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Agricultural Value Added:

Prospects for North Dakota

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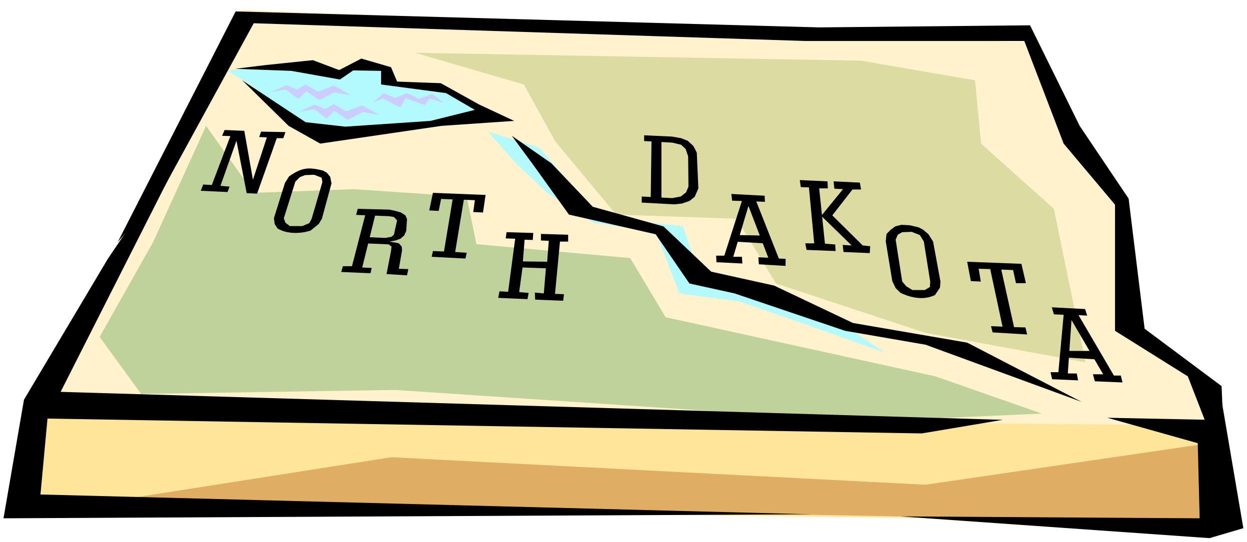

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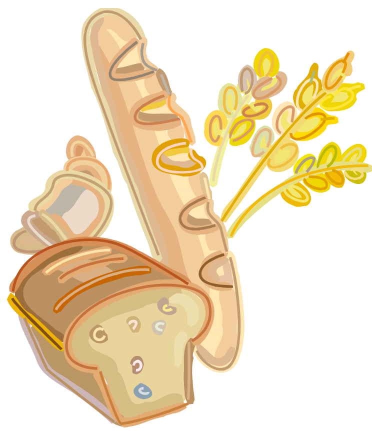
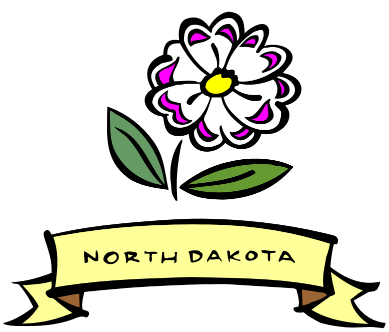
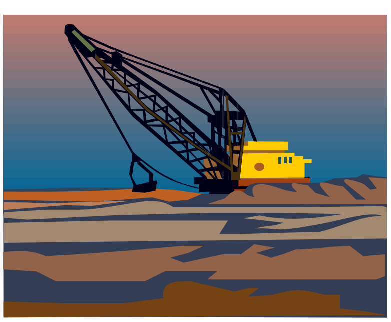
Introduction

This report provides an overview of the important factors affecting investments in agricultural value-added ventures. The introductory section outlines current research on factors important in the location of economic activity. Research applied to specific agricultural value-added ventures, such as food manufacturing and livestock feeding and finishing operations, are discussed. A listing of resources available to entrepreneurs considering value-added investments concludes the introductory section. Following the introductory section are short overviews of industries that already have, or may have, potential for increasing economic activity in the state. All are based on the important foundation of agriculture in the state's economy or upon the natural resource base giving the state a comparative advantage in investments in alternative energy or resource-based recreation.







An Overview of Agricultural Value Added

David K. Lambert, Siew Hoon Lim, and Kathleen Tweeten

Introduction

Farmers and policymakers throughout the United States are seeking to extract more local value from both agricultural products and from land, capital, and people located in rural areas. New ventures include ethanol, biodiesel, and other biobased product plants, animal feeding and processing plants, and increasing production of organic, functional, and other foods designed for niche markets. The impetus behind the quest for increasing added value is to increase state, and especially rural, incomes and to increase employment and investment opportunities in rural areas.

Value-added efforts can be successful. Investments in new products and processes, innovative marketing, and increasing the variety of products from agricultural lands can yield positive returns. Positive examples in North Dakota and Minnesota include refining facilities for sugar beets, confection sunflowers, oilseeds, malting barley, and a variety of other locally produced agricultural commodities. However, ill-conceived ventures that ignore basic economic concepts such as scale economies, location effects, comparative advantage, capital needs, and production efficiency can and do generate losses for unwary investors.

Value-added policies can focus on large-scale investments in new or expanded plants or processes. Ethanol plants, large feedlots, and research, development, and commercialization of new products from agricultural byproducts are examples. State efforts may also be directed towards encouraging expanding value-added activities by individuals. Smaller scale operations, accessible to individual entrepreneurs with limited resources, include resource-based recreation, identity-preserved marketing of a farm's products for niche markets, or packaging and sales of products for final markets (e.g., jams, salsa).

Investors must understand the markets they are entering. All investors must know current players in the market, including the production, marketing, managerial, supply chain, and other characteristics of the dominant firms in the industry. Investors in smaller entrepreneurial activities should also understand all relevant markets, but must also anticipate the managerial skills and the need for additional assets to successfully launch a new enterprise.

