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Sustainable Development: Building a Case for Hemp

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ABSTRACT

Objectives of this paper are to discuss hemp within the context of sustainable development and examine the economic impact of establishing a hemp sector in rural U.S. locations. This study focuses on the textile industry and examines the interlinking industry impacts from hemp production, fiber processing, and apparel manufacturing. First this paper discusses hemp cultivation in terms of sustainable development, secondly we identify its performance attributes, thirdly we talk about the market for hemp products, fourthly we describe the manufacturing and processing of hemp, and then we describe our input-output model, its analysis of a hemp sector, and research findings. Establishing one hemp apparel manufacturing firm and processing plant appears to be comparable to establishing one cotton apparel manufacturing firm and processing plant in terms of total industry output and employment based on the assumptions of the study.

Keywords: hemp sector, textile industry, economic impact, sustainable development

Introduction

U.S. demand for hemp made products grow rapidly during the 1990s with consumption of imported hemp fiber increasing 415.8% between 1995 and 1996 (Gross, 1997). Hemp products are substitutes for wood fibers, such as rayon, as well as being eco-sensitive (PR Newswire, 1997). Hemp improves soil fertility and is a durable rotation crop that is adaptable to most climates (Clark, 1999). Hemps cultivation requires little or no pesticides and herbicides, particularly when grown on smaller plots (Kane, 2000). It has the same appearance, growth and processing requirements ecological cousin as another best fiber, linen (Gross, 1997). Yet considerable debate continues regarding the viability of industrial hemp as a fiber alternative in the U.S.

Many assume that both the economic (lack of sustained profitability) and the political environment effectively impede renewed U.S. hemp production. Others believe the U.S. industrial hemp industry should be revitalized because the fiber survives without herbicides, adds to soil content, uses less water than cotton, and yields more paper per acre than trees (Kane, 1999). Thus, any discussion of the industrial hemp sector involves dimensions of economic development and environmental quality that are considered two aspects of sustainability (United Nations, 2002; Goodland and Day, 1996).

A critical part of the debate regarding hemp production is posed as the question: "What is the potential economic contribution of industrial hemp sector to the economy?" Cultivating and developing an industry to compete against imported hemp products would create price advantages and add to diversification of crops for farmers. However, adopting new crops for industrial use also creates risks for decision-makers involved with hemp production because of uncertain prices, demand, production costs, and returns on investments. On an aggregate level, changes attributed to hemp production could impact total industry output, employment, personal income levels and net imports.

Objectives of this paper are to discuss hemp within the context of sustainable development and examine the economic impact of establishing a hemp sector in rural U.S. locations. As of 1996, U.S. law enabled industrial hemp to be grown for research purposes. Since sales of hemp-based products in the U.S. are highly dominated by clothing items (Gettman, 1996), this study focuses on the textile industry and examines the interlinking industry impacts from production, fiber processing, and apparel manufacturing.

First this paper discusses hemp cultivation in terms of sustainable development, secondly we identify its performance attributes, thirdly we talk about the market for hemp products, fourthly we describe the manufacturing and processing of hemp, and then we describe our input-output model, its analysis of a hemp sector, and research findings. Lastly, we discuss the implications of our research findings.

Literature Review

<u>Hemp and Sustainable Development</u>

The intent of sustainable development is a "humane equitable and caring global society, cognizant of the need for human dignity for all (United Nations, 2002)." The theory is predicated on three interdependent components: (1) economic development, (2) social development, and (3) environmental protection. Sustainability seeks to maintain the total natural capital stock at or above the current level (Buescher, Sullivan, Halbrendt, and Lucas, 2001; Costanza and Daley 1992). This means an efficient use of resources in the present, with a plan for future resource needs. Costanza and Daley (1992) argue that a lower stock of natural capital may be sustainable, but society can not allow further decline in natural capital given due to large uncertainty and negative consequences from wrong guesses. This concern considers overall quality of life, in this case for those whose income is derived from fabric and apparel production. Costanza and Daley suggest current macro level measures of economic well-being (i.e., the Gross National Product) mainly quantify growth, or at best consider growth and development.

However sustainable development is more than growth and development. According to Goodland and Day (1996) sustainable development allows growth without using matter and energy beyond regenerative and absorptive qualities. They identify three components of sustainability as social, economic and environmental aspects. Social sustainability is created by systematic community participation. Economic sustainability maintains four forms of capital, human-made, natural, social, and human. Environmental sustainability tries to improve human and social welfare through protection of raw material sources used to require needs. The focus of environmental sustainability is to produce consumption waste products that are not harmful to humans.

Industrial hemp, an agricultural product is one example of how textiles may be used in sustainable development. The hemp fiber is environmentally friendly (Kadolph and Langford, 2002; Gross, 1997; Musselman, 1997). It can be grown without fertilizers and pesticides, is resistant to insects and fungus, and extracts soil pollutants such as zinc and mercury (Kadolph and Langford, 2002; Gross, 1997). Growing time for hemp is shorter (120 day average) and yields are 25% and 600% greater than cotton and flax respectively (Kadolph and Langford, 2002; Gross, 1997). Hemp is grown in a variety of climates and industrial hemp crop rotations are two to three years as compared to six to seven years for flax (Gross, 1997). Gross (1997) suggests, as a cellulose rich plant, industrial hemp should be a core crop in sustainable development.

