IENICA

Interactive European Network for Industrial Crops and their Applications

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REPORT FROM THE STATE OF FINLAND

Update Report

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EXECUTIVE SUMMARY

In Finland about 76,000 active farms were registered in 2002 of which about half consisted of more than 20 hectares. The most common crops are cereals (barley, oats, wheat and rye) and grass, consisting about 83% of the total cultivated arable land (2,186,000 ha). The interest among farmers and industry in non-food crops has increased gradually during the last decade, although the proportion of these crops from the arable land is still small. The first IENICA country report of Finland describes in detail the potential non-food crops including processing and application of raw materials.

By the end of year 2003 the most important plant-derived non-food product is starch from barley, wheat and potato. Also, betaine from sugar beet is one of the most important plant-derived non-food products. The total use of starch in Finland was about 200,000 tonnes and about half of that was imported. However Raisio, which is the most important producer of starch in Finland, will end the production of starch from cereals in 2004. There have been interests towards fibre crops during the last few years. Many research and development projects have been carried out, but still the cultivation area of these crops is quite small. West-Finland especially has been very active in this field and currently about ten small or medium size enterprises are processing plant fibres, mostly flax but also short fibre as a by-product from linseed. Nettle and hemp are the newest fibre crops. The cultivation area of non-food oil crops has been quite steady during recent years. The most important crop is still spring turnip rape, although only part of the production is used for non-food purposes. The interest in caraway and other herb-like crops has been increasing as well. The cultivation area of caraway was the highest ever in the year 2003, consisting of about 7,000 hectares. These crops are used mainly for food production but there are many research projects surveying also the non-food applications. The cultivation area of sugar beet is about 30,000 hectares in Finland. However, the extraction of betaine from domestic raw material has not been economical and therefore betaine is extracted abroad.

OIL CROPS

Raisio Chemicals utilises the largest part of oilseeds cultivated in Finland. About 70,000 tonnes of oilseeds, mainly spring turnip rape (*Brassica campestris* L.) are processed for food oils and about 5,300 tonnes of seeds for non-food industrial oils (Raisio Group). The seeds from linseed (*Linum usitatissimum* L.) are mainly processed for food and feed components, but about 15% is utilised for non-food purposes such as for timber protective agents (Elixi Oil Ltd). Plant derived mucilage is another new innovation from linseed, which may have potential also for non-food purposes (Oy Linseed Protein Finland Ltd). A new oil crop, Camelina, is cultivated currently only for food production, but also has potential for non-food purposes. A developing project in the application of hemp seed oil for cosmetics is also ongoing (ProAgria Rural Advisory Centre Etelä-Pohjanmaa). There are few small and medium size enterprises processing linseeds in Finland, and the capacity is bigger than the current production.

Oilseed Rape and Spring Turnip Rape

Production

74,600 hectares

93,600 tonnes of seeds

Yield - 1260 kg/ha

Industrial applications and market sizes

830 hectares for non-food use. Used as lubricants (chainsaws, forest harvesters). Production was 500 tonnes of oil in 2003 (900 tonnes in 1998). [Source: Information Centre of the Ministry of Agriculture and Forestry, Raisio Chemicals].

Linseed

Production

2,000 hectares

1,960 tonnes of seeds

Yield - 980 kg/ha

Industrial applications

The area for non-food oil uses is about 100 ha. This is used for paints, timber protective agents, etc.

100 tonnes was used in 2003. [Source: Information Centre of the Ministry of Agriculture and Forestry, Elixi Oil Ltd].

Camelina

Production

200 hectares

340 tonnes of seeds

Yield - 1700 kg/ha

Industrial Applications

No current cultivation for non-food purposes. [Source: Information Centre of the Ministry of Agriculture and Forestry, Camelina Ltd].

FIBRE CROPS

Fibre flax (*Linum usitatissimum* L.), fibre hemp (*Cannabis sativa* L.) and nettle (*Urtica dioica* L.) are the potential long fibre crops in Finland. In addition, short fibres as a by-product from linseed production can be exploited. The cultivation area of fibre crops is still relatively small, besides the interest towards these crops and many research and development projects (Agrifood Research Finland, University of Helsinki, University of Oulu, University of Turku, University of Tampere, ProAgria Rural Advisory Centre South Ostrobothnia). The applications with most potential are textiles, interior fabrics, thermal insulation, packing materials, reinforced composites and growth substances for greenhouse vegetables. The newest long fibre crops are nettle and fibre hemp and the growing area is estimated to increase in the next years. Besides the attempts the short fibre used in Finland is currently mainly imported. Research on fibre production from reed canary grass (Agrifood Research Finland) has shown that in addition to biomass the crop is also suitable for fibre production for the fine paper industry. Research is also carried out on potential fibre crops not cultivated in Finland, such as jute (*Chorchorus capsularis*) and empty fruit bunch[1] of oil palms (*Elaeis guineensis*) (University of Turku). There is a lot of interest in the application of plant fibres in West-Finland (Etelä-Pohjanmaa). About ten small or medium size enterprises are specialised in the processing of flax and hemp fibres in that area alone. The annual capacity is around 700 ha in addition to 1,200 tonnes of raw fibres. Overall, the capacity to process long and short fibres is currently many fold compared to the cultivation area of fibre crops in Finland.

