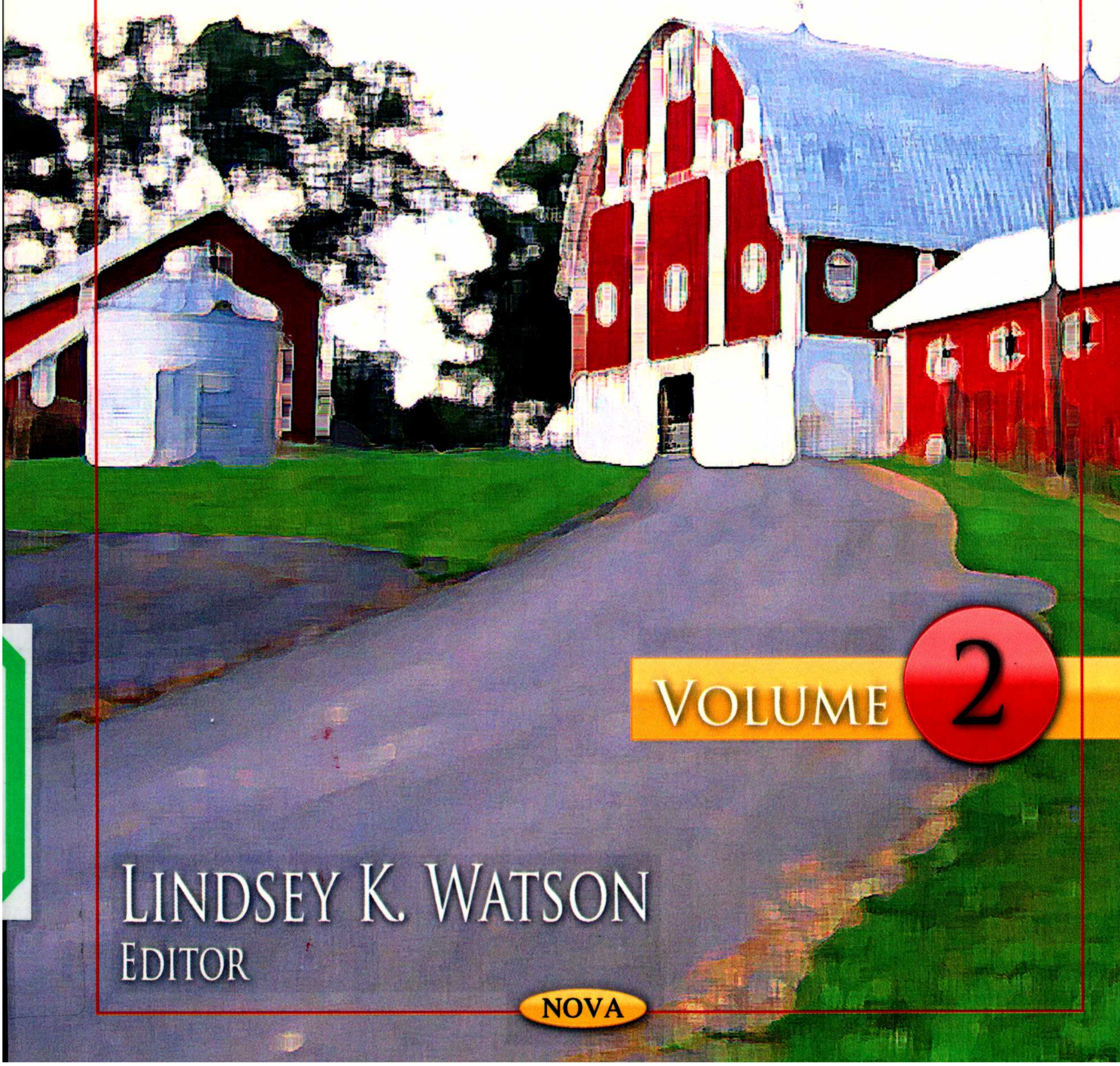
AGRICULTURAL ISSUES AND POLICIES



VOLUME 2

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PREFACE

Agriculture is one of the defining elements of a nation. This series consists of analyses on a variety of agricultural issues including (but not limited to) the developments, policies, programs, trade, trends and economics of agriculture. Topics will be seen from a U.S. perspective, but not to the exclusion of other countries particularly when the discussion has an international scope.

