

**INDUSTRIAL HEMP:  
GLOBAL OPERATIONS, LOCAL IMPLICATIONS**

**Valerie L. Vantreese  
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## I. INTRODUCTION

Industrial hemp has maintained its place in the public eye, as hemp advocates and opponents continue to spar across America. Despite general acceptance in agricultural and political communities around the world, US activists remain deeply divided over hemp legalization. Industrial hemp is repeatedly praised for its never-ending array of uses, for its harmony with the environment, as a production alternative for small farmers, and as a value-added enterprise for local businesses. Meanwhile, its twin cousin continues to muddy the water, as industrial hemp is seen as a stepping stone to the legalization of marijuana and an impediment to the war on drugs.

The legalization of industrial hemp production in the US is polarized, in part, on its purported profitability. Anti-drug activists have used the argument that low or lack of expected profitability from industrial hemp production does not compensate for the additional costs they believe would come with hemp legalization. If hemp is not profitable, why encourage a crop that would increase illicit marijuana production and drug monitoring costs? Hemp proponents counter that projected profitability has been dampened by “institutional” estimates that are static and short-sighted. They argue that industrial hemp could be profitable if the industry were allowed to fully develop as a commercial agricultural enterprise, with additional profits earned from a multitude of value-added applications.

To answer the question “*Would industrial hemp production be profitable for US farmers?*”, several key issues must be investigated. Would the US have a certified seed industry that could compete with the high-yielding, low-THC, French varieties? Would hemp production replace or complement revenue from other agricultural crops? What type and at what rate would investment occur in the hemp processing industry? How large and how reliable is consumer and industrial demand for hemp products? Profit projections are extremely vulnerable to changes in these and other underlying assumptions.

To examine the profitability question, this report assumes that “*If industrial hemp is profitable, world production will be thriving and trade will be vigorous*”. Nearly every country in the world has legalized hemp production – the United States is a rare exception. If the US were to legalize industrial hemp production, what type of competition would US farmers and manufacturers face from the international market?



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### Authors Note:

All world production and trade data presented in this paper was gathered from the Food and Agriculture Organization of the United Nations. Trade statistics for the US were gathered from the US Bureau of Census. Both sources are gratefully acknowledged. Only trade data for *cannabis sativa l.* was considered for this report; other types of hemp, such as manila and sunn hemp, were excluded.

This report updates prior manuscripts by the author, including *Industrial Hemp: Global Markets and Prices (1997)* and *Industrial Hemp: Resource Paper (1996)*. Thanks to Dr. Steve Vickner, Department of Agricultural Economics, University of Kentucky for his statistical assistance in modeling hemp market price elasticities.

### III. INDUSTRIAL HEMP

*Cannabis sativa l.*, which includes both industrial hemp and marijuana, is a bast or long fiber plant containing variable concentrations of tetrahydrocannabinol (or THC, a psychoactive component).<sup>1</sup> By definition, industrial hemp refers to those strains of *cannabis sativa l.* containing less than 1% THC. Most developed countries that permit industrial hemp cultivation limit production to those varieties with less than 0.3% THC. Marijuana contains THC levels that typically range from 3-15%. The National Narcotics Intelligence Consumers Committee (a government group responsible for compiling drug supply data) reported a THC concentration for commercial grade marijuana of 4.2% in 1996 and 8.9% for sinsemilla (the unpollinated flowering tops of the female plant). The concentration of THC is dependent on both genetic and environmental factors.

Although there are several hundred varieties of *cannabis sativa l.*, individual plants of marijuana and industrial hemp look nearly identical. If grown for seed production, industrial hemp closely resembles *cannabis sativa l.* grown for marijuana. If industrial hemp is grown for fiber, the plants are spaced very closely together to encourage stalk growth and discourage leaf (thus flower and seed) growth. Thus, hemp grown for fiber production looks dramatically different from marijuana. Consequently, it would be relatively easy to “hide” marijuana amongst hemp plants grown for seed, but not amongst hemp grown for fiber. A 1992 Dutch study of 97 marijuana cultivars and other research from the US Department of Agriculture concluded that chemical analysis was the only way to distinguish industrial hemp plants from marijuana.

Many have questioned if cross-fertilization would occur if marijuana and industrial hemp were grown in close proximity to one another. If two subspecies of *cannabis sativa l.* were planted sufficient distance from each other and had similar flowering times (which does vary somewhat by subspecies), the two could cross-fertilize, somewhat lowering the THC content in the marijuana plant and elevating the THC content in the industrial hemp plant. However, geneticists contend that the THC level change in the first generation (the parents themselves) would be relatively small. If the seed of the cross-pollinated plant was itself planted, the second generation of plants would exhibit stronger expressions of the change in THC levels. Both commercial hemp and marijuana growers have incentives not to alter the THC level and would prefer beginning each growing season with fresh certified seed. Thus, cross-fertilization would not be a strong incentive to separate marijuana from hemp production.

Research continues to develop high-yielding, low-THC hemp varieties. For example, recent French experimentation has resulted in a new low-THC variety (Epsilon) and another cultivar proclaimed to be THC-free. The industry is continuing to look for strains that are high in cellulose content (for biomass fuel production), primary fiber yields (for pulping) and extra-fine fibers (for textiles). Genetic research is also being undertaken to develop seed varieties with

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<sup>1</sup>Previously published manuscripts have described in greater detail the cultivation and uses of industrial hemp. Interested readers are encouraged to read *Industrial Hemp: Global Markets and Prices* (Vantreese, 1997), *Economic Impact of Industrial Hemp in Kentucky* (Thompson et al, 1998) or other published papers documenting this information.

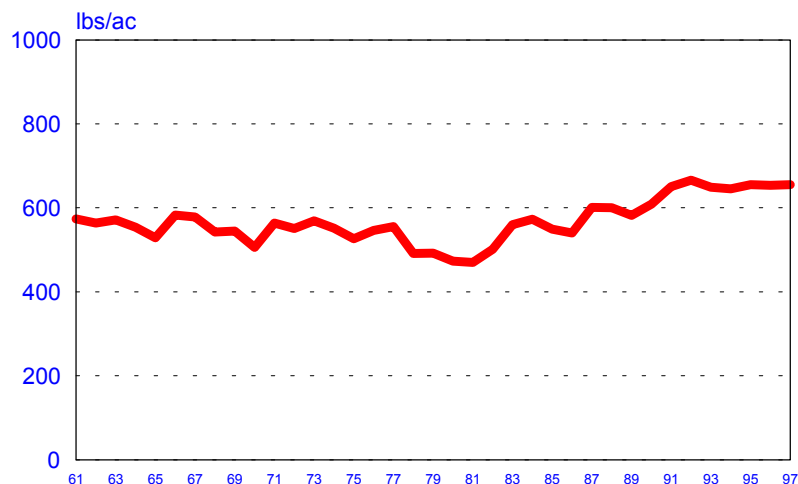
special amino acid profiles (for human and animal feeds), specific components for industrial uses (such as industrial lubricants) and various seed sizes (for easier hulling and assorted food uses).

Industrial hemp grows well in a multitude of different climates, altitudes, soils and weather conditions, although it is extremely sensitive to flooding and soil compaction. According to Canadian agronomic research, hemp requires about 105-130 lbs/acre nitrogen; 45-70 lbs/acre phosphate; and 52-70 lbs/acre potash. Although many claim that hemp is pest-free, *pest-resistant* appears to be more accurate. Consequently, hemp can be grown all over the world and competitive advantage may depend more on local processing capacity, due to the bulkiness of the raw commodity. The United States does not appear to have any unique advantage in growing hemp, despite our history of production.

While traditional seeding equipment can be used for hemp production, harvesting industrial hemp fiber can be very labor-consuming. Although traditional hand-cutting continues in much of the world, harvesting can be done with existing baling machinery. But, the height (up to 15') and superior length and strength of hemp fiber works to its disadvantage during harvest and can be very rough on equipment. Baled, industrial hemp can be left in the field for periods of time, depending on the end-use.

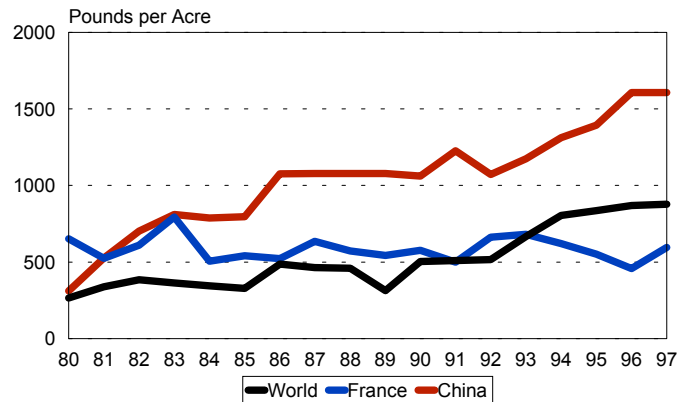
Over the last 35 years, hemp fiber and tow (the by-products of fiber separation) yields have increased very little from about 550 lbs/ac to about 650 lbs/ac in 1997. As expected, yield variability exists across countries. Over the last five years hemp fiber and tow yields have averaged 1,285 lbs/ac in China; 283 lbs/acre in the Russian Federation; and 556 lbs/acre in France. Yields are lower in France since most French production is for the seedstock industry, rather than for fiber production. Current US yield data is not available. Using data from Canada, hemp production on well-drained sandy soils of Southwestern Ontario yields about three to five tons of baled hemp stalks per acre (or 6,000 to 10,000 pounds per acre). While this is relatively high, it is in line with yields in Spain (5,700 lbs/acre) and other Western European countries experimenting with hemp production.

