DENMARK:

COUNTRY REPORT TO THE FAO INTERNATIONAL TECHNICAL CONFERENCE ON PLANT GENETIC RESOURCES

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Note by FAO

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CHAPTER 1
Introduction to Denmark and its Agricultural Sector

1.1 BASIC INFORMATION ON DENMARK

Denmark covers an area of 43,000 thousand ha. In the south, Denmark borders on Germany. The average annual precipitation lies between 500 and 800 mm and the potential evapotranspiration is 450 mm. The climate is coastal and relatively stable with an average spring temperature of between 10 and 11,5°C and an average autumn temperature of 12,5 to 14,5°C. In 1975, the annual average temperature for Denmark as a whole was recorded to have risen by 1°C over a period of 100 years. Denmark has no mountains, the highest point, Yding Skovhoj, measures 173 m o.s.l.

Agriculture was slowly introduced 6,000 years ago at a time, when Denmark was covered with forest. In the eastern part of Denmark the soil consists of glaciation deposits around 12,000 years ago formed during the last glaciation (Weichselian) and in the western part the soils are sandy and around 50 - 60,000 years old. The quality and fertility of the Danish soils are very varied with no distinct borders between soils of different quality. From 1850 the cultivated land increased. Marginal areas were taken into production and in spite of national differences in soil quality, Denmark is a fertile and easily cultivated land, compared to other countries. This is confirmed by the figure 76 per cent, which was the total cultivated area reached in 1983. However, since then areas have been taken out of production, mainly due to house buildings, public purposes, afforestation and marginalization. In the coming years this trend towards a further afforestation and marginalization will continue.

Denmark has a population of 5,162 million which gives an average density of 120 persons per km^2. This figure has since 1980 been stable although the percentage of young people is declining. The population is expected to rise by 2 per cent annually until around year 2005. In order to keep the rural areas populated efforts are made to maintain jobs, in a hope to avoid a depopulation. A depopulation is seen especially of the many small islands.

1.2 THE AGRICULTURAL SECTOR

The Danish landscape is a cultivated landscape. It is very influenced by the agricultural sector which is managing 64 per cent of the total area, meadows account for 1,5 per cent, forests and plantations for 11 per cent and cities and roads account for 22 per cent.

Since 1970 Danish agriculture has been characterized by a rapidly increasing plant production. The main farming system is an intensive high input production system whereas organic farming is only accounting for less than 1 per cent of the Danish cultivated areas.

The total number of agricultural holdings has decreased over the past 15 years and this reflects a structural change towards larger farms. There has been a considerable fall in the number of small farms whereas the number of farm holdings of more than 30 ha has increased.

Parallel with this development, the production at each farm has become more specialized, e.g. towards production of only one type of product. The number of farms with only crop production has increased, fewer farms have mixed animal productions. The total number of cattle has declined, the total number of pigs has increased, and the total production of manure has increased.

Simultaneously a geographical structural change has taken place with livestock holdings being concentrated in Western Jutland, mainly on the poor soils. This trend affects the regional difference in Denmark in three ways:

- employment, since livestock holdings are more labour intensive
- the regional amount of manure and slurry produced
- the environment.

1.3 THE LINKS FROM BREEDING TO FARMING, THE ROLE OF PRIVATE COMPANIES

Plant breeding in Denmark is done by private companies, mainly by the companies listed below:

Plant breeding companies

Danish Potato Breeding Foundation, Abed Research Station, The Pajbjerg Foundation, Sejet Plantbreeding, DLF - Trifolium Research Division, Danisco Seeds, Axel Toft Ltd., Carlsbergs Plantbreeding and D.Thnfelt Ltd and Vikema Seed Ltd.

Approval of new varieties

The Plant Directorate under the Ministry of Agriculture and Fisheries is responsible for the approval of new varieties. As of 3 1. December 1994 a total of 609 varieties of agricultural species and 264 varieties of vegetable species were included in the official variety list. As of the same date 1,495 varieties were granted plant breeders' rights.

The technical testing of the new varieties are on a contractual basis tested by The Danish Institute of Plant and Soil Science, on behalf of the Plant Directorate.

Supply systems of seeds

Production and supply of seed for sowing (cereals, pulse and oilseed) is in Denmark normally conducted by the grain and feedstuff companies in close cooperation with the plant breeding companies.

Grass and leguminous seeds are dealt with by seven companies contract with farmers for the production and they purchase the production. In 1994 the Danish production was around 60,000 t of grass and leguminous seeds. 54,000 t were exported (90 per cent). This figure demonstrates that the Danish companies are high class, and the Danish export is among the largest on the world marked.

Grain and feedstuffs

The agricultural crop production is of great significance for the livestock production and for a number of years the domestic production has supplied about three quarters of the total feed consumption. In 1993, 66 per cent of the total production of cereals was used as feed in the animal production. The rest was sold to mills, breweries etc. and exported. 75 per cent of the turnover

of seed and feedstuffs is also covered in country, by the 52 Danish companies, which are organized in The Danish Feed and Grain Trade Association.

1.4 MAJOR CROPS FOR FOOD AND AGRICULTURE

Cereals

The total area grown with cereals has declined over two decades. Today 52 per cent of the total cultivated area is covered with cereals, whereas the per cent was 63 per cent in 1980. The decline is especially marked for barley, which declined by 200,000 ha from 1992 to 1993.
Figures showing the agricultural area by type of cereals are shown in figure 1.1.

The amount of wintergrown cereals has increased from 16 per cent of the total agricultural area to 30 per cent in 1992 due to a higher yield/ha from these crops, a better distribution of work and with a view to complying with the requirements concerning wintergrown areas as part of two legislative initiatives to reduce nitrogen leaching in the autumn and winter. From 1993-94 there has been a small decrease in the wintergrown areas (decrease < 2 per cent).

Table 1.1 Cereal production 1000 ha

	1991	1992	1993	1994
Wheat, winter *Triticum aestivum*	507	567	609	560
Wheat, spring *Triticum aestivum*	12	15	11	13
Rye *Secale cereale*	80	88	77	88
Barley, winter *Hordeum vulgare*	140	151	176	182
Barley, spring *Hordeum vulgare*	795	760	534	518
Oats, *Avena sativa* and others	21	28	28	40
Mixed grains	3	3	3	4
Total cereal area	**1558**	**1612**	**1438**	**1403**

Denmark's reliance on cereals is seen in figure 1.2 (1993/94). More than 2/3 is used for consumption and feedstuffs and around 1/4 is exported.

Figure 1.2 Reliance on cereals

	mill t
Production	8,0
Stored - import	1,1
Available	9,9
Consumption and feedstuffs	6,2
Export	2,2
Final stored	**1,5**

Pulses and root crops

In figure 1.3 the areas used for pulses and root crops are listed. The areas grown with pulses have increased from 0.2 per cent of the total Danish area in 1980 to 4.3 per cent today.

Table 1.3 Areas used for pulses and root crops 1000 ha

	1991	1992	1993	1994
Fields Oea, *Pisum ssp arvense*	-	-	119	100
Pea for ripenes	-	-	0,8	0,4
Pulses total	**99**	**118**	**120**	**100**
Potatoes	41	52	46	38
Sugar beets for sugar production	65	65	66	66
Fodder beets	92	79	70	60
Sweeds and other roots for fodder	1	1	0,8	0,6
Root crops total	**201**	**199**	**184**	**165**

Seeds for industrial use and for sowing

The area covered by seeds for industrial use has been doubled from 1980 until 1992, whereas the area with seed for sowing has only increased by 0.3 per cent in the same period. The production of rape seed increased until 1991 (see figure 1.4) but from 92/93 it decreased simultaneously with the GAP-reform and from 93 to 94 there has been a further decrease even though the area used for spring rape has increased.

