns about the reliability of some traditional exporters; concerns about the pollution effects of methyl tertiary butyl ether (MTBE) and initial switching from MTBE to ethanol; and an environmental objective to increase the use of cleaner burning fuels. Without these developments, the increase in U.S. and world biofuels production would not have been nearly as great.

Corn used for ethanol rose from about 1 billion bushels in 2002/03 to a projected 3.1 billion bushels in the current (2007/08) crop year. With this increase, corn used for ethanol production now accounts for about 24 percent of total U.S. corn disappearance, up from 10 percent in 2002/03. This

increase was facilitated because U.S. corn production rose in response to increased demand and prices, and, in general, other uses of U.S. corn (food, feed, non-ethanol industrial uses, and exports) did not decline.

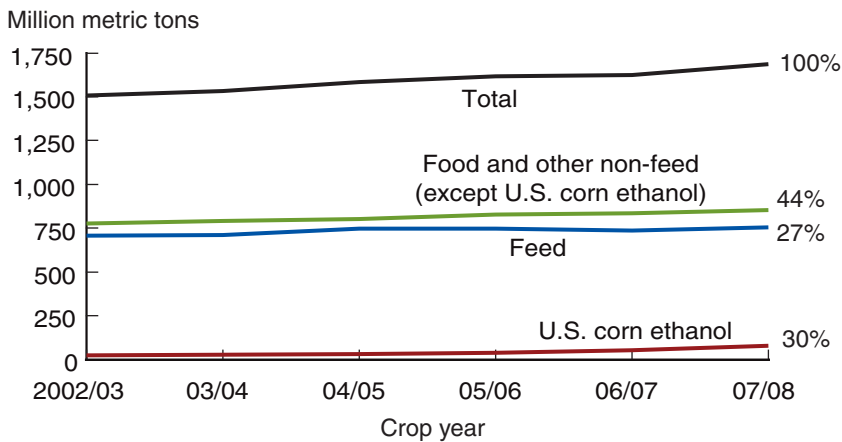
Figures 20 and 21 provide perspectives about the importance of grain used to produce ethanol relative to the total demand for grain used for all purposes over 1980-2002 and over the most recent 5 years. For both charts, average contributions to the markets, as well as marginal contributions to recent growth are discussed.

Figure 20
Global wheat and coarse grains use, 1980/81– 2002/03
U.S. ethanol accounted for 7 percent of historical global growth



Note: Category's share of the change in total use from 1980/81 to 2002/03 shown at the right.
 Source: USDA PS&D Database.

Figure 21
Global wheat and coarse grains use, 2002/03 – 2007/08
U.S. ethanol has accounted for 30 percent of recent global growth



Note: Category's share of the change in total use from 2002/03 to 2007/08 shown at the right.
 Source: USDA PS&D Database.

Historically, the amount of grain used to produce ethanol has been a small percentage of the global total used for all purposes. Furthermore, during the 1980s and 1990s, the increase in grain used to produce ethanol accounted for a small percentage of the total increase in demand. Between 1980 and 2002 (before the more rapid growth in ethanol production in the United States began), the amount of corn used to produce ethanol in the United States rose by 24 million metric tons. During the same period, global feed use of wheat and coarse grains increased 144 million metric tons, and food and other non-feed uses (besides U.S. corn for ethanol) increased by 160 million tons. Of the total increase in the demand for wheat and coarse grains (corn, barley, sorghum, rye and oats), ethanol accounted for 7 percent, feed use for 44, and food and other non-feed use, except for U.S. ethanol, for 49 percent. During this period, the strong growth in global demand for food and feed far surpassed the demand for industrial uses of grain. Biofuels was only one of several rising industrial uses of grain (fig. 21).

Ethanol output increased rapidly after 2002, and from the perspective of global market changes from 2002 onward, provides a somewhat different picture. Between 2002 and 2007, the quantity of U.S. corn used to produce ethanol rose by 53 million metric tons. This accounted for 30 percent of the global growth in wheat and feed grains use. Feed use grew by 48 million tons and accounted for 27 percent of the increase in total use. Food and other non-feed uses climbed 79 million tons and accounted for 44 percent of the global increase in wheat and coarse grains use.

