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STATE OF PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE IN NORWAY

Second Norwegian National Report on
conservation and sustainable utilisation of Plant
Genetic Resources for Food and Agriculture

Åsmund Asdal



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Front page: Timothy grass (*Phleum pratense*) is one of the most important plant species in Norwegian agriculture.
Photo: Åsmund Asdal

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Preface

The Second Norwegian National Report on conservation and sustainable utilisation of Plant Genetic Resources for Food and Agriculture aims at giving a brief but adequate status report on PGR in Norway. It addresses the request and guidelines from The Commission on Genetic Resources for Food and Agriculture given in the document CGRFA/WG-PGR-3/05/Inf.5, but it is also adjusted in accordance with national conditions and priorities.

The first Norwegian Country Report to The FAO International Technical Conference on Plant Genetic Resources was submitted in June 1995. This second report emphasises relevant developments since 1996, but it has also been written as an independent and updated status report covering all relevant aspects of the conservation and use of PGR in Norway.

The report has been prepared by The Norwegian Genetic Resource Centre during 2008. The Norwegian Advisory Committee for Plant Genetic Resources, where different governmental and private stakeholders are represented, has provided input and recommendations to the report.

The Nordic cooperation through The Nordic Genetic Resource Centre (NordGen) is essential to the national efforts regarding conservation and use of PGR, and the chapters dealing with *ex-situ* conservation of seed propagated crops are based on a common Nordic report from NordGen.

This version of the report is illustrated with images from Norwegian agriculture and nature.

Norwegian Ministry for Agriculture and Food, Oslo /
Norwegian Genetic Resource Centre, Ås /
10th November 2008

Key word: Plant genetic resources, gene banks



*Image 1. Agricultural landscape at the lake Sagelvatnet in Balsfjord, Troms County.
Photo Oskar Puschmann*

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Executive summary

The Second Norwegian National Report on PGR describes the current state of plant genetic resources (PGR) in Norway. Changes and developments since the first national PGR report in 1996 was issued are commented in particular.

The most important innovation over the last ten years has been the establishment of both a national programme for conservation and use of plant genetic resources in 2001 and the Norwegian Genetic Resource Centre in 2006. This has significantly increased the resources allocated to conservation and use of plant genetic resources in Norway, the scope of PGR activities has been broadened and the public awareness and stakeholders involvement has increased considerably.

The responsibility for ex-situ conservation of Norwegian germplasm is shared between The Nordic Genetic Resource Centre (NordGen, formerly the Nordic Gene Bank) and The Norwegian Genetic Resource Centre. The seed collections of varieties and landraces of edible agricultural and horticultural crops at NordGen have been extended and better documented and characterised since 1996.

Germplasm of vegetatively propagated crops is conserved in national field gene banks. A network of plant collections have been organised during the last 10-15 years, containing varieties, landraces and other genotypes of fruit trees, ornamental plants, vegetatively propagated vegetables and medicinal and aromatic plants. Holders of such collections are botanical gardens, R&D institutions, open air museums and agricultural colleges. According to national policy, material of conserved plants is available to all users for any purpose and in accordance with the International Treaty on Plant Genetic Resources for Food and Agriculture.

Norwegian breeding of agricultural and horticultural crops was in 2002 reorganised into Graminor AS, which is a limited company, jointly owned by private companies, cooperative organisations and governmental institutions. National plant breeding has been commercialised, and the breeding programmes now prioritise a smaller number of crops which are important for Norwegian agriculture.

The Norwegian Genetic Resource Centre emphasises dissemination of information with respect to available plant genetic material and the public demand for old plant varieties has increased. Non-commercial use of the diversity of plant varieties and the use of traditional plants as a cultural heritage is considered to be beneficial, both with respect to conservation and public awareness.

Norway has ratified the International Treaty on Plant Genetic Resources for Food and Agriculture in 2004. All relevant material conserved by NordGen has been included in the Multilateral System and there is still ongoing work on preparing national legislation for inclusion of other relevant material. Norway has also contributed actively to the implementation of the Treaty by the Governing Body, e.g. through supporting and participation in projects and contributions related to benefit sharing and Farmers' Rights.

By the establishment of the Svalbard Global Seed Vault in 2008, Norway has provided for a major element in securing the PGR on a global level. The Vault will also contribute to the Global System on PGR.

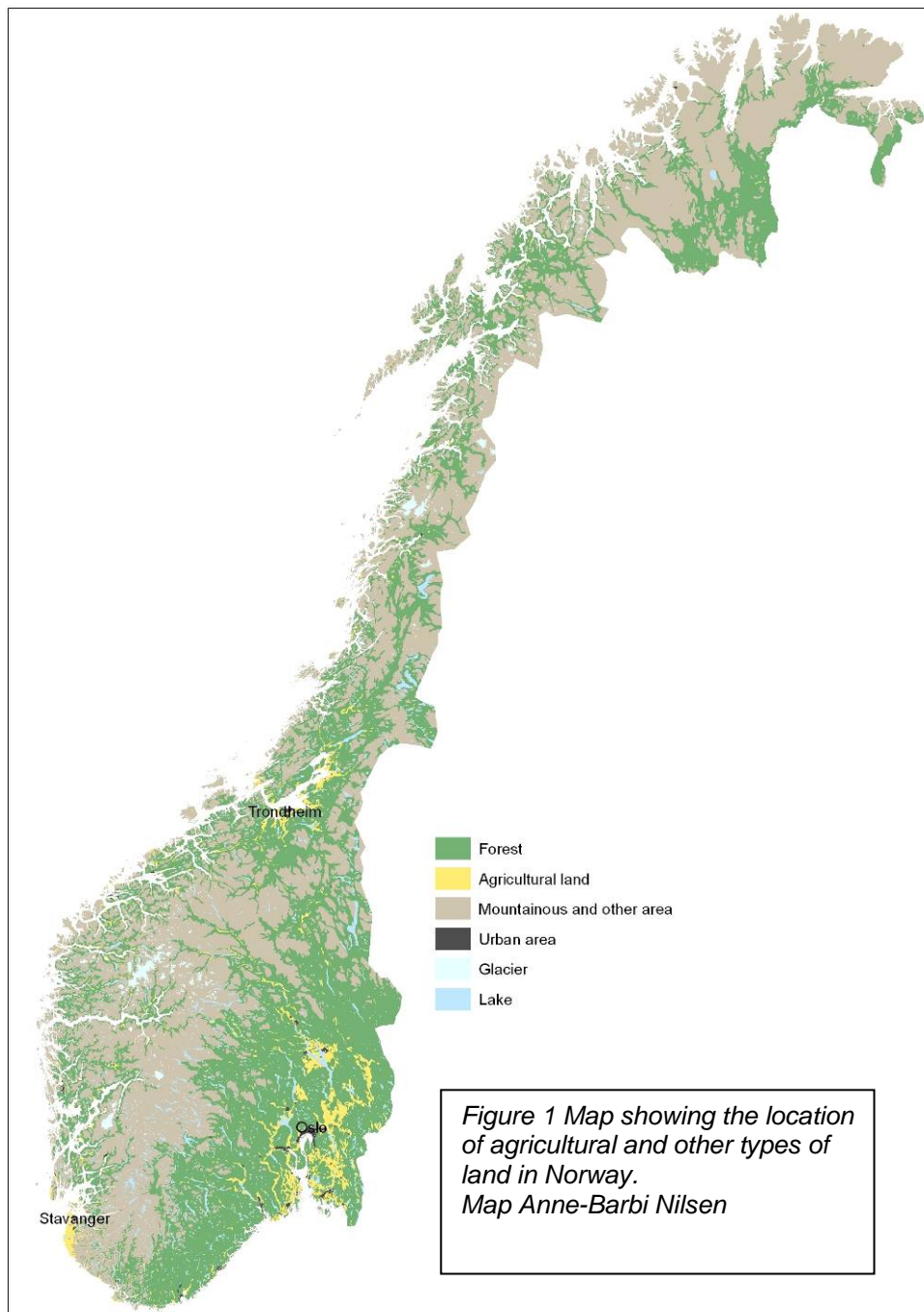
Securing efficient maintenance and availability of plant material and broadening the level and quality of such material are prioritised tasks for the coming years. Increased use of varieties and landraces of food and ornamental plants in combination with on farm conservation will be emphasised. The potential for utilising protected areas for in situ conservation of PGR will be investigated. Efforts in order to increase public awareness and to increase the significance and consideration given to PGR in general societal developments will be continued.

0. Brief Introduction to the Food and Agricultural Sector in Norway

0.1. Natural conditions

Norway is Europe's northernmost country, ranging over some 1750 km between 58 °N and 71 °N. The country's total land area is 323,000 km² (excluding the islands of Svalbard and Jan Mayen). Its population is 4.5 million, with a population density of 14 people per km².

The total agricultural area is 1.04 million hectares or 0.21 ha per capita. Of this about 0.86 million ha is arable land. Farmland accounts for 3 % of the total land area, compared to 57 % for the European Union as a whole. Productive forestland covers 22 % of the land area, whereas mountains, extensive grazing and other outlying land, lakes and built-up areas account for the remaining 75 %.



Norway has substantial north-south and east-west climate gradients. Inland areas in northern and eastern Norway have a typical continental climate, with warm summers and cold winters. The entire coastline is characterised by a maritime climate, with relatively cool summers and mild winters.

Annual precipitation also varies. The zone with the highest annual rainfall lies about 30-40 km inland from the coast. The driest areas are the inland regions of Finnmark (in the far north), as well as parts of the valleys of eastern Norway. The length of the growing season varies between 200 days (the most favourable areas are in southwestern Norway) and 100 days along the coast of eastern Finnmark. In the alpine regions, the growing season is even shorter. (The growing season is defined as the number of days with a mean temperature of more than 5 °C.)

The soil and topography of the Norwegian land area, also in addition to the climatic conditions, has had a great impact on where and how agriculture has been practiced. The main regions for field crops such as cereals, potatoes and vegetables are the region around the Oslofjord and north to the lake of Mjøsa in the south-eastern part of the country, the far south-western region (Jæren) to the south of Stavanger and the area around the Trondheimsfjord.

Smaller regions with favourable climatic conditions are important for the supply of horticultural crops. Such areas can be found along the coastline from Telemark to Rogaland and in the fjords of the western part of Norway. Important crops are fruit, berries and vegetables. Berries and some hardy vegetables can even be produced in the climatically best areas of northern Norway.



*Image 2. Animal farms in Lofoten in the northern part of Norway
Photo Åsmund Asdal*

Forage production and animal husbandry can be found in all parts of the country where the soil conditions are favourable for the growth of grass. Such areas exist from the coast to mountain levels as well as throughout the country from south to north.

0.2. Agriculture in Norway

Norway's agriculture sector has a small scale structure compared to the agriculture in other countries in Western Europe. Small and medium-sized family farms dominate, with an average farm size of 20 hectares. The small scale structure of Norwegian agriculture is mainly due to the country's topography, fields are often small and scattered and difficult to cultivate efficiently.