Table 1.4 Seeds for industrial use and for sawing 1000 ha

	1991	1992	1993	1994
Winter rape	203	118	136	96
Spring rape	76	63	27	73
Spinning and oil flax	0,7	0,8	0,4	0,9
Mustard, poppy and caraway	0,4	1,1	0,2	0,6
Seeds for industrial use, total	**280**	**181**	**164**	**171**
Seeds for sowing	48	52	56	53

Grass and green fodder in rotation/out of rotation

Arable products grown in Denmark are of vital importance in the livestock production and the Danish products account for 75 per cent of the consumption of feeds in the livestock production. In figure 1.4 the area used for grass and green fodder in rotation/out of rotation are listed. In 1993, the GAP-reform resulted in 193,000 ha set aside in Denmark, which is around 7 per cent of the total area.

Table 1.5 Grass and green fodder in rotation/out of rotation 1000 ha

	1991	1992	1993	1994
Lucerne	10	11	11	11
Maize for green fodder	19	20	26	31
Cereals for green fodder	54	64	68	78
Pulses, fodder cabbage and other green fodder	2	3	2	3
Grass and clover field in rotation	250	255	287	330
Grass and green fodder in rotation, total	**336**	**353**	**395**	**452**
Permanent grassland out of rotation	212	207	197	317

Horticultural production and greenhouse production

The production figures in ha for horticultural products in Denmark are given in figure 1.6. The production of vegetables grown in glasshouse has from 90-93 been stable, but prices have declined by 16 per cent compared to 1991.

Table 1.6 Horticultural production 1000 ha

	1991	1992	1993	1994
Vegetables grown in the open..	15	16	15	13
of which pea for canning	9	9	9	6
Bulbs and flowers for cutting	0,2	0,3	0,4	0,3
Apples	2	3	2	2
Pears	0,5	0,4	0,4	0,3
Strawberries	1	1	1	0,9
Other fruit and berries	4	5	5	5
Nursery area	3	3	3	4
Horticultural production, total	**27**	**29**	**28**	**25**
Greenhouse area	0,6	0,6	0,6	0,5

The production of ornamental plants (pot plants) is the most intensive production within Danish horticulture. It accounts for 2/3 of the total production in Danish greenhouses, 80 per cent of the production of ornamental plants is exported equaling a value of 2.2 mia DKK. Pot roses are dominating on the Danish market, and efforts have been made to find fast growing, homogeneous and durable varieties. The export figures for ornamentals, fruit and vegetables will appear in figure 1.7.

Table 1.7 Export 1000 DDK

	1989	1990	1992
Nursery plants	120	131	144
Fruit and vegetables	68	116	150
Ornamentals	2445	2595	3137
- of which: pot plants	1838	1979	2239

1.5 TRENDS IN PLANT PRODUCTION

Headlines in the changed circumstances for plant production the last few years are:

- growing awareness on the impact on the environment
- production systems
- surplus production
- consumer demands for quality

These four items are not separated but interlinked both according to reasons for being highlighted and with respect to possible solutions.

Growing awareness of the impact on the environment

In recent years, impact of nutrients from the high input Danish agriculture on the environment has been brought into focus. This resulted in a government plan for a sustainable agriculture.

The consumption of fertilizers peaked in the period 83/94 but has declined since, and today Danish agriculture uses around 20 per cent less than in 1980. Between 1980 and today the area grown with winter crops has increased and as a consequence of this, the consumption of fertilizers seemed to increase, but during the last three years the demand has fallen again. This last fall can be explained by improved farming practices, including a better management of manure and slurry. The consumption of nitrogen has declined by 15 per cent, the consumption of potassium has declined by 25 per cent and the consumption of phosphates has declined by 43 per cent.

The attempts to decrease nitrogen leaching covers legislated instruments such as "Winter green areas", to prevent leaching of N in the autumn and winter, because winter green areas are expected to function as a catch crop. As a consequence of this environmental legislation winter green fields made up more than 80 per cent of the land in 1990 (set aside areas included).

Only recently the impact of pesticides on the environment has been brought into focus. The use of pesticides reached a peak in 1984. Since then the consumption has declined in terms of kg of ingredients (29 per cent fall) and in terms of number of treatments. The goal, a 50 per cent reduction, set in the government's Pesticide Action Plan, is difficult to fulfill particularly in terms of number of treatments - but research and extension have been strengthened to help farmers reduce pesticide use.

Production systems

As a result of this growing awareness attention has been drawn to the production systems, and the Danish minister for agriculture and fisheries has very recently, in March, announced a plan of action for organic farming, setting goals for the size of the organic production. Five years ago 219 holdings were run organically covering a total area of 5,400 ha. However, this area has increased and today Denmark has 683 organic holdings covering an area of 20,000 ha.

Integrated farming system is another important topic, and these trends indicate a change in farming practices and of farming systems which will also involve great challenges for the breeding and plant science.

Consumer demands for quality

Furthermore, the more massive consumer demands with regard to quality and wholesomeness of products and production ethics provide new possibilities of changing the high input agricultural systems which have become so well-known in western Europe over the last decades.

Surplus production

As a result of the surplus agricultural food production in the EU and the attempt to solve this by among other instruments by set aside have e.g. resulted in a shift towards more attention given to non-food production. There is a political wish to develop and expand this production and more focus has to be put on crops developed for non-food production. The EU set aside scheme for 1990-95 has resulted in 220,000 ha taken out of production in 1993 and 259,000 ha in 1994, which is around 10 per cent of the total agricultural area. 46,000 ha of the 259,000 have been grown with non-food crops, mainly rape seed.

The weather

The climatic conditions in Denmark are relatively stable, if compared to other countries. Even though the dry year 1992, regionally, ended with disasters, effects from unexpected weather conditions are seldom seen in Denmark.

1.6 TRENDS IN PLANT BREEDING

For years producers demands have set the targets for the breeding. This means that mainly high yield, and to some extent also looking and quality has been the most important breeding parameters, in the main agricultural crops.

Breeding goals

For the major crop species the most important breeding goal as above mentioned has been high yield as a main prerequisite for economical production. Quality traits like baking quality in wheat, malting quality in barley, double low quality (low erucic acid, low glucosinolate) in oil seed rape in addition to the yield progress have never the less considerably improved the value of the production.

In breeding of beet the sugar yield or dry matter yield (sugar and fodder beet, respectively) have been the major goals but several quality traits facilitating industrial processing, especially in sugar beet have also had importance.

In the potato breeding the yield is in many cases the safest way to success for a new variety, but depending on the variety for consumption, or industrial processing (chips, French fries, starch production) quality traits have been quite important in this species.

Resistance

In all the major crop species incorporation of a high degree of resistance towards major fungal and viral diseases in new varieties has had high priority. This has mainly been achieved through introduction of new highly efficient resistance genes.

Breeding vegetables and ornamentals

In breeding of vegetables like cabbage and carrot the importance of quality characters like appearance, uniformity, and taste generally are more pronounced than the total yield compared to what is the case for the major crop plants. As for the crop plants, however, disease resistance towards fungi has been very important too.

Quality traits have been the most important goals for breeding of ornamentals where yield cannot be measured except on an economic scale where traits like earliness, short maturity time, and uniformity show their importance. Breeding for pest resistance in ornamentals has been relatively little important, since the intensive production enables chemical or biological pest control.

Towards a more environmentally neutral production

The changes in attitudes towards a more environmentally neutral production in agriculture has its impact on the breeding programmes because new varieties should maintain good economy in the production with less energy, chemicals and fertilisers invested. In the major crop plants new varieties with high yield will still be the most competitive in the production but the tendency to more specialization within species into diversified types based on quality characters for consume or special industrial purposes will be more pronounced. This trend will underline the importance in the future of identification and incorporation into adapted breeding material of new genetic traits.