The data suggest that while U.S. corn used for ethanol production had only a small effect on global markets in the 1980s and 1990s, the increase in U.S. ethanol production over the past 5 years and the related significant changes in the structure of the U.S. corn market have had a more pronounced impact on the world's supply and demand balance for total coarse grains recently. Importantly, since the United States is the world's largest corn exporter, some of the higher prices resulting from increased U.S. demand has spilled over onto world markets.

Most feedstocks used to produce biofuels come from annual crop production. Perennial crops, such as oil palm and coconut, as well as previously used vegetable oils and fats, that are feedstocks for biodiesel are the primary exceptions. Use of crops for biofuel may divert some cropland away from producing crops used for food, feed, and non-biofuel industrial uses. However, in some cases, coproducts such as distiller's grains (a byproduct when producing ethanol from corn) or soybean meal (a joint product in producing soybean oil from soybeans), continue to be available for food or feed use when biofuels are produced. Also, because global total area harvested is rising, increases in land used to produce biofuel feedstocks have not led to equivalent declines in area planted to traditional food and nonfood uses.

A rough estimate suggests that about 47.8 million acres were used to provide biofuel feedstocks in the 6 major producing countries in 2007 (see box). This would account for about 3-4 percent of arable land in these countries.

Update on Global Land Use in Biofuel Feedstock Production

Since the initial release of this report in May 2008, ERS has compiled additional information for estimating 2006/07 land used for biofuel feedstock production in other countries for 2007, as well as final data for updating estimates for the United States. These estimates cover the 6 major countries producing biofuel—either ethanol or biodiesel—together accounting for about 95 percent of global biofuel output in 2007. Estimates of biofuel production for 2007 are combined with crop yields and feedstock-biofuel conversion factors for 2006/07 crop years to derive implied harvested areas of the major feedstocks used in each country (see table). These estimates do not include land used for minor feedstocks in these countries, or biofuel feedstock production in other countries, such as Thailand, India, and Indonesia.

Despite rapid global expansion in biofuel production, total land cultivated in biofuel feedstocks amounted to about 47.8

million acres in 2006/07, or 3-4 percent of arable land, in the top six producing countries.* The United States accounted for about 46 percent of the global total, followed by the EU and Brazil. Per acre biofuel yields (combining both crop yields and feedstock-biofuel conversion factors) in 2007 range from 66 gallons for U.S. soybeans, to 140 gallons for EU rapeseed, to 403 gallons for U.S. corn, to 710 gallons for Brazilian sugarcane. With higher yields from sugarcane, Brazil produced about 76 percent more ethanol per acre of land in 2007 than the United States.

*Land used to produce biofuel feedstocks may also produce food or feed coproducts. Examples include distiller's grains (produced when corn is converted to ethanol by the dry-mill method) and soybean meal (a joint product of processing of soybeans to produce soybean oil, a biodiesel feedstock). These calculations do not include deductions for the area equivalent of coproducts.

Biofuel Production and Land Use by Major Producing Countries, 2006/07

Country	Biofuel production ³		Biofuel feedstocks ⁴		Biofuel yield ⁵		Implied feedstock area ⁶			Arable land ⁷	
	Ethanol	Bio-diesel	Ethanol	Bio-diesel	Ethanol	Bio-diesel	Ethanol	Bio-diesel	Country total	Area	Biofuel share
	Million gallons				Gallons/acre		Million acres			Percent	
Argentina	--	117	--	soy (100%)	--	65	--	1.8	1.8	70	2.5
Brazil	5,284	105	sugarcane (100%)	soy (66%)	710	65	7.4	1.1	8.5	146	5.8
Canada	159	27	corn (70%)	--	370	--	0.3	--	0.7	113	0.6
			wheat (30%)	--	115	--	0.4	--	--	--	--
China ¹	469	30	corn (70%)	--	215	--	1.6	--	2.4	354	0.7
			wheat (30%)	--	185	--	0.8	--	--	--	--
EU-27	488	1,480	wheat (48%)	rape (64%)	182	140	1.3	6.8	12.3	281	4.4
			sugarbeet (29%)	soy (16%)	550	60	0.3	3.9	--	--	--
United States ²	6,485	509	corn (98%)	soy (74%)	403	66	15.7	5.7	22.1	431	5.1
			sorghum (2%)		146	--	0.7	--	--	--	--
Totals	12,884	2,267					28.5	19.3	47.8	1,395	3.4

