Potential of Canola in Michigan

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ABSTRACT
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This study consists of four different aspects of canola in Michigan with special emphasis on northern Michigan. The economic feasibility of canola as an alternative cash crop, potential canola growing area, feasibility of establishing canola processing plant(s) in northern Michigan and the canola marketing situation in Michigan were appraised. Secondary data, previous research results, key informant interviews, informal visits, expert opinions and survey data were used to study these aspects of canola.

Review of past agronomic research results showed that canola can successfully be grown in various part of Michigan, including northern Michigan. Break-even analysis of canola with other alternative crops like wheat, corn, oats and soybeans suggested that canola can be more profitable than these crops whereas it cannot compete with kidney beans, dry beans and potatoes.

Key informant surveys revealed that out of 598,000 acres of cultivated land in Northern Michigan, approximately 10,000 acres would be shifted to growing canola immediately, under the assumption of no marketing problems. The area would be sufficient for supplying canola to run two small to medium scale processing plants at full capacity.

The economic feasibility of establishing canola processing plants has been evaluated in depth. Net present value (NPV) and internal rates (IRR) of return of proposed operations are encouraging. Various possible scenarios have been analyzed and it is concluded that canola processing has potential, particularly in northern Michigan.

The case studies with grain elevators showed that canola handling might be profitable and that there is good potential for canola in Michigan. The major bottleneck in this sector is the lack of processing facilities in Michigan. Farmers are presently reluctant to grow canola due to perceived difficulties in marketing. Grain elevators are not handling canola at present time because of the very small volume of production. All of the respondents believed that the development of canola processing plant(s) or a strong marketing chain is necessary to stimulate the canola sub-sector in Michigan.

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Chapter 1: Introduction and Problem Statement

1.1 Problem Statement

Many high yielding, low erucic acid, Canola varieties are available and have been successfully tested throughout Michigan, including the Upper Peninsula. Most successful production of winter canola has been in southern Michigan where it has better winter survival compared to northern locations. Spring canola is more successful in northern Michigan where winter canola varieties do not survive the winter. Yields of winter canola varieties ranged from 2,087 to 3,214 lbs/acre in 1991 and spring canola yielded 1,794 to 2,310 lbs/acre in 1992 (Department of Crop and Soil Sciences, 1993). Comparative economic analysis of canola with other prevailing crops of Michigan has shown that it can be a profitable alternative crop (Asuming-Brempong et al., 1995).

Private seed companies (e.g. Calgene) are interested in production and distribution of different transgenic lines (cultivars) of canola that can become valuable in product differentiation in the market place.

People in the United States and throughout the world are increasingly interested in canola/rapeseed oil for both edible and industrial uses. Thus, the demand for all rapeseed, including canola, has increased dramatically in the recent past. Farm level production, consumer demand and technical achievement in product differentiation are encouraging.

However, merely developing high yielding varieties, equipment, and cultural practices are not sufficient to establish a new crop. It also requires establishment of a new commodity sub-sector that will take the crop from input supply to the consumption level. In spite of production potential on one hand and high demand for the products on the other, the Michigan canola industry has not developed well. Thus, the major impediments to this sub-sector need to be identified, along with possible measures to overcome them.

The livestock industry is perhaps the most important sector of the northern Michigan economy. Large amounts (about *36,000 tons*) of soybean meal are transported to northern Michigan every year as feed for livestock. Furthermore, northern Michigan farmers have few alternative cash crops. Several new crops have been proposed but have not been successful because they are either not agronomically adapted or have limited markets (Martin et al., 1996). On the other hand, canola has been shown to be adopted in northern Michigan and there is a large market for its by-products. Although a local market does not presently exist for the unprocessed canola, the establishment of this commodity sub-sector could provide an alternative cash crop for northern Michigan as well as a high protein feed supplement as an alternative to imported soybean meal.

The most recent survey has demonstrated the lack of delivery points handling canola throughout Michigan. An earlier survey by Yumkella (1993) revealed that few grain elevators were willing to buy canola due to the perceived risk in handling it. However, since that time the canola acreage in Michigan has continued to decline. It is concluded that this decline has occurred because of the lack of a processing facility in Michigan. It is believed that the establishment of one or more small scale nonconventional (extruding and expelling) canola processing plants somewhere in northern Michigan could provide a jump-start for promoting canola as a cash crop which could in turn boost the livestock industry of the area.

Table 1 shows the reasons given by previous producers as disadvantages of canola production in Michigan. Some of the reasons in Table 1 are a reflection of the problem of new, inexperienced growers trying to sell the 1991 crop. Weather conditions in 1991 were particularly hot and unfavorable for canola (a cool season crop), resulting in poor seed development and low yields. Similarly, cold and wet weather during the harvest in 1992 deteriorated crop quality and further discouraged producers. Many growers, in attempting to market their crop in Windsor (ADM) were greeted with high discounts or rejections because of high moisture. Because of such experiences, Michigan growers are reluctant to adopt a crop that must be marketed in Windsor, Canada across an international boundary. However, markets do exist for canola based on the Winnipeg futures prices. Therefore, fluctuations in the exchange rates of Canadian dollars is also an area of concern. Furthermore, selling by individual growers to distant markets increases marketing costs along with the difficulty of gathering market information, negotiating prices, and transportation to the market. Since processing the crop involves large, costly plants, the closest market is located at Windsor, Ontario at the present time. However, Michigan growers have no alternative for marketing their crop.

Table 1. Major Problems Perceived by Michigan Canola Growers.

S. N.	PROBLEMS	MEAN RATING*
1	Very Few Number of Buyers	4.05
2	Crop Quality Discount	3.72
3	Storage	3.64
4	Lack of Price Alternatives	3.54
5	Transportation	3.53

**Means computed based on scores of five to one (five very important and one unimportant).*
Source: *Department of Agricultural Economics, Staff Paper #93-54, M.S.U.*

1.2 <u>Objectives of the Study</u>

In spite of growing interest, the ability of canola and its products to capture a larger share of U.S. oilseed markets and farm resources depends on a number of factors including whether a market for the products exist, and if so, if the crop be produced profitably are important ones. This study focuses on these research questions. The specific objectives of the study were:

- To study the economic feasibility of canola as an alternative cash crop for northern Michigan farmers.
- To determine the potential production areas of canola in northern Michigan at given price levels of canola vs. existing crops.
- To review the feasibility of small-scale non-conventional processing plants in Michigan and analyzing different possible scenarios.
- To study the present canola marketing situation in Michigan.

1.3 Hypotheses of the Study

- Canola is a profitable alternative cash crop for northern Michigan farmers.
- There is potential for small-scale canola processing plants in Michigan.
- Northern Michigan has sufficient potential area to provide canola to operate a small scale processing plant for the entire year at full capacity.

1.4 Organization of the paper

The paper is organized in different chapters. Chapter 1 deals with the general problem statement, objectives and hypotheses of the study and background of canola. Different aspects of canola in Michigan are discussed in separate chapters. The second and third chapters discuss the economic and agronomic feasibility of canola production in Michigan, including:

- Crop enterprise budgets of existing crops and break-even analysis of these with canola.
- A review of canola adaptation studies and potential canola acreage in northern Michigan counties. This area includes the entire Upper Peninsula and several northern counties in the Lower Peninsula. The study also considers the amount of canola seed that can be produced in the area.

The fourth chapter reviews the feasibility study for a canola processing plant in Michigan, including:

- A medium sized canola processing plant model and the total amount of canola required to supply the plant for one year.
- Different potential scenarios and cost/benefit analysis.
- The possible impacts of such processing plant to promote canola as a cash crop for northern Michigan farmers.
- Demand of meal as livestock feed in northern Michigan.
- Comparison of soybean and canola meal and relative profitability of processing canola.
- A simple plant location analysis for canola processing in Michigan

The fifth chapter discusses three case studies in the present canola marketing system. These case studies are presented with three leading Michigan grain elevators.

1.5 Background of Canola

The term CANOLA stands for Canadian oil, low acid. Canola is a cool season crop in the mustard family. Research in the 1960s and 1970s in Canada led to varieties of rapeseed with low erucic acid content (Younts, 1990). Canola is broadly grown in Canada and western Europe as an alternative crop to wheat *(Triticum aestivum L.)*. Canola oil is an ideal alternative to other vegetable oils due to its very low saturated fat content, which, at 6% is the lowest of all important food oils, compared with 15% for soybean oil and 86% for the palm oil (Thompson et al., 1993). Consumer opinions govern the success of any food product in the marketplace and health conscious consumers are attracted toward this low acid vegetable oil which is enjoying a rapid worldwide increase in the edible oil market.

1.5.1 History

Rapeseed was cultivated in the 20th Century B.C. in India. It was introduced into China and Japan near the time of Christ. Different crops belonging to Brassica species have been cultivated since prehistoric time for their edible plant parts. About 3,000 species of Brassica are found in the northern hemisphere. Rapeseed was developed and has been used as an oilseed crop for centuries. The term rapeseed came from the Latin word "rapum" meaning turnip.

Canola was introduced in Michigan in the mid 1980s (Yumkella et al., 1993). Rapeseed grown in the past had higher levels of erucic acid, and research in 1960s indicated the acid could be harmful to human health. Research and breeding programs in Canada were successful in developing rapeseed with erucic acid levels of 2% or lower and were termed as "canola".

1.5.2 Botanical Description

Canola belongs to the mustard (Brassicaceae) family. It was developed as a high quality genetic modification of rapeseed as either *Brassica napus* or *Brassica compestris* species. Botanically, it is related to cauliflower, cabbage, turnip and mustards. This genetic relationship is important since it provides a wide genetic base for varietal improvement. All of the commercially important canola grown in the U.S. is of the *B. Napus* type (Copeland et al., 1993). Crushing (processing) canola results in about 40% oil and 58% percent meal by weight (Story et al., 1993). Canola contains high levels of edible oil (40-44%) and protein (23%).

1.5.3 Agronomic Characteristics

Canola has wide adaptability and can perform well under variable condition, depending on the variety grown. *Brassica napus* requires 1,040 to 1,100 growing degree days compare to 860 to 920 *for B. compestris.* Agronomic characteristics vary among species and varieties (Table 2). Studies have shown that the Michigan climate is favorable for growing canola. Both winter and spring varieties are available. Mild winters moderated by the Great Lakes make southern Michigan a favorable location for winter canola. Mild, relatively cool summers also allow production of spring planted canola in northern Michigan (Copeland et al., 1993).

Table 2. Characteristics of Two Types of Canola Grown in Michigan.

Characteristics	Spring Canola	Winter Canola
Maturity	95-100 days	10 plus months, July harvest
Height	30-45 inches	40-60 inches
Cold Tolerance	Tolerates light freeze	Overwinters
Seed Yield (lbs/acre)	1,500-2,500	2,000-3,000
Seeds/lb	125,000-150,000	100,000-125,000
Adaptation	Northern Michigan and U.P.	Southern Michigan and U.P.

Source: *Canola Production in Michigan, Department of Crop and Soil Sciences, M.S.U. 1993.*

1.5.4 Varieties

Several spring and winter canola varieties are available from commercial seed companies. Some of these varieties have been tested in Michigan. The performance of several varieties tested in northern Michigan are listed in Table 3.

Table 3. Performance of Different Canola Varieties (Upper Peninsula Experiment Station, Chatham, MI — 1991 and 1992).

Variety (Winter 91)	Yield (lbs/acre)	Variety (Spring 92)	Yield (lbs/acre)
CXW02	3,214	Pactol	2,310
CC349	3,066	Cyclone	2,166
Liborious	3,041	Printol	2,087
CXW03	2,587	Hyola 401	2,073
Amcan	3,173	MLCP 035	1,991
Ceres	2,897	Polo	1,970
Cobra	2,715	ICN 24	1,895
Diaden	2,126	Bingo	1,812
D931	2,087	Iris	1,794
LSD (0.05)	**700**	**LSD (0.05)**	**459**

Source: *Three-year Canola and Rapeseed Research Report, pp. 30-31, Department of Crop and Soil Sciences/Agricultural Experiment Station and Cooperative Extension Service.*

1.5.5 Nutritional Value

Canola oil is considered as an ideal vegetable oil due to its very low saturated fat content (6%) which is the lowest of all important vegetable oils. Further studies on performance of the oil in different food products such as snacks and other fast foods are being conducted. Canola oil is used as a cooking oil, for salad dressing and for margarine. It has earned a good reputation as a health food oil and won the health food of the year award in the U.S. Canola meal is used as a protein food in livestock production. The protein content of canola meal is lower than that of soybean meal and has higher fiber content. Canola meal is mainly used for ration for pigs, dairy cattle and poultry.

