Study On
Markets and Prices for Natural Fibres
(Germany and EU)

nova Institute

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The nova Institute for Ecology and Innovation was founded in 1994. Its largest department focuses on renewable resources, particularly on markets and economics of biodegradable materials such as natural fibres and bio-plastics.

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Summary

The objectives of this study on "Markets and Prices for Natural Fibres" were to analyse the current and future markets for flax and hemp fibres produced in the EU, to characterise the economic situation of producers and to develop a suitable framework that will guarantee an adequate development of the natural fibres markets. The latter is mostly dependent on the EU subsidy policies, which are proposed to be fundamentally reformed for the economic year 2000/2001.

The study focuses on technical markets for short fibres, which particularly in the new flax and hemp countries - especially in Germany, the U.K. and Scandinavian countries - are of central importance and are to date not well known. The main focus of the research thus was a comprehensive data survey of all relevant manufacturers and associations in the EU by means of questionnaires and expert interviews.

Short fibre production

In the economic year 1999/2000, about 60,000-70,000 tonnes of flax and 25,000-30,000 tonnes of hemp short fibres were produced in the EU. In the traditional flax countries France, Belgium and The Netherlands, flax short fibre production ("tow") is a by-product of flax long fibre processing, which is entirely directed towards the apparel and home textile market. In contrast, in the new flax and hemp countries, processing of the short fibres is almost entirely done by so-called "total fibre" lines, which do not separate long and short fibres.

Markets

The most important markets for flax short fibres are pulp (commodity and specialty pulps) with a 45% share and the apparel and home textile sector with a 20% share. Another 25% are exported by the EU. For hemp, the specialty pulp sector is even more prominent with a market share of 87%. The specialty pulp sector is a stable, high-priced niche market. The most important product lines are cigarette paper, bank notes, technical filters and hygiene products.

Market developments through 2005

Upon closer examination of the short fibre markets, however, several interesting developments became noticeable over the past few years. Motivated by comprehensively sponsored research and development (R&D) projects and innovative entrepreneurs, novel technical product lines have been developed. The two most important product lines are composites in the automotive industry and thermal insulation materials in the building sector. Thus far, market shares for all new technical product lines are somewhat below 10% for flax and slightly above 10% for hemp. European fibre processors forecast a market share for these product lines of about 30-40% of the still growing market as soon as 2005.

Subsidies and investments

From 1982-2002 in the EU (DG VI, DG XII, DG XIV), more than DM 100 million in subsidies were directed towards the development of new flax and hemp applications and towards harvesting and fibre processing technologies. In addition, national projects contributed funding. In Germany alone, more than DM 175 million were invested in R&D of new harvesting, fibre processing and refining technologies

(thereof more than DM 88 million from federal and state public funds, the remainder from private sources). For the next years, Germany's primary processors plan further investments of about DM 150 million.

Automotive industry

The use of natural fibres in the automotive industry is particularly interesting. While in 1996, the European automotive industry used only 4,000-5,000 tonnes, in 1999 this had already increased to more than 21,000 tonnes. About 30% of these fibres were produced in the EU and about 70% were imported from Eastern Europe and Asia. In this context, it became evident that the currently used quantity of hemp fibres in the European automotive industry is entirely produced in the EU.

Use of natural fibres in the European automotive industry (in tons)

Survey of suppliers of automotive industry and fibre producers

Fibre	Germany 1996 according to suppliers	EU without Germany 1996 according to suppliers	Germany 1999 according to suppliers	EU without Germany 1999 according to suppliers	EU total 2000 prognosis according to suppliers	EU total 1999 according to fibre processors
Flax	Yes	Yes	**11,000**	**4,900**	+2 to +10%	**2,118**
Hemp	No	No	**1,100**	**600**	+3 to +20%	**1,770**
Jute	Yes	Yes	700		+2 to +5%	-
Sisal	Yes	Yes	500		0 to +3%	-
Kenaf	No	No	1,100		0 to +3%	-
Total	4,000	300	**14,400**	**6,900**	23,000 - 25,000	**3,888**

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Natural fibres are predominantly used for reinforcement of door panels, passenger rear decks, pillar cover panels and boot linings. The present state of technology allows the use of about 5-10 kg natural fibres per automobile.

The automotive industry made the decision for the use of natural fibres for several technical, environmental, and economic reasons. The demand in the EU is expected to further increase to 40,000 to 70,000 tonnes in the foreseeable future. In the long term, the use of novel technologies - thus far not fully developed for serial production - can double this demand. This presents a big chance for "total fibre" lines in the EU.

Ecological thermal insulation materials

The second-most important market for flax and hemp short fibres is their use in ecological thermal insulation materials. In many countries, this market is growing faster than the total market for insulation materials. Especially the flax fibre processors have high hopes in the thermal insulation market. By the year 2005, several 10,000 tonnes per year are expected to be sold. This development assumes that processing costs can be lowered and comprehensive marketing schemes will be implemented.

Specialty pulps

Experts in the pulp sector judge the market for specialty pulps, thus far the most important product line for flax and hemp short fibres, as stagnant to slightly decreasing. Nevertheless, the fibre processors expect to expand the market by 10% by the year 2000. Such expansion will only be possible by developing new markets or by substitution of other fibre plants. This requires specific and regional marketing activities and novel, e.g., ecological characteristics of the pulp.

Economic situation of the fibre market

The economic situation of the new EU "total fibre" processors is characterised by small profit margins despite the relatively high subsidy level. The reasons are mostly found in start-up problems of the new processing lines. Technical problems have to be solved, throughput and productivity need to be increased and new markets have to be developed. At the same time, fibre prices, pressured by competition from imports from Eastern Europe and Asia, have little financial flexibility. For the technical sector, industry purchases fibres at prices of DM 0.90 to 1.20 per kg. The main competing fibres for EU-produced hemp and flax fibres are flax fibres from Eastern Europe, jute and kenaf fibres from India and Bangladesh and sisal from South Africa, South America and Asia.

A sudden decrease of EU subsidies will jeopardise the existence of the processing facilities. The current proposals of the EU commission for a reform of the flax and hemp subsidy schedule do not represent a suitable framework for further development of the new natural fibre markets. A sudden and drastic decrease of the subsidies and added conditions will take away the financial basis for the new "total fibre" lines in their start-up phase. Even with drastic productivity increases, most of the new enterprises will not be able to achieve a profit. There is a real risk that the entire "total fibre" economy that developed in the past years in many of the new flax and hemp countries and that had been subsidised by considerable public funds will collapse and private and public investments will be lost. The goal to establish a novel, technically oriented natural fibre industry in the EU would then have failed.

Political decision

This imperilment of the young "total fibre" industry occurs at a time when the industrial demand for flax and hemp fibres is higher than ever. Especially in the automotive industry, the decision for an increased use of natural fibres has been made. The decision by the EU to what extent this demand will in the future be met by EU-produced flax and hemp fibres or by imports will be an agri-economic political choice. Within a suitable framework, there is a real chance to guarantee an ecological and sustainable supply of technical natural fibres for the industry from the EU. This chance should not be imperilled by the wish for short-term subsidy savings. Besides the subsidies, a comprehensive evaluation should take into account the substituting imports of natural fibres, any workplace and environmental effects, as well as the imperilment of already granted financial assistance and investments.

The most important objective for the future development of technical markets for EU-produced natural fibres is thus a modification of the current reform proposals by the EU commission. This study discusses several different alternatives to that respect.

The authors of this study are associated with the German nova Institute for Ecology and Innovation, which was founded in 1994. Its largest department focuses on renewable resources, particularly on markets and economics of biodegradable materials such as natural fibres and bio-plastics.

Chapter 1

Current Markets for Flax and Hemp Fibres and Their Development in Germany and other EU Countries

Reliable data regarding current production, trade, and uses of flax and hemp fibres in the EU are not readily available. Reliable statistics are only available for flax long fibres from France, Belgium and The Netherlands. These data are published in the VLASBERICHTEN from Belgium (VLASBERICHTEN 2000).

This study focuses on markets for short fibres because those hold the leading rank in all new flax and hemp countries – especially in Germany, the U.K. and the Scandinavian countries – and at the same time data availability is particularly scarce.

On December 14, 1999, the Council of the European Commission published the following derived production figures for flax and hemp fibres, which are the basis for the discussion on country quotas and "national guaranteed quantities" (see Table 2) (EU 1999b). The most important facts follow:

Table 1: Cultivation area and production volumes in the EU. Economic year 1999/2000 (Source: EU Statistics, see Table 2)

Cultivation Area		Production Area		Production		
Flax	Hemp	Flax	Hemp	Flax Long Fibre	Flax Short Fibre	Hemp Short Fibre
208,120 ha	31,972 ha	104,297 ha	22,984 ha	74,000 t	83,000 t	34,000 t

"Cultivation area" refers to the registered area eligible for the aid-per-hectare for flax and hemp. "Production area" refers to the fraction of the cultivation area the fibre output from which is further processed. The discrepancies between cultivation area and production area are mostly found in Spain, where the majority of the cultivation area is not used for production. The country-specific fibre yield per hectare is derived from the production area (see Table 2).

Table 2: Cultivation areas and fibre quantities produced in the EU, economic year 1999/2000 (Source: EU 1999a and b, supplemented by nova Institute)

EU Member Country	Cultivation Area		Production Area		Fibre Yields			Production		
	Flax	Hemp	Flax	Hemp	Flax Long Fibres	Flax Short Fibres	Hemp Short Fibres	Flax Long Fibres	Flax Short Fibres	Hemp Short Fibres
	ha	ha	ha	ha	tonnes[1] /ha	tonnes/ ha	tonnes/ ha	tonnes/ year	tonnes/ year	tonnes/ year
Belgium	12,199	-	11,500	-	1.20	0.90	-	13,800	10,350	-
Denmark	32	23	30	20	-	1.20	1.50	-	36	30
Germany	569	4,003	500	4,000	-	1.20	1.50	-	600	6,000
Greece	-	-	-	-	-	-	-	-	-	-
Spain	126,226	13,473	25,000	5,000	-	0.60	0.75	-	15,000	3,750
France	48,000	10,500	46,500	10,000	1.20	0.90	1.95	55,800	41,850	19,500
Ireland	-	22	-	20	-	0.60	1.05	-	-	21
Italy	-	197	-	190	-	-	0.75	-	-	143
Luxembourg	-	-	-	-	-	-	1.50	-	-	-
The Netherlands	3,568	872	3,568	872	1.20	0.90	1.95	4,282	3,211	1,700
Austria	336	289	336	289	-	1.20	1.30	-	403	376
Portugal	-	-	-	-	-	0.60	0.75	-	-	-
Finland	863	93	863	93	-	1.20	1.15	-	1,036	107
Sweden	1,327	-	1,000	-	-	1.20	-	-	1,200	-
U.K.	15,000	2,500	15,000	2,500	-	0.60	1.05	-	9,000	2,625
Total	208,120	31,972	104,297	22,984				73,882	82,686	34,252

The reported production figures represent an upper estimate. If real production figures, such as those derived from the nova survey (NOVA 2000) are substituted, production volumes are considerably lower, especially for short fibres. Mainly two reasons are to blame: for one, production areas were overestimated and second, the assumed fibre yields per hectare were unrealistically high. Overall, the following figures are estimated:

EU-wide production: economic year 1999/2000, estimate nova Institute

Flax short fibres 60,000 – 70,000 tonnes[1]
Hemp short fibres 25,000 – 30,000 tonnes

Table 3 shows the current forecast for flax long and short fibre production in the three traditional flax countries France, Belgium and The Netherlands. These three countries produce virtually all EU flax long fibres as well as about 50% of all flax short fibres. Inventories and imports and exports from and to non-EU countries are also included. Since imports and exports fluctuate considerably and estimates for 1999 were not yet available, the average of the past years was used.

Figures for the short fibres in Table 3 are essentially those for the tow by-product from the long fibre line. The traditional countries produce only very small quantities of flax short fibres from “total fibre lines” (see

[1] Tonnes in this documents are metric tonnes

Box Insert 6), whereas in the new flax countries, particularly in Germany, the U.K., and the Scandinavian countries, total fibre processing lines dominate.

Table 3: Forecast for flax fibre production from harvest 1999 (in metric tons) from France, Belgium and The Netherlands (DAENEKINDT 1999, EU 1999)

	Long Fibres	Short Fibres
Production France	59,000	25,500
Production Belgium	12,150	5,500
Production The Netherlands	3,600	1,600
Total	**74,750**	**32,600**
Inventory July 31, 1999	18,550	24,500
Total resources	93,300	57,100
Imports (average 94–98) from non-EU countries	6,000	12,600
Exports (average 94–98) to non-EU countries	36,267	16,530

Short and long fibres

Long fibres are the main product of traditional flax and hemp processing. The retted straw is fed in parallel orientation to the breakers of the fibre processing line and subsequently scutched and heckled. The most important end product is the valuable long fibre, which is used in the apparel and home textile industry. By-products are short fibres (scutching and heckling tow), shives (flax woody core) and hurds (hemp woody core).

Whereas in the traditional flax countries France, Belgium and The Netherlands, the long fibre processing line is still the most important one for flax processing, production of long fibre hemp is now limited to Eastern Europe and China.

Since the 1980s, so-called “total fibre lines” were developed in Europe, which yield the total fibre contained in straw as short fibre. Production costs are lower compared to long fibre lines. Short fibres from total fibre lines are predominantly used as technical fibres. Fibre lengths may vary considerably depending on the application. For use in nonwovens, average fibre lengths vary from 40 to 100 mm. In the EU, hemp fibres are exclusively processed with total fibre lines. For flax, especially in the new flax countries Germany, the U.K., Sweden and Denmark, total fibre lines are increasingly gaining importance.

Tow from long fibre processing and short fibres from the total fibre line differ particularly in their length distribution. Short fibres from the total fibre line are also referred to as staple fibres, since their fibre lengths are distributed around an adjustable value (Gauss bell curve distribution). Tow, in contrast, has a wider fibre length distribution and is often subject to fibre conditioning to achieve a staple fibre, which is easier to process in subsequent manufacturing steps.

Applications for flax fibres

Almost all **flax long fibres** are used in the apparel and home textiles industries. In the EU, more than 80% of the long fibres are further processed by wet spinning, more than 10% by dry spinning and the remaining ~10% are processed to twine. The long fibre (and short fibre) yarns – spun in the EU and other countries – are used for apparel (50%), for furniture covers (13%), for other home textiles (20%), and for sacks, tarps and other uses (17%) (CGFTL 1998, AGPL 1997, NOVA 1999, KARUS, KAUP & DAVID 1999).

More than 50% of the long fibres are in fact not spun in the EU, but exported for spinning, especially to China (50%) and Brazil (5%) (1998). In these cases, the most important elements of the value chain have already been removed from the EU. This trend continues to expand. The fibres return to the European market as yarns or fabric. Small amounts of flax long fibres are also imported, in particular from Egypt (60%) and Lithuania (13%) (1998) (BENOIT 1999).

The final destiny of the **tow**, i.e. the short fibres, depends on market conditions. About 50% of the flax short fibres are used in the pulp industry; about 25% are used in the apparel and home textile industry (about equal amounts in dry spinning, twine production and cottonisation) (KARUS, KAUP & DAVID 1999).

Obviously, the flax industry is interested in selling the largest possible quantities of short fibres into the high-priced apparel and home textile sectors (e.g., furniture, table cloths, linens). However, this only occurs during periods when flax is en vogue in the apparel industry. In these times about 50% of the tow find their way into the apparel and home textile sectors and only about 20–25% are used for pulp. During fashion periods, prices for good quality flax short fibres rise to about DM 1.50/kg and more. Regular prices range from DM 0.50 –1.20/kg (CIPALIN 1996 and 1998).

In 1999 and 2000, typical prices for EU flax tow used for thermal insulation materials and composites (automotive industry) were about DM 0.90–1.10/kg, which is a competitive price range. In flax fashion periods, flax tow quickly becomes too expensive for technical applications and other natural fibres may undercut prices (for details see Chapter 4).

At present these novel technical applications still play a subordinate role as markets for EU flax fibres (less than 10%). However, recent expert interviews indicate that the percentage of French and Belgian flax fibres, which find their way into the automotive and thermal insulation industry has been increasing over the past years and that there is an interest in expanding these new markets. In recent years, some large fibre processors have built their own nonwovens manufacturing facilities. This indicates that the technical textile market is increasingly seen as an interesting market by the European flax industry.

For price stability and supply safety reasons, the demand of these new technical markets has in the past years mostly been supplied by import fibres, e.g., from Eastern Europe (Lithuania) (DECLERCQ 1997, FRANK 1997 and 1998, HENDRIKS 1997, KINKEL 1997). The larger flax trading companies for the most part offer both fibres from the EU and from imports in addition to not further specified mixtures of fibres from various origins.

The importance of these new technical markets as well as the fraction of their fibre supply grown in the EU has been increasing in the past years and is expected to increase further. This development – in addition to the above-described changes in the traditional flax countries – is a result of the new flax industries in U.K., Finland, Sweden, Denmark and Germany, which employ only total fibre lines and target technical markets.

Also, spinning capacities in the traditional flax countries are decreasing. Especially for dry spinning, decreasing fibre sales are expected after two more dry-spinning plants in Belgium closed down.

In 1998, about 15,000 tonnes of flax short fibres were exported, especially to Japan (20%, likely mostly for pulp, Poland (16%, likely mostly for apparel), Czech Republic (14%). Imports amounted to about 7,000 tonnes and originated mostly in Egypt (40%) and Lithuania (23%) (BENOIT 1999).

Recent survey by the nova Institute

To illustrate applications and markets for flax and hemp short fibres from the EU with current data, two questionnaires (Germany and EU) were developed and mailed in January 2000. All responses received by March 1, 2000 were included in the evaluation.

Survey Germany

In January 2000, 20 flax and hemp processors, listed by the German Federal Bureau for Agriculture and Nutrition (Bundesanstalt für Landwirtschaft and Ernährung, BLE) as "registered or under construction," received a multi-page questionnaire. The questionnaires focused on questions regarding production figures for 1999 and forecast for 2005 – provided the EU subsidies maintain an acceptable level – as well as major applications and product lines.

Seventeen of the 20 companies responded; only one larger flax processor did not respond, the other two missing responses were from very small companies. Thus, the collected data can be considered representative.

However, it should be pointed out that in Germany in 1999 only very small quantities of flax were processed. Thus, these market data cannot be extrapolated to larger production quantities. For this reason, percentages were not listed in Table 4.

Survey EU

A somewhat shorter questionnaire in English was mailed to the more than 30 leading flax and hemp processors, to key associations, to all members of the Council committee for flax and hemp as well as to the national agricultural ministries.

Responses were – despite several fax, e-mail and phone inquiries – slow. Responses from 19 companies and institutions were received by March 1, 2000. Several countries submitted summary data (total of all companies). While the collected data on the European hemp industry can be considered essentially complete, data for flax remain incomplete. Especially the traditional flax countries France, Belgium and The Netherlands provided only very few data. Thus, the data basis for markets of European flax short fibres is weak and had to be supplemented by estimates based on available studies and previous market studies by the nova Institute (AGPL 1997, CGFTL 1998, EU 1999, NOVA 1998 and 1999). On the other hand, data from the smaller and more recent flax countries, where most processing lines are still under construction or in start-up mode, can be considered complete.

The following methodical issues – relevant for **both surveys** – should be pointed out:

- Only fibres from EU or Germany cultivation were considered for production and markets. Fibre imports were not included.
- Only figures for flax and hemp were collected – linseed was not included, even though smaller quantities of linseed fibre are used in technical applications.
- The listed fibre production quantities include fibres of varying quality. The shives/hurds content may vary between 3 and 50%. For this reason, the ratio between fibres and shives/hurds represent average values for various processing technologies.
- The low production figures for 1999 are mostly due to the fact that in many countries the new total fibre lines are still under construction. The considerably higher production quantities forecast for 2005 (see Chapter 2) result from the projected operation of these plants, increased throughputs of the existing facilities, and construction of additional plants.
- Definition of "**export**" in tables. Export figures in Tables 3 and 4 refer only to exports from the traditional flax countries France, Belgium and The Netherlands into non-EU countries. Export figures from the new flax countries are not reliable, but are assumed to be comparatively low. In the survey, several processors did not list their exports into non-EU countries as "export" (this category wasn't included in the questionnaire) but included it under the respective product line (assuming they were aware of the use of the fibres in the importing country). Thus, the differentiation between "export" and "product lines" is not precise. The lack of data did not allow for a distinction of all exports into product lines, which would have been the preferred option for Table 4.