Chapter 1 – Agricultural production is sensitive to changes in energy prices, either through energy consumed directly or through energy-related inputs such as fertilizer. A number of factors can affect energy prices faced by U.S. farmers and ranchers, including developments in the oil and natural gas markets, and energy taxes or subsidies. Climate change policies could also affect energy prices as a result of taxes on emissions, regulated emission limits, or the institution of a market for emission reduction credits. Here we review the importance of energy in the agricultural sector and report the results of a case study on the economic implications for the farm sector of energy price increases that would arise from plausible, constructed greenhouse-gas-emission reduction scenarios. Higher energy-related production costs would generally lower agricultural output, raise prices of agricultural products, and reduce farm income, regardless of the reason for the energy price increase. Nonetheless, farm sector impacts were modest for the scenarios and time periods examined. We demonstrate the unique distribution of effects resulting from price (or cost) increases for different types of energy due to pricing their carbon content, as well as the relative use of energy in production of different agricultural commodities. Our analysis focuses on relatively short-term adjustments to higher energy-related costs and does not include potential financial benefits from sequestering carbon or reduced climate change. Finally, we find that agricultural sector impacts on farming-dependent counties would not be substantial but would be potentially largest where education and employment levels are relatively low, while effects on rural communities due strictly to energy production adjustments would be concentrated in the few U.S. counties with significant employment in energy extraction industries.

Chapter 2 – While U.S. acreage and production of apples has declined in recent years, consumer demand has spurred a fast-growing organic apple sector. Apples managed under certified organic farming systems now account for about 6 percent of total U.S. apple acreage. In 2007, USDA conducted the first comprehensive survey of the production and marketing practices used by organic and conventional apple growers in the United States as part of the Agricultural Resource Management Survey (ARMS). In this report, we use data from ARMS and other sources to examine trends in the U.S. apple sector and compare production and marketing characteristics under organic and conventional farming systems. According to ARMS data, conventional and organic apple production systems shared many similarities in 2007, including the predominance of dwarf and semi-dwarf trees, tree density, and a focus on fresh-market apples. These systems do differ in the way pests and nutrients are managed, and a higher share of organic production comes from new varieties like Gala and Fuji. While conventional apple yields were higher than organic yields in 2007, organic apples commanded a price premium at every level—farm-gate, wholesale and retail—of the supply chain.

Chapter 3 – The U.S. rice farming industry experienced substantial structural changes from 1992-2007, with the average farm size more than doubling by 2007 and the number of rice farms dropping by almost half. In addition, a substantial share of production shifted from the high-cost Gulf Coast region to the more competitive Arkansas Non-Delta and Mississippi River Delta growing areas. Farm consolidation and regional shifts are being shaped by cost and productivity considerations, barriers to entry for new farmers, and competitive average net returns, which support continued production by existing operators. High startup costs, rice-specific production management skills, and risk exposure are likely the key factors deterring entry. Rice farms are the most capital-intensive row crop farms in the United States and have the highest national average land rental rate of all major crops. At the same time, returns to rice production are highly variable due to fluctuating input costs and volatility in farm prices. Though rice farming requires large investments in land and capital, lack of other economic opportunities and competitive average net returns support continued production by existing operators. In this report, we investigate the factors driving these structural changes and explore the implications of those changes for market efficiency and competitiveness of the U.S. rice industry. Recent trends and economic incentives point to continued consolidation and area shifts. Overall rice area is expected to average about 3.3 million acres over the next decade, above the 2000-2009 average of 3.1 million acres.