1.5.6 Alternative Use of Canola

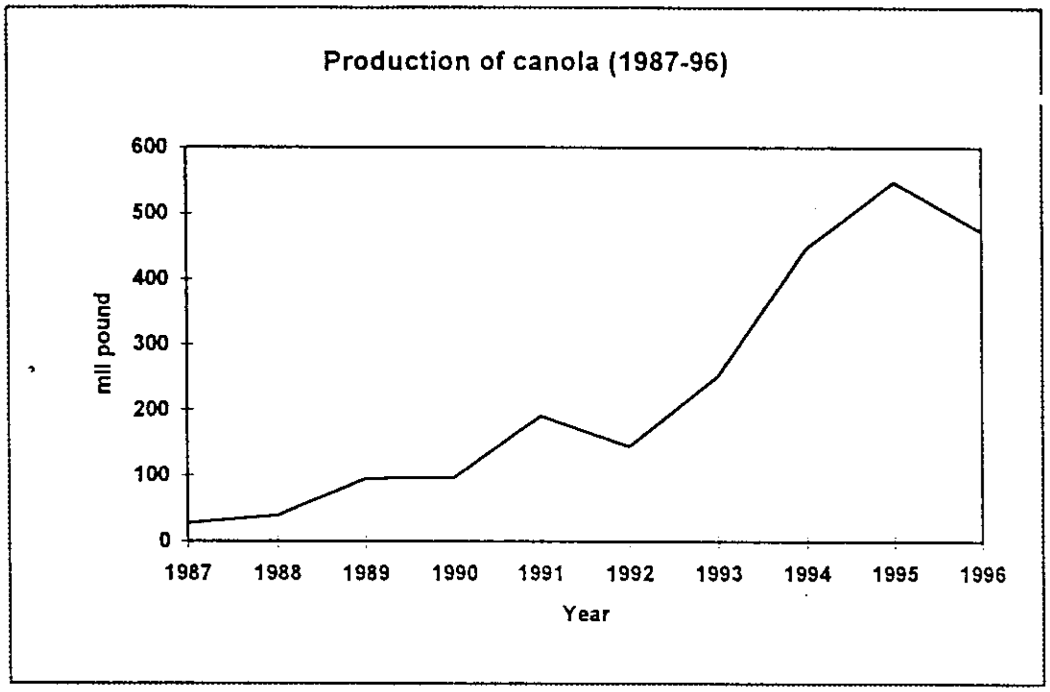
Significant achievements have been made in the development of canola and rapeseed varieties with specific fatty acid profiles that makes them useful for specific purposes such as:

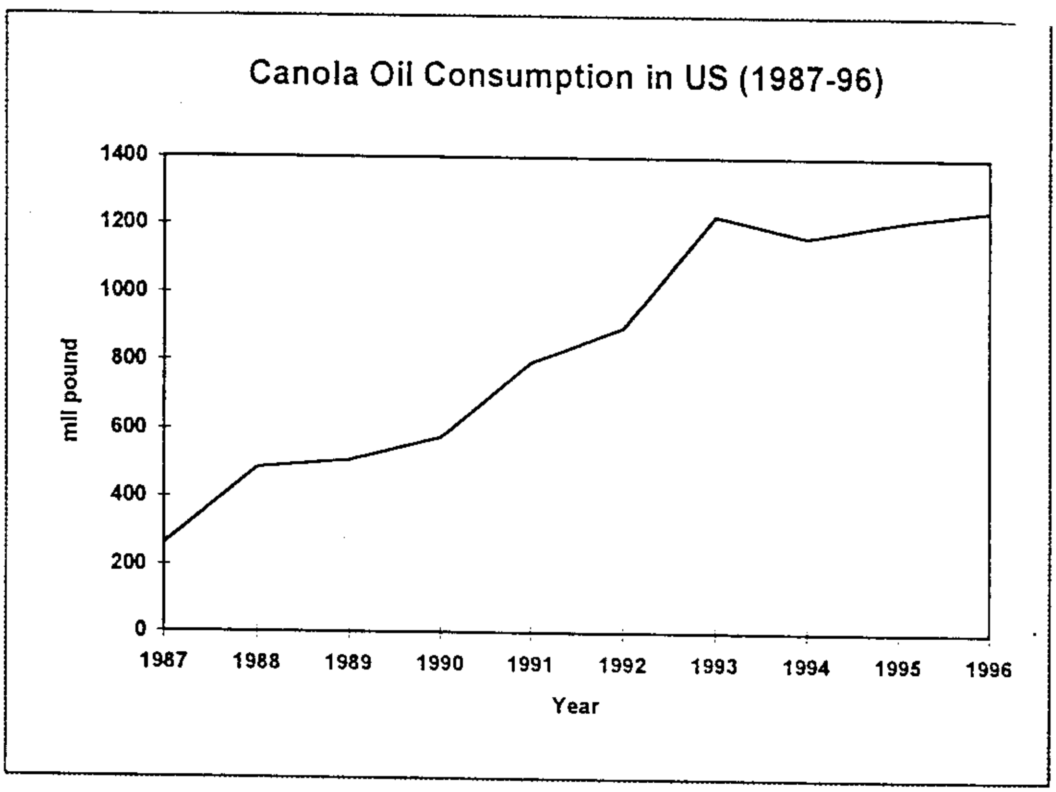
- High-lauric acid rapeseed used in the manufacture of detergents,
- High-stearic acid canola used for margarine because the oil is a natural solid at room temperature,
- High erucic acid rapeseed that can be used in the manufacturing of plastics, lubricants and bio-diesel.

1.5.7 Government Programs and Canola

In 1985, the U.S. Food and Drug Administration granted canola the status of GRAS or "generally recognized as safe". Since then the demand for canola in U.S. markets has increased dramatically and the production of canola in the U.S. has increased rapidly. Furthermore, 1990 legislation allowed the production of oilseed crops on flex land, and oilseed marketing loan provisions contributed to the expansion of the canola growing area and increased importance of this sub-sector. However, the 1995 farm bill (Freedom to Farm Act) ended the provision of oilseed production on flex acres since set aside programs were eliminated.

Figure 1, Production of Canola Seed and Consumption of Canola Oil in the USA





Source: *Oil Crops Yearbook, United States Department of Agriculture, Economics Research Service, October 1996.*

The above line graph (Figure 1) suggests the rapid increase of canola production and consumption of canola oil in the U.S. by year. The production was less than 50 million pounds in 1987 and it increased to about 600 million pounds within a period of nine years. Similarly consumption of canola oil is increasing very rapidly. This trend tells us something about the economic importance of this crop in the future

Table 4 shows that the proportionate increase in production of rapeseed (including canola) is higher than that of other competing oilseed crops. This increase may be in part due to health attributes of canola. Rapeseed oil has also been used as bio-diesel and other industrial uses.

Table 4. World Oil Seed Production (1989-1996).

	Million Metric Tones						
	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96
Soybean	107.27	103.62	107.38	117.30	117.50	137.44	123.82
Cottonseed	30.89	33.48	36.52	31.49	29.66	32.99	34.06
Peanuts	22.06	22.12	22.18	23.08	23.99	26.62	25.99
Sunflower	21.87	22.02	21.82	21.31	20.76	23.61	25.91
Rapeseed*	21.85	25.78	28.27	25.31	26.76	30.85	35.09
Total	214.01	217.68	224.31	227.41	427.88	261.42	254.57

**Rapeseed includes canola*

Source: *Oil crops: Situation and Outlook Report. USDA, Economic Research Service. World Markets and Trade. May-Global 1995/96 Oilseed Highlights. USDA, Foreign Agricultural Services.*

Table 5 shows the increasing canola acreage planted and harvested in the U.S. in recent years. The area harvested for canola was 112,000 acres in 1992 and it increased to 443,000 acres in 1995.

Table 5. Minor Oilseeds: Planted and Harvested Acres, U.S., 1992-95.

	1,000 Acres							
	Area Planted				Area Harvested			
	1992	1993	1994	1995*	1992	1993	1994	1995
Safflower	341.0	404.0	240.0	240.0	307.0	293.0	228.0	230.0
Flaxseed	171.0	206.0	178.0	213.0	165.0	191.0	171.0	206.0
Canola	140.0	199.0	354.0	459.0	112.0	187.0	340.0	443.0
Mustard seed	15.3	18.1	13.6	15.6	14.8	16.4	13.4	15.4
Rapeseed	12.0	7.2	7.4	4.6	9.8	6.1	6.7	4.2

Source: *USDA Publications.*

Table 6 shows the supply and demand situation in the past nine years. We can conclude from this table that both demand and supply of canola seed in U.S. markets is increasing. Based on information presented in the three previous tables, there is a high potential for the canola crop in the United States.

Table 6. Canola Seed: Supply and Disappearance in Million Pounds, U.S. 1987/88-1995/96.

Year (beg. June 1)	Supply				Disappearance			
	Beg. Stock	Production	Imports	Total	Crush	Exports	Total	Ending Stock
1987	3	27	2	32	30	0	30	2
1988	2	39	37	78	71	4	75	3
1989	3	95	231	329	298	10	308	21
1990	21	97	141	259	195	32	227	32
1991	32	191	2	225	109	97	212	13
1992	13	144	27	184	159	104	174	10
1993	10	252	773	1,036	850	78	940	95
1994	95	447	661	1,204	992	165	1,170	34
1995	34	584	661	1,280	1,048	165	1,230	50

Source: *Oil Crops Yearbook, United States Department of Agriculture, Economic Research Service, July 1995.*

Chapter 2: Break-Even Analysis of Canola with Other Existing and Alternative Crops (Northern Michigan)

2.1 Problem Statement

Canola is a comparatively new crop in Michigan. Both spring and winter varieties can be successfully grown. Canola offers producers several benefits, including profitability compared with other existing crops, it does not require additional production equipment and it helps to spread labor throughout the year. Canola can also provide valuable meal for the livestock industry in northern Michigan. Consequently, it is important to assess whether canola can be a profitable alternative crop in northern Michigan. Break-even analysis can provide farmers with a basis for deciding whether it is economically feasible to shift to canola or not.

2.2 Concepts

In break-even analysis, returns to basic factors of production (land, labor, machinery and management) from different alternative crops are compared as a criteria for their profitability. Variable costs (costs that are incurred if production occurs) relative to gross revenue are compared in break-even analysis. Hilker et al. (1987) developed a method of comparative break-even analysis and referred to the existing and alternative crops as "defender" and "challenger", respectively. The break-even price and break-even yield of the challenger are computed as follows:

$$BEP_c = (VC_c + RFF_d) / Y_c$$

$$BEY_c = (VC_c + RFF_d) / P_c$$

Where:

BEP_c = Break-even price of challenger

BEY_c = Break-even yield of challenger

VC_c = Challenger's variable cost (preharvest cost, harvest cost, drying and marketing cost)

RFF_d = Return to fixed factors from existing crop (gross margin less variable cost)

P_c = Price of challenger

Y_c = Yield of challenger

In order to be a more profitable crop, the challenger's returns to fixed factors should exceed the defender's return to fixed cost. A sensitivity analysis is also important to see the possible scenarios of risk and uncertainty of yield and prices.

2.3 Methodology

- The average yields of different crops in northern Michigan counties were obtained from Michigan Agricultural Statistics published by the Michigan Department of Agriculture.
- The data on application and prices of inputs were obtained from "1995 Crops and Livestock Budget Estimates for Michigan" (Nott et al., 1995). The application rates were decided based on the yield level of the crop in the area. Application of

inputs and cost were based on the level of yield expected. These data were the basis for the analysis.

- After compilation of all these secondary data, these were sent to selected northern Michigan counties[1] for verification.
- After we got feedback on the yield level, application rate and price; we modified the data to make it more realistic in northern Michigan conditions and run the break-even analysis.
- The break-even analysis was done using Quattro Pro spread sheet. Variable costs (costs that vary), prices of products and yields were entered in the spread sheet. Then break-even yields and break-even prices of canola with different crops were calculated.
- After the break-even analysis, we sent results again to MSU extension agents in five different northern counties to get their feedback on whether the data used in the analysis were realistic in the northern Michigan conditions or not.
- Final revision was made in the analysis and sensitivity analysis was done to see the possible scenarios after we got feedback from the selected counties.

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1 Counties selected based on the experience of the County Ext. Director on canola.

2.4 Results and Discussion

Table 7. Results of Break-Even Analysis.

Defender Crop==>	Wheat	Corn Grain	Barley	Soybean	Oats
Yield Bu/Acre	35.30	83.8	50	26.5	53.3
Price $/Bu	$3.40	$2.50	$2.20	$6.20	$1.52
Gross Revenue	$120.02	$209.50	$110.00	$164.30	$81.02
Variable Costs:					
Preharvest Cost/Acre	$95.70	$143.57	$71.55	$102.75	$50.46
Harvesting+Drying+Marketing/Acre	$21.77	$81.85	$14.10	$15.65	$8.10
Sum of Variable Cost (VC)	$117.47	$225.42	$85.65	$118.40	$58.56
Return to Fixed Costs (RTFC)	$2.55	($15.92)	$24.35	$45.90	$22.46
Challenger Crop (canola)					
Preharvest Cost/Acre	$110.85	$110.85	$110.85	$110.85	$110.85
Harvesting+Drying+Marketing/Acre	$25.40	$25.40	$25.40	$25.40	$25.40
Sum of Variable Cost (VC)	$136.25	$136.25	$136.25	$136.25	$136.25
To bid away RTFC Challenger> RTFC Defender					
Yield (Canola) Bu/Acre	30.00	30.00	30.00	30.00	30.00
Break-Even Price	$4.63	$4.01	$5.35	$6.07	$5.29
Price (Canola)	$6.00	$6.00	$6.00	$6.00	$6.00
Break-Even Yield	23.13	20.06	26.77	30.36	26.45

Table 7. Continued

Defender Crop==>	Dry Beans	Kidney Beans	Potatoes	Hay
Yield Bu/Acre	14.00	13.5	290	2.0 (ton)
Price $/Bu	$18.70	$32.00	$5.00	$64.00
Gross Revenue	$261.80	$432.00	$1,450.00	128.00
Variable Costs:				
Preharvest Cost/Acre	$109.05	$135.10	$1,071.70	
Harvesting+Drying+Marketing/Acre	$6.95	$37.10	$201.10	
Sum of Variable Cost (VC)	$116.00	$172.20	$1,272.80	$36.80
Return to Fixed Costs (RTFC)	$145.80	$259.80	$177.20	$91.20
Challenger Crop (canola)				
Preharvest Cost/Acre	$110.85	$110.85	$110.85	$110.85
Harvesting+Drying+Marketing/Acre	$25.40	$25.40	$25.40	$25.40
Sum of Variable Cost (VC)	$136.25	$136.25	$136.25	$136.25
To bid away RTFC Challenger> RTFC Defender				
Yield (Canola) Bu/Acre	30.00	30.00	30.00	30.00
Break-Even Price	$9.40	$13.20	$10.45	$7.58
Price (Canola)	$6.00	$6.00	$6.00	$6.00
Break-Even Yield	47.01	66.01	52.24	37.91

From this break-even analysis we may conclude that the return to basic factors of production (land, labor, machinery and management) from canola is higher than that of different existing crops like wheat, corn and oats in given level of yield and price of canola (30 bushels/acre and $6.00/bu, respectively) and existing crops. Break-even analysis showed that soybean crop is more profitable than the canola. So it is not economically feasible to shift from soybean to canola. It should be noted that soybean is not adoptable to most of the locations in northern Michigan.