Tables 4 and 5 show the applications for flax and hemp short fibres in the EU based on the nova survey (for flax including estimated additional quantities).

Table 4: Relevant applications for flax short fibres, EU 1999 (in tonnes) (NOVA 2000)

Product Line	Data from Survey 01–02/2000 for Germany	Data from Survey 01–02/2000 for EU (excluding Germany)	Additional Quantities Estimated for the EU (including Germany) (nova)	Total EU (including Germany)	%
Pulp for paper	0	0			
Specialty pulp	0	2,266	~ 27,000	~ 30,000	45*
Composites for automotive industry	0	2,118	~ 2,000	~ 4,000	6
Other composites	0	20	~ 100	~ 100	0.1
Construction and thermal insulation materials	99	973	~ 500	~ 1,500	2
Geotextiles and agricultural textiles	150	45	~ 200	~ 400	0.6
Apparel and home textiles	0	1,802	~ 11,000	~ 13,000	20*
Traditional uses: twine, rope, etc.	0	40	~ 1,300	~ 1,300	2
Other	2	0			
Export to non-EU countries	0	0	~ 16,000	~ 16,500	25
Total	251	7,264	~ 58,000	60,000–70,000	100

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* In flax fashion periods, the percentages or pulp and apparel and home textiles are reversed to 20–25% and 50%, respectively.

Sources for estimates: AGPL 1997, CGFTL 1998, EU 1999, NOVA 1998 and 1999

Table 5: Relevant applications for hemp short fibres, EU 1999 (in tonnes) (NOVA 2000)

Product Line	Data from Survey 01–02/2000 (excluding Germany)	%	Data from Survey 01–02/2000 EU (excluding Germany)	Total Quantity EU (including Germany)	%
Pulp for paper	0	0	100	100	0.3
Specialty pulp	0	0	24,882	24,882	87
Composites automotive industry	820	45	950	1,770	6
Other composites	20	1	100	120	0.4
Construction and thermal insulation materials	660	36	435	1,095	4
Geotextiles and agricultural textiles	80	4	154	234	0.8
Apparel	0	0	0	0	0
Traditional applications: twine, rope, etc.	0	0	150	150	0.5
Others	230	13	50	280	1
Total	1,810	100	26,821	28,631	100

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Notes on Tables 4 and 5

- In the flax sector, the survey covered only about 12% of the total amount of short fibres. Thus, the figures in Table 4 were supplemented based on other studies and surveys (see Table 2 and accompanying text). A discussion of the product lines for flax short fibres is found on the previous pages.
- It is worth noting that the sector for novel technical applications, particularly composites and construction and thermal insulation materials, while still small has, in recent years, increased to 9%. As already discussed, this is a result of the market entry of new flax companies from the U.K., the Scandinavian countries, Austria and Germany.
- The conspicuously dominant role of the pulp sector for hemp fibres (Table 5) is mostly owing to the traditional hemp pulp producers from France and Spain. In France, the leading country in hemp cultivation in the EU, the pulp sector accounts for about 95% of fibre production. This includes both specialty pulps and commodity paper pulps (see Chapter 2) (MATHIEU 1999). As a result of activities of the new hemp processors from the U.K., The Netherlands and Germany in novel technical applications, the share of the pulp sector has fallen from 95% to about 87%. Composites, construction and thermal insulation materials, geotextiles, agricultural textiles and other technical applications currently hold a 10% market share, which continues to grow (see Chapter 2).
- The apparel and home textile sector is currently irrelevant to EU-produced hemp fibres. This sector is exclusively supplied by fibres, yarn and fabrics imports from Eastern Europe and China. The main reason is that the production of hemp fibre qualities suitable for textile applications requires either traditional water retting or one of the new biological or physico-chemical retting technologies. In the EU, water retting has been abandoned for economic and ecological reasons and the new technologies are not yet established on a production scale.
- The exclusive orientation of hemp fibres towards technical markets (pulp, nonwovens) results in stable, fashion-independent prices and a focus on fibre qualities specific to the requirements of the specialty pulp and technical textile sector. In the traditional flax sector these industries had been considered as the users of “by-products”. This explains – in addition to technical quality aspects – the interest of, e.g., the automotive industry in technical hemp fibres.

- In Germany, EU hemp fibres for technical nonwovens are currently traded for DM 0.90–1.20/kg. This renders them competitive with other natural fibres (see Chapter 4).
- Table 5 does not include export figures for hemp to non-EU countries. In contrast to flax, export and import of hemp fibre is only of minor importance. Only very small quantities of hemp fibres are exported to non-EU countries. As a result of the almost complete collapse of Eastern European and Russian hemp cultivation, imports are currently not important either. However, this situation may be subject to change in the future (see Chapter 4).

Data obtained from the German Federal Bureau of Statistics (Statistisches Bundesamt)

For completeness, German figures for import and export of flax and hemp (EU and non-EU countries) from the German Federal Bureau of Statistics, Wiesbaden have been compiled. However, these data are not considered reliable because product inventory and classifications in the flax and hemp sector are not specific. For example, not all recorded materials were raw fibres, but also included processed products such as nonwovens. Also, some not otherwise classified flax and hemp products were recorded as tow.

Table 6: Flax and hemp imports and exports Germany 1996–1998 (in tonnes) (German Federal Statistical Bureau, Statistisches Bundesamt Wiesbaden 2000)

Product	Import 1996	Import 1997	Import 1998		Export 1996	Export 1997	Export 1998
Hemp Long Fibre	1	10.5	10.9		8.4	16.5	16.8
Hemp Tow	148.6	105.1	67		20.5	56	22.3
Flax Long Fibre	229.3	420.4	359.9		84.4	39.5	76.8
Flax Tow	3,449.7	3,314.6	6,120.2		207.1	47.1	25

Average market prices for flax tow of DM 1.20–1.30/kg, and for flax long fibre of DM 2.20–3.10/kg were reported. Prices for hemp fibres are not considered realistic, likely due to the above mentioned classification issues. Figures for German hemp long fibre exports are likely also subject to classification inaccuracies.

Chapter 2

Market Development and Potential of Major Product Lines

The nova survey solicited current and projected production figures and sales to the various market sectors from flax and hemp companies in Germany and the EU – provided the EU subsidies would maintain an acceptable level. Results of this survey show definite preferences for some product lines as illustrated by Tables 7 (for Germany) and 8 (for EU).

Table 7: Results of nova survey among German flax and hemp fibre processors (NOVA 2000) All figures in tonnes, unless indicated otherwise

Germany	Flax 1999	Flax 2005 (Projected)	Hemp 1999	Hemp 2005 (Projected)
Fibre processing capacity	1,500	10,000	4,930	23,800
Fibre production	384	9,100	2,571	23,800
Fibre sales (see below)	251	9,100	1,810	23,481
Shives/hurds production	690	19,000	5,844	45,150
Shives/hurds sales (see below)	220	data incomplete	4,333	40,450
Seed production	0	0	145	1,341
Seed sales (see below)	0	0	105	1,341
Fibre product lines				
Pulp for commodity papers	0	0	0	0
Specialty pulp	0	0	0	300
Composites automotive industry	0	0	820 (45%)	5,146 (22%)
Other composites	0	0	20	5,230 (22%)
Construction and thermal insulation materials	99	8,400 (92%)	660 (36%)	9,005 (38%)
Geotextiles and agricultural textiles	150	450 (5%)	80	2,400 (10%)
Apparel	0	250 (3%)	0	0
Other	2	5	230	1,400
Shives/hurds product lines				
Animal bedding	220	2,200	3,742	18,250 (45%)
Construction materials	0	300	488	18,700 (46%)
Other	0	0	100	3,500
Seed product lines				
Foods	0	0	0	20
Animal Feed	0	0	100	270 (20%)
Body care	0	0	0	1
Technical applications	0	0	5	1,050 (78%)

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Table 8: Results of nova survey among flax and hemp fibre processors in the EU (excluding Germany) (NOVA 2000)
All figures in tonnes, unless indicated otherwise

EU (excluding Germany)	Flax 1999	Flax 2000 (Projected)	Hemp 1999	Hemp 2005 (Projected)
Fibre production	7,901	36,020	27,937	47,245
Fibre sales (see below)	7,264	35,017	26,821	46,242
Shives/hurds production	33,918	101,040	44,035	83,290
Shives/hurds sales (see below)	data incomplete	data incomplete	43,384	82,700
Seed production	7,972	15,455	6,216	6,605
Seed sales (see below)	data incomplete	data incomplete	6,216	6,605
Fibre product lines				
Pulp for commodity papers	0	200	100	2,000 (4%)
Specialty pulp	2,266	3,200 (9%)	24,882	27,650 (60%)
Composites automotive industry	2,118	5,500 (16%)	950	8,150 (18%)
Other composites	20	2,300 (7%)	100	2,150 (4,5%)
Construction and thermal insulation materials	973	21,060 (60%)	435	3,715 (8%)
Geotextiles and agricultural textiles	45	654	154	2,325 (5%)
Apparel	1,802	1,403 (4%)	0	2
Traditional applications: rope, etc.	40	200	150	200
Other	0	500	50	50
Shives/hurds product lines				
Animal bedding	2,219	10,500	38,724	61,800 (75%)
Construction materials	2,010	43,800	4,660	18,400 (22%)
Other (including energy uses)	1,100	6,700	0	2,500
Seed product lines				
Foods	499	903	115	200 (3%)
Animal feed	250	600	5,500	5,400 (82%)
Body care	0	2	600	1,000 (15%)
Technical applications	2,100	2,009	-	-
Planting seeds	115	1,500	-	-
Other	0	450	0.5	5

nova 2000

Interpretation of results – flax

Germany

Several new flax fibre-processing plants are scheduled for construction and start-up in Germany over the next few years. At the same time, the existing plants, which in 1999 on average were only used to about 25% of their annual production capacity, expect to considerably increase their throughput by 2005 (several plants were only put into operation during 1999).

The German flax processing plants are to more than 90% directed towards the production of thermal insulation materials. 8,400 tonnes of flax fibres are expected to be sold in 2005. This is attributable to the fact that the new large integrated facilities incorporate both fibre processing and production of thermal insulation mats. Taking into account the projected fibre imports of about 6,000 tonnes in addition to the 8.400 tonnes of flax fibres from German production, the total fibre use for thermal insulation materials increases to nearly 15,000 tonnes. To what extent these quantities of insulation materials can be sold on the market, will be discussed below.

An interesting result from the survey is the lack of interest for German flax fibres in the composite sector, which is in sharp contrast to the hemp fibre market (see below).

The use of flax shives is for the most part projected for the animal-bedding sector; only very small quantities are forecast to be used in the construction sector.

Europe

As previously discussed in Chapter 1, reliability of the figures for flax fibre is limited because the most important flax countries France, Belgium, and The Netherlands – with the exception of two companies – did not provide any data.

In contrast, the new total fibre lines in the EU have provided an excellent response to the survey. Trends forecast for these new flax companies in the U.K., Finland, Denmark, and Austria – illustrated in Table 8 – are thus considered reliable.

Capacities are expected to increase almost fivefold from 1999 to 2005. Especially in the Scandinavian countries considerable capacities are currently under construction and are expected to be put into operation by 2005.

As in Germany, these companies focus on the market for thermal insulation materials (60%), partially also with integrated facilities. The importance of the composite sector is predicted to increase to 16%. Third is the specialty pulp sector (9%), which in the traditional flax countries dominates the market (see Table 4). The apparel industry holds a 4% share of the market.

The shives market is clearly dominated by the construction sector, followed by animal bedding (based on incomplete data).

Interpretation of results - hemp

Germany

In the hemp sector, several new facilities are under construction and expected to be put into operation between 1999 and 2005. Some of these facilities employ innovative processing technologies. At the same time, existing facilities expect to increase their use to capacity (the seemingly low capacity factor of ~50% is due to the fact that some plants started up in 1999) and expand their capacities.

Overall, the fibre production capacity of currently about 5,000 tonnes/year is projected to increase to almost 24,000 tonnes/year. Marketing concentrates on the composites sector – split about evenly between the automotive industry (about 5,200 tonnes/year) and other applications. These “other” applications are composites for the lorry, railway or aircraft industries as well as novel composites for the construction, furniture and packaging sectors.

The composites sector is followed close up by the thermal insulation sector (38%, corresponding to 9,000 tonnes/year), and by geo- and agricultural textiles with a 10% market share. Surprisingly, a new hemp pulp production plant in Germany, scheduled for operation in 2000 (HOFMANN 2000), is not reflected in these figures. This could shift the breakdown by product lines by the year 2005.

The 2005 forecast for the hurds market is equally shared by animal bedding (45%) and the construction sector (46%). These figures indicate a major gain in importance for the construction sector.

Production and use of hemp seeds will be discussed in detail in Chapter 5.

Europe

By including essentially all hemp enterprises in the EU, the survey produced a reliable data set. The companies estimate to considerably increase their fibre production from 27,937 tonnes/year in 1999 to 47,245 tonnes/year by 2005.

The forecast for 2005 still expects the largest market share for hemp fibres in the specialty pulp sector (60%), which, compared to 1999 (EU excluding Germany: 93%), represents a significant decrease in market share. The fastest increase is expected for the composites sector with more than 22% market share by 2005, up from 3.5% in 1999 (EU excluding Germany). The market share of the thermal insulation sector is forecast at 8%.

Animal bedding will continue to dominate the hurds market with a market share of 75%, followed by the construction sector with 22%.

Conclusions

Three product lines are clearly favoured for flax and hemp short fibres in Germany and the EU:

1) Composites with flax and hemp fibres

For the future, the German and (new) European hemp industry banks on a rapidly growing market for natural fibre composites, especially in the automotive industry. There, the focus is on technologies already established in series production. New technologies could open additional markets.

For the (new) European flax industry, composites are the second-most important market. Only the German flax industry shows little interest in this sector.

2) Thermal insulation materials from flax and hemp fibres

The German and (new) European flax industries focus entirely on the growing Eco-market for thermal insulation materials. This holds especially true for the Scandinavian countries, Germany and Austria. Some manufacturers plan to use novel technologies for insulation mat production. Such technologies are intended to considerably lower prices and thus create a competitive market situation compared to synthetic insulation materials.

For the German hemp industry, the thermal insulation sector is the second most important market, for the European hemp industry the third.

3) Pulp sector

For the traditional flax and hemp short fibre industries, the pulp sector will remain the core market. A few new hemp-processing companies also perceive the pulp sector as of market of permanent importance. For the new European flax industry, the pulp market merely plays a minor part, for the German flax industry, it is irrelevant. These three product lines are analysed in more detail and assessed for their future potential below.

First, however, several other fibre product lines and the shives/hurds sector are discussed briefly.

Other fibre product lines

The only other relevant product line named for flax and hemp fibres – besides apparel textiles for flax – is the geotextiles and agricultural textiles sector with shares of 2 and 10%, respectively.

Based on the outcome of various technical seminars in 1999 – organised within the scope of the EU project "Market Innovation Hemp" by the nova Institute, the Fibre Institute Bremen and the marketing firm The

Value:Marketing – the importance attached by the respondents to the sectors geotextiles and agricultural textiles was not anticipated. Results from these seminars indicated that domestic flax and hemp fibres could only occupy small niche markets and some specialty applications.

The main reasons were related to the biodegradability of domestic bast fibres and their market prices. Studies by the Fibre Institut Bremen showed that nonwovens from flax and hemp fibres exposed to water and soil disintegrate rapidly over the course of a few months (MÜSSIG & MARTENS 1999). For geotextiles and agricultural textiles, which demand long-term stability, especially when exposed to water and soil, cocos (coir) fibres are better suited. Due to their high lignin content (40–50%, compared to 2–5% in bast fibres) nonwovens from cocos fibres decompose much slower. Moreover, prices for cocos fibres are considerably lower than for flax or hemp fibres (see Chapter 4). The other rivals in the natural fibres sector are nonwovens from jute, also less expensive than flax and hemp.

This is not to say that there are no geotextile or agricultural textile applications for flax and hemp fibres. Yet, they are – especially in applications requiring large volume material use – limited by the competition with cocos and jute.

One example for a new product line, whose market introduction in Germany is anticipated in 2000, is the production of substrates for plant growth based on nonwovens from flax or hemp fibre. Uses include for example the sprouting of seeds of lettuce and herbs (cress, etc.) and replacement of currently used products in supermarkets. The main benefit is the full biodegradability of the product. Benefits claimed for using flax and hemp fibres from Germany are primarily environmental reasons (guaranteed pesticide free, regional processing) (KNEUKER 1999).

Shives/hurds

For the woody core of both, flax and hemp, there are currently only two relevant uses: animal bedding (especially horse bedding) and the construction sector. The animal bedding sector is forecast to lose importance. The gain in importance of the construction sector, which has a considerably lower profit margin, is mostly based on the anticipation of a saturation of the animal bedding market.

For hemp hurds, the animal bedding sector will continue to dominate through the year 2005 (75% EU excl. Germany). However, compared to 1999 (89%), the sector has already lost a considerable share to the construction sector. In contrast, for flax, the construction sector will have a considerably larger market share than the animal-bedding sector.

These differences for hemp hurds and flax shives are due to their different suitability for the animal bedding market.

From an economic standpoint, finding high-priced markets for shives/hurds (see Tables 19 and 20 in Chapter 6) is vital for allowing fibre processors to keep fibre prices competitive (see Chapter 4).

Detailed analyses

1) Composites from flax and hemp fibres

In the 1980s, several studies forecast large market potentials for composites from flax fibres in Germany and the EU. The development of these markets however, advanced slower and faced more obstacles than expected. The ambitious German flax program, which received substantial subsidies, did not survive these hard times (see Chapter 3).

Only in the past years, did an actual industrial demand for natural fibres develop. Nowadays, the use of natural fibres in certain applications has become a matter of course, a fact, which only five years ago no one dared to expect. The most relevant customer is the automotive industry.

According to surveys by the nova Institute, about 4,000 tonnes of natural fibres were used in the German automotive industry in 1996 (NOVA 1996). In September 1999, the nova Institute conducted a survey among 54 suppliers to the automotive industry in Germany and Austria regarding their use of natural fibres. A total of 16 companies responded, which corresponds to about 80–90% of the suppliers utilising natural fibres. These companies provided data only with the stipulation of confidentiality of company-specific data and restricted publication to total figures. For this reason, it is not possible to show the figures for each company separately.

Table 9 summarises the results of this survey in addition to results from a survey conducted in Europe by the Scottish consulting company "The Textile Consultancy, Ltd." (The study, which was prepared for the British Agricultural Department, had not been published by February 2000). The last column shows the results from the surveys of this study among European fibre processors.

Table 9: Use of natural fibres in the European automotive industry. Survey among suppliers and fibre processors (in tonnes) (NOVA 1996, NOVA 1999, NOVA 2000 and TTC 2000)

Fibre type	Germany 1996 According to suppliers	EU excluding Germany 1996 According to suppliers	Germany 1999 According to suppliers	EU excluding Germany 1999 According to suppliers	EU Total 2000 Forecast according to suppliers	EU Total 1999 According to EU fibre processors
Flax	Yes	Yes	**11,000**	**4,900**	+ 2 to + 10%	**2,118**
Hemp	No	No	**1,100**	**600**	+ 3 to + 20%	**1,770**
Jute	Yes	Yes	700	1,400	+ 2 to + 5%	**-**
Sisal	Yes	Yes	500		0 to + 3%	**-**
Kenaf	No	No	1,100		0 to + 3%	**-**
Total	4,000	300	**14,400**	**6,900**	23,000–25,000	**3,888**

Table 9 clearly illustrates the rapidly increasing demand for natural fibres in the automotive industry over the past years. Whereas in 1996 the use of natural fibres was only just beginning (no differentiation by fibre source for 1996), the figure of 14,400 tonnes for 1999 exceeds all projections, both published in the literature or referenced in presentations (e.g., DUPONT 1999). In Europe the use of natural fibres in the automotive industry in 1999 was about 21,300 tonnes, of which at least 3,888 tonnes (18%) were fibres grown and processed in the EU. It is not known, how many of the balance of flax fibres were imports, provided by processors not covered by the survey or from EU inventories (see below).