Note: When countries import/export feedstock for processing, calculations based on biofuel production overstate/understate feedstock area in that country.

¹China ethanol production for 2007 from USDA/FAS GAIN report. ²U.S. ethanol production for 2007 from Renewable Fuel Association (<http://www.ethanolrfa.org/>). ³Unless otherwise noted, biofuel production data for 2007 are from FO Licht, various publications. ⁴Percentages indicate feedstock shares of ethanol or biodiesel production; 100 percent is assumed when shares of other feedstocks are small. ⁵Biofuel yields based on 2006/07 crop yields from the USDA PS&D database and biofuel conversion factors based on USDA estimates for the United States and various USDA/FAS GAIN reports for foreign countries. ⁶Implied area estimates are adjusted for share of biofuel production from the major feedstocks indicated. ⁷Arable land data are from FAO.

Further Developments

Developments in 2004

In 2004, agricultural production costs began to rise, especially for energy-related inputs such as fertilizer, fuel, and pesticides. Although there was a lag between the increase in petroleum prices and when farmers began to pay more for fertilizer, fertilizer prices have risen sharply. In the long run, farmers must cover their costs of production. Farm output prices will increase because of reductions in output, until production again becomes profitable, or because of offsetting price increases due to demand strength.

Developments in 2005/06

In early 2006, food commodity prices began to rise more rapidly than in previous years. This increase reflected many diverse and not necessarily related factors.

During 2006, hedge funds, index funds, and sovereign wealth funds became more involved in agricultural commodity markets. The investors in these funds were not so much interested in agricultural commodities as they were in using commodities to diversify their financial portfolios. The funds held an increasingly large percentage of open interest in the futures market for agricultural commodities, as well as of nonagricultural commodities such as metals and energy. These investors only had a financial interest in the markets and did not intend to take delivery of the agricultural commodities. Indeed, it is likely that in general, neither the investors nor the financial managers that directed the funds' investments knew much about the fundamentals of agricultural commodity markets. It is unclear to what extent the effect these new investor interests had on prices and the underlying supply and demand relationships for agricultural products. However, computerized trend-following trading practices employed by many of these funds may have increased the short-term volatility of agricultural prices

The U.S. Energy Policy Act of 2005 mandated that renewable fuel use in gasoline reach 7.5 billion gallons by calendar year 2012. Additionally, the legislation did not provide liability protection for effects of methyl tertiary butyl ether (MTBE), an oxygenating gasoline additive that has been found to contaminate drinking water. As a result, blenders sharply reduced use of MTBE by May 2006 and switched to ethanol as a fuel additive.²

Adverse weather reduced crop production in some countries in 2006. Russia and Ukraine had yield losses due to drought. Australia was in the second year of a severe drought. South Africa also experienced drought. These droughts resulted in lower world production of grains and oilseeds, contributed to a further decline in the global stock-to-use ratio for aggregate grains and oilseeds, and contributed to rising prices. In September 2006, corn prices began a significant rise to a new high.

²Paul Westcott, "U.S. Ethanol Expansion Driving Changes Throughout the Agricultural Sector," *Amber Waves*, U.S. Department of Agriculture, Economic Research Service, September, 2007.