To promote agricultural value-added ventures, universities and government agencies offer many forms of direct assistance. In 1998-1999, a total of $280 million of state money was budgeted for value-added agriculture across all 50 states (Kilkenny and Schluter 2001). Every state provides at least one agricultural value-added program. Thirty-seven states provide financial assistance programs for value-added agriculture, with North Dakota being the first to provide such assistance in 1919. All but two states provided promotional programs for state-grown products in 1998-1999. Kilkenny and Schluter identified a total of 304 value-added agriculture programs. Programs include promotion and state labeling, business and technical assistance, loans and grants, directories, market research, jobs and training, and assistance on legal issues. In addition, two Canadian provinces provide comparable assistance programs for value-added agriculture (Bills and Scherer 2001). A new program, Innovate North Dakota (http://www.innovatend.com/), has just been started in North Dakota to provide business advice and to help find financing to begin new value-added ventures. A listing of available resources concludes this section of the value-added overview.

Based perhaps on their historical mission, land grant universities have become active in promoting value-added ventures within their state. The Center for Community Vitality at North Dakota State University (NDSU), for example, provides a broad range of training and analytical support to communities and to individual entrepreneurs considering starting or expanding value-added enterprises (http://www.ag.ndsu.edu/ccv/). Many regional universities, including NDSU, the Universities of Minnesota and Wisconsin, and Kansas State and Oklahoma State Universities, all have Centers for Cooperatives, designed to help groups and individuals wishing to investigate the cooperative model of structure for agricultural value-added ventures. More focused centers, such as the Center for Biorefining at the University of Minnesota, provide technical and economic support for specialized ventures.

The purpose of this report is to provide an overview of the economic factors behind successful value-added ventures. We first define agricultural value added. Next, the importance of efficiency in increasing value added is discussed. Whether expanding from an existing enterprise or starting a new business, efficient use of resources and production of the optimal mix of products is essential to company success. Finally, the importance of location in starting an enterprise is discussed. Some industries are best situated near large markets; some industries thrive scattered about the hinterlands.

The report concludes with several potential value-added ventures proposed by faculty in the Department of Agribusiness and Applied Economics that may lead to successful enterprises for North Dakota investors. Although not a complete listing of all potential areas for profitable value-added ventures, opportunities may exist in bioenergy and biobased products, organic production, wind energy, and strengthening the state's natural resource-based tourism industry.

What is Value-Added Agriculture?

Value added is the difference between the value of goods or services produced and the cost of the inputs used in their provision (BEA). Value added is the company's or industry's gross receipts, including receipts and other income, commodity taxes, and inventory changes, minus expenditures for goods and services purchased from other firms. Total value added for a firm is distributed among employee compensation, interest, and capital depreciation, and rents, taxes, and profits. In other words, value added and profits are not the same thing.

Table 1 presents an example of value added for the U.S. industrial sector, "Food, Beverage, and Tobacco Products." Gross value of output was about $627 billion in 2004. Approximately 73 percent of this gross output, or $459 billion, was used to purchase intermediate inputs from other firms, such as grains, slaughter animals, and other inputs having a farm origin, marketing and transportation services, energy, and other purchased goods and services required to produce food, beverage, and tobacco products. The difference, or about

$168 billion, equals value added for this sector. Of this total, 48 percent covered employee costs, 12 percent went to taxes, and 40 percent covered rents, capital costs, and profits (termed "gross operating surplus").

Table 1. Food, Beverage, and Tobacco Products Value Added, 2004

Category	Dollar Value (Millions of Dollars)
Gross Output	$626,973
Less Cost of Intermediate Inputs	$459,032
Equals Value Added	$167,941
Distributed Among:	
Employee Compensation	$81,398
Taxes on Production and Imports	$19,466
Gross Operating Surplus	$67,076

Those considering a value-added proposal must project expected gross receipts and subtract the cost of intermediate inputs, including both purchased and the opportunity, or transfer, costs of inputs having a farm origin. The investor must determine if the resulting expected value added is sufficient to cover employee compensation, taxes, and capital costs. The investor must then determine if the remainder, or profit, compares favorably with other opportunities for the entrepreneur's investment of time and money.

It is important to note that value added can be negative. For example, purchasing a feeder animal for $800, paying $200 for feed and other intermediate inputs, and selling the animal for $1,000 generates no added value. The gross value of output of $1,000 is exactly offset by the $1,000 in intermediate costs incurred in the purchase and feeding of the animal. In fact, since no value is added in this example, there would be a loss to the investor since value added must cover employee, capital, managerial, and other costs.

North Dakota is a major agricultural state. Consequently, local investors and policymakers are interested in agricultural value-added ventures. The Agricultural Marketing Resource Center (AMRC) defines agricultural value added as:

- Changes in the physical state or form of an agricultural product. Examples include milling wheat into flour, corn into ethanol, canola into biodiesel, and wheat straw into nanowhiskers;
- Changes in the production process that enhance the value of the final product (the AMRC identifies organic products in this category); and
- Through physical segregation, marketing a product based on its unique characteristics (for example, marketing food quality soybeans through an identity preserved marketing system).

Investors should obviously concentrate on activities that generate positive value added, including consideration of the intrafirm transfer costs of products or resources being transformed, enhanced, and/or segregated. In addition to transfer cost, investors should also assess changes in the risk profile because of new value-added activities. Cost and return estimates from a value-added activity may show an increase in expected profits over current practices. However, the new activity may have much greater risk, including a higher probability of net returns falling below debt-servicing requirements or coverage of other fixed costs. No value-added enterprise should be adopted without first fully considering the investment's risk.

Increasing Agricultural Value Added

There are two ways to increase value added: (1) increasing the efficiency of production, thereby widening the margin between gross output value and the cost of intermediate inputs; or (2) changing the form, function, quantity, or other product or process characteristics that increases the margin between gross output value and intermediate input cost.

Efficiency Improvements

Efficiency can be separated into technical, allocative, or scale efficiencies. Technical efficiency compares a firm's ability to utilize labor, land, intermediate inputs, and capital to similar firms. If one firm can produce five widgets and another firm can produce ten widgets with the same amount of inputs, the first firm is considered only half as (technically) efficient as the second. Prices play no role in technical efficiency.