The demand in Germany alone is expected to increase to 15,000 to 20,000 tonnes/year in the near future; medium-term forecasts expect 20,000 to 45,000 tonnes (KINKEL 1998 and 1999). The introduction of every new car model increases the demand – depending on the model – by 500 to 3,000 tonnes/year.

Because of its sizeable sales and innovative power, the German automotive industry represents – with a 2/3 share of the total natural fibre use – by far the most important customer in Europe. For all of Europe, about 23,000 to 25,000 tonnes of natural fibres for the automotive industry will be required in 2000; medium-term, a demand of about 40,000 to 70,000 tonnes is expected. At a price of about DM 1.00/kg fibre, this translates into an annual market volume of about DM 40 to 70 million

The development outlined above is supported by many automotive manufacturers and suppliers (e.g., DOUCHY 2000). In view of the fact that natural fibre composites have passed the test in the German automotive industry, Italian, French and Swedish automobile manufacturers now increasingly employ natural fibres in their new models (see Table 10).

One indication of the reliability of the figures presented in Table 9 is that the figures for use of hemp fibres in the automotive industry from suppliers and manufacturers, which have been surveyed independently of one another, are in good agreement. Based on the survey of German and European suppliers, about 1,700 tonnes of hemp fibres were used in the automobile sector in 1999. Those hemp fibre processors, who responded to the survey, specified sales of 1,770 tonnes of hemp fibres to the automotive industry.

For flax, the figures are less consistent (suppliers 16,000 tonnes, processors 2,100 tons), partly because only a small number of processors participated in the survey and partly because much flax fibres for composites are imported. These facts have been confirmed by numerous sources.

To paint a complete picture, it is worth mentioning, that the German automotive industry uses about 50,0000–60,000 tonnes/year of recovered cotton and 50,000–70,000 tonnes/year of wood fibres, in addition to the already mentioned natural fibres. However, these figures clearly show a downward trend. Reasons are found in the inferior mechanical properties of these fibres and the fact that composites from these fibres release odours (e.g., formaldehyde from phenol resin-bonded wood and cotton fibres). This downward trend in the use of cotton and wood fibres will benefit both bast fibres such as flax and hemp fibres and ABS components (KINKEL 1999, DUPONT 1999).

The following overview, which covers only recent car models, illustrates that the use of natural fibres in certain automotive parts is now well established.

Table 10: Use of natural fibres in automotive parts (Source: SEURIG-FRANKE 1999, STROBEL 1999, OPEL 1999, ENERGIEPFLANZEN 1999, THE TEXTILE CONSULTANCY 2000)

Manufacturer	**Model** Application (dependent on model)
Audi	**A3, A4, A4 Avant, A6, A8, Roadster, Coupe** Seat back, side and back door panel, boot lining, hat rack, spare tire lining
BMW	**3, 5 and 7 Series and others** Door panels, headliner panel, boot lining, seat back
Daimler/Chrysler	**A-Series, C-Series, E-Series, S-Series** Door panels, windshield/dashboard, business table, pillar cover panel
Fiat	**Punto, Brava, Marea, Alfa Romeo 146, 156**
Ford	**Mondeo CD 162, Focus** Door panels, B-pillar, boot liner
Opel	**Astra, Vectra, Zafira** Headliner panel, door panels, pillar cover panel, instrument panel
Peugeot	**New model 406**
Renault	**Clio**
Rover	**Rover 2000 and others** Insulation, rear storage shelf/panel
Saab	Door panels
SEAT	Door panels, seat back
Volkswagen	**Golf A4, Passat Variant, Bora** Door panel, seat back, boot lid finish panel, boot liner
Volvo	**C70, V70**

Though the already mentioned, existing market potentials for natural fibres are notable, they possibly represent only the tip of the iceberg. Estimates only include technologies already in series production (see below). New production technologies, e.g., natural fibre-reinforced plastics produced with injection moulding technology could develop new markets, as could modified natural fibres for outdoor applications. In addition, markets in the lorry, bus, railway and aircraft industries, which have not been included in this survey, may be developed.

Forecast for 2005 by fibre processors

In 2005, according to their own forecasts, flax and hemp fibre processors project sales of about 13,000 tonnes of hemp fibres and 5,500 tonnes of flax fibres to the European automotive industry, in addition to 7,400 tonnes of hemp fibres and 2,300 tonnes of flax fibres for other composites (see Tables 7 and 8). In light of the above outlined potential for natural fibres, these figures appear realistic, provided there will be no abrupt and drastic changes in the EU subsidy policy, which would compromise the competitiveness of EU-produced fibres.

For a reliable supply of these fibre quantities for composites, construction of new processing facilities is necessary, since the existing facilities in the EU can only partly meet quality demands, or not at all (pulp fibre lines). Several new facilities are currently built, e.g., in Germany.

The demand for natural fibres by the European automotive industry is real and growing noticeably. The question of whether to use natural fibres has long been answered positively. The remaining question is whether the demand will be met by supplies from growers and processors in the EU or by imports from Eastern Europe and Asia.

The present market situation is described below and in Chapter 4.

Why does the automotive industry employ natural fibres?

The most important arguments are as follows:

- Low density: weight reduction of 10 to 30%
- Favourable mechanical and acoustic properties
- Favourable processing properties, e.g., low wear on tools
- Potential for one-step manufacturing, even of complex construction elements
- Favourable accident performance (high stability, no splintering)
- Favourable ecobalance for part production and due to the weight savings during vehicle operation (several studies on this subject have been conducted)
- Occupational health benefits compared to glass fibres
- No off-gassing of toxic compounds (in contrast to phenol-resin bonded wood and recycled cotton fibre parts)
- Price advantages compared to previously used technologies and to synthetic fibres, which became increasingly costly due to the increase in oil prices.

Technologies

Technically speaking, natural fibres in composites are primarily used in press-moulded parts. Typical applications are door panels, hat racks, pillar cover panels and boot linings.

There are two state-of-the-art production technologies, which are most often used in series production. In the one process, natural fibres are blended with polypropylene (PP) fibres and formed to a fibre mat, which is then pressed under heat into the desired form (thermoplasts). In the other process, nonwovens from natural fibres are soaked with synthetic binders, e.g., epoxy resin or polyurethane, and then moulded into the desired form. The composite matrix is formed during the moulding process through polymerisation and hardening (thermosets).

On the fibre side, blends of natural fibres, e.g. flax and jute or flax and hemp, are interesting for technical reasons. The finer flax fibre imparts high stability to the part but prevents the complete permeation with the thermoset binder. This may result in fractures during use. Only a blend with the coarser jute or hemp fibres achieves an optimum balance between stability and saturation with binder.

In an automobile, the described natural fibre-press-moulded parts substitute especially wood and recycled cotton fibres as well as ABS parts.

A relevant substitution of glass fibres will not come to pass until natural fibre-reinforced plastics can be used in series production with injection moulding. In the past years, various research and development projects demonstrated the technical feasibility of a replacement of glass fibres in fibre-reinforced plastics with flax and hemp fibres, even for exterior applications of vehicles. Costs, however, are still an obstacle. Even though prices for natural fibres per kg are lower than for glass fibres, the production process is entirely geared towards glass fibres and retooling for the use of natural fibres is still costly. As soon as these production problems are resolved, a market for natural fibres can be developed, which according to expert opinions, is much larger than the current market for press-moulded parts involving natural fibres.

The press-moulded parts are used especially in door panels, pillar cover panels and boot linings. For a door panel, typically 1.2–1.8 kg of natural fibres are used. Other parts may require between 0.2 and 2.0 kg. In 1995, Daimler/Chrysler already used about 5–6 kg of plant fibres per vehicle (this corresponds to about 20,000–24,000 tonnes/year for the entire company) (POLLMANN 1998). At the current state of technology, 5–10 kg of natural fibres per automobile can be used (excluding seat upholstery). For the approximately 16 million vehicles (automobiles and lorries) annually produced in Western Europe (VDA 1999) this would correspond to 80,000–160,000 tonnes of natural fibres per year. Using the mentioned novel technologies, this amount could be at least doubled.

Which natural fibres are used?

The most important natural fibre for the German and European automotive industry is flax, with a use of about 16,000 tonnes in 1999 (Table 9). The exact origin of these 16,000 tonnes is one of the secrets of the flax market and especially of the trading companies in Belgium and France. In essence, the following sources exist:

- Cultivation and production in the EU: documented in the survey were 2,118 tonnes of flax from the EU. In Table 4, an estimated amount of about 2,000 tonnes were attributed to EU processors not included in the survey. In reality, this share might be even higher.
- The share held by imports is also difficult to assess. The EU Commission estimated in November 1999 that more than 9,000 tonnes of flax fibres were imported into the EU in 1998 (EU 1999a). EU statistics, however, show only 7,000 tonnes for 1998 (EU 1999). On average about 13,000 tonnes of short fibres were imported annually (see Table 3). According to BENOIT 1999, only about 23% of those short fibre imports were from Lithuania, the country cited by other sources as the most important exporter of short fibres for the automotive industry. Generally, experts assume that about 80–90% of all flax fibres used in the automotive industry originate from Baltic countries, particularly from Lithuania (DECLERCQ 1997, FRANK 1997 and 1998, HENDRIKS 1997, KINKEL 1997).
- Finally, larger quantities of flax fibres used in the automotive industry could also have come from inventories (July 31, 1999: 24,5000 tonnes, see Table 3).
- Ultimately, only the flax trading companies, especially those from Belgium, know details about the fibre material flows. Customers generally purchase fibre mixtures from various EU and import batches, without knowing their origin.
- However, it is assumed that the share held by France, Belgium and the Netherlands will increase or has already increased, since these countries take technical uses for tow generated from long fibre production increasingly seriously.

The use of hemp represents a new development with particular dynamics. Not until 1998 were hemp fibres from the EU used in series production. In 1999, already 1,700–1,800 tonnes were used (Table 9), which came from German (~50%), Dutch, British and French production. The new hemp processors in the EU are highly focused on the automotive industry. Since both quality and prices are acceptable and sufficient capacities are in existence or expanding, a further increase in the use of hemp fibres over the next few years is expected. As of yet, no relevant quantities of hemp fibres are imported. Only Romania could become an additional supplier in this market, starting 2000 or 2001. Plans exist to increase hemp cultivation in that country to 7,000 ha. In addition to long fibre production, production of about 7,000 tonnes of tow (short fibre) for technical applications is projected (HOLLER 1999).

The newcomer is kenaf fibre from the U.S. and especially from Asia (Bangladesh). So far, only few nonwovens manufacturers use kenaf fibres – in collaboration with U.S. companies – however, the market share has increased considerably in the past years.

Sisal and jute fibres have been used for years in the German automotive industry but their share among natural fibres is decreasing. This is due to the declining use of recycled fibres and the – at least marginally – higher price of new sisal and jute fibres compared to flax and hemp fibres (see Chapter 4). Supplies of recycled jute and sisal fibres are becoming less and less reliable (coffee bags are increasingly replaced by containers, flooding in the cultivation regions imperil harvests) and fibres are often soiled (pesticide residues, oil, coffee and cocoa residues), which leads to fogging problems (KINKEL 1999).

Further information on world markets for natural fibres, supply security and competition can be found in Chapter 4.

Prices and quality management

Prices for natural fibres have become predictable and range from DM 0.90 to 1.20/kg for fibres used in composites; a price overview can be found in Chapter 4.

Even more important to the future development of an EU natural fibre economy may be the implementation of a quality management system from cultivation through harvesting, fibre processing, nonwovens production to end product. To the same degree as the use of natural fibres is becoming accepted, the demand for higher and consistent fibre qualities is growing – independent of climate factors during cultivation, harvesting, and retting. This may provide opportunities for the EU fibre production.

Should the young fibre industry be able to consistently meet the manufacturers' price and quality requirements, flax and hemp will eventually awaken from their slumber and become an important natural and renewable raw material resource for the industry, next to oil and starch plants.

2) Thermal insulation materials from flax and hemp fibres

Ecological insulation materials represent a growth market, which in many countries expands faster than the insulation market as a whole. Since an evaluation of insulation markets and their trends in other EU countries was beyond the scope of this study, this market analysis is largely limited to the German market.

In 1998, according to the German Association for Insulation Materials (Gesamtverband Dämmstoffindustrie, GDI) and the German Association for Insulation Materials from Renewable Resources (Arbeitsgemeinschaft für Dämmstoffe aus nachwachsenden Rohstoffen, ADNR), the German insulation market had a total volume of 32,000,000 m^3 (more recent figures will be published in May 2000). The largest market share (60%) is held by mineral fibre insulation materials. The share of alternative insulation materials was about 2.9% and was composed as follows:

Table 11: Alternative insulation materials – market share in Germany 1998 and at an estimated 10% market share

	Current market share		Production capacity in Germany	At 10% market share	
	in %	in m^3/y	in m^3/y	in %	in m^3/y
Total	**2.93**	**940,000**	**1,770,000**	**10**	**3,500,000**
Cellulose	1.56	500,000	650,000	4	1,400,000
Wood fibre board	0.78	250,000	350,000	2	700,000
Flax and hemp	0.19	60,000	400,000	2	700,000
Sheep's wool	0.14	45,000	250,000	0.5	175,000
Cotton	0.09	30,000	60,000	0.3	120,000
Cork	0.09	30,000	-	0.1	35,000
Wood shavings	0.03	10,000	50,000	1	350,000
Other	0.05	15,000	10,000	0.06	20,000

Source: BRANDHORST 1998 nova 1999

The most relevant alternative insulation materials on the German market in 1998 were cellulose loose-fill and boards (53%), wood soft boards (27%), followed by flax and hemp fibre mats (6%). Noteworthy are the large excess production capacities: 400.000 m^3 could have been produced in Germany, actual production and sales amounted to only 60.000 m^3.

For the medium term (time frame 5 to 10 years), BRANDHORST 1998 considers an increase of the total market share of alternative insulation materials from currently 2.9% (940,000 m^3) to 10% (3,500,000 m^3) to be realistic. To realise this more than three-fold increase in market share, prices for "eco"-insulation materials will definitively have to decrease.

Based on this 10% market share, BRANDHORST forecasts a volume of 700.000 m^3 flax and hemp fibre-based insulation materials (20% of the total alternative insulation market). If the recently initiated flax projects survive, these 700.000 m^3 will mostly – because of their better insulating properties due to the higher fineness of flax fibres – come from flax. This has been confirmed by the nova survey (see Tables 7 and 8). The 700.000 m^3 correspond to about 28,000 tonnes of fibres at an assumed bulk density of 40 kg/m^3 (Note: depending on fibre type, insulation category and production technology, bulk densities of natural fibre based insulation materials may vary between 25 and 70 kg/m^3).

In a comprehensive study of insulation materials from renewable resources, MURPHY et al. 1999 arrive at similar conclusions regarding the total market potential. With respect to the market shares, MURPHY et al. presumed that for price reasons recycled and secondary raw materials stand a better chance when compared to primary raw materials, such as flax or hemp. The study's summary states the following (MURPHY et al. 1999):

> *Over the last five years, the market has grown consistently and is assumed to have a maximum potential of 10% of the total insulation market. All expert groups consulted consider that the greatest barrier to market expansion, and thus expansion of the market for the relevant raw materials, is the high price of biogenic insulation products compared to conventional materials (2–4 times as expensive). Even though the price of the raw materials represents only a small proportion (10–25%) of total production costs, pressure exists to minimise those costs. The industry indicates clearly that the market for renewable agricultural raw materials in insulation materials is strongly linked to, and influenced by, the market for lower-value materials (recycling materials, agricultural by-products and lower grade wood). Recycling materials and agricultural by-products are not only low-cost materials, they also have a favourable ecological profile. The future for primary agricultural materials (e.g., bast fibres from flax and hemp) in this market is considered limited. This is not only due to economic factors (raw material costs), but also because of limited raw material availability. It is unlikely that agriculture will be in a position to supply the quantities of bast fibres (e.g., flax) as a primary*

product at acceptable prices required to make a significant impact on the insulation materials market. In contrast, large quantities of low-grade wood, agricultural by-products (e.g., flax tow and cereal straw) and recycling materials (e.g., cellulose and jute) are already available. With a few exceptions, the market is indifferent to the type of raw material and its origin.

These are weighty arguments against a higher market share of flax and hemp insulation materials. Their validity is supported by the fact that some manufacturers of natural fibre insulation materials have already withdrawn from or are contemplating to opt out of the market because market development was slower than expected.

Arguments in favour of an increased use of flax or hemp are the efforts by the newly emerging processing lines and facilities to considerably lower their production costs. This is to be achieved by: higher capacity utilisation, integrated production facilities (from fibre processing to insulation mat manufacturing) and by new, less costly processing technologies, combined with a novel manufacturing technology, which abandons the traditional use of shive/hurd-free tow for manufacturing of insulation mats.

Prices of (below) DM 100–160 per m^3 of insulation material are targeted, which would greatly increase market potential. The new facilities, which will be put into operation in 2000 and 2001, however, will first have to demonstrate that they are able to meet this goal. Table 12 shows the current retail prices of various insulation materials.

Table 12: Retail prices for various thermal insulation materials (net) (Source: SCHMITZ-GÜNTHER 1998, NOVA 2000)

	Price in DM per m^2 at 20 cm thickness	**Price in DM per m^3**
Mineral fibre insulation mats	15–25	75–125
Recycled cellulose	20–50	100–250
Hemp fibre mats*	46	230
Flax fibre mats*	53–63	265–315
Forecast flax and hemp fibre mats	(below) 20–32	(below) 100–160

nova 1999

* If figures for flax and hemp insulation materials are normalised to the same thermal conductivity, the price advantage of flax compared to hemp fibre mats becomes negligible.

Forecast for 2005 by fibre processors

At the beginning of this chapter, Table 7 summarised the forecasts by the German fibre processors for the use of their fibres in the insulation sector. In 2005, the German flax industry (including imports) intends to sell almost 15,000 tonnes of fibres to the insulation material market, the hemp industry projects sales of an additional 9,000 t. This corresponds to a total 24,000 tonnes of flax and hemp fibres.

As discussed before (see Table 11), based on optimistic assumptions, a (maximum) share of about 700,000 m^3, which corresponds to about 28,000 tonnes of fibres, is forecast for the next 5 to 10 years. The projections of the German fibre processors will thus not be easily achieved. This will require great efforts with respect to marketing and reduction in production costs to sell the targeted quantities of fibres into the insulation sector. Whether this will be possible by 2005 is questionable – a time frame by 2010 seems more realistic.

Europe

Beyond Germany, sales of flax and hemp fibres to the insulation market by 2005 are also assumed (based on responses to the survey) to increase considerably from currently 1,400 tonnes to almost 25,000 tonnes.

Just how realistic this forecast is, most of which is attributed to an increasing demand and production in Scandinavian countries, is difficult to assess. There are indeed new impulses in the insulation market. The potential health risks associated with the use of glass and mineral fibres are increasingly discussed in the Scandinavian public.

3) Pulp sector

The potential market s for pulp and paper from flax and hemp fibres is divided into two sub-markets:

- **Specialty pulps and papers**

  Pulps produced from annual plants such as cotton, abaca, flax or hemp possesses properties that differentiate them markedly from those of wood pulps. They are used for specialty papers such as cigarette paper, filter paper, bank notes, hygiene products, and various technical papers.

  Flax and hemp pulp are traded for DM 3,500–4,000/tonne (wood pulp: DM 1,000–1,100/tonne). Flax and hemp fibres for pulping are traded for DM 0.55–0.65/kg. These fibre qualities can be produced with simple processing equipment such as hammermills.