Developments in 2007

In 2007, a number of adverse weather events affected yields across the globe, including:

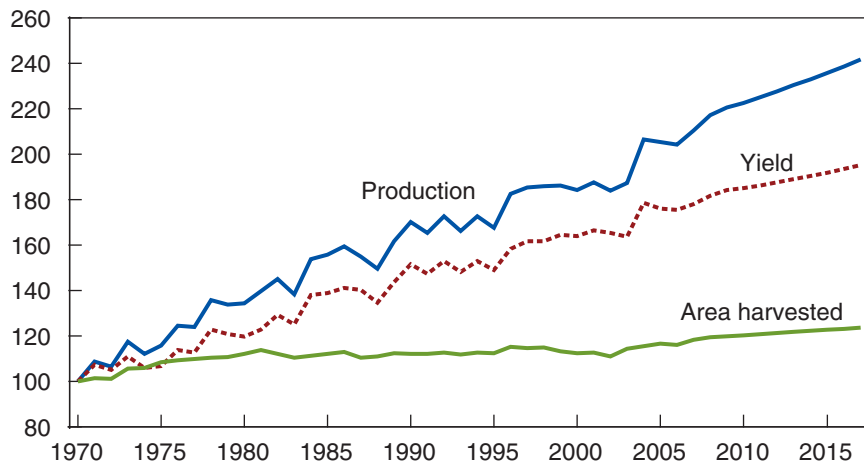
- Northern Europe had a dry spring and harvest-time floods.
- Southeast Europe experienced a drought.
- Ukraine and Russia experienced a second year of drought.
- A large area of the U.S. hard red winter wheat area had a late, hard, multi-day freeze that killed some of the crop and reduced yields over large areas.
- Canada's summer growing season was hot and dry, resulting in lower yields for wheat, barley, and rapeseed.
- Northwest Africa experienced a drought in some of its major wheat- and barley-growing areas.
- Turkey had a drought that reduced yields in its nonirrigated production areas.
- Australia was in the third year of the worst multiyear drought in a century. Grain yields were very low and exports plummeted.
- Argentina had a late freeze followed by drought that reduced corn and barley yields.

The result of adverse weather in 2007 was a second consecutive drop in global average yields for grains and oilseeds (fig. 22). In historical perspective, two sequential years of lower global yields occurred only three other times in the last 37 years. The lower production caused yet another decline in the global stocks-to-use ratio and created a world market environment

Figure 22

Total world grain and oilseeds¹ Production, yield, and area harvested

Index: 1970=100



¹Total oilseeds = soybeans + rapeseed + sunflowers.

Source: USDA Agricultural Projections to 2017.

characterized by concern among importers about the future availability of supplies.

In May of 2007, soybean prices began a rapid upward trend. Corn prices were already at record highs.

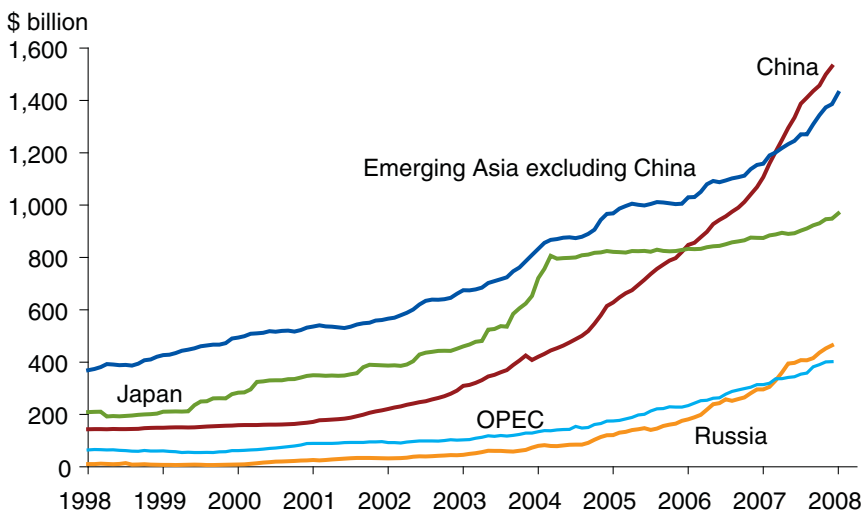
By late summer 2007, some importers were aggressively contracting for imports of grains and oilseeds. Even though prices were at record highs, importers were buying larger volumes, not less. Some countries that usually imported sufficient quantities of grain to meet their needs for the following 3-4 months began to contract for imports to meet their needs for the following 5-10 months.

