



C H A P T E R 8

CHALLENGES AND OPPORTUNITIES IN U.S. AGRICULTURE

U.S. agriculture fared better during the Great Recession than many other sectors and remains a bright spot in the U.S. economy. Despite an extensive and severe drought in 2012, net farm income is forecast to total \$112.8 billion, only 4.3 percent below the previous year's record of \$117.9 billion (USDA 2013a). Strong demand for agricultural products and below-average crop yields pushed up crops prices, and along with significant crop insurance indemnity payments, helped to make the 2012 income figure the second-highest since 1974 after adjusting for inflation. (See Economics Application Box 8-1 on the 2012 drought).

The strength of the U.S. agricultural sector is due in part to the demand for American agricultural exports. The value of agricultural exports has steadily risen and now accounts for a projected 31 percent of gross farm cash income. Exports reached a near record level of \$135.8 billion in 2012 and are projected to reach \$142 billion in 2013 (USDA 2012a).

Increasing demand from abroad created by rising incomes and a growing middle class will present opportunities for U.S. agriculture. The world population is expected to reach more than 9.2 billion by 2050, with growth coming primarily in developing countries, most of which are net importers of food products. The convergence of population growth and rapid urbanization, especially in developing regions of the world, will likely result in growing demand for food as well as changing dietary patterns.

Trade in agricultural commodities is a global endeavor, and the U.S. agricultural sector is subject to significant price volatility at the commodity level. Because of its high degree of integration with the international marketplace, U.S. agriculture is vulnerable to price volatility induced by other countries' agricultural policies—import and export restrictions—and growing conditions. Further, while the effects of climate change on livestock and

Economics Application Box 8-1: The 2012 Drought

A drought in the summer of 2012 across much of the United States caused significant crop losses and some livestock liquidation. About 80 percent of agricultural land experienced low rainfall and high temperatures, making the 2012 drought the most extensive since 1956. A striking aspect of the 2012 drought was the rapid increase in severity in early July. While the drought eased somewhat during early September, conditions during the June to August period largely determine production for most crops. By mid-August, crops worth 50 percent of the total value of all crops were exposed to drought.

Crop losses were most substantial for corn. In the spring of 2012, the U.S. Department of Agriculture estimated an expected corn yield of 166.0 bushels an acre. By October 2012, those estimates had dropped to 122.3 bushels an acre—a reduction of 27 percent. Soybeans, somewhat more drought tolerant, experienced a 14 percent yield reduction (from 43.9 to 37.8 bushels an acre). The livestock industry, still recovering from the 2011 drought in the Southern Plains, was hit especially hard. As of late October of 2012, 54 percent of pastures and ranges in the United States were rated poor to very poor. Beef production in 2012 was projected to decline 2.3 percent from 2011 levels and to fall another 4.2 percent in 2013. Broiler and pork production were also expected to experience declines in 2013, while milk production is expected to remain stable.

The effects of the drought on food prices were reflected first in the livestock sector, with increases in the price of meat and dairy products in late 2012 and projected into 2013. The full effects of the increase in corn and other commodity prices will likely take as long as a year to be fully captured in higher retail food prices.

Despite the drought, average income for farm businesses remained steady in 2012 at \$86,200, reflecting the increased prices for corn and soybeans as well as increases in crop insurance indemnities, which as of February 2013 had already paid out \$12.9 billion for 2012 losses (USDA 2013). Income increases on crop farms should more than offset livestock farmers' higher feed expenses and a decline in sales of wholesale milk. Additionally, the longstanding environment of strong commodity prices and low interest rates means that farm debt-to-equity ratios are approaching historic lows, which has reduced the financial vulnerability of farms to the production shocks.

crop production systems are expected to be mixed in the next 25 years, over the long term, continued changes are expected to have generally detrimental effects on most crops and livestock.

THE AGRICULTURAL SECTOR IN 2012

In the 1920s, farm households accounted for more than 25 percent of the U.S. workforce and generated approximately 8 percent of gross domestic product (GDP). Today they account for only 1.6 percent of the workforce and generate approximately 1 percent of GDP. Over the same period, the rural share of the population has fallen far less, from 49 percent to 19 percent, suggesting that rural areas are less dependent on farming's contribution to the rural economy (Table 8-1). The agricultural sector is still vital to our country, but because of growth in other sectors of the economy and rapid gains in agricultural productivity that have lowered the relative prices of agricultural products, it has become a smaller share of the U.S. economy.

The structure of farming continues to move toward fewer, but larger commercial operations producing the bulk of farm commodities, complemented by a growing number of smaller farms earning most of their income from off-farm sources. Small family farms—those with annual sales less than \$250,000—make up 90 percent of U.S. farms. They also hold about 62 percent of all farm assets, including 49 percent of the land owned by farms. However, commercial farms, which make up the other 10 percent of the sector, account for 83 percent of the value of U.S. production (Table 8-2).

While most of these large farms have a positive profit margin, average profit margins for small farms are negative because of high operating costs, low sales, and lower productivity (Table 8-3). Farms are predominantly organized as sole proprietorships (86.5 percent), followed by partnerships (7.9 percent) and corporations (4.4 percent).¹

Fifty years ago, average household income for the farm population was approximately half that of the general population. Today, however, farm households tend to be better off than other American households; in 2011, median income for farm households was about 13 percent higher than the U.S. median household income (Figure 8-1). The difference in income between farm households and the nonfarm households is due in part to the broad Department of Agriculture (USDA) definition of what constitutes a farm, which includes farms where the principal operator is retired or has a main occupation other than farming ("residence farms"). Households operating rural residence farms earn more than the U.S. median household income even though their net cash income from farming is negative. Households operating intermediate farms (farms where the principal operator is not retired and reports farming as his or her main occupation) have on average positive net cash income from their farming operations, but most household income comes from sources other than farming. The sources of

¹ Corporations include both Sub-chapter C and S corporations.

Table 8-1
90 Years of Structural Change in U.S. Agriculture

Year	1920	1950	1980	2000	2010
Number of farms (thousands)	6,518	5,648	2,440	2,167	2,192
Average farm size (acres)	147	213	426	436	419
Rural share of population (percent)	48.8	36.0	26.3	21.0	19.3
Farm share of workforce (percent)	25.4	12.1	3.4	1.8	1.6
Farm share of GDP (percent)	7.7	6.8	2.2	1.0	0.9

Note: 1920 data for farm share of GDP not available. Value reported is for 1930, as calculated by the Department of Agriculture, Economic Research Service.

Source: Department of Agriculture, National Agricultural Statistics Service, Farms, Land in Farms, and Livestock Operations; Bureau of Economic Analysis, GDP by Industry; Sobek (2006); CEA calculations.

Table 8-2
Farm Types

Small family farms (gross sales less than \$250,000)	Rural-residence family farms:	Retirement farms. Small farms whose operators report they are retired.	
		Residential/lifestyle farms. Small farms whose operators report a major occupation other than farming.	
	Intermediate family farms:	Farming-occupation farms. Small family farms whose operators report farming as their major occupation.	Low-sales farms. Gross sales less than \$100,000.
			High-sales farms. Gross sales between \$100,000 and \$249,999.
Large-scale family farms (gross sales of \$250,000 or more)	Commercial family farms:	Large family farms. Gross sales between \$250,000 and \$499,999.	
		Very large family farms. Gross sales of \$500,000 or more	
Nonfamily farms	Any farm not classified as a family farm, that is, any farm for which the majority of the farm business is not owned by individuals related by blood, marriage, or adoption.		

Note: The National Commission on Small Farms selected \$250,000 in gross sales as the cutoff between small and large-scale farms.

Source: Department of Agriculture, Economic Research Service, Farm Household Well-being

income for farm households are increasingly diversified, which means that many of them are less vulnerable to the fluctuations of farm income. In 2011, households operating commercial farms had median household incomes two and a half times the overall U.S. median household income, with most of their income from farming.

