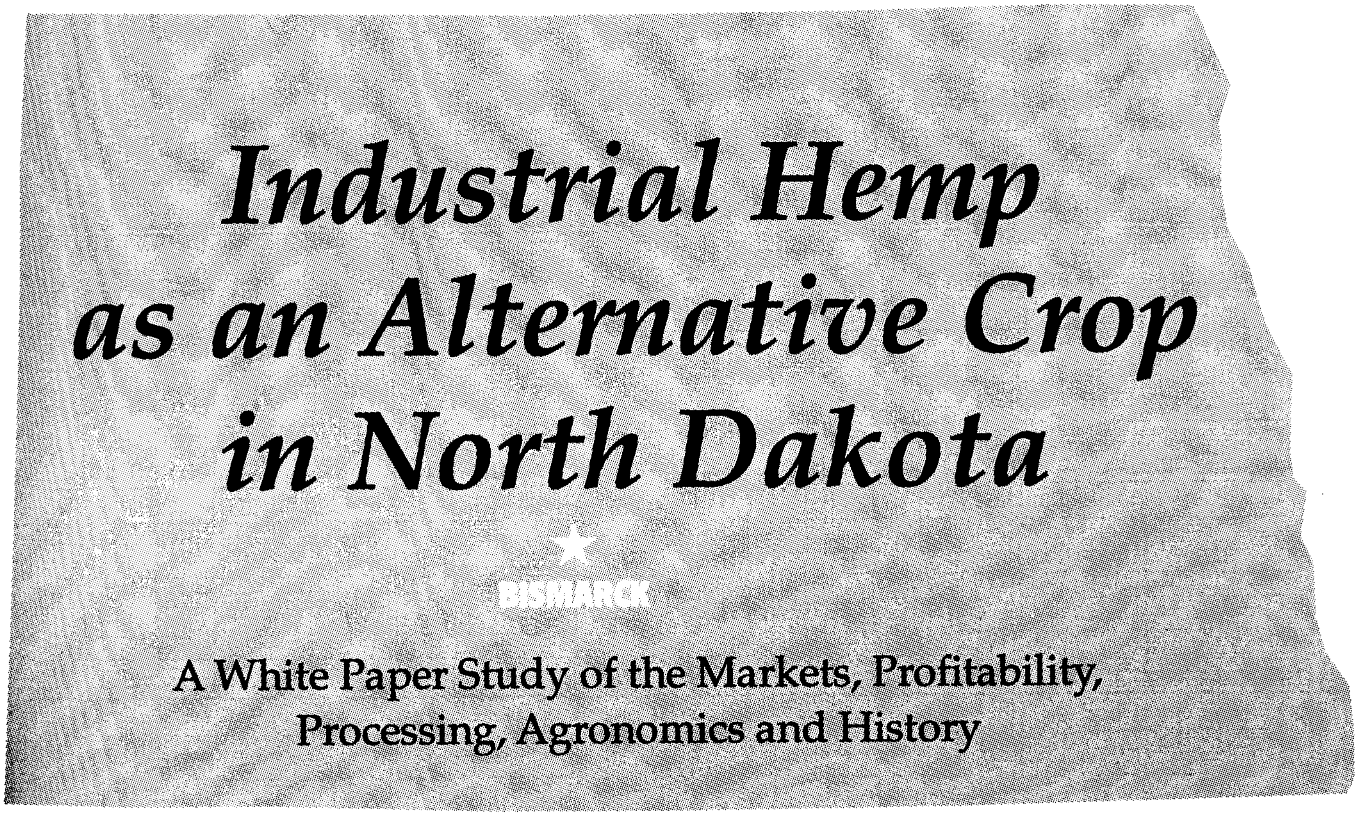
Agricultural Economics Report Number 402

# *Industrial Hemp as an Alternative Crop in North Dakota*




## A White Paper Study of the Markets, Profitability, Processing, Agronomics and History

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# Executive Summary

This preliminary study reports on current efforts to define existing world markets and possible United States markets for industrial hemp as well as resulting economic feasibility should production be legalized. A large percentage of the information available on industrial hemp is by non-agriculturists. This indicates a need for North Dakota to continue working with its agricultural counterparts to bring this potential alternative crop into the agricultural research domain.

- The industrial hemp world market consists of over 25,000 products in nine submarkets: agriculture, textiles, recycling, automotive, furniture, food/nutrition/beverages, paper, construction materials, and personal care. These products are made or manufactured from raw materials derived from the industrial hemp plant: fiber, hurds, and hemp seed/grain.
- World hemp fiber production has declined from over 400,000 tons in 1961 to 113,000 tons in 1996. India, China, Russia and Korea are the major low cost producers. This constitutes about 250,000 acres under production worldwide. Preliminary figures for 1997 indicate that this downward trend continues.
- A revitalization of industrial hemp may be occurring as indicated by projected increased demand (retail sales) from $75 million in 1997 to $250 million by 1999 worldwide (Wall Street Journal, April 24, 1998). Various reasons that would explain this phenomenon include technological advances in processing, an increase in pricing, or interpretation of existing information.
- The largest market opportunity for North Dakota identified in this report may be hemp seed oil. This opportunity was also identified by the University of Kentucky (July 1998).
- North Dakota may have a comparative advantage because a state of the art multi-oil processing facility already exists that is capable of processing hemp seed.
- Hemp hurds appear to be price competitive with wood chips, fine wheat straw, other types of animal bedding, and other high-end pet needs. Hurds may also be a complement or substitute material in strawboard production.
- Certified seed production is a market opportunity.
- Initially hemp appears to be comparable to barley. However, a 1998 Kentucky study projects higher returns (see Table 2) from $220.15 per acre for producing hemp seed for crushing to $605.91 for certified seed.
- Historically imported jute and abaca were intense competitors with American industrial hemp.
- Law enforcement agencies have legitimate concerns about their ability to enforce laws regulating industrial hemp production. Advances in biotechnology such as terminator genes may create solutions.
- **Recommendations.** Since industrial hemp may have potential as an alternative rotation crop, it is recommended that the North Dakota Legislature consider action that would allow controlled experimental production and processing, then, necessary baseline production, processing, and marketing data could be collected and analyzed. For example, all new enterprises would require a critical threshold volume (CTV) in order to succeed in terms of economic profit. What is the volume and the acreage required to produce it? At the same time the concerns and costs of law enforcement agencies could be addressed.

# Introduction

The 1997 North Dakota Legislature passed House Bill Number 1305 (Appendix A) mandating the North Dakota State University Agricultural Experiment Station to do a white paper study of industrial hemp as a possible alternative crop for production in North Dakota.

The following project team was formed to accomplish this mandate: David G. Kraenzel, Agribusiness Development Specialist and Principal Investigator; Tim Petry, Associate Professor; Bill Nelson, Professor; and Marshall Anderson, Agribusiness Undergraduate, all of the Department of Agricultural Economics, NDSU; Dustin Mathern, College of Business Administration Undergraduate; and Robert Todd of the Department of Soil Science, NDSU.

Funding was not provided to complete this task. Application was made in August 1997 to the North Dakota Agriculture Experiment Station through the USDA Alternative Crops Research Program. The starting date for this grant was May 15, 1998, with the account in place on May 29, 1998 (Vig, May 13, 1998).

# Intent

The overall objective to this project was to analyze the economic feasibility and desirability of industrial hemp production in North Dakota. The study was completed in several sections including markets, profitability, processing, political environment, history of industrial hemp production, agronomics and recommendations. Due to limited time, analyses were preliminary and based on various published and trade sources as well as personal interviews. A more in-depth report will be published when other sources of data have been examined.

StratSense ™ was the market procedure used to conduct this study (Kraenzel, 1997). This is a new way of analyzing market conditions and defining or detecting market opportunities for existing, new and value-added products/commodities produced in North Dakota. This procedure was first introduced by David G. Kraenzel in his Agricultural Experiment Station (AES) project as an umbrella procedure under which existing and alternative crops may be assessed for probable profitability and successful production in North Dakota and the region (Appendix B). The Industrial Hemp Project Team (Tim Petry, Bill Nelson, Marshall Anderson, Dustin Mathern and Robert Todd) have all made significant contributions to the use of this suitable and well-timed approach.

## What is industrial hemp?

Hemp belongs primarily to the *Cannabis sativa* plant, which has thousands of different uses for its seeds, stalks, flowers and oils. Industrial hemp is an annual plant which grows each year from seed. It has a rigid, herbaceous stalk which can range anywhere from 3 to 16 feet in height. The plant has well marked nodes at intervals of 4 to 20 inches that are obtusely four cornered and are fluted or channeled. Industrial hemp leaflets are dark green, lighter below, lanceolate, pointed at each end and serrate. The leaflets are 2 to 6 inches long and 3/8 to 3/4 inches wide.