Product quality being tailored

Increased diversification of new varieties into special types with quality traits meeting the demands from special consumers and industrial processors will need identification and characterisation of new quality traits. This trend is already seen in breeding of oil seed rape where introduction of hybrid varieties

are supposed to maintain or increase yield levels while the product quality is being tailored to fit very special demands from both oil industry and animal producers. Similar trends are appearing in potatoes where varieties become increasingly specialized towards special industrial products like chips, starch etc.

The present diversification of cereal varieties into baking and fodder types (wheat) and brewing and fodder types (barley) will be intensified in the future where special demands will be raised from consumers for special types of wheat for bread, high malting capacity with reduced addition of chemicals and quality of the fodder types that meet the demands of balanced nutrition for animal production.

Breeding demand for biotechnologically based techniques

On the technical level the trends in the breeding will demand further introduction of new biotechnologically based techniques for efficient manipulation of genetic systems i.e. Haploids for homozygotisation, genetic markers for efficient backcrossing, protoplast fusion for exploitation of male sterility and interspecific hybridization, and gene transfer techniques.

CHAPTER 2
Indigenous Plant Genetic Resources - Focusing on Crop Plants

Compared to the time when Denmark was covered with forest - the country has undergone a dramatic development towards an open landscape, both created by and dominated by the agricultural production.

In Denmark, as well as in other industrial countries, the number of indigenous species is decreasing both qualitatively and quantitatively even if the status of the threatened Danish vascular plant species is discussed.

At the same time, due to human influence a number of anthopocorous species are increasing. Many environmentalists mainly focus on the indigenous and naturalized species, the potential for pollution of their gene pool from cultivated, agricultural plants or from non-naturalized species.

In 1988, the Danish National Forest and Nature Agency under the Ministry of Environment set up a committee on threatened species of plants and animals. The lists of these species are published in the Red Data Book, but the committee decided to supplement its work with two new categories for more common species; one for species which have decreased dramatically, and one for species in need of special protection. The species of the lists are e.g. used as arguments for conservation, with the purpose of preserving as much genetic diversity as possible. Of the 3176 species listed, 261 are vascular plants, and from the list plants count for 22 per cent, and 5 per cent of the listed species lives in arable land and 59 per cent lives in forests.

2.1 WILD SPECIES AND WILD RELATIVES OF CROP PLANTS

Wild relatives of crop plants

The overview over the numbers and species of wild relatives to crop plants is far from what it ought to be. There are a need for additional surveys in this field.

Hardly any crops for food and agriculture are indigenous to Denmark. Exceptions are e.g. Bramle Rubus, and the herb, chives (*Allium schoenoprasum*). The cultivated lines for chives are genetically very similar to the wild population. The Danish wild population at Bornholm is geographically isolated and its unique properties need to be examined for reintegration in the cultivated lines.

Other species exists as breeding lines as well as wild lines: e.g. celia root *Apium gravolens,* beet *Beta, Brassica* and some grasses, the genera *Lolium, Festuca, Poa, Dactylis, Phleum* and *Trifolium.*

Wild species

Systematic recording in Denmark of the distribution of vascular plant species began early this century when the Topographical Botanical-Investigations (TBU) was established. Since then records have been reported and added to the TBU-archive. This impressive mapping of the wild vascular plants in Denmark is revised and updated these years, and this means that it should always be possible to find a specific species *in situ* from the TBU-archive.

2.2 LANDRACES AND MODERN VARIETIES OF CROP PLANTS

Since agriculture started replacing forests in Denmark, the plants used in agriculture have been developed. A continuous cultivation of wheat and barley has taken place. These crops have thus passed through several generations, have become genetically very diverse and have adapted to the Danish local climate and environment. Other species were domesticated later e.g. rye and oats, and other crops have been cultivated later but still been well adapted to Danish conditions.

In figure 2.1 the accessions of Danish origin preserved in the Nordic Gene Bank is listed.

Table 2.1 Danish seedmaterial preserved in Nordic Gene Bank (number of accessions)

Group	*Species*	Varieties	Landraces	Wild	Breeding	Total
Cereals	*Aegilops*	560	313	107	643	1779
	Arena	0	0	8	0	8
	Hordeum	191	12	10	15	247
	Secale	218	261	13	340	935
	Triticale	19	0	3	1	24
	Triticum	2	0	0	0	3
		130	40	73	287	562
Potatoes		4	0	0	0	4
Forage		214	1	224	0	439
Vegetables		416	0	8	5	429
Root, oil, pulses		91	3	648	59	802
Others		2	0	0	0	2
Total		**1287**	**630**	**987**	**707**	**3455**

A limited number of stands of old varieties of agricultural crops exist partly distributed in Denmark. The stands are often small and normally without any protection of conservation. These stands are characterized as non-persistent-cultivation.

2.3 FOREST GENETIC RESOURCES

A survey of national forest genetic resources, based on a questionnaire was conducted by the Tree Improvement Station under the then in force Ministry of Environment.

The survey is a FAO questionnaire and is enclosed as annex 2c.

CHAPTER 3
National Conservation Activities

Danish efforts to conserve plant genetic resources are mainly grouped to either cultivated species or wild species.

Strategies and work to conserve and utilize plant genetic resources for food and agriculture are centred around the Nordic Genebank. The efforts have been undertaken long before the international focus was put especially on national activities, therefore Denmark's activities are part of the collaboration between the Nordic countries in NGB as a regional center for PGR. As a consequence of this Denmark has no specific national programme for plant genetic resources for agriculture but Denmark is an active part of the Nordic network.

3.1 THE NORDIC GENE BANK, NGB

The Nordic Gene Bank (NGB) was officially established on January 1, 1979, as a joint Nordic undertaking. It reports to the Nordic Council of Ministers (NMR), an executive assembly which promotes cooperation between the Nordic countries: Denmark, Finland, Iceland, Norway and Sweden. It is situated at Alnarp, southern Sweden, around 10 km north of Malmî.

NGB works within a budgetary framework agreed between NGB and the Nordic Council of Ministers. Roughly 1/4 of the budget is allocated to projects related to the use of genetic resources. International cooperation of direct value for the institution is also covered by the ordinary budget. Other activities, such as development projects or extra duties that NGB has to carry out as a consequence of the Convention on Biological Diversity, have to be funded from external sources. For the period from 1993 to 1995 the budget agreed upon between NMR and NGB is approximately 32.5 million SEK.

The organization of NGB

NGB is headed by a Board of Trustees composed of two members from each Nordic country, being chosen by the countries, one with a central position in

agricultural or horticultural administration, the other with a central position related to plant breeding.

At the moment, NGB has six permanent inter-Nordic crop working groups: Cereals, Fruit and berries, Potatoes, Forage plants, Vegetables and Roots, and Oil-plants and pulses, each as a rule with one member from each Nordic country. The members are crop experts and they also act as NGB's extension arm in their countries, organizing collections, multiplications, observations etc. Presently, a further, temporary working group has been established to deal with mandate species of NGB and issues arising out of the Convention on Biological Diversity.

Under the board of the Nordic Gene Bank a national commission for the Nordic Gene Bank is established. This commission will ensure the contact between the Danish activities and the Nordic Gene Bank, and are involved when needed. The members are appointed by the minister of agriculture and fisheries.

Headquarters at Alnarp employs a staff of eleven, including two engaged by the Nordic donor agencies to handle a project for the Southern African Development Community (SADC) (see Chapter 6).