- **Commodity pulps and paper**

  Flax and hemp fibres can also be used for the production of commodity pulps and papers and are mostly used in mixtures with recycled paper and/or wood pulp. This market represents primarily an “emergency market” for inferior or overstock fibres. Sold is, e.g., uncleaned flax tow with a shive content of 25–50%, which is purchased for DM 0.20/kg.

During peak periods in the fashion cycle for flax, it is profitable to further process these fibre qualities and sell them to the apparel textile sector; prices of these fibre qualities then increase and become too costly for the commodity pulp sector. The amount of flax fibres used in commodity pulps thus depends mostly on the current demand by the textile industry (KASSE 2000).

Only the specialty pulp sector is interesting as a value-added product line for flax and hemp fibres. However, this market represents an almost inaccessible “mystery market” with only few actors.

The current production of flax and hemp pulp in the EU is about 25,000 to 30,000 tonnes/year (current production capacity 30,000–35,000 tonnes/year) and is mostly located in France (integrated pulp/paper facilities), Spain and the U.K. (NOVA 2000a, GILBERTSON 2000). To produce these quantities, about 37,000–45,000 tonnes of fibres are necessary (about 1/3 of the dry mass of bast fibres is lost during pulping).

According to Chapter 1, Tables 4 and 5 about 55,000 tonnes of flax and hemp fibres were used in the pulp sector. About 67–82% of the fibres were used in the specialty pulp sector and only 18–33% in the production of commodity pulps.

The share of pulping fibres, which are used for specialty pulps, is different for flax and hemp. For hemp the share is about 99%. The pulp fibres are almost exclusively produced on total fibre lines, which are especially geared towards these qualities. With flax, the fibres are mostly by-products of the long fibre production (which in the EU is non-existent for hemp); considerable quantities of lower grade flax tow are used in commodity pulps.

Development of specialty pulp markets

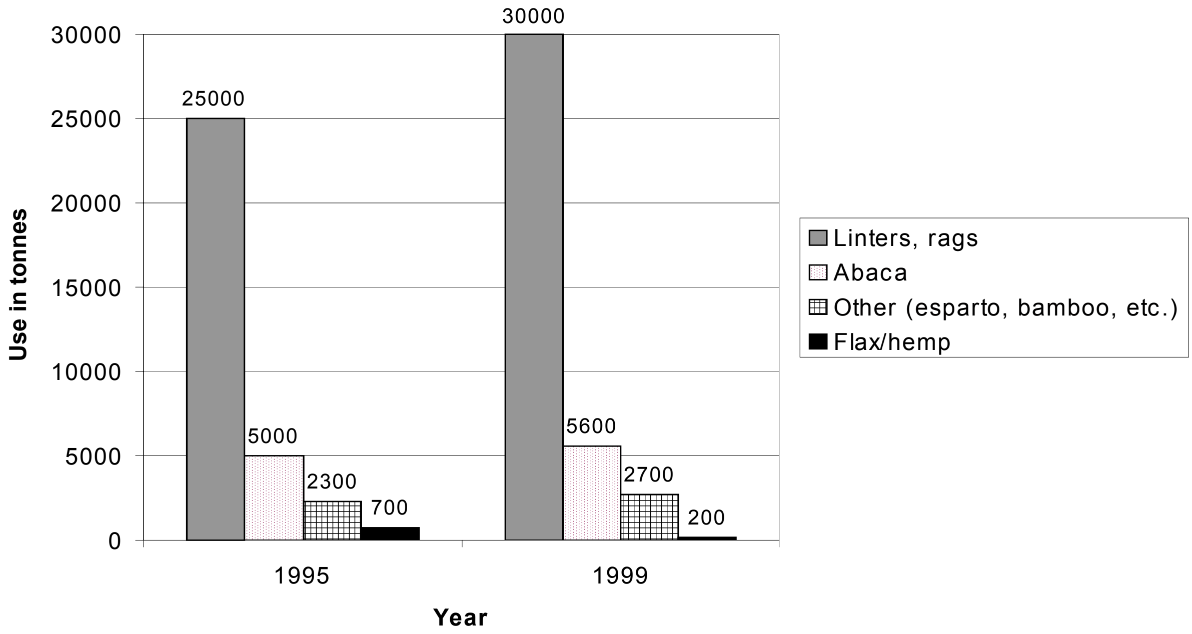
95% of the 25,000–30,000 tonnes of flax and hemp pulp processed annually in the EU are used for manufacturing cigarette paper. Flax and hemp pulp markets do not represent growth markets, but are stagnant or decreasing. The paper industry increasingly seeks to substitute expensive specialty pulps by less expensive wood pulps with suitable additives (NOVA 2000a, LESON 2000).

New capacities for the production of specialty pulp fibres and specialty pulp will likely lead to a displacement competition in the EU market, a development, which has already been observed.

On the other hand, the new processing facilities may to a certain extent also develop new markets, e.g. through special regional marketing activities or through novel properties of these pulps, such as more favourable environmental characteristics (production of chlorine and sulphur-free hemp pulps in Germany).

The specialty pulp market was investigated in more detail in several studies by the nova institute.

Figure 1: Figure 1: Use of pulp from fiber plants in German specialty paper industry 1995-1999 (Sources: nova 2000a, VDP 1995, VDP 1999, FIDA 1996, FIDA 2000)



*Estimate nova Institute 2000

Figure 1 shows that at present in Germany specialty papers are mostly produced from cotton linters and rags. Since pulp from cotton linters is also used for bank note production, the increase from 25,000 tonnes in 1995 to about 30,000 tonnes in 1999 is likely due to the pending introduction of the EURO in January 2001, which is in part produced in Southern Germany.

The use of abaca pulps in Germany, mostly imported from the Philippines, has slightly increased from 5,000 tonnes in 1995 to 5,500 tonnes in 1999. Abaca pulps are mostly used in the production of tea filters and vacuum cleaner bags.

The increasing share of bamboo pulp in the production of coffee filters will, over the next few years result in an increase of the category "others".

At present, there is no relevant demand for flax and hemp pulp in Germany. The decrease from 700 tonnes in 1995 to 200 tonnes in 1999 is due to the increasing use of high-quality sulphate or kraft pulp in the cigarette paper sector, which rendered the use of flax and hemp pulps technically unnecessary.

Prices

Table 13 shows the prices of various specialty pulps. This summary is of limited meaningfulness since technical properties of the various plant pulps differ. Pulps of highest quality fetch the highest prices. For technical reasons, the less expensive pulp can only partially replace more expensive pulps.

On the other hand, the technical potential offered for example by hemp pulp, is not needed for some applications, such as the cigarette paper sector, which only continues to exist for historical and image reasons.

Table 13: Current prices for plant fibre pulps

Pulp	Market prices in US$/tonne
Abaca	3,000
Flax and hemp (bleached)	1,900
Kenaf	900–1,200
Cotton	1,100–1,300
Esparto	1,300
Bamboo	700

Source: NOVA 2000a

Forecast for 2005 by fibre processors

The forecast of the fibre processors includes a comparatively small increase in sales into the pulp market. These sales are projected to grow from 24,882 tonnes in 1999 to 27,650 tonnes in 2005. For the flax pulp market, the data are incomplete. The surveyed companies plan to increase their sales from 2,266 tonnes (1999) to 3,200 tonnes (2005) (see Tables 7 and 8).

Since the overall market, as described above, is stagnant or even slightly decreasing, the targeted increase of about 10% will only be achieved if new markets are developed or if other fibre plants are substituted. This would require regional marketing activities as well as, for example novel environmental characteristics of the pulp.

Chapter 3

Private Investments and Public Funding for Research and Implementation in Germany and the EU

Since the 1980s, extensive research and development has been carried out in Germany and Europe on new varieties, cultivation and harvesting techniques, processing technologies, product lines and markets for flax. Outside of the traditional flax countries – France, Belgium, and The Netherlands – efforts were mostly geared towards new total fibre processing lines to produce short fibres for technical applications or towards mechanical or physical-chemical cottonisation technologies. In Germany, funding only became available in the second half of the 1990s, after hemp cultivation had been re-legalised.

In this chapter, it is attempted to give an estimate of private investments and public funding that went into research and the development of projects and companies in Germany, whose success is now possibly threatened by the recent proposals in Brussels.

In the 1980s, a multitude of projects were sponsored with funding from the German states. Since no federal statistics exist, it is currently difficult, if not impossible, to quantify total expenditures and was outside the scope of this study. It can be assumed that in the 1980s and 90s, several 10 million DM were spent on such projects.

Accurate data are available for the federally funded projects in the flax and hemp sector. From 1989 to 1993 such projects were conduced under the auspices of the German Federal Department of Research and Technology (BMFT) and German Federal Department of Agriculture (BML). Since 1993, projects were continued and re-initiated by the newly founded Fachagentur Nachwachsende Rohstoffe (FNR, Agency for Renewable Resources) (SCHÜTTE 2000):

> *The basis for this information is the FNR's project database, from which the total costs and funding for projects involving the product line "fibres" were excerpted. This database also includes projects carried out with funding through BMFT and BML prior to founding FNR, which were then transferred to FNR in 1993 for subsequent supervision.*
>
> *Between 1989 and 2000, total costs of more than DM 52 million were incurred for the development of the product line plant fibres. The German Federal Government funded this development with more than DM 33 million in federal funds.*

An overview of these projects is available through FNR.

The current nova survey questioned flax and hemp companies about their investments in harvesting technologies, fibre processing technologies and manufacturing (for integrated facilities only). Only investments made in 1995–2000 were included. The total amounted to DM 125 million, DM 55 million of which were from public funds.

Based on announcements by the German states and members of the industry, it was concluded that the fourteen registered fibre processors for flax and hemp straw have already invested DM 43.25 million in their processing facilities. Four other companies are currently in the process of constructing fibre capacities with investments of DM 23.6 million to date. Altogether, these companies plan to invest another DM 150 million (BML 2000).

In addition to the already mentioned financial resources, there are likely others, which were associated with different programs or are difficult to locate or categorise. At present, the InnoRegio-Program, for example involves at least two hemp projects ("NinA" in Saxonia-Anhalt and „Rio" in Brandenburg), which would receive more than DM 20 million each upon approval of the 3rd Inno-Regio phase.

Table 14: Private investments and public funding for the flax and hemp sector

	Time Frame	Total	Private	Public
Germany		**million DM**	**million DM**	**million DM**
Funding by the German states	1980s / 90s	several 10	?	?
Fachagentur Nachwachsende Rohstoffe FNR (BMFT/BML, SCHÜTTE 2000)	1989–2000	52	19	33
Investments in harvesting and processing technologies and down-stream processing (for integrated facilities only) (NOVA 2000)	1995–2000	125	70	55
Investments of fibre processors in flax and hemp processing facilities (BML 2000)	until 2000	67		
Planned investments of all fibre processors (BML 2000)	after 2000	150		
Europe				
EU-Funding (DG VI, XII and XIV) for flax and hemp projects (see Appendix)	1982–2002			101
Investments in harvesting and processing technologies; limited to companies included in the nova survey (NOVA 2000)	1995–2000	50		15

nova 2000

Funding by the EU

In addition to national funding, for a number of projects funding by the EU was also available. Within the framework of this study, all flax and hemp projects funded by the DG VI, DG XII or DG IV were identified using the Cordis and NF2000 databases and total project allotments were summarised. Since budgets for only a few of these projects were provided, funding for the remaining projects had to be estimated. For the timeframe from 1982 to 2002, total funding of €52 million was thus estimated. An overview of these projects can be found in the Appendix.

The projects are mostly geared towards the development of new technical applications for flax and hemp fibres and the associated framework (e.g. suitable varieties).

The €52 million represent a lower-bound estimate since only flax and hemp projects of the DG VI, XII and XIV were included. Other sectors of the EU also grant funding, e.g., the European Social Funds (ADAPT). These could not be included within the scope of this study.

In a number of member countries, there are additional national research programs and projects, e.g., in Austria (Alchemia NAWARO), in the U.K. (MAFF project: U.K.-grown Non-wood Fibres) and Denmark (Plant Fibre Composites – From Plant to Product).

Investments in the EU (excluding Germany)

The nova survey also requested information on their investments from the European flax and hemp companies. Since not all of these companies responded and because information on investments was often incomplete the following figure represents a lower bound estimate of the actual expenditures: €25 million, of which €7.5 million are public funds spent within the past few years.

Chapter 4

Competition Through Fibre Imports from Eastern Europe and Asia

Flax- and Hemp short fibres for technical applications from EU cultivation and production face competition on the market from the following fibres:

- **Flax and hemp fibres from Eastern Europe and other EU countries**

  EU companies import about 13,000 tonnes of flax short fibres annually (see Table 3), especially from Egypt and Lithuania. The prices (and qualities) are usually somewhat lower than those for EU flax fibres. These import fibres are mostly obtained through the same trading companies in Belgium and France that also trade EU flax fibres.

  Hemp fibres are currently only imported in marginal quantities. In the course of the disintegration of the USSR, most hemp companies in Eastern Europe collapsed. At present, investments are directed towards the Romanian hemp industry, which could result in a supply of up to 7,000 tonnes of hemp short fibres for technical applications within the next few years (HOLLER 1999).

- **Jute, sisal and kenaf fibres from Asia**

  In the technical sector, jute, sisal and kenaf fibres are used in composites in the same ways as flax and hemp fibres. Initially, these fibres were used as recycled fibres (from sacks, etc.), which frequently led to quality and fogging problems. At present, more and more primary ("virgin") fibres are used. Their price is equal to or even higher than flax and hemp fibres.

  Especially jute fibres are produced in much larger quantities than flax and hemp fibres (see Table 15). Most important countries of origin are Bangladesh and India.

- **Synthetic fibres**

  Natural fibres are also in competition with various synthetic fibres (plastics, glass and mineral or carbon fibres). Generally, prices of synthetic fibres are higher than those of natural fibres. The prices are also directly dependent on the – rising – crude oil prices.

  On the other hand, from a production technology standpoint, standardised synthetic fibres have big advantages in many applications, which can more than compensate the shortcoming of their prices.

  Natural fibres have good prospects against synthetic fibres if

  - Natural fibres can be further standardised (quality management);
  - New production technologies, specifically adapted to natural fibres can be realised;
  - Comparable (or better) product properties can be achieved;
  - Environmental aspects are considered;
  - Manufacturing costs of a part are comparable (or lower).

  In some applications, e.g., press-moulded parts in the automotive industry, this has already been achieved.

- Finally, EU flax and hemp short fibres are in **competition with each other**, which is also true for flax fibres from total fibre lines and flax tow from long fibre processing. Organization, production costs and market prices for fibres from total fibre lines and tow from long fibre processing are different. The technical fibres from total fibre processing have to yield the entire fibre profit; their market prices are closely associated with their production costs and vary only little.

  Tow from long fibre production is only a low value by-product, whose price is mostly determined by the market. Prices vary accordingly.

Competition among natural fibres is mostly determined by:

- Their technical properties (and, thus, their potential applications);
- Their market volume and market structure (and, thus, their supply security);
- Their market prices (and calculability).

The major goal of this study is to answer questions regarding markets and prices. Therefore, a discussion about technical fibre properties, different qualities and corresponding potential applications is for the most part omitted. The price overviews only classify fibre qualities roughly according to applications (see Table 16)

Table 15 provides an overview on the production of natural fibres worldwide. The worldwide predominantly produced natural fibre is cotton with about 20 million tonnes/year, followed by jute with 2.6 million tonnes/year.

Table 15: World-wide production of natural fibres (bast and hard fibres) for textile and technical applications 1999

Fibre	**Most important countries of origin**	**Production 1999 (provisional data)** in tonnes
Flax	EU (see Table 2) and Eastern Europe	636,000
Hemp	EU (see Table 2), China and Eastern Europe	79,000
Jute and similar fibres, e.g., kenaf	India, China, Thailand, Bangladesh	3,125,000
- Thereof jute	India, Bangladesh	2,562,000
Sisal	South Africa and South America	315,000
Cocos	India, Sri Lanka	266,000
Abaca	Philippines and Ecuador	91,000

Sources: FAO (http://apps.fao.org) and EU statistics, partially corrected nova 2000

Table 16 provides a comprehensive overview on prices of various natural fibres on the German market 1999/2000.

The nova survey and expert interviews conducted within the scope of this study resulted in an array of natural fibre prices. Prices obtained from the surveyed companies were in excellent agreement. Between 1998 and 2000, market prices for the named natural fibres were stable with exception of the recent price increases for flax fibres. Prices for natural fibres of defined qualities (or applications) have become calculable for the industry and show acceptable stability. Only prices for flax fibres can vary considerably in relatively short time periods due to the highly varying demand for flax long fibres (due to fashion waves).

The dependency of market prices for EU flax and hemp fibres on the EU subsidies are analysed and discussed in Chapter 6. The price overview shows that flax and hemp fibres are currently internationally competitive. At the same time, however, it is apparent just how small the flexibility for price increases is. Fibre imports from Eastern Europe and Asia determine the prices for EU-produced fibres. Buyers generally are not interested in the origin of the fibres but only in their quality, price and supply security. A sudden and sizeable reduction of the EU subsidies will acutely jeopardise the competitiveness of EU produced short fibres (see Chapters 6 and 7).

Table 16: Market prices of flax and hemp short fibres and competitive fibres. Germany 1999 and 2000

Natural fibre and application	Price in DM/kg
Flax fibres from EU, inferior quality, uncleaned for commodity pulp (shives content up to 50%)	starting at 0.20
Flax fibres from EU, for specialty pulp (shives content 10–25%)	0.50–0.60
Flax long fibre tow from Eastern Europe	starting at 0.70
Flax fibres from EU for floor sound insulation	0.80–0.90
Flax fibres from EU for composites	0.90–1.05 (02/2000: up to 1.30)
Flax fibres from EU for thermal insulation materials	0.90–1.10 (02/2000: up to 1.30)
Flax long fibres from EU for apparel	2.50–4.50 (some higher)
Hemp fibres from EU for specialty pulp (hurds content 10–25%)	0.55–0.70
Hemp fibres from EU for floor sound insulation	0.85–0.90
Hemp tow from Eastern Europe (good quality, 1998)	about 1.00
Hemp fibres from EU for composites	0.90–1.20
Hemp fibres from EU for insulation materials	0.90–1.20
Hemp long fibres from Eastern Europe (1998)	2.00–6.00 (some higher)
Chemically and enzymatically retted hemp fibres for apparel industry (3 qualities, China 1998)	3.00–7.00
Jute fibres new (Bangladesh) for composites	1.10–1.20
Jute fibres new (Bangladesh) for specialty pulp	0.80–0.90
Sisal new (Africa and South America) for composites	1.10–1.45
Sisal new (Africa and South America) for specialty pulp	1.10–1.20
Kenaf new (Bangladesh) for composites	1.05–1.20
Kenaf new (Bangladesh) for specialty pulp	0.90–1.00
Abaca (Philippines) for specialty pulp	1.60–1.80
Cocos fibres for geotextiles	0.40–0.60
Cocos fibres premier quality	0.70–0.80

nova 2000

Sources: BOHNDICK 1999, DAENEKINDT 1999, FRANK 1999, GÜTHE 1999, HENDRIKS 1998, HOLLER 1998, LANIUS-HOMANN 1998, KASSE 2000, KINKEL 1999, KÖRNER 1999, NOVA 1999, NOVA 2000, VLASBERICHTEN 2000

Current development of flax long fibre prices

Prices for flax long fibres are determined by demand for flax apparel textiles. While during fashion times, prices for flax long fibres increase to more than DM 4.00/kg, they are much lower at other times. In the past months, prices for flax long fibres have gone up considerably. Already in the beginning of November 1999, prices for medium qualities increased above the threshold of DM 3.00/kg. Prices for premium quality long fibres increased to more than DM 4.00/kg by the end of December 1999 (HEGER 1999a and 1999b).