Moreover, the entire hemp plant can be used in producing products. Approximately 25,000 different products are made from industrial hemp, a natural baste fiber (White, 1999). In addition to apparel products, industrial hemp is used to make paper, cosmetics, carpets and other home furnishings textiles, salad oil, snack, construction materials, biodegradable auto parts, and hormone-free, steroid-free, and anti-biotic-free hog food (Ackerman, 1999; White, 1999).

Textile Fiber Performance Attributes

In terms of the textile/apparel complex, industrial hemp fibers are found in apparel and home furnishings products, in addition to rope and twine. Hemp is a baste fiber similar to flax. It ranges in length from three to fifteen feet (Kadolph and Langford, 2002). In its natural state, hemp is coarser and stiffer than flax. However, processing of the fiber minimizes these differences.

The popular press reports hemp is the strongest natural fiber (Musselman, 1997). Hemp has a high tensile strength, low elongation of about five percent and resists ultraviolet, mold, and rotting when wet (Kadolph and Langford, 2002; Musselman, 1997). Hemp fabrics are comfortable because of an eight percent absorption rate. In addition, fabrics made from hemp can be machine washed because they are 78 percent cellulose.

The growth of industrial hemp sector in the U.S. is illegal because of the government's concern with its tetrahydrocannibinol (THC, the psycho-active agent in marijuana). However, its THC content is insignificant to be considered marijuana (15% THC level) (Musselman, 1997). Newer varieties of hemp have less than one percent THC content (Kadolph and Langford, 2002). While fiber demand for hemp products increased in the U.S. because of the fiber's performance qualities, its production remains illegal.

The Market for Hemp Products

The market for hemp apparel products is growing. Demand for hemp in 2001 outpaced supply and is expected to increase as the fiber is used in additional products (Karus, 2002) and cotton stocks decrease (Anonymous. (2002). Hemp products appeal to Sierra Club readers who champion environmental advocacy (Vobril, 2003). Vegans like hemp apparel products for comfort and quality and fashion conscious consumers purchase trendier hemp products. Eco-chic apparel also appeals to environmentally friendly fashion Hollywood celebrities, as organic products increasingly appear in luxury brands (Brown, 2003). About 73% of Americans purchase products that benefit the environment (LaFerla, 2001). Hemp apparel is positioned as a lifestyle product.

Hemp also is considered a sustainable product and should benefit from consumer demand trends regarding environmentally friendly products. For example, one hemp apparel manufacturing company reports a 300% increase in sales revenues between 2001 and 2003 due to appealing to eco-friendly consumers (Lewis, 2003). Companies such as Giorgio Armani, Ralph Lauren and Adidas market hemp products (Anonymous, 1997). Also a market for hemp exists in home textile products (Anonymous, 003A). Not only is hemp used for home products such as $200 hammocks and armchairs, it appears in industrial textile products. Hemp is used in automotive products with textile components (Anonymous, 2003B). They are considered cost effective with good performance qualities. Researchers currently are examining the possibility of using reinforced hemp products in automobile panels.

In summary, there is growing demand for hemp apparel. It appeals both to eco-friendly and luxury brand consumers of apparel and home furnishings textiles.

Model and Study Area

An unexaggerated state input-output model (IMPLAN) was used to evaluate the economic effects of establishing a new hemp sector in a rural state. The framework for an input-output model allows categorization and analysis of data that indicates the relationship between one industry and another, as well as interdependencies between them in a regional economy (Salsgiver, 1997). Thus, the direct, indirect, and induced impacts from a final demand change are calculated through input-output analysis. In the study, we consider hemp production, fiber, fabric, and apparel manufacturing, vertically integrated structure with the economic interdependencies. Input-output analysis provides an appropriate methodology for examination of direct, indirect, and induced economic impacts of hemp production. It has been used to study other industry sectors Hodges, Haydu, 2004; Lazarus, Platas, Morse, Guess-Murphy, 2002; Hughes, Litz, 1996; Kluender, Pickett, Trenchi,1991 as well as consider the economic impact of developing a hemp sector in Canada (Marcus, 1995).

During the last twenty years, a number of models were developed to generate small-area, such as state, or regional data that considers the economic impact of industrial sector activity. These models use technical coefficients of the U.S. input-output transaction matrix. Three models most commonly used in the U.S. are IMPLAN (by the USDA/Forest Service), REMI (from the Regional Economic Models, Inc.), and RIMIS II (from the U.S. Department of Commerce/ Bureau of Economic Analysis). Rickman and Schwer (1993) found that after benchmarking the IMPLAN and REMI models, multipliers from these models generally were statistically indistinguishable from each other.

In this study, the direct impacts are the sales and employment generated from hemp production, one hemp fiber processing plant, and one hemp apparel manufacturing firm. Indirect impacts are the sales, employment, and the value-added that result from other firms in the local economy supplying to the hemp enterprises (e.g. the agricultural input industries, agricultural services, machinery and equipment industries, and utility industries). Induced impacts are the sales and employment generated from the expenditures of the workers in the newly created jobs as the earnings are spent in that rural state. A multiplier is calculated to explain the economic value of a change in demand for hemp apparel. The state of Vermont was selected for this study because it was the only state with legislation allowing industrial hemp to be grown.

Assumptions of the Study

First, in this study one hemp apparel manufacturing firm was added to the IMPLAN model. In addition, one hemp processing plant was added to supply the newly established apparel manufacturing firm with hemp cloth. The assumption of this study was that the apparel manufacturing firm exclusively bought the cloth from the hemp processing plant. Furthermore, the hemp crop is grown in the study's region to satisfy the fiber input requirements of the hemp processing plant. The hemp grown in the study's region was the only fiber source for the processing plant. Thus, operations were vertically integrated at a local geographic area level.

