Indiana Agriculture: The Long View

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The overarching goal of this series of white papers is to assist the Indiana State Department of Agriculture in identifying the opportunities for profitable growth in Indiana agriculture and forest products and the factors that will influence those opportunities. The series consists of six papers plus this introductory paper. The six papers address the following topics:

- Indiana Food Processing and Value Added Activities
- Indiana Livestock Sector
- Indiana Crop Production Sector
- Biofuels/Energy Sector
- Hardwoods
- Specialty Crops Sector

The purpose of this introductory paper is to outline the key factors or drivers that will influence the future opportunities for Indiana agriculture. In addition, this paper makes suggestions for how ISDA and Purdue's Agricultural Economics Department may work together to develop an analytical approach needed to better inform future policy directions and implications for the Indiana agricultural sector.

Key Forces Influencing the Opportunities for Indiana Agriculture

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

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

We will address each of these broad forces of change in turn.

The Intersection of Agriculture, Food and Energy Policy

While national policy has always had an important impact on agriculture, the impacts of 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 the whitepaper on 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.

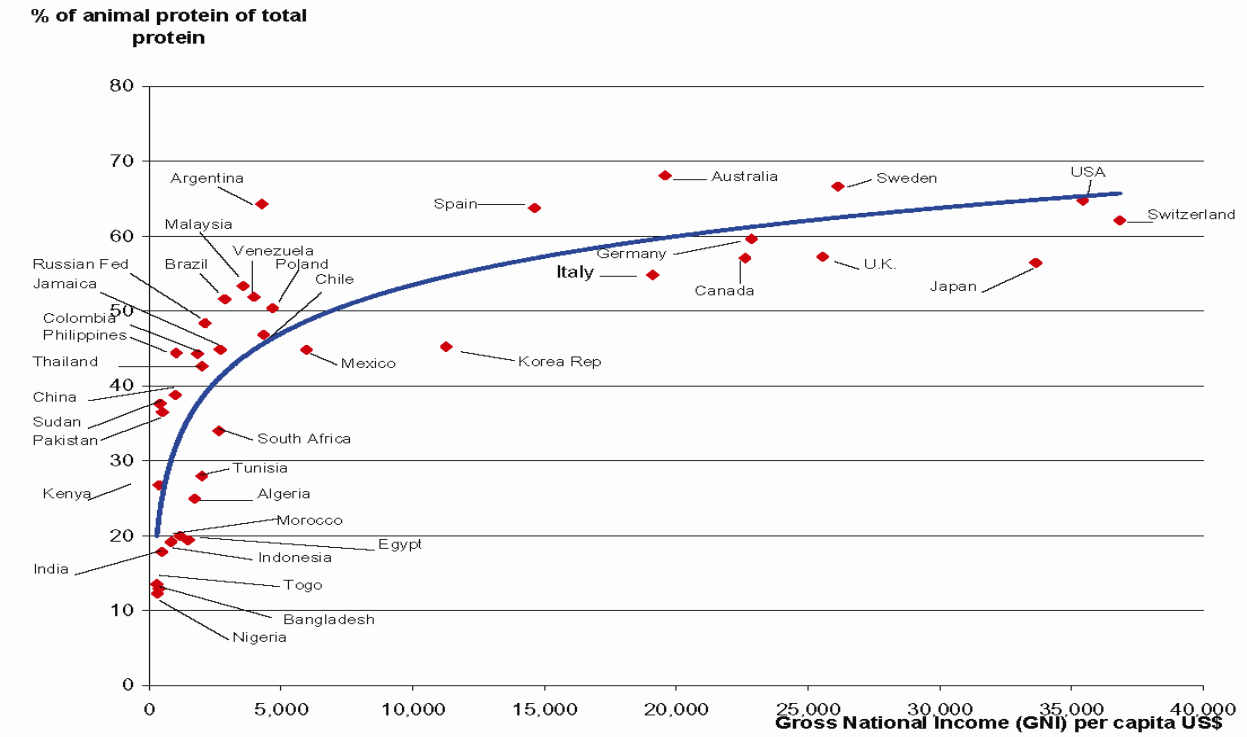
However, the pressure placed on supplies of feed grains to meet the growing biofuels demand, the export demand, and livestock demand is creating stress. Livestock producers, particularly pork and poultry, are under severe pressure with feed costs increasing dramatically. We could see more consolidation 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, and allow 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 impact consumers as well.

Thus, this intersection of energy, agriculture, and food policy leads to several questions. Will Congress face increasing pressure in the future to change its course on energy policy from livestock producers and consumers? Will there be increasing pressure to change course on agricultural policy 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 are the impacts of second-generation biofuel technologies on resources other than corn such as grasses or woods?

The Global Influence of Demand and Supply for Agricultural Products

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 protein based 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 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 countries other than the U.S.?

