

IENICA

Interactive European Network for Industrial Crops and their Applications

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REPORT FROM THE STATE OF DENMARK

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METHODOLOGY

Finn Rexen, Bioraf Denmark Foundation, has prepared this report. The information given has mainly been achieved through interviews with stakeholders, including industries and research centres, and the statistics are based on official statistical yearbooks (Danmarks Statistik, 1998 and 2003). The following organisations have been contacted:

- Grønt Center, Holeby
- Danmarks Jordbrugsforskning, Foulum
- Danmarks Jordbrugsforskning, Årslev
- Danmarks Jordbrugsforskning, Flakkebjerg
- Danish University of Agricultural Sciences
- Research Centre Risø
- Landbrugets Rådgivningscenter, Århus
- Århus Olie
- AKV Langholt
- Biosystemer, Ålgårde

EXECUTIVE SUMMARY

Developments in the non-food area since 1997:

The production of crops for non-food use (with the exception of bio-energy) has declined. The application of biomaterials in non-food industries has also declined.

There are exceptions to this, however:

- Danish producers of food packaging materials have thus shown interest in the use of biodegradable polymers and two food packaging factories are now using PLA and starch derivatives in their products. The bio-polymers are imported.
- Two new fibre tech centres have been established.
- The production of medicinal plants is modest, but growing and interest amongst growers is increasing.
- A new centre for medicinal plants and horticulture was set up in 2002.
- In December 2003 a consortium (PBD) was established in an effort to strengthen the plant genomics research in Denmark. All the major institutions involved in plant biotechnology research in Denmark are part of PBD.

OIL CROPS

As in 1998, only two major oil crops are grown in Denmark: rapeseed and linseed.

Rapeseed

Production

The average yield per hectare has not changed much since 1997. Today it is 2.6 tonnes per hectare. Table 1 shows the area of rapeseed grown in 1997 and 2002 respectively. Of the total rapeseed production, non-food rape constituted 9.5% in 1997, while in the year 2002 the percentage has declined to 7%. The total production has declined by 24% from 1997 to 2002.

Table 1. Production of rapeseed in Denmark in 1997 and 2002 (tonnes)

	1997	2002
Winter rape	223,000	208,000
Spring rape	68,000	12,000

Source: Danmarks Statistik, 2003

Industrial Application

As in 1997, Denmark's largest oil mill – Aarhus Oliefabrik - manufactures speciality fats and oleochemicals for the cosmetic and pharmaceutical industries. Since 1997, Aarhus Olie has been involved in the development of new biological hydraulic oils and cutting fluids from rapeseed oil. This work has, however, not yet led to any significant increase in the use of rapeseed oil for non-food purposes, and today the company is only producing rapeseed oil for the food and cosmetics markets.

Two other oil mills - Scanola and Dan raps - do not produce for the non-food market, while a third mill - Emmelev Mølle - produces biodiesel. Biodiesel cannot compete with fossil diesel in Denmark, as there is no domestic tax exemption on biodiesel. Therefore, the entire production is exported primarily to Germany.

Linseed

Production

The average yield of linseed has been relatively constant in this period - 1.2 tonnes/ha, but production has reduced from 3,500 hectares in 1998 to a few hundred hectares in 2003. In the same period the demand for linseed oil has increased. Danish farmers cannot compete with linseed grown in Eastern Europe e.g. Poland, Hungary – and Canada. Therefore a major part of the linseed crushed in Denmark is imported. Also, linseed oil is imported.

Industrial Application

Only a few farm-scale oil mills are producing linseed oil, mainly from imported seeds. The market is expanding, and also linseed oil is imported in increasing (but still small) amounts. Linseed oil is mainly used for wood preservation and in paints and varnishes. A new application for the oil is as chicken feed.

FIBRE CROPS

The production of fibre crops is very limited in Denmark. About ten years ago a revival of interest was expected, and a 'Centre for Plant Fibre Technology' was established in 1996. Two universities, two research centres and one commercial company made up the Centre. The Centre still exists officially, however the joint research activities are today rather modest, and the expected revival of interest in growing and processing of fibre crops has not yet been seen. Interest for fibres does however still exist: a few years ago the 'Fibre Tech Centre' was established. The Centre focuses on the establishment of new fibre-based productions and is composed of a research Centre – 'Green Centre', and an innovation centre – 'Syd Tech' and co-operation agreements with industries and the 'Danish Design Centre' have been set up. At the research Centre Risø a new department called 'Biomass for Energy and Materials' is under establishment.

The main crops grown for fibre in Denmark are flax and miscanthus.