Prices are important in a firm's allocative efficiency, however. Allocative efficiency compares input and output choices of firms based on prices. For example, if two firms both produce ten widgets, but one firm's costs are $10 while the other firm incurs $5 in costs due to using a different mix of inputs or finding a cheaper source of supply, the higher cost firm is said to be (allocatively) inefficient. Alternatively, if a firm could increase its revenues by producing eight bushels of wheat and two bushels of corn instead of two bushels of wheat and eight bushels of corn, without changing costs, the firm would be allocatively inefficient due to its choice of outputs. In both cases, both firms might be technically efficient in terms of converting inputs to outputs.

Finally, scale efficiency refers to the overall size of a firm's operations. Depending upon production practices, a firm might face increasing, decreasing, or constant returns to scale. Under increasing returns, for example, the per unit cost of production might fall if the plant were to increase in size. Increasing returns are mentioned as a leading engine of economic growth observed in many industrial sectors (Warsh 2006).

Numerous studies have compared the technical, allocative, and scale efficiencies of firms within various industrial sectors. Applications to agriculture and farms include Lambert and Parker (1998); Chavas and Aliber (1993); Featherstone, Langemeier and Ismet (1997); Tauer (1998); Paul, Nehring, and Banker (2004); Paul, Nehring, Banker, and Somwura (2004); Epstein (2003); Haghiri and Simchi (2003); Lambert and Bayda (2005); Mulik, Taylor, and Koo (2005); Kompas and Che (2006); and Zofio and Lovell (2001). These applications have compared individual farms and ranches, as well as the efficiency of agricultural production among different states and countries.

Similar studies have assessed efficiency in food manufacturing (Kerkvliet et al.1998; Lopez and Liron-Espana 2003; Chaaban, Requillart, and Trevisiol 2005), banking and finance (Paxton 2006; Oliveira and Tabak 2005; Manole and Grigorian 2002), and intermodal transportation and logistics systems (Cullinane, Song, and Wang 2005; Cullinane, Ji, and Tengfri 2005; Talluri, Narasimhan, and Nair 2006). All of these studies conclude that not all firms are efficient. When firms are inefficient in the production of their core products, increasing value added can result from pinpointing and correcting the sources of the inefficiencies.

Two points are important in considering efficiency. First, the individual entrepreneur might best increase value added by improving the technical, allocative, and/or scale efficiency of their core business. Second, when considering expanding into new value-added ventures, proposed business plans should be compared with existing firms in the industry. If the proposed development fails to achieve industry norms for technical, scale, or allocative efficiency, plans should be redrawn, reconsidered, or scrapped.

New Products, New Markets, New Ventures

Most agricultural value-added discussions focus on changes in the form of primary agricultural products, changes in the production process, or changes in marketing strategies. The single assumption underlying these efforts is that there are unexploited profits going unclaimed in the manufacture of food, fiber, industrial, or other products from raw agricultural outputs. To paraphrase the authors of a Cornell University study on agricultural value added (Streeter and Bills, 2003), all farmers need to do is to become more entrepreneurial, perhaps by focusing on niche markets or developing new uses for their products, and then the “small farm income problem” would vanish (p. 3). Before betting the family farm on a new venture, however, several fundamentals underlying entrepreneurial success should be understood.

First, a common argument is that profits earned in downstream manufacturers are largely due to the market power exercised by the large processors that dominate these downstream markets. Because of economies of scale in food manufacturing, for example, firms are large and there are, consequently, fewer buyers of agricultural raw products. Evidence does indicate that economies of scale do exist in food manufacturing (Morrison and Siegel 1998). In many cases, it does cost large plants less money per unit to produce a product than in a small plant. Since there are fewer buyers of farmers’ products, the argument continues, they are able to dictate prices for corn, soybeans, feeder calves, and other farm products. The argument concludes that, if farmers only invested in additional processing activities for their products, they could bypass the monopoly power of large agribusiness firms and thus retain more of the value of the raw agricultural product by selling directly into the wholesale or retail markets.

This strategy might be successful if new ventures can deliver either a new product filling a niche market, or if the venture allows an entrepreneur to bring a product to market at a lower cost than existing firms. Cost advantages might result from lower input costs, an improved technology, or a transportation advantage to reach a market.

Location, Location, Location

German economist Alfred Weber (1909) developed the first general theory of industrial location that took into account spatial factors for finding the optimal location for manufacturing plants. An optimal industrial location in Weber's model would be a location where the transport costs of bringing raw materials to the plant and transporting the final product to users are minimized. Weber considered three main factors that affect industrial locations: (2) a material index; (2) labor costs; and (3) agglomeration.[1]

Weber's model provides useful insight for modern business location decisions. It is obvious that farmers, especially those located in remote areas, could benefit from more and nearer value-added agricultural facilities because of lower transportation costs from the farm to the plant. However, producers located near sources of agricultural inputs and who are remote from larger markets, still must bear the transport cost of bringing their product to the market. This cost can be substantial depending on the types of goods produced and the availability of transportation choices. Based on Weber's model, value-added facilities that produce "weight-gaining" products should be located near final markets. Beer brewing is a classic example of a weight-gaining process, in which water is added to malt, yeast, and grain to produce the final consumer product. Moreover, if value-added facilities are dispersed, the benefits of agglomeration will be impossible to realize.

Weber's model enjoyed considerable success in both explaining and guiding locational choices of industries. However, significant improvements in economic geography resulted from work led by Paul Krugman in the early 1990s (Krugman 1991). Krugman added several distinctive considerations leading to a "new economic geography." The essence of Krugman's model of location is his characterization of centripetal and centrifugal forces. Table 2 is based on Krugman's (1998) identification of forces that affect the concentration of economic activity.

Table 2. Market Characteristics Driving Locational Decisions of Firms

Centripetal Forces	Centrifugal Forces
Market Size	Immobile Factors of Production
Labor Markets	Land Rents
Pure External Economies	Pure External Diseconomies

Source: Krugman (1998).