Flax

Production

More than 200 hectares. Potential is for 500-700 tonnes; potential dry straw yield is 5,000–7,000 kg/ha.

Industrial Applications (long fibre)

Production for non-food uses is more than 200 ha. Long fibres for textiles, speciality products from ecologically cultivated flax. [Source: Information Centre of the Ministry of Agriculture and Forestry]

[1] The parts of the plant when fruits for oil processing have been detached.

Hemp

Production

100 hectares. Potential is for 500–800 tonnes; potential dry straw yield is 5,000–8,000 kg/ha.

Industrial Applications

Production for non-food uses is 100 hectares. Long fibres for textiles, potential for reinforced composites and thermal insulation materials. [Source: Information Centre of the Ministry of Agriculture and Forestry].

Linseed

Production

2000 hectares

1,960 tonnes of straw

Yield 980 kg/ha

Industrial Applications (short fibre):

Production area for non-food uses is unknown, mostly imported. Short fibres for thermal insulation, packing materials, reinforced composites, growth substances. [Source: Information Centre of the Ministry of Agriculture and Forestry].

Nettle

Production

Approximately 10 ha are grown and 20–40 tonnes of straw produced. Yield is 2,000–4,000 kg/ha.

Potential Industrial Applications

Production for non-food uses is about 10 ha and this is used in textiles, interior fabrics and speciality products.

Reed Canary Grass

Production

2000 hectares, potential 10,000-16,000 tonnes, potential dry straw yield 5,000–8,000 kg/ha

Industrial Application

Bioenergy, also potential for fine paper production. [Source: Information Centre of the Ministry of Agriculture and Forestry].

CARBOHYDRATE CROPS

Barley *(Hordeum vulgare* L.*),* potato (*Solanum tuberosum* L.) and wheat (spring & winter) (*Triticum aestivum* L.) are the major starch crops. Raisio Food has produced the major part of starch in Finland. However, after the harvest season in 2004 Raisio will finish the production of starch of cereals in Finland. In 2002, about 113,000 tonnes of potato (Raisio), 80,000 tonnes of wheat (Raisio) and about 34,000 tonnes of barley (Altia Corporation) were processed into starch and mainly used for biopolymers, paper surfactants and starch filled paper. The total use of starch was about 200,000 tonnes, of which 95,000 tonnes was imported into Finland in 2003.

Barley

Production

529,500 hectares

1,697,400 tonnes

Yield 3210 kg/ha

Industrial Applications and Market Sizes

About 11,000 hectares for non-food use (Altia Corporation). [Source: Information Centre of the Ministry of Agriculture and Forestry]

Winter wheat

Production

34,400 hectares

117,700 tonnes

Yield 3420 kg/ha

[Source: Information Centre of the Ministry of Agriculture and Forestry]

Spring wheat

Production

156,800 hectares

561,000 tonnes

Yield 3580 kg/ha

Industrial Applications

At least 23,000 hectares (winter & spring wheat) for non-food use (Raisio). [Source: Information Centre of the Ministry of Agriculture and Forestry (production), Raisio Chemicals (use)]

Potato

Production

28,700 hectares

613,300 tonnes

Yield 21400 kg/ha

Industrial Applications and Market Sizes

The area for non-food use may be up to 30,000 hectares. [Source: Information Centre of the Ministry of Agriculture and Forestry (production), Raisio Chemicals (use)].

Sugar Beet

Production

28,800 hectares

885,800 tonnes

Yield 30 730 kg/ha

Industrial Applications and Market Sizes

Sugar beet is applied as sugar, molasses and beet pulp production. The area used for these products is unknown.

SPECIALITY CROPS

Crops producing secondary compounds and other crops

The cultivation area of biennial caraway (*Carum carvi*) has been increased during the last few years. Caraway is used as a spice and exported (Arctic Taste Ltd., Trans Farm Ltd.) to Central Europe. Research on caraway (Agrifood Research Finland) has shown that it may also have non-food applications. Essential oil production is a new field in Finland and a few small enterprises have been established as a result of a research and developing project carried out in recent years (Aromel, Karjalan Minttu). However, the oil produced from mint and other herbs are mainly used for food and alcohol production. Other recently studied herbs are *Arnica montana, Gentiana lutea, Rhodiola rosea, Panax quinquefolius* (Agrifood Research Finland), *Drosera rotundifolia, Hypericum perforatum, Rhodiola rosea,* and *Vaccinium myrtillus* (University of Oulu), which have potential in medical use. One of the few enterprises in Finland is Hankintatukku, which is specialised in nutrition and natural products and manufactures herbal products from numerous herbs. Another potential field is the application of plant-derived compounds in cosmetics and pharmaceuticals. Noiro Ltd. utilises plant-derived secondary compounds, oils and other raw materials in their cosmetic and hygiene products, which are imported especially to Baltic Sea countries. Finnfeeds Finland Ltd./Danisco A/S produces betaine from sugar beet, which is applied in addition to pharmaceuticals also in technical, fermentation and feed applications. Currently, all the betaine is extracted abroad and imported to Finland as a concentrate. Plant pigments are a third potential application area of plant-derived secondary compounds. A few hectares of crops producing pigments for animal feeds were cultivated in Finland in 2003. There are also research projects on the cultivation, extraction and application of indigo from woad (*Isatis tinctoria*) and *Polygonum tinctorum* (Agrifood Research Finland) as well as on the application of other plant-derived dyes for textiles (EVTEK Institute of Art and Design).