Miscanthus

Production

Miscanthus is an efficient producer of biomass and therefore well suited as an energy crop. It is also a fibre crop, however, with good quality fibres. Production in Denmark is modest: 40–50 hectares, and the yield varies considerably from year to year depending on the weather conditions during the growing season.

Recently, 10-15 ha of miscanthus was established on the island of Samsø to be used for local energy production.

Industrial Application

A Danish company, Nordic Biomass, has developed a system for the establishment of Miscanthus fields. The system is based on the use of rhizomes instead of plantlets. A rotary cultivator disintegrates the mother culture and the rhizomes are picked up with a stone picker. The rhizomes may then be planted in rows in a pre-selected depth with a newly developed

machine. This procedure reduces the cost of establishment considerably. Nordic Biomass exports rhizomes to the UK, Germany and Norway.

For some years Miscanthus has been used as thatching material on an experimental basis. Now a commercial thatching company on the island of Lolland is using Miscanthus on a commercial basis.

Flax and Hemp

Production

Flax and hemp are the oldest industrial crops in Denmark. At its peak in 1948, 18,000 hectares of land was used for the production of both linseed and textile flax. In 1998 the flax area constituted approximately 3,500 hectares, while today the production has almost terminated due to poor economy.

The Danish hemp production has always been modest. In 1942 hemp was grown on 2,000 hectares, but after the War hemp production was forbidden. However, the production of hemp containing low amounts of psychoactive components was allowed in 1998. This created some interest for hemp production, but the actual commercial production is still negligible.

Industrial Application

Until 1999 Denmark had a small production of moulded products for use in the car industry and tow for mattresses. The raw materials used were flax by-products (shieves and tow) imported from Poland. The factory, Danflax, had to close down due to financial problems, however the previous owner has recently started up a new company, Bio7fibre that shall produce high quality fibres from imported hemp and flax. The company has established close links to a University (Roskilde Universitet) and a research centre (Risø, Biomass for Energy and compounds).

In Saxkøbing, a small factory for the production of insulation mats from flax, hemp and waste paper was established in 2000. The factory has run into financial problems and production has now stopped. A reconstruction is currently under consideration.

CARBOHYDRATE CROPS

Carbohydrate crops are the dominating crops in Denmark. They are mainly used for the production of food and feed, however potato starch is to some extent also being used in the non-food industry.

Cereals

Production

Cereals are the dominating crops in Denmark. 8.8 million tonnes are produced annually. The main crops are wheat and barley, while oats and rye are produced in small amounts. More than half of the production is used as feed. In 1998 only 8% was processed, 5% was used for food and 3% for other industrial uses. In 2002, 7% was processed and 58% was used as feed.

Table 2. Cereal production in the years 1997 and 2002 (tonnes)

	1997	2002
Winter wheat	4,902,000	4,013,000
Spring wheat	63,000	46,000
Rye	453,000	230,000
Winter barley	1,047,000	654,000
Spring barley	2,840,000	3,466,000
Oats and mixed grains	155,000	276,000

Source: Danmarks Statistik

The average yields are:

Winter wheat: 7.09 tonnes/ha

Spring wheat: 4.22 tonnes/ha

Winter barley: 4.84 tonnes/ha

Spring barley: 5.57 tonnes/ha

Rye: 4.94 tonnes/ha

Oats and mixed grain: 4.99 tonnes/ha

Industrial Application

Danish-produced cereal grain is not used for non-food purposes. There are no cereal starch factories, but each year approximately 8,000 tonnes of wheat starch and starch derivatives are imported.

The Danish Centre for Food Research has for some years performed research on packaging materials based on biological raw materials and two companies are now producing biodegradable films and trays for vegetables and meat from starch and PLA. The production has started recently, and the quantity is still modest.

Potatoes

Most of the potatoes are used for direct consumption as food. However, Denmark has for many years produced potato starch, and the Danish quota is completely utilised. Approximately 25% of the starch is used in the non-food sector in more than 500 different products, making potatoes the most important non-food crop in Denmark

Production

Danish potato production has remained relatively constant for many years, as is seen in Table 3. The average yield is 35 tonnes/hectare. This figure represents huge variations. Some growers produce as much as 50-60 tonnes/hectare while others are well below average.