Secondly, farmers will grow hemp both for fiber and seed use. Profit statistics showed that growing hemp for fiber in general earned negative profit in Europe; if no government supports were given (In Germany hemp farmers receive EU aid of 1510 DM per hectare i.e. about $337 per acre, which covers all the variable costs and about 56% of the total cost.) If hemp were grown either for seed or stalk, it would likely generate negative returns even in the best scenarios (Marcus, 1997). For this study we assumed farmers grew hemp for both fiber and seed uses, which would be the best case scenario for profitable farm operation based on current market conditions.

Thirdly, the processing plant changed stalk to fiber, then made it into cloth.

Fourthly, constant returns to scale were assumed for the IMPLAN model. There are two implications of this assumption. The study assumes one hemp apparel firm and one hemp processing plant as representative and generalizable, because if more than one processing plant was built but the total sales kept the same, impact would not change. Two, if a decision-maker decides to build larger hemp sectors than the study assumes, impact can be enlarged proportionally.

Fifthly, no plant construction impact was estimated. Usually when a new plant is established, the impact to the economy is much greater in the first year than in the following years because the construction of a plant creates jobs and requires capital input.

Sixthly, since no exact wage information in the hemp production and processing industries is available in U.S., the direct employment numbers for hemp industries are derived from assumed wage rates. For hemp apparel manufacturing firms, employment number is assumed to be the average level of apparel manufacturing firms with the same size and the annual wage rate is found to be about $10,780. For the hemp processing sector, we assume the annual wage rate to be $22,900, which is the average wage rate of textile workers in the state studied (IMPLAN sector 123, SIC 2299). For the hemp growing sector, the annual wage rate is set to $2,142, the average wage rate of cotton (IMPLAN sector 10), food grains (IMPLAN sector 11), feed grains (IMPLAN sector 12), hay and pasture (IMPLAN sector 13), grass seeds (IMPLAN sector 14) and tobacco (IMPLAN sector 15).[1] The annual wage rate is the combination of full time jobs and part time jobs. The low agricultural wage rate reflects the fact that many jobs in agricultural sector are part-time positions.

Lastly, no costs of legalization and regulation, licensing and dellta-9 tetrahydrocannabinol (THC) [2] tests were assumed.

Model Data

The model used data that was generated from other studies and primary data collection. Data for the apparel manufacturing firm, processing plant and production were estimated from a number of sources including, Department of Community Development and Applied Economics' survey to hemp businesses in 1997, Marcus' study in Canada (1995), Gusovius' survey for Germany studies (1996), and Vantreese's global markets and prices study (1997). The data used for the IMPLAN model is explained in the following sections.

Hemp Apparel Manufacturing: Firm Size and Cost Structure

Hemp Apparel Manufacturing Firm Size

[1] For sectors not producing in Vermont, we used national average.

[2] THC is the chemical substance that gives marijuana its psychoactive properties

For this study estimates of the economic impacts of establishing one hemp apparel manufacturing firm were based on three representative firm sizes: large, medium and small. Firm sizes were determined from a combination of firm sales and number of employees and based on the evaluation of a total of 37 apparel firms in Vermont whose sales and employment are found in The Vermont Manufactures Directory (1997).

For a large size firm, hemp apparel sales were about $13 million. This sales amount approximated half of the U.S. industrial hemp sales of $23 million in 1996 (Bordenaro, 1997). A medium-size firm's sales were about $3.4 million and a small-size firm had about $0.36 million.

The IMPLAN model required data on sales, personal income, and number of employees. Sales and employment numbers were obtained from the Vermont Manufacture Directory 1997. Personal income for each firm size was estimated from multiplying the sales with the percent of expenditure on wages and proprietary income. The percent of expenditure on wages and proprietary income was estimated by the cost structure of hemp apparel manufacturing which will be introduced below.

Table 1 shows the different apparel manufacturing firm sizes and their corresponding sales, income and employment.

Table 1: Hemp Apparel Manufacturing Firm Size and its Sales, Personal Income and Employment

Firm Size	Estimated Sales	Personal Income [a]	Employment
Large	$13,438,798	$ 3,077,485	187
Medium	$ 3,392,039	$ 776,777	47
Small	$ 359,326	$ 82,286	5

[a] Personal Income = wages + proprietary income

Source: conducted from data from the *Vermont Manufactures Director, 1997*

It is interesting to note that sales generated per employee are about $68,000 at large-size firms and about $72,000 at small- and medium size companies.

Hemp Apparel Manufacturing Firm Cost Structure

To gather the cost structure data for one hemp apparel firm, this study developed the cost structure from the current cost structure of in-state apparel manufacturing firms (sector 124 in the IMPLAN model) together with the data from surveys of hemp firms across the U.S. and in Germany (Department of Community Development and Applied Economics, 1997) Forty-three percent of the costs were buying fiber and fabrics, which is the largest cost component of apparel manufacturing. The next largest cost component is employee compensation (15%), followed by other services (9%), and advertising (7%).