World Hemp Fibre and Tow Yield



Hemp *seed* yields have shown dramatic increases in recent years. In 1997, world average yields reached 876 lbs/acre. Yields rang significantly. China, the largest producer of hemp seed for consumption (including oil and meal), yields average 1,606 lbs/acre. France, the leading producer of certified hemp seed (sold to other farmers for seedstock) averages 595 lbs/acre. Notably, while hemp seed yields have grown significantly, seedstock yields have remained flat.

World Hemp Seed Yields (1980-97)  
France and China Compared



Farmers can typically expect to harvest only 50% of the hemp seed produced due to shattering and other problems. Despite the high quality of hemp seed oil, average oil yields (from crushing the seed) are lower than for any other major oilseed crop, with the exception of cottonseed (which is a dual purpose crop in that the seed is almost a by-product). At this point, raising hemp for simultaneous fiber and oil production would not maximize yields. Distinct hemp varieties are used for fiber versus oil production; fiber cultivation discourages flower (thus seed) production and oil production minimizes stalk production. Further, high-yielding oil varieties are not the same as the high-yielding fiber varieties.

#### IV. PROCESSING

Industrial hemp is grown for its fiber (outer bark), hurds (woody inner core of the stalk) and seeds (for oil and meal). Hemp stalk averages around 20-30% bast fiber (the strong woody fiber obtained chiefly from the phloem of plants). Retting, the separation of the hemp fiber from it's woody inner core, can be initiated in the field. Dew retting allows natural moisture to begin stalk decomposition. Small mechanical retters can also be used in the field to speed-up the process.

Industrial hemp fibers cannot be easily separated into fibers of consistent quality without specialized machinery. Pulping hemp fibers typically uses either mechanical or chemical pulping techniques, or a combination of both. Dutch research shows that a chemi-mechanical pulping process may prove to be the most cost-effective for hemp pulp. The Germans have introduced other innovative methods of fiber separation using steam explosion and ultrasonic waves. More recently, researchers in Poland have developed a plasma treatment for producing hemp paper.

The basic markets for bast fibers include cordage (such as rope), specialty textiles, and recycled and specialty papers (including teabag paper, coffee filters, cigarette paper, carbon tissues and

condensing tissues). Hemp has never been used for commercial (or high-volume) paper production due to its relatively high processing cost. According to the Dutch Institute for Agrotechnological Endeavors, the average hemp pulp and paper mill produces about 5,000 tons per year, compared to a minimum of 250,000 tons for a wood fiber pulp mill. The higher fixed costs of the hemp mill necessitates higher prices received for hemp paper products, indicating that hemp pulp is best suited for specialty paper production. However, specialty papers are limited to less than 5% of the demand for other major grades of paper, such as newsprint. Claims that the first bible was printed on hemp have not been confirmed, due to lack of evidence.

However, recent Dutch and German research suggests that industrial hemp is not competitive in the specialty paper market, but may be used as a fiber supplement to recycled paper pulp. The growing market for recycled pulp and paper (due to increased regulatory practices and rising wood prices) may increase the demand for agricultural fibers to strengthen recycled papers.

Current hemp pulping techniques produce a significant amount of chemical-contaminated waste water. Hemp fiber can also be bleached, similar to wood pulp, further creating environmental problems. It is hoped that some of the newer research mentioned above can significantly reduce the volume of waste water production during hemp (and other fiber) pulping.

As for textile production, small pulp mills have arisen in Britain, Spain and Eastern Europe for processing flax, hemp and other specialty fibers. Hemp Textile International is the first company in the US to commercially weave hemp fabric and a Georgia carpet manufacturer is using imported hemp slivers in carpet backing. However, continued competition from synthetic fibers and other natural fibers (such as cotton) has reduced the use of hemp fiber by the textile industry.

Approximately 70-80% of the hemp stalk is composed of hurds or the woody inner portion of the plant. Essentially, hurds are the by-products of extracting the bast fibers from the stalk. Hurds are 50-70% cellulose, lending itself to paper, particle board, biodegradable plastics, and animal bedding uses. For example, most of the hemp grown in the United Kingdom is for the horse industry.

Similar to soybeans, hemp seeds are pressed to yield seed oil and seed cake (or meal). Hemp seeds are approximately 30-35% oil by weight and can be used for food (the oil is over 70% polyunsaturated or cholesterol-fighting essential fatty acids and contains all 8 essential amino acids); fuel (mixed with 15% methanol for fuel 70% cleaner than petroleum diesel); paints; and varnishes. The seed cake contains 25% protein and can be used as a supplement to wheat flour. The whole seeds can be eaten (20% high-quality digestible complete protein) by humans and used for bird seed. However, due to the high content of polyunsaturated oils, hemp seed oil is fairly unstable and becomes rancid rather quickly unless preserved.

Shampoo, cheese, beer, toilet paper, shoes, laundry detergent and industrial cleaners are but some of the multitude of products on the market with some hemp content. Various sources have reported 20-25,000 different uses for industrial hemp fiber, oil and seeds. Not to be deprecating, figures such as these can be easily exaggerated or matched by other products (for example, corn).

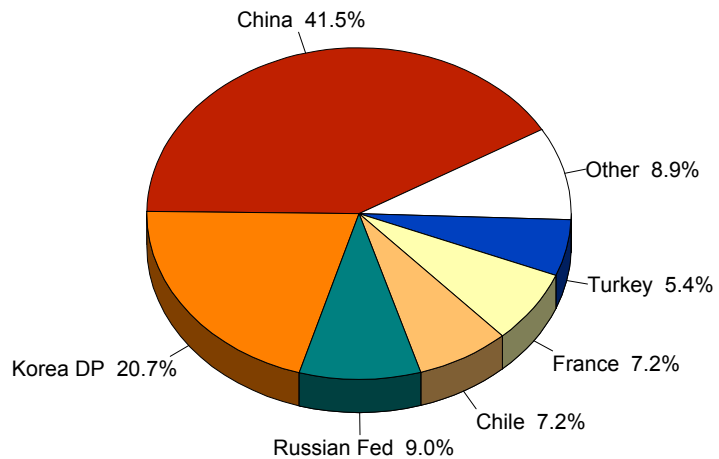


## V. WORLD SITUATION

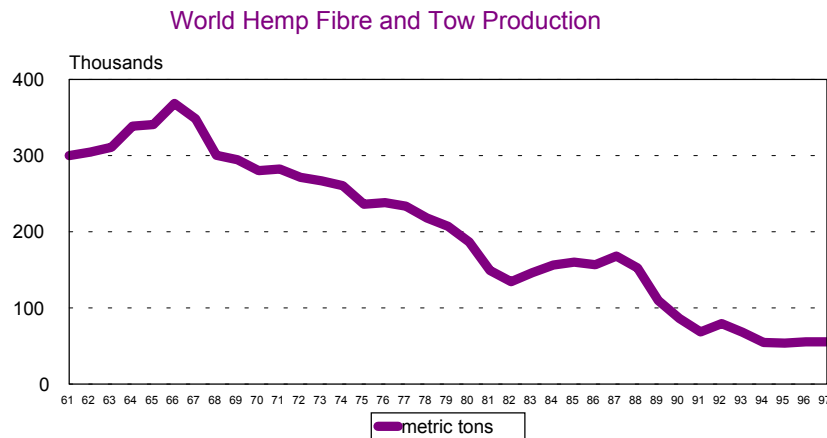
### World Fiber Market

In 1997, world hemp fiber production was about 55,500 metric tons, with China, South Korea and the Russian Federation producing more than 70% of total world supply. None of these countries has ever made industrial hemp cultivation illegal. China, Russia, Ukraine, Romania and the European Union are some of the countries which subsidize hemp production. Although more publicity has been given to revitalized hemp production in the European Union and Canada, these countries remain negligible producers.

World Market Share: Hemp Fibre and Tow Production (1997)



Notably, world hemp production has been on the decline, falling from over 300,000 metric tons in the early 1960's to one-fifth that level today. Although there has been a resurgence in interest in industrial hemp (due to the growing world demand for natural fibers and the adoption of more advanced hemp cultivation and processing techniques) production remains stable over the last five years.



The European Union has subsidized the cultivation of renewable crops (such as hemp and kenaf), primarily for research purposes, since at least 1988. Production in the EU has grown from about 22,200 acres in 1995-96 to almost 100,000 acres in the 1998-1999 season. Industrial hemp has been legally grown in France without interruption. All growers must obtain permits, crops are subject to inspection, and THC content cannot exceed 0.3%.