Crops and wild plant species cultivated for landscape use has been studied. One of the plant species of interest is *Centataurea jacea,* which may have also potential for biomass production. There are few companies producing wild flower seeds.

Caraway

Production

7,000 hectares

4,500 tonnes

Yield 1500 kg/ha

Industrial Applications

Most of the caraway is cultivated for food production. [Source: Information Centre of the Ministry of Agriculture and Forestry].

Other herbs

Production

900 hectares

Production and yield/ha varies according to the species

Industrial Application

Most of the herbs are produced for food production, but also for cosmetics and medical purposes. [Source: Information Centre of the Ministry of Agriculture and Forestry].

Sugar Beet

Production

28,800 hectares

885,800 tonnes

Yield 30 730 kg/ha

Industrial Applications and Market Sizes

Betaine from sugar beet is used for technical, pharmaceutical, fermentation and feed applications. Currently, betaine is not extracted from domestic raw material whereas all the betaine is produced abroad. [Source: DANISCO Animal Nutrition, Information Centre of the Ministry of Agriculture and Forestry].

Table 1

Total cultivation area ('000 ha) of crops also used for non-food purposes in 1995-2003

[The areas cultivated only for non-food purposes are not available].

	1995	1996	1997	1998	1999	2000	2001	2002	2003
Fibre crops									
Fibre flax	0	0.5	1.0	0.8	0.9	1.1	0.4	0.2	0.1
Fibre hemp	0	0	0.1	1.3	0.1	0.1	0.1	<0.1	<0.1
Nettle	0	0	0	0	0	<0.1	<0.1	<0.1	0
Reed canary grass	0	0	0	0.3	0.5	0.6	0.6	1.5	2.7
Oil crops									
Linseed	0.1	2.1	2.3	2.1	2.3	1.4	1.6	1.4	2.0
Spring turnip rape	8.4	60.5	59.3	63.6	60.9	51.3	72.1	66.2	73.7
Spring rape	0.1	0.7	1.3	1.2	1.5	1.3	1.1	1.3	1.2
Carbohydrate crops									
Barley	516.2	542.5	582.8	578.1	581.0	559.0	547.2	522.6	530.2
Potato	36.1	34.8	33.2	32.8	32.3	32.2	30.0	29.8	28.5
Wheat	100.7	112.5	124.8	137.2	117.7	149.9	144.6	174.5	191.3
Speciality crops									
Herbs*	0.2	1.8	1.9	1.5	1.4	2.5	3.6	5.5	0.9
Caraway									7.0
Sugar beet	34.8	34.7	34.9	33.2	24.8	32.2	31.1	30.6	28.8

* Including caraway until the end of 2002

Source: Information Centre of the Ministry of Agriculture and Forestry: Integrated Administration and Control System (IACS) 1995-1999, 2003 and 2000-2002 Information Centre of the Ministry of Agriculture and Forestry: Integrated Administration and Control System (IACS) and separate statistical survey of farms that have not applied for support.

Table 2

Summary on the production and application of industrial crops in Finland in 2003

	Cultivation area ('000 ha)	Yield (tonnes/ha)	Domestic production (tonnes)	Export (tonnes)	Import (tonnes)	Used in non food production (tonnes)
Fibre crops						
Fibre flax	0.1	5-7	500-700	0	**	500-700
Fibre hemp	<0.1	5-8	500-800	0	**	500-800
Nettle	0.01	2-4	20-40	0	**	20-40
Linseed (short fibre)	2.0	1,6	3,200	0	**	0
Reed canary grass (bioenergy)	2.0	5-8	10,000–16,000	0	0	10 000–16 000
Oil crops						
Linseed	2.0	0,980	1,960	0	**	100
Spring turnip rape	73.7	1,260	93,600	0	**	500 (oil)
Spring rape	1.2			0	**	
Carbohydrate crops						
Barley	530.2	3,210	1,697,400	0	**	48,000 (starch)
Potato	28.5	21,400	613,300	0	**	60,000 (starch)
Wheat	191.3	3,550	678,700	0	**	33,000 (starch)
Speciality crops						
Herbs*	0.9			**	**	Not known
Caraway	7.0	1	4,500	**	**	0
Sugar beet (as betaine)	28.8	30,730	885,800	**	all	**

** The amount of exported or imported raw material is not known.

People and Organisations Contacted

This report was updated by interviewing the following academic, industry and technology transfer specialists. The persons are listed here in alphabetical order (Last name, first name).

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