Chapter 4 – Vegetable and melon production is among the more financially successful components of U.S. agriculture. Based on data from USDA's Agricultural Resource Management Survey, this study provides a financial profile of specialized U.S. vegetable farms (farms with at least 50 percent of total value of production derived from vegetables and melons). During 2005-07, these farms generated 14 percent of all U.S. farm cash receipts and 6 percent of U.S. farm export value. Over the period, an average of 95 percent of the value of U.S. vegetable production was accounted for annually by operations with $250,000 or more in sales. These large farms had a debt-to-asset ratio of 14 percent, the same as all other large U.S. farms and ranches. Sixty percent of these large vegetable farms were classified as being in favorable financial condition during 2005-07, with an average net worth over $3 million.

Chapter 5 – This report highlights the anticipated consequences of the 2008 Farm Act's Planting Transferability Pilot Program (PTPP) on processing (pickling) cucumber plantings. PTPP allows program crop growers in seven Upper Midwestern States to reduce base acres and plant select vegetables for processing on those acres without reducing Government payments on their remaining base acres. Stagnant market demand and the farmers' ability to enter or expand processing cucumber production without the pilot program may explain why the acres planted to pickling cucumbers may increase only marginally. Our findings suggest that PTPP would increase production by 180 acres, or by less than 0.5 percent of acreage in the Upper Midwestern States. About half an average-sized cucumber farm (43 acres) would be created in the region due to PTPP and an additional 137 acres would be planted by existing processing cucumber growers. With these small changes in regional cucumber acreage, PTPP is not likely to affect the national market and price outlook. The availability of nonbase acres, prior planting history, and distance to a processor are significant variables in determining planted cucumber acres.

CONTENTS

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Chapter 1

IMPACTS OF HIGHER ENERGY PRICES ON AGRICULTURE AND RURAL ECONOMIES*

Ronald Sands and Paul Westcott

ABSTRACT

Agricultural production is sensitive to changes in energy prices, either through energy consumed directly or through energy-related inputs such as fertilizer. A number of factors can affect energy prices faced by U.S. farmers and ranchers, including developments in the oil and natural gas markets, and energy taxes or subsidies. Climate change policies could also affect energy prices as a result of taxes on emissions, regulated emission limits, or the institution of a market for emission reduction credits. Here we review the importance of energy in the agricultural sector and report the results of a case study on the economic implications for the farm sector of energy price increases that would arise from plausible, constructed greenhouse-gas-emission reduction scenarios.

Higher energy-related production costs would generally lower agricultural output, raise prices of agricultural products, and reduce farm income, regardless of the reason for the energy price increase. Nonetheless, farm sector impacts were modest for the scenarios and time periods examined. We demonstrate the unique distribution of effects resulting from price (or cost) increases for different types of energy due to pricing their carbon content, as well as the relative use of energy in production of different agricultural commodities.

Our analysis focuses on relatively short-term adjustments to higher energy-related costs and does not include potential financial benefits from sequestering carbon or reduced climate change. Finally, we find that agricultural sector impacts on farming-dependent counties would not be substantial but would be potentially largest where education and employment levels are relatively low, while effects on rural communities due strictly to energy production adjustments would be concentrated in the few U.S. counties with significant employment in energy extraction industries.

* This is an edited, reformatted and augmented version of the United States Department of Agriculture Publication, dated August 2011.

Keywords: energy prices, costs of production, fuel, fertilizer, farm income, agriculture, greenhouse gas emissions, farming dependent counties, rural economy, Economic Research Service, ERS, U.S. Department of Agriculture, USDA

SUMMARY

What Is the Issue?

Agricultural production consumes large amounts of energy, either directly through combustion of fossil fuels, or indirectly through use of energy-intensive inputs, especially fertilizer. Over 2005-08, expenses from direct energy use averaged about 6.7 percent of total production expenses in the U.S. farm sector, while fertilizer expenses represented another 6.6 percent. However, these sector averages mask much greater energy intensities for major field crops. Agricultural production is therefore sensitive to changes in energy prices, whether the changes are caused by world oil markets, policies to achieve environmental goals, or policies to enhance energy security.