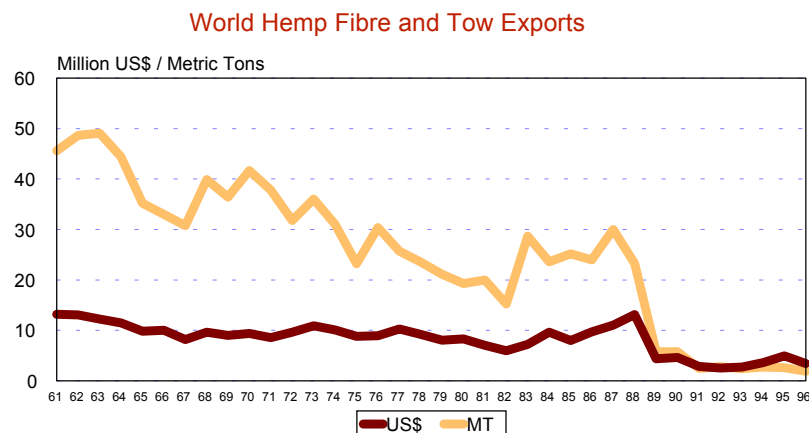
Although the European Union offers subsidies to hemp producers, not all EU countries participate due to individual country growing restrictions. Last year the subsidy was equivalent to about 700 Ecus per hectare (or US\$761 which amounted to US\$346 per acre). In spring 1998, the EU cut the subsidy 25% to 537.47 Ecus per hectare (or about US\$222 per acre) due to increases in raw hemp production, insufficient hemp processing activity, and concern that public money may be being used to cultivate marijuana production. These subsidies keep hemp prices artificially high in the EU. Last year French hemp fiber sold for about US\$200 per ton, including the subsidy.

After 4 years of licensing hemp production for agricultural research, in 1998 the Canadian government authorized commercial hemp production (less than 0.3% THC), under license from the Minister of Health. In addition to providing a detailed research plan, no parts of the plants can be sold and monitoring expenses must be paid by the farmers (or the contracting party). A private firm in Canada has imported certified hemp seed from France for planting and is selling the seed for \$3.30 per pound domestically. Kenex Ltd. recommends planting 50-60 lbs/acre for fiber, 40-50 lbs/acre for grain and 15 lbs/acre for seed. This same firm is contracting with local farmers to grow hemp at the price of CN\$240 per ton (US\$160). Although the Canadian hemp industry realizes that it may take years for Canadian fiber processors to get their quality comparable with Chinese or European mills, there appears to be tremendous enthusiasm for raising hemp in Canada.

Historically, US hemp production virtually stopped at the end of the 19th century due to foreign competition (particularly from manila hemp, which is not cannabis); the use of metal wire for cotton baling (rather than hemp twine); and the demise of sailing ships (which utilized hemp for rope and sailcloth). Perhaps the final death knell for US hemp production was the 1937 Marijuana Tax Act which levied a transfer tax of \$1.00 per ounce on all hemp transactions (which did not clearly differentiate between sub-species of *cannabis sativa l.*).

Production restrictions in the US were eased during World War II after supplies of manila hemp from the Phillipines were cut-off. However, many acres were left un-harvested as market prices were not sufficient to cover production costs. Production languished until the 1950s, when once again hemp production was outlawed. Currently, it is illegal to produce any variety of *cannabis sativa l.* in the US except under special permit.

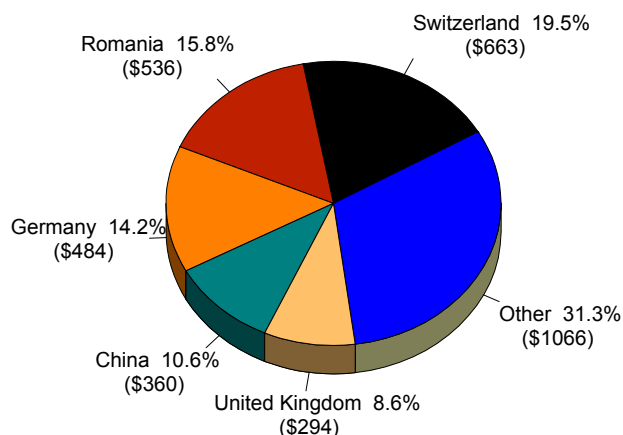
World hemp exports have declined over the years, falling from over US\$12 mil in the early 1960s to \$3.4 mil in 1996 (and after accounting for inflation, an even larger drop in real terms). Fiber exports have also fallen in tonnage, from 45.6



metric tons to 1.9 metric tons over the last 35 years. The surge in world hemp fiber exports during the mid-1980s was due to increases from the Soviet Union.

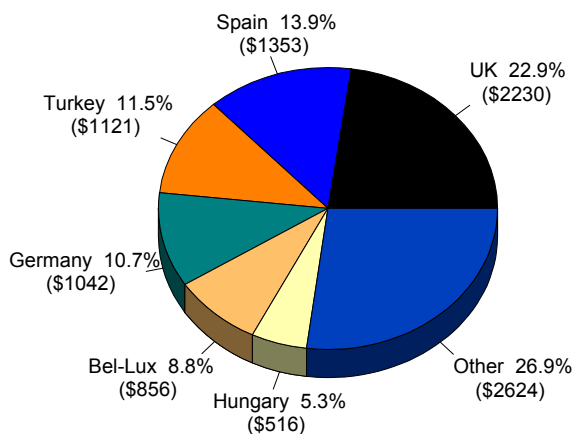
The export market is dominated by the European Union and Eastern Europe, while most Chinese production is used domestically. In recent years, western Europe (particularly Switzerland, United Kingdom and Germany) has increased fiber exports, most of which is value-added re-exports from the Former Soviet Union (FSU) and Eastern Europe.

World Hemp Fibre and Tow Major Exporters (1996)  
(\$1,000)



On the import side, major world buyers also include the European Union, Turkey and Hungary. Again, members of the EU (with a 70% world import market share), import raw hemp from Eastern Europe and the FSU for further processing in Western Europe.<sup>2</sup>

World Hemp Fibre and Tow Major Importers (1996)  
(\$1,000)



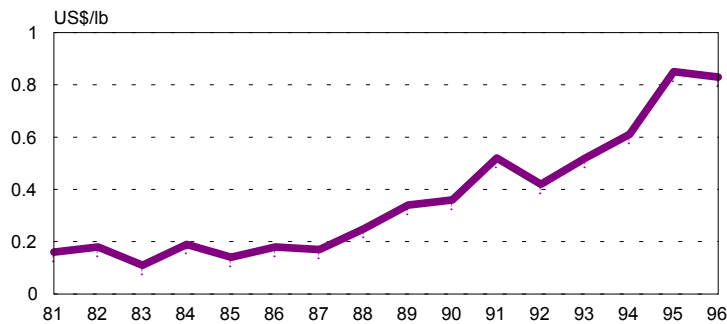

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<sup>2</sup> Import statistics are measured using CIF (cost of the goods, insurance and freight) value of the product when it arrives at the port of entry. Thus, transportation costs can be a significant portion of import values, particularly for bulky products.

It is legal to import industrial hemp into the United States. After decades of importing small amounts, US hemp fiber imports totaled nearly \$7 mil during 1986-88 before falling back to negligible levels. From 1989-96, the US imported a total of \$401,000 of fiber. The first US hemp fiber *exports* began in 1989. From 1989-1996, the US exported a total of 2,106 mt of hemp fiber, worth \$1.6 million. Obviously this must be re-exports, perhaps from surplus hemp purchased off the world market in the late 1980s.

Notably, world export prices have grown considerably in the last eight years, perhaps due to the growth in consumer demand for finished hemp products, which in turn may have spurred the slight increase in fiber exports the first half of this decade. Although export prices include some transportation costs, hemp prices have clearly grown faster than the rate of inflation. It is another question as to whether these prices can be sustained.

**World Hemp Fiber and Tow Export Prices**  
1981-1996



The average price of hemp fiber and tow traded on the world market was \$1819/mt or \$.83/lb in 1996. However, substantial variation exists amongst countries. For the major suppliers, average export prices were as follows:<sup>3</sup>

<b>Average Hemp Fiber and Tow Export Prices (1996, US\$)</b>		
Country	Price/lb	Price/mt
Switzerland	\$ 7.73	\$17,000
Romania	.35	771
Germany	12.20	26,889
China	2.15	4,737
United Kingdom	3.18	7,000
Italy	2.09	4,569
Belgium-Luxembourg	.31	685
United States	.35	769
World Average	.83	1,819

<sup>3</sup>Prices are FOB (free-on-board), and only include the price of the commodity and transportation costs to move the commodity from the point of production to the point of exit from the country. Import prices include insurance and freight, thus are not utilized here.

