PURDUE UNIVERSITY

PURDUE AGRICULTURAL ECONOMICS REPORT

SPECIAL ISSUE, JULY 2008

The Future of Indiana Agriculture: Challenges and Opportunities

In April, 2008, faculty members in the Department of Agricultural Economics were asked to provide input to the Indiana State Department of Agriculture as they prepare the next strategic plan for Indiana agriculture. The results of this input are summarized in this special issue of the *Purdue Agricultural Economics Report*. The introductory paper below outlines the key factors that will influence future opportunities for Indiana agriculture. The remainder of this special issue of the *Purdue Agricultural Economics Report* consists of six articles addressing six key sectors of the Indiana agricultural industry. The six papers address the following topics:

- Trends in Indiana Food Processing
- The Indiana Livestock Sector: Challenges and Opportunities
- Indiana Grain Production Sector
- Energy and Biofuels
- Indiana's Hardwood Industry – Retaining Market Share
- Trends in Indiana Specialty Agriculture

Key Factors Influencing Opportunities for Indiana Agriculture: The Long View

Sally Thompson, Professor and Department Head; Allan Gray, Professor and Mike Boehlje, Distinguished Professor

The broad sweeping changes taking place in the global agricultural marketplace will clearly affect the potential opportunities for growth of the Indiana agricultural sector. Here, we identify five major factors that we believe will be key contributors to the shape of the future of agriculture:

- The Intersection of Agriculture, Food, and Energy Policy
- The Global and Local Influence of Demand and Supply for Agricultural Products
- The Resurgence of Risk in Agriculture
- The Increasing Strain on Natural Resources
- The Role of Biotechnology in Redefining Agriculture

In This Issue

The Intersection of Agriculture, Food, and Energy Policy

While national policy has always been an important factor for agriculture, recent policy decisions regarding energy, agriculture, and food at the national level have had a profound impact on the agricultural industry. Because much of today's volatile shift in agricultural markets is due to policy influence, we must recognize the influence that further policy decisions will have on the agricultural industry in Indiana and elsewhere.

Current energy policy, described in more detail in "Energy and Biofuels," has been a major influence in the unprecedented rise in commodity prices particularly for corn, soybeans, and wheat. The Renewable Fuel Standard calling for 36 billion gallons of renewable fuels by 2022 suggests increased energy-based crop demand. This would suggest continued strong demand for corn, in the near term, and for cropland in general for some time to come. This may be good news for crop farmers for the future.

However, the pressure placed on supplies of feed grains to meet the growing biofuels demand, the export demand, and livestock demand is creating stress. Livestock producers, particularly pork and poultry, are under severe pressure, with feed costs increasing dramatically. We could see more consolidation in this industry in the near future. The issue at hand is not whether livestock can compete in the marketplace for feed grains, but rather that the current market conditions are not market driven, but policy driven. That is, national energy policy has resulted in the large increase in feed costs. Perhaps, over time, the price of poultry and pork products will rise, as consolidation reduces supplies, allowing the remaining producers to prosper. Of course, the rise in poultry and pork prices, along with other animal proteins, to offset the rising cost of feed will affect consumer prices for food.

Thus, this intersection of energy, agriculture, and food policy leads to several questions. Will Congress face increasing pressure from livestock producers and consumers in the future to change its course on energy policy? Will there be increasing pressure on agricultural policy to change course from assisting commodity crop producers, to more assistance for livestock producers? As the cost of food continues to rise, will there be increased pressure to focus agricultural/food policy more on food stamps and other assistance programs to offset this rising cost in lieu of commodity subsidies, crop insurance subsidies, and research in agriculture? Finally, what will be the impacts of second-generation biofuel technologies on resources other than corn, such as grasses or woods?

The Global and Local Influence of Demand and Supply for Agricultural Products

Dietary transition from vegetable to animal protein. Prior to the growth in the energy-driven demand for agricultural raw materials, the exciting longer-term opportunity for U.S. agriculture was the growing demand in the rest of the world for animal proteins. As consumers in China and Asia in general experience growing real incomes, they are beginning to change their diets from a primarily vegetable-based protein diet to an animal-based protein diet. Figure 1 depicts this dietary transition phenomenon. The graph clearly shows that as incomes increase, diets shift more towards animal protein. The current biofuels boom and the increasing costs of energy may or may not be slowing this dietary transition as real purchasing power declines. But, once the biofuels industry matures, will this dietary transition again be the major growth story for agriculture? Or will the demand for these products move to suppliers other than the U.S.?

Globalization of the food system. In the long run, food production can increase significantly in the rest of the world because, in contrast to most of history, global access to both production technology and financial capital has profoundly changed the constraints and unshackled productive capacity and capability in much of the rest of the world. In the U.S., most of the land and water needed for agricultural production is being fully utilized, and allocation of additional land and water resources to agricultural production is highly unlikely. In essence, the "plant" in terms of crop production is operating close to full capacity. This is clearly not the case in much of South America (Brazil, Uruguay, Bolivia,

Purdue Agricultural Economics Report is a quarterly report published by the Department of Agricultural Economics, Purdue University.

Editor
Gerald A. Harrison
Purdue University
Department of Agricultural Economics
403 W State Street
West Lafayette, IN 479072056
E mail: harrisog@purdue.edu
Phone: 765 494 4216 or
toll free 1 888 398 4636 Ext. 44216

Editorial Board
W. Alan Miller
Christopher A. Hurt
Philip L. Paarlberg

Layout and Design
Cathy Malady

Circulation Manager
Linda Klotz

Agricultural Economics Department
www.agecon.purdue.edu

PAER World Wide Web
www.agecon.purdue.edu/extension/pubs/paer/

Cooperative Extension Service Publications
www.ces.purdue.edu/extmedia/

Subscription to PAER
Paper copies of the PAER are $12 per year (payable to Purdue University). Electronic subscriptions are free and one may subscribe at: www.agecon.purdue.edu/contact/contact.asp

Purdue University Cooperative Extension Service, West Lafayette, IN

and Argentina) as well as in parts of Eastern Europe, where adoption of new technology and market-driven business models have the potential to dramatically increase agricultural output. U.S. animal production is not constrained by the same land and water resources as crop production, but expansion in the animal industries faces equally limiting constraints with respect to location and siting of livestock facilities and the regulatory permitting process. Most food companies are globally sourcing and selling, and, although transportation and logistics costs are rising, they are unlikely to reverse the trend of increasingly global rather than local production of food products.

In essence, the U.S. will face increasing global competition in a business climate where agricultural production can be expanded more cost effectively in other countries than it can in the U.S. In the longer term, agricultural output is likely to grow more rapidly in the Americas in the Southern hemisphere compared to the Northern hemisphere, and in Europe in the East, including countries of the former Soviet Union, compared to the West.