To illustrate the flow of energy prices through the agricultural system from farm to retail, we construct three scenarios: a reference scenario of agricultural production from 2012 through 2018, and two alternative scenarios over the same time period with energy price increases expected to result from pricing greenhouse gas emissions. Price increases for different energy sources in the alternative scenarios are based on their carbon content. Results are compared to the reference scenario to estimate economic implications. Higher energy-related production costs would generally lower agricultural output, raise prices of agricultural products, and reduce farm income in the short run.

What Did the Study Find?

- Energy-related production expenses vary significantly for different crops. On a per-acre basis, corn and rice have the highest energy-related costs of the eight major crops (corn, sorghum, barley, oats, wheat, rice, upland cotton, and soybeans) examined in this report, while soybeans have the lowest. With higher energy-related expenses (fuel up an average of 2.6 to 5.3 percent; fertilizer up 4 to 10 percent), total acreage for these eight crops would decline by an average of 0.2 percent (under the lower price change scenario) to 0.4 percent (higher price change scenario) over 2012-18. Planted area would decline for seven of the eight crops, the exception being soybeans.
- Energy-related expenses also affect livestock producers. Although their direct energy costs are lower than for crop production, livestock producers would face higher feed costs under both the lower (0.2 to 0.6 percent higher annually, 2012-18 average) and higher (0.6-1.3 percent higher) energy price change scenarios. Poultry production would be less affected than beef and pork, since poultry is the most efficient feed-to-meat converter of the animal types.

- The scenarios analyzed did not account for potential changes in technology (beyond those implicit in the reference scenario) in response to sustained increases in energy prices. Additionally, a decades-long declining trend in energy use per unit of output in the agricultural sector is likely to continue, which is only partly represented in the scenarios by increasing yields. For these reasons, reported impacts of higher energy prices on the agricultural sector may be somewhat overestimated. Additionally, longer run impacts of further energy price increases would not be proportionately as large as the short-term impacts we report here.
- Effects also vary regionally. The Mississippi Portal region is most affected by higher energy costs, due to the predominance of fertilizer-intensive crops like cotton. Farms in that region would see net cash income decline by 8 to 19 percent on average (in 2014) under the lower and higher energy price change scenarios, respectively.
- Although increased agricultural commodity prices affect consumer food prices, retail food prices are more affected by energy costs in food processing, distribution, and marketing than in agricultural commodity production. For the scenarios and time period focused on in this report, the Consumer Price Index (CPI) for food—including food at home and food away from home—would be 0.6 to 0.9 percent higher than without the simulated energy-related cost increases for electricity, diesel fuel, and natural gas.
- It does not appear that impacts through the agricultural sector of the higher energy prices scenarios studied in this report would have a substantial effect on farm county economies and populations. In general, farm counties tend to have relatively few people without high school degrees, very high proportions of adults employed, and low poverty rates compared with other nonmetro counties. Some farm-dependent counties in the Mississippi Portal region may be relatively more affected by energy-related farm income losses.
- A decrease in fossil fuel production under an emissions tax or a cap-and-trade program would reduce overall employment in related energy extraction industries. Counties specializing in energy production are over-whelmingly rural. However, few nonmetro counties derive a substantial share of nonfarm employment from energy production, so overall rural impacts would be small, with the exception of some mining counties, principally located in eastern Kentucky and West Virginia.

How Was the Study Conducted?