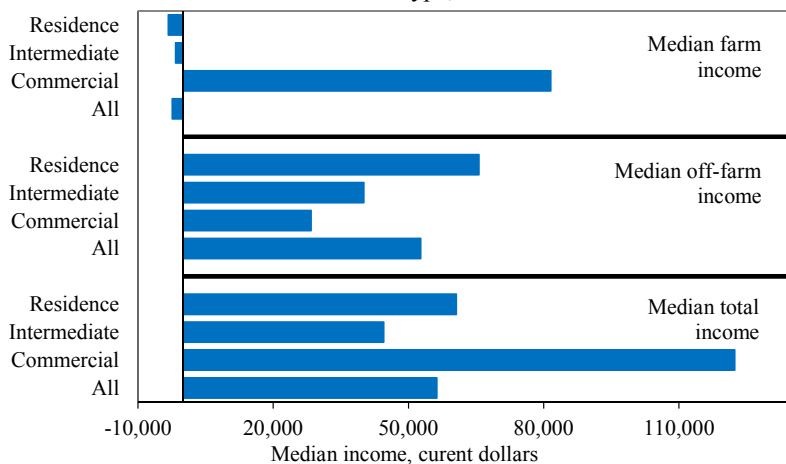
By 2000, 93 percent of farm households had income from off-farm sources, including off-farm wages, salaries, business income, investments, and Social Security. Off-farm work has played a key role in raising farm household income. In 2011, only 46 percent of principal operators of farms reported that farming was their main occupation. While farm household incomes have become more diversified, farm operations have become increasingly specialized: In 1900, a farm produced an average of about five

Table 8-3
Farm Income and Farm Operator Household Income by
USDA Farm Size Classification, 2010

	Rural residence farms	Intermediate farms	Commercial farms	All farms
Farm operator households	1,311,117	617,876	214,070	2,143,063
Average gross cash farm income (dollars)	14,974	52,790	840,315	108,320
<i>Average gross cash farm income, by source (%)</i>				
Crop, livestock, and other farm-related income	91.6	94.6	97.0	96.2
Government payments	8.4	5.4	3.0	3.8
<i>Average per farm operator household (dollars)</i>				
Total cash farm expenses	17,216	46,142	613,486	85,117
Net cash farm income	-2,242	6,648	226,829	23,203
Farm operator household income	83,738	51,054	185,098	84,440

Source: Department of Agriculture, Agricultural Resource Management Survey.

Figure 8-1
Median Income for Farm Households by Farm Type
and Income Type, 2010–2012



Note: 2012 forecasted values included for "all" farms. Values for farm-type breakouts are 2010–2011 averages.

Source: Department of Agriculture, Economic Research Service, Agricultural Resource Management Survey.

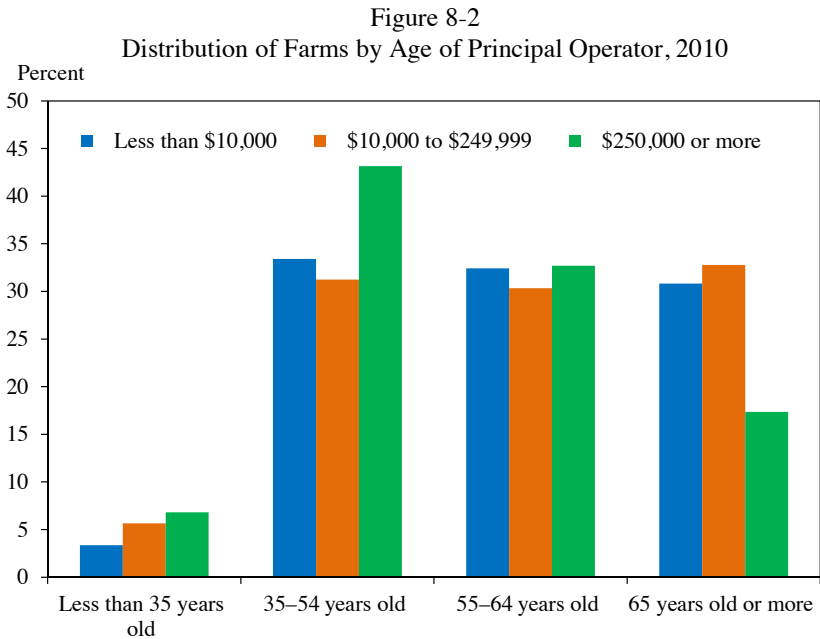
commodities; by 2000, the average had fallen to just over one. This change reflects not only the production and marketing efficiencies gained by concentration on fewer commodities, but also the effects of farm price and

income policies that have reduced the risk of depending on returns from only one crop or just a few crops.

The average age of U.S. farmers and ranchers has been increasing over time. In 1978, 16.4 percent of principal farm operators were over age 65. By 2007, 30 percent of all farms were operated by producers over 65. In comparison, only 8 percent of self-employed workers in nonagricultural industries in 2007 were that old (Hoppe, McDonald, and Korb 2010). One reason the farming sector is relatively older is that farmers are living longer and often reside on their farms. Many established farmers never retire. Additionally, one-third of beginning farmers are over age 55, indicating that many farmers move into agriculture only after retiring from a different career. More than 20 percent of farm operators report that they are retired. Another 32 percent of all farms are operated by farmers aged 55 to 64 years. Farmers aged 55 and older account for more than half of the total value of production. Farmers under 35 contribute only 6 percent of the total value of production (Figure 8-2). This demographic transition has implications for the future of the U.S. agricultural sector.

Barriers to Entry and Succession Planning in U.S. Agriculture

Starting a farm operation can be an expensive endeavor. Startup requires access to land and capital equipment, as well as the operator’s time.



Source: USDA (2010).

In 2011, the average farm operated 415 acres and held assets worth just under \$1 million, accounted for mostly by land and structures. Even for farm operators under age 35, asset values averaged \$811,500, highlighting the extent to which startup costs represent a hurdle for new entrants (USDA 2011).

The Federal Government recognizes the need to support and develop new farm operators. Through the Farm Service Agency, the USDA helps beginning farmers who are unable to obtain financing from commercial lenders by targeting a portion of its direct and guaranteed loan funds to farmers and ranchers who have not operated a farm or ranch for more than 10 years and do not own a farm or ranch greater than 30 percent of the median size farm in the county, as determined by the most current Census for Agriculture.

After spending a lifetime accumulating wealth in agricultural assets, farmers often wish to pass the farm business to their heirs. Special provisions in the Federal estate tax, such as a rule that allows farm assets of an estate to be valued at their farm-use value rather than a higher market value, facilitate the transfer of farm estates from one generation to the next. (See Economics Application Box 8-2 on the Federal estate tax.)

As farmers begin to consider transitioning from active operation to retirement, questions about what will happen to their land remain. In some cases, the land is passed to an heir who continues the family business; in other cases, it is sold at auction perhaps to another farmer, but sometimes for other purposes such as residential or commercial development. As much as 2 million acres of America's farms, ranches, forests, wildlife habitat, and other open spaces are lost to fragmentation and development each year, with significant implications for water resources, outdoor recreation, wildlife, rural economies, and other resources.

Making a donation of a qualified conservation easement is one way for farmers and ranchers to maintain their current operation and conserve the amenities and natural assets of rural America for future generations. Such a donation allows the farmer to create a separate, special right on the designated land stipulating that it will be used only for certain purposes, such as agricultural production. The farmer or rancher can continue to use the land for production, knowing that in the future, it will continue to be used in the same manner. In return for placing the land into a qualified conservation easement, the landowner may deduct the value of the easement from his or her income for tax purposes.