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



Source: Based on data through 2002 from FAO and World Bank.

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 the 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 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 more cost effectively expanded 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.

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 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.

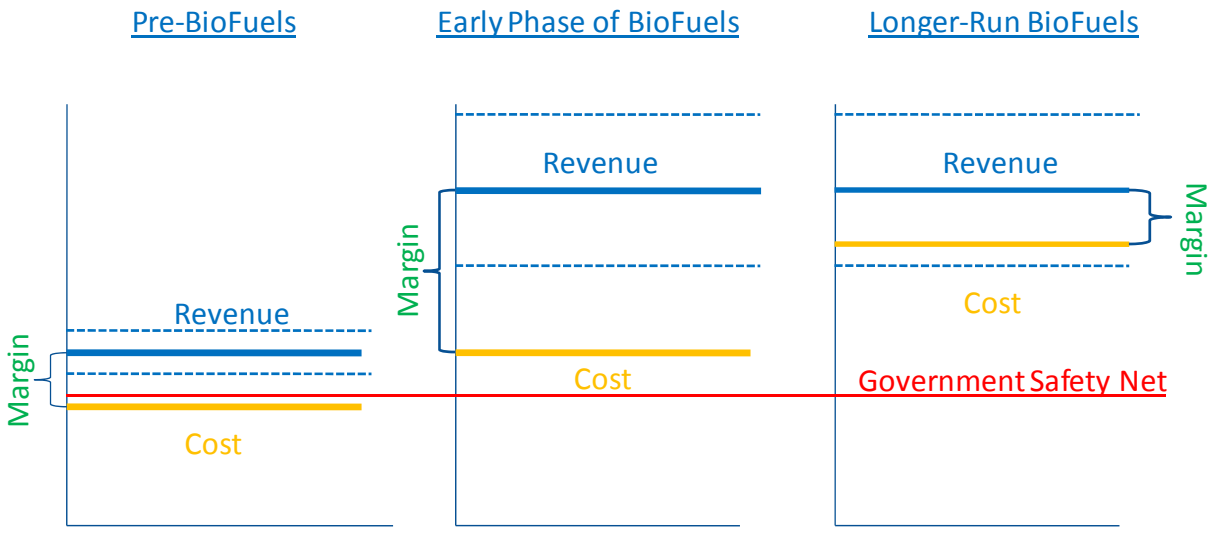
The Resurgence of Risk in Agriculture

The business climate and financial outlook for crop agriculture is 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% to 25% this year. Thus, while crop prices are very high, the rapid increase in costs of production and land are 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.

Figure 2 illustrates the impact of the structural shift taking place in crop agriculture and the impact it can have on the risk in producer margins. In the pre-biofuels era, revenues tended to fluctuate within a fairly narrow band (the dotted lines around the revenue line) as crop prices were relatively low and government programs were in place to help stabilize prices. The costs of production in the pre-biofuels era were low enough that producers faced little risk of experiencing negative margins (variable costs exceeded revenue not necessarily full costs exceeding revenue). In the early phases of the biofuels era, producers have experienced rapid increases in revenue and substantial increases in volatility of that revenue due to low stocks and the ineffectiveness of government safety nets at high crop price levels. The longer-run biofuels market may maintain these higher crop prices and increased volatility, but costs may continue to rise such that average margins are similar to the average margins pre-biofuels. However, with no

effective government safety net and continued volatility in crop prices, the increase in margin volatility could be substantial, resulting in periods of substantial hardships in the crop sector and consolidations.

Figure 2. Depiction of the Potential Structural Change in Crop Markets due to Biofuels



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 the overall U.S. economy, relationships (community, neighbor, supplier, and buyer) and environmental risks 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 versus 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

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 in the Western U.S. it will continue to be an increasingly important factor even in Indiana. The other critical resource is clean air. Increasing efforts to conduct research are noticeable to better understand 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) how much management, technology and/or regulation 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 Agriculture in Innovation

The rapidly expanding understanding of the science of biology and the application of this science through biotechnology has the potential to redefine the role of agriculture for two fundamental reasons. First, biology and biotechnology replaces and/or complements chemistry and the mechanical sciences as the fundamental science base for new technological and productivity advances. Much 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 for Indiana are: (1) how quickly will biological breakthroughs come to fruition that dramatically impact the yield of crops (particularly 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?