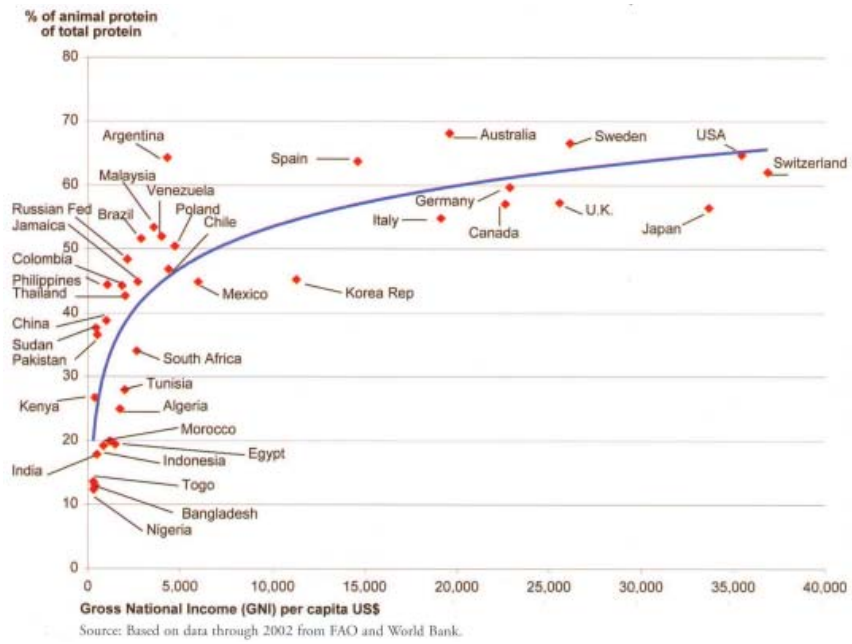
Demand for local, organic, and sustainably produced foods. While there is a continuing trend towards increased globalization in the food system, there is also an opposing trend towards local sourcing of food and use of less industrial methods for food production occurring at the same time in the United States and throughout the developed world, particularly in Western Europe. This trend is reflected in the rapid growth of organically produced foods and regional food labeling and marketing, along with the development of markets for food grown under "sustainable" social systems or at "fair-trade" values. This trend is also connected to public concern with sustainability in energy use. Issues such as the greenhouse gas emissions and the "carbon footprint" of food production and distribution—including "food miles," or how far food travels before consumed, and other environmental impacts of industrial food production are attracting increasing attention.

Besides environmental and sustainability concerns contributing to this trend, perceived taste, freshness, and health benefits are also driving the growth in consumer demand for organic or sustainably produced food products. The growth in demand for organic or sustainably produced food offers an opportunity to Indiana producers who may prefer or are more suited to smaller or specialized production practices, as well as to those producers who are committed to the values that underlie this trend.

Growth in exports and the declining value of the dollar. Most analysts expected that the increased use of corn for ethanol production would come at the expense of exports, but in fact that has not been the case. Exports of corn as well as soybeans and wheat have in fact grown dramatically in the past 2 years. The fundamental reasons for that growth are the continued strong economies and purchasing power of China, India, and much of Asia—as well as the declining value of the dollar. The dollar has declined not only relative to currency values for those countries buying our grain products, but it has also declined relative to the currencies of competing exporters of those products. The value of the dollar currently is below the record low levels of the mid-1990s, resulting in prices of agricultural products in importing countries being only modestly higher than 2-3 years ago, when we experienced a much stronger dollar but almost 50 percent lower commodity prices. The growth in personal income and food demand in Asia and foreign exchange rates and currency values will likely determine whether or not the foreign demand for U.S. agricultural products will continue to be strong.

Note however, that the declining value of the dollar is a two-edged sword relative to the agricultural

Figure 1. Animal Protein as a Share of Total Dietary Protein



industry. Although a lower currency value increases our competitiveness in selling agricultural products in global markets, it also increases the cost of imports. In addition, an increasingly larger proportion of agricultural inputs are being imported rather than produced domestically. In contrast to 3-5 years ago, when the vast majority of our fertilizer was produced domestically, almost two-thirds of our nitrogen is now imported, and P&K are also increasingly sourced from outside the U.S. borders. The same is true of chemicals for pest control. A significant explanation for the dramatic increase in the cost of production for corn, soybeans, and wheat in the Midwest (a 50 to 60 percent increase in production costs) is the increased dependency on imported raw materials and the higher cost due to increased transportation costs as well as the lower value of the dollar.

The Resurgence of Risk in Agriculture

The business climate and financial outlook for crop agriculture are favorable for the next 1 to 2 years. However, the greatest risk to this sector is the rising cost structure of the industry. In this year alone, production costs for corn (fertilizer, seed, chemicals, etc.) have increased 58 percent. In addition, land values and particularly land rents are expected to increase from 10 percent to 25 percent this year. Thus, while crop prices are very high, the rapid increase in costs of production and land is quickly eroding the increased margins that many producers experienced in 2007. While prices appear to be strong enough in the near term to offset the higher costs of production, the issue is the impact that continued rises in costs of production will have on the producer's margin risk.

Of course, the increased risk to the livestock industry is challenging as well, with feed costs not only rising rapidly, but the increased volatility in those prices making it much more difficult to budget and plan for feed costs. In addition, livestock producers continue to face increased risks associated with environmental regulations and community discord associated with the externalities of livestock production.

In summary, increased market risk coupled with the increasing risks associated with 1) the overall U.S. economy, 2) relationships with the local community, neighbors, suppliers, and buyers, and 3) the environment have placed new emphasis on the ability of producers to manage risk. In this uncertain environment, there is both increased opportunity to succeed and increased opportunity to fail. How these risks are managed by both producers and the industry as a whole will shape much of the future of agriculture in Indiana and beyond.

The Increasing Strain on Natural Resources

The intersection of increased global food demand and policy are placing unprecedented strain on our natural resources. Most notably, the debate over the use of land for energy crops, food crops, or conservation activities such as the CRP is beginning to heat up. There are a number concerns over the potential overuse and/or degradation of land resources due to intense farming practices ushered in by higher prices. In addition, pressure even in rural communities is increasing to consider whether rural land is best used for residential and/or recreational uses rather than agricultural uses. Specifically, intense scrutiny is being placed on location of livestock facilities vis-à-vis their potential rural neighbors and other competing uses for the land. Finally, as the demand for alternative uses of the land increases, the value of the land continues to increase as well, making it difficult for young and beginning farmers to enter farming while helping bolster the balance sheets of those who currently own the farmland.

Land is not the only resource being placed under pressure. Water is a critical resource for direct human consumption, crop production, livestock production, and even biofuel production. While the issue of water is not as intense in Indiana as it is in the western U.S., it will continue to be an increasingly important factor even in Indiana. The other critical resource is clean air. More research is necessary to understand better the externalities from agricultural activities that affect air quality and to design alternatives for managing these externalities.

Ultimately, the policy issues associated with these resource constraints are likely to be: 1) the mix of management, technology, and/or regulation that can/should be used to determine the use of land, water, and air resources; 2) whether those management, technology, and/or regulatory responses are acceptable solutions to the public, and 3) the extent to which the management, technology, and/or regulatory responses are burdensome to the industry's long-term financial health.