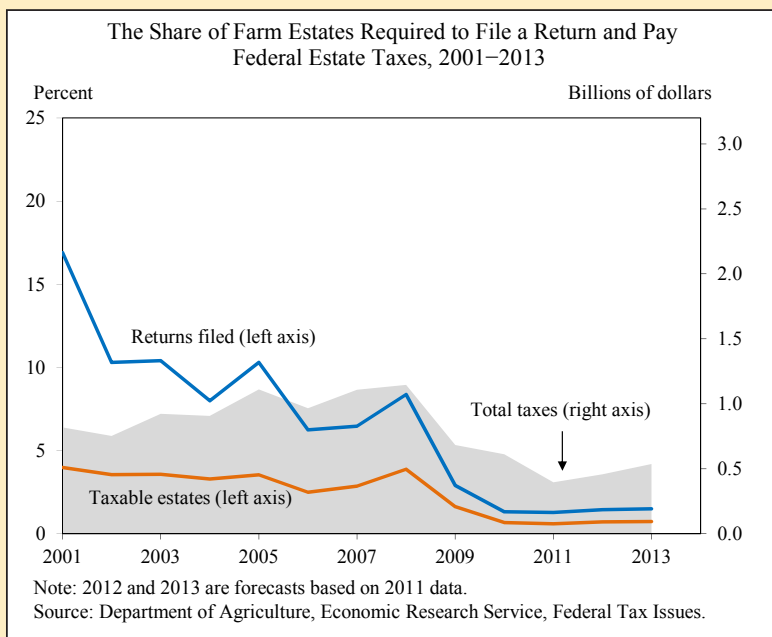
Starting in 2006, a new law encouraged additional conservation easements by significantly expanding the tax benefits landowners may receive when they donate easements to qualified organizations, such as a land

Economics Application Box 8-2: The Federal Estate Tax and Farm Business Succession Planning

An estate—in general, a collection of assets passed down from a decedent upon his or her death—is one vehicle available to farmers to transfer agricultural property from one generation to the next. Under current law, only those returns that have a taxable estate above the exempt amount after deductions for expenses, debts, and bequests to a surviving spouse or charity are subject to the tax.

While the estate tax has been amended many times, it has never directly affected a large percentage of taxpayers, including farmers. In fact, in no year since 1916 has the percentage of adult deaths generating a taxable estate surpassed 8 percent (Jacobson, Raub, Johnson 2012). Several targeted provisions have reduced the potential impact of estate taxes on the transfer of a farm or other small business to the next generation (Durst 2009). These provisions include:

- A special provision that allows farm real estate to be valued at farm-use value rather than at its fair-market value, which is often higher because it reflects the value of the land for housing or commercial development.
- An installment payment provision that allows an estate to elect to pay the estate tax attributable to the decedent's interest in a closely held business in up to 10 equal, annual installments. The provision covers a



decedent whose interest in the closely held business exceeds 35 percent of the adjusted gross estate, which describes a typical farm estate.

- A provision aimed at encouraging farmers and other landowners to donate an easement or other restriction on development that has provided additional estate tax relief.

The box figure illustrates the relatively low and declining burden the Federal estate tax has placed on farm estates. In 2001, 16.9 percent of farm estates were required to file a tax return and less than 4 percent had an estate tax liability. By 2011, as a result of the generous tax-exemption amount and low tax rate, those figures had declined to 1.28 percent and 0.6 percent, respectively. Total tax liability in 2011 was also lower than it had been the prior 10 years, despite record high agricultural land value, which represents a large majority of the assets in a farm estate. The American Taxpayer Relief Act of 2012 made permanent a maximum estate tax rate of 40 percent; it also set the exclusion amount at \$5 million and allowed for inflation adjustment, continuing the tax relief to most farm estates.

trust or public agency. More specifically, this enhanced incentive raises the maximum annual deduction a donor can take for the donation of a conservation easement and extends the period to claim the deduction from 5 to 15 years, from the year of the donation. In 2007 and 2008, a survey found that this incentive helped America's 1,700 local land trusts increase the pace of conservation by about 250,000 acres each year—a 36 percent increase over previous years.

The enhanced incentive provisions expired in 2009 but were renewed through December 31, 2013, by the American Taxpayer Relief Act of 2012. Making permanent the expanded tax incentives beyond 2013 would further bolster land conservation and job creation, especially on working lands, helping to keep landowners on their property and achieve a broad range of conservation outcomes.

A Mature Domestic Food Market

Americans benefit from a highly efficient agricultural sector and have higher standards of living now than at any point in the past. Of concern to producers in the U.S. food market is how much of their disposable income American consumers will spend on food in the future as well as what food products they will demand. Engel's law, which postulates that rising incomes lead to an increase in the nominal amount of income spent on food while the proportion of income spent on food falls, still holds in the United States. The share of American household budgets devoted to food fell from 15

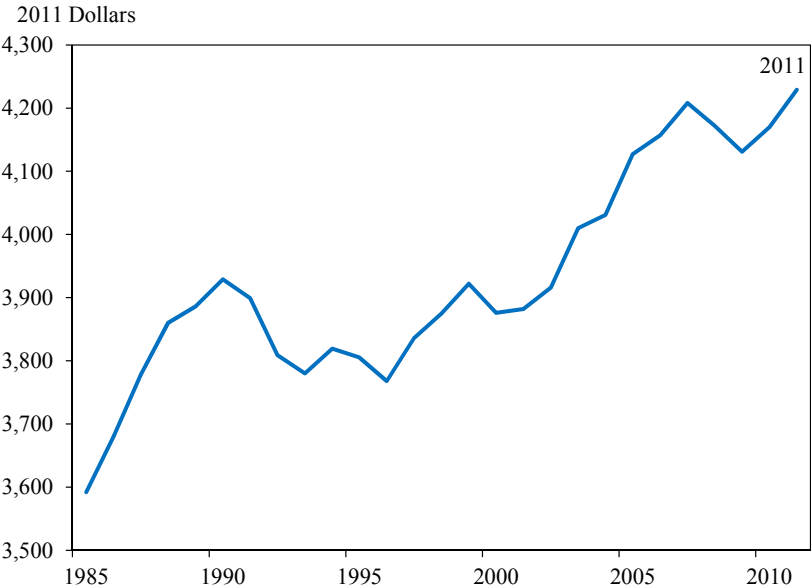
percent in 1984 to 13 percent in 2009. However, a rise in per capita income since 1984 has counteracted the decrease in the share of household budgets devoted to food, as real per capita spending on food has increased from \$3,592 in 1985 to \$4,229 in 2011 (in 2011 dollars) (Figure 8-3).

As their real incomes rise, most Americans do not need larger quantities of food to satisfy their nutritional needs. They are, however, changing their food choices to include higher value foods, such as better cuts of meat, a variety of fruits and vegetables, and organic and specialty food items. A mature U.S. food market will require the agricultural sector to focus on innovations that produce value-added products for the domestic market in order to satisfy rising U.S. consumer demand for specialty goods.

New Markets in Agriculture

Organic farming has been one of the fastest-growing sectors in agriculture, and double-digit growth in sales of organic foods has provided market incentives for the U.S. agricultural sector across a broad range of products. The retail value of the organic industry grew to \$31.4 billion a year in 2011, up from \$21.1 billion in 2008 and \$3.6 billion in 1997 (Dimitri and Oberholtzer 2009; USDA 2012a). Between 2002 and 2008, acres under organic production grew by an average of 16.5 percent a year. Organic

Figure 8-3
U.S. Real Per Capita Food Expenditures, 1985–2011



Source: USDA (2013c).

sales currently account for more than 3 percent of total U.S. food sales, and provide a larger share in categories such as produce and dairy. Growth has been particularly evident in the organic dairy sector, which accounted for 16 percent of organic sales in 2008. The number of organic milk cows on U.S. farms increased by annual average of 26 percent between 2000 and 2008. As demand for organic food has increased, the U.S. agricultural sector has taken steps to meet it; the number of operations certified as organic grew by 1,109—or more than 6 percent—between 2009 and 2011.

The USDA has taken steps both to promote and to regulate the growing organic food industry by establishing the National Organic Program (NOP), whose mission is to ensure the integrity of USDA-certified organic products in the United States and throughout the world. The NOP accredits nearly 50 domestic organic certifying agents who are authorized to issue an organic certificate to operations that comply with the USDA organic regulations. Between 2009 and 2011, the USDA has also supported its own scientists and university researchers with more than \$117 million in funding focused on improving the productivity and success of organic agriculture. For example, USDA research on weed management for organic vegetable production has produced techniques and tools that can help control 70 percent of weeds at 15 percent of the previous cost for weed control. Spreading the USDA organic research findings to people in the field is critical, and the “eOrganic” electronic extension service funded by the USDA has become an essential tool for compiling and disseminating knowledge about organic production.