Industrial hemp is often mistakenly associated with marijuana. The two plants are different in that the psychoactive element, tetrahydracannibol or THC, is present in considerably lower levels in industrial hemp. It is 0.3 percent in industrial hemp as compared to 4 to 20 percent in marijuana. Industrial hemp grown for fiber is easily distinguishable from marijuana because the plant is considerably taller and spaced closer together. However, when industrial hemp is grown for its seed, it does resemble marijuana.

# The Industrial Hemp Market

Industrial hemp provides both raw fiber and seed. The bast fiber[1], Figure 1, which is a small portion of the plant stem, must be separated leaving hurds as a co-product. For hundreds of years the job of separating the fiber from the stem was labor intensive. Competitiveness was dependent upon a cheap labor source such as slaves or serfs. In the beginning of this century, technological developments were made replacing some labor with machinery. This breakthrough posed a threat to large companies in the cotton, timber, oil, and textile industries. Shortly thereafter Congress passed the 1937 Marijuana Act, which critically impaired the hemp industries competitive ability. An in-depth history of industrial hemp and cultural practices are presented in the history and agronomics sections respectively.

## Overview

From carpeting to fuel and from personal care products to animal bedding, industrial hemp has a myriad of different uses. There are an estimated 25,000 different hemp related products and they can be classified into the following general submarkets (see Figure 2).

- Agriculture
- Automotive
- Construction materials
- Cosmetics
- Food/Nutrition/Beverages
- Furniture
- Paper
- Recycling
- Textiles

With such a wide variety and large number of uses, there is a great amount and rather diverse group of competitive commodities, raw materials and products. Cotton, lumber, and fossil fuels are some of the biggest and more powerful of these competitors. There are also minor crops such as jute, flax, abaca, and kenaf that might compete with or substitute for industrial hemp based on certain similarities.

[1] Bast — Any of certain strong woody fibers obtained chiefly from the phloem but also sometimes from the pericycle or cortex or various plants and used especially in the manufacture of ropes, cordage, matting and fabrics.

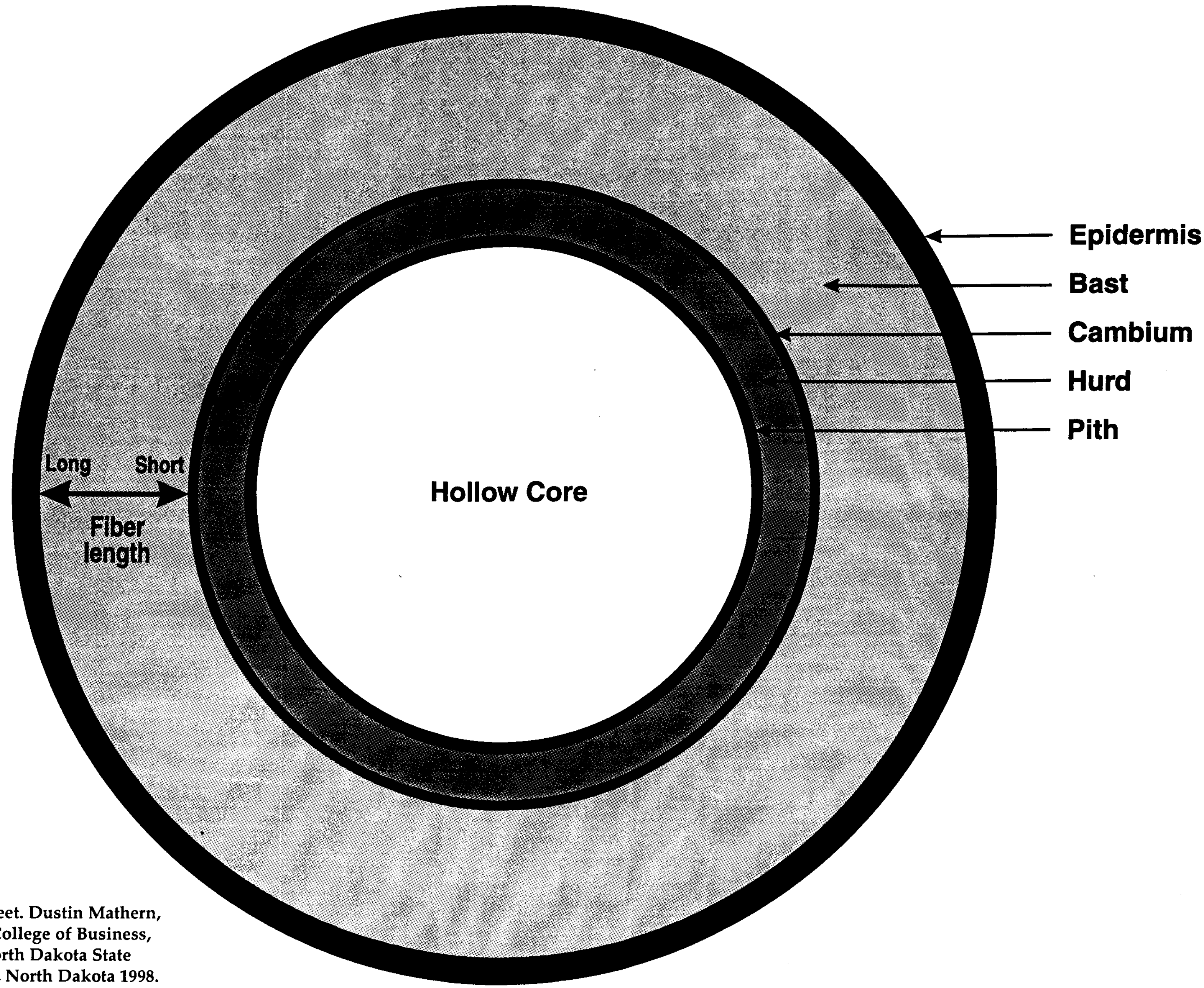



Figure 1. Fact Sheet. Dustin Mathern, Undergraduate, College of Business, Jodi L. Young. North Dakota State University, Fargo, North Dakota 1998.