The Role of Biotechnology in Redefining Agriculture

The application of biology through biotechnology has the potential to redefine the role of agriculture for two fundamental reasons. First, biology and biotechnology replace and/or complement chemistry and the mechanical sciences as the fundamental science base for new technological and productivity advances. Many of the technological advances that increased productivity and contributed to growth and overall economic development in the past 50 years have had their science base in the physical and mechanical

sciences. These advances will continue to be important in the future, but more of the science base for future technological advance, productivity growth and economic development is likely to come from the biological sciences. This places agriculture in the mainstream of productivity growth, and economic development in the developed as well as the less developed economies.

The second profound implication of biology and biotechnology in redefining agriculture is that it dramatically expands agriculture's role as a raw material supplier for a broader set of industries. The agriculture of the past 100 years has been a raw material supplier for the food and nutrition industry and, to a limited degree, the fiber and textile industry. But biotechnology and the advances in biology and biochemistry expand dramatically the potential uses for agricultural products. In fact, some are suggesting that in the future agriculture will be a significant supplier of raw materials for: (1) food and nutrition products, (2) bioenergy and industrial products, including synthetic fibers, plastics, wall coverings, and other products that have historically been derived from the petrochemical industry, and (3) health and pharmaceutical products. This significant broadening of the economic sectors that will use agricultural products as raw materials increases agriculture's importance in the overall economy.

The main policy questions surrounding this factor for Indiana are: (1) how quickly will biological breakthroughs come to fruition that dramatically affect crop yields (particularly for corn) in ways that reshape the current tight supply situation? (2) what opportunities, outside of biofuels, provide Indiana agriculture with the best options for diversifying its agricultural economy and capturing more value-added within the state? and (3) where should limited resources be invested to advance these potential opportunities and provide an environment for incubating and growing these opportunities within the state?

Conclusions

The overarching factors highlighted above will significantly affect the long term future of Indiana agriculture. Decision makers in Indiana's agricultural sector who understand and track these factors are more likely to make better decisions regarding future investments and policy choices. Each agricultural sector in Indiana will also face other important factors specific to those sectors. Sector-specific factors are discussed in the following papers.

Trends in Indiana Food Processing

John M. Connor, Professor

Three Types of Food Industries

There are three locational types of industries: supply-oriented, demand-oriented, and footloose. In order to minimize costs of location, the *supply-oriented* food industries must locate production close to their major material inputs because the inputs are perishable or otherwise expensive to transport relative to total manufacturing costs of production (or final product price). In contrast, the *demand-oriented* industries have high costs of distribution and storage relative to the finished product price. Demand-oriented industries can also be identified by a short radius of delivery zones from the manufacturing plant to the purchasing distributor's location. *Footloose* industries are those for which neither assembly costs nor distribution costs dominate.

The major examples of the three locational types of industries are listed in Table 1, and their major economic characteristics are shown in Table 2. (These industries are broadly defined and may contain segments that fall into more than one locational category). For decades in the past and for the years to come, this three-part framework has at least roughly predicted food-industry growth.

Generally speaking, the supply-oriented industries produce commodities with low value-added intensity (slim margins) and low job growth. A high share of production is sold to other manufacturers (mostly other food manufacturers) for further processing, and the rest goes to wholesale distributors. Plants tend to be large in scale and located in rural areas and small towns. Because these industries are tied closely to agriculture and its volatile prices, these industries as a group have the most real output volatility. Their product markets are the largest geographically, with broad national sales and relatively high export shares.

The demand-oriented industries are where they are because of the pull of their *retail customer locations*. They make moderately differentiated consumer products, many of them perishable, fluffy, or high in water content. Several of the demand-oriented food industries deliver direct to retail establishments via their own driver-salespersons; delivery zones

Table 1. Three Locational Types of Food Industries Found in Indiana

Supply-Oriented[a]	Demand-Oriented[b]	Footloose
Soy oil	Soft drink bottling	Canned specialties
Meat packing	Fluid Milk	Frozen specialties
Butter & Cheese	Animal feeds	Breakfast cereals
Flour milling	Bread, rolls, pastries (fresh)	Flour mixes and doughs
Meat processing	Ice cream, frozen desserts	Pet foods
Poultry processing	Packaged ice	Cookies and crackers
Rendering	Pasta	Frozen baked goods
Processed milk products	Margarine, cooking oils	Confectionery
Wet corn milling	Pickles and sauces	Alcoholic beverages
Canned, frozen fruits & veg.	Beer	Miscellaneous prepared foods[c]

a Listed in order of the ratio of agricultural-input costs to shipments value.

b Listed from smallest to largest average radius of the distribution zone for 80% of shipments; the first five have shipment zones of less than 200 miles, while the remainder are less than 500 miles.

c Includes perishable refrigerated consumer-ready prepared dishes (tortillas, salad mixes, tofu, etc.), puddings, sweetening syrups, dry rice mixes, dry pasta mixes, etc.

Source: Connor and Schiek (1997: 142).

are small. High transportation-cost intensity makes their plants relatively small and mostly in or near metro areas. The leading national companies tend to own or franchise dozens of manufacturing plants across the country. These industries are relatively labor-intensive and have high large gross margins (high value added relative to sales). The share of agricultural costs in shipments value is quite low, and real output stability is high.

The footloose industries tend to assemble a relatively large variety of food ingredients from many suppliers located at all points of the compass. Products are high-value-added, highly differentiated, convenient, innovative, consumer-ready items. Many of the footloose industries make products that substitute for products formerly made in a demand-oriented industry. Partly as a result, employment and shipments growth is significantly higher than the other locational types. For most footloose industries, an optimal (minimum-input-cost) location is typically unknowable. Distribution zones tend to be multi-state regions covering from one-quarter to one-half the U.S. population, for which calculating minimum shipping costs are also difficult. (Exports are minimal for most of these industries). That is why the footloose industries are fickle industries. Simple demand-and-supply economic considerations have weak effects on location investments.

Table 2. Economic Differences among Locational Types of U.S. Food Industries

Characteristic	Supply-Oriented	Demand-Oriented	Footloose
Ag. Costs/Shipments %	52	26	19
Shipping Radius (miles)	1092	340	869
Value Added/Shipments %	31	52	48
Shipment Growth 1963-92 %	539	569	853
Employment Growth 1963-92 %	-5.1	-30.1	68.2
Instability of Production[d]	17.8	12.8	11.6

d Sum of the absolute value of the differences in real 5-year growth rates 1963-1992 in percentage points.

Economic Development Implications

First it is doubtless obvious that, all other things being the same, a rational deployment of economic development effort and incentives would target footloose food industry investments – new plants and expansions. It is also clear that the locational advantages have less to do with hard-headed business calculations than with less easily evaluated factors: economies of agglomeration (found primarily in or near metro areas), the proximity of centers of food-industry R&D, the eagerness of state or local development officials, or simply managerial preferences for or perceptions of business or family lifestyles.