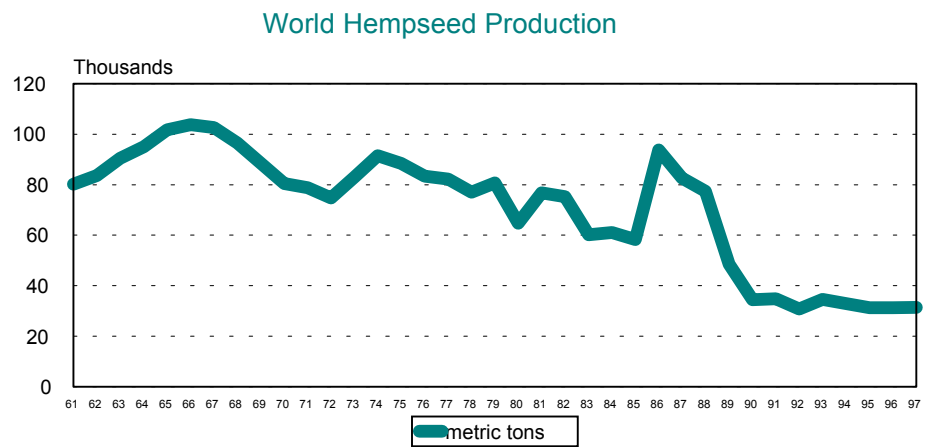
The variation in export prices appears to reflect more than just transportation costs to the port and basic quality differentials. One obvious explanation could be that prices are also reflecting differences in partial processing the hemp fiber has undergone.

If the US were to legalize industrial hemp production, US hemp producers will have to compete with imported hemp. The US import price for industrial hemp (processed, but not spun) averaged \$1.91/lb in 1996, compared with \$2.33/lb in 1995 and \$2.30/lb in 1996. Again, these prices include the freight and insurance costs of shipping the product to the US.<sup>4</sup>

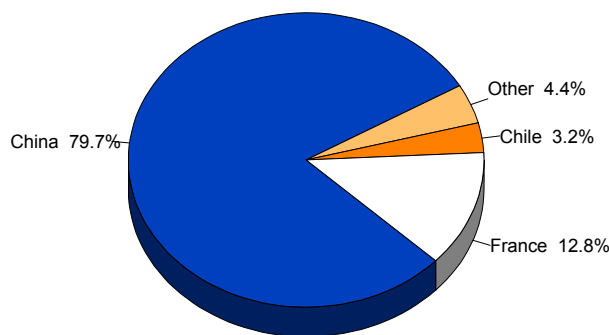
### World Seed Market

World hemp seed production has fallen by half since the early 1960s and has stabilized at around 33,000 metric tons per year. China, who has dominated this market for years, was responsible for the production surge in the mid-1980s and currently produces over 75% of total world hemp seed production

(usually primarily for oil and meal). France (which dominates certified seedstock production), is also a significant producer of hemp seed. As the result of recent legislation, a few Canadian breeders are attempting to develop low-THC strains suited to North America.



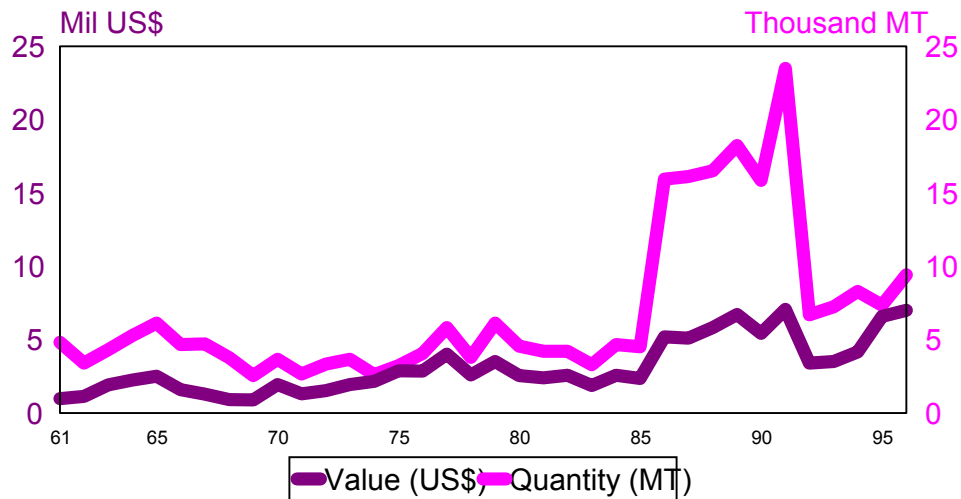
World Market Share: Hempseed Production (1997)



<sup>4</sup>For comparison, according to the National Narcotics Intelligence Consumers Committee, during the first 6 months of 1996, marijuana prices in the US ranged from \$200-4,000 per pound, with a typical price of \$800. Sinsemilla prices ranged from \$700 to \$8,000 per pound, but typically not falling below \$1,300. These prices are low according to frequent marijuana buyers.

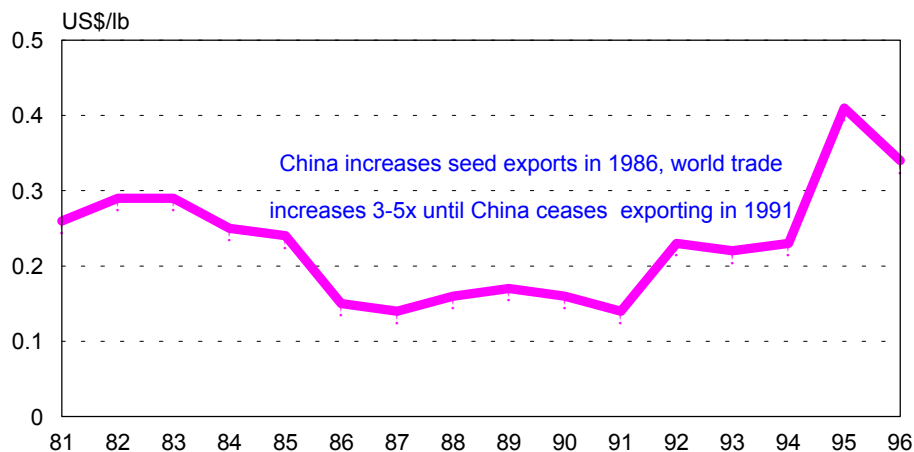
In 1996, world hemp seed exports totaled 9,432 metric tons, worth \$7 mil. This compares with over 43,000,000 metric tons of total oilseed trade, including soybean, palm, rape and sunflower seed. Importantly, the world hemp seed market has been extremely volatile the last ten years. World exports surged during the late 1980s, as China began producing and exporting hemp seed in large quantities, causing world prices to fall from about 56 cents/kg to 34 cents/kg (or from 25 cents/lb to 15 cents/lb). It wasn't until 1989 that production fell significantly (presumably in response to lower world prices), followed by a fall in world exports in 1992.

### World Hemp Seed Exports and Values (1961-1996)



The volatility in hemp seed export prices can be seen in the graph below. China began dumping hemp seed on the world market in the mid 1980s, tripling world trade and depressing world prices by nearly half. In 1991, China ceased exporting hemp seed and prices nearly doubled in 1992. In 1995, world export volume fell by 13%, while seed export prices almost doubled from 23 cts/lb in 1994 to 41 cts/lb that year. During the 1990s, the surge in industrial hemp production in the European Union (in response to subsidy program), also increased the demand for seed stock for planting purposes, thereby raising export values.

### World Hemp Seed Export Prices



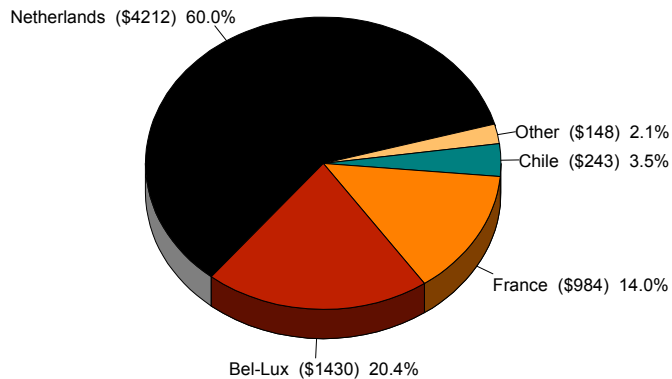
It would be very difficult for many farmers to weather this kind of price fluctuation and has important implications for increases in world production in the future. Similar to hemp fiber, the world market is so small for both of these crops that even modest increases in world production can significantly depress world prices.

Seed price variation is also found across sources, primarily due to those countries that raise seed for oil and crushing purposes as opposed to seedstock. Prices per bushel in the following table were converted using an average of 46 pounds of hemp seed per bushel.

