Fiber Markets

Currently, the markets for bast fibers like industrial hemp include specialty textiles, paper, and composites. Cordage markets have long disappeared, as natural fibers have largely been replaced by plastic and steel (Miller, 1991; Orgel and Ravnitzky, 1994). In recent years, Canada, Australia, and a few European countries, including the Netherlands and Germany, have researched industrial hemp as a possible fiber for textile and paper production. Hungary and China currently are the major producers of high-quality, water-retted hemp textile fibers (Ehrensing). Small specialty pulp and paper mills in Britain, Spain, and Eastern Europe process flax, hemp, and other specialty fibers. Other potential uses of hemp bast fiber include molded automobile parts and as a replacement for fiberglass. In addition, hurds are utilized in various applications such as animal bedding.

Industry sources and some academic studies, such as Thompson et al. (1998) and Gardner and White (1998), cite numerous current and potential uses for hemp bast fiber and hurds. For these applications to develop or expand, hemp will have to compete with current raw materials and manufacturing practices. In the market for nonwood fibers, hemp would have to compete with cotton, flax, abaca, sisal, and other nonwood fibers in terms of fiber characteristics, fiber quality, and price. The U.S. market for hemp fibers is, and will likely remain, a small, thin market. Changes in price or quantity could be more disruptive and have a greater adverse impact on market participants than would be the case in a larger market. For example, small increases in world hemp fiber and tow production caused export prices to fall by half to a world average of 35 cents per pound in 1996 (Vantreese, 1998). See Appendix II for a discussion and some examples of oversupply in small, thin markets.

Specialty Textiles

According to Ehrensing (1998), hemp textile production is based primarily in Asia and central Europe. Most hemp fiber used in textiles is water-retted in China or Hungary. However, water retting has been largely abandoned in countries where labor is expensive or environmental regulations are enforced. Several companies in Poland also make hemp yarn and fabrics (Gardner and White). A small market based on hemp textiles imported from China, Poland, and Hungary has developed in North America and western Europe during the 1990's. In the last few years, a couple of U.S. companies have begun producing hemp yarns and/or fabrics (Gross, Gardner and White).

The current, low-end size of the U.S. market for hemp raw materials may be defined as the equivalent domestic production and acreage required to replace imports of hemp fiber, yarn, and fabric in 1999.[1] Reichert (1994) reports hemp fiber yields of 800 to 2,320 pounds of fiber per acre. Assuming a potential U.S. yield of 1,550 pounds of fiber per acre (midpoint of the range) and using linen yarn and fabric conversion factors (1.0989 and 1.1447, respectively), the total import quantity of hemp fiber, yarn, and fabric in 1999 could have been produced on less than 2,000 acres of land. Given the average size of farms in the United States (near 500 acres), just a few farms could have supplied the hemp fiber equivalent of 1999 import levels. Detailed data are not available on the amount of hemp seed or oil or the levels of hemp-containing clothing and household furnishings imported into the United States. Thus, this calculation understates the production capacity needed to replace all hemp product imports. Nevertheless, the calculation does demonstrate the small, thin nature of the market for industrial hemp and its products in the United States.

Hemp's closest competing fiber for textile uses—in terms of fiber production, processing, and characteristics—is linen, which is derived from textile flax. Textile flax is not grown in the United States, with demand met wholly by imports. While U.S. imports of hemp fiber, yarn, and fabric have increased dramatically in recent years, 1999 hemp imports (January-September) represented just 0.5 percent of U.S. linen yarn, thread, and fabric imports. However, the U.S. market for linen may indicate the longer term potential demand for hemp fiber and products. During 1989-99, imports of linen yarn, thread, and fabrics accounted for 62 percent of total linen imports (table 2). Linen apparel accounted for another 33 percent, with household furnishing and floor coverings taking up the remainder. The United States also exports a small amount of linen products (table 3).

A long-term, high-end size of the potential U.S. market for hemp fiber could be defined by considering the equivalent domestic production and acreage required

[1] Nine months of import data were extrapolated to estimate a full year of imports.

Table 2—U.S. linen imports, by category, 1989-99[1]

Year	Yarn, thread, and fabric	Apparel	Household furnishings	Floor covering	Total[2]
			1,000 pounds		
1989	388,036	178,957	1,799	9,555	578,347
1990	408,078	170,367	1,512	9,611	589,568
1991	368,383	177,722	3,137	10,812	560,054
1992	320,325	192,787	1,611	22,877	537,600
1993	321,186	193,040	914	22,286	537,426
1994	339,604	196,292	1,797	34,089	571,782
1995	368,778	163,492	3,171	35,736	571,177
1996	246,191	144,194	1,990	32,559	424,934
1997	329,590	154,634	1,835	36,846	522,905
1998	253,270	183,602	1,954	44,995	483,821
1999[3]	186,301	148,106	3,142	41,707	379,256

[1] Estimated raw-fiber equivalent quantity contained in the products.
[2] Does not include imports of raw fiber and tow/yarn waste.
[3] January to September.

Source: Meyer.