Hemp Processing: Plant Size and Cost Structure

Hemp Processing Plant Size

To derive the sales data for the three processing plant sizes, this study assumes the hemp fiber processing plant sells hemp cloth to the newly built hemp apparel-manufacturing firm. Therefore the total sales of the processing plant can be estimated from the expenditures of the apparel-manufacturing firm on hemp cloth. Also, the personal income was calculated by multiplying the total hemp cloth sales by 43.4%, which is the percentage processors spent on wages and proprietary income according the estimated cost breakdown of the hemp processing firm. The number of employees for different size processing plants was estimated from dividing total wages expenditure by the assuming wage ($22,900).

Table 2: Hemp Processing Firm Size and its Sales, Personal Income and Employment

Firm Size	Estimated Sales	Personal Income[a]	Employment
Large	$ 5,886,194	$ 2,552,577	68
Medium	$ 1,485,713	$ 644,287	17
Small	$ 157,385	$ 68,251	2

[a] Personal Income = wages + proprietary income

Table 2 shows the different hemp processing plant sizes and corresponding sales, income, and employment. A large size plant has sales of $5.9 million, personal income of $2.6 million and employs 68 workers. A medium size plant has sales of $1.5 million, personal income of $0.65 million and employs 17 workers. A small size plant has sales of $0.16 million, personal income of $68 thousand and employs two workers.

Hemp Processing Cost Structure

Processing hemp requires two stages: (1) separating the fiber from stalk and making the yarn and (2) weaving the fabric into hemp cloth. Therefore, separate costs for the two stages were estimated.

Separating Fiber from Stalk

The traditional technology used to process hemp is labor intensive. The process of separating baste fibers from the stalks of a hemp plant uses a traditional method which is a lengthy method of water or dew retting (rotting) the crop. However, new and more efficient technology, such as steam explosion, ultrasound and pulping, is used in some countries. Though the latest technology is efficient, the installation and operation costs of such new processes are quite high. In this study we assume the newly established plant uses the steam explosion method, with a "low cost, high yield and low or no environment consequences" pulping technology (Staketech Co.) to process the hemp.

The cost structure for separating hemp fiber from hemp stalk was estimated using a typical cost structure for a non-woody pulping plant which uses steam explosion technology (Staketech Co.). It adjusted cost by average hemp stalk price and a stalk to fiber conversion rate of 13%.[3] The cost structure includes separating fibers from the stalk. Buying the hemp stalk is the largest expenditure (58%) followed by depreciation costs (14%), electricity costs (8%), effluent treatment costs (8%), maintenance costs (3%) and labor costs (3%) etc.

Processing Fiber into Cloth

This study derived the cost structure of processing fiber into cloth from the information found in sector "TEXTILE Goods, N.E.C." of the IMPLAN model data that includes hemp, jute, flax and ramie etc. Figure 4 shows the largest expenditure for processing hemp fiber to cloth is fiber and fabrics (28%), followed by employee compensation (15%), finance, insurance, and services (10%), corporate profit, investment and taxes (10%), and numerous other expenditures less than 10%.

Hemp Yield, Price and Revenue Data

Cost and yield data is unavailable for U.S. hemp production due to the fact that

[3] The conversion rate from stalk to fiber is 75% for the typical non-woody plant. The conversion rate for hemp is low because there is less fiber in the stalk than for other non-woody plant. The natural content of baste fibers in hemp stalk is in the range of 22-30% but only 12-15% can be obtained due to the loss of processing. Hence hemp processor requires greater expenditure on labor, electricity, water, steam etc. than for typical non-woody fiber production.

hemp cannot be grown in the US. Moreover, the existing data varies considerably due to differences in the growing regions and their productivity and labor costs. For example, seeding rates are different depending on the end use. It costs more to produce hemp for fiber, about 55 kg/ha to 70 kg/ha, as than for seed use, about 15 kg/ha. There also are different harvesting methods such as chopping, mowing, baling etc. Finally, there are differences in transportation, land and labor costs. All of this makes cost and profit estimations difficult.

After reviewing previous research, limitations to previous work were no U.S. data for hemp and only two studies of estimates of growing hemp for both seed and fiber. This study uses Marcus' average price and yield estimations for the following reasons:

1. Data comes from Ontario, which is more comparable to the U.S. than European data.
2. Marcus' study (1996) estimates price and yield based on production of hemp for both fiber and seed uses, which is consistent with the assumption of this study.
3. Marcus' price and yield estimation ranges fall in the lower range of most of the other studies reviewed. This is consistent with the fact that when hemp is grown for both uses, hemp yield and price will be lower than when it is grown for a single use.

Table 3 shows Marcus' yield and price estimations, which are used in this study.

Table 3: Hemp Yield, Price and Revenue Data used in this study

Price/Yield Scenario	Average Level
Yield(stalk+seed)/acres	19bu+2.75ton
Ave. Price(stalk+seed)	$6.16/bu+$45.96/ton
Total Revenue/ac	$248.13
Total Cost	$174.63
Return ($/ac)	$73.49

Source: David Marcus, an independent study project "Commercial hemp Cultivation in Canada: An Economic Justification."

Yield estimates are given in acreage. It is worth noting that costs amount to about 70% of sales revenue generated per acre.

Farm Size

Based on data in Table 3, the farm size (acres), the total sales and employment were estimated from the processing plant's expenditure on hemp stalk using the cost structure of hemp processing plant developed previously with the assumption for a wage rate of hemp growing. Table 4 shows the different farm sizes and their corresponding acres, sales and employment figures as used in the model.