Large foreign exchange reserves held by some major importing countries enabled them to contract for their import needs regardless of how high the world price rose. There have been very large accumulations of foreign exchange reserves held by oil-exporting countries (OPEC and Russia) and by countries with large non-oil trade surpluses (China, Japan, and other Asian countries). Countries holding these large foreign exchange reserves are able to import large volumes of food commodities in order to meet their consumption needs and allay their domestic food price inflation. In essence, they can bid supplies away from other traditional importers that do not hold significant foreign exchange reserves.

In August 2007, world wheat prices began a sharp upward trend. Rice prices jumped sharply later in the fall.

Figure 23

Foreign exchange reserves



Source: Oxford Economics / Haver Analytics

Policy Responses to Rising Food Prices

The rapidly increasing world prices for food grains, feed grains, oilseeds, and vegetable oils caused domestic food prices at the consumer level to rise in many countries. In response to rising food prices, some countries began to take protective policy measures designed to reduce the impact of rising world food commodity prices on their own consumers. However, such measures typically force greater adjustments and higher prices onto global markets.

In the fall of 2007, some exporting countries made policy changes designed to discourage exports so as to keep domestic production within the country. The objective was to increase domestic food supplies and restrain increases in food prices. A partial list of these policy changes follows:

Eliminated export subsidies:

- China eliminated rebates on value-added taxes on exported grains and grain products. The rebate was effectively an export subsidy that was eliminated.

Export taxes:

- China, with food prices still rising after eliminating the value-added tax rebate, imposed an export tax on a similar list of grains and products.
- Argentina raised export taxes on wheat, corn, soybeans, soybean meal, and soybean oil.
- Russia and Kazakhstan raised export taxes on wheat.
- Malaysia and Indonesia imposed export taxes on palm oil.

Export quantitative restrictions:

- Argentina restricted the volume of wheat that could be exported even before raising export taxes on grains.
- Ukraine established quantitative restrictions on wheat exports.
- India and Vietnam put quantitative restrictions on rice exports.

Export bans:

- Ukraine, Serbia, and India banned wheat exports.
- Egypt, Cambodia, Vietnam, and Indonesia banned rice exports. India, the world's third largest rice exporter, banned exports of rice other than basmati, significantly reducing global exportable supplies.
- Kazakhstan banned exports of oilseeds and vegetable oils.

Early in 2008, importing countries also began to take protective policy measures to combat rising food prices. Their objective was to make high-cost imports available to consumers at lower prices. A partial list of policy changes follows:

The following countries reduced import tariffs:

- India (wheat flour)

- Indonesia (soybeans and wheat; streamlined the process for importing wheat flour)
- Serbia (wheat)
- Thailand (pork)
- EU (grains)
- Korea and Mongolia (various food commodities)

Subsidizing consumers:

- Some countries, including Morocco and Venezuela, buy food commodities at high world prices and subsidize their distribution to consumers.

Other decisions by importers:

- Iran imported corn from the United States, something that has occurred rarely—only when they could not procure corn elsewhere at reasonable prices.

The policies adopted by importing countries also changed price relationships in world markets. Their policy changes increased the global demand for food commodities even when world prices were already rapidly escalating.

The policies adopted by exporting countries to reduce food price inflation within their own countries resulted in lower supplies available to the rest of the world. Importers who want to buy food commodities now have fewer sources. This heightened concerns among importing countries, stimulating them to buy additional supplies, even at record high prices. The combination of reduced supplies and increased demand meant that world market adjustments had to be made by the smaller number of countries trading in the world market that had not changed their trade policies.