Second, the demand-oriented industries are ultimately primarily influenced by the spending power of consumers in the industry's distribution zone. That zone may encompass as little as a few Indiana counties or as much as all of Indiana and its adjacent states. To the extent that Indiana is gaining population and employment relative to its neighbors, demand-oriented food-processing will move here. The increasing ethnic pluralism of the state's population also may stimulate demand for some of these industries' foods. Short of educating potential investors about such demographic trends, there is little economic-development effort justified for these industries. Since the 1920s, the center of U.S. population and household spending has moved steadily to the south and west, and is expected to continue to do so. To some slight extent, Indiana may be the beneficiary of demand-driven food-plant closings in northern

Illinois, Michigan, and Ohio, but in general, efforts to oppose this population shift is futile.

Third, the growth of Indiana's supply-oriented food industries is ultimately a by-product of improved low-cost supplies of perishable or bulky raw agricultural production. These industries will relocate and expand to the extent that present and future farm production remains high for hogs, fed cattle, poultry, farm milk, rough grains, soybeans, and certain fruits and vegetables. "Grow it, and they shall come" is the watchword. The maintenance of rural roads, barge, rail connections, and associated communications infrastructure is a secondary policy area that can contribute to the reliability and low cost of agricultural inputs for the supply-oriented industries.

The Indiana Livestock Sector: Challenges and Opportunities

Michael Boehlje, Distinguised Professor; Ken Foster, Professor and Brian Richert, Associate Professor, Department of Animal Science

The livestock sector has been a critical component of the agricultural industry in the state of Indiana, and in recent years livestock production has reversed the decline of the 90's and has generally been growing in numbers and value. Table 1 summarizes livestock production by species from 2001 through 2006; note the stabilization in hog production, which had been declining in numbers during the 1990's, and the growth in diary, egg, and turkey production since 2001. Further growth of the livestock sector in Indiana will be facilitated or challenged by the following forces.

Demand for Niche Products

Organic, natural, and locally produced food products are all growing in popularity among consumers whose incomes have risen and who are willing to pay for unique attributes that cannot be delivered by conventional production systems and extensive marketing channels. The overall organic market has experienced rapid growth over the past couple of years, with annual growth rates of nearly 20 percent. The growth in the organic meat segment has been even stronger, however. In 2003, the latest year for which data is available, the market grew by nearly 78 percent for fish, poultry, and meat. Continued growth in demand is almost assured as the supply chain for such products is expanded.

In order to capitalize on these opportunities, producers will eventually be called upon by retailers or customers to verify production process claims. In the case of organic production, federal standards exist. In other categories, such as natural, environmentally friendly, animal humane, etc., producers and their partners may find opportunities to develop their own standards to be verified by independent third parties. In some cases, government may find a role in certifying the compliance, as is the case with the USDA Agricultural Marketing Service's Process Verified Program.

Table 1. Trends in Livestock Production – Indiana[a]

	2001	2002	2003	2004	2005	2006
Hog Marketing's - thousand head	6,397	6,236	6,736	6,099	6,354	6,477
Cattle Marketing's – thousand head	282	293	283	270	250	280
Calf Marketing's – thousand head	117	127	114	107	97	124
Dairy Cows on Farms – thousands	153	151	149	151	156	165
Dairy Cows Milk Produced – million pounds	2,567	2,658	2,939	3,027	3,166	3,299
Sheep/Lamb Marketing's – thousand pounds	5,792	4,704	3,184	3,816	3,744	3,560
Eggs Produced – millions	6,025	5,973	6,035	6,256	6,254	6,593
Turkeys Produced – thousand pounds	399,000	403,000	396,800	409,640	428,800	462,300

a Source: Indiana Agricultural Statistics, 2006-2007, USDA, NASS, Indiana Field Office, West Lafayette, Indiana, 2007.

Food Safety and Traceability

Food safety is a key risk for all segments of the livestock industry. Food products that make people ill, or in a worst case scenario cause death, can quickly destroy brand value, the most valuable asset of a branded food product company. Supply chain management using a traceback system, combined with quality assurance procedures such as Hazard Analysis and Critical Control Point (HACCP), facilitates control of the system to minimize the chances of a food contaminant or to quickly and easily identify the sources of contamination. Traceability is increasingly a key motivation for controlled origination of raw materials from certified suppliers to implement a supply chain philosophy.

Animal identification and traceability systems have a key role to play in the future of the animal agriculture industry. Whether the underlying issue is animal health, food safety, animal welfare, process assurance, or quality attributes, animal identification and traceability are necessary. Identification and traceability systems should be evaluated and implemented to enhance the industry's ability to respond to natural and intentional disease outbreaks, improve food safety, and provide assurances of food quality and wholesomeness. Some elements of these systems will be developed and managed by government; other parts may be purely private; and some elements may require public/private partnerships.

Crop-Livestock Synergies

Increased synergy between animal and crop producers is anticipated in the future. In a long-term scenario of fertilizer costs increasing and fertilizer resources diminishing, the use of organic fertilizers will likely be much more valuable. When rations can be formulated to meet a specific animal's requirements, the need to supplement diets will be reduced, reducing excess excretion of nutrients that need to be stored, treated, and used on cropland. Costs would also be reduced, as would the pressure on the environment. On farms or in regions that import grain to feed animals because not enough is produced locally, manure nutrient management is more challenging.

Technologies are available to enhance the efficiency of animal production and control the impact of animal production on the environment. Large operations can better afford and manage manure treatment technologies, particularly those with high fixed costs, such as for biodigestors. They can spread the costs over a larger volume of product and have sufficient volume to potentially sell value-added products. Some technologies in nutrition or housing designs are size neutral and will not affect the structure of the industry as long as the technologies are cost effective.

Labor and Immigration

Most segments of animal agriculture in the United States and Indiana depend on a foreign-born labor force. Many of these workers are from rural Mexico or Central America, and some may be undocumented. The legal uncertainty associated with this undocumented work force has consequences for the workers and the companies for which they work. Workers may not receive full legal protections and may be reluctant to complain about working conditions. Employers are vulnerable to a variety of legal sanctions and risk the loss of a significant portion of their work force if immigration laws are strictly enforced. This legal uncertainty creates a cost that can be mitigated with revised immigration and guest worker government policies. A critical issue for both the livestock production and processing industries will be the resolution of the uncertainty surrounding immigration policy and guest worker programs so that the livestock sector can access a reliable and stable work force.

Environmental Regulations

Some of the most critical issues to shape the structure and location of the livestock industry in the future are storage and utilization of manure and other byproducts from production and processing, and mitigation of air and water pollution from the industry. Key environmental issues include: recycling of animal manure, processing manure into energy or other productive resources, and technological mitigation of nutrients and odors.

Recycling of animal manure as a crop nutrient would be facilitated by business models that efficiently aggregate, transport, and land-apply organic waste (maybe in combination with urban organic waste) combined with injection and other technology that reduces nutrient volatilization and odor problems. Biodigestor processing is increasingly technologically and economically feasible. For larger scale operations that can spread the fixed costs over more volume, the amount of energy produced will likely exceed that used in the livestock production unit, and access to the electrical transmission grid at competitive prices may be the key to the future of biodigestors.