Table 4: Farm Size and Their Corresponding Acres, Sales and Employment

	Acres	Total Sales: seed +stalk($)	Employment
Large	6,818	1,659,679	41
Medium	1,721	418,914	10
Small	182	44,376	1

Table 4 indicates if large size apparel manufacturing and processing plants are built, about 6,800 acres are required to supply hemp stalk for a firm with total sales of $1.66 million. If medium size apparel manufacturing and processing firms are built, about 1,700 acres are required to supply hemp stalk for a firm with the total sales of $420 thousand. If small size apparel and processing firms are built, about 182 acres are required to supply hemp stalk for a firm with the total sales of $44,000.

Results

State Level Impact

The economic impact of establishing a large size hemp sector in terms of total industry output and employment were calculated.

Total industry output increases by $30 million and 439 jobs will be created if a large size hemp apparel manufacturing firm and a hemp processing plant are established.

Figure 1: Total Industry Output Impact from Establishing A New Hemp Sector (Large Size Enterprises)

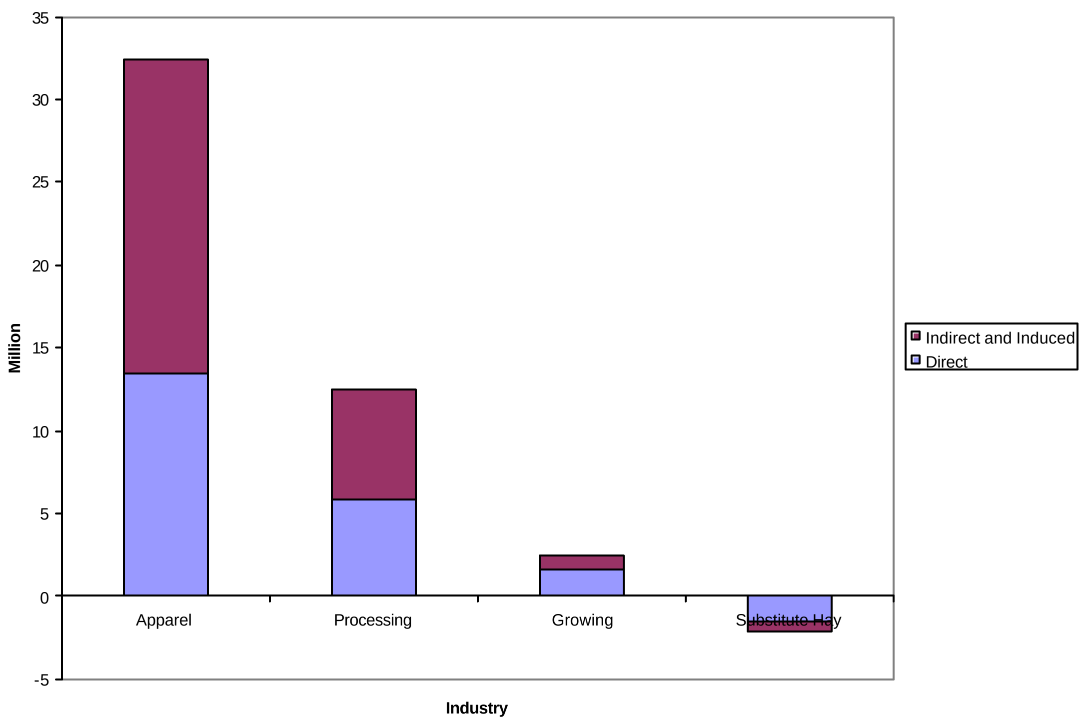
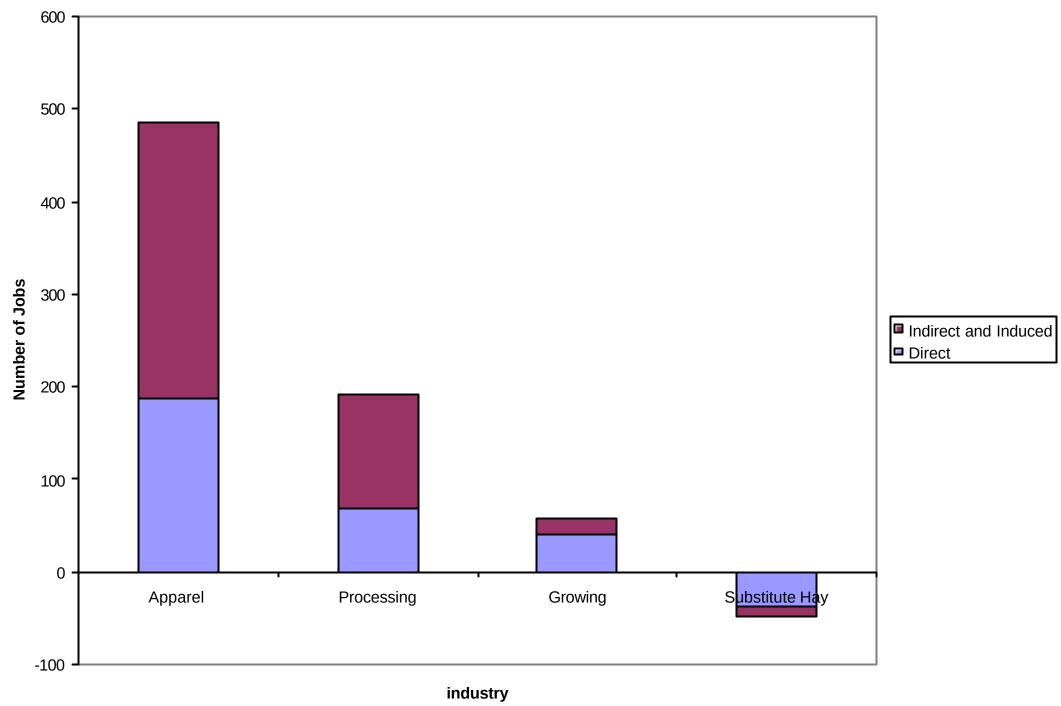


Figure 2: Employment Impacts from Establishing A New Hemp Sector (Large Size Enterprises)



The impact due to hemp production was estimated adjusting for the loss in hay production.