The increasing demand for organic foods has been accompanied by a growing “local” movement. The markets for organic and local food regularly overlap: organic farmers are much more likely than conventional farmers to sell their products locally (Kremen, Greene, and Hanson 2004), with about a quarter of all organic sales in 2004 made within an hour’s drive of the farm (Greene et al. 2009). Similarly, 82 percent of all farmers’ markets had at least one organic vendor. Sales of locally produced foods make up a small but growing part of U.S. agricultural sales, particularly for small farms. The USDA estimates that the farm-level value of local food sales totaled nearly \$5 billion in 2008, or 1.6 percent of the U.S. market for agricultural products. An estimated 107,000 farms, or 5 percent of all U.S. farms, are engaged in local food systems, with small farms (those with less than \$50,000 in gross annual sales) accounting for 81 percent of all farms reporting local food sales in 2008 (Low and Vogel 2011). Examples of the types of farming businesses that are engaged in local foods are direct-to-consumer marketing, farmers’ markets, farm-to-school programs, community-supported agriculture, community gardens, school gardens, food hubs and market aggregators, kitchen

incubators, and mobile slaughter units, among a myriad of other types of operations.

Local goods are also good for the economy. A USDA study found that produce growers selling into local and regional markets generated 13 full-time operator jobs for every \$1 million in revenue earned, for a total of 61,000 jobs in 2008 (Low and Vogel 2011). Farmers that did not sell into these markets generated only three full-time operator jobs per \$1 million revenue. To foster exposure to and growth in local foods, the USDA has created the Know Your Farmer, Know Your Food management and communications initiative, which helps stakeholders navigate USDA resources and efforts related to local and regional food systems. Future growth of the agricultural economy can be enhanced by growth in those sectors.

Today's Farm Structure

The current strength of the farm economy is also built on the restructuring that has taken place over time, making the most productive farms larger and more efficient. Agricultural innovations have been labor-saving, greatly reducing the amount of labor needed for specific farm tasks. Labor-saving innovations also affect farm structure, because they allow a farmer to manage more cropland or raise more livestock. In addition, innovations have led farms to contract out for specialized services. Farmers now rely extensively on private consultants, government extension agents, lenders, and supplier representatives for technical advice.

Some of these managerial innovations rely on further developments in the design of organizations and contractual relationships to effectively manage a series of complicated commercial relationships. The share of production under marketing or production contracts increased from 28 percent in 1991 to more than 38 percent by 2010. Corn, soybean, and wheat producers, for example, place about half of their production under forward contracts; many of them also invest in storage facilities to store products when anticipating future price increases, and nearly 30 percent of them use futures markets to hedge the risks from their cash sales (MacDonald and Korb 2011). Similarly, farmers have realized more intensive use of capital by leasing equipment from specialized suppliers, and they often engage additional specialized expertise and capital equipment by contracting with custom service providers for farm tasks such as spraying, field preparation, or harvesting.

Livestock operations have undergone dramatic changes in the last 30 years. Farmers now use information technology to adjust feed mixes and climate controls automatically to meet the precise needs of animals in confined feeding operations. Integrated hog operations, for example, sharply

reduced the amount of feed, capital, and labor needed to produce hogs as new technologies and organizational forms swept the industry. As a result, live hog prices were nearly a third lower than they would have been without the productivity growth that occurred between 1992 and 2004, and retail pork prices were 9 percent lower (Key and McBride 2007).

The market, scientific, and technological opportunities beckoning American farmers are as great as they have ever been. Over the past three decades, a series of revolutions in the understanding of the science of living organisms and exponential growth in the processing power of information technology have raised the potential for productivity growth in American agriculture that could outstrip even the impressive record of growth it logged over the course of the 20th century. But as America's own history shows, neither revolutions in science and technology nor market signals will find practical application on America's farms and ranches without careful, effective, smart investment by public science institutions. Even America's larger farms are too small to support sophisticated basic research, and many of the most significant improvements that farms can be expected to make as they apply the fruits of this research are not patentable. The partnership between public science and the private farm must continue if these possibilities are to be realized, particularly in the face of climate change. The Obama Administration believes America's agricultural future is worth investing in and has committed to increases in scientific research that could benefit the agricultural sector for decades to come.

Investing in Agricultural Productivity

In 1950, the average dairy cow produced about 5,300 pounds of milk. Today the average cow produces about 22,000 pounds of milk, thanks to improvements in cow genetics, feed formula, and management practices. Over that time period, the number of dairy cows in America has fallen by more than half, yet U.S. milk production has nearly doubled.

Persistent gains in efficiency have defined American agriculture. Public and private investments in agricultural research and development (R&D) have helped U.S. farmers find ways to grow more with less. While growth in U.S. industrial output over the past 50 years has come primarily from increases in capital and labor, agricultural output growth mainly has come from substantial increases in total factor productivity. American farmers have continually found ways to grow more with less; new seeds are less susceptible to disease and produce higher yields, new tractors are guided by satellites and spread fertilizer optimally across the field, and animals' diets are optimally calibrated to grow larger animals with less feed. These

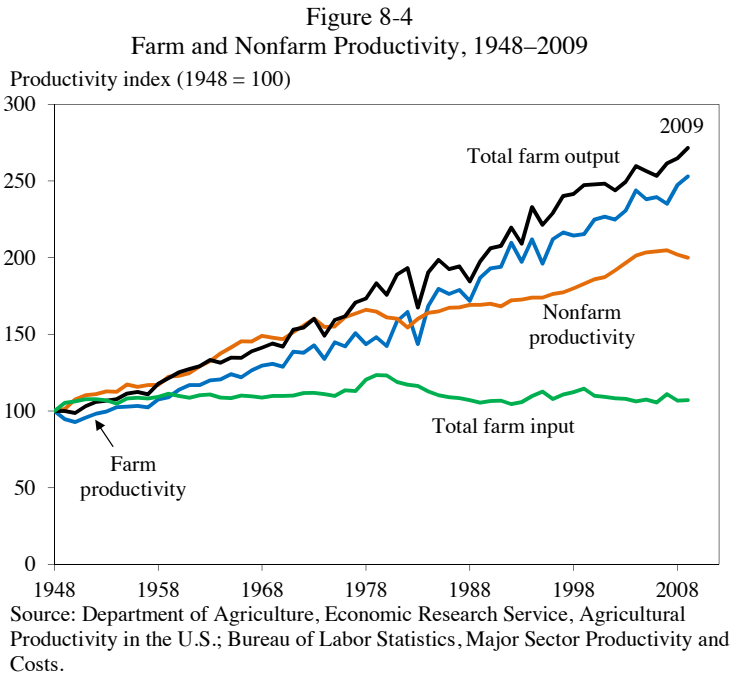
innovations have caused improvements in farm productivity to outpace improvements in non-farm productivity over the past 25 years.

From 1948 to 2009, farm productivity nearly tripled, growing at a rate of 1.6 percent a year. In the early part of that period, increased productivity, measured as output per unit of combined inputs, combined with increased use of equipment and chemical inputs to drive the growth in agricultural output. Between 1980 and 2009, equipment stocks fell along with continued declines in labor and land inputs; chemical use continued to rise, but at a much slower rate. Despite reduced input use, agricultural output grew by 1.5 percent a year in 1980–2009, with increasing productivity accounting for almost all of the growth (Figure 8-4).

Research and Development Drives Productivity Growth

Increasing productivity on U.S. farms stems largely from the rapid and widespread adoption of a continuing series of biological, chemical, mechanical, and organizational advances. Formal research programs are carried out in universities, government labs, and private firms. Agricultural innovations building on that research are developed by input suppliers in the private sector or by public institutions.