[1] The material index is equal to the weight of inputs divided by the weight of the final product. In a "weight-losing industry," the material index is higher than 1 and location tends to be toward raw inputs. In a "weight-gaining industry," the material index is less than 1 and location tends to be toward the market. It is also the case that unskilled labor tends to be easily found; whereas, skilled professionals may be hard to find. If production relies on low-skilled labor, location choices may justify greater transport distances. Agglomeration refers to concentration of firms and businesses in a locale. This clustering allows firms to enjoy both internal and external economies. Firms can achieve economies from shared facilities, labor, infrastructure, services, and other inputs, if they are located in the same place as existing factories.

Centripetal forces lead to the physical concentration of economic activity. Market size can influence both input and output markets. Production activities susceptible to increasing returns to scale, such as food manufacturing, benefit from location in large markets. Thick labor markets, or a large pool of locally-available workers suited for a variety of jobs, make it easier for workers to find jobs and for firms to quickly meet labor needs. Pure external economies refer to the classic concentration of industry clusters because of the potential for information spillovers. Software clusters in the Silicon Valley and along the Highway 128 corridor in Massachusetts are examples of firms benefiting from these positive externalities.

Centrifugal forces favor more dispersed industrial activity. Some production factors are relatively fixed in space or cannot easily be transported due to costs or, in the case of labor, international laws and regulations. Land and certain natural resources, such as lignite, gold, and oil deposits, are obvious examples of immobile factors. Land rents can have a dispersal effect on economic activity. As economic activity becomes concentrated, competition for land drives up rents and, depending upon the relative pulls of the centripetal and centrifugal forces, may disperse activity to lower rent areas. In this case, lower land rents may offset centripetal forces such as transportation costs and thick labor markets. Pure external diseconomies can serve to limit concentration as congestion costs, for example, increase production costs when activities are highly concentrated.

Krugman's (1998) economic geography model has been used to analyze locational trends of value-added industries. In their analysis of the food processing sector, Cohen and Paul (2003) found centripetal forces associated with market linkages to predominate in the food industry location. Their analysis found significant cost savings resulting from proximity to other food manufacturing centers (pure external economies) and from nearness to demand areas with high purchasing power (market size). Locating near other food manufacturers indicates forward linkages exist in the industry, lowering intermediate input costs for downstream producers. In addition, centripetal forces may favor concentrating activity near other food manufacturers to take advantage of a large, perhaps specialized labor pool. Proximity to consumers and suppliers indicates backward linkages economies, in which access to large markets may benefit producers, especially when manufacturing reflects increasing returns to scale. Consistent with Gopinath and Vasavada's (1999) analysis of the U.S. food processing industry, Cohen and Paul (2003) also found positive externalities resulting from industry spillovers of research and development findings resulting from locating near other food manufacturers. The positive centripetal pull resulting from positive knowledge spillovers also underscored Morrison and Siegel's (1998) finding of a positive impact of high-tech capital investment, research, and development expenditures, and human capital investment in the growth of localized food and kindred products industries.

On the other hand, Cohen and Paul (2003) found costs were significantly higher for large-scale food manufacturing activities located in heavily agriculturally dependent states. The higher costs were hypothesized to arise from the thin market effects arising from limited infrastructure support and input markets. Cohen and Paul related their finding to evidence of state governments' attempts to counteract diseconomies of locating in rural areas by offering tax and other financial incentives to encourage food manufacturing activities to locate in agricultural states.

Instead of considering the aggregate industry, Goetz (1997) considered location decisions within individual subsectors of the food manufacturing industry. He found population effects differed by industry. Counties with small population bases were able to attract new plants in meats (SIC 201), dairy (SIC 202), fruits and vegetables (SIC 203), confectionary (SIC 206), and fats and oils (SIC 207). However, small population bases had a negative influence on new plants in grain mills (SIC 204), bakery (SIC 205), beverages (SIC 208), and the miscellaneous category (SIC 209). Goetz also found benefits from investment in rural county transportation infrastructure, but even more beneficial were investments in human capital formation, measured through county-average educational attainment levels.

For some agricultural-based industries, centrifugal forces may predominate, and dispersed economic activity may be preferred. Farming is an obvious example. Immobile land resources, lower land rents, and the negative externalities imposed on non-agricultural industries and residents from many farming practices underlie the dispersal of farms across the rural landscape.

Centrifugal forces may also underlie the location decisions of large-scale animal production facilities. In an analysis of changes in the location of the U.S. hog industry, Roe, Irwin, and Sharp (2002) found centrifugal forces play an important role in the spatial distribution of hog production. These authors found that past investments in infrastructure in traditional hog production areas are less important in locating new large-scale hog operations than access to lower cost land, more favorable property tax schedules, lower populations, and lax environmental regulations. The authors also found proximity to large local processing facilities is important in the location of hog production, an important consideration for locating hog finishing operations. Therefore, decisions affecting the location of large-scale processing facilities also affect the location of primary hog production. This finding stresses the importance of understanding both upstream and downstream markets in value-added investments.

The approach of Roe, Irwin, and Sharp (2002) is especially relevant to discussions of expanding livestock production in North Dakota. Potential investors might consider the factors important in this research to determine if the centrifugal forces outweigh factors favoring concentration of livestock production activities. A thorough analysis should consider changes taking place in related value-added industries, such as potential cost advantages in procuring feed resulting from co-locating with ethanol and other processing plants producing feed as a byproduct.

Final Considerations

Having more value-added ventures does not necessarily lead to higher rural income or employment. The factors identified by Krugman (1991) suggest optimal location of business activities based on the relative strengths of centripetal and centrifugal forces. Research does support that these forces are important in the location of many agricultural value-added enterprises. Large agribusiness plants tend to locate near final markets due to better infrastructure and accessibility to labor and other (non-agricultural) inputs. Small-scale value-added agribusinesses, on the other hand, may be dispersed and may be located in either rural or urban areas. If rural development is the policy goal, providing support to new or small businesses may generate the desired results. Related investments in infrastructure and in education have also been proven to positively affect rural firm establishment and success. However, if the policy goal is to stimulate major value-added industries, such as selected food manufacturing industries, then large firms located in centralized market clusters should be encouraged and supported. As with any government policy, success will depend upon clear identification of specific objectives.