Analysis indicated the economic impact of establishing a medium size hemp sector in terms of total industry output and employment. Total industry output increases by $7.6 million and 110 jobs will be created if a medium size hemp apparel manufacturing firm and a hemp processing plant are established.

The impact due to hemp production was estimated adjusting for the loss in hay production.

Lastly, the economic impact of establishing a small size hemp sector is estimated in terms of total industry output and employment respectively.

Figure 3: Total Industry Output Impacts from Establishing A New Hemp Sector (Medium Size Enterprises)

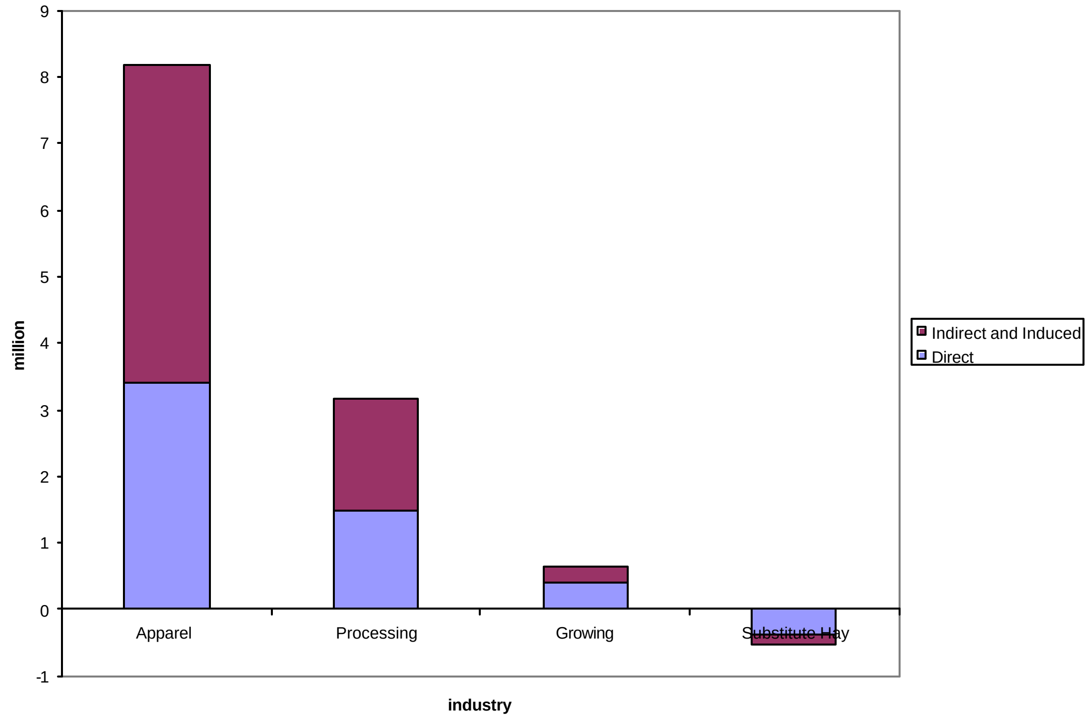


Figure 4: Employment Impacts from Establishing A New Hemp Sector (Medium Size Enterprises)