The number of farms was 78,000 in 1996 and has declined to 51,000 in 2006. The workforce in agriculture spent some 86,700 man-labour years on farms in 1996, whilst this had decreased to 62,900 ten years later. However, the average farm size on farms still in operation is increasing, 13.8 ha in 1997 to 20,3 ha in 2006. Farming methods are highly mechanised and the farmers have usually income from other sectors in addition to the income from the farm.

Traditionally, Norwegian agriculture has been assigned several public responsibilities in addition to producing food. National agricultural policy has been directed towards production and food security, farm incomes and regional distribution of production and employment. In the past two decades multifunctional objectives related to environment, landscape conservation, ecology, food safety and consumer demands have been included, with farm-based small scale food industry and tourism as the most recent elements. A national target has been set for 15% transition to organic farming by 2015.

The agricultural policy is based on import measures and a national farm support system combining budget allocations with extensive regulations. Administered product prices, direct support schemes, agricultural policy programmes and market regulation systems are annually negotiated between government and farmers' unions.

As shown in Figure 2 the total acreage of agricultural land has remained quite stable through the last 50 years. A drop in the 1970s has been compensated for during the last two decades, mainly due to increased political and economic support from the middle of the seventies.

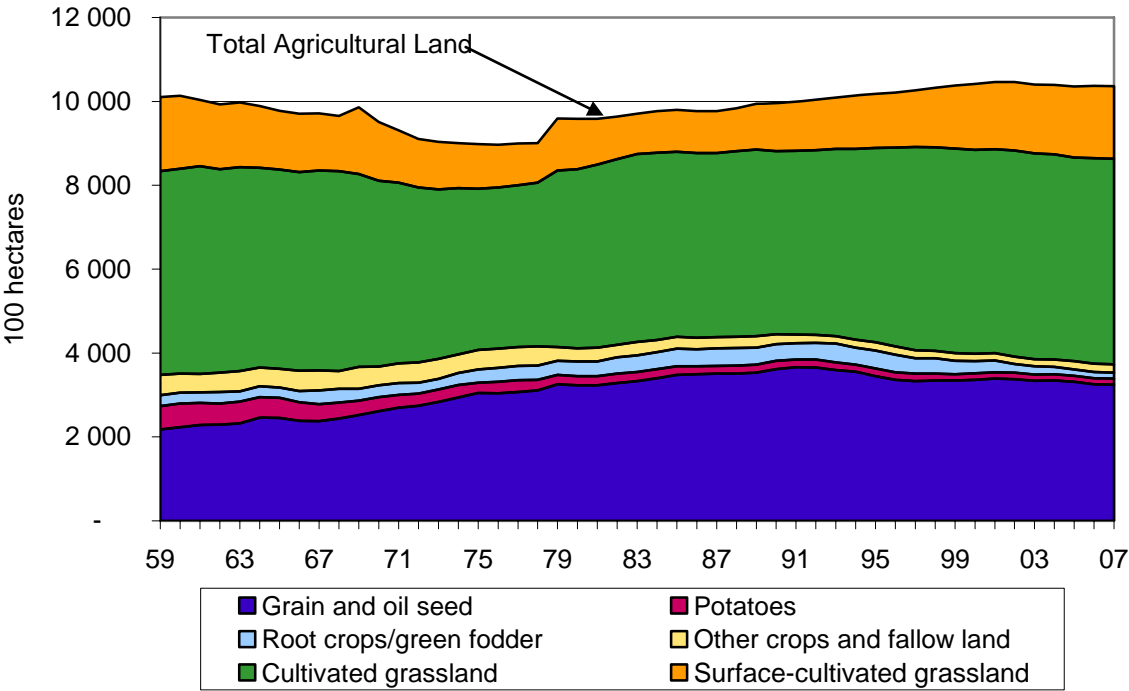


Figure 2 Agricultural area in Norway, total and by main crops, 1959–2007
 Source: Knutsen, H. (ed). Norwegian Agriculture – Status and Trends 2007. Norwegian Agricultural Economics Research Institute. Oslo.

While undergoing continuous change over the past century, much of Norway was perceived as an agricultural landscape heavily impacted by agricultural activities. Pasturing by a variety of livestock and harvesting of fodder in many kinds of habitats led to the development of an open and diverse landscape, which provided growing conditions for a broad range of plant species. During the last 2-3 decades this landscape has been changing rapidly. Small farms

have been abandoned, pasturing has ceased and previously open land has either been afforested or regenerated naturally. These developments are now having a large impact on the Norwegian macro-landscape and its diversity of plant species.



*Image 3.
Grazing animals
and fodder
production is the
most important
farming system
in rural areas.
The breed here
is the rare
Norwegian
"Vestlandsk
raudkolle".
Photo Anna
Rehnberg*

Agricultural policy measures in this period have aimed at securing sustainable livestock and fodder production in rural areas and curbing the structural development towards larger farms. To this end less labour-intensive grain production has been concentrated to lowland areas with good cereal growing conditions and easy access to non-farming employment. With the introduction of the acreage and cultural landscape subsidy in the 1980s environmental services became part of the general agricultural policy. In addition to this general subsidy, special programmes administered at county level have from the same time aimed at farming practices promoting biological diversity in the agricultural landscape. Particular attention is given to reducing the regeneration of open pastureland. Most recently, a general scheme aiming at increasing the numbers of grazing livestock both on cultivated pastures and on rough outlying land and mountain pastures was introduced in 2005, extending longstanding schemes in support of grazing on rough outlying land and mountain pastures.

Despite these measures, current trends in Norwegian agriculture, as in many neighbouring countries, can be summed up as:

- The number of fulltime farmers is decreasing
- The acreage being farmed by each farmer is increasing
- The production is becoming more specialised and mechanised, whilst the reduced numbers of professional full-time farmers have become an educated and skilled work force
- The diversity with respect to crops (and varieties) and production methods on each farm is decreasing
- For a growing number of part-time farmers, farming is considered to be a hobby or secondary occupation
- The rich diversity of low input agriculture and semi-natural habitats have been abandoned and the impression of an open managed landscape is now deteriorating in remote areas

1.0. The State of Diversity

The overall and long term changes in structure and methods in agriculture are the most significant developments affecting the state of genetic diversity in the agricultural sector. The majority of farmers use modern commercial varieties of agricultural and horticultural crops and base their agriculture on intensified production methods. This means that old varieties have been replaced and are now hardly to be found in commercial agriculture.

Forage production is also based on modern varieties. The cessation of pasturing and hay cutting on outlying and unploughed natural meadows is a threat to genotypes of plants which are dependent on such habitats. Loss of diversity and genetic resources in such habitats is considered to be significant and also increasing. Domestic breeding of forage crops, which utilises germplasm from indigenous sources, is to some extent compensating for the loss of such semi-natural habitats.

In some cases old varieties of cereals and horticultural crops have been reintroduced as niche produce directed towards small markets for products with special traits, tastes or products related to cultural heritage and history. Particularly interested groups of farmers and hobby growers also use such old plant varieties. This is sometimes idealistically motivated, or it is related to the search for special varieties and/or properties suitable for organic farming or special niche markets. The government is promoting organic farming and the acreage of organically cultivated fields has increased over the last 10 years. Growing systems based on organic production principles are currently practiced on 5% of the agricultural land. This is to some extent broadening the diversity of varieties and traits used in agriculture.

Maintenance and use of old varieties is also based on personal interest and commitment to plant heritage and cultural history.

The Norwegian programme for PGR also has the responsibility for ornamental plants. Such plants are considered to be a part of the national plant genetic resources due to their aesthetic importance in the daily life of the population in general and because of the value for the producing green sector.

1.1. Cultivation and diversity of major agricultural crops

The main crops in Norwegian agriculture are forage plants such as grasses and leguminoses, cereals and potatoes, industrial crops (mainly oil seeds) and horticultural crops such as fruit, berries and vegetables.

Table 1. The cultivated acreage of important crops for the years 1995, 2001 and 2006. (Numbers in 1000 hectares)

Crop acreage	1995	2001	2006
Cereals and rape oil seed	344.9	335.1	325.9
Potatoes	17.9	15.3	14
Cultivated grassland, incl. pastures	466	484.1	489.9
Forage tubers and green fodder	43.2	27.5	14.8
Others, incl. fallow	21.6	17.9	19.7
Total cropland	889.1	879.8	864.3
Natural and surface cultivated grassland	129.4	159.9	172.8

These figures show that the cultivated acreage and production of the main crops such as cereals and cultivated grassland have remained quite stable over the last ten years. Small

reductions in field crops have been compensated for by an increase in cultivated forage production.

Table 2. Norwegian production of potatoes and cereals for human consumption in 1995, 2001 and 2006 (Numbers in 1000 tons)

Crops	1995	2001	2006
Cereals for human consumption	133	192	206
Potatoes	389	351	333

The production of cereals for human consumption has increased considerably over the last few decades, from close to zero at the beginning of the 1970s. During the last few decades research has benefitted the development of Norwegian wheat production considerably. New growing techniques and new varieties adapted to the Norwegian climate and growing conditions have contributed to this development.

Table 3. Number of varieties of cereals and potatoes listed in the official list of varieties in 1996/97 and in 2008.

Crop	1996/97		2008	
	Total	Norwegian	Total	Norwegian
Oats	13	6	11	8
Barley	10	4	28	17
Wheat	15	5	18	4
Potato	20	10	36	13



Image 4. Norwegian varieties of oats can be grown in harsh climates. Photo Åsmund Asdal

As seen in Table 3, the number of varieties of wheat, barley and potatoes, approved for use in Norwegian agriculture, has increased over the last ten years. The number of Norwegian varieties in these crops, apart from wheat, has also increased. The total number of approved varieties of oats has declined, but the number and proportion of Norwegian varieties of oats has increased.

1.2. State of diversity of forage crops

The indigenous Norwegian flora has few wild plants which are or have been important for agriculture and food production. Forage plants are the most important exception. Many grass and legume species have been used as fodder crops, and the current pool of genotypes consists of original wild growing genotypes, genotypes in the wild flora contaminated by cultivated landraces and varieties, landraces and other genotypes found in agricultural or semi-natural habitats and varieties from modern breeding.

This represents altogether a broad diversity of traits and adaptations to different growing conditions. Some varieties and collected material from different habitats are conserved *ex-situ* at the Nordic Genetic Resource Centre, but the most comprehensive part of this rich and valuable diversity is still maintained in different landscapes, geographic and climatic regions within different farming systems and other habitats impacted by human activity. Given the ongoing changes in Norwegian agriculture it is evident that the richness and diversity of this gene pool is slowly decreasing.

The government is, however, implementing economic and political measures in order to reduce this negative trend, e.g. by designing grant systems for maintenance of certain fields, farmland and landscapes, to be maintained by traditional farming methods.

Forage production is carried out in two main farming systems; 1) In ploughed and fertilised fields, frequently renewed and sown with new and modern varieties and 2) in unploughed and surface cultivated meadows where locally adapted plant material and genotypes is harvested, either by machines for winter supplies or by grazing animals.