The mandate and strategy for NGB

The NGB mandate is to preserve, document and encourage utilization of genetic diversity in Nordic agricultural and horticultural plants and their wild relatives, and to distribute both material and information freely to plant breeders, plant scientists and other *bona fide* users.
NGB has a general strategy stating that:

- The activities of NGB shall always be consistent with the convention, as well as other international commitments concerning plant genetic resources.
- NGB takes long-term responsibility for the conservation of Nordic material of the mandate species.
- besides material growing in the wild in the Nordic countries, NGB considers modern varieties produced in the Nordic countries by Nordic breeders, as well as all other material produced by Nordic researchers and breeders, as Nordic material.
- NGB will, in accordance with article 8 in the Convention, investigate if and how far *in situ* conservation of wild material may complement or replace *ex situ* conservation, and whenever possible, NGB will cooperate with national authorities in nature conservation.

- NGB will continue to increase and update information on the material stored, through initiating, taking part in and financing projects aimed at describing the material.
- NGB is a Nordic information centre for plant genetic resources, making available information on the material in its collections, as well as material in international collections, including general information on plant genetic resources, so called non-accessional information.
- the material and information of NGB shall be freely available, without restrictions, as long as this is in accordance with interpretation of the Convention on Biological Diversity made by the Nordic countries.
- NGB will be an important resource for the Nordic countries in the transfer of knowledge and technology to developing countries.

The list of mandate species is a result of the work made by a special working group under The Nordic Gene Bank. The mandate of NGB includes species of actual or potential value for food and agriculture. This includes species of Nordic origin even if it is grown in other countries.

In situ conservation activities

There is a lack of information on genetic diversity and its distribution within and between populations of wild relatives of crops which has an indigenous gene pool in Denmark, although initiatives have been taken (cht 2). The wild forms of many of these species have such a wide distribution in the Nordic area that a representative conservation of this diversity can only be achieved *in situ*. The intention of NGB is to link up with the national bodies in each country responsible for nature conservation. NGB is presently in the process of deciding on a Mandate Species List. The foremost reason is to have a clear-cut division of responsibilities between NGB and the national nature conservation authorities when implementing the Convention on Biological Diversity.

Species for consideration for *in situ* conservation are:

- species comprising cultivated as well as indigenous wild forms in the Nordic countries
- woody species or species otherwise difficult to manage
- species very widely distributed in the region
- wild forms of threatened species
- species indigenous to the Nordic region, but only cultivated elsewhere and
- species not cultivated anywhere.

Of particular importance to the *in situ* and on-farm conservation of cultivated crops are landraces of outbreeding crops, forages, fruits and vegetables indigenous to the Nordic countries. This material is genetically diverse and influenced by natural conditions. The landraces ideally require multiplication in a farming system characteristic of its time, and at or near the area of origin. NGB has hitherto regarded this as a form of *ex situ* conservation in a historical form of farming or gardening. Since subsistence farming and use of landraces is non-existent in the Nordic countries, this problem is fairly academic. When appropriate, however, NGB makes agreements with specific farmers to multiply landraces in suitable areas and under suitable farming practices. Collaboration with, for instance, different museums, is encouraged.

Ex situ collections

In *ex situ* conservation, the organism or parts of it, such as seeds, tubers, etc., are removed from the original habitat and transferred to a gene bank. The collected material constitutes an accession which, for whole organisms, may be planted in clonal archives or, for seeds, stored under suitable conditions.
NGB holds three categories of *ex situ* collections, viz.:

- the Base Collection, stored in tightly sealed glass bottles to maintain viability for as long as possible
- the Safety Base Collection, a duplicate of the Base Collection, stored in containers placed in a coal mine under the permafrost on the Svalbard Islands and
- the Active Collection, used for distribution and characterization/evaluation; stored in sealed aluminium foil bags

Currently NGB preserves less than 100 species *ex situ* and stores as seeds the following total number of accessions:

- Ordinary collection: 8,667
- special seed collections (genetic stocks): 15,574
- safety Base Collection: 3,780 and
- duplicates for other gene banks: 3,102.

Of vegetatively propagated crops NGB stores:

- onions: 10
- rhubarb: 243
- potato, long-term: 49
- potato, pending: 43 and
- fruits and berries: 2,856.

Vegetatively reproducing species

Altogether 47 clones of potatoes, accepted for preservation, are stored in vitro at IVK potatoes AB. Many of the local potato varieties in the Nordic countries are foreign varieties which have been given Nordic names. Before accepting a local variety for preservation the NGB working group on potatoes compares it with reference material and the local varieties which have been accepted previously.

Storage facilities

Seeds are stored dry at -20°C in standard deep-freezers. Fruit, berries and landscape plants are maintained in clonal archives (field gene banks) and potatoes are maintained in vitro as mentioned above.

A seed sample delivered to NGB should preferably contain 20,000 seeds. In the collections of wild species and genetic stocks, it might be difficult to fulfill this requirement. About 5,000 seeds are stored in the base collection, 500 in the safety base collection while the remainder is placed in the active collection.

The seed quantity in each distribution bag should be enough to start a small multiplication or to begin a normal crossing procedure in a breeding programme. Rejuvenation of an accession generally takes place when the germination rate falls below 75%, or for collected material 50%. For most species germination tests in plastic petri dishes covered with glass plate in a laboratory at room temperature and in daylight is sufficient. For some species a growth chamber is used which permits some control of humidity, light, and temperature.

Documentation

Information relating to the material is stored in computerised databases. The computer system at NGB consists of personal computers (IBM and compatible) connected to a local area network. The database system dBase IV is used to handle the information.

Catalogues for various crops are published to make the information available. Potential gene bank users can also receive databases and request printouts of selected information. The information is now available on the Internet network. At present, the Nordic Wheat Database is available through Gopher, Lund University Electronic Library.

Evaluation and characterization

The terms characterization and evaluation have the following meaning here:

- Characterization, gives information of hereditary characters expressed in most environments;
- evaluation, deals with characters normally affected by many genes and much influenced by environment and therefore having a low heritability, but being of interest for breeding, such as yield, baking quality, resistance to diseases, etc.

Regeneration

NGB has insufficient green house space, fields or manpower to regenerate material of all of the different species stored in the gene bank. NGB relies heavily on the network of members on the different Working Groups for the crop concerned.

When regeneration is deemed necessary NGB approaches the station best suited to rejuvenate/ multiply the material to inquire:

- whether the station has the capacity to undertake the regeneration this year
- how many accessions the station can cope with
- how many of each species can be regenerated when considering isolation needs (insect or wind pollination).

For each accession successfully regenerated the station receives SEK 1500 from NGB. One third of the amount is paid the first year, the remainder when the seed has been harvested, cleaned and delivered to NGB. This sum does not cover the actual cost of labour, however, especially for forage grasses propagated over several years. NGB depends on the goodwill of the research institutions, and especially on the experts in the Working Group, who oversee the material during propagation.

3.2 OTHER GERMPLASM MATERIAL IN DENMARK

Botanic Garden, University of Copenhagen

The purpose of the maintenance of a diverse collection is research, education, and public information. With some 25,000 different plants the collection is among the richest in Europe, but aspects in connection into cultivated species are not included.

Since the 1790s the garden has maintained as seedbanking activity, which includes harvesting and storage seeds from plant cultivated in the garden as well as from wild plants of Danish origin. This is the basis for the Index Seminum, which is issued yearly and offers seeds from some 4,000 different taxa for exchange and distribution. About 12,000 portions of seeds are distributed annually to botanic institutions and other regular contacts around the world.

The Royal Veterinary and Agricultural University, The Pomet

In cooperation with NGB, The Pomet preserves a considerable collection of fruit trees, fruit bushes and a few strawberry varieties. Figure 3.1 shows the number of the main species in the collection at the Pomet.

To secure the preservation of these species efforts have been made to reintroduce the old Danish varieties of apples in the regions from where they originate. Around 50 per cent of the apple collection is reintroduced/introduced locally.