Two key economic models at USDA's Economic Research Service (ERS)— the Food and Agricultural Policy Simulator (FAPSIM) and the Farm-Level Partial Budget Model—were used as the foundation of this analysis. We started with a range of prices for carbon dioxide emissions, taken or derived from studies by the U.S. Environmental Protection Agency and the U.S. Energy Information Administration. Both studies are based on the American Clean Energy and Security Act of 2009 (House Resolution 2454), which specified an increasingly stringent cap on U.S. greenhouse gas emissions from 2012 through 2050. Corresponding impacts on prices for electricity, natural gas, and petroleum products were also provided by these studies. We focus on the 2012-2018 timeframe, which corresponds to the timeframe of results provided by the FAPSIM model.

Implications of these energy-related price impacts for changes in agricultural production costs were used as input to FAPSIM to provide national agricultural sector effects. The Farm-Level Partial Budget Model was used to convert national impacts into changes in farm business net cash income for nine resource regions in the United States. Econometric regression analysis provided a link from agricultural producer prices to retail food prices, including energy costs in food processing, distribution, and marketing channels from the farm to retail.

Results focus solely on effects of higher cash expenses associated with emissions pricing, and do not include potential financial benefits from sequestering carbon or reduced climate change.

1. INTRODUCTION

Agricultural production consumes large amounts of energy, either directly through combustion of fossil fuels, or indirectly through use of energy-intensive inputs, especially fertilizer. Over 2005-08, expenses from direct energy use averaged about 6.7 percent of total production expenses in the U.S. farm sector, while fertilizer expenses represented another 6.6 percent. However, these averages mask much greater energy intensities for major field crops. Several factors can influence energy prices faced by U.S. agriculture: availability of natural gas, world oil prices, energy taxes, or a greenhouse gas policy designed to reduce carbon dioxide emissions.

To illustrate the flow of energy prices through the agricultural system from farm to retail, we construct three scenarios: a reference scenario of agricultural production from 2012 through 2018, and two "what-if" scenarios over the same time period with higher energy prices. For illustrative purposes, energy price increases in the alternative scenarios are driven by prices on greenhouse gas emissions. The analysis uses a suite of models maintained at USDA's Economic Research Service (ERS). This case study is designed to (1) demonstrate the use of ERS models to simulate a change in energy prices through the U.S. agricultural system; (2) provide two scenarios of increased energy prices, with price changes for fossil fuels weighted by carbon content; and (3) provide an expanded discussion on methodology used to produce an earlier, related report (USDA, Office of the Chief Economist, 2009).

Different alternatives to limiting greenhouse gas emissions have been proposed over the past several years, and additional approaches are likely to be developed in the future. The assumptions for greenhouse gas emission prices, and resulting energy price impacts used in the two primary scenarios discussed in this report, are taken or derived from analyses by the U.S. Environmental Protection Agency (U.S. EPA, 2009) and the U.S. Energy Information Administration (U.S. EIA, 2009a). As such, the energy prices analyzed are in a range of recent climate change policy discussions and are meant to be illustrative rather than forecasts. EPA and EIA published separate analyses of the American Clean Energy and Security Act of 2009 (H.R. 2454), which includes a cap-and-trade system. However, results discussed here are not dependent on the emissions limitations resulting from cap-and-trade—alternatively, an emissions tax could have been the underlying mechanism driving higher energy prices.[1] The analysis is differentiated from those estimating effects of general energy price increases because of the relation-ship of price increases for different energy sources to their greenhouse gas emissions based on carbon content.

The focus in this report is on relatively short-term impacts of higher energy-related costs and does not include potential financial benefits from sequestering carbon or of reduced climate change. Recent studies that have examined potential benefits from agricultural practices to control climate change include analyses of methane digesters on livestock operations (Key and Sneeringer, 2011) and no-till farming (Horowitz et al., 2010).

2. Energy and Agriculture

Agricultural production consumes significant amounts of energy, especially in production of field crops. Consequently, energy prices affect costs of production in the agricultural sector. Production costs are important to farmers' net returns (profitability), defined as receipts for selling their output minus costs of its production, and net returns influence farmers' production decisions. Net returns affect what crops are produced by affecting the allocation of acres each season. Net returns affect farmers' livestock production choices as well, subject to biological constraints.