Environmental regulations can be a significant cost factor for the industry and will likely be a major factor in future investment decisions by the industry. Differences in environmental regulation across locales are problematic for animal agriculture. Broader multijurisdictional regulatory approaches may represent an opportunity for more efficient environmental management and lower industry costs. Litigation or legislative outcomes must provide legal rights and responsibilities that balance business practices with environmental concerns to resolve the issues. In the environmental arena, uncertainty is often a greater

problem than the level or type of environmental regulation.

Livestock Feed Costs and DDGS Use

The rapid growth in feed grains-based ethanol production has drastically affected the cost of feed for the state's livestock and poultry producers. Both corn and soybean meal (traditionally the two largest ingredients in confined animal and poultry feed rations) have essentially doubled in price over the past two years; this has put significant economic and financial pressure on livestock producers. At the same time, the boom in biofuel production promises greater availability of by-products that, to some extent, can substitute for corn and soybean meal in feed rations.

Dried Distiller's Grains with Solubles (DDGS) has the potential to be a valuable alternative feedstuff for the state's livestock and poultry industries. However livestock and poultry producers are wary of utilizing DDGS because the nutritional quality of DDGS varies widely from one batch to another and across ethanol plants. Accurate nutritional and fat composition information is not possible to determine in a timely fashion that would allow accurate reformulation of diets as DDGS quality changes. Additionally, several biological phenomena related to the feeding of DDGS may determine the upper limits of DDGS inclusion in livestock and poultry feed rations – generally 10 percent for poultry rations, 20 percent for pork rations, and 30 percent for beef and dairy rations.

Over time, efficiency in the markets for feedstuffs suggests that DDGS prices will be equivalent to their ability to substitute for the alternatives of corn and soybean meal. Thus, unless there is substantial expansion of ethanol production beyond the current ability of the livestock and poultry industries to utilize the byproducts, long-lived bargains associated with DDGS feeding should not be expected.

Indiana Grain Production Sector

Chris Hurt, Professor; Corinne Alexander, Assistant Professor; Craig Dobbins, Professor and Sally Thompson, Professor and Department Head

Indiana's grain production sector is in a period of dramatic adjustments to major world drivers of change. The drivers include short crop production in some key growing areas of the world; rapid world income growth, especially in developing economies where increasing incomes result in increased food demand; a weakened U.S. dollar; and increasing use of crops for fuel production. As a result, the economic environment has shifted from major crop surpluses to one of basic commodity shortages, with growing concerns for food security and record high grain prices.

As a result of these dynamics, the Indiana grain sector has had wide swings in planted acreage, sharp increases in crop prices, sharp increases in production costs, surging land values and cash rents, record incomes for crop producers, but with much greater variability and heightened uncertainty for the future.

New grain and soybean processing is a major factor of change in the state. Ethanol is the key driver for corn use. In 2007 and 2008, a total of 10 new plants have/will open, with capacity to use an additional 275 million bushels of corn. Total corn processing capacity in the state by the end of 2008 is estimated at 550 million bushels, composed of 310 million bushels for ethanol and 240 million bushels of other corn processing. Indiana corn production in 2008 is expected to be about 875 million bushels with normal yields.

Corn demand for the state's animal sector has experienced modest growth from an estimated 152 million bushels in 2004 to 170 million bushels in 2008. This growth has been primarily due to a 14 percent increase in market hog numbers from 2004 to 2008 and from small growth in dairy and poultry numbers.

For soybeans, a major new processor opened in 2007 with capacity to crush an additional 50 million bushels per year. Soybean crushing capacity is now estimated at 230 million bushels per year with 2008 production expected to be about 265 million bushels with normal yields.

Situation for 2009 to 2012

In the next few years, the crop production sector is expected to continue to adjust to forces already in motion. The largest annual increase in ethanol production capacity will be put in place in 2008. By the end of the year, most of the corn ethanol plants under construction in the U.S. will be completed. There will then be a much slower pace of new plant openings in 2009 and 2010. This is expected to be true for both Indiana and the nation in total.

The years of 2009 and 2010 are viewed as a period when crop production catches up to the new demands associated with the corn ethanol plants built in 2007 and 2008. It may take until the 2010 crop for world

production to reach levels that are in better balance with world demand.

This period from 2008 to 2010 will be one of adjustments for both crop producers and end users. This means that the domestic animal sector, the industrial sector (starches, etc.), foreign buyers, and of course the food sector will be changing. Food prices will continue to adjust higher and final consumption patterns among end-users will also adjust.

The crop production sector will have strong incentives to increase output in the next few years. That expansion will have both "extensive components" as some previously uncropped lands come into cultivation, and also "intensive components" as greater levels of inputs and technology are used to increase crop yields. Further development and implementation of specific attribute crops is expected as well.

The years of 2008 to 2010 are also expected to be a period of important research and development of new generation ethanol crops and ethanol extraction processes, especially from cellulose.

In the 2010 to 2012 period, the focus for energy crops is expected to shift toward the commercialization of cellulosic crops for fuel production. While corn residue is expected to be one of the first raw materials to be exploited in Indiana, there will also be new potential demands for cellulose from pasture lands, woodlands, and forest.

The economic environment for crop producers will be full of opportunity and risks. Crop and input price variability is expected to be extreme. Adding to the uncertainty is the importance of energy economics and uncertainties that come with the direction of energy markets. Indiana's crop producers are now linked directly to the energy business, which has a history of extreme volatility and huge cyclical swings.

Implications

Land Use-Extensive: There will be "new" crop land coming into production. Of the 15 million acres in farms in the state, there are 450,000 acres of pasture or grazing land in the state that are considered crop land. Portions of this land can be converted to cropping, particularly wheat production. There are also currently about 300,000 acres of Conservation Reserve Program (CRP) acres in the state. Contracts on about 125,000 of those acres will be maturing by 2012. And there are an additional 425,000 acres of grazing land on farms that are considered non-crop land. Finally Indiana farms have 1.2 million acres of woodlands that may have crop use for cellulose ethanol production.

Land Use-Intensive: High prices for crops will continue to stimulate increases in input use that increase yields. This includes both more inputs such as fertilizer and chemicals, but also products such as seed genetics with multiple traits and precision equipment for site-specific farming. The approach will be to maximize returns from each smaller area within a field in order to maximize total returns. More double cropping can be anticipated such as the traditional wheat/double-crop soybeans, but also new concepts of double cropping such as corn/corn residue cropping.

Technology: A dynamic period means opportunity for the discovery and application of new technologies. High income for many agribusinesses is stimulating larger investments in research. The Federal Energy Bill has also established the pathway for major expansion of bioenergy over the next two decades and is bringing larger funding for public research, as well. This means increased needs for education and training in understanding and implementing these new technologies.

Infrastructure: The changing Indiana landscape will mean needed changes in infrastructure such as transportation. Corn ethanol plants are already altering the needs for these services. Growing volumes of ethanol will have to be transported to East Coast markets, raising questions of the most feasible and economic way to do this: rail, truck, or pipeline. Movement to more identity preserved crops may mean the need for more specialized storage and tracking systems. Anticipated development of cellulosic ethanol will require development and implementation of new handling, storage, and transportation systems.