Table 3.1 Collection at the Pomet

Group	Species	Number	N° of this "Old danish var."
Fruit trees	Apple *Malus domestica*	700	200
	Pear *Prunus communis*	150	10-15
	Plum *Prunus domestica*	100	2-3
	Sweet cherry *Prunusa avium*	50	-
	Hazel *Cortlus avellana*	20-25	-
	Walnut *Juglans regia*	20-25	-
Fruit bushes	Goosberry *Ribes grossularia*	130-40	-
	Black currant *Ribes nigrum*	120	-
	Currant *Ribes rubrum*	70	-
Others	Strawberry *Fragaria ananasa*	200	-
	Blueberry *Vaccinium corumboides*	20-25	-

Besides the conservation of fruit trees a series of small companies and private persons are working with conservation of horticultural plants. As an example there has been and still is much private interest in conservation of old Danish varieties of roses. Two big "Rosegardens", placed in Valby and in Gerlev are collecting these old Danish varieties.

Danish Institute of Plant and Soil Science, DIPS

DIPS is in cooperation with the Nordic Gene Bank involved in collecting wild and cultivated varieties for conservation. E.g. collection *Prunus* and *Rubus* is conducted.

Collections at plant bleeders

Danish Potato Breeding Foundation, Vandel, holds a collection of potato *Solanum tuberosum L.* and wild tuber bearing solanum species. It is consisting of about 400 varieties and breeding lines, and 300 accessions of wild species. At present 200 accessions are kept in vitro. The collection is primary for breeding, but is available for exchange, education, and research.

3.3 CONSERVATION OF WILD VASCULAR PLANTS

The knowledge about the distribution of wild vascular plant species is well described, by Botanical investigators. However the data give only little information on the conservation status of many species, and information on the habitats of rare plants is mostly lacking, but this valuable information together with extracted information from literature gives-useful information for the conservation and monitoring of botanical localities.

In Denmark, there is a need for plant protection on natural localities, because:

- it is important to maintain as great a species diversity as possible in natural habitats
- it is of great importance to protect rare and threatened plant populations *in situ* in order to preserve their local contribution to the total gene pool
- many of the threatened species are indicator species of specific types of localities, which may be threatened too.

3.4 THE CONSERVATION OF DANISH FOREST GENETIC RESOURCES

The responsibility for the conservation of forest genetic resources in Denmark lies with the National Forest and Nature Agency under the Ministry of Environment and Energy. In 1994 the Agency finished a strategy for the conservation of forest genetic resources.

The overall objectives of the strategy is to conserve the genetic resources for tree and shrub species in order to secure their ability to adapt to environmental changes and to maintain the basis for future selection and breeding activities.

The strategy includes 75 tree and shrub species of actual or potential use for planting in Denmark. The genetic resources will be conserved in evolutionary conservation stands, *in situ* or *ex situ*. For most species a network of conservation stands is required to cover the spectrum of assumed genecological variability.

The Royal Veterinary and Agricultural University, Arboretum

The Arboretum was established in 1936 and has a special obligation to introduce, cultivate and show as wide a spectrum as possible of trees and shrubs from different places of the earth. This is done in a total area of 149 ha.

The Tree Improvement station, Danish State Forest Service

The Tree Improvement Station is responsible for major part of the responsibility for the planting material that is delivered to the Danish forests, and the Station covers about 70-80 per cent of the Danish forest seed market.

The three main activities of the Tree Improvement Station are:

- seed supply to the Danish forests
- supply of seedlings to the Danish state forests
- mass production of genetically Unproved tree seed
- conservation of forest genetic resources.

To undertake these activities the Tree Improvement Station has a seed extraction plant, seed storage facilities (cold rooms), cutting formation quarters, nursery and office- and laboratories facilities. Furthermore, a number of seed harvest areas (seed stands and seed orchards) and regional nurseries are run in cooperation with the local districts throughout the country.

The production of genetically improved forest tree seed is planned in cooperation with the forest research institutes, and Danish forestry. The actual production, which is needed for a stable supply of valuable seed for afforestation, takes place in specialty established areas for seed production. Most common are provenance seed stands and seed orchards.

CHAPTER 4
In-Country Uses of Plant Genetic Resources

4.1 UTILIZATION OF *EX SITU* COLLECTIONS

From the Nordic Gene Bank

In 1993-94 NGB received 211 requests for material and sent out 3407 accessions.

Figure 4.1 shows the requests by Danish breeders, scientists and others. During these two years the requests fall into four categories: (1) demonstrations and teaching; (2) cultivation of old material; (3) research; and (4) breeding. It is evident that, except for potatoes; the breeding side is not well represented. There were 13 requests to NGB in 1993 and 15 in 1994 from Denmark.

Table 4.1 Number of Request from DK to NGB

	1993	1994
Demonstration, museum or teaching	1	-
Cultivation of "old material"	-	3
Research	7	12
Breeding	5	1
Total	**13**	**15**

NGB focuses their work on informing all Nordic breeders and researchers of the collections at NGB. Furthermore the breeders and researchers address their needs for Plant Genetic Resources to NGB. From NGB's examination of the level of information, it seems that all Nordic breeders knows the collections of NGB's Nordic material. Despite this - the amount of requests from Denmark is not big, and this can be due to the fact:

- that the Danish breeding activity is not very big, and does not need more material
- that the collection at NGB does not consist of material, which is in demand
- that the material at NGB is not sufficiently described

The Nordic Gene Bank will put emphasis on information to the Nordic breeders, that NGB on request can provide them with information or material from NGB and other Gene Banks.

Public museums, private individuals and universities are well aware of the existence of the NGB and utilize it for obtaining material.

Use of the *Triticeae* collection

Over the years 1993-1994 393 accessions of wild species of *Hordeum* have been sent out on request mainly for research purposes, from the Danish Swedish/Triticeae Collection held at the Swedish University of Agricultural Sciences in Sval6v Sweden. The Triticeae collection started approximately 15 years ago, at that time known as the "barley-project". It has gradually grown to encompass the whole grass tribe Triticeae. The scope of the project has been enlarged to include not only the primary but also the secondary and tertiary gene pool of cultivated barley, wheat and rye.

In the work with the wild relatives of the cereals barley, wheat, and rye the aim is to investigate the possibilities of transferring valuable genetic traits, e.g. disease resistance from the wild relatives to the cultivated cereals. The work is a part of a broad international cooperation centred in southern Scandinavia.

Currently 12-15 Scandinavian scientists are engaged in the study of the *Triticeae* and the *Triticeae* collection can as a whole be described as a "working active collection".

4.2 UTILIZATION OF *IN SITU* COLLECTIONS

The systematic recording of vascular plant species in the TBU (Topographical Botanical Investigators-archive) gives a fundamental basis for finding single plant species on location. The Botanical association hosts an archive describing localities with attached species lists. Recently a reviewed survey "Atlas Flora Danica" has been initiated by the Danish Botanical Society. The aim is to obtain an up-to-date, accurate status of the distribution of the Danish flora - the common as well as the more rare species.

4.3 PROJECT FOR SUSTAINABLE USE OF PGR

Very recently an initiative has been taken to establish research projects on mapping, conservation, sustainable use and risks genetic flow. The results are expected to:

- clarify the preconditions for and possibilities of adaptation of cultivars to changing environmental conditions - e.g. low input agriculture and global climate changes
- give a better basis for genetic principles for *in situ* and *ex situ* conservation strategies.

The following genera may be part of the survey. *Brassica, Festus, Crataegus, Medicago, Lotus.* Genetical problems related to the use of (involving domestication) plants in Denmark will be examined. There is a need for examination of the introgression, and it is the intention to focus on the use of genetic resources from Danish wild and Danish naturalized species.