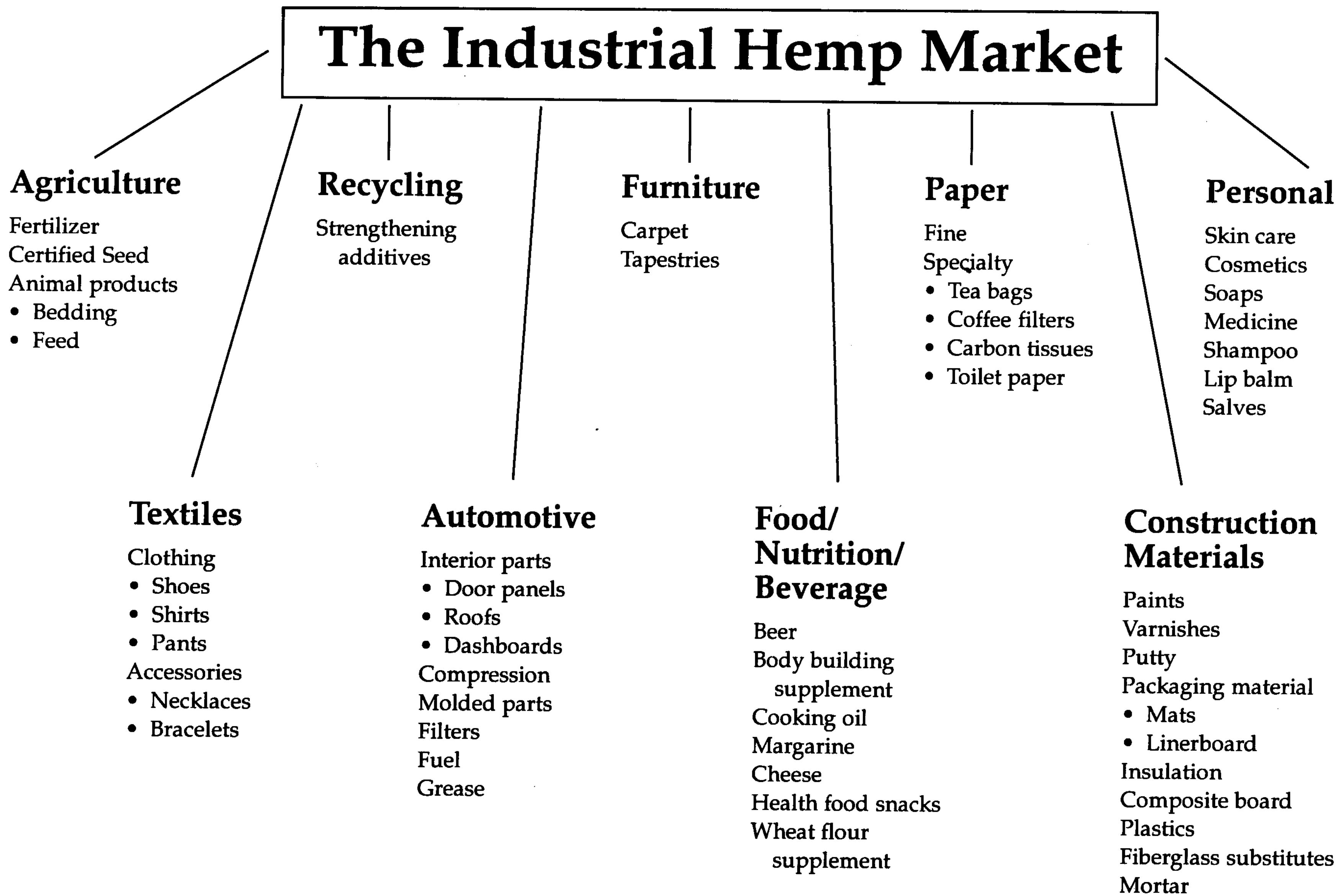



**Figure 2.** The Industrial Help Market, Submarkets and Market Segments. Marshall J. Anderson, Jodi L. Young, and David G. Kraenzel. Department of Agricultural Economics, North Dakota State University, Fargo, North Dakota, June 1998.

There are countries that allow (and some that always have) the cultivation of industrial hemp with the closest and most recent to begin research being Canada (Thompson et. al., 1998; Vantreese, 1997). These countries are:

- Australia
- Belgium
- Canada
- China
- Chili
- El Salvador
- England
- European Union
- France
- Germany
- Hungary
- India
- Italy
- Korea
- Pakistan
- Philippines
- Poland
- Romania
- Russia
- Switzerland
- The Netherlands
- Ukraine

## Procedure

StratSense ™ utilizes two specific methodologies to assess the market: strategic market management systems (SMMS) and scenario analysis. For the purposes of this white paper, SMMS was the sole methodology used. It is an information gathering/analysis method and is composed of the following components: 1) an external analysis focusing on those business elements exterior to the farm/firm to include a customer analysis; competitor analysis; market analysis; outside influence analysis; defining/detecting the opportunities and defining strategies; and 2) the internal analysis which includes focusing on the interior farm business considerations such as profitability.

A general outline of this system, being customized especially for North Dakota, is presented in Figure 3. The concentration in this report is on the preliminary market (external) analysis (**the Market**) and the farm/firm (internal) analysis (**Profitability**) built upon a current review and summary of research done on the subject of hemp marketing and production as of July, 1998.

## Customer Analysis

This customer analysis was done from the North Dakota producers' and processors' point of view. Given a background knowledge of the cultural practices and climatic requirements of industrial hemp, the crop can successfully be grown in North Dakota. The rainfall requirement of 20 to 25 inches suggests the most logical dryland locations to initially produce this crop may be on the light to medium soils in the eastern one-third of the state avoiding heavy clay soils. Irrigation could expand production

### Strategic Market Management System (SMMS)

| The Market (External) | The Farm/Firm (Internal) |
|---|---|
| ■ Customer Analysis<br>■ Competitor Analysis<br>■ Market Analysis<br>■ Exterior Influences<br>▲ Technology<br>▲ Economics<br>▲ Government<br>▲ Cultural<br>▲ Demographics<br>■ Defining/Detecting Market Opportunity<br>■ Determining Market Strategy | ■ Performance Analysis<br>▲ Profitability<br>▲ Sales<br>▲ Shareholder Value Analysis<br>▲ Customer Satisfaction<br>▲ Product Quality<br>▲ Brand Association<br>▲ Relative Cost<br>▲ New Products<br>▲ Employee Attitude<br>▲ Product Portfolio Analysis<br>■ Determining Performance Strategy |

Determining Overall Busines Strategy Identifcations/Selections

**Figure 3. Prototype Strategic Market Management System (SMMS) framework customized to North Dakota. David G. Kraenzel, Associate Director, Institute for Natural Resources and Economic Development (INRED). Adapted from David A. Aaker, University of California, Berkeley, CA, 1995.**

to drier areas of central and western North Dakota if proven economically feasible. Industrial hemp is also an excellent rotation crop for established standard North Dakota crops such as wheat and potatoes.

The first question to a producer then becomes, "What is my market?" Based on the submarkets presented in Figure 2, the most logical initial group of customers is in the agricultural submarket. These customers would be interested in buying certified seed and its co-product animal bedding. This conclusion is reinforced by the most recent United States industrial hemp study (Thompson et al., July 1998), which found that at this time, the most profitable customers for Kentucky farmers would be in the agriculture submarket in straw production for animal bedding only or straw and grain production, grain production only, and for raising certified seed.

Numerous authors and literature citations state the fact that no processing facilities exist in the United States to handle hemp. In fact the 1998 Kentucky study suggested that Kentucky's sustainable competitive advantage in the long run may be to pass legislation legalizing production so they would be first, and this would in turn encourage establishment of the processing industry in the state. This production oriented approach to industry establishment suggests the traditional idea of "produce it and the markets will come," which is often financially devastating to producers.

North Dakota's established grain processing facilities and market distribution infrastructure may be both a comparative advantage (Petry, 1998) and resulting sustainable competitive advantage (SCA) (Kraenzel, 1998) in hemp oils. If these facilities in fact could intermediately process hemp and if we view these processors as customers for industrial hemp producers, then four potential processing facilities could be identified in North Dakota. AgGrow Oils in Carrington is a state-of-the-art multi-seed, oil processing (full press) facility currently processing crambe, safflower, sunflower, flax, and borage (Metzger, July 1998); National Sun Industries, ADM in Enderlin, a large scale processor of soybeans and sunflowers, ADM in Velva, a large scale processor of canola, and Cargill Oil Seed Processing in West Fargo, a large scale processor of sunflower and flax. In contrast to the larger seed processing facilities which operate using a chemical solvent process on a large scale continuous basis, AgGrow Oils uses a natural full or cold-press process and focuses on significant market niches.

Dr. John Gardner, general manager, indicates AgGrow Oils has the capability to process industrial hemp seed/grain into oil. Therefore, North Dakota possesses a comparative and sustainable competitive advantage (SCA) in the natural processing of seed oils. Dr. Gardner, as director of the Carrington Experiment Station, considered production and processing of industrial hemp five years ago and concluded that given the cost of externalities, it was not worthwhile. As general manager of AgGrow Oils, Carrington, he has taken a more recent look at industrial hemp, and although progress has been made, the cost of externalities and the administrative burden continue to exist.

A flowchart of processed hemp (Figure 4) presents the product possibilities for both industrial hemp seed/grain as discussed previously and processed hemp stalks. No processing facilities currently exist in the United States to process hemp stalks, however, Canada is scheduled to bring such a facility on line in 1998.

Based on these preliminary findings, industrial hemp production and processing warrants further research and study. Other possible specialty and niche submarkets that exist in the United States include specialty papers, foods, oils, automobile parts, fiberglass replacements, upholstery and carpets (Thompson et al., 1998). Another distinct possibility is the use of industrial hemp hurd as a complementary input with wheat straw for strawboard production, a currently emerging North Dakota industry.