Table 3—U.S. linen exports, by category, 1989-99[1]

Year	Yarn, thread, and fabric	Apparel	Household furnishings	Floor covering	Total[2]
			1,000 pounds		
1989	24,256	12,160	2,471	8,154	47,041
1990	32,727	15,794	4,267	12,011	64,799
1991	28,005	16,072	4,300	15,440	63,817
1992	30,755	14,878	3,274	15,431	64,338
1993	30,178	19,629	2,610	17,455	69,872
1994	35,511	23,038	2,457	14,569	75,575
1995	35,106	24,397	3,011	13,733	76,247
1996	39,681	27,745	2,729	14,844	84,999
1997	54,604	19,803	3,980	26,784	105,171
1998	56,282	19,976	3,738	22,906	102,902
1999[3]	48,045	16,598	1,733	14,093	80,469

[1] Estimated raw-fiber equivalent quantity contained in the products.
[2] Does not include exports of raw fiber and tow/yarn waste.
[3] January to September.

Source: Meyer.

to replace both hemp and linen imports. The hemp fiber required to replace the equivalent level of hemp and linen fiber, yarn, and fabric imports in 1999 could have been produced on 250,000 acres—roughly 40 percent of 1997 tobacco acreage, 5 percent of U.S. oat acreage, or 0.4 percent of wheat acreage.

Hemp and linen are specialty textile fibers. Since 1980, linen and hemp together have accounted for less than 3 percent of world textile fiber production (table 4). Cotton and noncellulosic fibers are the dominant components. Worldwide production of hemp fibers decreased from a high of 569 million pounds in 1980 to 222 million pounds in 1995, a decline of 61 percent. A new data series was started in 1996, which does not

Table 4—World textile fiber production, 1980-98

Year	Rayon and acetate	Non-cellulosic fibers	Cotton	Wool (clean)	Silk	Flax	Hemp (soft)[1]	Total fibers
				Million pounds				
1980	7,147	23,095	31,427	3,675	123	1,389	569	67,425
1981	7,064	23,869	30,474	3,719	126	1,347	492	66,969
1982	6,493	22,368	31,993	3,656	121	1,437	459	66,603
1983	6,457	24,418	31,560	3,759	121	1,733	406	69,779
1984	6,605	26,023	42,552	3,831	123	1,512	443	71,669
1985	6,462	27,533	38,541	3,816	150	1,642	481	77,011
1986	6,304	28,499	33,880	3,924	139	1,605	485	80,688
1987	6,229	30,293	38,891	4,079	139	2,108	474	82,213
1988	6,385	31,784	40,514	4,202	141	2,039	465	85,530
1989	6,488	32,512	38,280	4,431	146	1,799	397	84,053
1990	6,079	32,838	41,808	4,359	146	1,570	364	87,164
1991	5,365	33,678	45,636	3,929	148	1,541	439	90,736
1992	5,130	35,629	39,650	3,794	148	1,484	432	86,267
1993	5,171	36,566	37,234	3,695	150	1,369	260	84,445
1994	5,087	39,549	41,229	3,437	152	1,261	209	90,924
1995	5,342	40,514	44,868	3,283	203	1,537	223	95,970
1996	5,004	43,887	43,219	3,289	194	1,448	139	97,180
1997	5,102	48,837	44,132	3,181	192	1,400	148	102,992
1998	4,817	50,135	40,629	3,120	192	1,424	152	100,469

[1] *Cannabis sativa*. Figures prior to 1996 include rough estimates for the former Soviet Union and Eastern Europe. A new data series was started in 1996 that does not include estimates from these regions.

Source: Meyer.

include production estimates from the former Soviet Union and Eastern Europe. During 1996-98, production averaged 146 million pounds, with China as the dominant producer.

According to industry sources, the fineness and quality of flax and hemp overlap depending upon growing conditions, variety, and how the crop is handled after harvesting. There is no industry consensus as to how closely the markets for the two fibers are allied (Gross). Nonetheless, with hemp fiber imports just 0.5 percent of linen imports, the near-term market potential for hemp in the United States (for domestic textile production) is closer to the low end of the 2,000- to 250,000-acre production-equivalent range. The general manager of Kenex Ltd. indicated that the 1999 supply of hemp fiber and seed from 35,000 Canadian acres has oversupplied the North American hemp market (von Sternberg, 1999).

Some people will buy hemp apparel and related items simply because they are made from hemp. This is probably a small but stable component of demand. A more volatile component is based on fashion trends and whether designers use hemp- or linen-containing fabrics in their designs. In the last few years, some famous designers, including Calvin Klein, Giorgio Armani, and Ralph Lauren, have included hemp fabrics in their clothing lines (Gross; *The Economist*, 1998; Copeland, 1999). Because of changing fashion trends, markets for specialty textile fibers tend to be cyclical. Cyclical markets would be more disruptive to fibers with small markets than to fibers with large market shares, such as cotton.

Hemp also is being used in the manufacture of household furnishings and floor coverings, particularly carpets (Gross; von Hahn, 1999). Competition with linen for traditional upholstery, drapery, and floor covering markets would depend on the fiber's quality and price.