Managing the Uncertainties of the Future of the Agricultural Industry: An Analytical Approach

In the six white papers that follow, many of the themes discussed are driven by the factors outlined here. The important thing to keep in mind is that many of those themes are based on assumptions that, while logical, are nonetheless uncertain. We do not, in these papers, profess to know what the future holds for agriculture in Indiana. We do, however, believe that we have a good understanding of the factors that will shape Indiana agriculture, whatever direction those factors may take. We argue that the uncertainties about the future of agriculture deserve a careful and analytical approach to the evaluation and pursuit of potential future opportunities. Thus, we propose that the Indiana State Department of Agriculture carefully consider a partnership with the Department of Agricultural Economics at Purdue University to develop the analytical capability needed to assess alternative market, technology, and policy scenarios to evaluate and anticipate future opportunities and outcomes. The partnership will also include outreach mechanisms to deliver the key findings of ongoing analyses. The section that follows outlines the Department of Agricultural Economics' proposal for this partnership.

Modeling the Indiana Agricultural Sector

We propose to develop a multiregional model of the Indiana agricultural sector that will allow us to evaluate how changes in prices for agricultural outputs and inputs, technology, policy, and general economic conditions affect the crops, livestock, and forestry sectors in different geographic regions in Indiana. We would like to partner with ISDA in the development and support of this effort for mutual benefit. The Center for Global Trade Analysis in the Department of Agricultural Economics at Purdue University is a recognized world leader in Computable General Equilibrium (CGE) modeling. In this project, we will leverage this expertise, through a dedicated post-doctoral fellow, in order to build a multiregional Indiana-CGE model with a strong focus on the agriculture, energy and food sectors. Of particular interest is the interplay between agriculture and non-agriculture through the markets for labor and land. In light of the fact that Indiana farm households earn the majority of their household income from off-farm activities, understanding the labor market linkages is critical for assessing the impact of state and national policies on farm household well-being. Given the increasing demand for land in bioenergy production as well as commercial and residential development, competition between the farm and nonfarm sectors for land is key. Through this approach, we will be able to evaluate land and labor use in different crop, livestock, and forestry subsectors, in a multiregional setting that allows for spatial interactions between urban and rural areas.

The expertise provided in CGE modeling will be augmented with departmental expertise in IMPLAN (Impact Analysis for Planning) modeling that allows estimation of local economic impacts, along with expertise in spatial economics and quantitative methods. State models have been developed for other states in the U.S., including Ohio and Oklahoma. Some of these models rely heavily on information about interregional input-output linkages; others have put more emphasis on the impact of agglomeration economies and transportation cost. CGE models have been used to address a wide variety of policy issues, such as the impacts of tourism on a city, the regional incidence of national and state taxation, or rural development policy. These models are useful to understand and anticipate the impacts of changes in policy, technology, infrastructure, and market price relationships on the state agricultural economy, especially to the extent that they can be designed in a multiregional setting for relatively small areas, allowing for commuting and migration behavior of the population to affect labor supply in the agricultural and other sectors of the Indiana state economy.

Our modeling efforts will allow us to address important issues facing Indiana agriculture and evaluate economic and environmental impacts in a consistent and formally structured manner. We will be able to assess the key factors and changes in those factors that influence economic and environmental outcomes. Issues that may be addressed include:

- Land use and land value changes; environmental implications
- Farm income projections
- Alternative market, production cost, and policy scenarios and implications
- Technology scenarios: biofuels and animal systems
- Infrastructure needs and constraints

There will be several benefits to the development and implementation of the model. One of the most compelling will be the ability to address emerging issues facing the Indiana agricultural economy on an ongoing basis with a common database and modeling approach allowing for consistency and comparability of analyses across time—we will reduce the "apples and oranges" problem common in *ad hoc* analytical approaches. We will also be using a general equilibrium framework, rather than a partial equilibrium approach, thereby allowing a more thorough assessment of the interaction and feedback of factors that influence the agricultural economy. The multiregional setup will allow us to account for spatial variation in interaction and feedback processes, which can be fruitfully used to assess the implications of differences in urban/rural responses to structural changes and different policy scenarios.

Another outcome of our modeling efforts will be the ability to evaluate on a regional and local level what types of agricultural and forestry enterprises as well as agricultural and forestry value-added activities are best or better economic development strategies, and what factors most affect the economic implications of alternative development strategies. We will also be able to assess potential environmental implications of alternative enterprises or development strategies. This information should help guide agricultural policy for the State.

The modeling effort will provide an integrated analytical framework and foundation for economic and market information for Indiana producers, agribusinesses, processors, and policy makers. We will collaborate with ISDA and Purdue Extension in disseminating model results

and implications. Possibilities for outreach strategies might include regional seminars within our existing annual Extension outlook program, and/or an annual ISDA supported Indiana outlook conference modeled after the USDA outlook conference.

The model will not be built over night, and in fact, should always be in a state of building, refinement, and renewal. There will be extensive data needs for the project that will require ongoing "care and feeding." We propose to initiate a pilot project in the next few months to develop a simple prototype for the model with the goal to present it to potential users and collaborators in early 2009 for review and approval of future development and funding. We would welcome the participation of representatives of ISDA in model development as well as a seed grant for prototype model development.