The combination of reduced supplies from traditional exporters and increased demand from importers, at a time when the global stocks-to-use ratio was unusually low, increased importers' concerns about future availabilities to meet consumption needs. This boosted world market prices even more. These contributions to higher world prices in April 2008 exacerbated an already tight supply and demand situation.

Implications for Food Security

Rising food commodity prices tend to negatively affect lower income consumers more than higher income consumers. First, lower income consumers spend a larger share of their income on food. Second, staple food commodities such as corn, wheat, rice, and soybeans account for a larger share of food expenditures in low-income families. Third, consumers in low-income, food-deficit countries are vulnerable because they must rely on imported supplies, usually purchased at higher world prices. Fourth, countries receiving food aid donations based on fixed budgets receive smaller quantities of food aid.

A number of factors affect how much of an increase in world food commodity prices passes through to consumers' budgets: the percentage of income spent on food, the percentage of retail food expenditures spent on staple foods, government trade and domestic food policies. A simplified comparison of the impact of higher food commodity prices on consumers in high-income countries and on consumers in low-income, food-deficit countries illustrates these differences.

Impact of Higher Food Commodity Prices On Consumers' Food Budgets*

	High-income countries	Low-income food-deficit countries
I. Base scenario		
Income	\$40,000	\$800
Food expenditure	\$4,000	\$400
Food costs as % of income	10.0%	50%
Disaggregate retail food spending (staples vs. non-staples)		
Staples as % of total food spending	20%	70%
Expenditures on staples	\$800	\$280
Expenditures on non-staples	\$3,200	\$120
II. Scenario: 50% price increase in staples, partial pass through on staples		
Assumed % pass through	60%	60%
Increase in cost of staples	\$240	\$84
New cost of staples	\$1040	\$364
New total food costs	\$4,240	\$484
Food costs as % of income	10.6%	60.5%

*These are illustrative food budgets that characterize the situations for consumers in high- and low-income countries.

Source: As compiled by ERS.

This illustrative comparison shows that for a consumer in a high-income country, a 50-percent increase in staple food prices causes retail food expenditures to rise 6 percent (\$240). This results in the percentage of income spent on food rising from 10 to 10.6 percent—less than 1 percentage point. For a consumer in a typical low-income food-deficit country, food expenditures increase only \$84, but that is a 21-percent increase in total food expenditures. Furthermore, this \$84 increase means that the percentage of income spent on food climbs from 50 to more than 60 percent.

For highly import-dependent or highly food-insecure countries, any decline in import capacity stemming from rising food prices can have challenging food security implications. Foreign food aid donations have provided supplemental assistance to lower income consumers in many low-income, food-deficit countries. However, food aid donations have stagnated during the last two decades, and food aid's share has declined relative to total food imports of low-income countries.³ Higher food commodity prices negatively affect the ability to provide food aid donations. Most food-aid donors budget a fixed annual amount to fund procurement of food aid commodities. When prices rise, their fixed budget buys less food to donate. Additionally, higher petroleum prices have been a major factor in the sharp increase in ocean freight rates. This further increases the cost of getting food aid donations to the recipient countries.

³Stacey Rosen and Shahla Shapouri, "Rising Food Prices Intensify Food Insecurity in Developing Countries," *Amber Waves*, U.S. Department of Agriculture: Economic Research Service, February 2008.

Food Price Inflation Impact on Social Unrest

The recent price spike has led to social unrest in a number of countries.⁴ Peaceful protests have been held in Malaysia (millers & bakers), Indonesia (markets selling soybeans and meats), and Pakistan (wheat marketers). Peruvian farmers blocked rail lines to protest rising fertilizer costs. In South Africa, members of the National Labor Federation demonstrated against higher food and electricity prices.