## Competitor Analysis

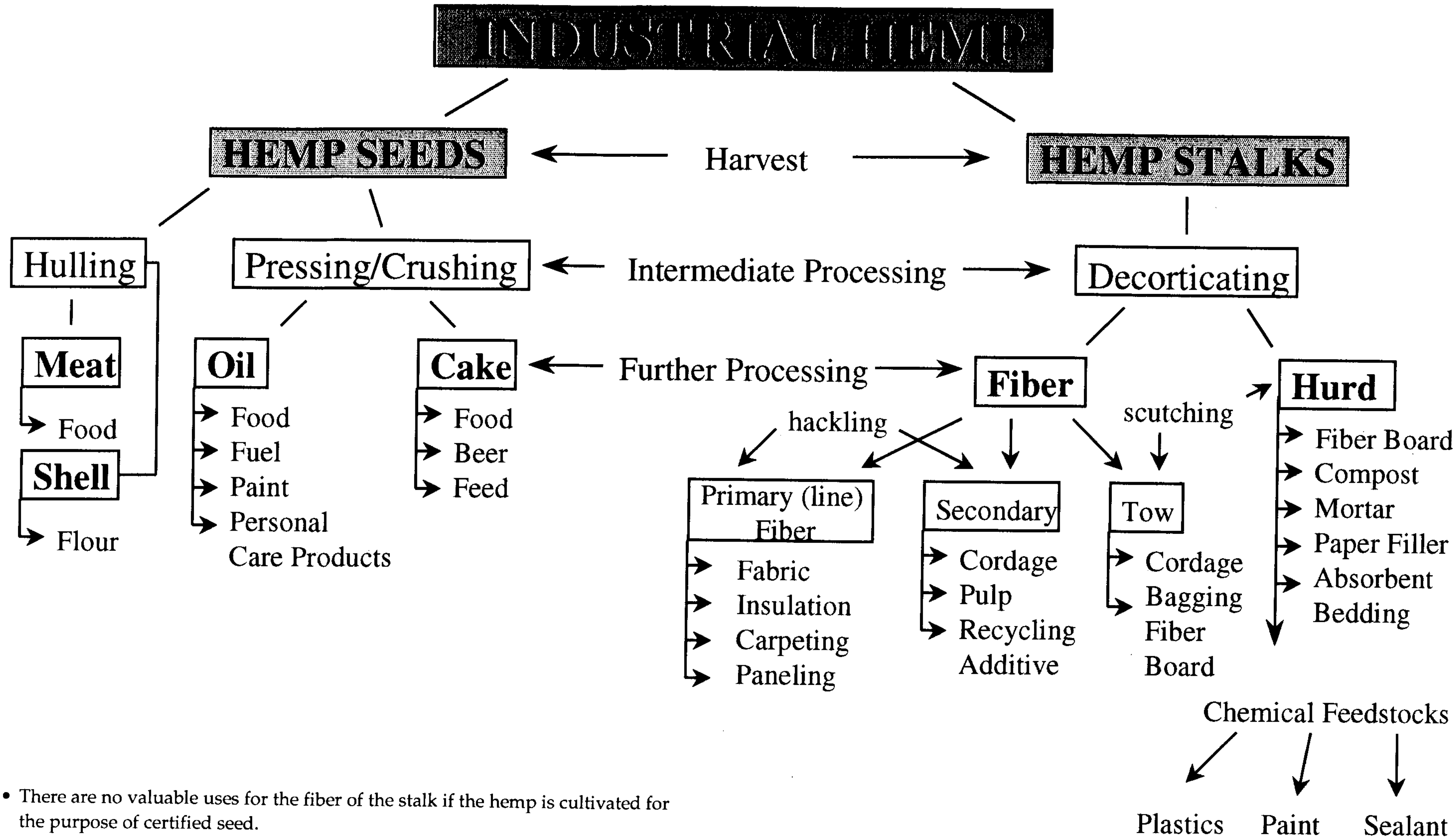
Competitors of North Dakota producers generating and selling straw, grain, and certified industrial hemp products would be primarily: other farmers and ranchers in the region who would grow the crop; other states seriously considering production such as Kentucky, Wisconsin, Vermont, Colorado, and California; and imports of raw material from China, Russia, and the Ukraine (who supply four-fifths of the world supply) followed by Romania and the European Union (Vantreese, 1997). Canada, although still considered a negligible supplier by world standards, is a formidable competitor given their entrepreneurial drive and proximity to North Dakota.

If a processing facility were adapted or established to intermediately process raw material to be further processed into value-added products for each of the submarkets identified, import competitors would be China, Romania, Hungary (these three supply three-fourths of all hemp fabric in the world), India, Korea, Phillippines, Belgium, Switzerland, Italy, Poland and El Salvador. Again, Canada, with its new legalization for research and processing facilities is an intense competitor for the United States. Competitors in seed production for both seedstock and oils are: China, France (mainly seedstock), and Pakistan.

The 1998 Kentucky study suggests direct competition with flax derived products by recapturing hemp's historical market share in paints, wood and concrete sealants and printing inks currently held by an already declining linseed oil or flax industry. The basis of this conclusion is hemp oil's strong penetrating properties in high-end paint products. The study also suggested to compete in other flax submarkets for animal meal and flax meal.

## Market Analysis

One of the most critical objectives of the market analysis is to determine exactly what type of possible United States and world markets exist for industrial hemp. It is important to note that in 1993 and 1994 there were no woven hemp imports reported in the United States. In 1995, the United States first reported imports totaling $697,000 in hemp and hemp products including: woven fabrics ($645,000); raw or processed hemp ($28,000); and yarn ($24,000). This is followed by an increase of 215 percent in the first 10 months of 1996 and a total of $1.3 million for the year (Vantreese, 1997). Whether or not this is just a current U.S. fad, the fact remains that it appears that there is a developing (growth) domestic market for industrial hemp products. Caution then must be exercised in market entry considering such important factors as




- There are no valuable uses for the fiber of the stalk if the hemp is cultivated for the purpose of certified seed.
- Using a dual purpose method does not allow for primary fiber production.
- Due to high processing costs, hemp's economic advantage lies in high-end, durable products.
- Scutching and hackling are processes within the decortication process. A further "combin" process, known as the cardin may be performed on the primary fiber.

**Figure 4. Hemp Products Flowchart. Processing to End Product Groups. Dustin Mathern, Undergraduate, Jodi L. Young. Department of Agricultural Economics, North Dakota State University, 1998.**

confirming a sustained growth trend into 1997, 1998 and solid growth projections into the future as well as defining the total market in dollars. This requires further in-depth analysis to include scenario analysis.

## Market Size

There are a number of ways to describe the size of the market in order to get a complete understanding of its true magnitude. This preliminary study estimates the size of the market for both hemp fiber and seed based on the current verifiable available estimates.

### Total Acres (Estimated)

- **World:** 250,000 acres grown worldwide figuring an average fiber yield of about 1,000 pounds per acre. There were roughly 1,000,000 acres grown worldwide in 1960. Some interesting figures revealed in the literature are: (Europe -- 52,000 acres) individual countries: 24,000 acres in France, Spain, Austria, the Netherlands, China, Russia, India; England (4,000); Poland (5,500); and the Ukraine (10,000).
- **United States:** 82,000 potential (Thompson, et. al, 1998)

### Total Revenue

- **World:** $75 million in retail sales in 1997 estimated to grow to $250 million by 1999, excluding China (Wall Street Journal, April 1998).

### Total Production (Estimated)

- **World:** World production of fiber is down from over 400,000 metric tons in 1960 to around 103,400 metric tons in 1996 or about 113,000 U.S. tons.
- **United States:** negligible at present. University of Kentucky estimates there may be a domestic market demand for up to 100,000 U.S. tons of hemp fiber.

### Seed Production

- **World:** 36,000 metric tons or 36,443 U.S. tons. This is down from over 100 metric tons in 1965 (Vantreese, 1997).
- **United States:** seed-negligible

### World Exports

- **World:** $5,000,000 in 1995 ($14,000,000 in 1960)
- **United States:** (re-exports) $449,000 of fiber and tow in 1995.

## Market Opportunities

- Even though ***it is illegal to grow*** industrial hemp in the U.S., ***it is legal to import*** industrial hemp into the United States (Vantreese 1997). Therefore if significant demand exists, then processing value-added products from raw or intermediately processed industrial hemp becomes a legitimate business consideration in North Dakota. Hence both importing and processing imports become market opportunities.
- *North Dakota presently* has a comparative advantage in the processing of hemp seed oil. This is a market opportunity that if acted upon could become a Sustainable Competitive Advantage (SCA).
- The sovereign Indian nations of North Dakota may have a competitive advantage in the production and cultivation of industrial hemp immediately.
- Hemp hurds may be a complement or substitute component in strawboard products.
- Initial markets for North Dakota producers would be certified seed and hurd straw for animal bedding.

## Outside Influences

**Technology.** The value-added product market is ripe for new technology that can increase the uses for industrial hemp. State-of-the-art processing advances in Europe and in particular Germany and France need to be investigated further in order to detect and identify further market opportunities. Advances in biotechnology such as terminator genes may create solutions.

**Economics.** Cost and return figures are primarily based on limited and inadequate information from Europe and other countries. Subsidized farming operations in other parts of the world make a true estimate of the production economics difficult at best. This implies the need for further market, economic and agronomic research in order to properly assess the true profit generating potential of industrial hemp. A key issue in the economics of industrial hemp are externalities or the security, enforceability and accountability costs associated with its regulated production and handling.

**Government — The Political Environment.** In the case of industrial hemp, the U.S. Federal government and the North Dakota state government ultimately hold the facilitating power to create new incentives and new opportunity for North Dakota producers. In the United States at this time, Federal Law prohibits the growing of industrial hemp (*Cannabis sativa*) by rendering it illegal and economically infeasible. There are different varieties of *Cannabis sativa*. Industrial hemp contains 0.3 percent

THC as compared to marijuana varieties which contain 4 to 20 percent THC. The controversy over legalization continues to hamper production of industrial hemp, however, legalized imports allow processing of value-added products to be conducted. Assurance of a large supply of consistently processed raw material becomes a key success factor. In 1996, various industrial hemp related bills were debated by three state legislatures considering industrial hemp as an alternative crop: Colorado, Kentucky, and Vermont. One Indian Nation, the Navajo in Arizona, is studying cultivation. It appears that as a growing number of states pass legislation legalizing the production of industrial hemp for research, pressure will come to bear on the U.S. Congress to legalize cultivation.