The following quotation illustrates the dynamics behind these price developments (HEGER 1999b):

> *"Prices for premium quality long fibres have crossed the psychological threshold of BEF80/kg (i.e., a little more than €2/kg). The current production, as well as sales from the (continually diminishing) inventories, rapidly finds markets. The positive outlook for summer 2001 also gives support to stabilise prices – backed up by the added effect of uncertain cultivation due to the uncertain subsidy situation. For the raw materials producers, prices have reached a sustainable level, somewhat above the long-term average. This is undeniably necessary to encourage further cultivation activities (December 28, 1999)."*

According to the VLASBERICHTEN 2000, the price range in January and February 2000 for water-retted and dew-retted flax long fibres of various qualities was DM 2.90–4.10/kg. In March, prices increased further to DM 3.20–4.40/kg.

As a result of the price increase for long fibres, prices for flax short fibres concurrently increased to about DM 1.10–1.30/kg as opposed to the typical DM 0.90–1.10/kg (NOVA 2000). These increasing prices brought about a growing demand for hemp fibres in the automotive industry (BOHNDICK 2000, HOPSON 2000).

For example: jute fibres

Jute fibres as well as sisal fibres have for years been used in the German automotive industry, however, at present, their shares have declining tendencies. This is due to a decreasing use of recycling fibres and the fact that new sisal and jute fibres ("virgin fibres") are more expensive than flax or hemp fibres (see Table 16). More and more, virgin jute fibres are used only where technically or qualitatively necessary.

Jute and sisal recycling fibres supply security is less and less guaranteed (coffee sacks are increasingly replaced by containers, flooding in cultivation areas jeopardise harvests) and fibres are often soiled (pesticide residues, oily residues from coffee/cocoa), which leads to fogging problems (KINKEL 1999).

In the most important jute producing countries – India (1.4 million tonnes of jute fibres) and Bangladesh (0.6 million tonnes) – tendencies of cultivation and production are opposite. In India, less and less cultivation areas are available because they are needed for food production. Jute production will therefore decrease in quantity and lose importance. In Bangladesh, on the other hand, efforts are directed towards improving the quality of virgin fibres through quality management and towards developing new markets. As a matter of fact, in 1999 premium quality jute fibres were offered on the German market, which, however, were fairly expensive (KÖRNER 1999).

In Bangladesh, specifically in West Bengal, jute production is an important branch of industry. There, 2 million jute farmers and their typically about 10 family members, i.e., about 20 million people, subsist on jute cultivation and fibre production. The fibres are produced in "medieval" manual labour by the farmers, who have to make do with very small incomes (KÖRNER 2000).

A large share of the produced jute fibres is used in the producing countries and their neighbouring countries, especially for manufacture of sacks and similar products. Even India, still the leading producer of jute, imports about 150,000 tonnes of jute fibres, e.g., from Bangladesh. But these markets are increasingly coming under pressure, since in Asia as in other parts of the world, sacks and other packaging materials are more and more produced from polypropylene (PP). Large production capacities, e.g., in China, offer inexpensive PP on the market and displace the traditional plant fibres.

Thus, jute fibres are in search of new markets, e.g., in the European automotive industry. To realise more attractive prices, fibre conditioning, which so far has been done in the EU, is planned to be moved to Bangladesh (KÖRNER 2000).

Environment

From an environmental standpoint, which evidently should also be a factor for their use, e.g. in automobiles, the following aspects have to be considered for a comparison of flax and hemp fibres from the EU and import fibres from Asia:

- Jute fibres are almost exclusively produced with manual labour, whereas the EU flax and hemp industry is largely automated. An energy balance for the processing step will thus be negative for European fibres.
- Jute and other tropical fibres are almost exclusively produced with traditional water retting. This causes considerable organic loads for lakes, rivers or marine coves. Impacts on the environment can be considerable. In the EU, on the other hand, flax and hemp fibres are produced with environmentally benign field retting. Traditional water retting, still used in Eastern Europe, has been abandoned for economic and environmental reasons. This is a point in favour for EU-produced fibres.
- Transportation from Bangladesh to Europe is not relevant, as has been shown in life cycle assessments for cotton since transportation by sea is energetically favourable.
- A life cycle assessment regarding the "environmental comparison of various natural fibres for technical applications in the EU" has yet to be performed, but would undoubtedly offer important additional information in the political decision process regarding sustainable environmental supply of natural fibres for EU industries.

Overall, from a quality and supply security standpoint, the future development of the fibre markets Asia, Eastern Europe and EU depends on a multitude of parameters, which are difficult to forecast. However, since all three markets are dependent on different economic and political parameters, the risk for industry to increasingly use natural fibres is comparatively low. By and large, a sufficient supply with improved standardised fibre qualities will certainly be available for the next years.

Chapter 5

Legal Situation and Significance of Hemp Seeds Use in Animal Feed and the Food Sectors in Germany and Other EU Countries

Animal feed sector

In the feed sector, we have no knowledge of any legal problems in the EU for the use of hemp seeds. Quite the opposite, supplementation of bird food and fish feed with hemp seeds or use as bait for fishing is a time-honoured tradition. The seed cake, which is a remainder from hemp oil pressing, has been, and still is, used for livestock feed. The demand of the feed sector is currently mostly met by imports from China. In the EU, France is the leading producer of hemp seeds for feed.

From an economic standpoint, the animal feed sector is of little interest, since qualities required are poorer than for the food sector and prices achieved are only DM 0.40–0.60/kg.

The nova survey showed that currently about 6,200 tonnes of hemp seeds are produced in the EU, of which almost 90% end up in the animal feed sector. These seeds are mostly harvested in France. The problem of the small value-added results in French enterprises improving seed quality and increasingly exploring markets in the food and cosmetics sector (see Table 8).

Currently, these companies rely on export, since in France, hemp seeds are not legally permitted for use in the food sector (see below). However, efforts exist to change this situation.

Food sector

Differently the food sector, which for most hemp seeds producers presents the most interesting and at the same time the most difficult market.

At present, no uniform legal regulation exists for the use of hemp raw materials in the food sector. In the EU member countries, various very different regulations are enforced; partly the sector hemp foods sector remains unregulated or is governed by regional arbitrariness.

Although there is scientific consensus that hemp seeds and hemp oil are nutritionally very valuable foods (KARUS et al. 1999a), there are two central problems for the marketing of hemp foods.

- **THC dilemma**

  Even though hemp seeds themselves do not contain THC (delta-9-tetrahydrocannabinol, the main psychoactive ingredient in hemp), THC contamination can result from adhering residues from THC-containing flower bracts, which depending on the harvesting and cleaning process can vary and is generally not problematic. For consumer protection reasons, THC limits are undoubtedly necessary, but are – with the exception of Switzerland – not yet established.

- **Image problem**

  Various national and international anti-drug institutions, such as the Drug Control Board of the United Nations (UN) fear that hemp foods will damage the negative cannabis image, which had been carefully put together for decades. They fear setbacks in the fight against the drug by again making cannabis acceptable through the introduction of healthful and publicly advertised hemp foods.

  In the EU reform proposal (EU 1999a) the following is stated:

Moreover, the International Narcotics Board (INCB, a United Nations body) states that: "while illicit cannabis cultivations (sic) have soared, a considerable market for food products and beverages produced with cannabis has developed in the European Union (...). The health effects of these products have not been adequately researched. (...) the wide and unrestricted availability of such products in shops, where cannabis candy bars can be sold to minors without restriction, contribute to the overall benign image of cannabis, a drug under international control."

It should be debated elsewhere, whether a prohibition of hemp foods really represents an adequate means to fight cannabis drug use.

Both topics, which are factually unrelated, are often mixed up in practice. Introducing suitable THC limits could easily solve the problem of a potential health risk for hemp foods consumers. Should prohibitive regulations for hemp foods be introduced in some countries, the rationalisation will be more ideological than scientific.

Overview on present legal situation in the EU

In 1997, on request of some member countries, the EU Food Committee discussed whether hemp foods should be categorised as novel foods. In this case, all hemp foods would have had to be removed from the market and be subjected to an extensive registration process. The decision was based on the answer to the question whether hemp foods were already present in relevant quantities on the European market on the effective day May 15, 1997. When companies and associations were able to deliver proof of this fact, the EU Food Committee decided on December 12, 1997 to not categorise hemp foods as novel foods.

On a European level, no THC limits for foods or corresponding recommendations exist. After long and controversial discussions in the EU Food Commission, the problem was transferred back to the authority of the member countries, since an EU-wide agreement was not perceived for the near future (KLEPSCH 1998). In 1998, a member of the EU Food Commission did not perceive any relevant activities for an EU-wide regulation and recommended that member countries implement national regulations as recommended by their food safety institutions. This to date is the status quo.

… and the other member countries

Regulations regarding hemp foods in the EU member countries differ markedly and are to some extent rather vague. In some countries hemp foods are categorically prohibited, e.g., in France, Greece, Sweden and Denmark. However, even there differences exist. In some places in Denmark hemp foods are sold and in France and Greece efforts exists to officially register hemp seeds and hemp oil as food items.

In other EU countries, e.g., The Netherlands, Spain, Austria and Germany, hemp foods may be sold without notable restrictions. Confiscations by uninformed police officers or public prosecutors still occur occasionally, however, the products are generally released after a brief examination.

Most of the other EU countries fall in between these two extremes, e.g., in Italy, where the import of hemp foods is prohibited, but at the same time, stores unhindered sell hemp foods, which somehow were imported anyway.

This legally insecure situation is not acceptable for hemp seed producers, downstream processors or consumers alike. It especially obstructs the development of larger markets. Because of this situation, large food processing companies – aware of the nutritional value, the delicate taste (especially of hulled hemp seeds) and the positive marketing image of hemp seeds – still abstain from introducing mass products with hemp seeds into the markets. As of yet, hemp foods are almost exclusively produced by small to medium, often only regionally-operating companies.

Germany

To reduce the uncertainties on the German market, the German Federal Ministry for Public Health declared to the German Federal Ministry of the Interior in 1999 (BMG 1999):

> *"In summary, or the control of products according to No. 1 through 3 ("1. Foods containing industrial hemp (with the exception of hemp seeds), 2. other products with industrial hemp (with the exception of hemp seeds) and 3. products which contain mostly hemp seeds.") it can generally be assumed that the products are legal products under the exemption regulations of the BtMG."*

At present, the Senate Commission for the Public Health Safety Assessment of Foods (Senatskommission zur Beurteilung der gesundheitlichen Unbedenklichkeit von Lebensmitteln, SKLM) is working on a proposal for THC limits, which will be presented to the German Federal Ministry for Public Health in spring 2000. Unfortunately, no written information could be obtained from the SKLM for this study. However, in personal communication it was verbally declared that the proposal will request decidedly more stringent restrictions than the Swiss limits (DUSEMAND 2000).

Swiss THC limits

As of yet, obligatory THC limits for hemp foods exist only in Switzerland. The following Table 17 shows these limits, which so far have shown resulted in positive experiences. In many EU countries, for a lack of own THC-limits, the Swiss limits are used.

Table 17: THC Limits in Food

Food	Limit mg/kg	Comments
Hemp seed oil	50	-
Hemp seeds	20	Based on dry weight
Baked goods	5	Based on dry weight
Other foods	2	Based on dry weight
Liquor	5 mg/l	Based on pure alcohol
Alcohol free drinks	0.2	Based on prepared mixture
Alcoholic drinks	0.2	Except liquor
Herb and fruit teas	0.2	Based on prepared mixture

Source: BUNDESAMT FÜR GESUNDHEIT 1996 and 1998

Food markets for hemp seeds

In the context of this study, a survey among the principal companies of the hemp foods sector was conducted. Table 18 shows the main results:

Table 18: Use of hemp seeds in food sector in Germany in 1999 and 2005 (projected) (NOVA 2000)

	1999	2005 (Projected)
Total use of hemp seeds	~ 450 tonnes	~ 4,000 tonnes
Whole seeds	~ 30%	~ 20%
Hulled seeds	~ 69%	~ 78%
Hemp oil	~ 1%	~ 2%

nova 2000

Market prices for hemp seeds on a tonnes-scale were specified between DM 1.00–2.50/kg. The lower prices are for standard qualities, the higher prices for organic qualities. Countries of origin were Austria, France, Germany and Eastern Europe. The percentages imported from each country could not be identified in this study. Due to incomplete data sets, Tables 7 and 8 also do not identify their origin.

Optimistic forecasts for the year 2005 are based on increasing demand, especially from larger companies. At the same time, companies hope that in the near future legally binding THC limits will be instituted in Germany and maybe also in other EU countries, thus creating a legally unambiguous situation, which is the prerequisite for a further market development.

Primary food products from hemp seeds and seed meal

Bread and pastries, pasta, chocolate, confectionary, nut and granola bars, cookies, cheese, ice cream, yoghurt.

Economic importance of the use of hemp seeds

At present only few hemp seeds are harvested and in Germany and even less sold in the food sector (see Table 7), which is mostly due to the currently produced quality. Various fibre processing facilities and cultivation associations are currently developing new harvesting techniques and are planning to produce larger quantities of high quality hemp seeds as soon as the economic year 2000/2001 or 2001/2002.

The goal of these efforts is to increase the value-added for hemp cultivation. Per hectare, about 600 to 900 kg of hemp seeds can be harvested (maximum yields on prime locations and fair climatic conditions can be up to 1 or 2 tonnes/ha).

If the cleaned hemp seed are sold, e.g., for DM 1.50/kg, a value-added of DM 900–1,300/ha results. These returns are countered by higher expenditures for harvesting, lower proceeds for fibres and additional costs for cleaning, storage and packaging of the seeds. At maximum, only about half of the returns of DM 900–1,300/ha will result as profit per hectare.

This also shows that a use of hemp seeds is only profitable if they can be sold to the food sector. As animal feed, hemp seeds only achieve prices of DM 0.40–0.60/kg. Higher prices are not attainable due to the presence of hemp seeds from China on the market. At the mentioned prices, the higher returns are practically offset by the additional expenditures.

In France, the situation is better due to climatic conditions and long-time experiences, which yield harvests of 1.0–1.4 tonnes/ha. The resulting higher price flexibility per hectare allows for profitable sales of hemp seeds to the animal feed sector. However, sales to the food sector are increasingly considered necessary for attaining sufficient value-added.

The importance of hemp seeds use for the future economy of the hemp industry in Germany has been repeatedly and explicitly stated in the nova survey. Three quotations by companies follow (without revealing the identity of the companies, since they were guaranteed confidentiality of their statements and data):

Company 1: "In the future, the use of hemp seeds will be of great importance for farmers. The sale of hemp seeds will increase returns, thus enabling the farmers to maintain stable straw prices."

Company 2: "In the beginning, the use of hemp seeds always creates difficulties. However, seed use is of great importance for the total hemp economy and great store should be set on their harvesting."

Company 3: "According to our calculations, hemp seeds account for about 55% of the profits before taxes (at current prices for oil and hulled hemp seeds)."

However, there were also other companies, for which the use of hemp seeds did not play any economic role and who thus did not consider them in their answers.

The nova survey among the raw material producers (see Tables 7 and 8) shows that only small quantities of hemp seeds are currently used in the food sector and that only small increases are expected by 2005. At present, the animal feed sector (about 90%) and cosmetic sector (about 10%) dominate the market in Europe.

Expert interviews showed that the food sector due to its potentially higher value-added is the most attractive market, which then again – so is feared – cannot be developed due to legal problems. The animal feed sector, which is in considerable economic competition to Chinese imports, is perceived as "emergency" market. Especially for new hemp companies, which initially need to invest in harvesting and cleaning technologies, this market is economically irrelevant.

Conclusions

The use of hemp seeds for the cultivation of fibre hemp may – adequate framework conditions provided – play an important role in the total economy of hemp cultivation. Hemp seeds could generate an additional profit per hectare, which, at decreasing EU subsidies, could stabilise straw and fibre prices.

However, this only holds true if hemp seeds can be placed in the food sector, since only this market offers interesting-enough possibilities regarding quantities and profits. The development of this market is essentially dependent on the following framework conditions:

- The EU does not make payment of subsidies conditional on not using hemp seeds for foods, but leaves the type of utilisation open.
- In the near future, legally binding THC limits for hemp foods are established, which ensure legal security and thus provide the basis for the targeted market development in the food sector.

Chapter 6

Economic Analysis of the Production Costs for Flax and Hemp in Agriculture and Fibre Processing (Total Fibre Line)

The economic analysis of the production costs in agriculture and fibre processing has been performed for a base scenario for total fibre processing – for both flax (Table 20) and hemp (Table 19) – as well as for variations of the base scenario with respect to EU subsidies, straw yields per hectare (Figure 2 and 3), throughput of processing facilities (Figure 4) and impact on fibre price (Figure 5).

The variations of the base scenario (Table 19 and 20) represent total cost calculations. For transparency reasons, individual positions are shown explicitly. Calculations were performed with the spreadsheet software FIBRECALC©, which was developed by the nova Institute and has already been used in various studies and by consulting firms. The most important assumptions and parameters are listed in the tables and on the following pages.

Base scenarios

Essentially, the base scenarios start out with actual data from agriculture and from a typical total fibre processing facility in Germany, which was either built in the past years or is under construction or in planning. Technically, these total fibre plants constitute improvements and modifications of traditional processing facilities, especially for flax tow refining. The goal was to develop a realistic scenario as it may be in practice and then to devise several variations. In contrast, the approach chosen by the EU Commission to employ data ranges from the beginning, leads to unrealistic data combinations and to data ranges in the final results that are almost impossible to interpret (EU 1999b).

Entirely new concepts, as are currently under construction or in planning in Germany, were not considered in this economic analysis; the for the most part considerably lower projected production costs anticipated for these projects should first be demonstrated in practice.

Since even the new conventional facilities still struggle with technical start-up problems (throughput) as well as with the marketing of their entire production, two of the assumptions in the base scenario must currently be considered optimistic, but are expected to be realised within the next few years:

For fibre processing, 2 shifts/day with a throughput of 1,800 kg/hour straw (dry matter) (90% efficiency) are assumed.

Additionally, it is assumed that all produced fibres and shives on the market can be sold for adequate prices.

Based on these assumptions, a profit of about €100/ha results for flax and hemp – for agriculture and fibre processing – under the base scenario is estimated. This is a very modest profit, which in the long term will not render flax or hemp cultivation sufficiently attractive, unless additional benefits, e.g., excellent rotation characteristics or liquid manure tolerance (hemp) are considered. As shown in the nova survey, the assumed base scenarios for flax and hemp closely reflect reality in Europe. Most new total fibre facilities in Europe operate – based on EU subsidies 1999/2000 – with profits in the magnitude of €100/ha (±€100/ha). Profits considerably above €200/ha that would make cultivation and processing interesting, practically do not exist – except in form of forecasts for facilities, which are not yet in operation (comment: naturally, projected profits vary widely. However, it is apparent that facilities with lower production costs also have lower revenues, which in turn keeps the profit within the range mentioned above.)

Most operators, however, assume that – provided unchanged framework conditions – they will be able to improve their profit situation within the next few years. This may be achieved mainly by overcoming technical start-up problems, improved straw yields, increased throughputs in processing facilities, improved quality management and cost optimisation along the entire production chain in addition to a development of stable markets for fibres and shives.

Variations of base scenarios

The variations of the outlined base scenarios (Table 19 and 20) are intended to make transparent the impact of the proposed changes in the EU subsidies (EU 1999a) and how they could be at least partially offset.

According to the proposal, the future EU-subsidy for flax and hemp is supposed to become equal to the regionally applicable cereal subsidy by the economic year 2005/06. For the economic years 2000/01 to 2004/05 transitory regulations are considered, which would reduce the per hectare aid in three steps from the current level to the cereal level and also introduce an additional straw processing aid for the produced fibres (flax and hemp short fibres €400/tonne), which would be eliminated in the economic year 2005/06. Between 1999/2000 and 2005/06, EU subsidies for flax and hemp would be reduced by 50% reduction (short fibre and total fibre lines; the somewhat more favourable situation for flax long fibre production shall not be detailed here, but can be found in Chapter 8).

Since the development of the flax and hemp subsidies are dependent on the individual cereal subsidies and because those are regionally different, an average value for the variations of the base scenario of DM 690.02/ha (€350.44/ha) has been assumed. The latter has also been used by the German Federal Department for Agriculture (BML) for its impact assessment. For regions with strongly varying cereal subsidies, the scenarios have to be recalculated accordingly.