<b>Average Hemp seed Export Prices for Major World Suppliers (1996, US\$)</b>				
Country	Price/bu	Price/lb	Price/kg	Price/mt
Netherlands	\$16.10	\$0.35	\$0.78	\$783
Belgium-Luxembourg	\$17.02	\$0.37	\$0.81	\$811
France	\$22.08	\$0.48	\$1.05	\$1,046
Germany	\$11.04	\$0.24	\$0.53	\$534
World Average	\$18.86	\$0.41	\$0.90	\$898

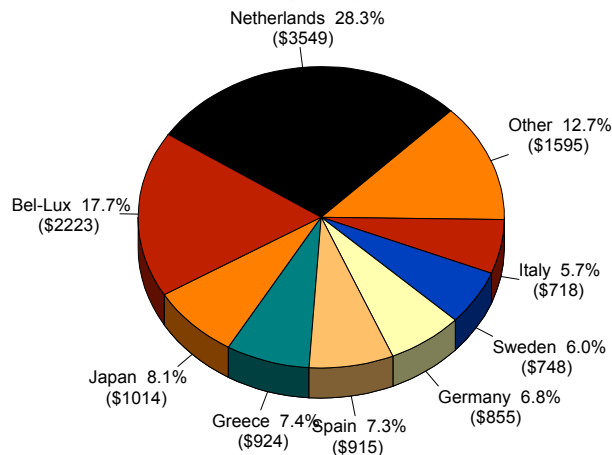
World Hemp Seed Major Exporters (1996)  
(\$1,000)

Major world hemp seed exporters include the European Union (in particular the Netherlands, with a 60% market share, Belgium-Luxembourg, France, and Austria) and Chile.



World Hemp Seed Major Importers (1996)  
(\$1,000)

Importers also include the European Union (again, the Netherlands with a dominant market share). While hemp production in the Netherlands is negligible, the Dutch have long been renowned for their role in global trade and logistics management, thus their dominant position in hemp seed trade.

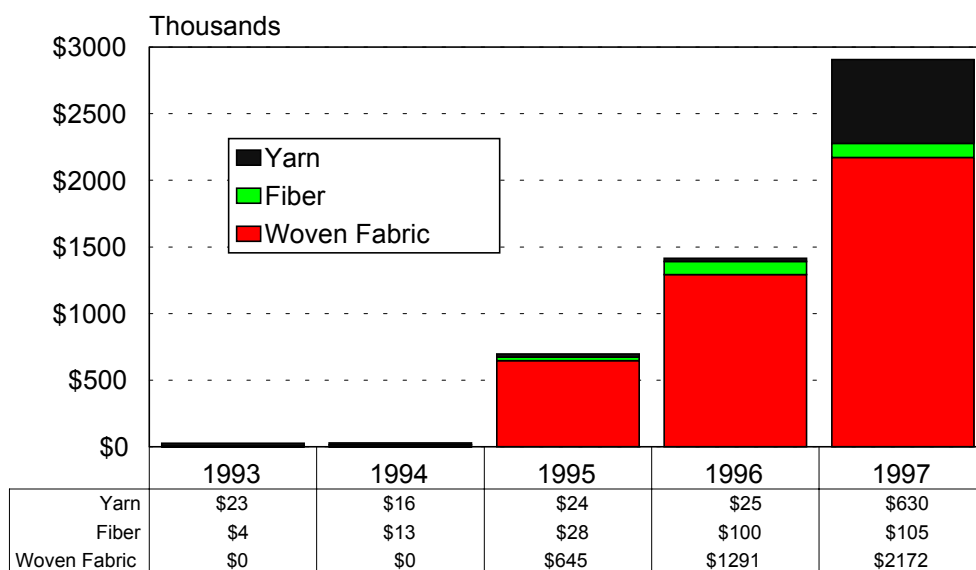


During the 1960s, 1970s and much of the 1980s, the US imported small amounts of hemp seed (averaging less than \$70,000 per year). After 1989, neither the US nor FAO report any US imports of hemp seed. Given that some importing does continue, these seeds must be classified another way and requests for more information were unsuccessful. (Typically combined with other miscellaneous seed imports.)

### Value-Added US Hemp Fiber Trade

The US also trades a variety of value-added hemp products. In general, US hemp imports have grown significantly in percentage terms over the last few years, but remain negligible in absolute value. In 1997, the US imported a total of \$2.9 mil in hemp products, including woven fabrics made of hemp (\$1.29 mil); raw or processed hemp (\$100,000); and yarn (\$25,000).<sup>5</sup>

US Industrial Hemp Imports 1993-97



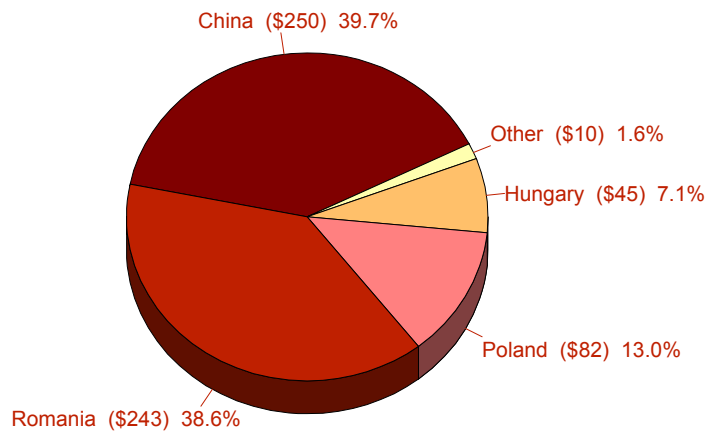
Finished goods such as clothing, shoes and hats made from 100% hemp, or those that have any hemp content, are combined with other natural fiber imports and are not reported separately by the US government. Other consumer goods that contain some hemp content (such as hemp shampoo, hemp paper, and hemp jewelry) are also not included in these statistics. According to Jon Gettman's report *Hemp Entrepreneurs and US Public Policy: The 1996 Hemp Business Survey*, a conservative estimate for finished hemp product sales was \$23.3 million in 1996, consisting of over 11,000 retail sales transactions per week. Of course, import values and retail values will vary significantly. Most 100% hemp products are imported, while products with some hemp content are frequently produced in the US.

<sup>5</sup>The trade statistics reported in this section are from the US Bureau of Census, who is responsible for collecting trade data domestically. The previous section on world trade was from the Food and Agriculture Organization (FAO) of the United Nations, which does not include value-added trade. The \$100,000 of imported hemp fiber in 1997 should be reflected in FAO data when it is published. Finally, all US trade statistics are reported at customs value.

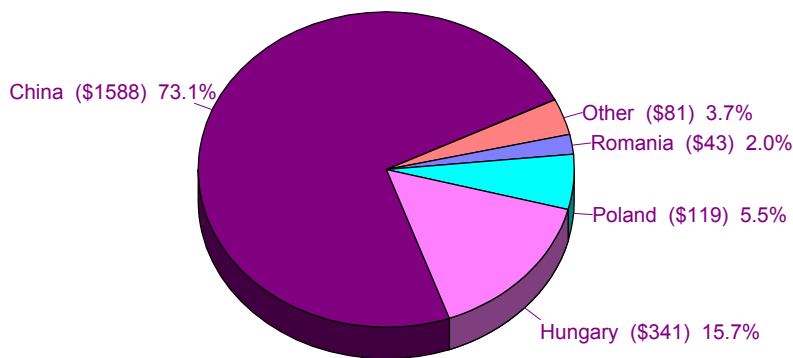


Almost three-fourths of all US imported hemp fabric came from China, with Eastern Europe also a significant supplier (1997). Many woven hemp products (such as hats, clothing and shoes) are actually a blend of many fibers including flax, cotton and linen. Although US hemp fabric imports have grown significantly larger in percentage terms, they are still very small in absolute value (\$2.2 million).

**True Hemp Yarn**  
1997 US Import Market Share (\$1,000)



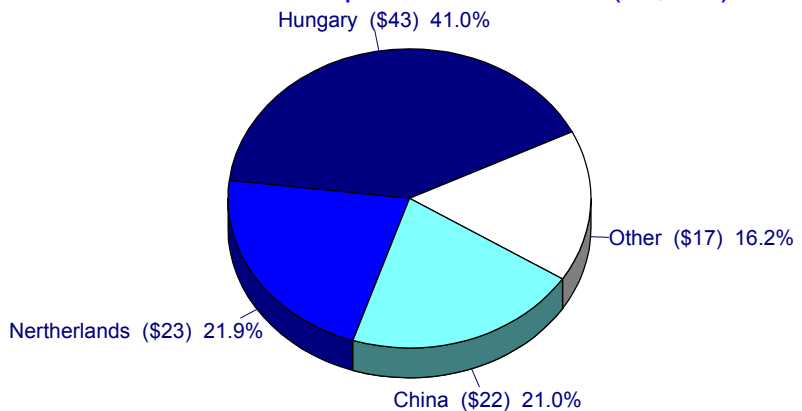
**Woven Fabrics of Other Vegetable Textile Fibers: True Hemp**  
1997 US Import Market Share (\$1,000)



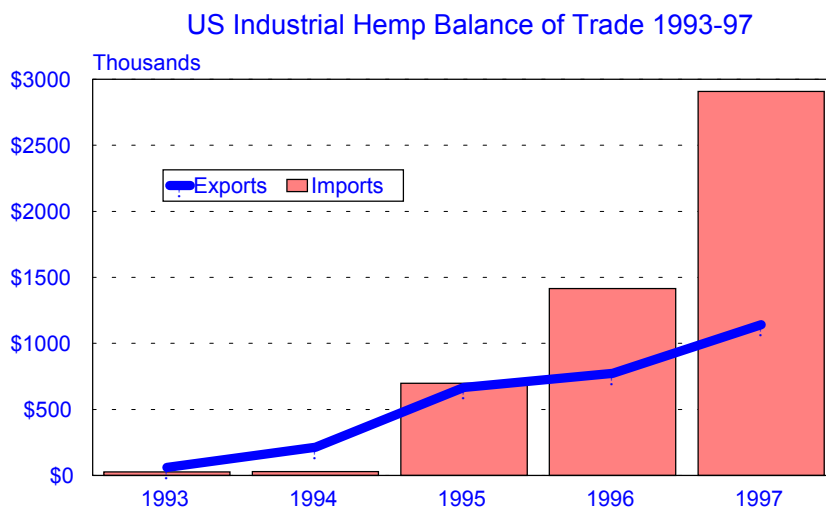
Hungary, Netherlands, China and the Philippines are the largest suppliers of raw or processed hemp (not spun) to the US. Transportation costs are quite high for shipping a low-value commodity such as raw hemp. Consequently, converting the hemp to a higher-valued product is more economical for shipping. Raw imports are typically for testing processing equipment.