Furthermore it is the intention to establish a network for conservation and utilization of plant genetic resources in agriculture.

4.4 BREEDING COMPANIES

If there is any commercial interest in Danish breeding this activity lies with private companies. Public breeding, is confined to a very limited area, e.g. strawberries Fragaria spp raspberry *Rubus* and asparagus *Asparagus officinalis*.

Potatoes *Solantim tuberosum*
Potato breeding is conducted by the Danish Potato Breeding Foundation.

Field Pea *Pisum arvense*
Breeding of field peas is conducted by 6 companies: Abed Research Station, at least to some extent, the Pajbjerg Foundation, DLF-Trifolium Research Division, Danisco Seeds and Axel Toft Ltd.

Horse Bean *Vicia faba*
Breeding of horse bean is conducted by Axel Toft Ltd.

Rape, spring and winter *Brassica*
Breeding of rape is conducted by Danisco seed and DLF Trifolium.

Barley, spring and winter *Hordeum*
Breeding of barley is conducted by Abed Research Station, The Pajbjerg Foundation and Sejet Plantbreeding and Carlsberg.

Oats *Avena*
Breeding of oats is conducted by Sejet Plantbreeding.

Wheat *Triticum*
Breeding of wheat is conducted by Abed Research Station, The Pajbjerg Foundation and Sejet Plantbreeding.

Fodder Beet *Beta*
Breeding of fodder beet is conducted by Danisco Seed and DLF/PP in cooperation.

Sugar Beet *Beta*
Breeding of sugar beet is conducted by Danisco Seed.

Forage Plants
Breeding of forage plants is conducted by DLF/PP and Trifolium Research Station.

Vegetables and ornamentals
Breeding of vegetables and/or ornamentals is mainly conducted by Dochnfelt Ltd and Vikema Seeds Ltd.

Daehnfelt Ltd conducts breeding in cabbage, broccoli, cauliflower *Brassica olieracea*, carrot *Caucus carota*, leek *Alliyn porrum*, spinach *Spinacia oleracea*, *cucumber cucumis sativus*, tomato *Lycopersicum esculentum* and ornaments e.g. *geranium Pelargonium* and primula.

Use of Forest Genetic Resources
Currently, each year approximately 50 million plants are planted in the forests and other semi-natural habitats. In addition a large but unknown number of plants are planted in urban areas and parks.

In spite of the growing tendency to naturally regenerate forest stands, the future demand for plants it is likely to be maintained due to the increase rate of afforestation activities. Further, the general problems related to so-called novel forest decline have - not only in Denmark, but also internationally - put

the choice of correct plant material in to focus. On this background, Denmark is currently preparing a strategy for the national use of forest genetic resources.

Benefits derived from the use of Plant Genetic Resources

There is no doubt that plant selection and plant breeding have provided much benefits to the agriculture production but a precise description of the benefits, which is achieved, is impossible to make.

Improving PGR Utilization

As pointed out in chapter one the shift towards a more environmentally friendly agricultural production and the future demands for tailoring characters in plant production will require

- a better technical level in the breeding so the years used for breeding for new characters will be reduced this will furthermore requires
- more knowledge on where to find the demanded characters, which implies more specific description of PGR.

CHAPTER 5
National Goals, Policies, Programmes and Legislation

Responsibility for these subjects is in Denmark divided between different ministries. The Ministry of Agriculture and Fisheries is responsible for plant genetic resources for agricultural and horticultural plants and their wild relatives. The Ministry of Environment and Energy is responsible for the gene pool of wild species and the gene pool of forests.

5.1 NATIONAL GOALS AND POLICIES

The Ministry of Environment and Energy have in may 1995 published a review and a strategy for the Biological Diversity in Denmark, It is published in Danish. The aim of review is to describe the Danish policy toward protection of the biological diversity.

This is done by describing tile actual situation for the biological diversity in the main ecosystems (the sea, coastal areas, fresh waters, the open land, the forest and in the city).

5.2 NATIONAL PROGRAMMES

Concerning conservation of PGR most activities are coordinated by NGB. NGB is also an information centre for PGR, making information available on the material in its collections. As the Danish coordinator for the Global Plan of Action for PGR, Dir. Arent B. Josefsen was appointed by the Minister of Agriculture and Fisheries.

Activities

The description and utilization of PGR are carried out by universities, sectorial research institutes and private plant-breeding companies.

5.3 NATIONAL LEGISLATION

The national legislation within PGR can be divided into two parts, the landscape ecosystem level and the plant species level.

Level of Landscape

At the level of landscape the effect on PGR is corresponding to the protection of the biological diversity. The protection is conducted by protecting either the habitat, the area of distribution for the species or by protecting those ecosystems in which they are part. This is done by protecting a range of ecosystems by Nature Protecting Act from 1992, by establishing game reserves by the Hunting and Game Management Act from 1987 or by protecting areas or appointing areas for reestablishing nature.

The following list of regulations will have more effect on nature management and will only be named here: protection of the marine environment (1980), Use of the Danish sub soil (1981), The coastal protection law (1988), Hunting and Game Management Act (1987), Forest Act (1989), Agricultural Act (1989), Environmental protection (1991), Regional Planning Act (1991) Nature Protection Act (1992).

Furthermore it is to be mentioned that the Nature Protection Act gives the Minister of Environment and Energy provision to regulate on the transplanting and sowing species not native in Denmark. This provision has not yet been used.

Plant level

The legislation on plant level has more direct relevance for conservation and use of genetic resources. The legislation and regulations enclose:

Law No. 834 of 18. December 1991 of seed, potatoes and plant Law No. 866 of 23. December 1987 of news plant varieties; Regulation No. 810 of 11. December 1987 of a variety list of agricultural plants; Regulation No. 36 of 23. January 1974 of testing and indusion of varieties of crop plants on variety list; Regulation No. 22 of 12. January 1994 of plants; Regulation of the

Ministry of Agriculture and Fisheries No. 150 of 31. March 1981 of trade in forest reproductive material; Regulation of the Plant Directorate No. 1193 of 23. December 1922 of patents of supplemental certificates of protection; Law No.. 356 of 6. June 1991 of environment and gene technology.

Genetically Modified Plant (GMP)

In the period from October 1992 to May 1995 more than 340 releases of genetically modified plants have taken place in EU. A summary of each application for a field release is circulated to the authorities of the different countries within EU for release.

In 1993 The Plant Directorate has considered 88 applications for release of gene modified plant species.

The legislation on GMP is shifting towards being more internationally oriented, and hence this the regulation is changing toward a less restrictive legislation.

The Washington Convention, CITES

The Plant Directorate under the Ministry of Agriculture and Fisheries is responsible for the import and export control of endangered plant species. The control includes natural collected as well as artificially propagated plants.

The number of exported species under CITES was in 1992 18,844 but the number was reduced to 6,657 in 1993. This reduction is due to new rules in EU.

CHAPTER 6
International Collaboration

6.1 GLOBAL INITIATIVES

Follow up to UNCED

Denmark has ratified the convention on Biological Diversity and this convention requests the parties to "develop national strategies, plans or programmes for the conservation and sustainable use of biological diversity or adapt this purpose in existing strategies, plans and programmes".

The impact on national programmes, strategies, plans and legislation was described in chapter 5.

New and additional funds

Following up on the Rio Conference on Environment and Development, Denmark has established new and additional funds by creating the Special International Environmental and Catastrophe Facility. Part of the strategy will shortly be described in section 6.3 The Danish Aid Programme.

Denmark has also actively contributed to The Global Environmental Facility, GEF, with a view to fulfilling the targets, set in Rio in 1992. Denmark's contribution to the GEF was 143,1 mill DKK in 1991-1993 and 226,5 mill DKK for 1994-1997.