Rural Renewal Opportunity: Higher incomes on crop farms, greater interest in going back to the farm, and added job opportunities from grain and animal product processing facilities in non-urban communities will create growth opportunities in rural areas. While many citizens will view these opportunities as positive, these opportunities will foster environmental and social issues that will need to be addressed.

Risk Management: The risks of doing business in crop production have increased sharply. These include concerns over availability for inputs such as fertilizers and seed, but also for availability of supplies of corn for ethanol plants or for animal industries. The concerns extend into marketing institutions, where grain elevators recently have been unable to provide contracting service to their farmer customers due to the excessive risks involved. Those marketing risks may extend further into changes in futures markets, where the role of new speculative interests is being examined more closely. The massive changes in the crop/animal industry dynamics have left some animal producers near financial ruin. Lenders are voicing concern they are seeing from agribusinesses, ranging from animal producers to grain elevators.

Energy and Biofuels

Wallace Tyner, Professor; Frank Dooley, Professor; Allan Gray, Professor; Paul Preckel, Professor and Faculty Director of the State Utility Forecasting Group and Otto Doering, Professor

Until recently Indiana had little activity in renewable energy and biofuels. Up until 2006, Indiana only had one corn based ethanol plant, which produced about 100 million gallons/year. There was no investment in wind energy, and biogas also had minimal activity. Recently, all this has changed. It is expected that by 2009 Indiana will have about 13 ethanol plants with about 1 billion gallons of total capacity, and 7 biodiesel plants will have 135 million gallons of capacity. Wind energy installations have taken off, and there is now some biogas production from animal manure. For the future, there is potential for cellulose based ethanol and more wind energy.

Corn Based Ethanol

The 2007 energy bill increases the renewable fuel standard (RFS) to 36 billion gallons by 2022. The standard is partitioned among corn ethanol (15 billion), biodiesel (1 billion), and advanced biofuels including cellulose based ethanol (20 billion). By the end of 2008, the national level of corn ethanol capacity could reach 13 billion gallons, close to the 15 bil. gal. RFS. We do not expect to see much significant additional investment in corn ethanol in Indiana.

Associated with the growth of corn based ethanol production in Indiana are far-reaching changes for transportation needs and infrastructure demands. The transportation system built to facilitate the large-scale export of grain from Indiana by unit trains and barge is quickly shifting to a system with a much greater reliance upon trucks for inbound shipments of corn and beans, as well as outbound movements of ethanol biofuels and DDGS.

Cellulose Ethanol

As indicated above, the RFS calls for massive investments in cellulose based ethanol. Indiana is well positioned to produce ethanol from cellulosic materials including corn stover, high yielding grasses (switchgrass), and fast growing trees (poplar). Of these sources under current practices, by far the cheapest is corn stover. We estimate corn stover could be delivered for about $40 per dry ton compared to about $60 for switchgrass. So the state could foresee investments in cellulose ethanol production beginning in areas with high production levels of corn stover.

Biodiesel

Current national biodiesel capacity estimates from the National Biodiesel Board (NBB) indicate the industry can produce 864 million gallons of biodiesel, not far from the biodiesel RFS. In 2006, NBB estimated that the industry produced 250 million gallons. The disparity between production and capacity illustrates the current excess capacity in the industry due to poor economic conditions. The margins for biodiesel are expected to be under severe pressure for the next several years. Given this situation, growth in biodiesel production in the next 3 to 5 years is expected to be very slow, with only a few of the plants currently expected to be built coming to fruition.

Wind Energy and Electricity Issues Important for Indiana Agriculture

Utility scale wind farms have recently become a significant source of stable income for farmers in northern Indiana counties, with Indiana's first wind farm currently begining production in 2008. This 130 MW Benton County Wind Farm has signed long term power purchase agreements to sell all its output to two of Indiana's electric utilities. Other wind farms are being developed. The upsurge in the construction of wind farms nationwide and in Indiana is a reflection of efforts by electric utilities to have in place non-carbon emitting technologies to meet growing electric demand in the face of expected national legislation to regulate carbon emissions or to meet renewable energy standards. Although Indiana is not as generously endowed with wind energy as some other states, it has the unique advantage of having adequate transmission capacity linking it to major national markets.

Another potential energy related revenue stream for farmers is the conversion of livestock waste into useful energy. At least three dairy farms in Jasper County are already using anaerobic digestion technology to capture the biogas and convert it into electricity. In general these anaerobic digesters are not viable economically if selling electricity to the grid is the main outlet.

Substantial investment and scale economies generally are required for such operations.

Prospects for the Near Future

In the energy and biofuels area, the prospects with greatest potential for Indiana are cellulose ethanol and wind energy. Indiana has or could have sufficient cellulose resources to produce 400 million gallons of ethanol from cellulose sources at current conversion yields and 600 million gallons or more with anticipated future yield increases. Adding wood wastes and other resources could mean an industry as large as 1 billion gallons – the size of the corn ethanol industry in Indiana. If other raw materials such as municipal and industrial wastes were used, the increase could be even larger.

There are also prospects to increase the fraction of renewable electricity produced in Indiana using wind energy. Wind, like corn and cellulose ethanol, is not viable with market incentives alone. Either government subsidies or a renewable energy standard or some combination of the two are necessary to foster growth in the industry.

Policy Options and Programs to Foster Development of These Industries

For cellulosic ethanol, the policy options and programs that could be considered include the following:

- Cellulose plants require transportation of massive amounts of cellulosic material to a central plant. To enable this substantial increase in road loads, advance planning will be necessary to enable the plant supply of cellulosic materials.

- Growth of total ethanol consumption much beyond current levels will require investments in infrastructure. One investment that would facilitate expansion of the ethanol market in Indiana would be additional outlets for E85 fuel. Some other states provide tax credits or other incentives to gasoline stations that add E85 capacity. This approach could be considered in Indiana.

- The State of Indiana could consider tax incentives for early investors in commercial scale cellulose biofuels plants if it wants to attract the industry to Indiana.

- For both corn and cellulose ethanol, investments in ethanol transportation infrastructure could be considered.

For renewable electricity generation, the most popular incentive is a renewable energy standard. This incentive guarantees a market to investors in renewable electricity production. Because the states in the Northeast have limited opportunities for renewable electricity generation, yet many have renewable energy standards, Indiana is well positioned to serve this market.

Indiana's Hardwood Industry – Retaining Market Share

Rado Gazo, Professor and William L. Hoover, Professor, both in the Department of Forestry and Natural Resources

Good markets for Indiana's high-quality hardwood timber will remain a significant source of periodic income. Globalization, however, is driving a major restructuring of the domestic markets for hardwood products. As a result, deflated average prices for timber have been below the long-term upward trend line for the last several years. Increasing the productivity of timber stands through timber stand improvement practices can make up for part of the decline, but differentiation of Indiana hardwood products by quality, service, and product mix activities is need to retain domestic and overseas market share. Differentiation through green certification would provide immediate market leverage in the primary sector – lumber and veneer. Mass customization – providing consumers with tailored furniture and fixtures with a one to two week turnaround, unachievable by Asia producers – would recapture domestic market share from Asian manufacturers.