Resources

There are many state and national resources that can assist individual producers who are considering value-added enterprises. Listed below are several resource websites:

Business Planning:

- Business Planner Software from the Agricultural Innovation and Commercialization Center at Purdue University - https://www.agecon.purdue.edu/planner/login.asp

Financial:

- Bank of North Dakota Lending Services - http://www.banknd.com/ls/index.jsp
- U.S. Government Loans - http://www.govloans.gov/govloans_en.portal
- USDA Rural Development Value-added Grants - http://www.rurdev.usda.gov/NY/toolbarpages/rbspages/valueadded.htm
- Agriculture Product Utilization Commission – http://www.growingnd.com/index.asp?Section=Detail&PageID=268

Labor:

- North Dakota Department of Labor - http://www.nd.gov/labor/
- North Dakota Job Service - http://www.jobsnd.com/data/index.html
- North Dakota Workforce Dev. - http://www.ndcommerce.com/wfd/index.html

Regulations and Information:

- North Dakota Department of Agriculture - http://www.agdepartment.com/Laws/Laws-ND%20Dept%20of%20Agriculture.html
- NDSU Extension Center for Community Vitality “Business Reports, Forms and Licenses Required in the State of North Dakota” - http://www.ag.ndsu.edu/ccv/ced/publications/ec752/businessforms.htm

- ND Secretary of State – Business Registrations - http://www.nd.gov/sos/businessserv/registrations/index.html

- ND Tax Department – Agriculture Exemptions - http://www.nd.gov/tax/salesanduse/pubs/guide/gl-21814.pdf

Other helpful resources:

- NDSU Extension Publication - Farm and Ranch Recreation Resource Directory - http://www.ag.ndsu.edu/ccv/ced/resources/farmranch/introduction.htm

- NDSU Extension Publication - Starting a North Dakota Bed and Breakfast Business - http://www.ag.ndsu.edu/pubs/agecon/market/ec1231w.htm

- NDSU Extension Publication – Food Entrepreneurship - http://www.ag.ndsu.nodak.edu/cdfs/foodent/fex-2.html

- Agricultural Marketing Resource Center - http://www.agmrc.org/agmrc/default.html
- Wisconsin Agricultural Innovation Center - http://aic.uwex.edu/
- U. S. Agricultural Innovation Centers - http://www.agmrc.org/agmrc/directories/agmrcdir/aginnovationcenters.htm

    The AIC Program funds innovation centers to provide technical and business development assistance to agricultural producers seeking to enter into ventures that add value to commodities or products they produce.

- North Dakota Department of Commerce - http://www.ndcommerce.com/
- North Dakota Business Information Center - http://webhost.btinet.net/~onestop/BIC.htm

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Biomass-based Energy and Products

F. Larry Leistritz

Background

Recent changes in world energy markets have led to heightened awareness of U.S. dependence on foreign supplies of petroleum. While consuming approximately 25 percent of world oil production, the U.S. has only about 3 percent of known reserves. Concerns about foreign oil costs and supply dependability are leading to revived interest in alternative energy sources. One of the sources that has attracted particular interest is biofuels derived from agricultural biomass.

Environmental concerns also support renewed interest in renewable energy sources. While consuming fossil fuels releases greenhouse gases into the atmosphere, biofuels and other products derived from biomass are essentially carbon-neutral, as the carbon dioxide (CO_2) released during processing is offset by the CO_2 drawn from the atmosphere by the growing plants.

The recent growth of the ethanol industry demonstrates the potential of biofuels. From an annual production capacity of 1.1 billion gallons in 1990, ethanol production is expected to reach 5.0 billion gallons in 2006. However, corn supply will likely limit ethanol's role in U.S. energy markets. The Energy Policy Act of 2005 included a renewable fuels standard (RFS) which mandates 7.5 billion gallons of biofuels production annually by 2012. At this level, ethanol-based corn demand will exceed exports when the 7.5 billion gallon RFS is fully implemented. If bioenergy is to expand its role in national energy markets, a broader resource base and corresponding processing technologies are clearly needed.

Ethanol and other liquid fuels derived from agricultural products and biomass have been an object of recent energy legislation. As noted earlier, the Energy Policy Act of 2005 included an RFS starting at 4 billion gallons in 2006 and reaching 7.5 billion in 2012. The 2005 Act also created a Cellulosic Biomass Program to encourage production of cellulosic ethanol. This program includes authority for the federal government to provide loan guarantees up to $250 million per production facility. A $650 million grant program was authorized to fund research on cellulosic ethanol production, while $550 million was authorized for the U.S. Department of Energy (DOE) to create an Advanced Biofuels Technologies Program.

Increased priority on developing biomass-based energy and products is of particular interest in the Midwest/Great Plains as the states with the largest potential supplies of agricultural biomass are all located in this region. A consortium led by NDSU is currently engaged in a project that would use cellulose nanofibers derived from wheat straw to make a product that could substitute for fiberglass and plastics in many applications, including automotive parts. A recent report analyzed the economic value of adding a cellulose nanofiber production system to an ethanol biorefinery (Leistritz et al. 2006).

Opportunities for North Dakota

Whether biomass-based industry utilizes agricultural residues (e.g., wheat straw) or dedicated energy crops (e.g., switchgrass), the bulk of the feedstock and costs associated with transporting it appears to dictate that processing must occur near the source of the feedstock. Hence, the growth of a biomass-based industry offers the prospect of major economic stimulus for the areas supplying the feedstock. For example, a 50 million gallon per year (MGY) cellulosic ethanol facility would have annual operating expenditures of about $75 million annually, of which $53 million are estimated to represent payments to in-state entities (Leistritz et al. 2006). The largest single expenditure ($36 million) is for feedstock (wheat straw). All of this outlay would represent payments to entities within the local supply area (e.g., for baling and transporting the straw plus incentive payments to landowners).

Factors that suggest that North Dakota could be well positioned to host a biomass-based industry include feedstock availability and the recent growth of the biofuels industry in the state. Wheat straw is arguably one of the lowest cost biomass feedstocks, and it also appears to have desirable attributes as a feedstock (e.g., higher cellulose and lignin content than switchgrass). Also, the state has substantial amounts of marginal cropland (e.g., more than 3 million acres in CRP) that could have potential for energy crop production.