The CGAR

Denmark is happy about the cooperation with the International Agricultural Research Centres, where there are several cooperations on bilateral basis between persons and institutions. Denmark is also supporting the collaboration with IPGRI.

Denmark has also actively participated in all stages of ECP/GR managed by IPGRI. The participation and the Danish input and contribution is coordinated by The Nordic Gene Bank.

6.2 REGIONAL, INTERGOVERNMENTAL INITIATIVES

EU

In the European Cooperative programme for Plant Genetic Resources (ECP/GR), coordinated by IPGRI, now in its fifth phase, the Nordic Gene Bank has proposed membership in following working groups: *Allium, Avena, Barley, Brassica,* Forage crops, Grain legumes, *Prunus*.

In 1993, the EU Commission initiated the establishment of an EU-research programme in Plant Genetic Resources. Denmark has, as a member of EU, contributed, to the formation of the programme.

Denmark is participating in a number of applications either in cooperation with The Nordic Gene bank or in cooperation with other institutions in EU. At this moment, the applications have not been evaluated yet.

Danida Forest Seed Centre

Danida Forest Seed Centre (DFSC) is a project under the DANIDA (DANIsh Development Assistance) financed by the Danish Ministry of Foreign Affairs. It has been in operation since 1969 and the present project period expires at the end of 1999.

Although the Centre is situated in Denmark, the work relates entirely to the conditions in developing countries in the tropics.
The objective of DFSC is to "strengthen the seed programmes in developing countries using appropriates and improved techniques and methodologies of seed procurement, tree improvement and gene resource conservation".

These three technical fields constitute one of the three priority areas in Danida's Sector Policy for Forestry and Agroforestry.

The standard of seed handling, at all stages form collection to sowing, is an important factor affecting physiological quality, while genetic characteristics are affected by choice of seed source and, in the long term, by the breeding of improved genotypes, and at the same time, by the conservation of the maximum possible diversity of genetic resources.

DFSC has become one of the few internationally well-known and respected institutions within its fields. This may well be due to the close collaboration with institutes in the developing countries and DFSC's flexibility in adjusting to their changing demands.

Nordic

The Nordic cooperation work is visible through The Nordic Gene Bank, to where Denmark contributes and from where Denmark benefits.

In the frame of The Nordic Council of Ministers a committee was in 1990 appointed to evaluate the global gene resources and the needs for conservation. The Nordic Council of Ministers recognized the need for additional work. The Nordic Council of Ministers (Ministers of Agriculture and Fisheries) cooperate primarily in the following fields: research, courses for researchers, plant breeding, preservation of genetic variation, agricultural environment and cooperation between authorities.

Furthermore see section 6.5 The Nordic Gene Bank below.

6.3 THE DANISH AID PROGRAMME

Danida

Danish assistance to bilateral agricultural development in developing countries is as old as The Danish Development Assistance itself and is mainly conducted by the Organisation, DANIDA (DANIsh Development Aid) under the Ministry of Foreign Affairs. The bilateral portfolio of agricultural aid also includes assistance to a series of programmes within the area of plant genetic resources. In this respect, programmes in the developing country as well as education or research activities are conducted in Denmark. The education activities are mainly run by a special programme at The Royal Veterinary and Agricultural University. Furthermore financial assistance is given to a series of programmes, which is closely related to plant genetic resources. Among these is e.g. phytosanitary aspects and seed testing.

Danced

Following up on the Rio Conference on Environment and Development, Denmark had established new and additional funds by establishing DANCED (Danish Cooperation for Environment and Development) under the Ministry of Environment and Energy. The -1995 budget of the grant programme is approx. 50 million USD. Biological diversity covers e.g. 27 per cent of the predisposed grants for Malaysia and 9 per cent of the predisposed grants for Thailand.

6.4 THE INVOLVEMENT OF DANISH SCIENTISTS IN INTERNATIONAL WORK

Denmark has as a small country always been oriented towards other nations and it is well known that by far the most scientists are cooperating with other scientists all over the world. Most of this cooperation is thus initiated by the researchers themselves, so therefore no overview of this work can easily be made. Involvement of Danish scientists in international work is expected to increase in the future.

One example to be given here is a bilateral institutional agreement between the Botanic Garden, University of Copenhagen and a Botanical Garden in Ecuador. There is an exchange of researchers and training.

At the same time, the Ecuadorian Botanical Garden is working as a partner in the "Project Yambean Pachyrbizus spp, which is a broadly funded cooperation, where a substantial part of the funding is directly attached to institutions in developing countries. This project is headed and coordinated by the Botanical Institute at the Royal Veterinary and Agricultural University, Denmark has built up partnership relations with a number of institutions e.g. Tonga, Senegal, Mexico and Costa Rica, where locally breeding work is done.

6.5 THE NORDIC GENE BANK AND ITS AREA OF COOPERATION

NGB defines four main areas of international cooperation:

- general international cooperation within organizations such as FAO and IPGRI
- Co-operation within our neighbouring countries, a prerequisite for achieving a comprehensive conservation of the plant genetic resources of the area
- cooperation regarding crops of economical importance in the Nordic area. This will include participation in international networks and cooperative projects concerning domesticated plants, essential for achieving a rational conservation and effective utilization
- transfer of knowledge and technology to developing countries and countries in eastern Europe, for which the low technology and cost effective conservation activity at NGB is well adapted.

The SADC gene bank project

Since 1989, NGB has been involved in a Nordic Development Project in the SADC countries in southern Africa. The primary objective of the project is to establish a regional centre for plant genetic resources, the SADC Plant Genetic Resources Centre (SPGRC), and a network of national plant genetic resources programmes. The SADC project is a commitment from NGB to act as Management Consultant to the Nordic development agencies to develop a regional gene bank for the SADC region i.e., the countries Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe. NGB will continue as Management Consultant in the project for the period 1994-199'7, and provide any backup required including financial administration and management of project funds.

The New SPGRC building was opened in October 1993. The genebank has a current storage capacity of 25,000 samples of base collection. The building is situated on a 86 ha farm 25 km east of Lusaka and houses the seed bank, technical section, processing unit, library and administrative block. All these units are served by a local area network of computers in a PC environment. In 1993 each of 10 national centres received a 4 wheel drive vehicle to be used for the exploration and collection of germplasm. Storage equipment, computers, printers, fax machines, photocopiers, generating sets, driers and other genebank facilities were also supplied.

The gene bank project in the Balticum Countries

The Baltic countries, Estonia, Latvia and Lithuania, have initiated a programme for the conservation and utilization of plant genetic resources. The initial phase of the programme is supported by the Nordic Council of Ministers, which will allocate approximately US$ 200,000 to the programme from 1994 to 1996. In this initial phase the programme will be coordinated by the Nordic Gene Bank, who will also provide technical support and training.

The Nordic and Baltic countries are geographically, climatologically and historically closely linked to each other. The Baltic countries have not until now started a programme of their own. Collections kept at breeding and research institutes in the Baltic countries are mainly working collections, maintained for breeding and research purposes. These consist of varieties from foreign countries, as well as old Baltic varieties and landraces. A detailed inventory of these collections is not presently available and the viability of the collections is in some cases alarmingly low, due to inappropriate storage conditions and a lack of funds needed to rejuvenate

the material. Institutes conserving vegetatively propagated crops also report problems in keeping the material.

The scope of the programme and to what extent it should be integrated with the Nordic programme for the conservation and use of genetic resources has to be decided. During the initial phase, a network of Baltic institutes holding collections will be established. A Plant Genetic Resources Coordinator has been appointed in each Baltic country and an overall coordinator has been appointed at NGB. Computers and software for database management have been provided by NGB and staff training will be organised in 1995 both at NGB and in the Baltic countries. Funds will be sought in the individual Nordic Countries to provide seed drying and packaging equipment and to increase the training component of the programme.