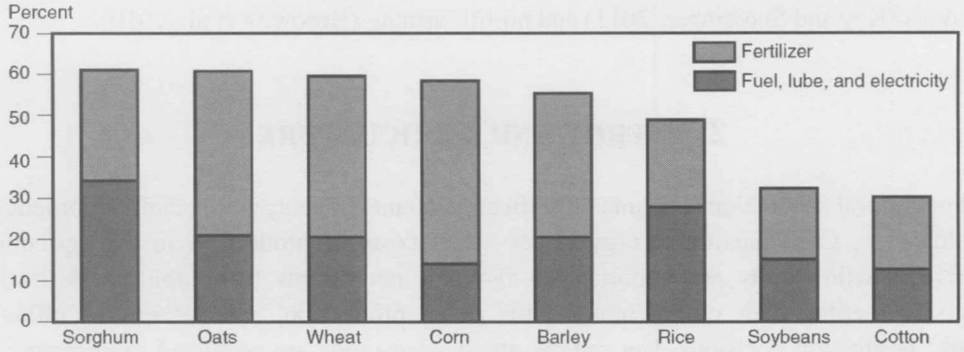
Energy consumption in the sector can be either direct—as with gasoline, diesel, petroleum, natural gas, electricity, and energy use for operating irrigation equipment (see box, "Irrigation and Energy")—or indirect, as with fertilizer (see box, "U.S. Supply of Nitrogen-Based Fertilizer Coming More From Abroad"). Over 2005-08, expenses from direct energy use averaged about 6.7 percent of total production expenses in the sector, while fertilizer expenses represented another 6.6 percent. This time period saw an increase in energy costs, and the combined share of these inputs reached nearly 15 percent in 2008. Additionally, feed costs for livestock production include indirect energy costs due to the influence on crop prices, such as for corn and soybean meal.

The importance of energy and the effects of energy price changes are not uniform across commodities or regions, as energy intensity in production varies considerably. Figure 2.1 shows the share of total operating costs for selected crops represented by the two largest energy-related input categories (fuel, lube, and electricity; and fertilizer) in 2007-08. Operating costs are out-of-pocket cash expenses paid for production inputs for each commodity. Operating expenses reflect the quantities and prices of production inputs and thus depend on production practices used by farmers. Costs cover inputs such as seed, fertilizer, fuel, lube, electricity, feed, chemicals, and repairs.

Sorghum has the highest share of energy-related inputs while cotton has the lowest. For sorghum, oats, wheat, corn, and barley, energy-input categories are more than 50 percent of operating expenses.[2]

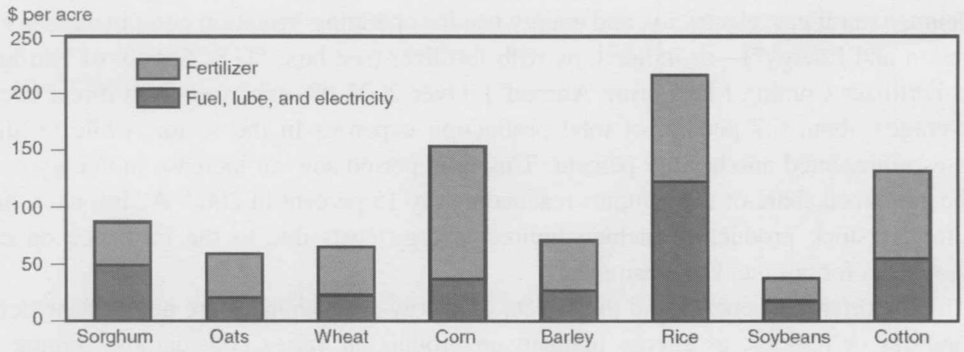
The distribution of energy-related input costs for these crops is different in absolute terms. Per-acre operating costs are important for determining producer net returns, which influence farmers' cropping choices. Rice, corn, and cotton have the highest per-acre expenses for energy-related inputs (figure 2.2). While rice and cotton have the highest per-acre costs for fuel, lube, and electricity, corn has the highest costs for fertilizer. Again, energy-related costs for soybean production are relatively low.