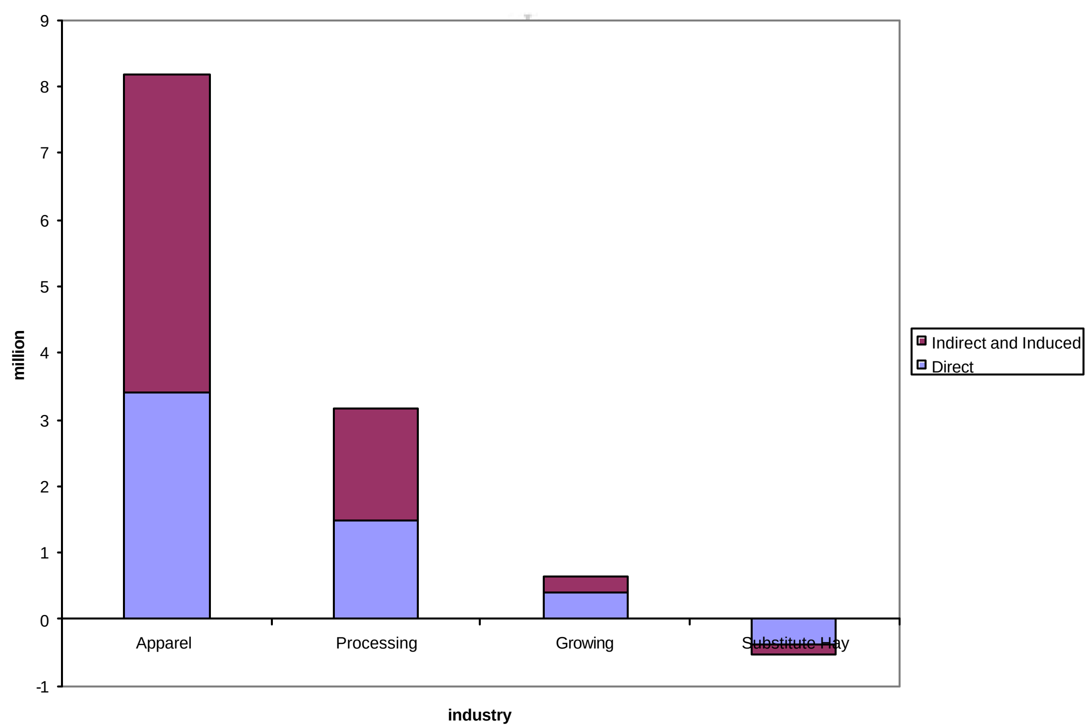
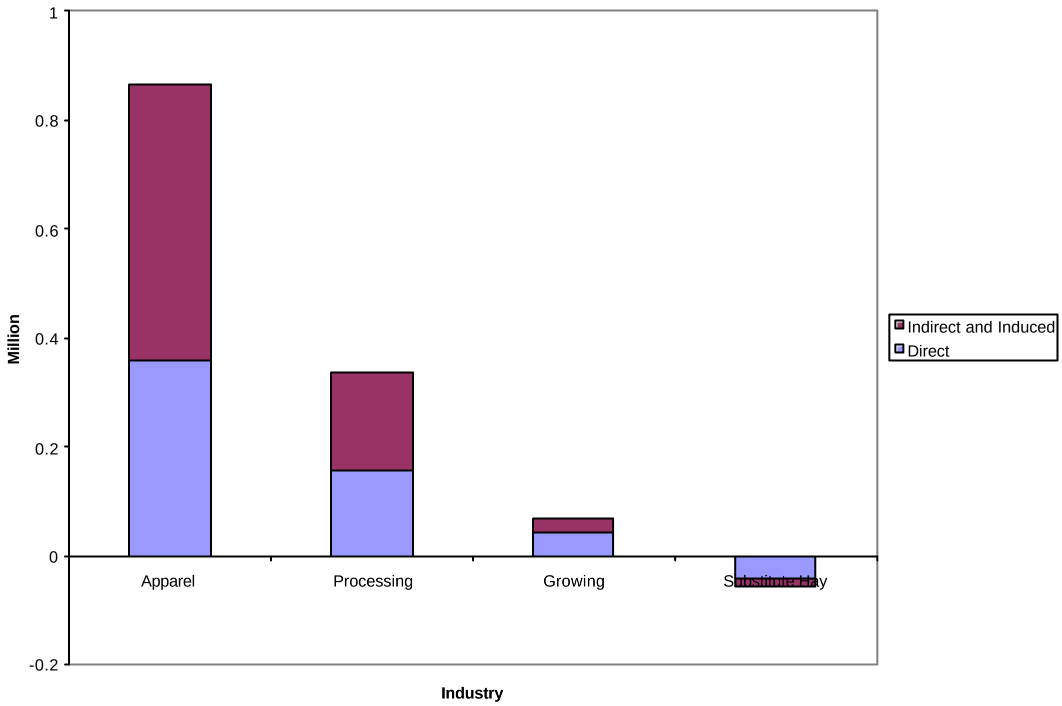
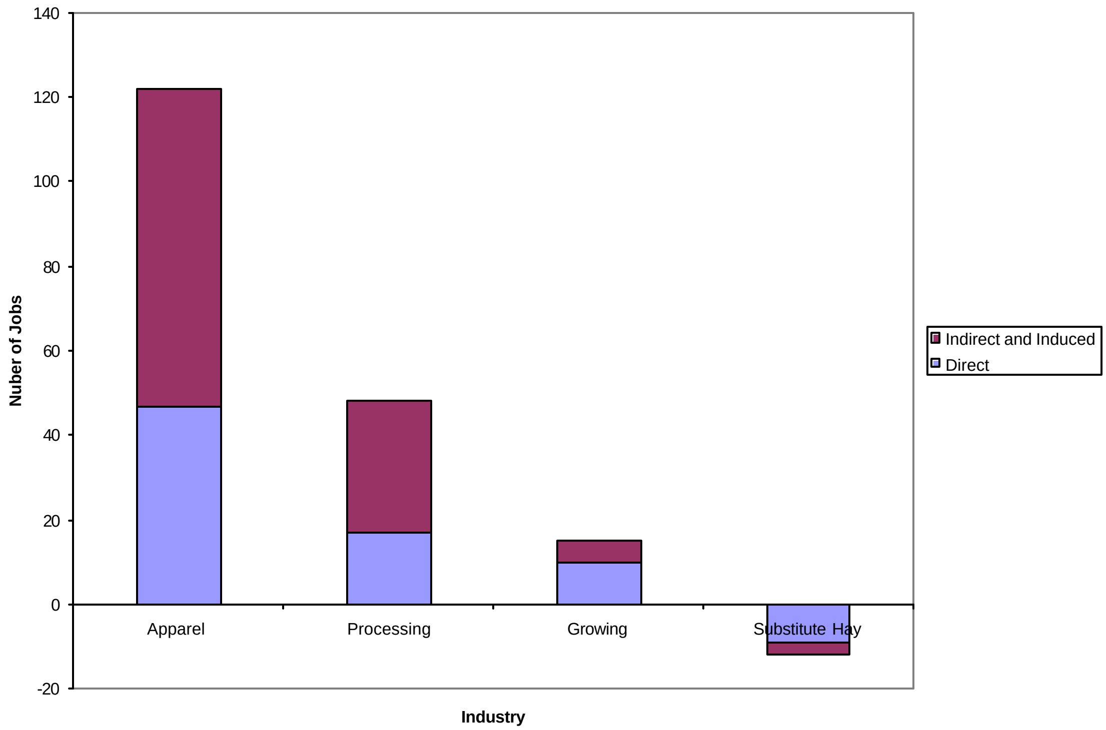