It is not economically feasible to shift from beans, potatoes and hay to canola since return to fixed factors of production from canola is lower than from these crops. Similarly, break-even yields of canola to bid away the resources from wheat, corn and oats are lower than its average yield, 30 bu/acre. It means that the switch from these three existing crops to canola is feasible. The break-even yields of canola with beans, potatoes and hay is very high so it cannot bid away resources from these crops. So replacing these existing crops by a less profitable canola crop is not feasible.

The numbers used in breakeven analysis may change or be different for various situations. The concept and method used to calculate breakeven yields and prices to compare the different alternative crops do not change.

Chapter 3: Potential Acreage of Canola in Northern Michigan

3.1 Problem Statement

Break-even analysis of canola with different crops in Chapter 2 has demonstrated that canola can be a profitable crop in northern Michigan. As described in Chapter 1, northern Michigan has an urgent need of a profitable alternative cash crop that can lead to economic development.

A processing plant in the northern Michigan area could entice local farmers to grow canola, whereas they are now reluctant to produce a crop that must be transported to a distant market (Windsor) because of perceived difficulties in transportation and price uncertainty. However, farmers have expressed interest in growing canola if there were canola processing plants in their area or somewhere in Michigan. Some agribusiness firms have shown interest in establishing canola processing plants in Michigan. However, they need assurance that adequate supplies exist for seed processing the year-round. So, it seems to be a matter of the "proverbial chicken and egg".

Estimating the potential acreage of canola in the northern part of Michigan under the conditions of:

1. Presence of one or more canola processing plants in Michigan,
2. Local marketing terminals,
3. Given yields and price levels of canola so that it is profitable compared to alternative crops would be an important step toward establishment of canola in northern Michigan.

1.2 Concepts

Farmers may switch to canola from the existing crop if:

- Canola fits into the crop rotation.
- Canola can give higher return to labor and fixed cost of production.

Shifting to this new crop requires an economic incentive for growers. There are risk factors that must be considered when adopting a new crop, so break-even price and break-even yield may not be an appropriate measure of needed return. Certain levels above the break-even point (say 15% more, for example) may be required to motivate growers to adopt what they might perceive to be a more risky venture. This includes:

- Assured market for their produce.
- Shifts to a new crop takes a considerable time lag. Less innovative farmers do not adopt new technology readily.

3.3 Methodology

- Data on total cultivable acreage was obtained from Michigan Department of Agriculture, and this was verified by County Extension Directors, however, some necessary modification was done.
- A key informant survey (telephone survey and informal meetings) was conducted to find out the existing crop rotations and extra margin required to cope with the risk involved in shifting to the new crop "canola". Respondents to the survey were County Extension Directors and Extension Agents.
- The key informant survey (export opinion survey)was guided by the following questions/issues:

  -- Total cultivable land in different counties (consistency with data obtained from Michigan agriculture statistics).

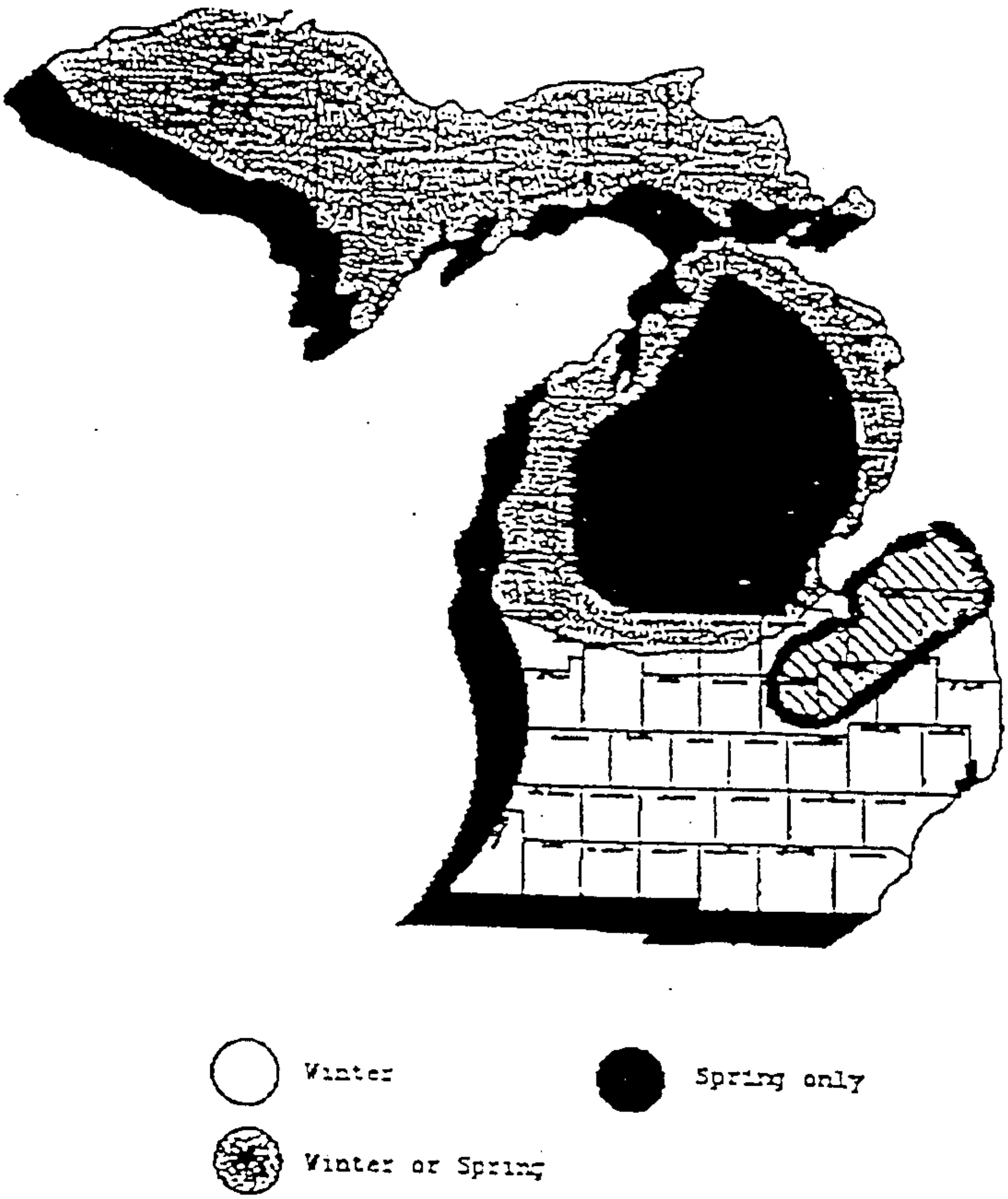
  -- Dominant cropping pattern in the area.

  -- Crop to be replaced by canola? How many acres will it cover?

  -- Additional return required from canola per acre (from break-even point) in order to shift to canola?

  -- Canola acreage expected in northern Michigan.

Figure 2. Michigan Map Showing Potential Canola Growing Regions



3.4 Results and Discussion

Table 8. Area Under Different Crops in Northern Counties (3 yrs average).

County	Cultivated area	Barley	Beans	Corn	Soybean	Oats	Wheat	Hay	County Total	Possible canola*
Alcona	28,738	217	917	2,167	33	800	650	15,067	19,851	100
Alpena	55,482	567	7,617	7,433	360	6,067	1,700	20,833	44,577	500
Antrim	32,965	33	333	3,833		983	350	9,500	15,032	100
Benzie	10,723			1,333		33		2,033	3,399	100
Cheboygan	26,660	433	167	1,767		633	117	13,033	16,150	500
Charlevoix	25,246	383		3,000		400		10,133	13,916	300
Emmet	25,926	267		2,333		750		12,400	15,750	300
G.Traverse	46,467	267		6,500		967	2,467	11,300	21,501	300
Iosco	29,498	417	317	7,767		1,533	1,733	13,467	25,234	1,500
Kalkaska	12,045			1,400		33	517	3,500	5,450	100
Leelanau	42,279			4,033	117	350	200	6,067	10,767	2,000
Montmorency	13,036	467	783	2,100	247	1,167	800	5,467	11,031	500
Missaukee	63,321	33		13,467		1,933	833	26,733	42,999	500
Menominee		2,650	200	15,025	150	3,300	300	31,500	53,125	200
marquette		500		500	675		5,000		6,675	100
Manistee	27,299		1,233	1,700		367	257	8,067	11,624	200
Ogemaw	54,875	110	488	11,000	67	2,467	1,733	24,000	39,865	1,000
Otsego	19,911	183	67	1,233		783	433	11,233	13,932	500
Oscoda	8,594			650	50	50	1,633	5,000	7,383	600
Presque Isle	51,617	1,600	6,450	4,533		5,100		17,933	35,616	500
Roscommon	2,723						560		560	200
Wexford	20,366	33		3,067	33	567	650	8,600	12,950	500
Total	597,771	8,160	18,572	94,841	1,732	28,283	19,933	255,866	367,587	10,600

Source: *Michigan Agriculture Statistics, Michigan Department of Agriculture.*
**Estimated by County Extension Directors with input by Dr. L.O. Copeland, Professor, Department of Crop and Soil Sciences, Michigan State University.*

A total estimate of 597,771 acres of land is cultivated in this region. Detailed break down of acreage in different crops is in the Table 8. We showed in the previous chapter that the canola could be profitable crop, compared with existing crops like wheat, soybean, corn and barley. It is not expected to replace these crops immediately by canola due to other factors involved in adoption of the crop. According to the survey, canola can be grown at least on 10,300 acres of land. This estimate is out of 597,771 cultivated land, i.e., only about 1.6 % of total cultivated land and is more conservative. However, Copeland[2] estimates the potential northern Michigan acreage adapted to canola to be between 50,000 and 75,000 acres over time.

[2] Dr. Larry Copeland is a professor in the Department of Crops and Soil Sciences at Michigan State University. He has studied and worked on canola in Michigan over a decade.

Chapter 4: Feasibility Study of a Canola Processing Plant in Michigan

4.1 Problem Statement

The nearest canola processing plant is located in Windsor, Ontario, Canada. As indicated earlier, Michigan is lacking in canola handling and processing facilities. Establishment of a large conventional type (hexane extraction) processing plant may not be feasible in Michigan because it involves huge capital investment on one hand and the Michigan canola acreage may not be sufficient for supplying the processing plant for year-round operation. Small scale extruding and expelling processing plants consisting of two or three lines of extruders and expellers depending on the availability of canola, might be more feasible.

4.2 Concept

4.2.1 Present Value Analysis

Present value analysis is a tool for feasibility studies. The model is a mathematical relationship that depicts the value of the discounted future cash flow in the current period. Net present value is the present value of the incremental net benefit or incremental cash flow stream (Gittinger, 1982). The net present value (NPV.) can be expressed as:

$$NPV = -V_0 + \sum_{n=1}^{t} \frac{R_n}{(1+r)^n}$$

Where ,

V_0 = The amount of initial investment
R_n = Cash return in each period
n = Length of the investment
t = Last year of the investment's cash flow
r = Discount rate used in the investment

Net present value is an important indicator for deciding whether an investment is profitable or not. If NPV is positive, it indicates that the present value of the firm's equity will increase by the amount of NPV if investment is undertaken.

4.2.2 Internal Rate of Return (IRR)

It is a measure that is frequently used in present value analysis. IRR is the discount rate that makes the NPV of the investment's cash flow equal zero. In other words the IRR is the maximum interest that a project could pay for the resources used if the project is to recover its investment and operating costs and still break even. Mathematically this situation is difficult to express and is calculated by trial and error method (Gittinger, 1982).