Impact of Globalization

The hardwood industry has faced competition from Asian furniture manufacturers and raw material suppliers since the early 1990's. The industry responded by closing inefficient operations and increasing productivity at those remaining. Decreased demand reduced timber harvests and most prices. Demand for green certified wood products has increased; however, Indiana's industry has lagged in recognizing this opportunity.

Next 2-3 Years

The market for green certified primary and secondary hardwood products will continue to expand. Servicing it requires certification of Indiana's forests and of the chain-of-custody from the forest to final consumer products. There is also a growing market for wood

products acceptable under U. S. Green Building Council's LEED standards. Improved efficiency in the primary sector will be driven by increased log conversion efficiency. Logs are the largest cost factor for both lumber and veneer. This will be achieved by increased log sorting and merchandising based in part on x-ray scanning for internal defects.

Policy Options

Indiana's hardwood industry will remain competitive if it has the information and portfolio of resources needed to adapt. ISDA, in partnership with the Indiana Hardwood Lumbermen's Association, Forest Industry Council, Purdue University, IDNR Division of Forestry, and other stakeholders, make needed information available. Strategic planning should be conducted to structure primary and secondary sector markets to maximize value added as competition increases for wood raw materials for biofuels and traditional end uses. On-going market development programs should be continued.

Timber production – The policy focus should be on meeting landowners on their terms with the information needed for them to balance their values with those of society at large and the wood products industry. Owners of tract of 10 acres or more who are interested in timber production must come to grips with green certification.

Timber and log procurement - Although owners selling with the assistance of a professional forester receive a higher price than those taking the price offered by a first-offer single buyer, the viability of the industry is determined by the average cost of timber and logs for individual firms. Loggers and mills are caught between a highly elastic lumber market and an inelastic timber and log markets. The resulting cost squeeze is a significant factor in the downsizing of the industry. Policy options must be explored that increase the use of professional foresters in the management and marketing of timber and keep timber and logs affordable. Opportunities to reduce the high overhead cost of timber procurement should be investigated.

Harvesting – Loggers must become more sophisticated to remain profitable. However, there will continue to be a role for undercapitalized operators who enter and exit the industry based on other employment opportunities. Higher unit costs result from harvesting ever smaller tracts and having to merchandize to a larger variety of log buyers. Increased costs will also result from chain-of-custody certification that requires BMP training and continuous documentation of operations. Except in areas of the state dominated by flat-woods, the logging operations have not fundamentally changed since the introduction of rubber-tired skidders. Trees continued to be felled and bucked by on-the-ground chain saw cutters subject to risks not incurred by operators in the cabs of modern automated logging equipment. Opportunities for use of modern equipment should be explored.

Lumber industry – Increased automation is required to reduce labor and raw material costs. This generally means increasing mill capacity; however, there will continue to be role for small capacity mills located close to the source of logs and shipping mill-run green lumber to concentration yards.

Veneer industry – Mills have adjusted to export demand by changing slicing, trimming, and packaging practices; however, additional adjustments may be needed, including slicing thinner. Most important, they must have access to certified logs and receive chain of custody certification to retain existing markets that now require certified products.

Wood residue utilization – Value-added opportunities for wood byproducts can be supported -- direct conversion to energy, cellulosic ethanol, landscaping products, and other uses -- without competing for future supplies of high quality by utilization of harvesting residues. There is a need to match by-product sources and processors with competitive hauling cost. There is also a need to provide the information necessary to source raw material directly from natural stands and plantations while maintaining balance with quality timber management practices. Logging equipment to harvest timber as a biofuels source should be explored.

Specific Options

Timber - (1) Support IDNR Division of Forestry's effort to increase the acreage of FSC-certified private forest land using group certification. Promote certification on other private lands with cost share payments for acreages above a specified minimum. (2) Facilitate markets that provide payments for environmental services from forest land. (3) Promote green building standards to increase demand for locally grown wood products. (4) Promote the development and manufacture of certified dimension lumber for local markets. (5) Broaden the definition of "agriculture" for property tax assessment purposes to reflect multiple use management of forest land. (6) Promote the use of professional forestry assistance. (7) Explore alternatives to reduce the overhead cost of timber and log procurement.

Logging - (1) Facilitate training for loggers in BMP's and chain of custody certification. (2) Investigate the potential for increased mechanization of logging. (3) Investigate tree-length logging with bucking at concentration yards to achieve economies of scale required for log

scanning, biofuels, and unitized shipments of logs sorted by end use.

Lumber - (1) Investigate ways to assist firms to become more efficient in sourcing, processing, and targeting market niches, including certified markets. (2) Promote chain of custody certification for mills producing grade lumber and certified hardwood dimension lumber. (3) Seek opportunities for firms to partner in raw material procurement and other mutually beneficial ways while maintaining legal autonomy. (4) Expand the existing branding program to include certification logos for qualifying firms.

Veneer - (1) Promote chain of custody certification. (2) Encourage firms to participate in the Indiana certified branding program, and incorporate certification logos for qualified firms.

Furniture and fixtures - (1) Facilitate the adoption of mass customization for firms of all capacities. (2) Promote chain of custody certification.

Trends in Indiana Specialty Agriculture

Maria Marshall, Assistant Professor; Corrine Alexander, Assistant Professor; Jennifer Dennis, Assistant Professor; Roberto Lopez, Assistant Professor and Floriculture Extension Specialist, Department of Horticulture and Landscape Architecture and Kwamena Quagrainie, Aquaculture Marketing Specialist

Agriculture is undergoing a transition in the types of crops produced and the types of people who are farming. According to the Indiana Agricultural Statistic Service, the number of Indiana farms has decreased by 10 percent in the last five years, resulting in a decrease of over 400,000 acres in farmland. Despite this decrease in total farms, small farms (10 to 49 acres) have increased steadily (National Agricultural Statistics). Indiana has 44,990 small farms (defined as operations with less than $50,000 in gross sales), and these small farms account for approximately 75 percent of total farms in Indiana (National Agricultural Statistics Service).

Many of the farms dedicated to specialty agriculture production are small. Specialty crop and animal production in Indiana is very diverse. Specialty crops range from tomatoes and apples to floriculture and organic agronomic crops. Specialty animal production ranges from goats to aquaculture.

Fruit and Vegetable Production

Indiana's specialty crop production varies from small farms to larger, more commercial farms. Distribution methods range from retail (for fresh market) to wholesale (fresh market and processing). It is well known that Indiana ranks among the top five in the production of tomatoes, watermelons, and cantaloupe; however, Indiana has a rich history of producing specialty crops. Indiana is home to a productive tomato, snap bean, and cucumber processing industry. However, production decreased from 2004 to 2005. Most of the fruit production such as apples, watermelons, and cantaloupe in Indiana is targeted for the fresh market. Indiana's apple production in 2005 was down 17 percent from 2004. Meanwhile, blueberry and watermelon production both increased 13 percent from 2004 to 2005.