The diversity of fields with forage crops is reduced by:

- new and fewer varieties used in ploughed grass and legume fields, replacing the traditional use of seeds from own / local production
- the abandonment of many extensively cultivated fields, thus altering the species composition in these fields
- some of the traditional methods for harvesting of fodder being replaced by modern harvesting machines, causing changes in plant composition, e.g. through earlier harvest
- farms or groups of farms in remote areas being abandoned completely



Image 5. Traditional mountain farms are abandoned, and the buildings and fields are not maintained. Photo Åsmund Asdal

The overall significance for plant genetic resources from these developments has not been estimated.

1.3. Cultivation and diversity of horticultural crops

Table 4. Norwegian production of vegetables and fruits and berries in 1996, 2001 and 2006 (Numbers in 1000 tons)

Crops	1996	2001	2006
Vegetables	163	160	158
Fruit and berries	59	22	23

A broad range of vegetables are produced for the domestic market. The main crops are carrots, cabbage and other *Brassica*, onions, lettuce and greenhouse tomatoes. The production of vegetables has remained quite stable over the last 10 years. The domestic production of fruit and berries has, however, dropped significantly. The reason for this is mainly that restrictions and customs duties on imported products have been reduced in recent years.



In 2008 most of the varieties used in Norwegian horticulture were developed in other countries. Exceptions are to some extent swede and turnip. For these a number of Norwegian varieties from former breeding programmes or old domestic landraces are still some used.

Image 6. Cabbage is one of the most important crops in Norwegian horticulture. Photo Åsmund Asdal

1.4. Use of ornamental plants

The range of species used as ornamentals is quite comprehensive, particularly in private gardens. However, the trends in the use of plants in parks, public gardens and other green areas have shown a similar development to that seen within agriculture and horticulture. Old varieties and genotypes are being replaced by new varieties and new species, and the concentration and globalisation of production and trade in these plants has enforced the use of fewer species and varieties.

Old species, varieties and genotypes of ornamental plants have been mapped and registered through the national PGR programme in collaboration with various partners over the last 6-7 years. This includes herbaceous perennials, roses and perennial bulb and tuberous plants such as *Narcissus* and *Dahlia*. Ornamental trees and lignoses have not been surveyed to the same extent.



The surveys have shown that a broad diversity of perennial plants have survived in old gardens and parks, and also in abandoned gardens in remote areas, where plants still survive or have naturalised, even though the buildings have disappeared. Nevertheless, many ornamental perennials and indoor plants that were commonly cultivated some decades ago have disappeared.

*Image 7. Genotypes of Paeonia have survived in old gardens.
Photo Åsmund Asdal*

1.5. State of crop plants and relatives in the natural flora and habitats

The state of crop wild relatives (CWR) and other plants of socio-economic value in the wild flora has not been comprehensively evaluated and there is a lack of statistical data about their distribution and use. However, the current status and threats to these plants are the same as for the wild flora in general.

The most valuable plant genetic resources from the Norwegian native flora are considered to be the grasses and legumes, especially those within the same genus and species as the cultivated forage crops. These plants represent a large diversity through the adaptation to different climatic conditions, day length, altitude and soil. These resources have traditionally been used for feeding domestic animals, both directly by pasturing and hay cut in their natural habitats or domesticated as landraces of cultivated forage plants on farms. These resources are still relevant as gene sources for further breeding.

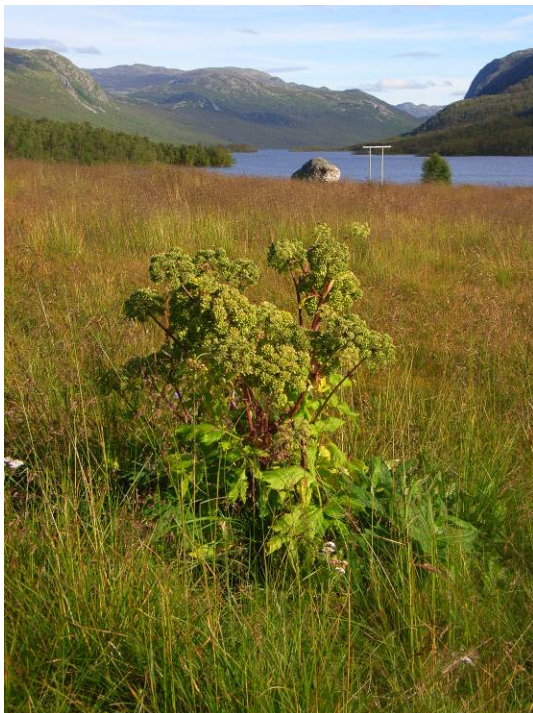
The main harvesting of food plants for human consumption from nature is the traditional picking of berries. The most important wild berries are species in the genus *Vaccinium* and *Rubus*. As only the berries are harvested, the population size and genetic diversity is not impacted in any negative way.

*Image 8. Vaccinium uliginosum is an underutilized relative of the more popular blueberry.
Photo Åsmund Asdal*



Commercial harvest of green plant parts or roots from populations of wild plants, e.g. for medicinal or culinary purposes, is considered to be very low. At present, this hardly represents any threat to natural populations of such plants. However, national authorities are aware that such harvesting could be a threat to wild plants, especially for slow growing plants where roots are in demand. Such harvesting is causing threats to medicinal and aromatic plants (MAP) in other countries. There is a concern that certain species might be in the position of exploitation if the demand increase due to new developments and research regarding health benefits from consumption of wild plants.

A Nordic / Baltic project has identified approximately 130 plant species in the wild flora as relevant genetic resources as medicinal and other aromatic herbs. Of these, 107 species are present in the Norwegian flora. The populations and distribution of some MAP species are decreasing, and 11 of these are red-listed (*Vulnerable* or *Endangered* according to the national red list, published in 2006).



*Image 9. Angelica archangelica is a traditional plant from Norwegian cuisine and medicine. Its history is documented back to the 11th century.
Photo Åsmund Asdal*

2. The State of *In Situ* and On Farm Conservation

In situ conservation comprises the conservation of viable populations of species and genotypes through the conservation of their ecosystems and natural habitats. In the case of domesticated or cultivated species the *in situ* habitats are the surroundings and environment where the plants have developed their distinctive properties. Species remain exposed to evolutionary processes within their ecosystems, which ensure natural selection and genetic adjustment to changing environmental conditions.

On farm conservation implies that landraces and traditional varieties are maintained through continuous farming. The landraces continue to evolve, influenced by natural selection as well as by selection pressures imposed by farmers and gardeners, thus providing opportunities for further local crop adaptation and improvement.

As regards forage plants which are present both in surface cultivated grass fields and in the surroundings, there is no clear distinction between *in situ* and on farm conservation. Conserving plant genetic resources of forage plants on farm by securing continuity in the cultivation of selected fields has been prioritised in the national PGR programme since 2001. Some other on farm activities have also been supported by the national programme.

Conservation of plant genetic resources *in situ* in the wild flora has played no major part in the national or joint Nordic efforts in this field. The transformation of agriculture and the dominance of modern varieties have led to the current focus on *ex situ* conservation of varieties and landraces that are no longer used in professional agriculture. Comprehensive collecting of genotypes of grass and clover species from the wild flora and semi-natural land has also been carried out, and the germplasm is conserved *ex situ*.

Conservation of threatened species in the wild flora has been promoted by other authorities within the environmental sector.

With the establishment of the National PGR programme in 2001, the scope of prioritised tasks has been broadened. The plant groups defined as genetic resources have been extended and the importance of *in situ* conservation has been recognised.

So far, a list of species in the wild flora with actual or potential value for use has not been developed for Norway. However, key groups of valuable plants have been identified. This includes:

- Forage plants; *Gramineae* and legumes
- Berries, fruit and nut species
- Medicinal and aromatic plants
- Crop wild relatives
- Plants relevant for ornamental use; perennials, bushes and trees
- Special plants with new and potentially valuable properties

(*Forest genetic resources are not included*)

2.1. On farm conservation

Traditional use of old varieties and Landraces in commercial agriculture and horticulture hardly exists today in Norway.



Image 10. *Arnica montana*. A redlisted medicinal species growing in semi natural habitats. Photo Åsmund Asdal

The most remarkable exception to this main picture is one old landrace of timothy grass (*Phleum pratense*). Timothy is the most important forage grass in Norway, and the landrace 'Grindstad' is, despite substantial timothy breeding, still the preferred variety in the southern part of the country. The owners of this landrace have skillfully improved the landrace over several decades and succeeded in the competition with modern varieties.

Other examples of the use of landraces on farm can be found in small scale farming and hobby gardening. Some initiatives have been supported through the national PGR programme.

In one case a small group of farmers discovered that landraces and old varieties of cereals had properties of value for organic farming. They therefore started to multiply the seed and they established a community gene bank with the aim of distributing varieties to other farmers. The main goal of this project is now to establish a user's gene bank and disseminate seed to other farmers, to provide information and to maintain diversity in the crops and in cereal based products.

There are some other cases where the old varieties combine special properties such as good flavour with historical use and local traditions. Such products can attain high prices in a narrow and specialised market. Some of these have also been protected under a Norwegian trade mark concept that has been developed for such products.

The production of such varieties and landraces has expanded due to increased interest for traditional varieties, new cultivation techniques and a rediscovery of the excellent taste and flavour of these crops. This is also regarded as part of the national activities within on farm conservation of PGR.

Some old landraces are still produced, or have been reintroduced, and are marketed commercially; examples are

- Potato: 'Ringerikspotet', 'Mandel', 'Gullauge' and 'Blue Congo'
- Pea: 'Ringeriksert'
- Turnip: 'Målselvnepe'

Genetic diversity in meadow and pasture plants has been, and still is, among our most significant PGR, commercially speaking. The genetic resources particularly in grasses and clovers are important for current and future agriculture and these species have been prioritised in the national PGR programme over recent years.



Image 11. The turnip *Målselvnepe* has been cultivated in Troms and Finnmark since 1850. Photo: Ulrike Naumann

In line with the Norwegian PGR Action Plan 2001 – 2005 the project *On-farm methods for conservation and further genetic adaptation of forage crops* was initiated in 2003. Collected genotypes of Timothy (*Phleum pratense*), Common fescue (*Festuca arvensis*) and red clover (*Trifolium pratense*) were crossbred and seeds with new genetic combinations were created. These crossings were sown in fields in several places in Norway under different soil, climatic and farming conditions. As in the development of landraces, the farmers will use the best plants from the third year for further regeneration of the meadow fields, and through the years new adapted landraces of the three species will slowly be created.

The National PGR programme considers this project to be a contribution both to on farm conservation and also to farmer assisted plant breeding.

Seeds of several species suitable for forage production have been collected and are stored at the Nordic Genetic Resource Centre. However, it has been considered important to establish *in situ* or on farm conservation of important species in semi natural open landscapes where some kind of extensive farming still exists. This objective has coincided with the overall goals for maintenance of the traditional farming landscape in Norway. Therefore there has been close collaboration in recent years between the PGR programme and other authorities in order to establish *in situ* conservation areas for valuable forage plant species.

This has resulted in a register of valuable meadows, which have over many decades been pastured or mowed without being ploughed. The use of fertilisers in these fields has been limited and they have been cut and harvested according to traditional methods. Management plans have been made for some registered fields and they have been prioritised for grants and support from local and regional agricultural authorities. This work will continue and in some years time the national programme aims to have a considerable number of *in situ* conservation fields serving as *in situ* or on farm gene banks ensuring conservation of genetic resources and further adaptation of grass and clover species.