4.2.3 Sensitivity Analysis

Sensitivity analysis involves the evaluation of scenarios under the state of uncertainty. It gives the idea about what happens to the earning capacity of the project if events differ from assumptions made during planning. How sensitive is a project's net present worth at financial prices and economic rate of return or net benefit-investment ratio, to increased construction cost, to fall of prices? Reworking an analysis to see what happens under these changed circumstances is called sensitivity analysis. Sensitivity analysis has important implications for investment decisions and project management (Gittinger, 1982).

4.3 Methodology

"Canola Processing in Michigan: A Feasibility Analysis of an Extruding and Expelling System" (Martin et al., 1996) is the basis for this study. We reviewed the paper and analyzed different possible scenarios. The total amount of canola required to run the plant at different capacities was estimated. Sensitivity analysis were done to decide the possible impact of changing certain assumptions. Furthermore, we have worked on the demand and supply possibilities of canola meal for the livestock industry in northern Michigan. Additional information was collected from different key informant persons and from published documents.

4.4 Results and Discussion

Table 9. Net Present Value and Internal Rate of Return Estimates Under Different Scenarios

	Double 2500 Extruder			Single 2500
	A	B	C	D
Opportunity cost of capital (%)	10	10	10	10
Land	$3,000	$3,000	$3,000	$3,000
Site Preparation and Building	$38,000	$0	$38,000	$38,000
Storage Equipment	$84,104	$84,104	$84,104	$42,052
Office Building and Equipment	$16,500	$0	$16,500	$16,500
Canola Purchasing Price	$5.00	$5.00	$6.00	$5.00
Price (Oil)	$0.28	$0.28	$0.30	$0.28
(Meal)	$0.09	$0.09	$0.10	$0.09
NPV	$838,651	$896, 851	$576,960	($581,772)
IRR %	25.8	29.21	20.50	Negative

In Scenario "A", the costs of storage are assumed to be $84,104. Canola purchase and canola oil price are put at a minimum of $5.00 per bushel and $0.28 per pound, respectively. The price of byproduct (i.e., canola oil) is assumed to be $0.09/lb. The net present value (NPV) is $838,651 and the internal rate of return (IRR) is 25.8% percent. This implies that it is profitable to invest in canola processing (NPV is positive) if the opportunity cost of capital is less than 25.8 percent.

Scenario "B" assumes that there is an existing storage facility and all that is required is the processing and storage equipment. This scenario applies the typical case of an elevator who chooses to expand into canola processing. In this case also price of canola seed, oil and meal is assumed to be same as in scenario B. The NPV is $896, 851 and the IRR is 29.21 percent. This scenario has good potential for profitability for the investors since the IRR seems to be higher.

Under Scenario "C" the purchase price of canola is $6.00 per bushel and canola oil and meal sells at $0.30 and $0.10, respectively per pound. The NPV under this scenario is $576, 960 and the IRR is 20.50 percent. Under Scenario "D" costs to all items are proportional. It is assumed that there will be only one line of processing (a single extruder). Due to the very small scale of operation net present value is negative. This scenario is not feasible since it doesn't meet the economy of scale.

Table 10. Other Alternate Scenarios.

Descriptions	Scenario I	Scenario II	Scenario III	Scenario IV
Machine/Model	2500 Inst Pro.	2500 Inst. Pro	2500 Inst. Pro	2500 Inst. Pro.
No. of Extruder	One	One	Two	Two
Interest Rate %	9.75	9.75	9.75	9.75
Risk Factor %	20	0	20	20
Weighted Aver. Discount Rate	14.88	9.75	14.88	14.88
IRR%	23.58	23.58	46.56	46.58
NPV $	263,182	504,359	1,261,208	1,178,022
Duration Years	30	30	30	20

Sensitivity Analysis:

Scenario III in table 10 has been taken as the base case for sensitivity analysis and the results are as follows:

1. Ten percent increase in cost of canola and soyhull:

   Internal Rate of Return: 32.48%

   Net Present Value: $745,353

2. Ten percent decrease in price of oil and meal:

   Internal Rate of Return: 24.82%

   Net Present Value: $450,280

3. Twenty percent increase in total expenses:

   Internal Rate of Return: 14.5%

   Net Present Value: $64,112

4. Twenty percent decrease in plant efficiency:

   Internal Rate of Return: 32.9%

   Net Present Value: $745,820

5. Ten percent decrease in efficiency coupled with 10% increase in canola price and 10% decrease in oil price:

   Internal Rate of Return: 19.8%

   Net Present Value: $232,890

The effect of change of canola price on internal rate of return and net present value assuming the price of meal and oil per pound and other costs are unchanged, are summarized in Table 11. The cost of producing the canola oil under such scenarios are calculated. Assuming the market price of canola oil (unprocessed) to be at $0.28, the margin per pound of canola oil is given in the last column. However, change in canola price leads to change in price of its products(oil and meal). The purpose of this assumption is to see the possibility of offering higher prices to growers in order to promote canola by the local canola processor(s)

Table 11. Price of Canola and its Effect on Cost Benefit Parameters.

Price/Bushels	Internal Rate of Return %	Net Present Value	Cost per Pound of Oil	Margin
$5.00	49.39	$1,361,076	$0.15	$0.13
$5.50	36.92	$911,010	$0.18	$0.10
$6.00	25.85	$493,602	$0.21	$0.07
$6.50	14.26	$43,536	$0.24	$0.04

We calculated the amount of canola required to operate the processing plant at full capacity all the year-round as 147,840 bushels. The area required to supply canola grown locally is estimated under the scenarios of various yields (Table 12). In a previous chapter we estimated the possible canola acreage in northern Michigan. We estimated the conditional acreage that might be available immediately for growing canola as about 10,000. Therefore, we can run two different small-scale canola processing plants at full capacity from canola produced in this region.

Table 12. Acreage Required to Supply Canola to Run the Processing Plant in Full Capacity all the Year-Round.

Yield (Bushels/Acre)	20	25	30	35
Acreage	7,392	5,914	4,928	4,224

Tables 13 and 14 show the relative crushing margin that a processing firm can obtain by crushing a bushel of soybeans and canola. The prices per bushel of soybeans (60 lbs/bu) is assumed to be a little higher than canola (50 lbs/bu). The canola oil is more valuable than the soy oil and converse is true for meal. The crushing margin is higher in soybean so the processors are better off by crushing soybeans if both of these commodities are available locally and other factors remain the same.

Table 13. Crushing Margin of Canola Processing (40% oil and 60% meal).

Price of Grain/bu	$5.25	$5.50	$5.75	$6.00	$6.25
Price of Meal/lb	$0.09	$0.09	$0.09	$0.09	$0.09
Price of Oil/lb	$0.28	$0.28	$0.28	$0.28	$0.28
Crushing Margin/bu	$3.05	$2.80	$2.55	$2.30	$2.05

The different prices of canola grain and constant prices of its byproducts may not be the case in real world. The purpose of this table is to see the possibility of offering higher prices to canola growers given the prices of oil and meals unchanged in central market.

Table 14. Rough Estimate of Crushing Margin of Soybean Processing (36% oil and 64% meal).

Price of Grain/bu	$5.75	$6.00	$6.25	$6.50	$7.00
Price of Meal/lb	$0.10	$0.10	$0.10	$0.10	$0.10
Price of Oil/lb	$0.26	$0.26	$0.26	$0.26	$0.26
Crushing Margin/bu	$3.71	$3.46	$3.21	$2.96	$2.46

Demand of Soybean meal in northern Michigan:

As stated earlier, livestock industry is important in northern Michigan economy. Livestock firms import concentrated protein feed from outside Michigan (mainly from Decatur). Looking at the demand and supply aspects of meal before establishing a processing plant is necessary. We should address the question of competitiveness of processing plant. The oil and meal produced by Michigan processor(s)should compete with prices in Decatur after adjusting for transportation. We have presented tentative demand supply situation and competitiveness of Michigan Processor(s) in following few pages.

Table 15. Distribution of Selected Livestock in Northern Michigan Counties.

County	Milk Cows	Swine	Sheep and
Alcona	700	100	550
Alpena	2,500	800	800
Antrim	1,250	1,000	400
Benzie		700	50
Cheboygan	1,500	400	300
Charlevoix	1,100	500	200
Emmet	1,100	700	100
Grand Traverse	800	3,600	100
Iosco	1,700	1,200	500
Kalkaska	300	500	100
Leelanau	700	500	50
Montmorency	900	300	100
Missaukee	9,500	2,000	500
Menominee	7,000	800	700
Marquette	600	300	50
Manistee			100
Ogemaw	5,600	1,200	300
Otsego	400	200	50
Oscoda	500	200	600
Presque Isle	2,200	1,500	100
Roscommon		100	200
Wexford	1,100	200	200

Source: *Michigan Agriculture Statistics 1995-96, Michigan Department of Agriculture.*

Milk cows, swine and sheep and lambs are important for protein concentrate demand. Poultry birds are not kept in large scale in northern Michigan so we ignored them in the estimate.

Table 16. Distribution of Livestock by Region (Northern Michigan).

Region	Milk Cows	Swine	Lamb
Upper Peninsula (1)	16,000	4,000	4,500
Northwest (2)	16,000	10,000	1,700
Northeast (3)	16,000	6,000	3,500
Total	48,000	20,000	9,700

Source: *Michigan Agriculture Statistics 1995-96, Michigan Department of Agriculture.*

The calculations of meal demand are based on the assumption of the following constituents of soybeans and canola (Table 17). In terms of supply of protein 1 pound of soybean meal is equivalent to 1.33 pounds of canola meal. Yield of soybeans and canola in northern Michigan is assumed to be 30 bu/acre.

Table 17. Constituents of Canola and Soybean (meal and oil).

Constituents	Canola	Soybeans
Meal %	40.00	36.00
Oil %	60.00	64.00
Protein in Meal %	36.00	48.00

Table 18. Use of Protein in Northern Michigan as Feed for Livestock Industry.

Potential demand of Protein, Meal and Soybeans					
Animal Type	Total Numbers	Meal (lb) per Day	Meal (lb) Total	Total Grain/Day (lb)	Grand Total Grain (Bu)[1]
Milk Cows	48,000	4.27	204,960	273,280	1,662,453
Replacements[2]	23,000	1.34	30,820	41,093	249,984
Swine:					
15-25 days	20,000	0.30	6,000	8,000	2,667
26-40 days	20,000	0.50	10,000	13,333	6,667
41-150 days	20,000	0.90	18,000	24,000	88,000
150+ days	20,000	1.40	28,000	37,333	52,267
Lambs	9,700	0.40	3,880	5,173	23,280
TOTAL			297,780	397,040	2,062,039
				Area Req.	68,735

[1]Two cycles of swine per year are common. Swine are ready to sell in six months of age where as lambs are generally sold at the age of nine months (100 lb. body weights).

[2]According to the USDA, Cattle Inventory Report, 1996, the number of replacements is about 42% (U.S.) and this number is about 48% in Michigan.

Table 18. (continued).

Demand of Protein, Meal and Canola in Northern Michigan					
Animal Type	Total Numbers	Meal (lb) per Day	Meal (lb) Total	Total Grain (lb)	Total Grain (Bu)
Milk Cows	48,000	5.14	246,720	411,200	3,001,760
Replacements	23,000	1.61	37,030	61,717	450,532
Swine:					
15-25 days	20,000	0.24	4,800	8,000	3,200
26-40 days	20,000	0.40	8,000	13,333	8,000
41-150 days	20,000	0.72	14,400	24,000	9,600
150+ days	20,000	1.12	22,400	37,333	62,720
Lambs	9,700	0.66	6,402	10,670	57,618
TOTAL			333,350	555,583	4,055,758
				Area Req.	135,192

Similarly, we extrapolate the information to calculate the derived demand of canola as a supplement of protein for the livestock industry in three counties in Michigan "Thumb".

Table 18. (continued).

Demand of Protein, Meal and Soybean in Michigan Thumb					
Animal Type	Total Numbers	Meal (lb) per Day	Meal (lb) Total	Total Grain/Day (lb)	Grand Total Grain (Bu)[1]
Milk Cows	49,000	4.27	209,230	278,973	1,697,088
Replacements[2]	24,000	1.34	32,160	42,880	260,853
Swine:					
15-25 days	65,000	0.30	19,500	26,000	8,667
26-40 days	65,000	0.50	32,500	43,333	21,667
41-150 days	65,000	0.90	58,500	78,000	286,000
150+ days	65,000	1.40	91,000	121,333	169,867
Lambs	3,000	0.40	1,200	1,600	7,200
TOTAL			442,890	590,520	2,444,142
				Area Req.	61,104

Two cycles of swine per year are common. Swine are ready to sell in six months of age where as lambs are generally sold at the age of nine months (100 lb. body weights). According to the USDA, Cattle Inventory Report, 1996, the number of replacements is about 42% (U.S.) and this number is 48% in Michigan.

Table 18. (continued).

Requirement of Canola Grain and Acreage to Fulfill Protein Demand					
Animal Type	Total Numbers	Meal (lb) per Day	Meal (lb) Total	Total Grain (lb)	Total Grain (Bu)
Milk Cows	49,000	5.14	251,860	419,767	3,064,297
Replacements	24,000	1.61	38,640	64,400	470,120
Swine:					
15-25 days	65,000	0.24	15,600	26,000	10,400
26-40 days	65,000	0.40	26,000	43,333	26,000
41-150 days	65,000	0.72	46,800	78,000	31,200
150+ days	65,000	1.12	72,800	121,333	203,840
Lambs	3,000	0.66	1,980	3,300	17,820
TOTAL			378,900	631,500	4,609,950
				Area Req.[1]	115,249

[1] Yield of canola is assumed to be 40 bu/acre.