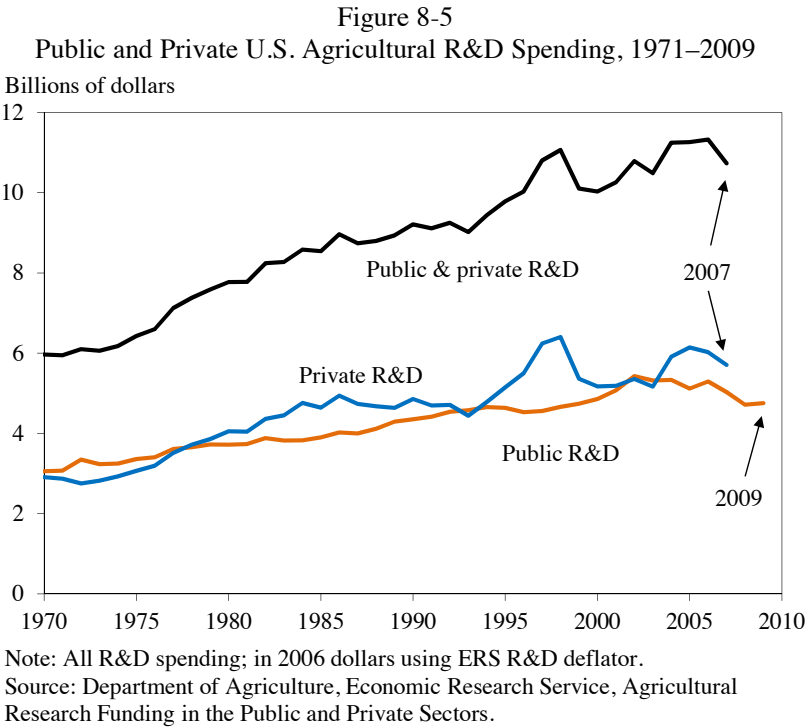
Public support of agricultural R&D generates high payoffs for farmers and the public. Fuglie and Heisey (2007) found that every dollar invested



in public agricultural research generates 10 times that amount in benefits to society. Another recent study (Alston et al. 2009) found an even higher return on Federal and State agricultural research expenditures, with estimated benefits of \$20 for every \$1 invested. Other academic studies reached broadly similar conclusions.

Total R&D spending in agriculture reached \$11 billion in 2007, or nearly 8 percent of the value added in the sector. Annual public agricultural R&D spending, through universities as well as government laboratories, rose 77 percent between 1970 and 2002 (after accounting for inflation). Public expenditures have not kept up with R&D cost inflation since, however, falling by 13 percent in real terms between 2002 and 2009. Private R&D expenditures are sensitive to the business cycle but doubled in inflation-adjusted terms between 1970 and 2007 (Figure 8-5).

Spillovers are ubiquitous in R&D in general and in agricultural R&D in particular. Ideas that are discovered by one institution may have an impact on the research productivity of another. Some of the important, and overlapping, categories of spillovers in agricultural R&D are geographical, for example, from one state or one country to another; institutional, from the private sector to the public, or vice versa, across competing institutions



such as universities, or from one industry to another; and across scientific areas, from “pretechnology” sciences to agricultural sciences, for example, or from biomedical science to agricultural science.

Economists have studied spillovers related to agriculture R&D (see, for example, Evenson 1988 or Griliches 1998). One of the more commonly addressed spillover areas for agricultural research is the geographical spillover from one state to another. Pardey and Alston (2011) estimated that roughly one-third of the benefits of state-level agricultural R&D are generated through spillovers to states other than those in which the research was conducted.

Conservation Practices and the Environment

The overuse of nitrogen fertilizer has widely recognized detrimental effects on the environment, especially downstream of treated fields. Particularly in the Gulf of Mexico, excess nitrogen is associated with low-oxygen environments, or “dead zones.” Corn is the most widely planted crop in the United States and the largest user of nitrogen fertilizer. In 2010, more than 97 percent of planted corn acres received nitrogen fertilizer (commercial and manure), an increase of 18 percent from 2001. At the same time, farmers have improved their use of nitrogen—corn acres where nitrogen was applied in excess of agronomically necessary rates declined from 41 percent to 31 percent (Ribaud et al. 2012).

Adoption of other conservation management practices also has the potential to reduce environmentally harmful impacts of agricultural production. Since 2000, corn, cotton, soybean, and wheat acreage under conservation tillage (mulch, ridge, and no till) has increased; conservation tillage may reduce soil erosion and water pollution but increase pest management costs (Osteen, Gottlieb, and Vasavada 2012).

The Federal Government plays an important role in encouraging conservation adoption by offering numerous conservation programs to assist private landowners in conserving the soil, water, wildlife, and other natural resources found on their property. These programs give landowners incentives to consider natural resources in their agricultural practices. Two relatively new programs, Working Lands for Wildlife and the National Water Quality Initiative, help producers stay in operation by providing financial and technical support, as well as regulatory certainty, if the landowner takes steps to restore and conserve wildlife habitat or water quality on their property.

The USDA’s National Water Quality Initiative works with farmers, ranchers, and forest landowners in priority watersheds to help improve water quality and aquatic habitats in impaired streams. As of 2012, approximately

\$34 million had been obligated for improvements on about 161,000 acres. Another \$21 million was obligated through more than 800 contracts with private landowners for Working Lands for Wildlife, also administered by the Natural Resources Conservation Service and Fish and Wildlife Service. The contracts will restore wildlife habitat on more than 310,000 acres of range, pasture, and forest lands across the country.

Natural Capital, Conservation, and the Outdoor Economy

Agriculture, as a land use, affects a large amount of natural capital (land, water, air, and genetic resources on farms and ranches) in the United States. Based on 2002 data, private farms accounted for 41 percent of all U.S. land, including 434 million acres of cropland, 395 million acres of pasture and range, and 76 million acres of forest and woodland (Ribaud et al. 2008). This capital can provide a host of environmental services, including water quality, air quality, flood control, wildlife, and carbon sequestration. These services can be consumed directly or combined by consumers with other goods to create final goods, such as sightseeing, fishing, wildlife viewing, or hunting, all of which support the outdoor economy.

Multisector efforts under the President's America's Great Outdoors initiative have bolstered outdoor recreation, conservation, and restoration of America's natural resources on public lands, as well as on working farms, ranches, and forests. In a 2012 study of 11 western states, economists found that national parks, monuments, and other protected Federal public lands promote more rapid job growth and are correlated with higher levels of per capita income in surrounding areas. Companies use the high quality of life provided by localities with access to healthy and protected lands and waters as a recruiting tool to attract new and talented employees who value natural beauty and outdoor recreational opportunities.

Outdoor recreation is an often overlooked but significant economic driver in the United States, with one industry study estimating that it provided 6.1 million jobs, spurred \$646 billion in spending, much of it on travel and tourism, and raised \$80 billion in Federal, State, and local tax revenue in 2010 (Outdoor Industry Association 2012). National parks and Federal lands and waters located across the entire United States, including in many rural areas, play a significant role in supporting the travel and tourism industry. Each year, millions of international tourists visit U.S. public lands and small towns, spending money at local businesses that provide lodging, dining, retail shopping, and entertainment. Rural America plays a particularly important role in the national tourism economy by attracting and retaining tourists for longer visits (Interior 2012).