Image 12. Agricultural landscapes and old unploughed fields containing valuable genotypes of fodder plants are maintained as in-situ conservation sites for plant genetic resources. Image from an open air museum in Setesdalen, with farm buildings dating back to the 16th century. Photo Ellen Svalheim.

These fields will also ensure the *in situ* conservation of other species of socio-economic interest. Out of the Norwegian wild flora of about 2500 vascular plant species, it is considered that about 700 species are present in cultivated fields and in other kinds of fields influenced by agriculture. About half of these are totally dependent on such fields for their survival. Ongoing trends in agriculture including natural regeneration and afforestation of previous farm land is considered to be one of the major threats to biodiversity in general and especially to natural genetic resources.

The Norwegian Forest and Landscape Institute is conducting the long term so called 3Q Programme for monitoring of agricultural landscape. The acreage of agricultural land in categories such as cultivated forage land, pastures and abandoned fields is monitored within certain intervals, and the flora of vascular plants in a number of small scale fields is registered. On the municipality level the local authorities have mapped and registered valuable habitat types. These data about evolution and trends regarding the agricultural landscape and the present flora are used in the planning and implementation of PGR efforts on farm.

In many countries NGOs and individuals have contributed significantly to conservation and the continuous use of traditional crop varieties. Seed Savers and similar organisations and networks are examples. This has so far not been the case in Norway. There have been individuals who have cared for certain varieties over many years, but such activities have not been organised and have not been a part of the national PGR programme. This has resulted in the unfortunate situation that no one has taken over the responsibility or maintenance of these varieties when the person in question is no longer able to maintain the variety.

The national programme has organised dedicated enthusiasts in networks within different crop groups whereby farmers or gardeners are appointed custodians and maintain certain varieties each year. These custodians produce seeds or propagate plant parts for distribution making annual reports about the conservation of each maintained variety.

2.2. *In situ* conservation

In situ conservation of valuable plants in the wild flora, including crop wild relatives, has so far not been organised as a part of the national PGR programme. However, a broad range of nature reserves and sanctuaries are protected in Norway, and they provide a significant potential for *in situ* conservation of genetic resources.



Image 13. The medicinal plant *Rhodiola Rosea* in Hardangervidda national park. Photo Åsmund Asdal

Protected areas in Norway are protected through The Nature Conservation Act. There are four different types of protected areas which differ in size, objectives (i.e. what is protected) and management regulations.

The four types of protected areas are:

1. National parks have been established to prevent activities that could disturb unspoiled areas of significant size, and also to protect landscapes and habitats for plants and animals. National parks also safeguard areas for outdoor activities, nature experience and recreation. Traditional farming and mountain dairy farming are usually allowed in a national park.
2. Protected landscape areas comprise distinctive and/or beautiful natural or agricultural countryside and often used to maintain actively used farming landscapes. Restrictions are less severe than in other protected areas and farming and forestry can usually be continued, though with greater attention to not reducing landscape qualities.

3. Nature reserves or sanctuaries which have the strictest protection regime among Norwegian protected areas. They cover mainly untouched nature, often with particular species present and they often also serve scientific purposes as well. There are county-wide protection plans for a comprehensive number of nature reserves for wetlands, marshlands, sea bird breeding cliffs, nemoral deciduous and coniferous forest. Activities that can impact the targeted protection objectives are strictly forbidden.
4. The final type of protected area comprises different kinds of natural monuments, features or relics, covering also biotopes, geological or biological values, e.g. protection of certain plant species without protecting a corresponding area as a nature reserve.

Altogether about 14 % of the total land area is protected through one of the first three types of protected area. This then allows the possibility to combine *in situ* conservation of genetic resources with other protection objectives in already protected areas. Nature reserves form the most relevant option because such areas are quite well documented as regards species content, the conservation regime is quite strict and development in such areas is to some extent monitored.

Table 5. Area protected through The Nature Conservation Act in Norway.

	Number	Coverage (in km ² (incl. lakes)	% of Norwegian mainland area
National parks	29	26756	8.3
Protected landscapes	174	15093	4.7
Nature reserves	1822	4299	1.3
Nature monuments	101 (3)	2	0
Other protected areas	122	126	0
Sum	2248	46276	14.3

Table 6. Development in the establishment of nature reserves in Norway from 1996 to 2008.

	1996	2008	% increase
Number	1220	1822	49.3
Area (km ²)	2210	4299	94.5
Average size	1.81	2.36	30.3
% of total land	0.68	1.3	91.2

In 2008 there are 1822 nature reserves in Norway covering 4,299 square kilometers of land, which represent 1.3 percent of the total Norwegian main land area. These numbers have increased from 1220 nature reserves covering 2,210 square kilometers in 1996. The average size of Norwegian nature reserves has increased by 30 % over the last decade.

So far the possibilities to use nature reserves as sites for conserving PGR have not been explored as regards crop wild relatives and wild plants of socio-economic importance. In the forest sector some target tree species have been identified, their presence in protected forest areas has been registered and the use of these areas as conservation sites for tree species is under consideration through a European network (EUFORGEN) project.

A parallel process is planned for other plants. A list of target species will be made, and the use of protected areas as sites for conservation of plant genetic resources *in situ* will be implemented. *In situ* conservation in nature reserves is most appropriate for species that do not require special care or management measures.

There are several threats to *in situ* conservation of species. These are common to several countries and they will not be further elaborated in this document. However, it should be noted that The Norwegian Biodiversity Information Centre published in 2007 a Norwegian Black List containing an ecological risk analysis for alien species. Internationally this work represents a pioneering development. Methodologies for assessing ecological risk have been developed and a thorough risk analysis has been carried out for 217 alien species.



*Image 14. Rosa rugosa is an invasive species and it is registered on the Norwegian Black list.
Photo Åsmund Asdal*

Among these, both plants, plant diseases, insects and animals (such as the Spanish slug) can pose threats and affect plant life and species distribution. Of the vascular plant species that have been evaluated 17 have been considered to constitute a high risk for indigenous biological diversity. The Black List presents a list of 2,483 alien species in the Norwegian flora and fauna.

2.3. Priorities for *in situ* management of plant genetic resources

The Norwegian Action Plan for Conservation and use of Plant Genetic Resources for Food and Agriculture 2007 – 2010 has identified the following prioritised areas for action and priorities in the field of *in situ* conservation:

- a) Prioritising species for *in situ* conservation and plans for implementation
- b) Registration and documentation of prioritised crop wild relatives in nature reserves and development of management measures to conserve and monitor populations of value
- c) Identify potential and support on-farm projects which includes production and marketing of old varieties of food crops
- d) Evaluate the potential effects of climatic change on the forage plant genetic resources in pastures and semi natural open landscapes, particularly in Northern regions and at alpine levels.



*Image 15. Arctostaphylos uva-ursi is harvested for its medicinal properties and a vulnerable species in many countries. The need for *in situ* conservation and monitoring in Norway is considered. Photo Åsmund Asdal*

3. The State of *Ex Situ* Conservation

The responsibility for *ex situ* conservation of PGR germplasm from Norway is shared between the Nordic Genetic Resource Centre (NordGen, the former Nordic Gene Bank) and the National Programme for Plant Genetic Resources (NP) managed by the Norwegian Genetic Resource Centre.

NordGen consists of divisions for the three sectors; Plants, Forestry and Farm animals. This merger of three sectors into a joint NordGen is a regional and political initiative carried out in the Nordic countries through the Nordic Council of Ministers. Joining Nordic forces of genetic resources improves the quality of work and outcome and also rationalises the administrative work.

NordGen is a collaborative institution representing the Nordic Countries. As such NordGen applies a regional and cooperative approach throughout its work. In the plant sector NordGen takes care of the germplasm of the seed-propagated agricultural and horticultural crops for all the Nordic countries. NordGen's external PGR network consists of 4 crop specific working groups in which also the respective national programmes are represented.

Responsibility for conservation and maintenance of vegetatively propagated crops lies within the national programme. However, there is collaboration between NordGen and the national programme regarding documentation, databases and creating a Nordic system for joint security of accessions of clone varieties.

3.1. Conservation of seed propagated crops and potatoes

NordGen is responsible for the conservation of genetic diversity in seed propagated agricultural and horticultural crops and for the potato variety collection for the five Nordic countries. Details on conserved germplasm can be found on the NordGen website and the online database SESTO (www.nordgen.org/SESTO).

The active NordGen seed collection is situated in Alnarp, Sweden and a duplicate of the active collection (called the base-collection) is stored in Årslev, Denmark. Both collections apply a number of household freezers (-18⁰C) in accordance to the techniques developed through the Nordic Model for storage of seed samples. Cryopreservation is being investigated as a new method for conservation of germplasm in a limited number of species. NordGen has also a safety-collection on Svalbard in the Svalbard Global Seed Vault.

The main tasks over the past 10 years have been running regeneration activities and documentation of the material. To prevent genetic erosion in the collections during regeneration, a sufficient number of plants of each accession is ensured and regeneration procedures are followed to prevent unwanted pollination. Time and space isolation is practiced for wind pollinated crops, and cages are used for insect pollinated crops.

NordGen has an implemented routine for initiating regeneration activities when the seed germination is below 60%. Thereby seed viability is maintained with a high frequency.

Inventory activities within the active, base and safety-collections have been carried out and the ex-situ information system SESTO has continuously been upgraded.

Additional collecting missions and enlargements of the collections have also been carried out. During the last 10 years NordGen has carried out collecting missions to the Nordic countries and the autonomous regions of Scandinavia (The Faeroe Islands, Greenland and the Åland Islands). Data and material from these collecting missions have been stored in SESTO.

The documentation system SESTO includes a GIS mapping tool, where it is possible to identify on a map where collection expeditions have been carried out. NordGen registers seed collections also by use of GPS coordinates. Increased focus will be given on documentation of relevant evaluation data, genetic data and data on cultural history.

3.2. Germplasm conserved at NordGen

At the end of 2007 a total of 27,747 seed accessions are conserved at NordGen, either on long term or short term conditions. All the material are according to decisions in the Nordic Council of Ministers, plant genetic resources jointly owned by the five Nordic countries. The storage conditions for long term and medium term conservation are identical, but the medium term material is not monitored for viability and not regenerated.

Available documentation about the material is recorded in SESTO. This includes also the country of origin of the germplasm. An overview of the number of accessions in different collection categories is shown in table 7.