The total area required to supply canola meal to meet the demand of livestock industry is very high. Having the processing facility to crush 4,000,000 bushels of canola immediately is difficult (2500 tons). However, we can conclude that the meal produced from the canola processing plant(s) as we proposed earlier, could easily be used by the livestock industry in northern Michigan. This leaves the question whether the canola meal produced by small-scale processing plants can compete with soybean meal that is being transported from plants in Indiana, Illinois and Zeeland, MI.

4.5 Transportation Cost and Regional Price Differences

Transfer cost is an important variable cost determining the price of oils and meals in various locations. The transfer cost between two points cannot be determined only by trucking cost. It also includes costs associated with loading and unloading. Therefore, transfer cost has two components: fixed cost and variable cost (costs per mile). Determination of cost per mile is a complex mechanism. It may not be a linear function of distance because as the distance of transfer increases, cost of per mile transportation declines. In some cases transportation costs are discounted by the distance and volume. Furthermore, transportation costs vary depending on the means (train, truck etc.) of transportation.

The price of a commodity that a buyer pays under the assumption of homogenous products and perfect competition is the price in the production or processing site plus the transfer cost (Tomek and Robinson,1990). Perfectly competitive behavior assumption imposes the requirements for the regional pattern of price differentials and flows of the products. A competitive process called arbitrage tends to keep price differences in line with transportation (Ferris, 1996). If price differences exceed transfer costs, resources are attracted to that activity.

Decatur, Illinois is a central production location for soybean oil and meal. Processors in other areas such as northern Indiana and Ohio also form base points for pricing these products. Livestock farmers import soybean meal from these plants and also from a new plant located in Zeeland, Michigan. Price of soybean meal in Michigan includes price of meal at these processing plants plus the transportation cost and a fixed margin. Being a net deficit in high protein meal, canola meal produced in Michigan will be utilized locally. To be competitive, the proposed canola processing plant should be able to supply meal at the prices (adjusted for protein content) equal to or lower than the prices at the soybean mills plus the transfer cost. Similarly, canola oil extracted by a processor in Michigan need to be transferred to a custom processor to refine it before going to grocery shelves or food manufacturers. In short we can represent the spatial price differences as follows.

P_{mm} = Price of meal in Michigan (in a given location)

P_{om} = Price of oil in Michigan (in a given location)

P_{mp} = Price of meal at a nearest processor in Ohio, Indiana and Illinois

P_{op} = Price of oil at a nearest processor in Ohio, Indiana and Illinois

TC = Transportation cost per mile

D= Distance (miles) from a nearest processor in Ohio, Indiana and Illinois

FM= Fixed margin for transfer

$$P_{mm} = P_{mp} + (TC*D + FM)$$

$$P_{om} = P_{op} - (TC*D + FM)$$

As stated earlier, transportation cost may not be linear with the distance from the central market. Availability of back hauling is also an important factor for the determination of transportation cost.

Prevailing transportation cost was obtained from a trucking agency and Central Soya at Decatur, Indiana. Transportation of meal and crude oil require different trucking facilities. Oil transportation requires sophisticated equipment to prevent it from heat and freezing temperatures. Therefore, transportation cost of oil is relatively higher than that of meal.

Proposed small-scale processing plants will not have crude oil refining facility. Central Soya has a processing facility and moves the processed oil to various locations in and outside the Midwest region. The transportation cost is two dollars per mile for a truckload of 50,000 lbs. (including loading unloading costs). Approximate distance from Decatur, Indiana to Lansing is about 160 miles. The cost of transportation comes about) 0.64 cents per lb. of oil. We can extrapolate this relationship to potential canola processing sites in northern Michigan to calculate the transportation cost. The approximate transportation cost of oil to Decatur from Marquette (560 miles) and Gaylord (330 miles) for example would be 2.24 and 1.32 cents per pound respectively.

Table 19, Price of Oil Adjusted for Transportation at Different Locations in Michigan.

Soybean oil					
Location (Plant)	**Price in Decatur (cents/lb)**	**Distance from Decatur (mile)**	**Transport Cost (cents/lb)**	**Price at the location (cents/lb)**	**Canola oil price with 2 cents premium**
Marquette	27	560	2.24	25	27
Iron	27	640	2.56	24	26
Gaylord	27	330	1.32	26	28
Saginaw	27	250	1.00	26	28

By subtracting the transportation cost, we can obtain the actual price of canola oil received by the processors in Michigan. On canola oil, the net price to a processor in Northern lower Michigan or UP would be the price at Central Soya or other plants processing crude oil minus the transportation costs from the canola mill to the oil processor. It is assumed that canola oil gets 2 cents premium over soybean oil

Table 20. Price of Transported Meal at Different Locations in Michigan.

Soybean Meal						
Location (Import)	Price/ton (Decatur)	Transportation Cost[1]	Margin (per ton)	Total Cost/ton	Price/lb	Canola Meal Equiv. Price
Marquette	$225	$36	$10	271	$0.14	$0.110
Iron	$225	$38	$10	273	$0.14	$0.111
Gaylord	$225	$ 26*	$10	261	$0.13	$0.106
Saginaw	$225	$16	$10	251	$0.13	$0.102

[1] Information on trucking charge was obtained from Central Soya, Decatur, Indiana and Hogel Trucking at Perrington, Michigan.
* Estimated based on the information for other locations.

Assume that long term soybean meal prices given in table 20 would be $225/ton at Decatur, Indiana (obtained from averaging forecasted prices 1997-1998). Canola meal equivalent price in Table 20 shows the price that livestock firms can pay for canola meal if it is available locally instead of buying soybean meal from distant markets. This price is very close to the $0.09/lb as we calculated in the benefit-cost analysis of soybean processing plant. In other words it is economically feasible to establish a canola processing plant and the meal would be cheaper if canola is processed locally.

Table 21 gives an idea about the relative prices of 44% soybean meal and 36% canola meal in the U.S. market. The average price ratio for 44% soybean meal and 36% canola meal would be 1.49 but, as for a protein supplement the ratio between two meals is 1.22. Since the price ratio 1.49 is greater than the substitution ratio, shifting to canola meal is profitable with other factors remaining the same.

Table 21. Soymeal and Canola Meal Prices (Minneapolis - St. Paul).

S. No.	Observation	Soybean Meal (44%) Price/Ton	Canola Meal (36%) Price/ton	Price Ratio
1	9-02-96	$258.00	$176.00	1.47
2	9-16-96	$300.00	$180.00	1.67
3	9-23-96	$258.50	$182.00	1.42
4	9-30-96	$265.20	$173.00	1.53
5	10-07-96	$233.80	$165.00	1.42
6	10-21-96	$225.20	$158.50	1.42
			Mean Ratio	1.49

Source: *Feedstuff Magazine (this location was chosen because the prices of both commodities are listed).*

Chapter 5: Marketing System — Case Studies

5.1 Problem Statement

In addition to development of improved production technology, establishment of a new commodity sub-sector is important to take the crop from input supply to the consumption level. Although Michigan has high production potential for canola on one hand and high demand for the products on the other, Michigan canola industry has not developed well. Previous studies have suggested that the poor marketing chain for canola is the major barrier to this sub-sector. Thus, the marketing system in Michigan for canola needs to be appraised to identify the problems along with possible measures to overcome them.

5.2 Concepts

The production process is not completed in the farmers' field but continues as the commodity moves from producer to consumers via different intermediate market participants. A sub-sector approach allows us to study along the vertical slice involving all the stages of production originating from input supply and ending with final consumption. This approach recognizes that the efficiency with which a good or service is produced depends on the efficiency of the production process at each stage in a vertical chain and how well the various stages are coordinated with each other (Staatz, 1993). The sub-sector method stresses the interdependence of related activities as a system. When we look at the canola sub-sector, major important bottlenecks within the matrix (Figure 3) are perceived in assembly, storage and processing. Individual problems should be studied in a systems perspective. Variety development should be directed by the consumer desire. Poor performances of one or more components (cells) in the matrix affect the performance of the whole system. Similarly, small incremental improvements in one part of the sector brings about the potential improvement in the entire system. Lack of coordination between buyers and sellers at any stage of the vertical marketing chain reduces the overall operational efficiency.

Coordination harmonizes the vertical stages of production and marketing, however, this is not an easy job. Variation in production, technological change and consumers' demand contribute to production risks. Sub-sectors should be adjusted along with the changing world to reduce the risk and to improve the market performance. One major structural change in the food system in the present market situation is vertical integration within the system. We can observe this in the poultry and hog industry for example.

High moisture content leads to rapid deterioration of canola seed. It can absorb moisture during handling if proper care is not taken. Production is seasonal and, depending on crop moisture, the crop may be difficult to store for a long time by the farmers. Thus, an orderly marketing arrangement is necessary. Fundamentals of orderly market are:

- Assured and adequate supply
- Price stability
- Appropriate price differentials over time, space and quality.

Orderly marketing permits the flow of supply to market throughout the normal marketing season to avoid prominent fluctuation in supplies and prices. All the market participants would benefit from the orderly marketing because of reduced risks.

While dealing with the canola sub-sector we should not forget the soybean sub-sector. Both the oil and meal products of canola will be competitive with soybean products in the marketplace. The soybean market is strong and well established. To cross the barrier and enter the canola market, participants in the food system matrix should be vertically coordinated for an orderly marketing system. Participants in the vertical chain are equally important since the production process is continuous as the commodity moves from farm level production to consumers.

Similarly, looking at the farming systems approach, the livestock sub-sector is also closely associated with the canola and soybean sub-sector, particularly in northern Michigan. Dairy and beef production require large amounts of concentrate rations. The supply of protein concentrate in northern Michigan as livestock feed supplement is a problem. Soybean meal is brought from distant markets at high transportation costs. For the most part, soybeans can not be grown in the northern part of

Michigan. Canola production and its processing could help solve this problem. The livestock sector can be treated as a consumer in the canola sub-sector study since the livestock industry is a potential consumer of meal, one of the major products of canola.

Advertisement and market information can play an important role in the better performance of this sub-sector. Information about health attributes of canola and its different types of products and their importance to human life and environment should be communicated to the potential consumers and other market participants. Information about the attributes of the food products can influence consumer preference, though such promotional/educational efforts require a large amount of money. Increasing marginal returns of dollars spent in advertising must be done on a large production scale because this industry is new and needs to spend comparatively more on advertising in order to compete with other oil industries. Essential market information is difficult to gather and is often expensive to acquire. Market participants in a coordinated system can provide much information about the production and marketing trends. Furthermore, such information can play a crucial role in effective coordination among participants in this sub-sector.

Figure 3. Food System (Agriculture Sector) Matrix.

<table>
<tr><th rowspan="2">Production and Distribution Function</th><th colspan="5">Subsectors</th></tr>
<tr><th>Canola</th><th>Soybean</th><th>Corn</th><th>Barley</th><th>Livestock</th></tr>
<tr><td>Input Distribution</td><td rowspan="11">S
U
B
S
E
C
T
O
R

A
P
P
R
O
A
C
H</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Extension</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Farm Level Production</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Assembly</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Storage</td><td colspan="4">**Farming System Approach**</td></tr>
<tr><td>Transportation</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Processing</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Wholeselling</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Retailing</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Financing</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Consumption</td><td></td><td></td><td></td><td></td></tr>
</table>

Adopted from "Role of Sub-sector Analysis in Setting Research" by Bernston and Staatz.

5.3 Methodology

A structured survey questionnaire was developed to gather information on problems and prospects of canola marketing in Michigan. We made contact with several owner/operators of grain elevators. Among those, only three agreed to give interviews and to meet with us. The rest declined an interview, citing their inexperience with canola handling. We went to the three grain elevators as scheduled and conducted the semistructured interviews to learn about the present marketing situation of canola and views on future prospects. The questionnaire used in the case studies are listed in appendix 1:

5.4 Results and Discussion

Summary of three case studies:

Michigan Agriculture Commodity (MAC)

Michigan Agricultural Commodities (MAC) is an agribusiness firm through which most of the canola seed produced in Michigan has been marketed. MAC has grain elevators in different parts of Michigan (Newaygo, Seaforth/Ontario, Lansing, Middleton, Jasper and Blissfield). Thus, it covers a large area and each elevator has a handling capacity of more than one million bushels of grains. Most growers deliver their produce directly to the grain elevator but MAC also has farm pick-up service.

MAC began handling canola in 1988 with the first 400 bushels. They trucked it to ADM in Windsor with soybeans because the amount of canola was not sufficient for a truck load. The amount of canola handled has decreased in the past three years from 50,000, 25,000 to 5,000 bushels. This shows the decreasing trend of canola production in Michigan. The minimum amount of canola required for elevator handling is 5,000 bushels (economy of scale).

Charges for storing grain in elevators differ depending on the type of grain. Canola absorbs and loses moisture very fast, thus there is risk of shrink in storing high moisture canola. Canola is more likely to heat during warm temperatures. Small holes from infestation by rodents in seed bins may result in loss of canola seed during storage. The charge for storing canola and soybeans is 20 cents/bushel/month (it looks high but it is according to respondent) compared to that for other grains of 3 cents/bushels/month.