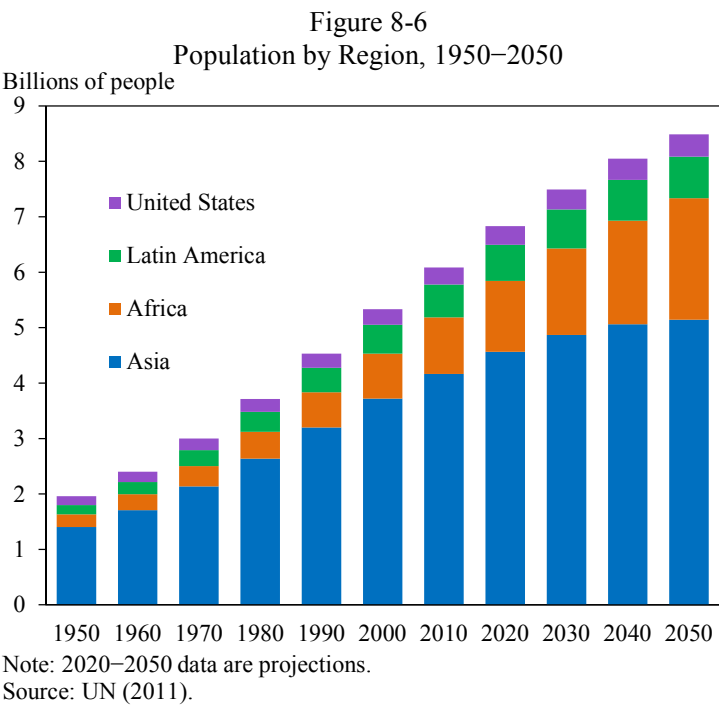
GROWING GLOBAL DEMAND FOR FOOD AND AGRICULTURAL COMMODITIES

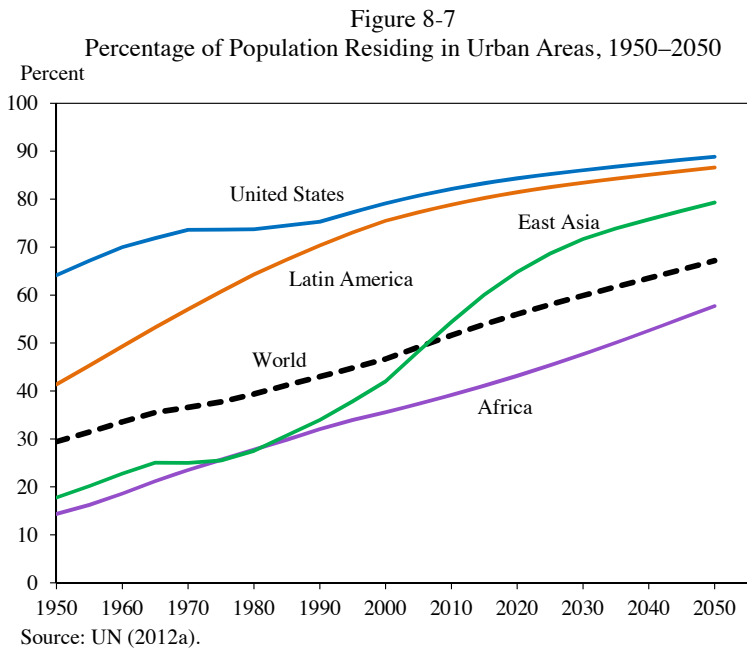
The U.N. Food and Agricultural Organization (FAO) estimates that global agricultural production will need to increase by around 60 percent to meet the anticipated increase in demand in 2050, given an additional 2.3 billion people and current consumption patterns. Meeting this demand will depend largely on increases in agricultural productivity because input scarcity, particularly of natural resources and environmental services, will become more binding with population growth and climate change.

Population Growth and Urbanization

The world’s population grows by more than 200,000 people each day and is expected to increase from 7 billion in 2012 to more than 9.2 billion in 2050. More than 95 percent of all population growth is expected to occur in low-income countries (Figure 8-6).

As the worldwide population increases, most of the growth will come from urbanization. More than half of the world’s population was living in urban areas by 2008, compared with just 29 percent in the 1950s. Approximately 70 percent of the world population is expected to be living in urban areas by 2050 (Figure 8-7).

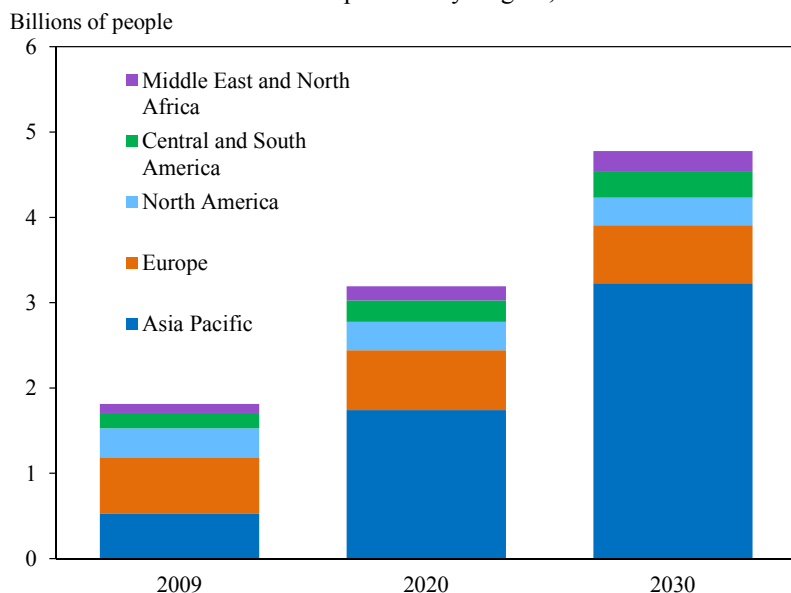




A world population living primarily in cities and towns will present unique challenges to the agricultural sector, because urban populations rely heavily on a stable and efficient worldwide food chain to provide the nutrient-dense and diverse foods they demand. The rising global population is also expected to be accompanied by falling poverty rates and increasing incomes for a large fraction of the world's population, particularly in Asia. Notably, the poverty rate in East Asia fell from nearly 80 percent in 1980 to less than 20 percent in 2005. Along with the decline in poverty, there is an emerging middle class in the Asia Pacific region that the OECD projects will increase rapidly, from 525 million in 2009, to more than 1.7 billion in 2020, and to 3.2 billion in 2030 (Figure 8-8) (Kharas 2010). The result will likely be increased consumption of food per capita and a change in diets toward a higher proportion of meat.

Rising global food demand and the expected change in dietary patterns accompanying the growth in income throughout the world, particularly in China, will lead to opportunities for growth in the U.S. agricultural sector, most notably in meat export. World meat and dairy consumption doubled between 1950 and 2009. Global meat consumption has been growing much more rapidly than consumption of grains and oilseeds, and between 1985 and 1990, production of meat (beef, pork, chicken, and turkey) rose more than 3 percent a year, well above the world's population growth rate of 1.7 percent a year.

Figure 8-8
Middle-Class Population by Region, 2009–2030



Source: Kharas (2010).

Pressure on Agricultural Land and the Environment

Continuing increases in the demand for agricultural products, especially resource intensive foods such as meat, are expected to have a deleterious impact on agricultural land, soil, and water, and to create broader ecosystem-level pressures (UN 2012b). According to the United Nations, global food production currently uses nearly one-quarter of all the habitable land on earth, accounts for more than 70 percent of fresh water consumption, and produces more than 30 percent of global greenhouse gas emissions. In addition, global food production accounts for 80 percent of deforestation and is the largest single cause of species and biodiversity loss.

A collaborative report on climate change prepared by the USDA and scholars from a variety of universities and other Federal and nongovernmental agencies suggests that climate change will impact both agricultural productivity and commodity price volatility (Walthall et al. 2012). The increased temperature will increase the likelihood of grain and oilseed crop failure, forest fires, insect outbreaks, and tree mortality. Further, elevated levels of carbon dioxide are expected to reduce the productivity of livestock and dairy animals and increase weed growth. Although some agricultural and forest systems may experience productivity increases in the near term, the benefits provided by these ecosystems, such as clean drinking water and

natural waste decomposition, will diminish over the long term, requiring a change in management regimes. Management of water resources will become more challenging, and natural disasters such as forest fires, insect outbreaks, severe storms, and drought will occur with increased frequency and severity, placing heavy demands on management resources, such as Federal disaster assistance. (For additional discussion of climate change, see Chapter 6.)

GLOBAL COMMODITY MARKETS AND PRICE VOLATILITY

Trade in agricultural commodities is a global endeavor and prices respond to supply and demand conditions around the world. As a result, agricultural commodity markets are characterized by a high degree of volatility. Four major market fundamentals explain why that is the case. First, agricultural output is in large part at the mercy of nature. Shocks from weather, pests, and other natural phenomena have unpredictable effects on supply. With the effects of global climate change already being seen in many parts of the globe and projected to continue, the unpredictability of these impacts is likely to increase over time. Second, diets are somewhat inflexible in the short run, which means demand for certain foods remains relatively constant.² A third source of volatility is the natural growing cycle, which contributes to a relatively fixed short-run supply. Finally, declining stock-to-consumption ratios amplify the effects of food price shocks.