Figure 5: Total Industry Output Impacts from Establishing A New Hemp Sector (Small Size Enterprises)



Total industry output will increase by $0.81 million and 13 jobs will be created if a small size hemp apparel manufacturing firm and a hemp processing plant are established. The impact due to hemp production was estimated adjusting for the loss in hay production.

Figure 6: Employment Impacts from Establishing A New Hemp Sector (Medium Size Enterprises)



It should be noted that the study assumes that the seed, which amounts to 12.7% of the total production cost, is imported (thus no further backward linkage to the economy) and all of the production for seed use are exported outside the state (Farmers do not need to purchase seeds from the second year on because they produce their own, but the impact to the economy will not change a lot because seed cost are not substantial to the total costs.)

Economic Impact of Growing Hemp

The economic impact of growing hemp for a large hemp sector is $2.5 million and 59 jobs. The economic impact of growing hemp for a medium sector is $636 thousand and 15 jobs. The economic impact of growing hemp for a small hemp sector $67 thousand and two jobs.

The following analysis compares hemp with hay production because hemp is considered a possible alternative crop for land currently grown hay in Vermont. The economic impact of reducing hay production by the same acres was estimated by IMPLAN. About $2.1 million and 47 jobs will be lost if a large hemp sector is established. About $540 thousand and 12 jobs will be lost if a medium size sector is established. About $57 thousand and 1 job will be lost if a small size sector is established. Overall, hemp provides greater sales and more jobs than producing hay.

Table 5: Comparing Hemp and Hay Production

		Hemp	Hay
Agricultural employment	(jobs per $1 million output)	24.7	25.2
Additional employment impact	(jobs per $1 million output)	10.8	7.0
Agricultural Output Multiplier		1.52	1.39

Table 5 shows the comparison of hemp crop (large sector) and hay. The direct economic impact of growing hemp is comparable to that of growing hay. Hemp has slightly higher indirect and induced impacts in terms of employment and output.

Comparison of the Hemp Sector in with the Cotton Sector

For hemp production to be economically viable, it must be competitive as well as substitutable. Thus, hemp must compete with other fiber and oil substitutes such as cotton. To gain an understanding of the competitiveness of hemp, this study additionally compares hemp sector in Vermont with cotton sector in Louisiana. Table 6 shows the impact comparison between a hemp sector and a cotton sector.

Table 6: Comparing Hemp Sector and Cotton Sector

		Hemp (Vermont)	Cotton (Louisiana)
Agricultural employment	(jobs per $1 million output)	24.7	26.3
Agriculture Additional employment impact	(jobs per $1 million output)	10.8	15.5
Textile Employment	(jobs per $1 million output)	13.2	27.1
Textile Additional employment impact	(jobs per $1 million output)	21.9	6.7
Agricultural Output Multiplier		1.52	2.34
Textile Output Multiplier		2.41	1.76

The cotton agricultural (growing) sector in Louisiana appears to create more agricultural and additional jobs than hemp growing sector and have higher output multiplier. The hemp textile sector (processing and manufacturing) has higher output multiplier and creates more jobs in total than cotton textile sector. Thus growing cotton creates slightly more jobs (1.6%) and greater revenue than growing hemp. However processing hemp fibers and manufacturing has a higher output multiplier which means it generates more dollars in the local economy.

Conclusions

Establishing one hemp apparel manufacturing firm and processing plant appears to be comparable to establishing one cotton apparel manufacturing firm and processing plant in terms of total industry output and employment based on the assumptions of the study. This study assumes that hemp and cotton are substitutable products. However, additional research is necessary to determine if consumers perceive the wear and care characteristics of hemp and cotton as substitutable. For example, hemp is a baste fiber similar to linen and wrinkles more than cotton.

Establishing a hemp value added sector (processing and manufacturing) will create more but lower paying jobs than existing agricultural processing sectors. The net gain from adding a hemp sector needs to be considered carefully. Although more jobs are created, chances are that they pay less money. Thus there are trade offs between number of jobs and quality of jobs. However, the economic impact of hemp may increase with demand, luxury brand apparel, and development of new product applications.

This study is an important first step in analyzing economic viability of alternative fiber crops. With the rapid growth of hemp-oriented businesses, policy makers can use this information to evaluate the economic contribution of this new crop sector in terms of aggregated economic indicators such as output and employment, and compare it with other crops. Thus policy can be generated using this predictive model for new crop sectors.

The environmental impact of producing and processing hemp is one argument for adopting hemp production. However, this study did not examine that aspect of hemp production. Further research should include evaluating the environmental impact of growing and processing hemp and its contribution to sustainable competitive advantage.

Acknowledgements

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