Canola handling is risky because of its hygroscopic nature and rapid deterioration, along with changes in weight. Duration of elevator storage depends on the market price offered by purchasers.

Canola requires different machinery in drying. Flow dryers are most common but "batch dryers" are more suitable because of the smaller grain size.

The most important problem in handling canola is the limited number of buyers. Elevators may purchase canola from farmers, but they don't have many wholesale options. Windsor is the only buyer at the present time that provides a realistic market for most Michigan areas. The price of canola is based on the Windsor price and is closely tied to that of soybeans. The quality of canola is also very important in determining the actual price paid to the growers. Moisture levels and maturity of the grain are important aspects of quality. Major problems associated with handling of canola were noted as:

a. Uncertainty of production
b. Low margin in handling canola
c. Low volume of production in the area
d. Need for separate machinery in handling (in drying)
e. High handling cost
f. Hedging problem

MAC is interested in handling and promoting canola if there were canola processors or more buyers. Although canola handling is not profitable under the present conditions, there are high prospects for the crop if the marketing infrastructure could be developed. Greater production throughout Michigan would also increase the likelihood of greater profitability. One MAC representative suggested that canola developmental efforts should be concentrated in one area at a time before moving to another part. He added that the U.P. has good potential for canola, and that we should learn from the Canadian marketing system where subsidies and grain marketing opportunities are favorable for canola.

When we talked about the non-edible canola oil for making detergent and other industrial uses the respondent got excited and responded positively. Processing such type of rapeseed could be more profitable and many processors may come into existence.

St. Johns (Countrymark)

St. Johns Countrymark Cooperative is located in St. Johns, a small town in Clinton county. We went to the coop office according to a prescheduled appointment with one of the representatives of the cooperative. The respondent was familiar with canola and had some experience in handling it. Some of the important points about the facts and opinions expressed by the person we interviewed follow.

There is only one grain elevator in the area. This elevator is working under the Countrymark Cooperative which has a network throughout three states (Michigan, Ohio and Indiana). The St. Johns elevator covers an area 12 miles in radius.

Corn, soybeans and navy beans are three important grains handled by the elevator and the volume they handle is 500, 350 and 200 thousand bushels per year, respectively. A total of 1.1 million bushels of grain are handled each year. The elevator has experience in handling canola but they have not done so in recent years.

They do not have a local collection center for collecting grains from the growers. Generally, growers bring their product to the elevator. Farm pickup service is also provided depending upon the volume of the crop (need at least a truckload).

At least 10,000 bushels of canola are required to make it profitable to handle canola. At the present time there is not production of this amount and thus it is not profitable if the amount is lower. The year and approximate amount of canola handled in the past is given below (Table 22).

Table 22. Approximate Amount of Canola Handled by St. Johns (Countrymark).

Year	Volume (Bushels)
1989	10,000
1990	20,000
1991	30,000
1992	20,000

After 1990, there was gradual reduction in acreage and production. Storage charges are different relative to soybeans and other grains. Charges per bushel depend on the weight per bushel and price per bushel. Soybeans are charged 5 cents/bushel/month and corn is charged 4 cents/bushel. The canola which was previously handled was spot sold at harvest so has not been generally stored.

They did not find canola handling to be risky because they moved the product immediately and had a fixed margin. It used to be a back to back (fixed) margin to grain elevators. A margin of 2.5 to 3% of cost price is a reasonable margin for canola handling. If canola needs to be stored for a long time, maintenance of low moisture condition in storage facilities is very important. It needs suck-through air movement instead of blow-through aeration.

The low volume of production and lack of processing plants in Michigan are major problems. Moisture level and grain maturity are two major quality discounting factors and canola with this problem are discounted.

The price of canola is based on the Windsor price and the Winnipeg futures market. Growers are usually paid at the time of buying and canola collected is sold in Windsor. There was no practice of contracting with growers but forward contracts for a new crop should be encouraged. This assures the potential quantity of canola to be handled. The respondent expressed optimism about a canola processing plant in Michigan to compete with Windsor but was not sure about establishment of smaller processing plants at various locations in Michigan. The present charges for shipping canola to Windsor is 25-30 cents per bushel. Shipping to Canada is not a big problem. It is a matter of competition.

Canola is considered a "noxious weed" in the minds of many farmers because of its similarity to wild mustard. Thus, the control of canola as a weed is an important factor if it is to be grown extensively. The respondent didn't know whether they would promote canola if processing facilities are established, but was sure that if the problem of weeds could be solved, canola could be successful.

Marlette Cooperative

We talked to two coop representatives simultaneously. The Marlette Coop handles corn, wheat, soybeans, navy beans and black turtle beans. The coop has five grain elevators in five different locations (Marlette, Yale, Brown City, Lapeer and Richman). Its marketing area covers the eastern half of Michigan (40 miles in radius from Marlette Coop). It also has farm pick-up service, but the growers bring their product to the elevators for sale.

They do not handle canola any more. Although they handled 1,200 bushels of canola in 1993, they consider it to be very risky. High seed moisture deteriorates the quality and fluctuations in test weight also occur due to small seed size. They also considered it difficult to dry canola. The risk factor is not considered in the price which is based on the prices at ADM. Canola needs better storage facilities and equipment.

Some of the points/issues that the respondents expressed:

--Price of canola is not influenced by the price of soybeans (as indicated by the respondents, but this statement may not be true because these two commodities are close substitute to each other).

--Contracts with farmers for price and production in early spring is important for good marketing relationship and the coop would be interested in making such forward contract if farmers are willing to grow canola.

--They strongly agree on:

1. Michigan needs to establish one canola processing plant in a central location.
2. It is not feasible to establish large, hexane-style canola processing plants in Michigan because there is insufficient canola production to run the plant on an economic scale. However, a feasibility study is needed to look at the potential of an alternative-type canola processing plant.

--They would consider promoting canola if there were Michigan processors and would handle it if there were sufficient canola produced in the area.

Major Difficulties in Handling Canola:

a. Lack of a processing plant.

b. Uncertainty of production.

c. Low margin in handling canola compared to soybeans (10% margin in canola).

d. Low volume of production in the area (need at least 100,000 bushels of canola to justify handling it).

e. Need separate machinery for handling and drying.

f. High handling cost (transportation charge to Windsor is $0.22/bushel).

g. Fluctuation in Canadian dollar (exchange problem).

h. Other problems are similar to sunflowers.

Summary of the Case Studies:

The case studies with the three grain elevators provided a clear-cut picture of canola sectors in Michigan. There was a growing interest of canola in late 1980s and early 1990s. Farmers and agribusiness firms were interested in this newly introduced crop. Since Michigan did not have a canola processing facility, canola grown in Michigan was marketed in Windsor, Canada. Due to the poor canola marketing infrastructure in Michigan, acreage under canola is decreasing and grain elevators are not handling it anymore. Nevertheless, grain elevators are still interested in handling it if there was a sufficient amount available to meet the scale of economy. Lack of a canola processing facility in Michigan is the most important bottleneck in this sector. Farmers do not like to grow canola due to perceived difficulties in selling canola in Windsor, Canada. According to the respondents of the study, canola has a bright future in Michigan, provided the arrangement to process it and they will strongly consider promoting it. If canola sub-sector is to develop, the acreage and marketing infrastructure need to be developed simultaneously.

Summary and Conclusion:

Past agronomic research has shown that canola can be successfully grown in various parts of Michigan, including northern Michigan. Break-even analysis of canola with other alternative crops like barley, wheat, corn, oats, soybeans, potatoes, dry beans and kidney beans suggested that canola can be more profitable than barley, wheat, corn and oats but not as profitable as soybean, kidney beans, dry beans and potatoes where these are well adapted. However, soybeans do not have wide adaptability in northern Michigan. Consequently, we cannot reject the hypothesis that "canola is a profitable alternative cash crop, particularly for northern Michigan farmers" since it can be more profitable than some of the existing crops.

An economic feasibility study of establishing a canola processing plant has been conducted in depth. The economics of an extruding and expelling type of processing system was evaluated by net present value approach. Net present value and internal rates of return of proposed operation are encouraging. Various scenarios have been analyzed to cope with the risk and uncertainty of operating the business. It is concluded that "canola processing can be a profitable business in Michigan and that there is potential for small scale canola processing plants in Michigan".

Key informant surveys revealed that out of 598,000 acres of cultivated land in northern Michigan, approximately 10,000 acres would be shifted to growing canola immediately if no marketing problems existed. This area (northern Michigan) would have sufficient land for supplying canola to operate two small to medium scale processing plants at full capacity. Therefore, the hypothesis "Northern Michigan has sufficient potential area to provide canola to operate a small scale processing plant for the entire year at full capacity" cannot be rejected.

The case studies with three leading grain elevators in Michigan suggested that canola handing might be profitable business. They foresee good potential for canola in Michigan although they do not handle it at the present time. The major bottleneck in this sector is the lack of a processing facility in Michigan. Grain elevators are not presently handling canola because of the very small volume of production in Michigan. Farmers are reluctant to produce it because of perceived difficulties in marketing. All of the respondents in this study believed that development of either canola processing plants or a strong marketing chain would be essential to encourage the development of this sub-sector in Michigan.

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APPENDICES

Appendix A, Marketing System Case Study (Survey Instrument)

1. What are the types of grains you handle?

   _____ Corn
   _____ Wheat
   _____ Soybean
   _____ Navy beans
   _____ Other beans
   _____ Barley
   _____ Canola
   _____ Others (please specify) ____________________

2. How do you collect grains?

   ___ a. Farmers bring to the elevators
   ___ b. Grain merchant/dealer
   ___ c. Farm pick up service
   ___ d. Other

3. Do you have local collection centers?

   ____ Yes
   ____ No
   If Yes, how many? ____________________________

4. How do you classify your firm?

   Large____
   Medium____
   Small____

5. Farmers from how many counties bring produce to your elevator? (Please specify the counties)

   1. ______________________
   2. ______________________
   3. ______________________

6. Is there a minimum amount of canola you would require in order to handle it?

____ Yes

____ No

If Yes, how many bushels? _______ Bushels

7. Approximately, how much canola did you handle in the past three years?

One Year Ago:_______ Bushels

Two Years Ago:______ Bushels

Three Years Ago:_____ Bushels

8. What is the charge for storing grains in your elevator?

$/Bushel per month:

Corn	________
Wheat	________
Soybeans	________
Navy beans	________
Other beans	________
Barley	________
Canola	________

9. When did you first handle canola?

a. 19___ (list year)

b. Do not handle canola

10. Is there any risk involved in canola handling?

____ Yes ____ No

If Yes, please list your top three risk factors:

1. _____________
2. _____________
3. _____________

11. Do you consider risk factor(s) for establishing cost price?

____ Yes ____ No

12. Do you need special storage structure, equipment and machinery for handling canola?

_____Yes _____No

If Yes, please specify:

a. Storage structure:_____

b. Equipment:_________

c. Machinery:_________

d. Other:___________

13. What are major difficulties in handling canola? Please check all that apply.

___ a. Lack of processing plants

___ b. Uncertainties of production

___ c. Low margin in handling canola

___ d. Transportation to processing plant

___ e. Fluctuation in Canadian dollar

___ f. Low volume of production in Michigan

___ g. Storage and handling equipments

___ h. Others (please specify)

____

14. How do you usually decide the price of canola when buying?

___ a. Canola futures price (Winnipeg futures market)

___ b. Windsor's price

___ c. Other (please specify)

____

15. Where do you sell the canola that you collect?

___ a. Local processors

___ b. Windsor

___ c. Winnipeg commodity exchange

___ d. Other (Please list)

____

16. What is the relationship between the price of canola and price of soybeans?

___ a. Highly influenced by soybean price

___ b. Slightly influenced by soybean price

___ c. Soybean does not affect the price of canola

17. What do you expect from canola growers for better marketing relationships?

___ a. Maintain quality of produce

___ b. Bring commodity to the elevator
___ c. Contract for production and price
___ d. Others (please specify)

____

18. Do you make contract with growers before growing canola?

______ Yes ______ No

If Yes, what type of contract?