Table 7. Accessions conserved at NordGen at 31.12.2007 categorised by country of origin, collection category and whether the material is conserved for long or medium term. The Other column contains accessions from non-Nordic countries or material of unknown origin. Source: State of Plant Genetic Resources for Food and Agriculture in Finland. 2008

Long Term	DNK	FIN	ISL	NOR	SWE	Other	Total
Ordinary Seed Collection	1520	1152	300	1512	2465	447	7396
Special Barley Collections	24				1684	743	2451
Collection of Wild Triticeae	5	14	8	6	12	1174	1219
Pisum Genetic Stock	25	45			831	748	1649
Other Special Collections	5				390	425	820
Total number of accessions	1579	1211	308	1518	5382	3537	13535
Medium Term							
Ordinary Seed Collection	1740	354	22	93	1062	1782	5053
Special Barley Collections	370				7880		8250
Collection of Wild Triticeae						1	1
Pisum Genetic Stock					84	820	904
Other Special Collections						4	4
Total number of accessions	2110	354	22	93	9026	2607	14212



Image 16. The seed collection of The Nordic Genetic Resource Centre contains high numbers of accessions of barley originating from Nordic breeding and research. Photo Åsmund Asdal

At present (October 2008) 1770 accessions of seed propagated material of Norwegian origin are stored at NordGen. This includes varieties, landraces, breeding lines and germplasm collected from wild or semi-natural habitats. Approximately 75 % of the accessions are forage species and a major part is collected from agricultural or semi-natural habitats. Table 8 shows the distribution of these 1770 accessions in crop species.

Table 8. Accessions of forage plants, cereals, vegetables and other seed propagated plant species of Norwegian origin conserved at NordGen. Numbers from SESTO in October 2008.

Scientific name	Crop	No. Acc.
Forage plants		1362
<i>Agrostis capillaris</i>	Common Bent	114
<i>Agrostis stolonifera</i>	Creeping Bent	2
<i>Alopecurus pratensis</i>	Meadow Foxtail	20
<i>Bromus inermis</i>	Awnless Brome	22
<i>Calamagrostis purpurea</i>	Scandinavian Small-reed	1
<i>Dactylis glomerata</i>	Orchard Grass	212
<i>Deschampsia flexuosa</i>	Wavy Hair Grass	1
<i>Elymus alaskanus</i>	Alaskan wheatgrass	3
<i>Elymus caninus</i>	Awed Wheat Grass	3
<i>Festuca ovina</i>	Sheep's Fescue	12
<i>Festuca pratensis</i>	Meadow Fescue	113
<i>Festuca rubra</i>	Red Fescue	120
<i>Lolium perenne</i>	Rye Grass	15
<i>Medicago sativa</i>	Alfalfa	1
<i>Melilotus alba</i>	White Melilot	1
<i>Melilotus officinalis</i>	Yellow Melilot	2
<i>Phalaris arundinacea</i>	Reed Canary Gras	75
<i>Phleum pratense</i> ssp. <i>pratense</i>	Timothy, Cat-s-tail	272
<i>Poa pratensis</i>	Meadowgrass	114
<i>Trifolium hybridum</i>	Alsike Clover	17
<i>Trifolium pratense</i> ssp. <i>pratense</i>	Red Clover	131
<i>Trifolium repens</i>	White Clover	99
<i>Trifolium repens</i> var. <i>repens</i>	White Clover	10
<i>Vicia sepium</i>	Hedge Vetch	2
Cereals		278
<i>Avena fatua</i>	Common Wild Oat	5
<i>Avena sativa</i>	Oat	42
<i>Hordeum vulgare</i> ssp. <i>vulgare</i>	Barley	171
<i>Secale cereale</i>	Rye	15
<i>Triticum aestivum</i> ssp. <i>aestivum</i>	Bread Wheat	45
Vegetables		116
<i>Allium cepa</i> var. <i>cepa</i>	Garden Onion	3
<i>Allium fistulosum</i>	Welsh Onion	5
<i>Allium porrum</i>	Leek	1
<i>Allium schoenoprasum</i> var. <i>schoenoprasum</i>	Chives	6
<i>Allium scorodoprasum</i>	Sand Leek	1
<i>Angelica archangelica</i> ssp. <i>archangelica</i>	Angelica, Holy Ghost	2
<i>Brassica napus</i> var. <i>napobrassica</i>	Swede	27
<i>Brassica oleracea</i> var. <i>capitata</i> f. <i>alba</i>	White Cabbage	34
<i>Brassica oleracea</i> var. <i>gemmifera</i>	Brussels Sprouts	1
<i>Brassica rapa</i> ssp. <i>rapa</i>	Turnip	17
<i>Lycopersicon esculentum</i>	Tomato	1
<i>Phaseolus vulgaris</i> var. <i>vulgaris</i>	Bean	8
<i>Pisum sativum</i> ssp. <i>sativum</i>	Garden pea, English pea	10
Others		14
<i>Alliaria petiolata</i>	Garlic mustard	1

<i>Betula pubescens</i> ssp. <i>czerepanovii</i>	Mountain birch	2
<i>Carum carvi</i>	Common Caraway	6
<i>Linum usitatissimum</i>	Flax	1

NordGen is also responsible for conservation of the Nordic collections of potato varieties, landraces and breeding lines. This collection contains 64 accessions, and 16 of these are considered to be of Norwegian origin.

3.3. Priorities for NordGen *ex situ* conservation and management

The NordGen priorities for the upcoming years are to sustain existing collections and secure continuous funding of the activities, such as 1) implementation of sustainable acquisition systems, 2) training and educating staff, 3) updating and applying sufficient equipment, 4) improving and updating documentation, 5) continuing collecting missions, 6) emphasising the utilisation and information sharing and finally 7) increasing public knowledge and access.

A strategy plan for NordGen's next four years is currently under development and will be presented in the autumn of 2008. Increased focus on utilisation and information will be indicated. However, since NordGen is a Nordic knowledge centre alongside being a gene bank, future emphasis will also comprise improvements of the activities for education, research and public communication.

Other priorities are rescuing endangered special / research collections, collecting missions on wild species and repatriation of Nordic germplasm from gene bank collections abroad.



Image 17. Crambe maritima grows on the sea shore in some parts of Norway. Photo Åsmund Asdal

NordGen wishes to carry out research focusing on the material in the gene bank both within documentation, utilisation and information, in order to display and demonstrate the value of the conservation of biodiversity. To accomplish this task NordGen needs to collaborate with skilled researchers and expertise in the field of PGR.

Maintaining sufficient funding in order to continue to run the gene bank in a constructive and professional way is a challenge, also for NordGen. Securing funding from all Nordic governments and the Nordic Council of Ministers is important. Additional funding options can be external fundraising through collaborations, networking and research projects.

Efforts to maintain public support in the Nordic countries and in funding bodies for The Nordic model of gene banking is emphasised. This model has been considered to be the best and most cost-efficient way of doing gene banking for the Nordic countries, and it has also been implemented in other parts of the world.

Among optional internal reforms which can save costs, enhance quality and extend the activities are measures for sharing the burdens of the costs of conservation and development of low cost technologies. NordGen is also committed to participate actively in the European initiative on AEGIS (A European Gene Bank Integrated System), which is a strategic direction towards a more rationalised gene bank system at the European level.



Image 18. The old apple variety 'Herrasal' has been cultivated in the western part of Norway. Photo Åsmund Asdal

Other strategic directions for NordGen are projects relevant to climate change and environmental impact.

3.4. Conservation of fruit varieties

Four fruit crops have been cultivated commercially in Norway; apples, pears, plums and cherries. A survey of important varieties has been carried out, concluding that 336 varieties are considered as Norwegian mandate varieties prioritised for permanent conservation.

Criteria for nominating mandate varieties have been:

- a) Norwegian varieties with commercial significance or an important trial variety from Norwegian breeding.
- b) Norwegian landraces which should be conserved
- c) Varieties with certain features and/or properties
- d) Foreign varieties of importance for commercial production.
- e) Mutations of significance

Assessing the significance of the varieties is partly based on a thorough survey of Norwegian agriculture which was carried out in 1946. Detailed statistics about the number of trees of each variety is available.

Conservation of crop varieties in field collections in Norway is organised through close collaboration with open air museums, botanical gardens, agricultural colleges, R&D institutions and others. Regarding fruit varieties the conservation programme comprises 12 local variety collections holding more than 400 different varieties. Many of these host institutions hold, for historical reasons, a number of local landraces in addition to the national mandate varieties.

Table 9. Number of mandate varieties of the four fruit crops and the situation regarding conservation in 2007.

Fruit crop	Mandate varieties	Not yet conserved
Apple	201	36
Pear	55	10
Plum	51	7
Sweet cherries	21	2
Sour cherries	8	2
Total	336	57

Through the establishment of a national PGR programme in 2001 and a public campaign in 2007, 12 of the missing mandate varieties were found in old orchards or private gardens. These varieties are now being propagated and trees will be added to existing collections. Some other missing varieties were found in other Nordic collections. Some varieties are still missing and they are being searched for.

Apple, plum and cherries can also be found in the wild and semi-natural flora. Species of wild *Sorbus* are also considered to represent indigenous genetic resources, mostly as ornamental plants, but also for the use of the berries.

3.5. Conservation of vegetatively propagated vegetables

Most vegetable crops grown in Norway are seed propagated and varieties are conserved by NordGen. Collecting has been carried out since the 1980's. The Norwegian Genetic Resource Centre has an ongoing general public call for information about old landraces and genotypes of vegetables and the collections are extended when new accessions are identified.

Field collections are maintained in cooperation with the Norwegian Institute for Agricultural and Environmental Research. Data and documentation of the accessions has been generated during the last ten years, mainly through cooperative projects between NordGen and the NP.

Table 10: Number of accessions of vegetable crops in Norwegian field collections

Crop	Accessions
Jerusalem artichoke	40
Shallots	18
Rhubarb varieties*	23
Rhubarb landraces	52
Horse radish	21

*) The collection of foreign varieties used in Norway is located at the University of Life Sciences



*Image 19. Clone collection of rhubarb.
Photo Åsmund Asdal*

3.6. Conservation of berries

Besides the rich diversity of plants for forage, the genetic resources of wild berry plants are considered to be the richest with respect to PGR in the Norwegian flora.

The cultivation of berries has long traditions in Norway. The cold climate has limited crop diversity in agriculture and horticulture, but different species of berries could always be grown on farms and in gardens and they could also be harvested from nature. This has been the case even in mountain regions at high altitude and in the far north of the country. Some varieties have been imported, and wild growing specimens exhibiting favourable properties have evolved into landraces.

Plant genetic resources of value in cultivated fruit crops can be found in the genera *Fragaria*, *Rubus*, and *Ribes*. Several species of these genera are also distributed in the wild flora, some genuinely wild, but some escaped from cultivated fields. In addition a broad range of wild growing berry species is distributed throughout the country with representatives from the following genera: *Vaccinium*, *Empetrum*, *Oxycoccus*, *Sambucus* and *Hippophae*.

The blackberry (*Rubus fruticosus*) is represented by many species and subspecies, and several species of blackberries are to be found in the southern and south western parts of the country. About 20 rare species have been collected and a long term collection was established in the first phase of NP (2001-2005).



Image 20. Species collection of blackberries. Photo Åsmund Asdal

A survey of important varieties of cultivated berry crops has been carried out in the national programme, and a number of varieties have been identified for long term conservation. The collection of specimens and establishment of a national variety collection for berries has not yet been completed.

Table 11. The number of national mandate varieties of berries to be collected and conserved

Berry crop	Number
Strawberry	23
Raspberry	18
Cloudberrries	4
Blackcurrants	15
Redcurrants *	7
Gooseberries	9

*) In addition to the described varieties a number of genotypes of red currants from natural habitats have been collected and will be evaluated before decisions about long term conservation are taken.