Annual US hemp yarn imports have averaged \$22,000 the last four years, but jumped to \$630,000 in 1997. Major suppliers include Poland, China, Hungary and parts of the European Union. (In the last few years, raw Hungarian hemp supplies have been diverted to the EU for processing, before being re-exported to the US.)

**True Hemp: Raw or Processed, But not Spun**  
1997 US Import Market Share (\$1,000)



In the past few years, the US has also re-exported small amounts of industrial hemp. In 1997, the US exported \$271,000 of hemp (processed, but not spun) and \$99,000 of hemp yarn to countries such as Canada, European Union and Singapore.



## VI. POLITICAL ENVIRONMENT

*Cannabis sativa l.* is classified as a Schedule 1. Controlled Substance (regardless of its narcotic or THC content) in the United States. The 1937 Marijuana Tax Act (Title 21, U.S.C. Section 802(16)) effectively outlawed industrial hemp production in the US. The Drug Enforcement Administration (US Department of Justice) contends that the 1937 Act applies to both marijuana and industrial hemp, regardless of THC level. This law was temporarily lifted from 1942-1945, in an attempt to replace manila hemp (which is not as *cannabis sativa l.*) from the Philippines.

The fact that US domestic law does not distinguish between industrial hemp and marijuana is inconsistent with US international policy. International treaties signed by the US declare that hemp with less than 0.3% THC shall be considered industrial hemp and not marijuana. For example, Article 28: *Control of Cannabis, of the Single Convention on Narcotic Drugs*, United Nations, 1961 (signed by the US) declares that “This Convention shall not apply to the cultivation of the cannabis plant exclusively for industrial purposes (fibre and seed) or horticultural purposes”.

Both the North American Free Trade Agreement and the World Trade Organization recognize hemp as a “valid agricultural crop”. With the exception of the US, all members of the G7 (the major industrial democracies) permit the cultivation of industrial hemp.

### US Drug Enforcement Administration

The US Drug Enforcement Administration (DEA) holds firmly that industrial hemp and marijuana are indistinguishable. All hemp production in the US is strictly regulated (as vested in the Attorney General and carried out by DEA). The DEA is adamantly opposed to industrial hemp production for the following reasons:

- It is too difficult to distinguish “legitimate” industrial hemp from illicit cannabis with a higher narcotic concentration.
- It has been suggested that industrial hemp advocates have a hidden agenda of supporting the legalization of marijuana.

Permits to grow cannabis are restricted to researchers and police analytical laboratories. Permit holders must maintain strict security requirements (including complete fencing, 24-hour guards, an alarm system and limited, controlled access) and detailed records concerning stored or cultivated cannabis. The University of Mississippi has been under contract for several years to maintain industrial hemp and marijuana test plots for the US government. A woman in Santa Cruz, CA also has local political and law enforcement approval to grow marijuana for 125 seriously ill patients, with ailments ranging from cancer to AIDS.

### **US Department of Agriculture**

In recent years the US Department of Agriculture (USDA) has been mostly silent on the issue of industrial hemp. In 1995, USDA released a 3.5 page white paper *Industrial Hemp and Other Alternatives for Small-Scale Tobacco Producers*, jointly produced by the Agricultural Research Service and Economic Research Service, for the Under Secretary for Research, Education and Economics. The paper acknowledges that there are few alternative crops that can provide high returns comparable to those received from tobacco. USDA also claims that European research has not established the profitability of commercial industrial hemp production, but concedes that “few estimates are available for modern production and processing costs and the market potential is uncertain”.

The white paper indicates several constraints to industrial hemp production in the US:

- Crop and fiber yields must increase to bring down costs
- Research is needed to develop modern hemp fiber harvesting and processing methods
- Uses for co-products need to be found to make processing operations profitable
- Efforts to legalize hemp production would encounter stiff Congressional and Administration opposition
- All hemp production is strictly regulated and “DEA’s interpretation of these matters discourages any attempt to conduct field trails at a reasonable cost...it would be virtually impossible to collect useful, realistic agronomic or economic information about hemp production”
- Unless economic viability is proven, “hemp fabrics and paper uses will likely remain a very small niche market which is satisfied by imports”

### **American Farm Bureau**

In January 1996, at their annual convention, American Farm Bureau unanimously passed a resolution which read:

“We recommend that American Farm Bureau Federation encourage research into the viability and economic potential of industrial hemp production in the United States. We further recommend that such research includes planting test plots in the United States using modern agricultural techniques.”

It was thought by many hemp proponents that this endorsement would assist state efforts in legalizing research efforts and add credibility to the industrial hemp movement. However, during their annual meeting in January 1997, AFB voted against the research and production of industrial hemp (by a vote of 198-168) and further stated that “*We do not support the production of industrial hemp.*” It is not clear what, if any, impact these resolutions have had thus far.

### **Individual State Efforts**

While various federal agencies are resistant, if not adamantly opposed, to the legalization of industrial hemp, several states are pursuing their own policy initiatives. However, the DEA continues to insist that only they can authorize hemp cultivation. A few Indian reservations have produced hemp test plots, under unique Indian sovereignty.

Since 1995, eleven states have written bills supporting industrial hemp production, of which nine have been introduced as legislation. Only Vermont, Hawaii, and North Dakota have authorized agronomic and economic feasibility studies, yet none have authorized research plots. Industrial hemp bills in Colorado, Hawaii, Iowa, Kansas, Minnesota, Missouri, Oregon, and Virginia all failed in 1997.

In 1996, Vermont passed legislation (H.728) mandating the analysis of market conditions that would affect the development of an industrial hemp industry, the agronomic conditions required for economic levels of hemp production in Vermont, and analysis of other research regarding minimum THC levels of industrial hemp. This research has been undertaken by the University of Vermont and will be discussed in the next section.

Hawaii also passed legislation in 1996 to investigate the economic, agronomic and legal implications of industrial hemp production. House Resolution 71 and House Concurrent Resolution 63 authorizes the study of:

- 1) the commodity value,
- 2) economic potential and other benefits,
- 3) comparison of the economic potential with that of other similar crops, including kenaf and sunn hemp,
- 4) interest of Hawaii landowners, businesses and other parties in growing industrial hemp,
- 5) federal procedures for obtaining a permit to grow hemp, and
- 6) the barriers, including federal procedures and current drug policies at the federal, state and county levels that inhibit and prohibit the growing of hemp.

The Hawaii Agribusiness Development Corporation has been working with the University of Hawaii College of Tropical Agriculture, the Legislative Research Bureau, and other cooperating agencies on this study. Other bills calling for the decriminalization of "non-psychoactive" (less than 2 percent of THC) strains of cannabis to allow the cultivation of industrial hemp in Hawaii were tabled in the 1997 legislative session. These bills have been active in the 1998 session and are currently pending a hearing in the Judiciary Committee. Rep. Thielen is planning on introducing another bill to permit industrial hemp test plots to be planted, upon the DEA issuing a research permit.

In North Dakota, a bill was passed and signed by the Governor requiring North Dakota State University to study hemp cultivation, marketing, environmental and law-enforcement issues. The bill did not mandate a test plot of hemp. This research is underway and results are expected to be released very shortly.

Although hemp legislation in Kentucky failed to get out of committee last year, a lawsuit by 6 farmers, the Kentucky Hemp Growers Cooperative and the Hemp Company of America has been levied against the US Department of Justice, Drug Enforcement Administration (DEA) for failing to make a distinction between industrial hemp and marijuana. Entered May 1998 in Ashland, Kentucky, the suit asks for a judicial judgement to define the rights and obligations of Kentucky farmers to grow industrial hemp. In July 1998, the US government asked that the suit be dismissed. It is unclear when an opinion will be rendered.

In March 1998, the Resource Conservation Alliance (a Ralph Nader organization) filed two petitions in Washington, DC on behalf of the North American Industrial Hemp Council. One petition calls for DEA to end its classification of hemp as a Schedule 1 drug. The other petition asks USDA to develop a regulatory framework for legalized hemp cultivation.