Less peaceful demonstrations of consumers' anger and fear over higher food prices (generally referred to in the news media as riots) have occurred in a variety of countries including:

Guinea	Mauritania	Morocco	Senegal
Cameroon	Mexico	Uzbekistan	Yemen
Niger	Burkina Faso	Egypt	Haiti
Ethiopia	Philippines	Thailand	Mozambique
Ivory Coast	Bangladesh	Indonesia	

Most of these incidents have occurred in low-income, food-deficit countries.

⁴Incidents gleaned from news media reports.

Summary of Factors Contributing to Higher Food Prices

Food prices, and particularly the prices for basic food commodities, have risen sharply during the last 2 years. Many factors contributed to these price increases. Long-term trends that led to slower growth in production and rapid growth in demand contributed to a sharp downward trend in world aggregate stocks of grains and oilseeds that began in 1999. Recent factors that have further tightened world markets include increased global demand for biofuels feedstocks and adverse weather conditions in 2006 and 2007 in some major grain- and oilseed-producing areas.

Additional recent developments that have put upward pressure on food commodity prices by further restricting available supplies or increasing demand for food commodities include the devaluation of the U.S. dollar, rising energy prices, increases in agricultural costs of production, growth in foreign exchange holdings by major food-importing countries, and protective policies adopted by some exporting and importing countries.

As a result of these market factors, stocks of grains and oilseeds in the world have fallen to levels that make the global aggregate stock-to-use ratio for grains and annual oilseeds the lowest since 1970. Stocks in major exporting countries are particularly low. All of these factors have contributed to higher world prices for food commodities.

Prospects for the Future

In assessing prospects for the future, there are a number of uncertainties and concerns:

Global economic growth: If rapid growth continues, particularly in developing countries, it will continue to put upward pressure on food commodity prices through increases in food demand.

Energy prices: If petroleum prices continue to rise, costs of agricultural production will rise, as will the cost of processing, and the cost of transporting products to markets both within a country and exporting to other countries. Continued high petroleum prices will also sustain the global incentives to produce more biofuels.

Biofuels production: Global growth in grains- and oilseeds-based biofuels production is expected to slow in the next several years from the rapid gains of the past several years, even with the higher mandates in the United States under the Energy Independence and Security Act of 2007. This will lessen further demand pressures on agricultural markets and likely will result in some reductions in grain and oilseed prices. Nonetheless, with sustained higher levels of biofuels-related demand, world food commodity prices are not projected to retreat to past levels. However, several years into the future, the underlying long-term trend in rapidly increasing global demand is expected once again to be the primary contributor to future upward pressure on food commodity prices.

Supply response capacity of the global agricultural production system:

- *Cost of inputs:* Continued increases in production costs, especially in energy-related costs, will restrain the world's production response. Higher costs for fertilizer, fuel, and seeds could cause farmers without access to credit to plant less than they otherwise would have, or to shift to crops requiring fewer inputs.
- *Additional cropland (quantity and quality):* What will be the longrun impact of higher world food commodity prices on the amount of land used to produce the crops? What is the productivity of the land that will be used to increase production?
- *Water shortages:* How quickly will constraints on the amount of water available for agricultural production become more widespread?
- *New seed varieties and use of biotechnology:* Will higher food prices encourage some countries to adopt the use of biotechnology, especially genetically modified seed for crops? Will future research focus more on yield-enhancing varieties rather than cost-reducing innovations?
- *Biophysical response to climate change:* How will climate change affect agricultural production? How will it change temperatures, precipitation, the length of growing seasons, and variability of yields? How, and under what circumstances, will climate change increase and/or reduce production? In affected regions, how difficult will it

be for producers to shift to different crops, to adopt new cropping patterns, and to adjust production practices to the new environment?

With such low world stocks of food commodities, food prices are vulnerable to a production shortfall in one or more major production areas. If a significant shortfall occurs this year due to weather or disease, food prices might continue to rise sharply from the current high level. Although trade flows can mitigate some of these effects, new or existing trade restrictions or barriers can exacerbate price impacts. However, if good crop production conditions exist in the Northern Hemisphere during the next 6 months, food commodity prices could retreat significantly from their current highs.