3.7. Conservation of medicinal and aromatic plants

A survey of medicinal and aromatic plants (MAP) in the Nordic & Baltic flora has been carried out. A list of 134 MAP species relevant for further investigation and conservation has been created. NordGen has decided to consider the 134 species as NordGen mandate MAP species. Of these 107 species are present in the Norwegian flora.



Image 21. Clone collection of hop. Photo Åsmund Asdal

During the last ten years field collections of specimens from the wild flora for further investigation have been established by The Norwegian Institute for Agricultural and Environmental Research for *Rhodiola rosea*, *Origanum vulgare*, *Carum carvi*, *Tanacetum vulgare*, *Allium ursinum* and *Humulus lupulus*.

Long term conservation of genotypes and collection of other species will be considered and determined.

3.8. Conservation of ornamental plants

Conservation and use of the PGR of ornamental plants has been included in the NP from 2001. The National programme has cooperated with various institutions, NGO's and individuals in the fields of botany and cultural history to register, evaluate, collect and establish collections of perennials, roses and ornamental bulb and tuber plants.

Five principal collections of perennials have been established at the five main botanical gardens in Norway. These institutions have agreements with the Norwegian Genetic Resource Centre on conservation and maintenance. The plants are displayed in the public area of the botanical gardens and the material can be made available for different purposes.

In addition to the principal collections a number of institutions hold collections of old perennials, mainly to conserve and display these traditional garden plants for the sake of their cultural heritage. The Norwegian Genetic Resource Centre keeps records on these plants and considers these secondary collections to be a part of the national PGR programme.

A rough estimate shows that more than 1,500 different perennials, species and cultivars, with known history prior to 1950 have been collected. These plants are now conserved and displayed in botanical gardens, at open air museums etc. The plants represent different genera and plant groups, but have in common that they are robust and adapted to northern climatic conditions and can survive long periods in old gardens with a minimum of maintenance and care.



*Image 22. The 'Steigenlilje', an old perennial with documented history back to the 19th century.
Photo Åsmund Asdal*

Old traditional roses have been registered and collected through different projects, conducted by botanical gardens at universities and through the Norwegian Rose Growers Association. Some 3-400 old historical rose cultivars have been collected. Three principal collections have now been established where the roses are being identified and evaluated. Consideration of permanent conservation of mandate rose cultivars will be taken later.

Ongoing calls for historical *Dahlia*, *Paeonia* and *Narcissus* have so far localised around one hundred old cultivars which will be collected and evaluated further before long term conservation will be implemented.

About 20 traditional indoor ornamental plant varieties that are no longer commonly used are being conserved at the Norwegian Arboretum at the University of Bergen.

3.9. Documentation and information

Documentation and information about accessions held at NordGen are stored and displayed through their data base system SESTO (<http://www.nordgen.org/sesto/index.php?scp=ngb&thm=sesto>).

This is also the case for accessions of vegetatively propagated crops such as vegetables and fruits, which have been collected and registered in cooperation between NordGen and the national PGR programme. Collection, characterisation and evaluation of these crops have been coordinated through the Nordic gene bank working groups and generated data have accordingly been filed in NGB / NordGen. Data about vegetable crops have been compiled and displayed, while the fruit database is under development.

These are the most important food crops of which varieties and old cultivars from Norway can be required for plant breeding or for other scientific investigation. These data have been further distributed to international databases, such as EURISCO and the ECPGR Central Crop Databases.

Equivalent information about other field collections has so far not been gathered, compiled and displayed. A final decision on whether to develop a common Nordic solution together with NordGen or national solutions has not been taken.

At the present data from collecting missions in Norway and information about the accessions in the national field gene bank collections are only available through reports and field protocols for each project and each collection. A comprehensive inventory of all data and the compilation into a common database has not yet been carried out.

The Norwegian NP considers the public and the “green oriented” part of the population to be an important target group for information about plant heritage, the historical plants and the plant collections. Websites managed by the Norwegian Genetic Resource Centre have therefore been established with the aim to disseminate popular science and achievements with respect to the plant heritage. To compile and make available information about all collected accessions is a huge task, and this will proceed according to available resources.

3.10. Priorities for national *ex situ* conservation in field gene banks

- a) Characterisation and evaluation of accessions of prioritised crops
- b) Gather and publish missing data and information about the accessions in national field collections
- c) Complete the national system of field gene banks according to the national strategy including supplementing missing mandate varieties, measures for security accessions and availability of material and information
- d) Conduct collecting missions in some remaining crop groups within vegetables, MAP and ornamentals and conserve valuable germplasm as seeds or living plants.

4. The State of Use

Plant genetic resources in Norway are used in commercial plant breeding and in agriculture as commercial varieties for farming and production. In addition a broad range of old varieties, landraces and genotypes are used directly in small scale production or through different kinds of non-professional utilisation.

4.1. Plant breeding in Norway

Due to the limited acreage and volume from Norwegian agriculture, commercial plant breeding aimed solely at the Norwegian market has limited income potential. Nevertheless, development of adapted varieties and maintaining a highly developed agriculture in all parts of the country is a political priority. Settlements in remote and sparsely populated districts of Norway where agriculture is carried out under marginal conditions need to be supplied with locally adapted high yielding varieties which will have a limited market value. Norwegian plant breeding is based on support from the State budget and plant breeding in the main crops is conducted through a public-private partnership.

The plant breeding sector in Norway has undergone organisational reforms in the recent years. While plant breeding was previously carried out at The Agricultural University and in agricultural research institutes, from 2002 all Norwegian plant breeding was merged into one commercial company, Graminor AS. Graminor is a limited company which is jointly owned by private companies and governmental institutions.

The aim of this reorganisation was to establish a robust and coordinated plant breeding programme aimed at providing Norwegian agriculture with high quality varieties of major crops. Adaptation to Norwegian climates and resistance to major plant pests are important goals for the breeding programme.

Graminor is also aiming at increasing the revenues from Norwegian varieties and to increase the use of Norwegian varieties in Norwegian agriculture. Graminor achieve annual governmental support, earmarked to political goals for a vital Norwegian agriculture, also in areas with limited production potential.



Image 23. Trifolium pratense is included in Norwegian plant breeding programs. Photo Åsmund Asdal

Table 12: Breeding programmes of the Norwegian breeding company Graminor AS

Crop group	Crop
Cereals	Spring wheat, barley and oats
Forage grass and clovers	Timothy, meadow fescue, festulolium, red and white clover
Potato	
Fruit and berries	Apple, plums, raspberries, strawberries and cloudbberries

Norwegian varieties from Graminor compete with foreign varieties in the agricultural seed and transplant market.

Table 13: Approved varieties from the Graminor breeding programme in the period 2000-2007 and the share of the Norwegian seed market covered by varieties owned by Graminor (incl. protected varieties approved before 2000).

Crop	Approved varieties	Market share % (2007)
Wheat	2	37
Barley	10	75
Oats	7	30
Forage crops	28	58
Potatoes	2	32
Strawberries	4	2
Raspberries	6	1
Cloudbberries	4	100
Apple	4	4
Plums	0	7

In addition to the breeding conducted by Graminor a small breeding programme for fruit and berries is carried out with governmental support at the University of Life Sciences.

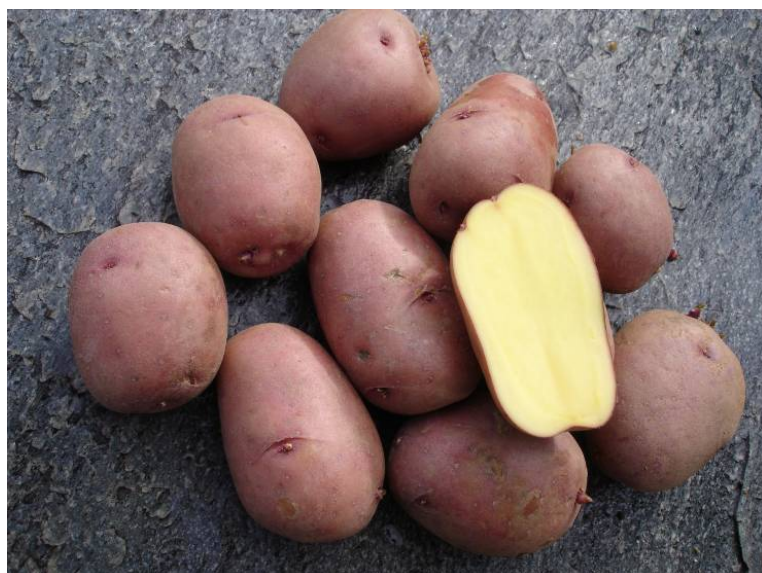


Image 24. The new variety N-92-22-14 from Graminor is currently undergoing variety trials. Photo: Kirsten Bundgaard

In the current action plan period the national plant genetic resource programme supports two plant breeding projects; a) a joint Nordic initiative *Phenotypic and molecular characterisation of genetic resources of Nordic Timothy* investigates Nordic timothy gene bank material, and prepares for further timothy breeding in the member countries and b) a long term project developing “new landraces” in timothy, meadow fescue and red clover in cooperation with farmers at different locations throughout the country.

4.2. Diversity in the seed and transplant sector

The marketing of seeds is regulated through seed marketing legislation which is harmonised with the European Union. Certification of the varieties and authorisation of the seed companies are prerequisites for marketing of agricultural seeds in Norway. Marketing of propagation material is also regulated to ensure authenticity and high plant health status. This secures the farmers high quality and well adapted propagation material.

However, strict rules for the marketing of varieties in many crops are an obstacle for distribution and use of old varieties and landraces which do not meet the requirements for seed certification. High basic costs for registration, approval and control of each variety are

also contributing to reduced distribution of plant varieties that are of interest only for a few farmers.

New legislation for certification of local varieties and for more flexibility in the distribution of unregistered seeds is under development, aiming at broadening of the diversity of varieties used in agriculture.

4.3. Use of PGR in small scale and non-commercial production

As in most industrialised countries groups of individuals are for different non-commercial reasons taking care of and cultivating old plant varieties. The Norwegian Genetic Resource Centre supports several small initiatives, and considers efforts carried out by individuals on an idealistic basis to be significant and of great value.

No accurate statistics on the number of varieties used or the volume of these activities exists, but some examples can be given.

- a) The Nordic Genetic Resource Center (former Nordic Gene Bank) provides seeds from their collections to farmers and gardeners who want to cultivate varieties that are not available through the seed marketing system. This is a free service from NordGen aiming at sustainable use of genetic resources and at raising public awareness.
- b) A group of farmers are maintaining and using old cereal varieties, and provide seeds for potential users. They investigate properties and develop products where these varieties are better adapted or have valuable properties. The old varieties are also tested in organic farming.



*Image 25. A group of farmers evaluating old cereal varieties.
Photo: Kari Bysveen*

- c) A trademark for old varieties and landraces has been developed; PLANTEARVEN®, (literally “The Plant Heritage”). Small scale producers are allowed to use the trademark and they take advantage of common marketing and publicity of old plant varieties conducted by the Genetic Resource Centre. Propagation material from gene bank collections is freely distributed to small scale businesses. So far the trademark is used for ornamental plants and fruit trees. Such small industries contribute to increased use of the diversity of old varieties, landraces and genotypes.