Direct energy costs account for smaller shares of operating costs for livestock operations, representing about 4 percent of operating costs for hogs, 5 percent for milk production, and about 10 percent for cow-calf operations, on average, in 2007-08 (table 2.1). Livestock operations also see indirect effects of energy costs through higher feed costs. In 2007-08, feed costs accounted for about 11 percent of total operating costs for cow-calf operations, 58 percent for hog production, and 76 percent for milk production.



Source: USDA, Economic Research Service, Cost of Production Estimates.

Figure 2.1. Energy-related inputs relative to total operating expenses, 2007-08 average.



Source: USDA, Economic Research Service, Cost of Production Estimates.

Figure 2.2. Energy-related expenses, selected crops, 2007-08 average.

Table 2.1. Energy-related inputs relative to total operating expenses, livestock, 2007-08 average

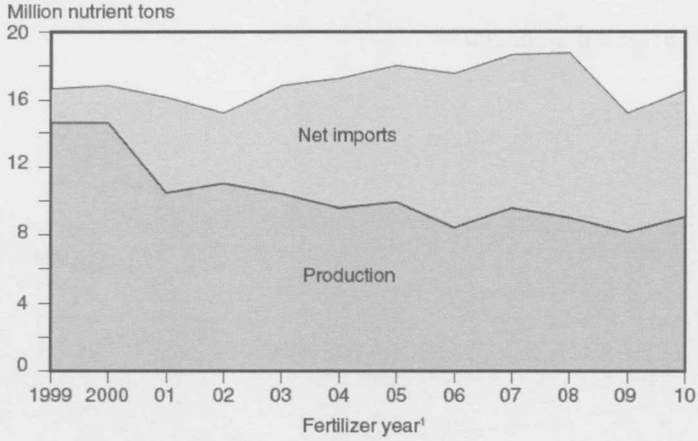
	Fuel, lube, and electricity	Feed[1]
	Percent	
Cow-calf, per bred cow	10	11
Hogs, per hundredweight gain	4	58
Milk, per hundredweight sold	5	76

[1]Feed for cow-calf costs includes supplemental feed, concentrates, and other feed; feed for milk costs excludes grazed feed.

Source: USDA, Economic Research Service, Cost of Production Estimates.

U.S. SUPPLY OF NITROGEN-BASED FERTILIZER COMING MORE FROM ABROAD

Fertilizer is an important component of production costs for crops, especially corn. Nitrogen fertilizer production is energy-intensive as natural gas makes up 70 to 80 percent of production costs. U.S. nitrogen fertilizer supplies, while historically domestic, have been increasingly imported over the past decade. Shares of U.S. nitrogen fertilizer are now nearly equal between domestic and foreign suppliers.



[1] The fertilizer year runs from July of the preceding year to June of the year indicated in the chart.

Source: Huang (2009), USDA, Economic Research Service. Updated using data from the U.S. Department of Commerce for nitrogen production and from ERS for net imports.

U.S. nitrogen supply from domestic production and net imports, 1999-2010.