Table 3. Production, import and consumption of potatoes (tonnes)

	1997	2002
Production	1,545,000	1,504,000
Imports	249,000	212,000
<i>Utilisation</i>		
Export	116,000	197,000
Seed potatoes	108,000	91,000
Industry	880,000	763,000
Other manufacturing	16,000	64,000
Human consumption	300,000	306,000

Source: Danmarks statistik

Industrial Application

Denmark has 4 starch factories today (5 in 1998), of which 3 are merged in a co-operative, KMC, owned by more than 2000 growers. The fourth factory, AKV Langholt, is partly owned by farmers and partly by CERESTAR (Cargill). The potato starch producers meet tough competition from especially cheaper maize starch. Potato starch still has a better quality than maize starch, but the quality difference has diminished due a considerable quality improvement of maize starch.

The four factories use approximately 900,000 tonnes of potatoes per year for production of up to 170,000 tonnes of starch, equal to the Danish quota. The quota has been reduced by 5% since 1998. The Danish factories are concerned about the European Commission's decision to allocate quotas to the new members, especially Poland, and thus allowing for an expansion of the European potato starch production.

KMC only produces for the food industry, while 80% of the production – mainly starch derivatives - from AKV is sold to the non-food industry, mainly the paper industry. Approximately 32,000 tonnes is used for non-food purposes.

Both KMC and AKV utilise the fruit juice for the production of protein (approximately 2,800 tonnes/year), and the potato pulp is used as feed. The starch factories have initiated a development programme to upgrade the by-products to products for human consumption in an effort to improve the overall economy.

Sugar Beet

Production

In 1998 Denmark produced 3,367,000 tonnes of sugar beet for industry and 250,300 tonnes of fodder beet. In 2002 the figures were 3,385,000 tonnes and 717,000 tonnes respectively. The production of sugar in 2002 was 521,000 tonnes, while the import constituted 275,000 tonnes. 12,900 tonnes was used in the chemical industry.

Industrial Application

Denmark has 3 sugar factories. Only a very small part of the sugar produced in Denmark is used for non-food purposes. The by-product, molasses, is used as feed and to some extent also as a feedstock in the Danish fermentation industry.

A small quantity of sucrose derivatives is imported for use in the production of detergents, emulsifiers and adhesives.

SPECIALITY CROPS – MEDICINAL PLANTS

Medicinal plant cultivation in Denmark is mainly concentrated on two islands – Lolland and Fyn. On Lolland the research Centre ‘Green Centre’ offers extension service to the growers, while on Fyn the ‘Research Centre Årslev’ is involved in the development of new plants, chemical analysis and testing of the effects.

In 2002 “Udviklingscenter Årslev” was established. It has an objective to strengthen Danish horticulture and the production of medicinal plants. It is publicly and privately financed. A co-operation between Årslev Research Centre, Syddansk University and the University hospital in Odense has been established. On Fyn there are approximately 25-30 growers of medicinal plants. Årslev has, together with industry and growers, screened 20 plant varieties and 6 were selected as potential commercial crops.

Ginseng

Field trials at ‘Green Centre’ on the island of Lolland have confirmed that ginseng grows well in Denmark, and the yield of active components is at a satisfactory level. Therefore there has been interest amongst farmers in establishing a commercial ginseng production. It is, however, very costly to establish and maintain a ginseng field. It takes three years from the establishment to the first harvest, and the cost in this period might reach up to 600,000 DKr/ha (80,000 €). Besides, there are not yet any extraction facilities suitable for ginseng extraction in Denmark, therefore the crude material has to be exported. The result is that so far only 2-3 ha has been established on a commercial scale.

***Echinacea purpurea* L.**

Since 1998 purple cornflower has been grown commercially in Denmark. Besides its use in herbal remedies for humans, extracts are used as a “growth promoter” in animal feed. The actual production size is not known.

Dog-rose

Dog-rose is grown on the island of Langeland. Patients with rheumatism use the dried and finely ground seeds as a pain releaser.

Willow

A modest production of extracts from willow has started recently. The extracts contain salicin, which in the human gut is transformed to salicylic acid. It is claimed that the product does not have the negative side effects associated with synthetic salicylic acid.

GENERIC ISSUES

On 1st December 2003 a consortium (Plant Biotech Denmark, PBD) was established to strengthen the plant genomics research in Denmark. The consortium consists of the major institutions engaged in plant biotechnology research in Denmark. They are: Risø National Laboratory, Danish Institute for Agricultural Science, The Royal Veterinary and Agricultural University, Aalborg University, University of Copenhagen, University of Aarhus. 284 persons, including 142 scientists and 77 PhD students will be involved in PBD.

The intention is to create a viable national platform that makes it possible for Danish scientists to join with other European plant genomics programmes to establish the European Research Area (ERA net).

Plant Biotech Denmark aims at developing low input, high quality crops to sustain agricultural production in Europe and to improve food supply in Third World countries.