6.6 DANISH NGO (INTERNATIONAL, GRASS-ROOTS)

Among Danish NGO's - of different kinds - there are a considerable expertise in practical bio-diversity, conservation-strategies either based on scientific knowledge and/or expertise based on the spokesmen's role on behalf on many individual members. Examples are Danish Botanical Society, and WWF.

6.7 INTERNATIONAL COOPERATION ON FOREST GENETICAL RESOURCES

Danida Forest Seed Centre

Danida Forest Seed Centre (DFSC) is a project under the DANIDA (DANIsh Development Assistance) financed by the Danish Ministry of Foreign Affairs. It has been in operation since 1969 and the present project period expires at the end of 1999.

The objective of DFSC is to "strengthen the seed programmes in developing countries using appropriate and improved techniques and methodologies of seed procurement, tree improvement and gene resource conservation".

The standard of seed handling, at all stages form collection to sowing, is an important factor affecting physiological quality, while genetic characteristics are affected by choice of seed source and, in the long term, by the breeding of

improved genotypes, and at the same time, by the conservation of the maximum possible diversity of genetic resources.

EUFORGEN

At the first ministerial conference on the protection of forests in Europe that was held in Strasbourg, Denmark signed resolution 2 on conservation of forest genetic resources. Based on resolution 2 a European forest genetic resources programme (EUFORGEN) has been set up. Four species specific networks have been established under the programme. Denmark is a member of EUFORGEN and will participate actively in the networks concerning Piecea abies and noble hardwoods.

CHAPTER 7
National Needs and Opportunities

7.1 RESOURCE SUPPORT TO NGB

Denmark actively participates in - and contributes to the work and strategy of the NGB. This indicates that a great part of the national needs concerning conservation is carried out by the regional work in the Nordic Gene Bank. However, the existing needs are bigger than the resources available at NGB allow. Further technical and financial support are needed on the following items:

- correct seed handling at a high level
- further development of methods e.g. for knowledge of minimum seed quantity, capability of germination, methods for supporting biotechnology
- support for documentation systems, the area is of vital importance for any use of PGR
- strengthening *in situ* conservation activities.

The Nordic Council of Ministries have appointed a Committee for Strategy on the Plant Genetic Area. This committee will - based on an examination - recommend at which area there is a needs for strengthening. The Committee for Strategy on the Plant Genetic Area have two members for each Nordic country, and the Danish delegation consists of one representative from the Ministry of Environment and Energy and one from the Ministry of Agriculture and Fisheries.

NGB as a focal point

Denmark encourages NGB as the central point in the network among Nordic institutions and persons working with PGR as spelled out in its strategy towards year 2000.

Denmark furthermore recognizes that the NGB has a central role in the European cooperative work for conservation and development of PGR, where NGB as a matter of course also will take care of the interests of the Nordic countries.

Denmark stimulates NGB to establish global networks consisting of institutions working with conservation and utilization of PGR. This work will as a minimum result in exchange of information, so that any single researcher can get information from any Gene Bank in the network, just by asking one Gene Bank. Furthermore a global network has to work towards collaboration and sharing of responsibility for different collections.

7.2 INTERMINISTERIAL PROGRAMMES

Taking into account that much work already has been carried out on breeding and research, there is a need for improved coordination between the different activities. This has to include the public administration as well as the private sector and the private plant collectors.

The responsibility for setting both conservation and utilization priorities has to be recognized which means that responsibility has to be shared between the different ministries. Further initiatives should therefore be initiated for a coordination of PGR-activities.

7.3 GUIDELINES, BINDING RULES AND LEGISLATION

The existing legislation in DK is focusing on species and ecosystems. Taking the international development into account it is necessary that the National legislation also includes aspects of the use and conservation at the plant genetic level.

7.4 OPPORTUNITIES THAT PGR OFFERS MANKIND

As a consequence/result of the wish and demand for a continuing change of the Danish agricultural production systems, where energy consumption, use of pesticides and other inputs must be minimized as much as possible, gene resources are recognized as an important opportunity for providing the seeds for sowing with the desired hereditary characters. This is to be seen in the context of other agronomic measures such as more efficient plant use of

nutrients, improved nutrient value for humans, less sensitivity to variations in plant growth factors e.g. sensitivity to drought, - resistance to pests, better taste and so forth). The expectations to plant breeding and genetechnology are already great - and it is expected that the demand for desired hereditary characters will expand.

Access to PGR

Ensuring access to PRG implies,

- insurance of *ex situ* and *in situ* conservation of PGR to ensure the supply for the common needs
- that the PGR has to be available, (barriers have to be overcome - the breeders asks for free and unhampered access)
- that sufficient documentation and information in the existing PGR have to be improved. Even though PGR collections are described, the mapping of genes and of their hereditary characters can be improved. It is seen that breeders to a very limited degree demand material from NGB. This could probably be improved
- the distribution of documentation and information has to be improved, to optimize the use of PGR at different levels.

PGR has to be considered as a basic element for making the agricultural production sustainable.

7.5 RESEARCH/GENERATION OF MORE KNOWLEDGE

Research at different levels, traditional methods of breeding, as well as biotechnology are very central because each improved step of knowledge gives more information on PGR and the possible sustainable use of it. These activities have to be strengthened.

7.6 DENMARK'S ADVANTAGES

Some advantages which is special for Denmark is listed below:

- Denmark has a very competent education and research expertise covering different areas of the work with PGR. We do have the possibilities to contribute to the world wide capacity building up this areas.
- Denmark is a small country and hence its wild species is relatively well described and is it possible to refined them on location.
- Denmark has a uniform climate which makes breeding easier, and the climate is comparable to other countries e.g. Japan, which also gives opportunities for exchange of knowledge e.g. in breeding for specific growing conditions.
- Participating in a Nordic Network reduces the basic costs, - which is an advantage especially for small a small country like Denmark.

CHAPTER 8
Proposals for a Global Plan of Action

- To secure a proper function of a "State of the World Plan of Action for PGR", it is vital that it can be updated, at regular, short intervals e.g. every second year so that it can serve as an early Warning System.
- The harmonization of FAO's Undertaken in the Commission of Plant Genetic Resources for Food and Agriculture with the convention in Biological Diversity is essential if the former is to be adopted as a legally binding protocol under the convention.
- New information technology shall be applied within PGR and databases be available through the Internet system or other future global systems.
- The definition of Farmers Rights should be extended so that farmers from industrialized countries, particularly those in marginal areas, have equal rights with those in developing countries.
- It is appropriate that multilateral, as opposed to bilateral, agreements are based upon a species list, issued by FAO and agreed upon in the Commission of Plant Genetic Resources.
- In order to streamline long-term conservation, at least within Europe, it is essential that the recently initiated Nordic Gene Bank/Baltic cooperation is formalized and strengthened.
- Within Mid-programmes for developing countries conserving and utilization PGR shall be focused.
- Free access and availability of genetic material for research and breeding purposes must be set as a goal.
- The regional cooperation on PGR within ECP/GR has to be confirmed and it has to coordinated with future regional activities within EU. Cooperation between scientist working with PGR must be continued e.g. within EUCARPIA.

Characterisation

- To strengthen the use of conserved genetic resources it is vital that large scale programmes are initiated for characterisation of new important genetic traits in conserved material.
- A major political problem is the financing since the present Plant Variety Protection system cannot generate funding for the more basic parts of such activities.
- As part of priorities for action new information technology shall be used to submit information in PGR to everybody who demands it.
- Denmark do highlight the need for further education and the capacity building within the area of PGR. This need is recognised by the Nordic Council of Ministries, which have disposed financial support for this.
- Research programmes improved knowledge about possible use, negative impact, methods, etc. must be given priority in future funding.