- d) An association similar to the US based Seed Savers Exchange has been initiated in Norway. Groups set up to care for a) heritage vegetables, potatoes and herbs and b) for indoor ornamentals are already actively growing several old varieties and distributing plant material to other group members. Other groups for perennials, berries and roses are planned to be established.
- e) Plant material from field collections have been distributed to open air museums, historical gardens etc. in order to restore grounds and green areas with authentic plants and landraces. This is considered to be an import public awareness activity.

4.4. Priorities to promote the use of plant genetic diversity

It is a major challenge to increase the value of the conserved germplasm, and to ensure its availability and value for different users. Ongoing breeding projects use conserved material only to a quite limited extent. However, it is obvious that future breeding programmes, e.g. for a changing climate, will have to search for genes and properties through the gene banks.

To prepare the material, e.g. with respect to the evaluation of properties according to future needs is a prioritised task, which will be carried out in cooperation with breeders and researchers. The Genetic Resource Center will also stimulate increased research. The Action Plan has identified prioritised research topics both with respect to conservation and the use of the material.

It is assumed that the large number of crops and varieties that are conserved has significant potential for the development of new commercial products for niche markets. The national programme prioritises the contribution towards identifying relevant germplasm and in accommodating production and marketing.

5. The State of the National PGR Programme, Training and Legislation

The Norwegian Ministry of Agriculture and Food is the national authority responsible for the management of plant genetic resources in Norway. The Ministry has complied with this responsibility through the Nordic Gene Bank since 1979 and through a separate national PGR programme from 2001. In 2006 the Norwegian Genetic Resource Centre was established as a national centre of expertise on genetic resources in agriculture, including plant genetic resources.

5.1. Achievements in the Norwegian Plant Genetic Resource Programme

The Norwegian PGR programme was established in 2001 in accordance with recommendations from the Global Plan of Action for Conservation and Use of Plant Genetic Resources for Food and Agriculture. The programme was managed by a secretariat hosted by the Norwegian Crop Research Institute and guided by a national PGR advisory committee.

The advisory committee consisted of representatives from research institutions, the breeding company, farmers' unions, national authorities within agriculture and environment and stakeholder NGO's. This secured a broader scope and anchoring of the national PGR-activities to user groups and stakeholders. Through the last ten years the awareness of issues related to plant genetic resources has enhanced significantly in the public and among users groups in particular.

The national programme of 2001-2006 extended the range of plant species in national PGR activities to include ornamental plants and crop wild relatives. The programme has organised national field gene banks in vegetatively propagated crops, such as fruit crops, some vegetables, clones of aromatic species, roses and ornamental perennials.

New varieties of seed propagated crops have also been located, and these have extended the seed collections at the Nordic Genetic Resource Center (NordGen). In cooperation with the Nordic Gene Bank (now NordGen) conserved material and varieties in many crops have been characterised and evaluated during the last decade.

This applies both to seed accessions in the gene bank and to national material in clone collections.

Some national clone collections were already established in the early 1990s, but these were extended through surveys and collecting missions. They have all been formally united in the national PGR programme, which leads to improved documentation of the material.

More details related to the specific crop groups, cf. crop discussions in chapter 3.

The national programme has secured access to the material and promoted the use of plant genetic diversity. Projects including investigations of properties and preparations for breeding and use were carried out in cooperation with the research institutes. The use of DNA-analyses in breeding and management of field collections was investigated.



Image 26. Allium victorialis has been used both for food and as an ornamental. Photo Åsmund Asdal

The national programme strengthened the efforts regarding public awareness in this period. Increased awareness and knowledge about PGR in the public and in different user groups has increased significantly. This has been achieved through extensive use of mass media such as radio, television, magazines and newspapers. The NP has also organised a few seminars and meetings, published leaflets and brochures and issued relevant information through the websites.

An evaluation of the national management of genetic resources for food and agriculture resulted in the establishment of the Norwegian Genetic Resource Centre in 2006 as a department of the Norwegian Forest and Landscape Institute. National programmes for animal, plant and forest genetic resources were merged in the centre.

5.2. Norwegian Genetic Resource Centre

In general, the Norwegian Genetic Resource Centre promotes the conservation and sustainable use of national genetic resources in farm animals, crop plants and forest trees. It is the national centre of expertise on genetic resources in agriculture, advisory to the Ministry of Agriculture and Food and coordinates a wide range of activities.

The Centre is secretariat for The Norwegian Genetic Resource Council and for advisory committees within each of the three sectors for farm animals, crop plants and forest trees. Together with these bodies the Centre conducts national programmes for conservation and sustainable use of genetic resources in agriculture and is responsible for the execution of the national programmes for animal, plant and forest genetic resources.

*Image 27. The Norwegian Genetic resource Centre coordinates activities in three sectors; animal, plant and forest genetic resources.
Photo Åsmund Asdal*



The Centre initiates and administrates activities within the three sectors, but depends heavily on cooperation within gene conservation networks for practical implementation. It contributes to increasing the general public awareness and information flow on genetic resources and is the national participant in Nordic and international programmes.

The main objectives for the plant section at the centre:

1. Carry out The Norwegian Action Plan for Conservation and Use of Plant Genetic Resources for Food and Agriculture 2007- 2010
2. Coordinate national activities and initiate new projects aimed at conservation and use of PGR
3. Develop cooperation with institutions, organisations and individuals regarding PGR.
4. Ensure dissemination of knowledge, promote capacity building and raise public awareness about PGR.

5.3. The National PGR programme

The national programme for plant genetic resources has four year planning periods.

The programme has two main fields of activities; a) measures related to the current plant genetic resource material and b) general activities related to management, information and public relations.

Activities related to the current plant material are:

- Maintenance of Norwegian field gene banks
- Surveying and inventorying plant genetic resources in cultivated fields and in natural flora
- Considering the need for conservation actions, and when necessary, to undertake required measures.
- Documentation and dissemination of data about conserved PGR
- To provide plant material for all kinds of use and to promote economic activities based on PGR



*Image 28. The national PGR program is securing the maintenance of the field gene banks.
Photo Åsmund Asdal*

Activities related to plant genetic resources in general are:

- Coordination of national networks and cooperation
- Information tasks
- Secure that the need for management of plant genetic resources is mirrored in related national processes, institutions and bodies
- Review national legislation related to PGR and advise on needs for adaptation.
- Coordinate Nordic regional cooperation, especially the cooperation with NordGen.
- Assist the Norwegian Ministry of Agriculture and Food through participation in international fora on PGR, and in the national implementation of international agreements and regulations

5.4. Partners in the national PGR programme

The staff of the Norwegian Genetic Resources Centre comprises five persons, of which only one is dedicated to the plant sector. Accomplishment of the national programme is therefore highly dependent on synergies and close cooperation with a broad range of partners. The kind of partners and related tasks can be summarised in the following table.

Table 14. Tasks and cooperative partners in the Norwegian PGR programme

Cooperative tasks	Partner(s)
Conservation of fruit varieties in filed gene banks	Open air museums and agricultural colleges
Field gene banks for ornamental plants	Botanical gardens, universities and open air museums
Field gene banks for vegetables, herbs and berries	Research institutes and institutions holding and providing propagating material of healthy plants
Documentation and databases	Nordic Genetic Resource Centre (NordGen)
Survey of old plants, field work and collection missions	Universities/botanical gardens, R&D institutes, breeding companies, museum staff and individuals
Investigation of properties in collected material	Universities, breeding companies and NordGen
Business enterprise based on PGR	R&D institutions, breeding companies, economical organisations in agriculture and private enterprises
Conservation of PGR in cultivated landscapes and conservation On-farm	Governmental and regional agricultural authorities and R&D Institutions
Management of PGR <i>in-situ</i>	Governmental and regional authorities within agriculture and environment, botanical expertise and institutions
Broadening documentation and use of plant genetic diversity	Farmers and their associations and cooperative institutions
Non-professional and hobby conservation and use of PGR	NGOs within gardening, nature conservation and biodiversity
National legislation for trade and distribution, import / export etc.	Norwegian Food Safety Authority
Information and public awareness	Holders of variety collections, NordGen, cooperative R&D institutions and project partners.

The national programme supports every year projects carried out in partner institutions at levels according to the annual budget provided from the Norwegian Ministry of Agriculture and Food.



Image 29. Botanical gardens and open air museums are important partners for the maintenance of traditional plants. Image from Milde outside Bergen, where the Norwegian Arboretum is situated. Photo Åsmund Asdal

5.5. Education and training

Advanced education in topics related to agriculture at university level is the responsibility of the Norwegian University of Life Sciences. Their courses include basic genetics, molecular genetics and plant breeding. The topics range from the initial plant genetic resources and domestication of crops to modern plant breeding and genetic modification.

Particular lectures are given in conservation genetics and topics regarding description, measurements and prediction of changes in genetic variation are included. The use of DNA sequencing is applied for different analytical purposes.

From this year conservation and use of plant genetic resources is included in the introductory course in plant science, and students visit national plant variety collections and locations for ongoing plant breeding.

Biodiversity and management of plant genetic resources is also an emphasised issue at Noragric, which is the Department of International Environment and Development Studies at the University of Life Sciences. Noragric's activities include research, education and assignments, focusing particularly, on developing countries and countries with economies in transition. Research and education relevant to plant genetic resources includes both technical issues and policy subjects

Plant breeding and the importance of choosing good crop varieties is important in education and training of farmers. This is further followed up in the activities of the farmers' cooperative extension service. Farmers are also involved in evaluation and selection of the best varieties for Norwegian agriculture, through hosting variety trials of different crops.

In cooperation with the Genetic Resource Centre, information on related topics relevant to conservation of PGR is passed on within these organisations.

5.6. National legislation

Significant legislation regulating conservation and use of plant genetic resources in Norway is the law on plant breeders' rights and the Food Act.

The Act on Plant Breeders' Rights of 1993 implies that Norway continues as a member of the UPOV convention of 1978. Joining the UPOV of 1991 has been considered, but Norwegian policy has kept to the regulations of UPOV '78, mainly due to the fact that this version gives more space for traditional agricultural practice regarding the use of own seeds and transplants. This policy can be considered to contribute to implementing article 9 of the International Treaty on Plant Genetic Resources for Food and Agriculture on Farmers' Rights in Norway.

The Food Act from 2003 aims at ensuring healthy and high quality food to the consumers and environmentally sound production. Particular regulations are aiming at promoting healthy plant production and minimising pests and plant disease problems. These regulations put some restrictions on seed trade and the distribution and use of old varieties.

Norwegian legislation is according to Norway's membership in EEA (European Economic Area), harmonised with EU legislation on several issues, including on the legislation for marketing of seeds. This legislation, states that seed marketing is regulated by a system of certification of varieties and by authorisation requirements for the marketers. Old varieties may have difficulty in meeting the requirements regarding distinctness, uniformity and stability (DUS) which is needed for the certification.

This seed marketing regulation has complicated small scale distribution and use of old varieties of e.g. cereals and vegetables. However EU is from 2008 issuing new seed directives for conservation varieties which will legalise and simplify the approval procedure and the distribution of a broader range of old varieties. Accordingly, the Norwegian Seed Regulation, which is a part of the Food Act, will be revised in the near future with the aim to make small scale and non commercial exchange of seeds easy and legal.