Results

Fibre production in Germany: Profit as a function of EU subsidies and straw yield (Figure 2 and 3).

Based on the described base scenario of 4 tonnes of flax straw yield/ha and 6 tonnes of hemp straw yield/ha, the figures show that the proposed subsidy reduction will already in the economic year 2000/01 causes losses in the value added. To raise the profit to about €100/ha, considerable yield increases are necessary: for flax more than 6.5 tonnes/ha (compared to 4 tonnes/ha), for hemp 10 tonnes/ha (compared to 6 tonnes/ha). Further reductions of the EU subsidy to the targeted level in economic year 2005/06 cannot – even under the most optimistic assumptions – be compensated by yield increases. The facilities will inevitably operate at a deficit. For the base scenarios deficits between €200 and 250/ha are calculated. Additional data can be obtained directly from the two figures.

Two more aspects are worth discussing:

The temporary split of the EU subsidy into a per-hectare-aid and a straw processing aid (economic years 2000/01–2004/05) does not result in a noticeable effect. Only the slope of the line in Figures 2 and 3 is somewhat steeper than for economic years 1999/2000 and 2005/06, in which only per hectare aid is granted. Overall, the effect is so small that the efforts associated with this split do not appear to justify their effect.

Profit or loss in the flax fibre production is more strongly dependent on hectare yields than in hemp fibre production. The slope of the line in Figure 2 is steeper than that in Figure 3. This implies in practice that flax yields below 4 tonnes/ha result in particularly high losses, whereas yields above 4 tonnes/ha will lead to steeper profit increases than is the case for hemp (based on 6 tonnes/ha). The profits or losses in hemp production react less severely to differences in yield.

Text continues after Figure 5, page 49.

Table 19: Complete cost analysis for hemp fibre production (total fibre line) 1999 in Germany in €/ha (all values in €, €1 = DM 1.969)

	(€/ha)
(I) Costs of cultivation and harvesting	
Seeds	-160
Soil preparation and seeding	-125
Fertiliser and application	-110
Harvesting and cutting	-125
Bale pressing	-120
Lease	-125
Storage	-60
Transportation	-120
Subtotal: costs of cultivation and harvesting	**-945**
(II) Processing costs (fibre processing facility)	
Wages and salaries (including non-wage costs)	-300
Administrative expenses (office supplies, etc.)	-90
Packaging	-65
Depreciation	-275
Other costs	-90
Electricity	-75
Outside capital interest	-65
Subtotal: costs of fibre processing	-960
(III) Total costs (I) and (II)	**-1,905**
(IV) EU subsidy economic year 1999/2000	**and 663**
(V) Profits	
Technical fibres, nonwovens grade (6–8 cm, card opener only)	and 761
Fine fibres (6–8 cm) (card opener plus fine opener 1 and 2)	0
Shives (cleaned and packaged)	and 582
(VI) Profit before taxes (for agriculture and fibre processing)	**and 101**

Calculated with FIBRECALC© nova 2000

Base scenario (assumption hemp total fibre line)

- Seeding rate = 40 kg/ha at €4.06/kg
- Baling costs = 250 kg bales · €5.08/bale
- Baling costs = transportation costs
- Storage costs = €10/tonne of straw
- Straw yields 6 tonnes/ha dry matter, corresponding to about 1.5 tonnes/ha of fibre yield
- Location of fibre processing in a structurally weak region (EU subsidy region A)
- Total investments for fibre processing facility: €3,555,000
- 2-Shift operation with 1,800 kg/h of dry matter straw throughput (efficiency 90%)
- Production and sales of nonwovens grade hemp fibres: 1,500 kg/year · ha at €0.51/kg

Production and sales of cleaned, packaged, paletted shives: about 3,300 kg/year · ha at €50.80–229/tonne

Table 20: Complete cost analysis for flax fibre production (total fibre line) 1999 in Germany in €/ha (all values in €, €1 = DM 1.969)

	(€/ha)
(I) Cultivation and harvesting costs	
Seeds	- 150
Soil preparation and seeding	- 125
Fertiliser and application	- 90
Pesticides and application	- 145
Pulling	- 140
Baling	- 80
Lease	- 125
Storage	- 40
Transportation	- 80
Subtotal: costs of cultivation and harvesting	**- 975**
(II) Processing costs (fibre processing facility)	
Wages and salaries (including non-wage costs)	- 200
Administrative expenses (office supplies, etc.)	- 66
Packaging	- 45
Depreciation	- 185
Other costs	- 60
Electricity	- 50
Outside capital interest	- 40
Subtotal: fibre processing costs	**- 646**
(III) Total costs (I) and (II)	**- 1,621**
(IV) EU subsidy economic year 1999/2000	**and 685**
(V) Profits	
Technical fibres, nonwovens grade (6–8 cm only card opener)	and 610
Fine fibre (6–8 cm) (card opener plus fine opener 1 and 2)	0
Shives (cleaned and packaged)	and 420
(VI) Profit before taxes (agriculture and fibre processing)	**and 94**

Calculated with FIBRECALC© nova 2000

Base scenario – Assumptions flax total fibre line

- Seeding rate = 100 kg/ha at €1.52/kg
- Baling costs = 250 kg bale · €5.08/bale
- Baling costs = transportation costs
- Storage costs = €10 per tonne straw
- Straw yields 4 tonnes/ha dry matter, corresponding to about 1.2 tonnes of fibre yield/ha
- Location of fibre processing in a structurally weak region (EU subsidy region A)
- Total investments for fibre processing facility: €3,555,000
- 2-Shift operation with 1,800 kg/h of dry matter straw throughput (efficiency 90%)
- Production and sales of technical, nonwovens grade hemp fibres: 1,500 kg/year · ha at €0.51/kg
- Production and sales of cleaned, packaged, paletted shives: about 2,000 kg/year · ha at €50.80–229/tonne

Notes on total cost calculations (Tables 19 and 20)

Hemp: Seeds, harvesting/cutting, baling, storage and transportation are the determining cost factors.

- **Planting seeds**: Seed quantity and variety are often pre-decided by the processors for quality reasons. Even they have few options for purchasing less expensive seeds due to the current situation on the seed market. However, it is foreseeable that the French monopoly will end in the coming years and seed prices may fall from currently €4.00/kg to €2.50–3.00/kg € savings of about €40–60/ha are conceivable.
- **Harvesting/Cutting**: Specialty equipment such as the "Hemp Cut 3000" or "Blücher 02" require investments of €50,000–70,000 and are thus comparable to other large-scale agricultural machinery. The estimated expenses of €125/ha represent, for Germany, average to upper third figures. For European companies, which already optimise utilisation of their machinery, €113/ha have been assumed, which eliminates the potential for additional larger savings. Every mistake/disruption is not only reflected in the harvesting chain but also during processing, e.g., by reduced throughput, higher shives content, etc.
- **Baling**: Baling is costed per bale, not per hectare. Assuming a bale weight of 250 kg, a straw yield of 6 tonnes/ha results in at least 24 bales, independent of bale size. On average in Europe baling costs tend to be even higher, although part of the transportation costs were probably reallocated. In this cultivation region, straw is baled, loaded and transported in one step by contractors. The baling equipment has been adapted for hemp and features, e.g., wrapping protection, etc., which requires only minimal investments unless processors have specific requirements.

  In one region, contractors had to invest in a self-propelled PowerPress (about €100,000 per machine). However, this unit can also be used on other crops. For cereal straw, €4.00/bale are common, however, use of the press for hemp requires increased maintenance and causes higher strain on the equipment, thus likely upholding the surcharge → no room for cost reductions.
- **Storage**: Almost everywhere, the straw must be stored by the farmers themselves. Storage requires a roof in order to maintain fibre quality. Hemp is considerably more hydrophilic than, e.g., hay. The base scenario assumes storage until the next harvest, because processors pay a premium to farmers for extended storage. The requirements for storage space depend on the bale form, which is generally pre-determined by the processor. Almost all processors require square bales. The storage costs are estimated and the amount of the real storage costs is strongly dependent on actual conditions, e.g., potentially competitive income from storage of recreational vehicles would certainly increase storage costs for bales. Since storage has a significant influence on straw quality, reductions in storage cost do not appear feasible, rather the opposite.
- **Transportation**: With average tractors and trailers the farmer can transport only a limited number even of bales per trip. The trend will go towards outsourcing of the transportation of bales. This will also allow operating just in time. This is already common practice in neighbouring European countries and is practised, e.g., for sugar beet transportation. To what extent this will lead to direct cost reductions is difficult to estimate, although definitively indirectly for the farmer due to the increased professionalisation and workload reduction. The figures used in the scenario are close to countrywide averages for Germany.
- **Yield**: Farmers have little control over yields, but definitively on the quality of the straw. Here, processors and farmers need to co-operate more closely so higher qualities will yield better prices in the future, as is the case for other crops. Yields in France show that long-term, there is definitively a need for improvement in the cultivation regime to increase yields. This will certainly not come about as long as most of the farmers are pioneers and there are practically no consultants for cultivation.
- **Location description**: The base scenario assumes average operating conditions. The soils yield an average of 6 tonnes of hemp straw/ha. The farmer provides all labour except for harvesting/cutting, baling and transportation and no organic fertilisation is used (for accounting reasons!). For higher-yielding locations, straw yield increases but so do additional costs, e.g., through higher baling, storage and transportation costs, however profitability. On fertile soils – adequate water and nutrient supply provided – hemp can realise its full yield potential. However, in these locations, competition by other crops is also strongest. Hemp is particularly interesting for farms with livestock, which have extra acreage beyond acreage used for the production of animal feed. Here, a large fraction of revenues comes from the stable and little time is available for outside productivity. Other benefits are that hemp also responds favourably to fertilisation by manure and can beneficially break up the often very close rotations.
- **Coupling with cereal subsidy:** The level of cereal subsidy paid by the EU is a function of the average yield. Accordingly, Germany has been divided into several regions. The subsidy is calculated from €58.67/tonne · regional average cereal yield (tonnes) DM 1.95583. Because of the coupling with the cereal subsidy, hemp is subject to strong competition. At the current subsidy levels, hemp is regarding its profitability competitive with

other summer cereals but cannot compete with winter wheat. However, in regions with high cereal subsidy levels, hemp is measured up to winter wheat at lower subsidies and presumably lower returns. In regions with low cereal subsidy levels, crops such as potatoes or carrots are often found. There, hemp cannot compete, even under current conditions. Here, the above-mentioned arguments are valid and also that profitability is barely achieved. With this coupling to cereal subsidies, the benefits of hemp such as favourable environmental characteristics (no pesticide use), high rotational value, as well as low labour demand are not accounted for.

Flax

For Germany, a base scenario analogous to that for hemp was developed. However the database is less reliable due to small area currently under flax cultivation. In addition, the figures by various European flax processors regarding cultivation and harvesting costs show a considerably higher variation than for hemp. Cost data compiled in the nova survey range from €450/ha to €1,700 /ha. Especially large variations are found for the items planting seeds and harvesting. Since currently almost no flax is cultivated in Germany, no standard cultivation or harvesting scheme can be described. Many interesting developments in the harvesting sector have not been tested in practice due to the scarcity of acreage.

The recommendations for cultivation and harvesting for the traditional long fibre lines are likely different from the modern total fibre lines, especially regarding seeding (quantity and varieties) and harvesting technique (parallel deposit after cutting not necessary for short fibre production).

Figure 2: Flax fiber processing in Germany: profit as a function of EU subsidy and straw yield

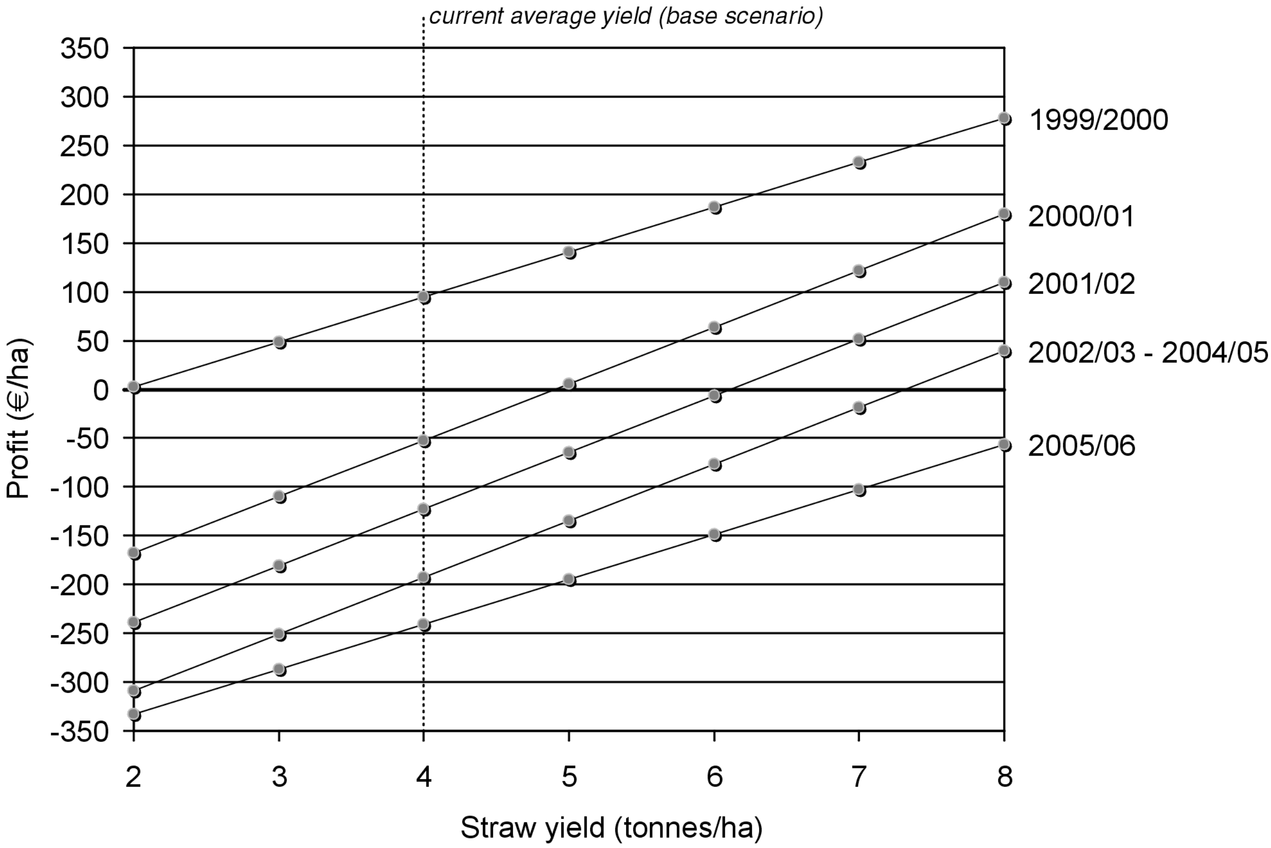


Figure 3: Hemp fiber processing in Germany: profit as a function of EU subsidy and straw yield

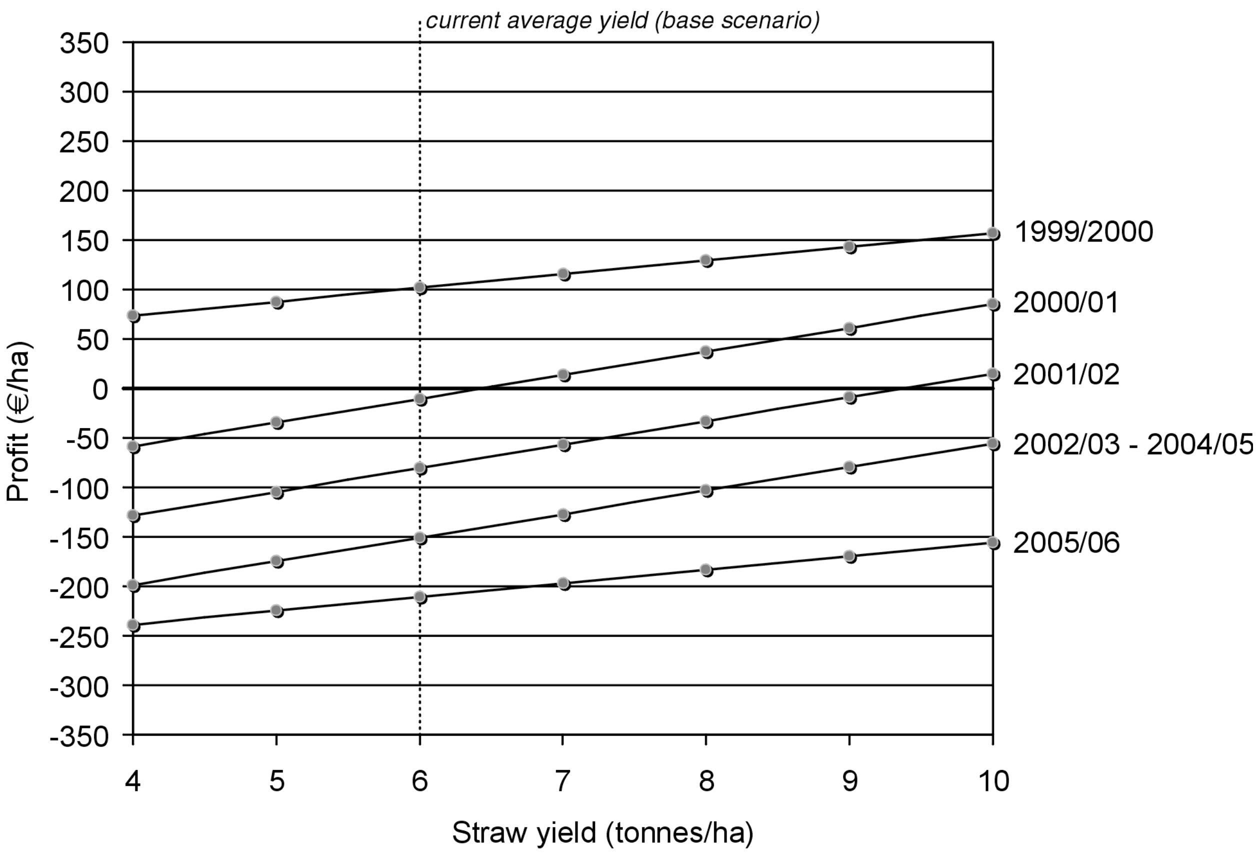


Figure 4: **Hemp fiber production in Germany: profit as a function of EU subsidy and throughput**