Regional Differences in Costs of Energy Inputs

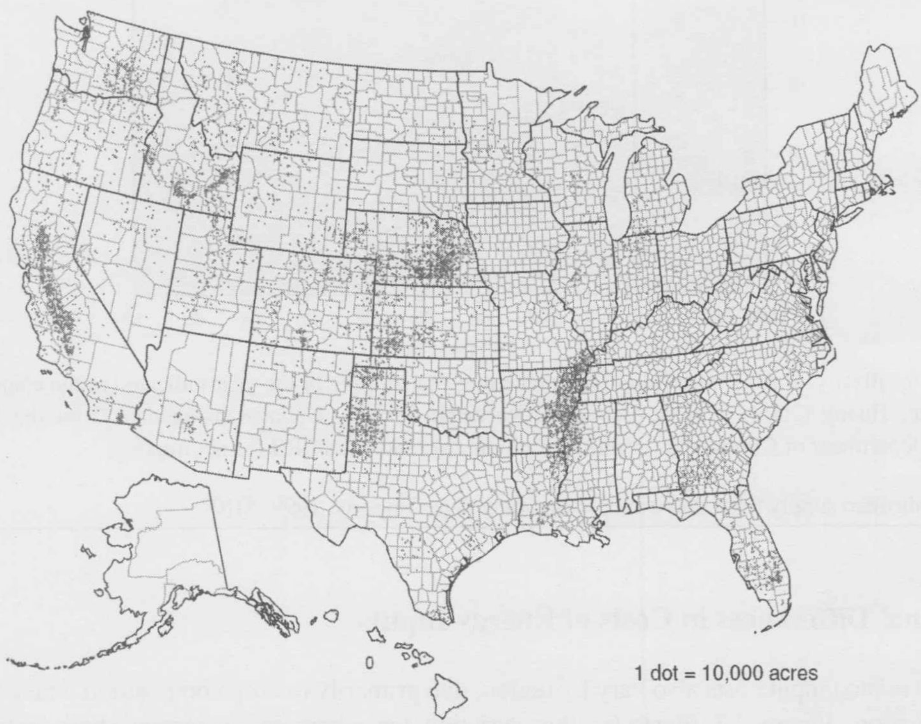
Energy-related input costs also vary by region, due primarily to crop composition and reliance on irrigation. Figure 2.3 illustrates this variation for wheat and soybeans, two sectors at opposite ends of the energy-input share spectrum. For wheat, the regions with the largest shares of costs from energy-related inputs are the Fruitful Rim, the Heartland, and the Prairie Gateway. For soybeans, the regions with the largest share of costs from energy-related inputs are the Southern Seaboard and the Eastern Uplands. The Northern Great Plains has the lowest share of energy-related inputs for both wheat and soybeans, well below the national averages of 60 percent and 31 percent.

Wheat production costs in the Northern Great Plains and the Prairie Gateway, where the majority of the crop is grown, present an interesting contrast in operating expenses. While the two regions have a similar share of production costs attributable to fertilizer expense (37 percent), the shares of costs accounted for by fuel, lubrication, and electricity are much different (28 percent for the Prairie Gateway, versus 12 percent for the Northern Great Plains). This is largely due to the high level of irrigation used in the Prairie Gateway.

IRRIGATION AND ENERGY

Irrigation makes a significant contribution to U.S. agricultural production. For 2007, the market value of agricultural products sold for all farms was $297.2 billion, with irrigated farms (a farm irrigating any land) accounting for nearly 40 percent of this total. The average farm value of products sold for an irrigated farm ($393,700) was more than 4 times the average value for a non-irrigated farm ($93,900). Irrigation makes an obvious contribution to the value of crop products sold, but it also contributes to the farm value of livestock and poultry products via the use of irrigated crop production used as feed.

Acres of irrigated land, 2007



Source: USDA/National Agricultural Statistics Service.

In 2007, 56.6 million acres in the United States were irrigated (51.5 million harvested cropland acres and 5.1 million pastureland and other cropland acres), accounting for about 7.5 percent of total cropland and pastureland acres.

About 16.6 percent of U.S. harvested cropland acres nation-wide were irrigated, while only about 1.2 percent of total U.S. pastureland acres were irrigated. The map shows 2007 irrigated acres by State, with each dot representing 10,000 acres. Most irrigated agriculture occurs in the 17 Western States.

Energy use in irrigated agriculture is determined primarily by the amount of land devoted to irrigation, the quantity of applied irrigation water, and the status of irrigation efficiency—more conserving irrigation systems and water-management practices generally mean lower peracre energy costs.