Concerns or Cautions

While North Dakota is one of the leading states in feedstock availability, it appears to rank substantially lower than some potentially competing states on other criteria that may be important in determining its attractiveness to industrial participants in the biobased economy. These criteria include (1) level of state funding for bioprocessing research, (2) presence of nationally recognized bioprocessing research institutions, (3) scale of local life sciences industry, (4) price and availability of other inputs, such as water, (5) current and projected infrastructure necessary to support the industry, (6) access to markets, and (7) training and education facilities for bioprocessing. State policymakers may wish to address some of these areas if they wish to enhance the state's potential to participate in this promising new industry.

It is important to recognize that the technology for biomass conversion to fuels and other products is far from mature. Many of the key aspects of biomass conversion have been demonstrated only at the laboratory or pilot plant scales. Much research, development, and engineering work remains before commercial scale plants can be built. Further, preliminary analysis suggests that biomass-based industry will be characterized by substantial economies of scale and large capital requirements. For example, a 50 MGY plant would have a capital cost of $185 million, compared to an estimated cost of $73.5 million for a comparable plant using corn as feedstock (Swenson and Eathington 2006). With yields and efficiencies representing the best results demonstrated to date (e.g., 60 gallons of ethanol per ton of feedstock), the cellulosic plant would be marginally profitable (ROI = 7%) at an ethanol price of $1.80 per gallon (2005 average). Many potential investors might not consider this level of return sufficient, especially given the pioneering nature of the technology involved. However, programs authorized in the

Energy Policy Act of 2005 provide for loan guarantees, grants, and other incentives to make first-generation plants a more attractive investment.

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Biodiesel from Canola

William W. Wilson

Background

The biofuels industry is changing the landscape of agriculture throughout the United States and the world. Though most focus is on ethanol, the biodiesel sector is comparably dynamic. Biodiesel is produced primarily from soybeans and canola, two crops grown in abundance in North Dakota.

Biodiesel production capacity is increasing rapidly. As of early 2006, about 50 plants were operating with over 300 MGY of production capacity. At least another 3,000 MGY capacity will come on line in 2006 followed by another 5,000 MGY in 2007. Some industry analysts suggest the numbers could even be higher by the end of 2007. The average size of operating plants has been in the 5-7 MGY range since 2001. Plants currently under construction and expansion have an average plant size of 7.7 MGY. The big change will occur with the plants that are now under construction. These 22 plants have an average size of 22 MGY.

In North Dakota, there are two plants being developed and expected to be processing by 2007. An additional plant is being planned at Underwood to supplement its ethanol production, and another is planned in an undisclosed location in Northern North Dakota. Minnesota (amongst other states) is also developing a biodiesel industry with three plants in the planning stage.

ADM and Dakota Skies Biodiesel are building new biodiesel plants in Velva and Minot, respectively. The cost of each is about $55 million, and they are designed to produce biodiesel from canola. These plants would directly employ 45-55 individuals and may generate substantial secondary jobs and economic impacts. Though initially their focus is on cold weather biodiesel, they are also looking at other derivative products which they believe over time will become of greater importance.

The value of crop-based oils can be dramatically increased through agbiotechnology modifications. Specialty crops can produce unique oils that support the personal care, cosmetics, medicines, cooking, or lubricants industries. Modifications can also increase oil's value as a feedstock for the biodiesel industry. However, this business is not without competition. Other biodiesel plants are emerging in the southern part of the United States and there have been recent announcements of new plants in Yorkton, Saskatchewan, and just north of Minot, North Dakota. The competitiveness of North Dakota canola is also impacted by Canadian canola production.

Opportunities for North Dakota

The rapid escalation of oilseed production and processing in North Dakota has resulted in a major change in North Dakota's agricultural economy. This has evolved since 1996 as a result of the simultaneous changes in the Farm Bill, diseases in traditional small grains, and the advent of biotechnology in row crops, particularly oilseeds. In fact, some counties in North Dakota are now the largest producers of soybeans in the United States. Much of this growth is also driven by changes in income and demographics around the world, resulting in an increased demand for oils with different and healthful traits. North Dakota is the leading producer of canola with about 90 percent of the U.S. production. This production is challenged by competition from Canada, a much larger producer, and from winter canola varieties being introduced elsewhere. Compared to other states, and due in part to the historical marketing practices of small grains, North Dakota can segregate and isolate special grains and oilseeds. Since segregation is a pre-requisite to commercializing some of the emerging agbiotechnology traits, North Dakota has a distinct advantage in this regard.

The opportunities for growth are largely driven by the rapidly changing demand for fuels, as well as the support prices and renewable standards included in the Energy Bill and varying state regulations.

Canola has unique properties potentially giving these plants an advantage in some segments. Specifically, canola oil is highly valued for biodiesel production because the product can be used in a much larger range of temperatures. It can be used in cold weather; whereas, biodiesel produced from other crops such as soybeans can be used only at higher ambient temperatures.

Concerns or Cautions

The primary risk is that of agronomic competitiveness of this industry. Currently, North Dakota farmers plant about 1.2 million acres of canola. With plants currently proposed or under construction, local production will have to more than double. Increased production can occur through increased plantings, increased yields, reduced rotation requirements, and/or improved targeting of oil traits. It is expected that these can be accomplished through transgenetic breeding. However, if they cannot, the demand for local processing will either go unfulfilled or be diverted to using imported canola from Canada. In either case, potential benefits for North Dakota farmers would be reduced.

There are other challenges. The initial success of the industry requires the continuance of federal subsidies and renewable standards. Second, increases in canola production in Canada and in winter canola in southern Kansas and Oklahoma will affect North Dakota farmers and local biodiesel processing plants. Third, the value of oilseed meal may likely fall sharply due to increasing supplies and difficulties of shipping it to outside markets. Fourth, prices of petroleum-based diesel must remain at current historically high levels in order for biodiesel to compete in the marketplace.

Production and Marketing of Organic Produce in North Dakota

Gregory J. McKee, William E. Nganje, and Cheryl S. DeVuyst

Background

U.S. organic sales are projected to be around $30.7 billion by 2007 (Willer and Yussefi 2004). Organic production in North Dakota presents unique opportunities and challenges for farmers to benefit from this growing market. Although North Dakota has some of the richest soils in the United States, most of the demand for organic products in North Dakota is met through imports from California and other states, even for commodities that can be locally grown like corn, potatoes, and other vegetables. With consumers and grocers asking for more locally grown vegetables and organic produce, and with quantities of rich soil available, North Dakota is in an excellent position to help bring locally grown, organic produce to market.