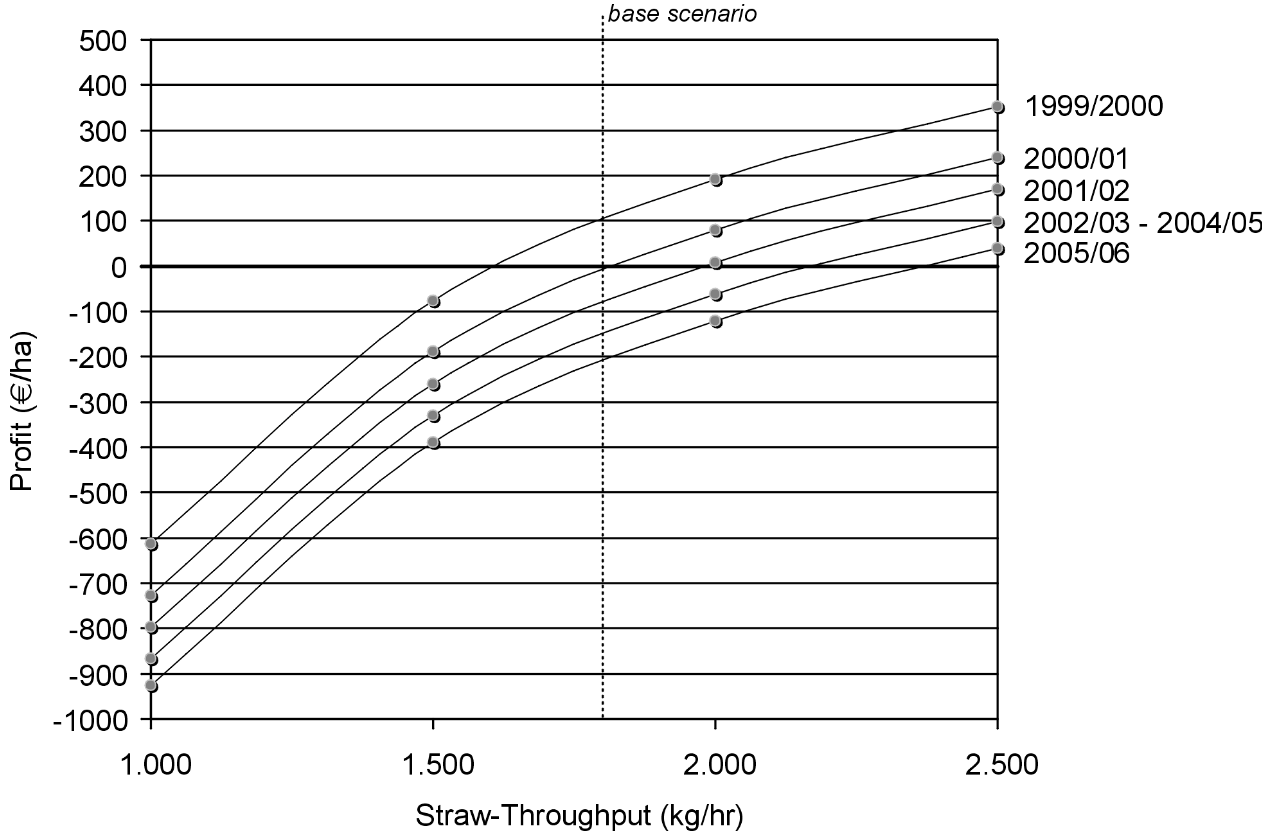
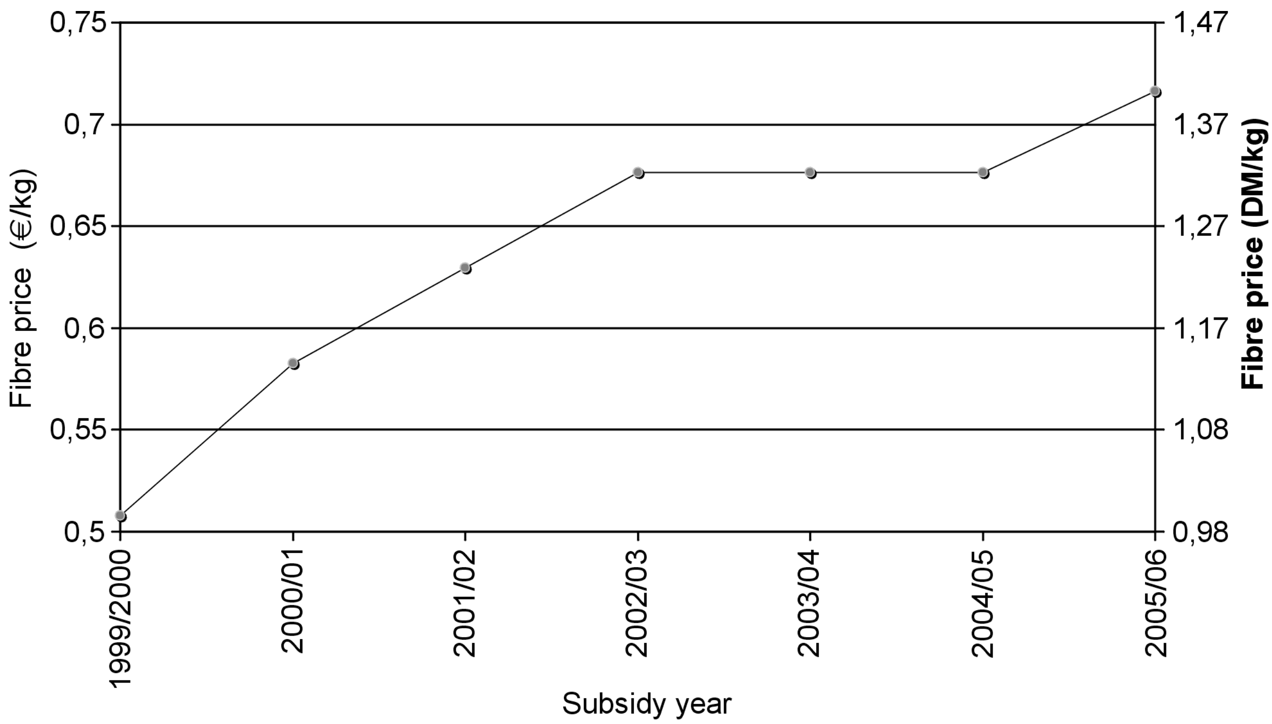


Figure 5: **Hemp fiber production in Germany: fibre price as a function of EU subsidy (at fixed profit)**



The reason for these differences between flax and hemp are due a) to a higher fibre content in flax and b) to higher straw-volume dependent costs for cultivation and harvesting of hemp (or higher fixed costs for cultivation and harvesting during cultivation and harvesting of flax); see Tables 19 and 20.

The figures show these effects for hemp cultivation, only. A detailed presentation of the flax results has been omitted because there are no significant differences compared to hemp.

Hemp fibre production in Germany: Profit as a function of EU subsidy and throughput (Figure 4)

Figure 4 shows how profit per hectare can be increased by increasing productivity. Compared to the base scenario (Table 19), only straw throughput was varied (base scenario: 1,800 kg/h). It can be shown that a decreasing throughput – whether for technical reasons or insufficient sales – has strongly adverse effects on profits. On the other hand, in creases in productivity can positively affect profits – up to a certain limit. The profit of €100/ha for the targeted subsidy levels for the economic years 2002/03–2004/05 – insufficient in the mid to long-term – can only be realised if the throughput can be increased to 2,500 kg/h, which for the facilities under consideration is unrealistically high and technically not feasible.

At the same time it is apparent that at current EU subsidy levels (1999/2000), feasible productivity increases would enable appropriate profits for farmer and fibre processors of more than €200/ha.

Even more obvious than in Figures 2 and 3, it is apparent that the temporary split of the subsidy would not have a relevant influence on the trend of the curves.

Hemp fibre production in Germany: fibre price as a function of EU subsidy (at constant profit) (Figure 5)

Based on the base scenario hemp and assuming a profit along the entire value chain of about €100/ha, the price for technical hemp fibres, including EU subsidies is about DM 1.00/kg for the economic year 1999/2000. Assuming decreasing EU subsidies and constant profit (€100/ha), the fibre price will have to increase. At the targeted subsidy for the economic year 2000/01, it increases to DM 1.15/kg, then to DM 1.24/kg (2001/02), DM 1.33/kg (2002/03–2004/05) and finally to DM 1.41/kg (2005/06).

If one is to compare the fibre prices with the prices of competing plants (see Chapter 4, Table 16), it is apparent that in 2001/2002, at the latest, sales of EU produced hemp fibres will become very difficult, and effective 2005/06 impossible.

Cost structure

The following Table 21 shows the typical cost structure for a total fibre processing line in Germany. Most important cost factors are raw materials costs (straw) and personnel costs.

Table 21: Cost structure for a fibre processing line (total fibre line hemp or flax) located in Germany, 2000

Type of cost	Percent of total costs
Raw material (straw)	33
Personnel	22
Depreciation	17
Administrative and marketing costs	7
Other costs	6
Electricity	6
Packaging (fibres and shives/hurds)	5
Interest (on own and outside capital)	4
Total	**100**

Calculated with FIBRECALC© nova 2000

Chapter 7

Potential Impacts Arising From Implementation of EU Reform Proposal

The potential economic impacts arising from the implementation of the EU reform proposal have been presented and discussed in detail in Chapter 6. It was shown that already the targeted cut of the subsidy for the economic year 2000/01 will economically challenge the new total fibre facilities (and their contract farmers) because current profit margins along the value chain are already very small (see Figures 2 and 3). However, since for many farmers and processing facilities – especially those currently in the start-up phase – productivity increases are possible, compensation in the economic year 2000/01 is potentially conceivable (see Figures 2, 3 and 4).

On the other hand, pioneer companies in the start-up phase have – especially if new processing technologies are implemented for the first time – significant economic problems, which would be greatly amplified by the subsidy cut for the economic year 2000/01. Particularly in Germany, several such technologically novel facilities will be put into operation in 2000 and 2001.

Even if the subsidy reduction for the economic year 2000/01 can be counterbalanced by productivity increases, subsidy reductions planned for the economic years 2002/03 through 2005/06 cannot be compensated by productivity increases (see Chapter 6). Only simultaneous realisation of several scenarios, which are even unrealistic by themselves, such as a remarkable increase in straw yields and straw throughputs in processing facilities as well as the complete sale of fibres and shives/hurds for adequate prices, would possibly allow for a profit in the value chain. For most of the new flax and hemp companies in the EU the planned subsidy reductions would almost certainly result in bankruptcy within the next five years.

This creates the real risk that the entire total fibre industry, which in the past years had been established and supported with much public funding in many new flax and hemp countries – especially in Germany, the U.K. and the Scandinavian countries – would collapse, private and public investments would be lost and the almost two decades old goal to establish a new, technically oriented natural fibres economy in the EU would have failed after all.

This is contrasted by an industrial demand for flax and hemp fibres, which has never been higher than at present. The major problem is that the declining EU subsidies cannot be compensated by higher prices for the processed fibres but only by cost optimisation along the value chain. EU-produced flax and hemp fibres are in severe price competition with import fibres from Eastern Europe and Asia, which only allows for very small price flexibility (see Chapter 4).

Already the introduction of the EU reform proposal end of 1999 disconcerted the entire flax and hemp industry and caused economic difficulties as has unquestionably been shown by the nova survey (NOVA 2000).

- On grounds of supply security for the coming years, one large automobile manufacturer had in the beginning of 2000 on short notice decided against EU-produced and for natural fibres from Asia.
- In the beginning of the year 2000, it was particularly difficult to win farmers for the cultivation of flax and hemp. Already in the economic year 2000/01 farmers feared not being able to achieve an adequate return per hectare and decided for the cultivation of other crops. Since flax and hemp straw due to its low density can at maximum be transported over distances of 50 to 100 kilometres, fibre-processing facilities depend on regional cultivation. If regional farmers cannot be convinced to cultivate flax or hemp, the continued existence of these processing facilities is jeopardised.
- The current increase of flax prices in the apparel textile sector is, among other things, attributed to the uncertainty caused by the reform proposal. Potential supply shortages for flax long fibres in the coming

years push demand and prices. Flax short fibres also cease to be competitive in the technical sector due to prices increases.

- Various investors have put their plans on hold; owners of existing facilities contemplate a departure from the natural fibres economy. And this in a time, when the industrial demand for short fibres is noticeably increasing.

A detailed assessment of the reform proposal by the Commission is found in the following chapter.

Chapter 8

Development of Proposals for a Framework Securing an Appropriate Future Development of the Natural Fibres Market

The currently most important framework conditions for the future development of the natural fibres market is determined by the EU subsidy regulations, which may, according to present reform proposals of the EU Commission will change considerably.

The individual propositions and their rationale are discussed in more detail below and analysed for their impact on an appropriate development of the natural fibres market. However, first those framework conditions will be discussed that impact the market development entirely independent of the EU subsidies.

- **Financial rewards for environmental benefits**

  In life-cycle assessments, products and intermediates based on flax or hemp fibres have definite advantages compared to the corresponding synthetic products. When these environmental benefits become economically important, market prospects of natural fibres will increase.

  In practice this could be achieved by increasing energy or "eco" taxes, which would directly exonerate renewable resources economically due to their environmental benefits. Additionally, products from natural fibres could be entirely exempt from some taxes, such as is the case, e.g., for biodiesel in Germany, which is exempt from mineral oil taxes. Without this tax exemption the success story biodiesel is not conceivable. In the same way it would be possible to subject products from natural fibres to a reduced sales tax.

- **Legal directives**

  Legal directives could promote the use of natural fibres, e.g., in the automotive or construction industry. In the context of devising the EU "Used Car Regulation", which requires all manufacturers to take back and recycle automobiles registered after January 1, 2001 free of charge, the use of natural fibres could be explicitly supported. This applies to the thermal use (from an emissions technology standpoint, incineration of natural fibres is comparably unproblematic and largely CO_2-neutral) as well as for the materials use.

- **Standardisation**

  The international, EU-wide and national standardisation plays an important and somewhat undervalued role for the market prospects of natural fibres. Often, technical standards are made for synthetic raw materials and products and, because their specific properties are not taken into account, this may put natural fibres at a considerable disadvantage.

  Efforts, to explicitly include the specific properties of natural fibres in standards should be promoted, especially on the international level. An important aspect in this context is the development of quality standards for the technical use of flax and hemp fibres as well as an adequate quality management.

- **Research and development**

  When funding research and technology development projects, environmental, economic and market parameters should receive much higher consideration at an earlier stage. In the EU, still too much money is invested in research and development projects, whose relevance for the market – even if the project is successful – is difficult to see.

  Especially problematic is the fact that projects primarily concerned with market development have only small prospects for funding, even though in most cases market development *is* the major obstacle. This applies especially to multi-company marketing projects.

Discussion and analysis of the EU-Commission's reform proposals

The following text (*italics*) is excerpted from the main position paper of the EU Commission on the reform of flax and hemp subsidies of November 1999 (EU 1999a).

The new subsidy system:

Per-hectare-aid:

Linked to the level of linseed subsidies and gradual reduction to cereal level (until 2002/2003).

Straw processing aid:

a) Flax and hemp short fibre: €40/tonne of processed fibres (2000/01–2004/05), then none;

b) Flax long fibre: €60/tonne (2000/01), €120/tonne (2001/02), €180/tonne (2002/03– 2004/05), € 200 /tonne (starting 2005/06)

The justification for a subsidy based on processed fibres as quoted in the EU paper is as follows:

> *"... per-hectare aid does not promote productivity and, above all, treats all products equally, regarded of their intended use. Granting aid per tonne of produce eliminates the risk of subsidy-driven production but requires that the quantities concerned be verified more stringently. Since straw is more difficult to trace than the fibre that is obtained from it, aid should be granted to processors depending on how much fibre with specified characteristics they produce."*

Straw processing aid is only granted for

> *...short flax fibre and hemp fibre containing not more than 5% impurities and shives."*

In a later paper, the Commission offers a detailed explanation of this position:

> *"...e.g., the direct production of products other than hemp straw by means other than separation of fibre and woody stalk parts cannot be granted subsidies because the 5% purity limit is obviously exceeded."*

Differentiation between long and short fibres and subsidy levels

In our estimation, the reform proposal is not suitable for securing an adequate development of the natural fibres markets, especially not for fibres from total fibre processing lines and their technical markets.

To begin with, the planned subsidy system will lead to a severe distortion of the long and short fibre subsidies. By the year 2005/06, the subsidy for flax short fibres and hemp fibres will have decreased to about €350/ha (cereal subsidy), whereas for flax long fibres it will only have decreased to about €540/ha (figures for an average location in Germany). This is particularly problematic for the new total fibre processing lines, as detailed in Chapter 6, whose survival would be severely at risk at such reduced subsidy levels. The short fibres produced in total fibre lines will additionally experience strong competition from short fibres (tow) from long fibre production, whose price, which is based on a mixed calculation offers much larger flexibility than the fibres from a total fibre processing line. The proposal by the Commission reflects the dissimilar valuation of the different processing lines, which are detailed below.

Some member countries have proposed uniform subsidies for long and short fibres (this would also minimise the objectionable competition between traditional and new processing lines), others support some differentiation, yet to a far lesser degree than proposed.

Another alternative is to implement three different subsidy levels, one for flax long fibres, one for flax and hemp fibres from total fibre processing lines and one – the lowest – for short fibres (tow) as a by-product from long fibre production. This would take into account the various technical, economic and market structure differences between tow from long fibre lines and short fibres from total fibre lines. The new total fibre lines, which were initiated with extensive funding programs (see Chapter 3), now in their early phases, would have much better chances of survival and the traditional tow lines could carry on in the market with a mixed calculation. At the same time, pressure would increase to find better value-added uses for the tow, since the commodity pulp market would cease to be profitable.

Straw processing aid for fibres with less than 5% impurities and shives

We are concerned that this regulation would bring about severe complications without efficiently achieving the targeted goal.

The economic analyses (Chapter 6) show that the division in aid-per-hectare and straw processing aid would ultimately not have any relevant economic effect. Also, we do not expect a noteworthy impact on productivity and quality management. All companies that are seriously interested in supplying to new technical markets (This includes virtually all companies in the new flax and hemp countries) increasingly tie the price for straw they pay to farmers to straw quality and are introducing quality management systems – with or without straw processing aid.

The straw processing aid, which is initially paid to the straw processors, ultimately, by way of a higher straw price, are redirected towards the farmers, who depend on them in this overall economy. Again, in reality, the difference to a subsidy system based entirely on cultivation area is insignificant.

In addition, the new regulation would lead to a new monitoring problem. The fibre production needs to be monitored closely – it is crucial to exclude from subsidies lower quality import fibres, which are refined on the processing line. The latter constitutes a serious problem. It is not clear, why the Commission considers straw distribution more difficult to monitor than fibre distribution. Straw, in contrast to fibres, is not a commodity, and because of its low density can only be transported short distances. It is generally contracted by and delivered regionally to a processor.

Should the 5% regulation be kept in place, additional frequent monitoring of the shives content will become necessary. In addition to new monitoring efforts, this will lead to problems regarding standards and costs. At present, no standardised techniques exist to determine the shives and hurds content in fibre samples. Depending on the method used, a price of 100 to 200 DM for determining shives content is assumed.

How often are samples to be taken and sent to specialised laboratories? Who pays for the costs of the analysis and the necessary logistics? Are fibres with different shives content valued the same? This would lead to the problem that especially very fine fibres, which are produced at a lower fibre yield, would be at a disadvantage. In addition, it is feared that experienced subsidy hunters will find a multitude of opportunities for fraud.

The designation of a maximum acceptable shive content of 5% creates an additional fundamental problem – not counting a lack of standards and costs of monitoring. First of all, some traditional and value-added product lines, e.g., the specialty pulp sector, manage well with a shive content of 10–20%. It is difficult to understand why these product lines, which especially for hemp play a central role (see Chapter 1), should be entirely eliminated from the subsidy system. A shive content reduction in these product lines is not achievable with the existing technology (hammer mills). Also, from an economic standpoint, using (unnecessarily) clean and thus more expensive fibres would eliminate their competitiveness in this market.

At least equally important is the fact that a number of new technical applications, which use fibres with a high shives content (10 to 50%), e.g., as construction materials, in composites, geotextiles and agricultural textiles, would be excluded from the subsidy system. Many research and development projects as well as already implemented investments would face cessation even though the targeted applications are environmentally and economically equally sound as other product lines and markets.

The goal of the Commission – to stop subsidising the supply of the commodity pulp market with low-grade flax fibres – will (possibly) be met at the expense of valuable applications. The proposed distinction between short fibres from total fibre lines and tow would probably present a more adequate solution. However, it remains controversial whether the market for commodity pulps is really as big a problem as the Commission assumes (see below).

All things considered, we conclude that it is a good deal easier and less problematic to pay out the entire subsidy as an aid-per-hectare as before.

In this context, the proposed elimination of the regulation specifying a minimum straw yield as a prerequisite for granting full subsidies, only established this past economic year, should be reconsidered. Elimination of this regulation has largely been proposed because of the considerable associated monitoring efforts. As discussed, we expect an even higher monitoring demand as a result of the new regulation. After all, minimum yield requirements (with no exemptions) would prevent cultivation of flax and hemp in entirely unsuitable locations.