## **VII. COST AND RETURN PROJECTIONS**

Industrial hemp production must be profitable from an economic standpoint, regardless of the political environment, to be a viable alternative crop. Hemp must be competitive not only with other fiber and oil substitutes (such as wood, cotton, flax, and soybean and palm oils), but with other production alternatives (for example, corn, hay and tobacco) as well.

There is some fairly good production cost data for other countries, but less than complete profit data. Given that the US lacks current production cost data and a commercial hemp processing market, other countries experiences become valuable, but lead to a certain degree of variability in both cost and return estimates. Production costs should be similar across geographic regions (given the minimal agronomic conditions and chemical applications that are required). However, the lack of processing facilities and other infrastructure necessary for a viable commercial hemp market in the US makes demand and profit projections extremely speculative.

Specifically, production cost estimates will depend on a complex array of factors including:

- seed cost, varietal selection, planting density and yield estimates,
- labor and other input costs,
- transportation costs to processing centers,
- security and THC-testing costs,
- growing license or permit requirements and cost,
- the availability of government production and processing subsidies, and
- the relative profitability of other production alternatives.

Certified seed costs about US\$1971 per ton, of which roughly half is transportation costs from Europe (certified hemp seed is not currently grown in Canada or the US, and most certified seed containing 0.3%THC or less comes from France). Since no varieties have been specifically adapted to North American conditions, yields may be slightly less than average, particularly during early years of commercial production. The creation of a certified hemp seed industry in North America could reduce seed costs.

Labor costs for both harvesting and processing hemp are significantly lower in other non-western countries, such as China and Eastern Europe. Harvested hemp is very bulky and minimizing transport distance between processing centers (at least first stage) is advantageous. As for security and testing costs, legal constraints may be more influential in determining production location advantage.

Currently, hemp growers must compete with substantial production subsidies in the European Union (approximately US\$222 per acre) and parts of Eastern Europe. It is very unlikely that industrial hemp production and processing in the US would be eligible for any subsidies.

With regard to hemp fiber processing technology, in the short-run US producers are at a clear disadvantage. Further, hemp seed crushing facilities and oil producing equipment are rare. If industrial hemp were legalized in the United States, it require significant amounts of investment and several years to upgrade US harvesting and processing technology to make the US hemp market globally competitive. On the bright side, any US investment in the industrial hemp market would most likely be state-of-the-art.

Despite these caveats, production costs and return estimates are presented below as a starting point to evaluate the economic feasibility of producing and processing industrial hemp in the US. While others have reported production costs and returns estimates (and summarized in *Vantreesse (1997)*), two of the more recent and comprehensive pieces of hemp research in the US come from the Universities of Vermont and Kentucky. Another major study from North Dakota State University should be published in August 1998.

Major findings of the University of Vermont research include:

- In a survey of hemp experts, of three sectors examined...the paper industry showed the highest potential, followed by the textile industry. The composite

industry was shown to have the lowest potential to be a viable industrial hemp industry. *(From 23 hemp experts in several countries.)*

- The lack of processing facilities and other infrastructure necessary for a viable commercial hemp market in the US makes demand and profit projections extremely speculative.
- Establishing one hemp apparel manufacturing firm and one pressing plant appear to be comparable to establishing one cotton apparel manufacturing firm and one processing plant in terms of GDP and employment based on the assumptions of the study...The economic impact in terms of GDP and employment appears to be similar in terms of growing hemp versus hay, based on the assumptions of the study.
- Based on the data collected, many Vermont soils are capable of producing a hemp crop, although they may not be ideal.

*(From Lawrence K. Forcier, Dean, College of Agriculture and Life Sciences (University of Vermont) to Chairs of both the state House and Senate Agriculture Committees. January 15, 1998)*

The University of Vermont study contributes to the US hemp debate by evaluating specific hemp sub-industries using a survey of international experts in each field. Targeting the paper industry for hemp producers might have been expected. The paper industry is very well established and dominated by large multinational companies which rely on economies of scale to keep margins low on large volume production. But, specialty papers rely on smaller scale production and product diversity to capture higher profits per unit on a much lower volume of production. It is this market in which new entrants, would have the best chance of succeeding.

With regard to textile manufacturing, it is important to note that most cotton production and processing has moved out of the US as cotton subsidies are wiped out and labor costs are lower elsewhere. Again, those remaining apparel manufacturers have been forced to substitute technology for labor and focus on specialty markets. It would follow that the hemp market would follow a similar path. The carpet and industrial fiber market may hold more promise. The University of Vermont is continuing to research the costs of substituting industrial hemp for other products in the manufacture of composite materials, textiles and paper.

The University of Kentucky Center for Business and Economic Research, under contract with the Kentucky Hemp Museum and Library, has recently (July 1998) published a study that estimates costs, returns and the potential economic impact of growing and processing industrial hemp in Kentucky. Among the key findings of the *Economic Impact of Industrial Hemp in Kentucky* by Thompson, Berger and Allen are (as taken from the Executive Summary):

- *A market for industrial hemp exists in a number of specialty or niche markets in the United States, including specialty papers, animal bedding and foods and oils made from hemp.*
- *Additional markets could emerge for industrial hemp in the areas of automobile parts, replacements for fiberglass, upholstery, and carpets.*
- *Using current yields, prices, and production technology from other areas that have grown hemp, Kentucky farmers could earn a profit of approximately \$320 per acre of hemp planted for straw production only or straw and grain production, \$220 for grain production only, and \$600 for raising certified seed for planting by other industrial hemp growers. In the long run, it is estimated that Kentucky farmers could earn roughly \$120 per acre when growing industrial hemp for straw alone or straw and grain, and \$340 an acre from growing certified hemp seed.*
- *Industrial hemp, when grown in rotation, may reduce weeds and raise yields for crops grown in succeeding years. Several agronomic studies have found that industrial hemp was more effective than other crops at reducing selected weeds. One study found that industrial hemp raised yields by improving soil ventilation and water balance.*
- *The economic impact if Kentucky again becomes the main source for certified industrial hemp seed in the United States is estimated at 69 full-time equivalent jobs and \$1,300,000 in worker earnings. The total economic impact in Kentucky, assuming one industrial hemp processing facility locating in Kentucky and selling certified seed to other growers, would be 303 full-time equivalent jobs and \$6,700,000 in worker earnings. If two processing facilities were established in Kentucky, industrial hemp would have an economic impact of 537 full-time equivalent jobs and \$12,100,000 in worker earnings. If one processing facility and one industrial hemp paper-pulp plant were established in Kentucky, industrial hemp would have an economic impact of 771 full-time equivalent jobs and \$17,600,000 in worker earnings.*
- *These economic impact estimates reflect possible outcomes for Kentucky given a national industrial hemp industry that is focused in specialty niche activities that have already been demonstrated to work in Europe. It is important to remember, however, that technologies are under development that may allow industrial hemp products to compete in bulk commodity markets. The economic impacts that would occur if these technologies were found to be commercially feasible would be substantially greater than those identified in this report.*



(Note: Straw production refers to fiber and hurd production. Grain production is for seed oil crushing and meal production. Certified seed is producing viable seed for other farmers to grow hemp.)

The University of Kentucky study has added significantly to the hemp profitability discussion and is commended for its thorough and conservative approach in evaluating US hemp market potential. The researchers talked with a multitude of hemp growers, processors and marketers to calculate production costs and returns. Although one could argue with specific yield projections or demand estimates, the study does a very good job in pulling together quite reasonable short-run estimates.

Thompson et al contend that once the hemp industry was re-established in the US that increased production would push raw hemp prices down, as increased demand would tend to have upward pressure on prices. Long-run costs and returns estimates suggest that profits per acre would fall to approximately \$110 per acre for hemp straw and grain production, \$130 per acre for straw production only, \$5 per acre for grain production only, and \$342 per acre for raising certified seed.

However, it should be noted that most projected cost and demand projections were gathered from the “pro-hemp” side of the debate. It would be worthwhile to see how the demand projections would change if some of the large paper, textile, apparel, feed, seed, automotive and oil companies had been consulted. Industry observers and experts might have very different forecasts for the industrial hemp market. Of course, this information would be difficult to obtain, but would provide a more accurate assessment of future commercial demand for hemp.

The UK study correctly notes that US hemp production would likely displace economic activity generated by a less-profitable crop alternative (whether it be a few less acres of cotton, hay, soybeans, or wood pulp production). Alternatively, the pie for agricultural commodities might get larger if we substituted hemp for petro-based products. Of course, which would expand faster – demand or supply – is a key part of the price, thus profitability, question.

One of the questions the UK study raises is “*Does Kentucky (or any state for that matter) really have an edge in the industrial hemp market?*” Could any one state circumvent federal hemp growing restrictions to capture the early innovator profit? This is particularly critical in establishing certified seed production, which is estimated to have the highest return. It appears that both federal and state law would have to be modified to permit legal hemp production in any one locale. It is reasonable to assume that early US hemp seed production would be under contract from one of the French companies which hold the patents on high-yielding / low-THC hybrid varieties. Obviously, the holder of the patent would want to contract with not only the “best” growers, but also would want to diversify regionally to minimize production risks (in the event of drought, etc).