**The Navajo Indian Nation**. Industrial hemp was planted in 1996 on two hectares (Vantreese, 1997).

**Colorado**. Proponents include the Colorado Farm Bureau and the University of Colorado.

**Vermont**. Passed legislation to legalize cultivation for research purposes.

**Kentucky**. John Gilderbloom, in the most recent study on industrial hemp by the University of Kentucky, feels they have presented a powerful case for the legalization of industrial hemp production (Thompson et al., 1998). The key outcome of the study is the belief that if Kentucky is the first to legalize industrial hemp production, this will constitute a sustainable competitive advantage (SCA) in establishing a processing industry and marketing distribution infrastructure.

Other states where industrial hemp is being considered as an alternative crop include California, North Dakota and Wisconsin and others. The National Farm Bureau and the Drug Enforcement Agency come to the legislative debate arena as opponents (Vantreese, 1997).

In conversations with Jeff Beersman, Resident Agent in Charge of the Drug Enforcement Administration in Fargo, and Richard G. Olson, Chief Agent, Criminal Division of the Bureau of Criminal Investigation in Bismarck, similarities as well as differences surfaced concerning their agencies' views toward industrial hemp. The conversations were similar in that the main concerns of both men were for the well being of the farmers. Both parties set up the scenario of illegal plants getting mixed in with a legitimate industrial hemp crop without the knowledge of the farmer. They both stated that they would not want to be responsible for the seizure of the crop or farm in such a situation.

Concerns include ways to distinguish industrial hemp from marijuana; policy change may be viewed as a foot-in-the-door for marijuana supporters and not a saving grace for the family farm; and how industrial hemp would be policed and whose responsibility it would be to police it.

**Cultural.** The trend in consumer demand for natural products that are environmentally and economically sustainable favors opportunity for industrial hemp. The durability of industrial hemp is complemented by its biodegradability and recycling properties. The trend in declining woodlands on a U.S. and global basis favors a "Tree Free" resource for specialty paper products. The interest in health and nutrition has extended to the pet industry and creates opportunity for industrial hemp beyond bedding. For example, bird seed and other animal meal.

**Demographics.** Demographics can be a powerful underlying force in the industrial hemp market. This has already been demonstrated by the economic impact of the "fad" products associated with young people in the past five years and its contribution to the emergence of consumer demanded hemp products. The 13 to 19 year old population in the U.S. is expected to peak at 31 million in 2010 (Zinn, 1994) thus comprising 40 percent of the Baby Boomer impact of 77 million. Retailers such as The Gap and Adidas have already discovered their impact on the clothing segment of the textile submarket. Asian-American and Hispanic-American populations that have immigrated to the U.S. are often already familiar with the attributes of industrial hemp products. This is because of its accepted use in those countries.

## Profitability

United States industrial hemp profitability can only be based on proforma or projected cost and return data because it is illegal to produce hemp in the United States and documented research does not exist for the most part. Cost and return data are estimates converted from foreign currency and growing conditions in other countries. Vantresse (1997) noted that, "It is not surprising that those entities that strongly favor legalization of industrial hemp production have, in general, the most favorable profit margins and multiplier effects."

The following expected profitability table was adapted from Vantreese (1997) and Marcus (1997). The hemp estimates were for Ontario, Canada and were for raising hemp for seed and fiber simultaneously. It is difficult to estimate potential yields in North Dakota compared to those projected for Ontario. However, it looks like hemp could be at least as profitable to produce as barley at the farm level. Marcus concluded that if hemp were grown for only seed or fiber, negative returns would occur even in best case scenarios.

**Table 1. Expected Profitability of North Dakota Hemp for Seed and Fiber vs. Other Crops, 1998 ($US).**

| | Spring Wheat[1] | Malting Barley[1] | Corn Grain[1] | Conf. Sunflowers[1] | Irrigated Potatoes[1] | Low P/Y[3] Hemp[2] | Avg. Hemp[2] | High P/Y[3] Hemp[2] |
|---|---|---|---|---|---|---|---|---|
| Avg Yield (bu ac) | 31 | 50 | 54 | 1080 lbs | 325 cwt | 1.43 bu/ac; + t/ac | 19 bu/ac; +2.75 t/ac | 23.8 bu/ac/ + t/ac |
| Avg Price ($ bu) | 3.71 | 2.41 | 2.25 | 0.131 | 4.50 | $5.51/bu; $40.44/t | $6.16/bu; $45.96/t | 23.8 bu/ac; +3 t/ac |
| Total Revenue | 115.01 | 120.50 | 121.50 | 141.48 | 1462.50 | 179.96 | 248.13 | 316.29 |
| Total Costs | 117.32 | 115.02 | 159.70 | 140.62 | 1017.59 | 174.63 | 174.63 | 174.63 |
| Return $/ac | –2.31 | 5.48 | –38.20 | .86 | 444.91 | 5.33 | 73.49 | 141.65 |

[1] Swenson, A. and R. Haugen. "Projected 1998 Crop Budgets, Northeast North Dakota," Farm Management Planning Guide, Section VI, Region 3A, NDSU Agricultural Extension Service, December 1997.

[2] Van Treese, Valerie. **Industrial Hemp: Global Markets and Prices**, Department of Agricultural Economics, University of Kentucky, Lexington, KY, January 1997.

[3] P/Y is an abbreviation for price/yield.

**NOTE:** Information for North Dakota crops is very reliable, but the hemp data is secondary and not substantiated by North Dakota research.

**Table 2: Growing Costs and Returns for Industrial Hemp Using Current Technology, Yields, and Prices.**

| Variable Costs | | Straw | | Grain | | Certified Seed | | Straw & Grain |
|---|---|---|---|---|---|---|---|---|
| | | | | $/acre | | | | |
| Seed (lbs.) | (50) | $125.00 | (10) | $25.00 | (10) | $25.00 | (50) | $125.00 |
| Fertilizer | | 45.01 | | 45.01 | | 45.01 | | 45.01 |
| Herbicides | | 0.00 | | 10.95 | | 10.95 | | 0.00 |
| Lime (tons) | (1) | 12.12 | (1) | 12.12 | (1) | 12.12 | (1) | 12.12 |
| Fuel, Oil (hrs) | (4.5) | 18.43 | (2.2) | 14.06 | (2.2) | 14.06 | (2.2) | 22.25 |
| Repair | | 16.14 | | 30.38 | | 30.38 | | 23.12 |
| Interest | | 8.38 | | 5.24 | | 5.24 | | 8.94 |
| Storage | | 5.00 | | 5.00 | | 5.00 | | 5.00 |
| Transport to Processor | | 27.20 | | 8.00 | | 5.60 | | 24.00 |
| Total Variable Costs | | $257.28 | | $155.76 | | $153.36 | | $265.44 |
| Fixed Costs* | | $50.27 | | $45.00 | | $70.73 | | $75.05 |
| Operator Labor (8) | (8) | $56.00 | (8) | $56.00 | (10) | $70.00 | (9) | $63.00 |
| Total Enterprise Costs | | $363.55 | | $256.76 | | $$294.09 | | $403.49 |
| Stalk Yield | | 3.4 t/acre | | 0.5 t/acre | | 0.5 t/acre | | 2.25 t/acre |
| Price per Ton | | $200/t | | $120/t | | $120/t | | $200/t |
| Total Stalk Revenue | | $680/t | | $60/t | | $60/t | | $450/t |
| Seed Yield | | | | 1,069 lbs/acre | | 700 lbs/acre | | 700 lbs/acre |
| Price per Pound | | | | $.039/lb | | $1.20/lb | | $0.39/lb |
| Total Seed Revenue | | | | $476.91 | | $840.00 | | $273.00 |
| Profit | | $316.45 | | $220.15 | | $605.91 | | $319.51 |

* Fixed costs include depreciation, taxes, and insurance. Figures are updated to 1997 and based on estimates by Dave Spalding published in the Report to the *Governor's Hemp and Related Fiber Crops Task Force*. Several additional adjustments to Spalding's estimates are included in the text. Herbicide, storage, and transport to processor costs are added onto Spalding's estimates. Spalding's estimates for repair were increased by 50%. 50 lbs of hemp seed per acre were assumed for cultivating hemp for fiber rather than 40 lbs as in the report cited above. Although, it should be noted that Hempline in Ontario, Canada, a processor which is focusing on industrial hemp fiber for textiles, is recommending that its growers use 60 to 65 pounds of certified seed per acre (Kime, 1998).