____

19. What are the factors for quality discount of canola?

___ a. Moisture level
___ b. Maturity of grains
___ c. Variety of canola
___ d. Grain size
___ e. Weevils/insects
___ f. Tare
___ g. Other (please specify)

20. How do you deal with high moisture and immature canola seed?

___ a. Do not accept
___ b. Accept with quality discount
___ c. Other (please specify)

____

21. Usually, how long do you store canola?

______ weeks.

22. What is the average margin in handling canola?

______ % of cost price

23. What is your transportation charge to the processing plant?

$____/Bushel

24. What advice would you like to offer on canola marketing in Michigan?

____

____

____

25. Would you consider handling and promoting canola if there were Michigan processors?

______ Yes ______ No

26. What problems are there for not having a domestic delivery point, i.e., closest processor is in Canada?

____

27. What would it take to entice you to handle canola?

____

____

____

____

Appendix B

Appendix B. 1, Canola Processing plant Enterprise Budget (Summary Sheet)

Projected Income	Pounds	$ per Pound	Monthly	Yearly
Oil	149600	$0.28	$41,888	$502,656
Meal	730400	$0.09	$65,736	$788,832
	Total Projected Income		$107,624	$1,291,488

Production	Per Hour	Per 8-hr Shift	Per Month	Units
Production Capacity	100	800	17600	Bushels
Percentage Output	17.00%	Oil	149600	Pounds
	83.00%	Meal	730400	Pounds

Operating Expenses	Per Hour	Per 8-hr Shift	Per Month	Per Year
Maintenance	$6	$48	$1,056	$12,672
Labor	$20	$160	$3,520	$42,240
Management Labor	$25	$200	$4,400	$52,800
Clerical Labor	$12	$96	$2,112	$25,344
FICA			$606	$7,271
Utilities	$12	$96	$2,112	$25,344
Office expense			$750	$9,000
Grounds expense				$1,025
Insurance & Property Tax				$372
Bad Debt Expense				$12,915
Loan Payment				$159,199
			$14,556	$348,181

	Price/Bushel	# of Bushels	Monthly	Yearly
Canola purchasing Costs	$5.00	12320	$61,600	$739,200
Soyhull purchasing CostS	2.15	5280	11352	136224
Handling Costs (5%)	$0.21	17600	$3,648	$43,771
Selling/brokerage Fees				
	Total Operating Expenses		$91,155	$919,195
		Net Profit/(Loss)		$372,293

Operating Capital Needed	Per Month	Per Year
Operating Expenses	$91,155	$919,195

Appendix B. 2, Canola Processing Plant Proforma Income Statement

Canola Processing Plant Proforma Income Statement		
Discount Rate	10.00%	
Growth Rate	0%	0.0%
Tax Rate	28%	
Single Business Tax Rate	1.1%	

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Income														
Oil		$502,656	$502,656	$502,656	$502,656	$502,656	$502,656	$502,656	$502,656	$502,656	$502,656	$502,656	$502,656	$502,656
Meal		$788,832	$788,832	$788,832	$788,832	$788,832	$788,832	$788,832	$788,832	$788,832	$788,832	$788,832	$788,832	$788,832
	$0	$1,291,488	$1,291,488	$1,291,488	$1,291,488	$1,291,488	$1,291,488	$1,291,488	$1,291,488	$1,291,488	$1,291,488	$1,291,488	$1,291,488	$1,291,488
Expenses														
L, B, & E (*)	$428,328													
Canola Purchasing Costs		$739,200	$739,200	$739,200	$739,200	$739,200	$739,200	$739,200	$739,200	$739,200	$739,200	$739,200	$739,200	$739,200
Soyhull Purchasing Costs		$136,224	$136,224	$136,224	$136,224	$136,224	$136,224	$136,224	$136,224	$136,224	$136,224	$136,224	$136,224	$136,224
Handling Costs		$43,771	$43,771	$43,771	$43,771	$43,771	$43,771	$43,771	$43,771	$43,771	$43,771	$43,771	$43,771	$43,771
Selling/brokerage Fees		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Maintenance		$12,672	$12,672	$12,672	$12,672	$12,672	$12,672	$12,672	$12,672	$12,672	$12,672	$12,672	$12,672	$12,672
Labor		$42,240	$42,240	$42,240	$42,240	$42,240	$42,240	$42,240	$42,240	$42,240	$42,240	$42,240	$42,240	$42,240
Management Labor	$26,400	$52,800	$52,800	$52,800	$52,800	$52,800	$52,800	$52,800	$52,800	$52,800	$52,800	$52,800	$52,800	$52,800
Clerical Labor		$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344
FICA		$7,271	$7,271	$7,271	$7,271	$7,271	$7,271	$7,271	$7,271	$7,271	$7,271	$7,271	$7,271	$7,271
Utilities		$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344
Grounds Expense		$1,025	$1,025	$1,025	$1,025	$1,025	$1,025	$1,025	$1,025	$1,025	$1,025	$1,025	$1,025	$1,025
Loan Interest Payment		$59,218	$49,470	$38,771	$27,028	$14,143	($0)	$0	$0	$0	$0	$0	$0	$0
Bad Debt Expense		$12,915	$12,915	$12,915	$12,915	$12,915	$12,915	$12,915	$12,915	$12,915	$12,915	$12,915	$12,915	$12,915
Single Business Tax		$7,103	$7,103	$7,103	$7,103	$7,103	$7,103	$7,103	$7,103	$7,103	$7,103	$7,103	$7,103	$7,103
Ins. & Prop. Tax		$372	$372	$372	$372	$372	$372	$372	$372	$372	$372	$372	$372	$372
Total Expenses	$454,728	$1,165,498	$1,155,750	$1,145,052	$1,133,310	$1,120,424	$1,106,281	$1,106,281	$1,106,281	$1,106,281	$1,106,281	$1,106,281	$1,106,281	$1,106,281
Cost of oil per lb		0.21	0.20	0.20	0.19	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Net Income/Loss Before T	($454,728)	$125,990	$135,738	$146,436	$158,178	$171,064	$185,207	$185,207	$185,207	$185,207	$185,207	$185,207	$185,207	$185,207
NPV of Cash Flows	$1,742,652													
Net Present Value Before	$1,287,924													
After Tax Depreciation Shield		$17,721	$14,561	$12,031	$12,031	$9,958	$8,265	$6,883	$5,752	$4,624	$4,081	$3,431	$15,244	$12,345
After Tax Loan Interest Shield		$16,581	$10,856	$7,568	$3,960	($0)	$0	$0	$0	$0	$0	$0	$0	$0
Net Income/Loss After Tax	($454,728)	$100,317	$104,854	$110,922	$118,366	$125,954	$135,663	$135,277	$134,960	$134,700	$134,488	$134,310	$137,817	$136,606
NPV of Cash Flows After	$1,293,379													
Net Present Value After Ta	$838,651													
Internal Rate of Return (IRR)	25.80%													
*Land, Building & Equipment														
Retained Earnings		$100,317	$205,171	$316,092	$434,458	$560,412	$696,076	$831,352	$966,312	$1,101,012	$1,235,499	$1,133,085	$1,270,702	$1,407,508

Weighted Average Discount Rate Calculation		
Weight	Rate	
1.00	10.00%	10.00%
0.00	0	0.00%
		10.00%

Equip. Price Growth Rate 0%

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Processing Equipment		$246,724	$246,724	$246,724	$246,724	$246,724	$246,724	$246,724	$246,724	$246,724	$246,724	$246,724	$246,724	$246,724
Storage Equipment		$48,185	$48,185	$48,185	$48,185	$48,185	$48,185	$48,185	$48,185	$48,185	$48,185	$48,185	$48,185	$48,185
Scale		$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000

Appendix B. 2, Continuous ....

14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
$502,656	$502,656	$502,656	$502,656	$502,656	$502,656	$502,656	$502,656	$502,656	$502,656	$502,656	$502,656	$502,656	$502,656	$502,656	$502,656
$788,832	$788,832	$788,832	$788,832	$788,832	$788,832	$788,832	$788,832	$788,832	$788,832	$788,832	$788,832	$788,832	$788,832	$788,832	$788,832
$1,291,488	$1,291,488	$1,291,488	$1,291,488	$1,291,488	$1,291,488	$1,291,488	$1,291,488	$1,291,488	$1,291,488	$1,291,488	$1,291,488	$1,291,488	$1,291,488	$1,291,488	$1,291,488
$739,200	$739,200	$739,200	$739,200	$739,200	$739,200	$739,200	$739,200	$739,200	$739,200	$739,200	$739,200	$739,200	$739,200	$739,200	$739,200
$136,224	$136,224	$136,224	$136,224	$136,224	$136,224	$136,224	$136,224	$136,224	$136,224	$136,224	$136,224	$136,224	$136,224	$136,224	$136,224
$43,771	$43,771	$43,771	$43,771	$43,771	$43,771	$43,771	$43,771	$43,771	$43,771	$43,771	$43,771	$43,771	$43,771	$43,771	$43,771
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
$12,672	$12,672	$12,672	$12,672	$12,672	$12,672	$12,672	$12,672	$12,672	$12,672	$12,672	$12,672	$12,672	$12,672	$12,672	$12,672
$42,240	$42,240	$42,240	$42,240	$42,240	$42,240	$42,240	$42,240	$42,240	$42,240	$42,240	$42,240	$42,240	$42,240	$42,240	$42,240
$52,800	$52,800	$52,800	$52,800	$52,800	$52,800	$52,800	$52,800	$52,800	$52,800	$52,800	$52,800	$52,800	$52,800	$52,800	$52,800
$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344
$7,271	$7,271	$7,271	$7,271	$7,271	$7,271	$7,271	$7,271	$7,271	$7,271	$7,271	$7,271	$7,271	$7,271	$7,271	$7,271
$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344	$25,344
$1,025	$1,025	$1,025	$1,025	$1,025	$1,025	$1,025	$1,025	$1,025	$1,025	$1,025	$1,025	$1,025	$1,025	$1,025	$1,025
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
$12,915	$12,915	$12,915	$12,915	$12,915	$12,915	$12,915	$12,915	$12,915	$12,915	$12,915	$12,915	$12,915	$12,915	$12,915	$12,915
$7,103	$7,103	$7,103	$7,103	$7,103	$7,103	$7,103	$7,103	$7,103	$7,103	$7,103	$7,103	$7,103	$7,103	$7,103	$7,103
$372	$372	$372	$372	$372	$372	$372	$372	$372	$372	$372	$372	$372	$372	$372	$372
$1,106,281	$1,106,281	$1,106,281	$1,106,281	$1,106,281	$1,106,281	$1,106,281	$1,106,281	$1,106,281	$1,106,281	$1,106,281	$1,106,281	$1,106,281	$1,106,281	$1,106,281	$1,106,281
0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
$185 207	$185.207	$185 207	$185 207	$185.207	$185.207	$185.207	$185 207	$185 207	$185 207	$185 207	$185 207	$185 207	$185 207	$185 207	$185 207
$10,012	$8,132	$6,618	$5,371	$4,201	$3,423	$2,796	$2,288	$18,394	$16,394	$13,376	$10,837	$8,962	$7,361	$6,062	$5,006
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
$136,153	$135,626	$135,202	$134,653	$134,525	$134,308	$134,132	$133,990	$137,940	$137,940	$137,095	$136,412	$135,859	$135,410	$135,047	$134,751
$1,543,661	$1,679,287	$1,814,489	$1,949,343	$2,083,868	$2,218,176	$2,352,308	$2,176,389	$2,314,328	$2,452,268	$2,589,363	$2,725,774	$2,861,633	$2,997,043	$3,132,090	$3,266,841
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
$248,724	$248,724	$248,724	$248,724	$248,724	$248,724	$248,724	$248,724	$248,724	$248,724	$248,724	$248,724	$248,724	$248,724	$248,724	$248,724
$48,185	$48,185	$48,185	$48,185	$48,185	$48,185	$48,185	$48,185	$48,185	$48,185	$48,185	$48,185	$48,185	$48,185	$48,185	$48,185
$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000

Appendix B. 3, Loan Repayment and Depreciation Schedule

Loan Repayment and Depreciation Schedules

Debt/Equity Schedule

Plant, proper	$428,328		
Permanent o	$759,997		
Start-up loss	$26,400		
	$1,214,725	Loan % Rate	
Equity Capit	$607,362	Equity	50.00%
Debt Capital	$607,362	Debt	50.00%

Loan Repayment Shedule

Amount	$607,362		
Term	60	Years	5
Interest	9.75%	Pmt/Year	12
Payment/yea	$159,199		

Year	Interest	Principal	Balance
1	$59,218	$99,981	$507,381
2	$49,470	$109,729	$397,652
3	$38,771	$120,428	$277,225
4	$27,029	$132,169	$145,056
5	$14,143	$145,056	($0)
6	($0)	$0	$0
7	$0	$0	$0
8	$0	$0	$0
9	$0	$0	$0
10	$0	$0	$0
11	$0	$0	$0
12	$0	$0	$0
13	$0	$0	$0
14	$0	$0	$0
15	$0	$0	$0
16	$0	$0	$0
17	$0	$0	$0
18	$0	$0	$0
19	$0	$0	$0
20	$0	$0	$0
21	$0	$0	$0
22	$0	$0	$0
23	$0	$0	$0
24	$0	$0	$0
25	$0	$0	$0
26	$0	$0	$0
27	$0	$0	$0
28	$0	$0	$0
29	$0	$0	$0

Depreciation Schedule

		Cost	Salvage	Life	
Land & Site Prep		$18,000			
Building & Fees		$23,000	$0	30	
Storage Equip		$84,104	$7,500	20	8.92%
	In Year 21	$48,185	$4,297	20	
Scale		$40,000	$7,500	20	18.75%
	In Year 21	$40,000	$7,500	20	
Processing Equip		$246,724	$10,000	10	4.05%
	In Year 11	$246,724	$10,000	10	
	In Year 21	$246,724	$10,000	10	