The next question is “*Who would develop new strains for North America - the French, the land-grant Universities or private sector seed companies (such as DEKALB, Monsanto or Pioneer)?*”. Very few Universities have licensed patented seed production. Nearly all seedstock production in the US is under contract with domestic private sector companies or with some of the large multinational companies noted above. It is reasonable to assume that the industrial hemp seed market in the US would travel a similar path. If hemp seedstock production was contracted out by private sector companies, what premium could US producers earn over producing hemp seed for grain?

The UK study forecasts that hemp seed grain would sell for 15 cents/lb versus 60 cents/lb for hemp seedstock, or at a 400% premium to the farmer. For soybean, wheat and corn seedstock production, farmers typically earn a 10% premium above market price. (For example, if corn is selling for \$2.25 per bushel, corn seedstock would contract for about \$2.48/bu.) Cottonseed (which might be more analogous to the hemp seed market) premiums are quite a bit higher. Cottonseed for ginning sells for about \$120 per ton, while cotton seedstock is contracted for around \$184 per ton (about a 50% premium). In either case, the seed prices used by the UK study appear to be out of line with other seedstock markets.

Perhaps the biggest uncertainty in projecting hemp profits is that of price volatility. Any changes in supply (including production costs, technology or the number of producers) or demand (for the wide-variety of uses for hemp) will result in price changes. For example, an increase in the market supply of hemp would effectively lower hemp prices. While farmers could sell more hemp at a lower price, the larger question is “*Would the reduction in hemp prices be outweighed by the increase in hemp sales?*”. As discussed earlier, the world hemp seed market has endured extreme price volatility over the last 20 years.

China is the largest producer of hemp seed (with nearly 80% of world production), and is one of the largest hemp fiber producers. From 1986-88, China significantly increased hemp seed production. As a result, from 1986-91, China’s share of the hemp seed market exploded from zero to controlling nearly three-quarters of world trade, before falling to zero once again in 1992. During this period, world hemp seed exports increased from around 5,000 mt to 18,000 mt (an increase of 360%) per year.

As China dumped hemp seed on the world market, hemp seed prices fell 43% (from an average of 26.5 cents to 15 cents per pound) during the late 1980s and early ‘90s. This confirms the conventional wisdom that increased hemp production would lower world prices, thereby creating some increase in world demand. However, without significant reductions in production costs, the 15 cents/lb price range is the reported break-even price for hemp farmers in UK’s study.

In 1992, China abruptly reduced production, exports fell back to 7,000 mt and prices recovered to 23 cents. A significant part of this price sensitivity is due to the relatively small volume of the hemp market. A 13,000 mt increase in world soybean exports (approximately 32 million mt last year) would be insignificant. The smaller the volume of a market, the greater the price sensitivity, as supply and demand change.

Economists use the concept of elasticity to determine the effect of changes in price, resulting in changes in demand, thus revenue to the producer. The UK study used a general price elasticity measure of -0.55 from corn and soybean markets to project hemp market demand changes. However, using actual hemp market data over the last 36 years, hemp seed has a price elasticity of demand of approximately -1.3 for price decreases, -.67 for price increases and an overall own-price elasticity of -0.99. This means that, for example, a 10% decrease in hemp seed prices will result in a 13% increase in hemp seed demand, while a 10% increase in hemp seed prices would result in a 6.7% decrease in hemp seed demand.<sup>6</sup> Thus, the market is much more responsive to *decreases* in the price of hemp.

While hemp fiber prices have been much more stable, recent small increases in world production have caused fiber prices to fall in half in 1996. Again, the small volume of the hemp fiber export market -- only 1.9 mt in 1996! -- is minuscule compared to world cotton exports (approximately 27 million 480-pound bales last year) and wood paper pulp trade. While the bulkiness of hemp fiber encourages value-added hemp trade (rather than raw product), it is easy to see how small increases in hemp exports could dramatically lower world prices.

It is the combination of projected hemp demand uncertainty, coupled with a low volume market, that makes hemp prices volatile and profit estimations adventurous. The current US hemp import market is about \$3 mil, nearly all of which is value-added hemp products (not counting

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<sup>6</sup> World hemp seed prices have exhibited two distinct periods of volatility due to the Chinese presence in the market and more recent demand for French seedstock due to European Union hemp subsidization. The data set was divided into three time periods and using statistical regression, own-price elasticities of demand were calculated. Imputed lagged prices (gleaned from quantity and value FAO trade data) were regressed on lagged trade volumes in each time period. While a fully specified market equilibrium model might give more precise results, the issue of price volatility is adequately demonstrated here.

Variable	DF	B Value	Std Error	t ratio	Approx Prob
Intercept	1	8.395843	0.1521	55.206	0.0001
Lag Price (T1) 1961-85	1	0.022107	0.1769	0.125	0.9013
Lag Price (T2) 1986-91	1	-1.274091	0.1649	-7.727	0.0001
Lag price (T3) 1992-1996	1	-0.670499	0.2912	-2.302	0.0282
Auto1 *	1	-0.498150	0.1794	-2.776	0.0092

\*Durbin-Watson tests for auto-correlation proved positive and the model was corrected. Other statistical approaches resulted in elasticity coefficients within close proximity to those reported. It is interesting to note the lack of statistical significance for the first time period, 1961-1985, between price and quantity demanded.

consumer-ready goods). Despite the current fad for products made from hemp, legalized hemp production in the US would very likely depress US hemp prices, particularly in the short-run, and may even have a dampening effect on world prices, given the current state of world hemp processing technology and capacity. Of course, lower hemp prices would make hemp more price-competitive with other substitutes. But, at current world prices it does not appear that hemp can compete on a large scale and may be confined to a niche or specialty market until processing technology improves.

## VIII. CONCLUSIONS

Many have argued the merits of hemp fiber and oil -- superior fiber length and strength, excellent oil quality for both industrial and feed uses, and a myriad of other applications. Despite these claims, the global industrial hemp market has been on a downward trend for the last 30 years and remains negligible in magnitude. World hemp fiber production has fallen to 55,500 metric tons, one-fifth the level of the 1960s, while world hemp seed production has slipped to 33,000 metric tons.

Similarly, world exports continue to decline. Total world trade in industrial hemp fiber and seed amounted to only \$10.4 million in 1996! It appears that world trade in consumer-ready hemp products has been on the increase, although statistics are not available to support that claim. Declines in the hemp market may be signaling that hemp profits are also on the decline -- either absolutely and/or relative to other production alternatives.

Although hemp processing technology remains antiquated, new innovative fiber separation techniques are being tested, particularly in western Europe. The lack of processing facilities and other infrastructure necessary for a viable commercial hemp market in the US makes demand and profit projections extremely speculative.

The silence of the large paper, textile and oil manufacturers is notable. Multinational companies are not confined to the US for investment opportunities and have the capacity to invest in production and processing facilities all around the world. Non-existent US industrial hemp production does not impede their investment elsewhere. It is notable that foreign investment in hemp processing facilities in China and Europe are small and logical to assume that these decisions were based on prudent business sense.

None of the large multinationals has openly supported the legalization of hemp in the US. Why? Is it short-sightedness or disregard over abusing our natural resource base? Is it concern over the confusion with marijuana? Or is it simply that they don't care? Corporate America is not waiting for the US to legalize hemp. They have access to plenty of raw material and low labor costs (China and Eastern Europe), and a stable economic and political environment where hemp production is legal (the European Union). Why bother with the convoluted politics of America?

A good illustration of the lack of investment in the hemp industry is found in the hemp pulp market. Currently, there are about 20 paper mills worldwide that use hemp as a fiber source

(along with flax, cotton, bagasse, sisal, abaca, and other annuals). This compares to thousands of non-wood paper mills in the world. World hemp pulp production is estimated to be about 120,000 tons per year, or about 0.05% of the world's annual paper production volume. About half of these mills are located in China and India (the leading producers of industrial hemp (*cannabis sativa l.* and sunn hemp respectively). The remaining mills are located in the western world.

While wood pulp mills typically produce over 250,000 of wood pulp per year, average hemp pulp and paper mills typically produce about 5,000 tons per year. Hemp pulp sells for about US\$2100 per ton (again, for specialty paper uses) and typical bleached softwood pulp at US\$800 per ton. Further, these small mills have difficulty in meeting western environmental regulations and have beginning to migrate to countries with more permissive environmental standards. (Van Roekel)

Again, it must be emphasized that hemp production is not the problem. Of course, pulp is but one use for industrial hemp. But, it is the challenge of improving hemp processing that will open the doors of cost competitiveness. At the risk of being repetitive, the large multinational paper, textile and oil companies are not stupid. Nor are they short-sighted. They also have research and development budgets that would dwarf that of public universities. If they can't make hemp work in the marketplace, what type of costs and return differential might small farmers and businesses work towards? That is the crux of the great hemp debate.

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