The integration of markets can also be a source of volatility. Food and energy markets in the United States and around the world have become increasingly interlinked through the use of agricultural feedstock in the production of ethanol and the use of oil and natural gas in agricultural production.³ Growth in the use of biofuels, for example, not only increases the demand for agricultural feedstocks but may also make demand less elastic through such measures as biofuel blending requirements. As such, integration can cause shocks in one market to be transmitted to another.

Since the early 1970s, food prices have become much more volatile. In general, high food prices bring with them higher price volatility, and average real food prices in the past five years were 35 percent higher than prices in the previous decade, according to the FAO's Food Price Index. The index tracks the monthly change in the average international prices of five commodity groups, namely, meat, dairy, cereals, oils, and sugar. The index peaked in February 2011 and has since fallen 10 percent. Overall food prices

² For data on commodity and food elasticities, see USDA Economic Research Service, <http://www.ers.usda.gov/data-products/commodity-and-food-elasticities.aspx>.

³ Natural gas is the primary feedstock in the production of ammonia, and ammonia is the primary input for all nitrogen fertilizers.

surged in the summer of 2012, driven by higher cereal prices. Food price spikes are not uncommon, and in most cases prices eventually fall as much as they have risen. Figure 8-9 demonstrates the increasing variability in the nominal price of corn since 1866–67.

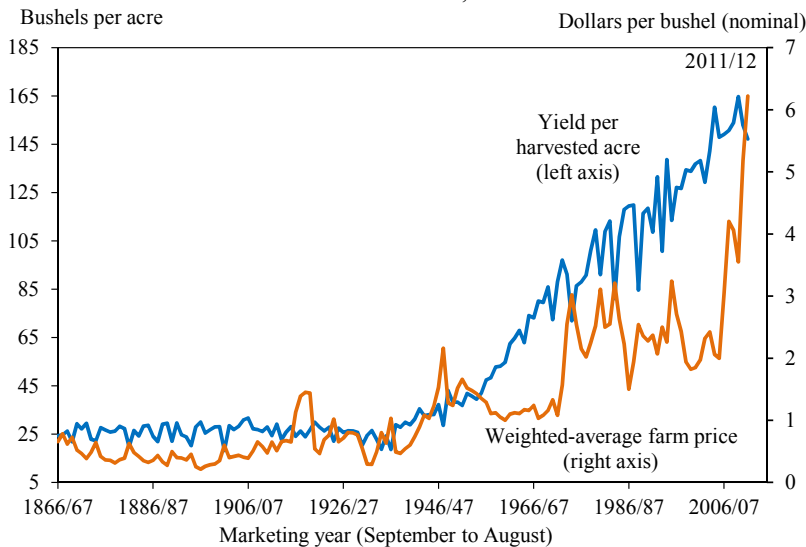
MEETING THE CHALLENGES AND HARNESSING THE OPPORTUNITIES OF GLOBAL DEMAND GROWTH

For U.S. agriculture to benefit fully from the growing food demand and changing food patterns around the world, access to the global market must be ensured. Successful efforts by the Federal Government to open foreign markets have contributed to an agricultural export boom. In FY 2012, American agricultural exports reached \$135.7 billion, just short of the record high level of \$137.4 billion set in FY 2011. Additionally, America runs a trade surplus in agricultural goods—a surplus that reached \$32.4 billion in FY 2012 (USDA 2012b).

Open Trade and Access to Global Food Markets

The Obama Administration has made reducing trade barriers to market access overseas for U.S. farmers and ranchers a top priority, alongside

Figure 8-9
Corn Yields and Price, 1866–2012



Source: Department of Agriculture, Economic Research Service, Feed Grains Database.

efforts to ensure that America's trading partners fully honor all the commitments they have made under existing trade agreements. The President has signed several historic trade agreements that significantly expand market access for U.S. agricultural exporters. The recently implemented U.S.-Korea Free Trade Agreement (KORUS) is set to deliver substantial gains for U.S. agricultural exports in coming years. In a separate beef import protocol concluded in 2008, Korea agreed to adjust its import restrictions on U.S. beef. As a result, U.S. beef exports to Korea more than doubled in value from 2008 to 2011, to about \$686 million. Under KORUS, Korea will gradually bring its tariffs on imports of U.S. beef and pork down to zero, and the U.S. meat industry will benefit from even greater gains in trade. The improved access provided by the agreement for a wide range of other products, beginning in 2012 and continuing over the agreement's phase-in period, will yield new market opportunities for U.S. exporters. The USDA estimates that, when fully implemented, KORUS will expand U.S. agricultural exports to Korea by an estimated \$1.9 billion a year—gains that will benefit agricultural producers and processors across the United States. The Korean Free Trade Agreement, together with the free trade agreements with Panama and Colombia passed at the same time is expected to boost U.S. agricultural exports by \$2.3 billion a year (Wainio, Gehlhar, and Dyck 2011).

The Obama Administration has worked with a number of other developing and developed countries to reopen their markets to U.S. beef products. Partly as a consequence of these steps, U.S. beef exports in 2011 exceeded 2003's historic levels for the first time, reaching \$5.4 billion. Similarly, 57 countries, including many important emerging markets, have now lifted bans on U.S. poultry products. Between 2007 and 2011, the value of U.S. poultry exports increased from \$4.1 billion to \$5.6 billion. U.S. pork exports to the rapidly growing Chinese market soared after H1N1-related bans were lifted. Immediately before the ban, the United States exported on average about \$132 million a year in pork and pork products to China. In 2010, pork exports to China totaled only \$79.3 million. In 2011, pork exports to China grew by a factor of six, exceeding \$477 million and quickly demonstrating the value of better access to this key emerging market. In the first quarter of 2012, roughly two years after the ban was lifted, the United States exported about \$122 million in pork and pork products to China.

Hired Farm Labor Costs in a Global Economy

Hired labor is a crucial component of U.S. agricultural production. Costs associated with such labor account for 17 percent of variable production expenses for all agricultural commodities and 40 percent of expenses

in the production of labor-intensive crops such as fruits, vegetables, and nursery products.

For fruits and vegetables, total agricultural production expenses are near parity between U.S. and international producers, but labor costs are often much lower for foreign growers. In response to higher labor costs, U.S. farms have already turned to mechanization of the harvesting and production processes. For example, mechanized production of raisins, including harvesting and drying of grapes, increased from 1 percent of the raisin crop to 45 percent between 2000 and 2007. Harvesting of baby leaf lettuce is currently 70–80 percent mechanized (Calvin and Martin 2010). These trends will likely increase if wages rise and could potentially lead to consolidation among growers. Some crops are not well suited for fully mechanical production, however. U.S. growers of such commodities may invest in technology that increases labor productivity, such as conveyor belts now common in Southern California strawberry fields.

Although mechanization is attractive in many cases, the costs associated with converting to mechanical processes are high, and larger farms typically stand to profit the most from mechanization. Moreover, growers may be hesitant to adopt the technology because of concerns about loss of quality. Given the difficulties associated with converting to mechanized production in the short run, the affordability of hired farm labor, and immigrant labor in particular, takes on greater importance. It is estimated that, for the past 15 years, about half of all hired laborers working in crop agriculture have lacked the proper immigration designation to work in the United States (Zahniser et al. 2012). Immigration policy, which influences the supply of and demand for labor as well as food prices ultimately paid by the consumer, is an important issue in the agricultural sector.

In their research, Zahniser et al. (2012) used a simulation to illustrate the effects different changes in immigration policy could have on the agricultural sector, including the effects of disruptions in the supply of labor on farm wages and crop production. Expanding the number of agricultural workers eligible for the H-2A Temporary Agricultural Program, which allows U.S. farms to hire temporary nonimmigrant foreign workers if not enough domestic workers are available, would increase agricultural production and exports by around 1.6 percent and 2.5 percent, respectively, in the long run for labor-intensive sectors like produce and nursery products. On the other hand, a 5.8 million decrease in the overall number of undocumented workers would reduce production and exports throughout all sectors of the economy, with agriculture and other labor-intensive sectors the hardest hit. Agricultural exports would fall by about 3.7 percent.