Organic Agriculture

Organics is one of the fastest growing food sectors, at 21 percent growth between 2005 and 2006. The fastest growing organic categories between 2005 and 2006 are meat, at 29 percent; dairy at 25 percent; fruits and vegetables at 24 percent; and bread and grains, at 23 percent. Because of the substantial growth in consumer demand for organics, there are opportunities for Indiana farmers.

As of 2005, Indiana had 43 certified organic operations and 5,156 acres of certified organic cropland and pasture (ERS, 2005). In addition, Indiana had 180,300 certified organic layer hens, 167 beef cows, 237 milk cows, 70 other cows, and 2,000 hogs. Organic production has been increasing in Indiana since 2005 and is expected to continue to increase. There is substantial room for growth in organic field crop acreage and organic livestock in Indiana and in and the Corn Belt overall. In 2005, the Corn Belt had less than half of the US supply of organic livestock but roughly 80 percent of the US supply of organic corn and soybean acreage. The Corn Belt has a clear advantage in producing organic livestock and poultry relative to the rest of the US because of its substantial feed base. Going forward, the biggest challenge in the region will be to match the growth in production of organic feed to the growth in production of organic livestock.

Floriculture Production

Indiana ranks twenty-third among states in floriculture production, with more than 260 commercial greenhouse growers, with a wholesale value conservatively estimated

at $60 million. (USDA, 2006). In 2005, the wholesale value of herbaceous perennials, bedding, propagative, potted, and foliage plants grown in Indiana was $9.0, 31.2, 3.1, 5.8 and 1.3 million, respectively. The future of commercial greenhouse operations in Indiana is dependent on immigration reform and energy costs. Today, energy accounts for 50 to 85 percent of the total operating costs of greenhouses. The cost to heat and light a greenhouse has increased in the past decade because the cost of fuel (e.g., natural gas and heating oil) has nearly doubled. One reason for Indiana's lack of prominence in the floriculture industry compared to surrounding states is that its growers have not had access to production and marketing information to grow new, alternative, more profitable specialty crops to replace ones that have become marginally profitable.

The Green Industry

The Indiana Green industry is an important part of the state's agricultural sector. The "Green Industry" consists of wholesale, nursery, and sod growers; landscape architects; designers and builders; contractors and maintenance firms; retail garden centers; home centers and mass merchandisers with lawn and garden departments; and marketing intermediaries such as brokers and horticultural distribution centers, known as "re-wholesalers". According to the National Green Industry Survey, the output impact of the Indiana green industry was $3.01 billion for all sectors combined, based on 2002 data that is expressed in 2004 dollars. The horticultural service sector accounts for $1.44 billion of Indiana's Green Industry, and the trade sector accounts for the other $1.34 billion in sales. The landscaping services sector is the leader in value-added impact for Indiana, with an impact of $746 million, followed by the lawn and garden sector, at $412 million and then by the nursery & greenhouse sector, at $156 million. Indiana's green industry ranks 7th amongst Midwestern states for economic impact and 5th for employment impact.

Aquaculture Industry

The aquaculture industry in the state is growing, with an estimated total product value of $3.1 million, though it accounts for only 0.3% of the $1.1 billion US aquaculture industry (USDA-NASS, 2003, 2006). The 2005 Census of Aquaculture indicated 18 Indiana aquaculture farms. Indiana's aquaculture industry represents the diversity present in today's aquaculture economy.

Fish are grown for human consumption, recreational fishing, and ornamental display. Martinsville, Indiana is home to one of the largest ornamental fish (goldfish) farms in the US. A number of food fish production facilities, mainly largemouth bass, hybrid striped bass, yellow perch, and tilapia, as well as crustaceans (e.g., freshwater prawn), have been established in the state in recent years, increasing the production capacity of Indiana's aquaculture industry. In 2007, Bell Aquaculture began operation in Albany, Indiana as the largest yellow perch operation in the US.

Implications

Even though producers have been successful at marketing their products, there is room to help them improve production systems and business management strategies, especially marketing. Marketing and financial risks are two of the biggest concerns for small-scale producers. Although some producers sell directly, identifying markets and understanding pricing and costs of production relative to calculating a break-even point can be challenging. Producers often do not have the knowledge and skills to identify new opportunities provided by export markets and new production practices and threats from new competitors or government regulation. It is imperative that producers learn how to effectively manage opportunities and threats to increase their profitability. Research and educational programs that address the problems faced by the specialty agriculture industries in Indiana are limited. Specialty agriculture producers would benefit from applied research and Extension programming in sustainable production practices and market development.

References

Economic Research Service (ERS), United States Department of Agriculture. 2005. "Data Sets." http://www.ers.usda.gov/Data/organic/index.htm#tables.

Energy Information Administration (EIA). 2000. Historical natural gas annual 1930 through 2000. Washington, D.C. p. 331.

Energy Information Administration (EIA). 2008. Natural gas monthly February 2008. Washington, D.C. p. 55.

Organic Trade Association (OTA). 2008. "2007 OTA Manufacturer Survey Overview." http://www.ota.com/pics/documents/2007ExecutiveSummary.pdf.

United States Dept. of Agriculture (USDA). 2006a. Floriculture crops 2005 summary.

USDA-NASS. 2003. "2002 Census of Agriculture - Ranking of 2002 Market Value of Agricultural Products Sold." Available at: http://www.nass.usda.gov/census/census02/topcommodities/topcom_IN.htm.

USDA-NASS. 2006. "2005 Census of Aquaculture." Available at: http://www.nass.usda.gov/Census_of_Agriculture/2002/Aquaculture/index.asp.

USDA-NASS.2006. Available at: http://usda.mannlib.cornell.edu/usda/current/FlorCrop/FlorCrop-04-26-2006.pdf.

USDA-NASS. 2006. *Indiana Agricultural Report*. Available at: http://www.nass.usda.gov/Statistics_by_State/Indiana/Publications/Ag_Report/2006/agr060220.pdf.

US Department of Commerce, National Marine Fisheries Service, USDOC-NMFS. 2007. "Fisheries of the United States - 2006." Available at: http://www.st.nmfs.noaa.gov/st1/fus/fus06/index.html.

COLLEGE OF AGRICULTURE *Department of Agricultural Economics* PURDUE UNIVERSITY

Contributors to this issue from the Department of Agricultural Economics:


Corinne Alexander
Assistant Professor


Michael Boehlje
Distinguished
Professor


John Connor
Professor


Jennifer Dennis
Assistant Professor


Craig Dobbins
Professor


Otto Doering
Professor


Frank Dooley
Professor
and Teaching
Coordinator


Ken Foster
Professor


Allan Gray
Professor


Chris Hurt
Professor


Maria Marshall
Assistant Professor


Paul Preckel
Professor and
Faculty Director
of the State Utility
Forecasting Group


Kwamena Quagrainie
Aquaculture
Marketing
Specialist


Sally Thompson
Professor and
Department Head


Wallace Tyner
Professor

Department of Animal Sciences


Brian Richert
Associate Professor

Department of Forestry and Natural Resources


Rado Gazo
Professor


William L Hoover
Professor

Department of Horticulture and Landscape Architecture


Roberto Lopez
Assistant Professor
and Floriculture
Extension Specialist