> ***Stabiliser regulation****: Introduction of Maximum Guaranteed Quantities, which would be allocated on a per-country basis according to historic production. According to the proposal, Germany would be granted a national guaranteed quantity of 6,300 tonnes/year flax and hemp fibres, new flax and hemp countries would be granted 50 to 100 tonnes/year.*

Quotas hamper adequate market development

The introduction of Maximum Guaranteed Quantities does not appear to be a suitable means to constructively influence the market development. Regarding demand, corresponding cultivation areas and production quantities, the considerable dynamics of the new technical markets, especially in the composite and insulation industries (see Chapter 2), as well as the development of new processing and manufacturing technologies will lead to developments in the member countries that should not be limited by historic production quantities. The maximum quantity system would – independent of potential inequalities in quotas for individual countries – easily become a barrier to innovations and it is particularly innovations and market dynamics that are necessary to secure flax and hemp fibre production in the EU in the long term.

In Germany, the processing facilities under construction or in their start-up phase alone will produce multiples of the quotas allotted to Germany. New flax and hemp countries have – due to their production quotas of 50 to 100 tonnes/year – no prospects to develop a new fibre industry because a production of about 1,000 tonnes/year represents the lower limit for a profitable operation.

From our perspective it is also not sensible to settle on a limitation of production quantities (and thus subsidy payments) as the foremost or even solitary objective. A complete evaluation would be necessary, which also considers the economic effects of avoided natural fibre imports, job creation and environmental benefits. From our point of view, quotas should be renounced at this point and future market development be observed.

> ***Basis area problem****: Inclusion of flax and hemp cultivation areas in aid regulations. Desire to increase allotted basis areas and future consideration in the computation of areas designated to be idle.*

This problem, which represents itself differently in the various member countries, has already been comprehensively discussed among agricultural experts and shall not be detailed in this study. In at any rate, the cultivation of flax and hemp is further impeded by this measure.

Use of hemp seeds in food sector

Certified hemp processors will only be authorised on condition that they commit to not supply to companies that manufacture or sell foods from hemp seeds:

> *The per hectare aid for fibre hemp will be made conditional ... on the conclusion of contracts for the entire production with authorised processors for uses other than food. ... authorisation of primary processors, specifically excluding processors of hemp products used in human nutrition."*

> *„To avert such dangers (comment: potential impacts on health and general down-playing of the risks associated with Cannabis), the cultivation of hemp for fibre must be strictly controlled, which means the area cultivated will have to be restricted, and the uses to which it is put must not include human nutrition."*

> *Viability of imported hemp seeds not intended for seeding has to be prevented.*

Since this problem has already been discussed in detail in Chapter 5 a brief summary shall suffice at this point.

It would economically damage the hemp industry if these regulations would come into effect. From a nutritional standpoint, hemp seeds are exceptionally valuable. Appropriate THC limits can be adopted to prevent potential risks to the consumers.

Especially with decreasing subsidies, the utilisation of hemp seeds gains economic importance. Adequate profits, however, can only be realised in the food sector. A prohibition on the use of hemp seeds as foods would further intensify the economic pressure on hemp companies.

In our opinion, the confusion of drug and agricultural politics, which often is the background of this subject matter, should be avoided and more pragmatic solutions should be found in the agricultural and food sectors.

The recently implemented German regulation which distinguishes between hemp seeds for food uses and hemp seed for illegal Cannabis cultivation depending on their price and quantity, has, according to the German ministries involved passed its test and should be considered in other member countries. This would also eliminate the postulated need for sterilizing imported hemp seeds, which would results in additional costs and monitoring efforts and diminish the reduced nutritional value of hemp seeds.

The hemp food market is still a young pioneer market, which is at risk of collapsing due to a change for the worse of framework conditions. Provided suitable framework conditions, prospects exist for the production of high quality foods and an additional value-added for agriculture and production.

Pure seed cultivation without fibre production should also be made possible and regarding their aid-per-hectare be treated like cereal cultivation, as is practiced for corn farming.

Furthermore, it is desirable for hemp seeds to obtain a KN code as a product designation, analogous to linseed and flax and hemp straw.

Short fibre processors as second-class producers?

As mentioned before, the thread running through the reform proposal by the Commission is to secure the survival of traditional long fibre lines, whereas the survival of short fibre line is considered a secondary issue.

Before discussing the "value" of the various processing lines from our perspective, some quotations and comments by us shall illustrate their different valuation from the viewpoint of the Commission.

Commodity pulp markets

> *"Short flax fibre and hemp fibre are mainly used in paper-making pulp and the market is more or less unlimited provided the price remains close to zero. ... By virtue of the aid it has received, which often covers its cost, it has in some cases become an end product in its own right. ... Fibre pulp for ordinary or recycled paper is not commercially viable without aid to cover production costs and revenue for the producer. Given these conditions, the selling price can be almost zero and potential applications are almost without limit. ... In any event, no processing aid should be paid for fibre with a high percentage of shives remaining. Products such as this, for which the straw processing costs are low, are most likely to be used in the ordinary paper pulp industry."*

The nova survey conducted as part of this study and the evaluation of other available studies has shown that the EU Commission overestimates the magnitude and importance of the commodity pulp market. This market only presents an "emergency" market for uncleaned, low-grade flax tow, which does not find a market elsewhere. The real target market is the high-priced specialty pulp market, which represents a valuable product line worth sustaining.

Pulp markets, their structure and growth potential are detailed in Chapter 2. On the whole, only 20 to 30% of pulp short fibres (flax and hemp) end up in the low-grade commodity pulp sector and 70 to 80% in the specialty pulp sector. In flax fashion times, the proportion of commodity pulp declines even more since then it is worthwhile to even refine lower-grade fibres.

According to the nova survey, the commodity pulp sector is irrelevant to the use of hemp fibres. 99% of all pulp hemp fibres are produced in associated processing lines directly for the specialty pulp market. The situation in the new flax countries with total fibre lines is similar.

An economic disadvantage of the flax and hemp specialty pulp sector would immediately lead to increased imports of tropical fibres and tropical fibre pulps and would jeopardise entire processing lines in the EU, which in general also operate more environmentally sound than companies in Asia.

Markets for short fibres

> *"Commercially viable applications for these products do exist, although they often use other plant fibres such as jute or sisal. ... The markets ... are expanding but unstable. ... However, certain operators and research institutes are of the opinion that, even if Community aid is sharply reduced, many products have the potential to rapidly become commercially viable. ... the areas down to short-fibre flax and hemp have increased without any comparable increase in either output or real market demand for these products."*

As detailed in Chapter 2, in the past years attractive and growing markets have developed for short fibres; especially in the automotive and insulation industries a real demand exists nowadays. Mid- to long-term, these new technical markets definitively have the potential to supersede the long fibre markets in volume and importance. Also, these markets are not dependent on fashion waves and associated demand fluctuations but represent a more stable (or growing) demand.

Especially the most recent developments in the automotive industry show that the use of natural fibres is not in question anymore. The decision has long been made and the demand for natural fibres grows continually.

However, it depends on the economic and political framework conditions in the EU, whether the growing demand will be met by EU-produced flax and hemp fibres – with its associated employment and agropolitical and environmental benefits – or by imports from Eastern Europe and Asia.

Costs and profit margins of processing

Production costs of flax long fibres are considered relatively high and the market situation as highly volatile. These conditions are just to justy the continually high subsidies. At the same time, costs for production of short fibres, especially for the total fibre line, are underestimated.

> *"If only short flax fibres and hemp fibre are required, the straw can be harvested by cutting. ... The major economic problems encountered in the common organisation of the market stem from the existence of aid levels per hectare which, for short fibres, are extremely high in relation to production costs and the value of the product itself. A major cut in aid levels, either directly or via the impact of Maximum Guaranteed Area, would have the effect of eliminating the traditional producers or those whose products are economically viable, without necessarily doing away with subsidy-driven production."*

As shown by the economic analysis of typical total fibre lines in Germany, the EU Commission underestimates the necessary cultivation, harvesting and processing technologies and costs. Evidently, the production of long fibres is more complex and costly than the production of short fibres from a total fibre line. At the same time the likely profits for long fibres are considerably higher than those for short fibres, during flax fashion periods even by several times. Prices for long fibres are mostly determined by demand and less by competition with other fibres. Prices for technical short fibres have little flexibility, determined by prices for import fibres from Eastern Europe and Asia (see Chapter 4).

Safeguarding long fibre processing lines

> *"We should continue to support the preservation of this traditional sector, as it guarantees both a diverse range of crops (in particular by means of its low-pollution methods of production), and a livelihood for rural small and medium-sized enterprises."*

Subsidy merits of various fibre lines

The last quotation directly reveals the central problem. In the eyes of the EU Commission, the traditional long fibre flax sector is worthy of subsidies and preservation – in contrast to the short fibre and total fibre lines. The real criteria for these preservation merits remain unclear.

The keywords "environmentally sound", "diversify", "small and mid-size companies in rural regions" apply in the same way to short and total fibre lines. For the new total fibre lines, "innovative" and "promising" could be added.

From our perspective, both processing lines possess their own value and right to existence. Favouring the traditional long fibre market seems arbitrary in this context.

Economics

For decades, it has been obvious – and the reform paper of the EU Commission supports this yet again – that the traditional long fibre sector will depend on substantial subsidies, even long-term

The new total fibre lines on the other hand have the potential to be competitive mid to long-term even with lower subsidies – once start-up problems are overcome and productivities (also through new technologies) have increased and stable markets have been developed.

However, the reform proposal at hand jeopardises the existence of the new total fibre lines and in contrast keeps the long fibre lines alive with high continual subsidies.

The current subsidy for total fibre lines is – other than in the long fibre sector – a start-up subsidy, which should only be reduced slowly and moderately and in harmony with the markets (!) without jeopardizing the existence of the new enterprises. In contrast to the established long fibre markets, the new companies not only need to overcome their technical problems but also need to develop marketing and trade structures as well as trade associations.

Furthermore, it is difficult for the new processing facilities to compete with older, already depreciated facilities. Capital costs play a significant role in determination of fibre prices (see Chapter 6).

Adding value in the EU

While adding value in the traditional flax long fibre line has been moved increasingly to non-EU countries because of the demise of EU spinning mills, value adding in total fibre lines takes place almost entirely in the EU.

About 50% of the long fibres produced in the EU are exported for spinning, especially to China and Brazil (see Chapter 1). Based on the same logic used by the EU Commission for short fibres, one could state that EU subsidies serve to supply low-cost raw materials to the textile industry in China and Brazil. Since spinning and weaving mills in the EU are still closing down, this trend will likely continue in the future.

The new total fibre lines, partially with integrated down-stream processing, are entirely geared towards a realisation of the entire value chain in the EU or even in the cultivation region, all the way to the final product.

Ecological and innovative aspects

In this context, one should not overlook the reason for the EU-wide, substantial funds used in the 1980s to develop total fibre lines directed towards new technical markets (see Chapter 3). The focus was on developing a new perspective for agriculture and an environmentally sound, sustainable supply of the industry with renewable resources (see Appendix).

After a long start-up phase, over the past years a real demand for natural fibres by the industry can be observed for the first time. New investors and companies have stepped up to implement the long-standing, expressed goals of the EU.

There is a real opportunity to establish an environmentally sound and sustainable supply of the industry with natural fibres from the EU. This opportunity should not be jeopardised for short-term subsidy savings, but should be analysed for its mid- to long-term potential.

Avoiding additional obstacles

In addition to eliminating any further subsidy reductions, other obstacles to the use of flax and hemp that may have an indirect impact on the economy should preferably be eliminated.

- The final decision on subsidies for flax and hemp should be announced prior to seeding to ensure planning security to fibre processing lines and farmers. The inclusion of flax and hemp cultivation areas in the support system for producers/area should be eliminated because it further complicates their cultivation.
- Subsidy payments should not be made conditional on a designation of specific processing technologies, such as a maximum shives content of 5%. The latter would restrict application options and hamper new, innovative fibre processing and down-stream processing, as well as traditional applications (specialty pulp).
- The harvesting time for hemp cultivation should only be determined by the technical maturity and not be restricted by further regulations (50% seed maturity), which under unfavourable climatic conditions could lead to substantial yield losses.

- The dual-purpose cultivation of hemp for fibre and seed should not be impeded by a prohibition to supply to the food sector. The actual value adding occurs especially in this sector, which makes the dual-purpose cultivation of hemp economically interesting in the first place.

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Appendix

Flax and Hemp Related EU Projects 1982–2002

(DG VI, DG XII and DG XIV)

Project Title	Programme / Acronym	Project Reference	*EU-Funding in € / Budget in € / Months
(I) Cultivation, Breeding & Harvesting			
Improvement in basic raw materials (upgrading of linen)	PRE FWP/TEXTILE 2c	TX2*0008	.../.../27 months
Research programme for a new national harvest and processing method for flax	PRE FWP/TEXTILE 2c	TX1*0039	.../.../30 months
The genetic improvement of *Linum usitatissimum* L., flax and linseed	1st FWP/Stimulation 1c	ST2*0396	.../.../40 months
Improvement of linseed crop management	2nd FWP/CAMAR	80010006	.../.../36 months
Technologies for a new harvest process for fibre flax	3rd FWP/AIR	AIDA0004	.../.../12 months
Demonstration of new harvesting and breaking down processes for flax and hemp short fibres	3rd FWP/AIR	AIR10367	4,650,000/15,500,000/36 months
Control of wall extensibility in flax	4th FWP/TMR	FMBI961002	*[3] 36,000/.../24 months
Multifunctional flax combine	4th FWP/BRITE/EURAM 3	BRST970598	*[1] 22,500/.../6 months
Crop development for cool and wet regions of Europe	IC/COST	814	*[2]/5,000,000/108 months
(II) Materials Technology, Industrial Manufacture			
New materials deriving from cellulosic fiber crops, agricultural commodities and wastes	3rd FWP/CRAFT	CR175091/BRE21269	*[1] 22,500/.../3 months
Structural resin transfer moulding (SRTM) of reinforced phenolics	3rd FWP/CRAFT	CR144691/BRE21140	*[1] 22,500/.../3 months
Development of life-time adjustable geotextiles based on plant fibres	3rd FWP/CRAFT	CR166791/BRE21241	*[1] 22,500/.../3 months
New materials deriving from cellulosic fibers, agricultural commodities and wastes	4th FWP/BRITE/EURAM 3	BRST965032	.../.../24 months
Development of thermoplastic composites based on upgraded ligno-cellulose fibres for improved durability and their	4th FWP/BRITE/EURAM 3	BRST970580	*[1] 22,500/.../6 months

Project Title	Programme / Acronym	Project Reference	*EU-Funding in € / Budget in € / Months
processing for components			
Development of thermoplastic composites based on upgraded ligno-cellulose fibres for improved durability and their processing for components	4th FWP/BRITE/EURAM 3	BRST985474	.../.../24 months
New functional biopolymer-natural fiber-composites from agricultural resources	4th FWP/FAIR	FAIR983919	1,500,000/2,410,000/36 months
Production of fiberboard through high-speed refining, double-wire pressing & high level intelligent	4th FWP/BRITE/EURAM 3	BRPR950039	.../.../37 months
The use of hemp in cars	4th FWP/BRITE/EURAM 3	BRST970597	*[1] 22,500/.../6 months
New materials deriving from cellulosic fibers, agricultural commodities and wastes	4th FWP/BRITE/EURAM 3	BRST965032	.../.../24 months
Hemp for Europe - manufacturing and production systems	4th FWP/FAIR	FAIR950396	1,400,000/2,054,000/36 months
Optimisation of the production chain for high performance 'light natural sandwich materials' (LNS) as a basis for scaling-up	4th FWP/FAIR	FAIR983784	900,000/1,350,000/36 months
Hemp for buildings	4th FWP/BRITE/EURAM 3	BRST950131	*[1] 22,500/.../13 months
Hanf als Baumaterial für den Niedrig-Energie-Holzbau	4th FWP/BRITE/EURAM 3	BRST970652	*[1] 22,500/.../5 months
Hemp as building material for energy efficient wooden houses	4th FWP/BRITE/EURAM 3	BRST985500	.../.../24 months
Development of high quality engineering materials based on natural fibre composites by optimising the interface characteristics	4th FWP/TMR	FMBI972376	*[3] 36,000/.../24 months
Annual fibre reinforced polypropylene composites for industrial applications: development of a quality controlled fibre production chain	4th FWP/FAIR	FAIR950195	1,200,000/2,400,000/36 months
New integrated approach for the optimisation of European flax products through the engineering of the process and material	4th FWP/BRITE/EURAM 3	BRPR980798	.../.../36 months
New process for energy saving optimisation pollution abatement of small non-wood pulp mills	4th FWP/NNE-THERMIE C	IN./00128/96	500,000/1,250,000/17 months
Energy saving resource optimisation pollution abatement, non-wood long fiber treatment, heat and chemical recovery	ENG/THERMIE 1	IN./00058/92	950,000/2,380,000/48 months
Multifunctional flax combine	4th FWP/BRITE/EURAM 3	BRST985368	.../.../24 months

Project Title	**Programme / Acronym**	**Project Reference**	***EU-Funding in € / Budget in € / Months**
High mouldable fiberboards	5th FWP/HIFI		3,000,000/5,100,000/36 months
Hemp as raw material for novel industrial applications	5th FWP/HARMONIA		2,500,000/4,800,000/48 months
(III) Textiles			
Study of the open-end-rotor spinning systems and their suitabilities for linen	PRE FWP/TEXTILE 2c	TX1*0007	.../.../24 months
Upgrading of linen	PRE FWP/TEXTILE 2c	TX1*0025	.../.../25 months
Volarisation of different types of flax	PRE FWP/TEXTILE 2c	TX1*0017	.../.../24 months
Flax volarisation: Technological and economic improvement of transformation processes of fibre into manufactured goods	PRE FWP/TEXTILE 2c	TX1*0010	.../.../25 months
Flax volarisation	PRE FWP/TEXTILE 2c	TX1*0011	.../.../24 months
Technical and economical improvement in scutching for specific flax spinning and presentation for new uses	PRE FWP/TEXTILE 2c	TX1*0009	.../.../24 months
Upgrading of linen	PRE FWP/TEXTILE 2c	TX1*0031	.../.../24 months
Chlorine free rove treatment in the flax spinning industry	3rd FWP/CRAFT	CR157791/BRE21203	*[1]22,500/.../3 months
New manufacturing techniques for economical and qualified production of new type of flax products „Neoflax“	3rd FWP/BRITE/EURAM 2	BRE20240	2,000,000/.../36 months
Novel approach for objective and systematic qualification of flax fibres and products	3rd FWP/CRAFT	CR164391/BRE21231	*[1] 22,500/.../3 months
Integration of liquid-ammonia treatments in finishing operations for cellulosic materials	3rd FWP/CRAFT	CR104191/BRE20404	*[1] 22,500/.../30 months
Validation industrielle d'une filière de transformation du chanvre textile basée sur le rouissage enzymatique	4th FWP/INNOVATION	IN206431	.../.../...
Validation industrielle d'une filière de transformation du chanvre textile basée sur le rouissage enzymatique	4th FWP/INNOVATION	643	.../.../...
New integrated approach for the optimisation of European flax products through the engineering of the process and material	4th FWP/BRITE/EURAM 3	BRPR980798	.../.../36 months
Merging technologies from cell-wall biochemistry and advanced enzymology for high added value flax fibres	4th FWP/BRITE/EURAM 3	BRPR970490	.../.../36 months
Network on clean technology for	4th FWP/INCO	IC15980823	.../.../36 months

Project Title	Programme / Acronym	Project Reference	*EU-Funding in € / Budget in € / Months
ecological high quality 'cottonized' flax fabrics production from worthless raw materials			
Cultivation and processing systems for the cost efficient recovery of fibres from flax for use as a staple textile		FAIR-S2-9074	.../.../24 months

Sources: www.cordis.lu; www.NF-2000.org

*[1]: CRAFT-Projects: research awards of maximum €22,500

*[2]: COST-Projects: normally no EU-funding

*[3]: Training Through Research: Research grants of about €1,500/month

Normally contract type of all the listed projects is CSC (cost-sharing contracts). Under this assumption the EU-funding can be estimated as follows:

Estimated EU-funding = Total of months unknown CSC · average EU-funding per month of known CSC + known CSC + CRAFT-Projects + COST-Projects + Training Through Research

Estimated EU-funding = 640 months · €18,600,000/365 + €18,600,000 + €247,500 + € 0 + € 72,000 = €51,533,199 (DM 101,468,860)