Year	Building	Storage	Scale	Proc. Equip	Total
1	$1,533	$8,410	$4,000	$49,345	$63,289
2	$1,431	$7,569	$3,600	$39,476	$52,076
3	$1,336	$6,812	$3,240	$31,581	$42,969
4	$1,247	$6,131	$2,916	$25,265	$35,558
5	$1,164	$5,518	$2,624	$20,212	$29,518
6	$1,086	$4,966	$2,362	$16,169	$24,583
7	$1,014	$4,470	$2,126	$12,935	$20,544
8	$946	$4,023	$1,913	$10,348	$17,230
9	$883	$3,620	$1,722	$8,279	$14,504
10	$824	$3,258	$1,550	$6,623	$12,255
11	$769	$2,933	$1,395	$49,345	$54,441
12	$718	$2,639	$1,255	$39,476	$44,088
13	$670	$2,375	$1,130	$31,581	$35,756
14	$625	$2,138	$1,017	$25,265	$29,044
15	$584	$1,924	$915	$20,212	$23,634
16	$545	$1,732	$736	$16,169	$19,181
17	$508	$1,558	$0	$12,935	$15,002
18	$475	$1,403	$0	$10,348	$12,226
19	$443	$1,262	$0	$8,279	$9,984
20	$413	$1,136	$0	$6,623	$8,172
21	$386	$4,819	$4,000	$49,345	$58,549
22	$360	$4,337	$3,600	$39,476	$47,773
23	$336	$3,903	$3,240	$31,581	$39,060
24	$314	$3,513	$2,916	$25,265	$32,007
25	$293	$3,161	$2,624	$20,212	$26,290
26	$273	$2,845	$2,362	$16,169	$21,650
27	$255	$2,561	$2,126	$12,935	$17,877
28	$238	$2,305	$1,913	$10,348	$14,804
29	$222	$2,074	$1,722	$8,279	$12,297
30	$207	$1,867	$1,550	$6,623	$10,247

Appendix B. 4,

Description of Canola Processing Plant

Description	Cost
Land (3 acres)	$3,000
Site Preparation	$15,000
Processing Building	$23,000
Office Building	$9,600
Office Equipment	$6,900
Processing Equipment	$246,724
Storage Equipment	$84,104
Scale	$40,000
Total Plant Cost	$428,328

Processing Equipment

Description	Cost
2500R Insta-Pro Dry Extruder	$91,500
1500 Insta-Pro Continuous Horizontal Press	$132,000
Portable Hopper (approx.)	$300
12'x 6" Screw Conveyor (3 each)	$2,500
20'x6" Ventillated Auger 1/2 hp Blower and	$4,575
20' Auger (4")	$135
13' 6" Auger (4")	$105
5' Auger (4")	$40
Davis 10"x10" Roll Mill w/ 3hp Motor	$5,825
Model 700 Cooler Tumble Drum	$7,100
Model 24-10 Honeyville Bucket Elevator	$2,519
6" 2-way Valve	$125
Total Proc. Equip. Cost	$246,724

Storage Equipment

Option 1	
Description	Cost
Butler drying Bin 3015C	$24,432
Labor: Bin and Floor	$1,728
Labor SHIVVERS equipment	$1,350
Concrete labor and re-rod	$760
Butlet storage bin 3622	$16,139
Labor: bin and floor	$2,826
Concrete labor and re-rod	$950
Storage Cost	$48,185
Options:	
Second burner unit for 331 BPH	$4,554
Deluxe computer w/ printer	$2,785
Total Storage Cost	$55,524

Option 2 Description	Cost
Butler 4218C heavy duty drying bin	$32,148
Labor: bin and floor	$3,480
Labor: stirring equipment	$1,050
Concrete labor and re-rod	$1,150
Storage Cost	$37,828

Options:	
2 60KVA with 2 power packs	$4,224
Total Storage Cost	$42,052

Site Preparation Description	Cost
Sewer	
Water	$15,000
Gas	
Sand fill	
Concrete	
Electricity	
Road	
Approx. Total Site Prep.	$15,000

Office Equipment Description	Cost
Desk and chair	$400
Bookshelf and filing cabinet	$200
486 Computer and printer	$2,800
Copy machine	$2,500
Phone/fax machine	$1,000
	$6,900

Appendix B. 5, Cost of Producing Canola Oil at Various Prices of Canola Seed and Meal

Meal Price	Cost of producing canola oil at various canola seed cost ($/bushels)									
$/lb	Price of Canola/bushel									
	5	5.25	5.5	5.75	5.6	6.1	6.2	6.3	6.4	6.5
0.081	0.23	0.24	0.26	0.27	0.26	0.28	0.29	0.29	0.30	0.30
0.082	0.23	0.24	0.25	0.26	0.26	0.28	0.29	0.29	0.29	0.30
0.083	0.23	0.24	0.25	0.26	0.25	0.28	0.28	0.29	0.29	0.30
0.084	0.22	0.24	0.25	0.26	0.25	0.27	0.28	0.28	0.29	0.29
0.085	0.22	0.23	0.24	0.26	0.25	0.27	0.28	0.28	0.28	0.29
0.086	0.22	0.23	0.24	0.25	0.25	0.27	0.27	0.28	0.28	0.29
0.087	0.22	0.23	0.24	0.25	0.24	0.26	0.27	0.27	0.28	0.28
0.088	0.21	0.23	0.24	0.25	0.24	0.26	0.27	0.27	0.27	0.28
0.089	0.21	0.22	0.23	0.24	0.24	0.26	0.26	0.27	0.27	0.28
0.09	0.21	0.22	0.23	0.24	0.23	0.26	0.26	0.26	0.27	0.27
0.091	0.21	0.22	0.23	0.24	0.23	0.25	0.26	0.26	0.27	0.27
0.092	0.21	0.22	0.23	0.24	0.23	0.25	0.25	0.26	0.26	0.27
0.093	0.20	0.21	0.22	0.23	0.23	0.25	0.25	0.26	0.26	0.26
0.093	0.20	0.21	0.22	0.23	0.23	0.25	0.25	0.26	0.26	0.26
0.094	0.20	0.21	0.22	0.23	0.22	0.25	0.25	0.25	0.26	0.26
0.095	0.20	0.21	0.22	0.23	0.22	0.24	0.25	0.25	0.25	0.26
0.096	0.20	0.21	0.22	0.23	0.22	0.24	0.24	0.25	0.25	0.26
0.097	0.19	0.20	0.21	0.22	0.22	0.24	0.24	0.25	0.25	0.25
0.098	0.19	0.20	0.21	0.22	0.22	0.24	0.24	0.24	0.25	0.25
0.099	0.19	0.20	0.21	0.22	0.21	0.23	0.24	0.24	0.24	0.25
0.1	0.19	0.20	0.21	0.22	0.21	0.23	0.23	0.24	0.24	0.25

Appendix C, Canola Processing: Expelling and Extruding Concept.

Appendix C. 1, The Extruding-Expelling Process (Source: Insta-Pro ® International, Division of Triple "F", Inc.

The two main components of the process are -- an Insta-Pro® Extruder and a Horizontal Press. The objective of the process is to extract oil from oil bearing seeds such as soybeans, sunflower seeds, canola or rape seed.

The Insta-Pro extruder generates heat through friction to cook, sterilize, stabilize, texturize, and dehydrate products. In processing soybeans, the anti-nutritional factors in raw soybeans are deactivated thus making the finished product fit to be used as an ingredient.

1. Extruded soybeans contain on average 18% oil. Because of the shear, temperature and pressure, cells are ruptured, including the oil cells, allowing for better and more efficient separation of the oil when a screw press is used.

The extrusion temperature of the soybeans as they exits the extruder is 280-300° F; the pressure is estimated at 400 P.S.I. The dwell time is less than 30 seconds. The extruded soybeans are augured to the press and enter at 160-180° F and approximately 6% moisture. The exit temperature of the expelled meal or cake is about 180-200° F.

The amount of oil expelled depends on factors such as the oil and moisture content of the raw beans and the set-up of the press and controlling temperature and moisture of the product to be expelled. On average, 50-66% of the oil can be expelled.

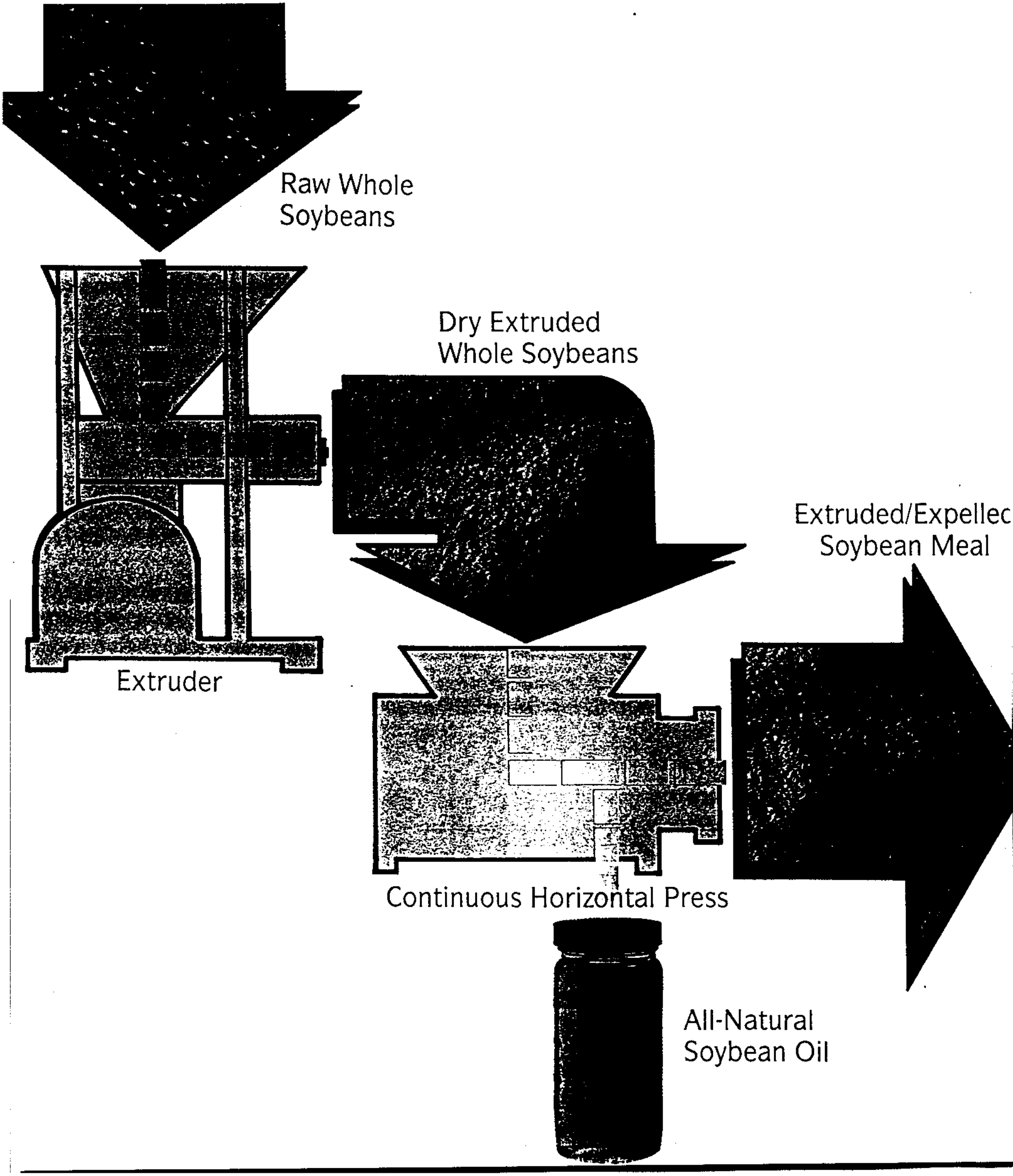
Nutritional profiles for the raw soybeans, extruded soybean, expelled meal and crude soybean oil are available.

2. Sunflower seeds contain about 32-40% oil with 16-22% crude protein. The process of expelling the oil from extruded sunflower seeds is similar to the process described above. The differences are the temperatures.

Sunflower seeds are extruded at 240-260° F. They enter the press at 180-190° F while the exit temperature of the partially defated sunflower cake is about 200° F. As with soybeans, 50-66% of the oil can be expelled from the seed. Typical profiles of the sunflower products at each stage of the process are available.

With the Insta-Pro Extrusion-Expelling process, the quality of the meal and the oil is as high as possible. The shelf life and stability of the product are enhanced due to the fact that when the oil cells are ruptured, the natural tocopherols are released which act as anti-oxidants that help retain the quality.

Appendix C. 2 Schematic Diagram of Extruding-Expelling Process



MICHIGAN STATE
UNIVERSITY

December 21, 1995

TO: Bishwa B. Adhikari
Dept. of Agri. & Extension Edu.
410 Agriculture Hall

FR: David E. Wright, Ph.D.
Chair
The University Committee on Research
Involving Human Subjects (UCRIHS)
232 Administration Building

RE: IRB#: 95-005
TITLE: "CANOLA MARKETING SYSTEM INFRASTRUCTURE FOR MICHIGAN"
CATEGORY: 1-C
APPROVAL DATE: 02/22/95

RENEWAL: Our records indicate that this project was approved on the date shown above. As you know, UCRIHS approval is valid for one calendar year. If you are planning to continue your study after February 22, 1996, you must complete and return to the UCRIHS office a green renewal application form by January 22, 1995. There is a maximum of four such expedited renewals possible. Investigators wishing to continue a project beyond that time need to submit it again for complete review.

CHANGES: As you are aware, UCRIHS must review and approve all revisions to human subjects activities, prior to initiation of the change. Therefore, if you have any future study revisions you wish UCRIHS to review and approve at this time, please answer question #7 on the renewal form "no" and follow the instructions given there.

If you have decided to discontinue the research or if you have already submitted your application to renew this study, please disregard this reminder.

cc: James Hilker

OFFICE OF
RESEARCH AND GRADUATE STUDIES

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Research Involving
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