Demand for organic produce is increasing. As consumers increase their demand for high quality food, the production of which may be relatively friendly to the environment, this trend will continue. Similarly, the supply of organic produce is increasing throughout the United States. Certified organic crop acreage in the United States increased by 11 percent between 2001 and 2003, with large increases for fruits and vegetables and for hay crops used in dairy (USDA/ERS, 2006). Organic farmers in 48 states farmed 2.2 million acres of land organically in 2003, a 63 percent increase from 1997 (USDA/ERS). In 2002, the value of U.S. organic food product exports was estimated at between $125 million and $250 million.

Opportunities for North Dakota

There are at least three trends which have recently strengthened the demand for organic production, some of which are specific to North Dakota. First, Wal-Mart, a major retailer, has announced moves to enter the organic market. This will have significant long-run implications for large regional organic contract agreements. Second, Hornbacher's (a local retailer of organic and conventional produce) management noted that in addition to organic green top carrots, organic green onions, celery, tomatoes, and potatoes are increasing in demand. Third, local retailers of locally produced organics would enjoy the benefits of rapid information flow as local production of these crops will significantly reduce the current order lead-time of 2 to 3 weeks, since most of this fresh produce is imported from California and other states. This could decrease needs for capital investments in storage capacity by producers, wholesalers, and retailers.

North Dakota has also begun to develop a dominant presence in the production of selected organic products. North Dakota is poised to accelerate this growth through its comparative advantages in soil quality and proximity to selected markets. According to the USDA/ERS in 2003, North Dakota had 145 certified organic farms. In August 2005, 29 companies in North Dakota were certified to handle and/or process organic products. North Dakota leads the United States in the production of organic oilseeds and specialty grains such as milo, triticale, kamut, amaranth, and quinoa; it also remains competitive in production of dry beans and lentils (Jacobson 2005). Several other factors indicate that future growth for North Dakota is possible in organic farming. It was noted that North Dakota has a bright future for organic production with: 1) some of the richest soils in the United States; 2) the possibility of utilization of land under the Conservation Reserve Program; 3) several complimentary programs to support North Dakota organic agriculture, such as the Sustainable Agriculture Research and Education (SARE) program, the Organic Farming Research Foundation, and the North Dakota Agricultural Products Utilization Commission (APUC) (Jacobson 2005); 4) the significant producer, retailer, and end-user interest/participation in organic production that conforms to certification standards in the state (Jacobson 2005); and 5) increasing local demand for organic produce.

Concerns or Cautions

Challenges for production and marketing of organic produce (e.g., vegetables) in North Dakota remain, however. First, marketing organic produce remains an issue in North Dakota since an organically certified processing and packaging infrastructure is needed. Second, information about market conditions, such as prices and supply, must be exchanged among producers. Lastly, due to the novelty of some of these products, attention will need to be paid to developing market penetration techniques.

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Nature-based Tourism

F. Larry Leistritz

Background

Rural communities around the country are increasingly looking to the tourism sector as a source of economic growth. With substantial growth in tourism over the past several decades, both in the United States and elsewhere in the industrialized world, tourism promotion has become an important economic development strategy. Increased leisure time and discretionary income for substantial segments of the population have supported growth in tourism and recreation, and the notion that tourism and recreation can contribute to the economic base of rural areas gains support when socioeconomic trends in rural counties are examined. Since 1970, population growth of the 327 rural U.S. counties most economically dependent on recreation-tourism activities has been more than double the population growth in non-metro counties overall (Johnson and Beale 2002). During the 1990s, population growth in these tourism dependent economies averaged 20.2 percent, compared to 6.6 percent for counties that were economically dependent on farming and 2.3 percent for those dependent on mining.

In the northern Great Plains region, many rural counties have historically been dependent on farming and mining, and many have a history of population and economic decline. In North Dakota, 46 of the 49 rural counties experienced declining populations during the 1990s. As a consequence, many farm families and other rural residents have been exploring nature-based tourism as a potential source of supplemental income, and economic development professionals and policymakers are examining rural tourism as a potential rural economic development strategy.

The state's unique resources support the potential for tourism development. North Dakota's 62 National Wildlife Refuges, more than any other state, showcase its potential for wildlife-oriented recreation. In addition, over the past decade, hunting and fishing by non-resident sportsmen has increased substantially in North Dakota (Bangsund, Hodur, and Leistritz 2004), which in turn has stimulated the development of outdoor recreation-oriented businesses (Hodur, Bangsund, and Leistritz 2004). Many business operators and other community leaders would like to broaden the region's nature-based tourism sector to include birding and other wildlife viewing, hiking, biking, and similar soft adventure activities.

Opportunities for North Dakota

A statewide survey of nature-based tourism businesses conducted in 2003 provides insight regarding this emerging sector. The most common business focus was hunting (e.g., guiding, fee hunting) and providing lodging and/or meals for hunters. Most of these businesses were relatively small and provided only supplemental income for their operators (25 percent of household income on average). Most businesses were relatively recent start-ups – 85 percent had begun operations since 1990. The operators generally reported a growing number of customer-days, and they were optimistic about the economic development potential of nature-based and agri-tourism. Hunting and fishing was the activity rated as having the greatest potential (90 percent of respondents rated it as having substantial potential), followed by birding and wildlife viewing (51 percent). The respondents reported that more than 70 percent of their customer base came from outside North Dakota.

A survey of participants in a 2004 birding festival gives insight regarding this segment of the nature tourism clientele (Hodur, Leistritz, and Wolfe 2005). Almost 41 percent of festival participants were from outside North Dakota while 35 percent were from other parts of the state and only 24 percent were local residents. Out-of-state visitors came from locations as distant as Oregon, Tennessee, and Utah. Respondents' level of satisfaction with the festival itself was nearly unanimous: 98 percent indicated they were 'very satisfied' or 'somewhat satisfied,' 54 percent would be 'very likely' and 46 percent 'somewhat likely' to recommend the event to a friend, and 65 percent would be somewhat or very likely to attend the event again within two years.