Source: Thompson, E., M. Berger, S. Allen. *Economic Impact of Industrial Hemp in Kentucky*, Center for Business and Economic Research, University of Kentucky, July, 1998.

A study of hemp production in Kentucky (Thompson et al., 1998) projected higher returns (see Table 2). Returns from $220.15 per acre for producing hemp seed for crushing to $605.91 for certified seed were estimated. However, these are returns to land, capital, and management. Net returns would be lower if costs for those categories were documented.

Neither study included costs for monitoring licensing, or regulating hemp production. Obviously, these external costs should be considered and could be borne by taxpayers or passed on to growers and/or processors.

Seed imported to Canada costs $.99 per pound, 50 percent of which is due to transportation costs. Any substantial production of hemp seed in North America could improve hemp profitability by lowering seed costs.

Uniformity in world hemp price information is difficult to obtain with prices varying from $0.07 to $8.09 per pound with the average world price of $0.85 per pound (Vantreese, 1998).

It is worthy to note an excerpt from DTN's Farm Roundup under the headline *Hemp Creeps Into Mainstream*, "Once sold primarily at hippie fairs and through ads in magazines with an environmental bent, goods made from industrial hemp are moving into the mainstream. Adidas used it in a shoe, the Body Shop features a line of hemp products and European car makers use it in interiors. There's even a beer made with it. I feel the industrial hemp crop could very easily be the soybean crop of the new millennium, said Jeffrey Gain, a former farm lobbyist who now is chairman of the U.S. Department of Agriculture's Alternative Agricultural Research and Commercialization Corp" (Associated Press, 1998).

# Processing

The harvesting and processing techniques are dependent upon the output that the grower wishes to produce. The grower may focus on long fibers, seed only, or both seed and fiber (dual purpose). Hemp is a dioecious plant. The males produce more fiber than the females and the females produce the seeds. The males are ready to harvest at technical maturity, four to six weeks before the seeds are ready (biological maturity). This creates a trade off situation in the case of dual purpose crops. However there are advances through hybridization that produces a unisex variety of hemp.

## Fiber and Hurd Production

Processing has always been the most difficult step in the production of hemp. The goal of the intermediate stalk processing stage is to remove the long fibers from the rest of the plant (see Figure 4). Before the days of the machine break, the hemp stalks had to be broken and the fiber removed by hand. This was a tedious and labor intensive task. Since then there have been technological advances such as the decorticating machine.

The first stage of processing begins in the field. In order to separate the fibers, the cohesive materials of the plant (lignin and pectin) must be broken down. This is accomplished through the process of retting. A common method of retting (rotting) is field or dew retting. After the plants have been mowed or swathed they lay in the field for four to six weeks. During this time, the stalks are turned three or four times in order to ensure that the entire stock is retting. This method is particularly advantageous because so much of the plant is left in the field. After the stalks are properly retted and dried to about 15 percent moisture, they are baled and shipped to the intermediate processing facilities. Stalks that are retted and dry can be stored for at least a year before losses in fiber quality occur.

Another common method of retting is called water retting. This method results in a higher quality fiber because the retting is very even and thorough. In this method the stalks are harvested and placed into sheaves to dry. The sheaves are then transported to the processing facility and placed into water for a few days. This process is more expensive, harder on the land, and the water that is used becomes polluted.

Once the plants reach the processing plant they are ready to be decorticated. The bales are undone and the stalks are spread out evenly and fed into the machine. The first stage of the process, scutching, is to break the hemp. The hemp is run through a series of fluted rollers. During the process, the woody core is broken into small pieces and it is beaten out along with the coarse "scutching tow," which falls onto a conveyor belt. The pliable fiber remains in the machine and continues onto the hackling stage. This step combs the fibers and removes the short and intermediate fibers leaving only long fibers. The fiber can be twisted into yarn and from here it has numerous applications.

The decorticating process can be very hard on the fiber and losses do occur. Furthermore, the output quality of the fiber is dependent upon the maturity of the stalk and the uniformity of the retting and stalk sizes. However, there are new processes such as steam explosion and ultrasonic breaking techniques that can improve quality of the long fiber after it has been obtained from the decorticator. The processes are more expensive, but using them allows the processor to tailor the fiber for use on cotton or wool processing machinery.

### Dual Purpose

Another method, which is used in western Europe, is dual purpose. The seeds mature after the fiber, so in order to maximize yield a balance must be found where the seed is mature enough, yet the fiber is not too overripe. The hemp fiber of the dual purpose method must be short and uniform because the quality of the long fiber has been compromised. This allows for different harvesting techniques. The first step is to cut of the tops off the plants, which contain the seeds. After that is done the remaining stalk is chopped into two foot long segments. The fiber is then allowed to ret. The best uses for this material would be paper, particle board, and isochanvre, which is a mortar-like substance made from mineralized saps and resins. The dual purpose method is advantageous because it does not require highly specialized or modified machinery.

### Seed Production

Hemp is also valuable for its seed products. The oil of the seed may be extracted and has a wide range of uses from heating oil to cooking oil and even beauty aids. The meat of the seed is also a good source of protein suitable for both livestock and human consumption. The seed may be obtained during the harvest of the fiber by equipping the cutting machine with a thresher. To maximize seed production the plants should be planted farther apart to allow the plant to develop a canopy. In addition, the wider spacing of the plants causes the stalks to be much thicker, which is not conducive to fiber production. Furthermore the seeds are obtained from the female plant, which matures later than the male plant. Therefore by the time that the seed is ready the stalk of the male plant (the main fiber producer) will be overripe and the fiber will be unusable.

### Constraints

Added costs make the use of hemp more difficult. Hemp's durability makes it hard on the harvesting and processing machinery. There is also a lack of processing infrastructure. For example, while hurds may be good paper producing materials, companies do not have in place the equipment to use hurds. Hemp fiber often requires different equipment than cotton to be made into yarn. Most importantly, because developed countries have not grown hemp for almost 50 years, the harvesting and processing technology is antiquated and needs improvement.

# History of Industrial Hemp

Experts are in general agreement that hemp was one of the first plants cultivated by man. It is believed to have originated in Central Asia. Among the earliest relics is 12,000 year-old sand pottery with hempen cord marks covering the surface. Alongside this find was a rod-shaped stone used to pound hemp and remove the fiber. Hemp used as fiber and clothing begins to appear 1500-1000 BC. Hemp was so important that China was also known as the "land of mulberry and hemp."

India and the Middle East also made use of hemp, which they called bhang. They used hemp for cloth, one of the oldest archeological relics is a fragment of hemp cloth, dated 8000 BC, found in Mesopotamia.

The Egyptians also used hemp. The pollen of hemp can be found in Ramses II (1200 BC). The Egyptians used hemp for making rope which they used in construction of the great pyramids.

Hemp was spread into Europe with the Scythians. There is record of hemp usage in Greece and Italy (circa 200 BC) when it came to be used in sheets and ropes. The Roman Empire helped to spread hemp throughout Europe. Hemp seeds are found in the remains of Viking ships built around 850 AD. German Franks and the French grew hemp. The Moors started Europe's first paper factory in 1150 AD using hemp. When Guttenberg invented the printing press in the 1400s, bibles were printed on hemp paper.

Hemp is ideal for ocean faring vessels because of its strength and resistance to corrosion from salt water. This durability characteristic is one key to hemp's sustainable competitive advantage. The domination of the Italian hemp industry allowed the Venetians to have the most superior fleet on the Mediterranean until nearly 1800. The shipping industry was big business and hempen rope and sails were needed to outfit the cargo ships. When Christopher Columbus set sail for the West Indies, his ships were rigged with 80 tons of hempen fiber.

Hemp was also used on ships of war. England, Holland, Spain, and France all had large navies that had to be outfitted with hemp fiber. By the 1800s, Russia's high quality hemp and cheap serf labor supply propelled it into being the leading world hemp supplier. For example, England imported 90 to 98 percent of its hemp from Russia, a paradox which fueled the War of 1812.

Colonials arriving in America found hemp a fundamental good already growing in the wild, although supplies were not sufficient to meet usage demand. As early as 1619, the Jamestown colony was encouraged to grow hemp to meet growing demand. Later, tougher "must grow" laws (1631 Massachusetts, 1632 Connecticut, Chesapeake 1700s) were enacted to increase the supply of hemp. Hemp was even used as legal tender to make up for the lack of printed money and promote its growth.