Improving Risk Management

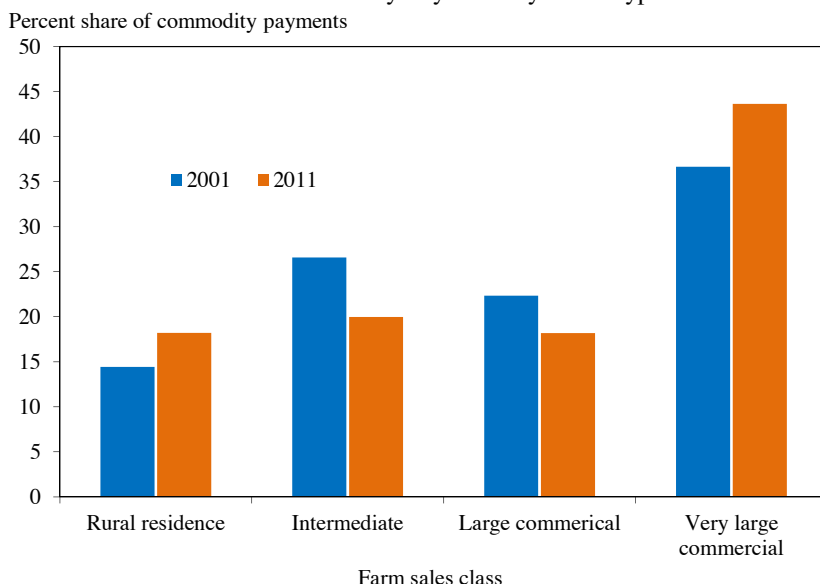
Traditionally, every five years, Congress passes a bundle of legislation, commonly called the “Farm Bill” that sets national agriculture, nutrition, conservation, and forestry policy. The last Farm Bill, passed in 2008, was set to expire on September 30, 2012 but was extended through fiscal year 2013. The coming expiration of the current Farm Bill represents an opportunity to make the most significant reforms in agricultural policy in decades. The Senate Agricultural Reform, Food and Jobs Act of 2012 would end direct payments—fixed annual payments to farmers based on their farms’ historical crop production, paid without regard to whether a crop is currently grown—and streamline and consolidate farm programs, as well as reduce the Federal deficit by as much as \$23.6 billion over 10 years (CBO 2012). It could also strengthen priorities, such as efficient risk management, that help farmers, ranchers, and small business owners protect their investments and ensure a stable supply of needed agricultural product, while continuing to help the U.S. agricultural sector grow the economy.

Highly volatile agricultural commodity prices can create significant income risk for farmers. At the same time, the current farm safety net is inefficient and unfair, creating distortions in production and crowding out market-based risk management options. Because program commodity production is concentrated on larger farms, these farms receive the largest share of taxpayer-supported program payments, even though this group of farm households has incomes that are on average three times the average U.S. household (Figure 8-10).

Currently, those households with an average adjusted gross nonfarm income up to \$500,000 are eligible to receive government payments, while those with as much as \$750,000 in average adjusted farm income are eligible for direct payments. Farmers who produce fruits and vegetables do not receive any government program payments. Adding provisions that make lands that have not previously been used to grow crops ineligible for crop insurance or other Federal benefits would help protect the nation’s prairies and forests from being converted into marginal cropland.

Today’s agricultural commodity support programs are rooted in the landmark New Deal legislation that followed the agricultural depression of the 1920s and 1930s. These programs were designed to sustain prices and incomes for producers of cotton, milk, wheat, rice, corn, sugar, tobacco, peanuts, and other crops, at a time when a large portion of the U.S. population was engaged in farming. Today, less the 2 percent of the U.S. population is engaged in farming, and changing economic conditions and trends in agriculture since these programs began suggest that many of the original motivations for these farm programs no longer apply.

Figure 8-10
Government Commodity Payments by Farm Type



Source: USDA (2001, 2011).

For example, the increasing reliance of farm families on income earned from sources other than their farms and a shift toward market-oriented farm policies have made farms and commodity markets less vulnerable to adverse price changes than before. These changes imply that moving away from traditional commodity support programs would have a much smaller impact on farm household income than in previous decades. Nonetheless, substantial government support of agriculture remains.

Risk management involves choosing among many options for reducing the financial effects of such uncertainties. In addition to participating in government commodity programs that are available for certain commodities, farmers today have private options for managing risk that were not available when commodity price support programs were introduced. For instance, the growth of futures and options markets provides a market-based method for farmers to protect themselves against short-term price declines. Other private means to stabilize farm incomes include saving; borrowing; diversifying among different types of crops, trees, livestock and ecosystem services; contracting farm output with processors at assured prices; crop insurance and total revenue insurance; utilizing a wide range of farm management practices that reduce crop loss (such as irrigation, pesticide use); leasing out farmland; and taking advantage of expanded opportunities for earning nonfarm income.

The Dodd-Frank Wall Street Reform and Consumer Protection Act

In 2010, President Obama signed the Dodd-Frank Wall Street Reform and Consumer Protection Act, with the goal of addressing the lack of transparency, systemic risks, and interconnectedness risks in the over-the-counter (OTC) derivatives markets that, in part, precipitated the recent financial crisis. Modern farm operations—and agribusiness in general—rely greatly on services provided by the OTC derivatives market, including the swaps market. Derivatives, which are financial instruments whose value is based on the value of an underlying asset, liability, or event, perform essential economic functions of price discovery and risk management. The Act strengthens financial market regulation by requiring most standardized swaps to be centrally cleared and traded on an exchange or execution facility, with exemptions from clearing for commercial end-users; subjecting dealers and major participants that trade these derivatives to registration, business conduct, risk management, and collateral requirements; and subjecting all swaps to new recordkeeping and reporting rules.

Although the OTC derivatives market serves an important risk-management role amounting to trillions of dollars in notional value, in the past, OTC derivatives were essentially an unregulated market. The lack of market oversight allowed substantial counterparty credit risk to build up in these markets, with significant consequences for the financial system. In addition, the lack of regulation created inefficiencies by reducing information available to market participants and regulators, hampering price discovery, and facilitating opportunities for fraud. Before passage of the Act, regulators had no authority to monitor the market and prescribe rules. The new clearing and margin requirements will act as safeguards for the performance of the OTC derivatives markets, eliminating counterparty credit risk between the original traders. In addition, new real-time public reporting requirements and execution standards will improve market transparency and lower transaction costs.

The Act further seeks to protect the market for agricultural swaps, while ensuring that agricultural market participants are still able to access risk-management markets. The Act provides that derivatives on agricultural commodities may be conducted only by eligible contract participants—that is, counterparties who hold more than \$10 million in assets or have a net worth of \$1 million or more. Because many smaller farmers would not qualify as eligible contract participants and consequently could not engage in swap contracts that are not traded on a designated contract market (an exchange) or swap execution facility (SEF), the U.S. Commodity Futures Trading Commission granted them an exemption for physical commodity

options. This exemption provides flexibility for all farmers to manage risk using agricultural derivatives contracts.

CONCLUSION

Although farming has become a progressively smaller share of the U.S. economy, the President believes that a vibrant U.S. agricultural sector is vital for the Nation's prosperity. U.S. agriculture has remained a bright spot in the economy during the Great Recession and its immediate aftermath and despite the most severe drought in more than a half-century. Much of the sector's success can be attributed to growth in global demand for American agricultural exports. In 2012, agricultural exports reached a near record level and are projected to continue to expand. The world's population is expected to reach more than 9.2 billion people by 2050, with most of the growth occurring in countries that are net food importers. President Obama believes that expanding overseas market access is crucial for the continued strength of American agriculture.

Persistent gains in efficiency have defined American agriculture and nearly tripled farm productivity in the second half of the twentieth century. To continue this tradition and maintain the strength of the sector, the Nation must continue to invest in agricultural R&D, helping farmers find new ways to grow more with less and to continue their stewardship of natural resources for future generations. The agricultural sector is increasingly vulnerable to price volatility because of the globalization of agricultural commodities, volatile weather conditions as a result of climate change, and changing consumption patterns. To cope with these challenges, U.S. agriculture must stay at the forefront of agricultural innovation.