A 2004 study conducted for an economic development group in southwestern North Dakota provided additional insights regarding opportunities and constraints to developing the tourism sector (Leistritz, Hodur, and Wolfe 2004). Community leaders and tourism business operators alike identified hunting, birding/wildlife viewing, hiking, biking, and cultural and heritage activities as activities with substantial potential.

An issue that arose in a majority of discussions with operators of hunting-related businesses was the need to find other activities that would extend their season. As one outfitter said, "it's really difficult to pay for a lodge based on a hunting season of only 4 to 6 weeks." Some felt that they could try to promote birding, wildlife viewing, and heritage activities as the basis for family vacations during the spring and summer seasons.

Another finding was that, while the region has a wealth of natural resource amenities [Theodore Roosevelt National Park, the Maah Daah Hey Trail, the Killdeer Mountains, Lake Sakakawea, and White Butte (the state's highest point)], and heritage and cultural attractions (Killdeer Mountain and Badlands Battlefields, the Medicine Hole, Buffalo Jump, and old Fort Berthold were a few examples), many of these resources are under-developed, lacking signage, interpretation, and in some cases even public access.

In sum, recent research reveals that the nature-based and agri-tourism sector has grown substantially in recent years, and those most familiar with this sector believe that substantial potential exists for future growth. However, in considering potential business ventures or development initiatives in this area, a number of concerns and limitations also must be kept in mind.

Concerns or Cautions

When considering potential tourism ventures, it should be kept in mind that North Dakota is located far from population centers, which limits the potential clientele. Stated differently, a tourism business needs a significant attraction to motivate clientele to travel from distant locations. (In recent years, of course, the state's reputation as a premier hunting destination has been sufficient to attract hunters from around the country.)

Another limitation for tourist-oriented businesses is that many of the activities that attract tourists to the state are quite seasonal. The peak of the pheasant season lasts only 4 to 6 weeks and the waterfowl season can be even shorter. Similarly, birders are likely to find North Dakota most attractive during the spring migration/mating season and/or the fall migration.

North Dakota's unique wildlife resources have been one of its key nature tourism attractions, but these resources can be sensitive to weather conditions. A severe winter could have very adverse effects on pheasant populations while a drought period could have similarly adverse effects on waterfowl hunting, as well as birding, in the Prairie Pothole region.

Finally, wildlife-based tourism is potentially quite sensitive to public policy actions. Much of the recent increase in wildlife populations is attributable to the Conservation Reserve Program (Bangsund, Hodur, and Leistritz 2004). Future changes in that program could have major effects. Similarly, state policies with respect to non-resident hunters can have major effects on businesses that depend on this clientele. For example, actions by the 2003 Legislative Session to raise non-resident license fees and restrict the days non-residents can hunt were blamed by some for a decline in numbers of non-resident hunters in the southwest region (Leistritz, Hodur, and Wolfe 2004).

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Wind Energy – Generating Electricity from Wind in North Dakota

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Background

Advancing wind energy technology is a national goal as stated in the vision statement of the U.S. Department of Energy's (DOE, "Wind Energy Mission") Wind Energy program:

> "Wind energy will become a major source of energy for the nation, which has only just begun to tap its vast wind resources."

The DOE's Wind Program and the National Renewable Energy Laboratory describe North Dakota's broad potential for wind energy:

> "North Dakota has wind resources consistent with utility-scale production. Good-to-excellent wind resource areas are located throughout North Dakota." (DOE, North Dakota Wind Resource")

The state is already home for several wind energy projects (DOE, "Installed Capacity"), but North Dakota has not yet tapped the full potential. Perhaps more important for North Dakota, though, is the potential for wind energy to contribute to the state's economic development (DOE, "Wind Energy Development"). The goals for expanding wind energy in North Dakota would be economic development for the rural communities, as well as contributing to the national goal of expanding availability of renewable energy sources.

Opportunities for North Dakota

North Dakota has several resources on which to expand its wind energy industry. The state already has several wind farms, a long history of coal-fired generating plants, and a well-established interstate market for electrical power. As a key provider of coal generated electricity, the state has an extensive electrical grid capable of delivering power. Electricity in the state is provided by both investor-owned utilities and user-owned electrical cooperatives. Several North Dakota businesses manufacture components for wind generators, such as DMI Industries (DMI) and LM Glasfiber. The state also has the natural environment for wind energy, including open space where generators can be located at safe distances from communities and aviation.

These state resources, coupled with the national interest and federal government support for wind energy, advancing technology, and extensive research-based information (e.g., DOE "Wind Powering America") suggest that wind energy is an opportunity for North Dakota.

Concerns or Cautions

Expanded wind energy does raise concerns about environmental impact (e.g., noise and interference with birds), adequacy of interstate transmission lines, cost-competitiveness of wind energy, market opportunity for additional electricity, initial capital needs, and impact on radar for air travel. Likewise, the profitability of any wind energy venture will have to be carefully evaluated as existing development incentives and subsidies are of finite life. For example, the wind energy Production Tax Credit is scheduled to expire at the end of 2007 (AWEA News Release). Entities interested in wind energy will need to consider all of these factors when formulating a business plan, acquiring government permits (e.g., see ND Public Service Commission), as well as preparing proposals for federal government support (see DOE, EERE).

Although some wind energy will be developed as large-scale projects, there also is opportunity for local entities (such as user-owned cooperatives) to develop localized or distributed wind energy (DOE, "Distributed Wind"). Assisting entities that may not have the resources, expertise, or experience to assemble research-based information, prepare business plans, and develop funding proposals is an opportunity for NDSU researchers to contribute to these efforts. Similarly, NDSU researchers may be able to assist the state in formulating a wind energy policy as the State of Iowa has done, for example (Energy Policy Task Force).

Additional information about wind energy is available from numerous sources, including:

- American Wind Energy Association at: http://www.awea.org/
- U.S Department of Energy at: http://www.eere.energy.gov/windandhydro/windpoweringamerica/wpa_about.asp
- National Wind Technology Center, National Renewable Energy Laboratory at: http://www.nrel.gov/wind/
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