Hemp played a key part in our nation's independence. The first two drafts of the Declaration of Independence were printed on it, colonial soldiers dressed in it, and the first flag was sewn from it. Presidents Washington and Jefferson both grew hemp on their plantations to meet market demand. Benjamin Franklin began his penny printing press with it. After America gained its freedom and began to expand west, it was hemp that covered the wagons. When Levi Garret began selling his jeans to miners in California, he made them from hemp.

In the 1800s the United States imported about 80 percent of its hemp. Although it was grown throughout the states, it was most successfully cultivated in Kentucky. There were, however, two drawbacks. Before the Erie Canal was built, the Atlantic states could receive hemp three times faster and also cheaper from Russia than from Kentucky. The dew-retting method that Kentucky used to separate the fibers of the plant from the stalk was inferior to the water-retting method used in Russia. Therefore the United States Navy used very little Kentucky hemp. After the Civil War, Kentucky hemp production declined because there was no more slave labor. By the end of the 1800s most of the hemp grown domestically was from Wisconsin, which was now beginning to use machines to aid in the breaking process. It provided a higher quality fiber than Kentucky's hand break method.

Hemp saw a boost in the beginning of the 1900s and a gradual decline from 1912 on. A 1913 USDA yearbook report outlines domestic hemp problems and identifies why the industry was in decline. The reasons given were lack of labor and new technology advances such as the cotton gin for cotton. These competitive shortcomings severely hampered the hemp industry. USDA also cited increasing profits in other crops. Kentucky, for example, was starting to plant tobacco. Competition from other fibers also hindered the hemp industry. Jute, imported from India, was used to make gunny sacs. Abaca (Manila hemp, although not actually hemp) was being used increasingly on ships. The last reason that USDA gives was the lack of knowledge of the crop outside the limited area of Kentucky. In conclusion, they stated that "the market would expand if manufacturers could be assured of larger supplies." Vantreese (1997) indicates two other major contributors to decline were foreign competition and the demise of sailing ships.

In 1916 the USDA published Bulletin No. 404 titled "Hemp Hurds As Papermaking Material." Until this time it was thought that the hurd was a waste by-product of the breaking process. Hemp's growth rate, high cellulose content, and comparatively lower lignin make it a more suitable source for paper than trees. In Kentucky, where the hand break was common, the hurds were burned in various piles after the breaking. However, Wisconsin, Indiana, Ohio, and California were using machines to do the breaking. This would be the best source of hurds because it is done in one location.

As the import of jute and abaca continued to hamper the American hemp industry, there were many improvements made in the area of machine breaks. In 1917 George Schlichten invented the decorticator. The decorticator removes the green outer layer, breaks the hemp, removes the hurd, and combs the fiber, removing the more coarse tow. The decorticator overcomes the most substantial barrier to producing hemp profitably by reducing the amount of manual labor required. This was illustrated in Scientific American of June 4, 1921, "Revolutionizing an Industry: How Modern Machinery is Minimizing Hand Labor in Hemp Production."

In August 1930, the federal government started the Federal Bureau of Narcotics (FBN) and appointed Harry J. Anslinger as commissioner. The job of the bureau was to prosecute violators of Prohibition and the Harrison Act (mainly outlawing opium). However, several years later with the repeal of prohibition, Anslinger and the FBI began an assault on marijuana, the Mexican slang for the flowering buds of *Cannabis sativa*. At this time marijuana was obscure, known primarily to the Mexican immigrants and parts of the African-American population. While fighting the war on marijuana, all varieties of *Cannabis sativa* were drawn into the conflict. The bill passed in December 1937. Marijuana came to incorporate the entire *Cannabis* plant, which was to be taxed at $1.00 per ounce and rendered *Cannabis*, industrial hemp, unable to compete against substitutes. The following two articles advocating hemp production were published two months after the passing of the Act.

In February 1938, Popular Mechanics published an article heralding hemp as the "New Billion Dollar Crop." Claiming that hemp has over 25,000 uses, the article contends that advances in processing technology (i.e. decorticating) allowed hemp to be grown profitably. Also in February of 1938, Mechanical Engineering, "Flax and Hemp: From the Seed to the Loom," claimed that hemp may be "The Most Profitable and Desirable Crop that Can Be Grown."

A resurgence in hemp production occurred during World War II when supplies of abaca from the Philippines were cut off. As an insurance measure the USDA launched Hemp for Victory and the USDA distributed 400,000 pounds of hemp seeds to farmers and even had a Kentucky 4H group working on the project. Industrial hemp was also grown in North Dakota at this time. The hemp turned out to be unnecessary and much of it went to waste. After the war, hemp farming was once again illegal.

Interest in hemp production remained idle until the early 1990s when "hempsters" such as Jack Herer, began to promote its attributes in, "The Emperor Wears No Clothes." A revitalization of the industry appears to be occurring with current uses including renewable materials for apparels, food oils, building materials, auto parts, and paper to name a few.

# Agronomics of Industrial Hemp

## Climate

Optimum industrial hemp growth occurs in a mild, humid temperature climate but can be grown almost anywhere. Four months free of killing frosts are needed in order to produce the best fiber and 5 ½ months for seed production.

Both young seedlings and mature plants can endure light frosts of short duration with little injury. In comparison, young hemp fields are less susceptible to injury from frost than oats. The *1913 Yearbook of the US Department of Agriculture* reported that fields of hemp ready for harvest were uninjured by frosts, while cornfields all around them were ruined.

Ideal temperatures for hemp growth range between 60 and 80 degrees F. When the average daily temperature reaches 61 degrees F. or higher, the plant enters into rapid growth stage, during which it grows 4 to 6 cm. per day. However, it can endure both higher and lower temperatures. The ideal rainfall for hemp ranges between 25 and 30 inches annually. Hemp especially needs ample moisture supply during its first six weeks, during germination and until the plant has become well rooted and established. After this, the plant can endure drier conditions.

## Soils

An amazing characteristic of industrial hemp is its ability to grow in such a wide range of soils and climates, however, there are soils that are best suited for growth and soils that should be avoided. For the best development of the plant and for the production of large quantities with good quality fiber, industrial hemp requires a soil that is rich and has good, natural drainage but not subject to severe drought at any time of the growing season. A clay loam with rather loose texture and containing a plentiful supply of decaying vegetable matter of an alluvial deposit alkaline and not acid in reaction is ideal for industrial hemp production.

Industrial hemp production is not recommended on still, impervious clay soils or light, sandy or gravelly soils. The ideal soil acidity for hemp growth has pH values which range between 5.8 and 6; industrial hemp will not grow well on soils with high acid levels. There will be only mediocre growth on soils with a hardpan near the surface or in fields that have been over cultivated.

## Seeding

Industrial hemp is a dioecious plant. This means that the male plant bears male flowers with pollen and the female plant contains the ovary, from which the fruit later develops. This simply means that there are two separate hemp plants. The male, which is the best fiber producer, and the female that is the seed producer.

When the main goal is to produce fiber the seeds can be sown closer together. Usually the row spacing is 4 to 8 inches. To maximize fiber production, suggested seeding rates range anywhere from 150 to 400 seeds per square yard. This will allow the plant to have a longer stalk with little branching.

When hemp is sown for seed there will be more spacing in the field so the stalks will be shorter and there will be numerous branches on the plant. According to *The Cultivation of Hemp*, the distance between rows for seed cultivation can be 8, 12, or 16 inches. Increasing the distance between the rows will also increase overall seed yield. Seed production will require lower seeding rates; a Kentucky study says about one-fifth that of the seeding rate for fiber. The rates for both fiber and seed production will vary with different soil types and fertilities. However, the ground should remain overshadowed by plant foliage and any spacing over 16 inches may not allow this to happen.

Industrial hemp should not be planted at a depth greater than 2 inches and the optimum depth is between 1.2 and 1.6 inches. After the seed has been put in the ground it will germinate within 24 and 48 hours and with adequate moisture and warm temperatures it will emerge in 5 to 7 days.

Spring weather conditions rather than just a date on the calendar should dictate the sowing period. Hemp seeds can begin germinating in soils with temperatures ranging from 34 to 36 degrees F. However, it is recommended to wait for planting until the soils are warmer. One source says the soil temperatures should range from 50 to 54 degrees F (Bosca and Karus, 1998). In a different report that was put out by Ridgetown College and the University of Guelph, both of Ontario, the soil temperature should be in the range of 42 to 46 degrees F.

Any machinery that is easily adjustable, such as row widths, and performs well is suitable for sowing industrial hemp. Standard grain drills and modified alfalfa seeders are examples of suitable machinery. "No-till systems" can have good results but may be more prone to erratic emergence.