A comparison of the import values for hemp and linen yarns reveals that hemp may be able to compete on price (table 5). From 1994 to 1998, the import value

Table 5—U.S. import value of linen and hemp yarns, 1989-99

Year	Linen yarn, single	Linen yarn, multiple	Hemp yarn
		Dollars/pound	
1989	2.47	6.76	na
1990	2.50	6.34	12.92
1991	2.38	5.33	21.19
1992	2.14	5.67	18.26
1993	2.38	4.61	1.34
1994	3.49	2.26	1.34
1995	3.73	2.24	2.89
1996	2.39	1.86	1.93
1997	3.14	2.62	1.01
1998	2.86	3.34	2.47
1999[1]	2.79	3.09	3.31

na = Not available.
[1] January-September.

Source: U.S.Department of Commerce, Bureau of Census.

of hemp yarn averaged $1.93 per pound, while the value for single- and multiple-strand linen yarn averaged $2.97 per pound. Information on yarn quality is not available, which may account for linen's higher value. Nevertheless, the value of hemp imports per pound, calculated by dividing the value of hemp yarn imports by the volume, has fluctuated widely since the early 1990's. During 1990-92, the value of hemp yarn ranged from $12.92 to $21.19 per pound. Between 1993 and 1999, the value ranged from $1.01 in 1997 to $3.31 for the first 9 months of 1999. The lower values in recent years may be to due to the increased volume of imports, enabling companies to spread their costs over more tonnage. Similar variations occurred in the import values of raw hemp fiber, which settled at around 40 cents per pound in 1997 and 1998.

Paper and Composites

The specialty and recycled paper markets are also possibilities for industrial hemp bast fibers. Specialty paper markets include currency, cigarette papers, filter papers, and tea bags. A number of companies in U.S. and European markets are selling paper that contains small amounts of hemp fiber, usually blended with less expensive nonwood fibers. These papers have gained some market acceptance as ecologically friendly or tree-free, but at present are considerably more expensive than wood-based paper (Ehrensing, Gardner and White). Within the mainstream pulp and paper market, fibers compete on quality characteristics, with cotton predominant among nonwood fibers, then flax, and then kenaf and other specialty fibers. Manufacturers are willing to pay more for specialty fibers if quality dictates. For example, abaca fibers retain their strength and form when wet, commanding a high price.

Rising wood prices and regulatory practices have promoted the growth of recycled pulp and paper. Therefore, a potential market may exist for agricultural fibers as an additive to strengthen paper made from recycled materials. Recent Dutch and German research suggests that industrial hemp may not be competitive in the specialty paper market, but may be used as a fiber supplement to recycled paper pulp.

In North America, use of nonwood fibers, such as hemp, in composites is still largely in research and development or the early stages of commercialization. Flax, kenaf, jute, hemp, and wheat straw—in combination with various resins—can be used to make composite board. Wheat straw is the dominant nonwood fiber in these applications (Glaser and Van Dyne, 1997). Hemp fibers could be desirable in this market because of their length and strength. Composites made using agricultural fibers are being developed in companies and research institutes in Europe, Canada, and the United States. The USDA Forest Service's Forest Products Laboratory is a leader in the research of nonwood fibers in composites. The percentage of the composites market captured by nonwood fibers in coming years will depend on economics and availability of raw materials.

Other Potential Uses

The *Economic Impact of Industrial Hemp in Kentucky* cites molded automobile parts and fiberglass replacement as potential uses for hemp bast fiber. Hemp fibers have been used in the manufacture of trunk liners and press-molded airbag parts for several BMW models. Kenex Ltd. has developed prototype molded car parts. Transit buses are being retrofitted in Florida with molded hemp parts for use in Orlando (Thompson et al.). In recent years, several automobile companies have investigated using nonwood fibers, such as hemp and kenaf, in the manufacture of molded car parts because they are lighter and more recyclable than current raw materials (Domier, 1998; Copeland). For nonwood fibers to gain a part of this market, they will have to be supplied in adequate quantities

throughout the year at prices competitive with current raw materials.

The Kentucky report also suggests that hemp and other nonwood fibers could replace fiberglass in certain applications. The short fiber length and absorbent properties of these fibers would limit their use to replacing chopped fiberglass and in applications where moisture is not a problem. Given current market conditions, it can be assumed that synthetic fibers are the raw material of choice because of their properties (e.g., moisture resistance), their price, or both.

Hemp Hurds

In countries currently producing industrial hemp, hurds are sold for a variety of uses, including animal bedding, composites, and low-quality papers. According to Thompson et al. (1998), industrial hemp hurds appear to be price-competitive with wood chips, fine wheat straw, and other types of bedding used for high-value racehorses. Hemp hurds are favored over cheaper alternatives since they are more absorbent, and thus, reduce illness. Companies in England, France, and the Netherlands are making horse bedding from hurds. Some members of the racehorse industry in Kentucky have expressed interest in using hemp hurds (Patton, 1999). In addition, hurd-based cat litter is being sold in England, France, and Germany (Gardner and White). Since hurds are a joint product with the bast fiber, finding markets for hemp hurds may make the difference between a profitable and unprofitable industrial hemp enterprise.