## Growth

Due to high yields of dry matter and its rapid growth, industrial hemp requires considerable amounts of nutrients. The plants nitrogen uptake, which is considered the most important nutrient for hemp, is the most intensive in the first 6 to 8 weeks. Potassium, and in particular phosphorus, are needed in the flowering and the seed formation. It may be necessary to apply commercial fertilizers to grow industrial hemp effectively. As would be expected, the 1913 Yearbook of the U.S. Department of Agriculture recommends the best single fertilizer for hemp is simply barnyard manure. The manure supplies three important plant foods — nitrogen, potash, and phosphoric acid.

Industrial hemp is an extremely effective weed killer. No chemicals are needed in production. The dense shade created by a decent crop of hemp quickly chokes out most, if not all, unwanted weeds. There have been cases where a hemp crop has completely wiped out Canadian thistle and severely checked quack grass. Industrial hemp restrains weeds so well that they very seldom mature. This weed control carries over to the next year.

## Harvest

The harvesting times and methods are different for fiber and seed production. In fiber production, harvesting occurs as soon as the last pollen is shed. Harvesting for fiber usually takes place 70 to 90 days after seeding. Harvesting for the seed begins when 60 percent of the seed has ripened. When the hemp seed is ready to harvest, its marble-like characteristic is easily identifiable. Their external husks also turn yellow to a bright green in color. This usually occurs 4 to 6 weeks later than the harvesting for fiber.

Harvesting of hemp for fiber can be done with existing baling machinery which includes a mower, rake, swather, and baler. Industrial hemp harvest can be broken down into six basic steps:

1. Chemical Defoliation (removal of unnecessary leaf mass with chemical use)
2. Cutting
3. Retting
4. Baling
5. Loading
6. Transport

When hemp is baled and then stored, the moisture content of the hemp stalks should not exceed 15 percent. Bales can be stored for long periods of time in dry areas which includes storage sheds, barns, and other covered storage areas (Dragla, 1997).

In the seed harvest a combine equipped with a dual beam cutter can be used. Harvest is currently the most problematic and the least understood aspect of hemp cultivation. More efficient and specialized harvesting machinery is needed to bring the handling of hemp up to date with the modern processes of small grains and corn.

The yields that hemp will produce depend on the land it is planted on, the growing conditions, and the farming techniques that are utilized. Yields of about 3 to 5 tons of baled hemp stalks per acre could be expected in fiber production (Dragla, 1997). After processing, this generally breaks down to around 1 ton of fiber and 3.5 tons of hurds. In seed production the yield can range from 12 to 25 bushels per acre according to the 1913 U.S. Yearbook of the Department of Agriculture.

### Benefits of Hemp Growth

The growth of hemp has other qualities beneficial to the land along with weed control and the obvious avoidance of harmful chemicals. Hemp loosens, mellows, and shades the soil; the fallen foliage also forms mulch and preserves moisture and bacteria in the soil. The root system penetrates deeply and decays quickly after the crop is cut; hemp's coarse taproots tend to loosen the soil more effectively than the fibrous roots of wheat, oats, and other similar broadcast crops. Hemp's taproot penetrates deep into the ground aerating the soil and at the same time preventing erosion.

As much as two-thirds of the organic matter is returned to the soil if hemp is field retted and land is easier to work up after hemp than after corn or small grains. Hemp also makes an excellent rotation crop. Although rotation is the most desirable, hemp can be planted on the same land for several years in succession. It is also possible that the introduction of hemp in a crop rotation could improve soil health (Dragla, 1997). Basically, industrial hemp is easier on the land than any other crops except for legumes such as clover and alfalfa.

## Summary

The purpose of this report was to study the feasibility and desirability of industrial hemp production in North Dakota (Fifty-fifth Legislative Assembly). The analysis was conducted by an extensive review of literature and discussions with trade sources. Since industrial hemp has not been produced in North Dakota since World War II, little current marketing research and agronomic information is available.

Literature revealed that production and processing of industrial hemp has the potential to be a viable industry in the United States and possibly North Dakota. The fact that hemp was grown successfully in southeastern North Dakota in the 1940s indicates that it will grow here. Advantages from an agronomic standpoint seem to be that it requires few pesticides or herbicides, is relatively disease free, and is a good rotation crop because it may enhance yields in crops that follow it.

Projected cost and return budgets for Ontario, Canada and Kentucky indicate that hemp could be a potentially profitable alternative crop. There is concern about the impact of increased production in the United States and Canada on world market prices.

World production of hemp has been declining even with subsidies, but the United States market for the myriad of hemp products from both fiber and seeds is projected to increase. North Dakota may even have a comparative advantage because a state of the art oil processing facility exists that is capable of processing hemp seed.

However, very little is known about the potential yield and quality of industrial hemp fiber and seed that could be produced in North Dakota. The relatively short growing season, variable soil types, fertility, and precipitation levels across the state are all concerns that need to be addressed. Furthermore, law enforcement agencies have legitimate concerns about their ability to enforce laws regulating the higher THC marijuana if industrial hemp is allowed to be produced.

## Recommendations

Since industrial hemp may have potential as an alternative rotation crop, it is recommended that the North Dakota Legislature consider legislation that would allow controlled experimental production and processing. Then, necessary baseline production, processing, and marketing data could be collected and analyzed. For example, all new enterprises require a critical threshold volume (CTV) in order to succeed in terms of economic profit. What is that volume and the acreage required to produce it? At the same time, the concerns and costs of law enforcement agencies could be addressed.

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# Appendix A

70484.0100

Fifty-fifth
Legislative Assembly
of North Dakota

**HOUSE BILL NO. 1305**

Introduced by

Representatives Monson, Olson, Nichols

Senators Heitkamp, Sand, Thane

A BILL for an Act to provide for a study of industrial hemp production by the agricultural experiment station.

BE IT ENACTED BY THE LEGISLATIVE ASSEMBLY OF NORTH DAKOTA:

**SECTION 1. North Dakota agricultural experiment station - Study of industrial hemp production.** The North Dakota agricultural experiment station shall study the feasibility and desirability of industrial hemp production in this state. The study must include an analysis of required soils and growing conditions, seed availability, harvest methods, market economies, environmental benefits, and law enforcement concerns. The study may also include the feasibility and desirability of other alternative cash crop production. The North Dakota agricultural experiment station shall report its findings and recommendations to the legislative council before August 1, 1998.

Page No. 1 70484.0100

# Appendix B

North Dakota State University
Agricultural Experiment Station
Department of Agricultural Economics
David G. Kraenzel
Agricultural Development

**Project Number:** To be assigned

**Project Title: StratSense™** (Strategic Sensitivity Scans). An advanced market data system for successfully assessing and entering existing or new agricultural value-added/commodity markets.

**Objectives:** The general objective is to identify market opportunities for existing, new or value-added North Dakota agricultural products. Specific objectives are:

1. To design a market data system for early identification/detection of potentially lucrative market opportunities.
2. Initiate and develop concepts (value-added propositions) and enablers (operational systems) for use in "going-to-market" or the execution of Sustainable Competitive Advantages (SCAs).
3. Develop market knowledge blocks and educational materials for targeted audiences.

**Justification:**

In the past few years, regional farmers, ranchers and agribusinesses have experienced shrinking profit margins at the farm gate marketing level (Hauck, Kraenzel and Rose, 1997). As this margin between prices received and costs incurred narrows and the food market is increasingly driven by consumer demand, producers are faced with a decision. Do they continue to do the same thing? Do they differentiate their product at the farm gate? Do they get closer to the consumer? Or, do they do some of each? Any decision other than continuing to do the same thing means they have selected to pursue value-added marketing opportunities.

The NDSU College of Agriculture, the Agricultural Experiment Station and NDSU Extension Service are working with industry to make a concentrated effort to address developing a market-oriented approach to producing existing, new and value-added agricultural products. My current position as agribusiness development specialist was created to assist in meeting this need. Previously, the high-value crops coordinator position was created in Barnes County to begin to build up the statewide production base for specialty value-added crops. As this base grows the need to focus on markets is critical as markets must lead production, but by the same token production must be geared up to meet emerging markets. There is an increasingly faster paced United States and world food supply system than was operating in the past (IAMA Conference, 1997). Vertical integration and vertical coordination create the need for timely accurate market information on a real-time basis to guide short, intermediate and long term production and enhance profitability (Saxowsky and Duncan, 1998).

The impact of this project will be to develop a market-oriented framework for agricultural producers and agribusinesses to define market opportunities and to form strategies to pursue those opportunities. This market data system is highly responsive to the rapidly changing (Real-Time) consumer driven market environment. This system will assist the agribusiness sector in being highly competitive in the global economy as measured by market share, volume of business (product) and dollars while being supportive of rural communities at the same time. In addition, there will be enhanced economic opportunities and quality of life for North Dakotans as measured by the number of living wage jobs and income levels.