The Norwegian Genetic Resource center considers small scale and idealistically motivated use of old crop varieties to be an important part of the national PGR programme regarding conservation and use, and also regarding public awareness. Revised and improved seed trade legislation will therefore be a significant achievement.

Since 2004 the Norwegian government is in the process of preparing a new Biodiversity Act (Act on the Conservation of Nature, Landscape and Biodiversity). This act will regulate the conservation, access and use of plant genetic resources in nature, and it will reflect the Norwegian policies on this issue. The act has not yet been adopted.

5.7. Public awareness

The national PGR programme has, since its establishment in 2001, emphasised dissemination of data about plant genetic resources and information about the importance of their conservation and use. Several methods and information channels have been used:

- Development of PLANTEARVEN which incorporates a combined concept for information, public events and plant exhibitions, promotion of use and trade mark label for plant production and marketing
- Own websites; a) www.genressurser.no which disseminates information about activities in the national PGR programme including projects and a news service and b) www.plantearven.no which includes information about the plant material. (These websites are in Norwegian language)
- Conferences, seminars, lectures and meetings targeted at certain stakeholders and user groups
- Active use of mass media; radio, television, newspapers and magazines
- Public events at the host institutions of field gene bank collections and posters for visitors
- Production and distribution of posters, brochures and other printed material for the public

The public awareness of the values related to plant genetic resources has increased significantly during the last decade.



Image 30. The inauguration of a picnic area and information board about "The Plant Heritage" at one of the fruit variety collections in Ulvik, Hardanger. Photo Åsmund Asdal

6. The State of Regional and International Collaboration

According to governmental policy Norway has played an active role both regionally and globally in implementing and supporting multilateral bodies, agreements and different related projects.

6.1. Nordic cooperation

The former Nordic Gene Bank, today NordGen, was established in 1979. Through almost 30 years, it served as a common regional gene bank for seed propagated crops and potatoes from the Nordic countries. The policy has been to conserve all crop genetic diversity from the five Nordic countries and today very few accessions in the seed collections have their origin in other countries.

The Nordic cooperation on genetic resources is organised under the Nordic Council of Ministers. From the 1st of January 2008 the Councils work on genetic resources within plants, animals and forest trees was unified in the Nordic Genetic Resource Centre (NordGen), with the aim to strengthen and coordinate efforts and activities in genetic resources in all sectors.

During the first 10 years, collection of old crop varieties was carried out nationally by breeders, researchers etc. and the seed samples were deposited in the gene bank. National members of six crop oriented working groups of the gene bank were in charge of the conservation of national plant genetic resources, and these individuals also served as a national advisory committee in PGR matters for the Ministry of Agriculture.

Through this Nordic cooperation coordinated by the Nordic Gene Bank/NordGen, varieties of vegetatively propagated crops as fruits and some vegetables from the five countries have also been collected. These accessions were successively conserved in national field gene banks and they are still conserved nationally. However, documentation and database work has been carried out and coordinated on a Nordic basis.

The Nordic Gene Bank/NordGen has over the years conducted projects regarding characterisation, evaluation and the use of the conserved genetic material, including cooperation with national breeding companies. The SESTO database has been developed and this now holds available data of all gene bank material.

In 2003 the Nordic Council of Ministers adopted declarations and recommendations stating that the collections held or administered by the Nordic Gene Bank (now by NordGen), are to be regarded as a common Nordic resource, under common Nordic management. The material is freely accessible and relevant material is included under the Multilateral System of the International Treaty on Plant Genetic Resources on Food and Agriculture. The security collections held by NordGen for other gene banks are of course excepted.

The Nordic Gene Bank/NordGen has also coordinated Nordic participation in European and international networks and projects.

NordGen is still the main body for conservation of Norwegian PGR of seed propagated crops and potatoes in addition to documentation systems covering all agricultural and horticultural crops, including material maintained in national field gene banks. There is close collaboration and coordination between NordGen and the Norwegian PGR programme.

6.2. The Svalbard Global Seed Vault

The Svalbard Global Seed Vault was established by the Norwegian government and opened in February 2008. The Seed Vault aims at providing facilities for safety deposit of samples of seeds of distinct genetic resources of importance to humanity. The Seed Vault will provide secure conservation facilities free of costs for deposits under “black box conditions” on request from public and private holders of seeds, with priority on safeguarding a complete set of the world’s seed accessions of plant genetic resources of importance for food and agriculture. This means that the deposit of the seeds in Svalbard will not affect any property rights or other rights pertaining to the material and the Seed Vault will take no action to further transfer the material except back to the depositor.



Image 31. The Svalbard Global Seed vault was opened in February 2008. Photo Åsmund Asdal

The Seed Vault was planned and established in close collaboration with international bodies, and it can be considered as a step to facilitate the implementation of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). Management of the Seed Vault is carried out in cooperation with the Global Crop Diversity Trust (GCDT) which partly funds the operation of the vault, and NordGen, which is responsible for the everyday management. The website www.seedvault.no provides information in six languages.

By October 2008 more than 320,000 accessions from more than 20 international and national institutions are deposited in the Seed Vault. An international Advisory Council will monitor the activities and advise Norway on a wide range of issues related to the Svalbard Global Seed Vault.

6.3. European networks

Norway is a member of the European Cooperative programme for Plant Genetic resources (ECPGR), which aims at facilitating the long term *in situ* and *ex situ* conservation on a cooperative basis as well as improving the utilisation of plant genetic resources in Europe.

ECPGR is structured through networks and working groups. Several working groups deal with crops that are relevant for Norwegian agriculture. Criteria for Norwegian participation in working groups have been the availability of relevant Norwegian plant material and relevant expertise for active participation in working group discussions and projects.

Norway participates in about 10 networks and working groups. National and Nordic participation is coordinated through NordGen.

6.4. International programmes and agreements

Norway considers international cooperation through multilateral bodies, agreements and programmes to be essential for the future conservation of and access to plant genetic resources. The national PGR programme has been planned and carried out in accordance with recommendations from The Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture adopted by the International Technical Conference on Plant Genetic Resources in Leipzig, Germany in June 1996.

Norway has participated actively in the negotiation for the International Treaty on Plant Genetic Resources for Food and Agriculture and served as a member of FAO Commission's Intergovernmental Technical Working Group on Plant Genetic Resources for Food and Agriculture. Norway ratified the International Treaty on Plant Genetic Resources for Food and Agriculture (IT) in 2004, and is supporting projects and activities that can facilitate the IT implementation worldwide.

This includes international studies on Farmer's Rights of the Norwegian research institution, the Fridtjof Nansen Institute. Farmer' Rights are critical to ensuring the conservation and sustainable use of genetic resources for food and agriculture and consequently for food security

Norway has also co-hosted an international consultation with Zambia on Farmers' Rights in 2007. The output from this consultation was shared with the 2nd Governing Body on the International Treaty which adopted a resolution on Farmers' Rights.

The Global Crop Diversity Trust (GCDDT) is one element of the funding strategy of IT. The Trust is in particular funding PGR projects and regeneration of gene bank material in developing countries. Norway is one of the Partners to the GCDDT and has provided economical contributions to its Trust Fund.

Norway is also providing regular funds for the Consultative Group on International Agricultural Research (CGIAR) and its centres. These centers act as international gene banks holding vital collections of germplasm of major food crops and they carry out research aimed at using genetic diversity in breeding of new varieties to feed the worlds growing population. A great portion of the CGIAR centre's gene bank accessions has been stored in the Svalbard Global Seed Vault.

Governmental funds have also been allocated to international development projects concerned with conservation and use of plant genetic resources through the governmental aid agency Norad and the non-governmental The Development Fund. The Development Fund supports development projects through local partners in Asia, Africa and Latin America, many of them concerned with issues related to conservation and the use of plant genetic resources.

7. Access to Plant Genetic Resources, Sharing of Benefits and Farmers' Rights

7.1. Access to plant genetic resources for food and agriculture

The national seed sector is well organised and the average Norwegian farmer does not face any problems in receiving the varieties and seeds needed for production. A well functioning system including national breeding, import of suitable foreign varieties, testing of new varieties for Norwegian growing conditions and the production and trade of seeds is in place.

The Norwegian Genetic Resource Center is monitoring the state of diversity in the market and tries to counteract developments that cause loss of diversity.

As for genetic material in gene banks, the Norwegian policy has been to consider all conserved material to be in the public domain and freely available for all uses. This has been affirmed in the Nordic Kalmar declaration adopted by the Nordic Council of Ministers in 2003 (cf. Chapter 6.1.). This applies primarily to the collections at NordGen and to national collections owned by governmental institutions. The material in these collections is available for breeding and research, but also for direct commercial production, small scale niche production and more idealistic or hobby related uses of germplasm.

This policy has also broad support among private stakeholders, ranging from private foundations holding field collections to private persons who maintain old plants in their gardens. Accordingly, plant genetic material from private owned collections is also available to different users, but by more informal routes.

The Genetic Resource Centre aims to formalise the state of germplasm in field collections and to harmonise routines for exchange of material from all collections. This will be achieved through formal agreements between the center and the owners of the collections. Furthermore, donors of plant material are informed by the Centre that the material enters into public domain when it is donated to the national system of gene banks, i.e. NordGen for seeds and national field gene banks for vegetatively propagated material.



*Image 32. In Norway, the strawberry is the most important berry crop on the Annex 1 list of the International Treaty.
Photo Åsmund Asdal*

According to Norwegian ratification of the International Treaty for Plant Genetic Resources the national material will be included in the Multilateral System of the Treaty. Distribution of material will be carried out in accordance with the regulations in IT, including the use of the

Standard Material Transfer Agreement. In the first place these routines will be implemented for NordGen material and for national material of Annex-1 crops.

The Nordic Council of Ministers has in 2008 decided to distribute non Annex-1 crops on the conditions of a NordGen MTA developed for such material and for purposes other than food and agriculture. A NordGen Hobby-MTA has also been developed for the distribution of small quantities of material distributed for direct non-commercial use. The Norwegian PGR programme will implement the same routines as NordGen regarding access to material from national field collections.

7.2. Sharing of benefits arising from the use of plant genetic resources

To facilitate the implementation of the Multilateral System of the International Treaty, the Norwegian government has decided that an annual contribution to the Access and Benefit Sharing Fund should be made from 2009. One main task for the fund is to promote and support plant breeding in developing countries. The contribution amounts to 0.1 percent of the annual turnover of the seed trade in Norway. It will be financed through the budget of the Norwegian Ministry of Agriculture and Food.

Benefits arising from the utilisation of plant genetic resources with regard to the International Treaty include non-monetary benefits such as free access to material of conserved varieties. Furthermore, farmers, breeders and researchers benefit indirectly from varieties which have been bred using plant genetic resources.

In some cases the old varieties and corresponding knowledge is exploited to create new products and income for farmers. Norwegian protected trademarks are available for the marketing of products based on landraces which can document long traditions and / or connection to a certain geographical region.

7.3. Farmers' rights

In addition to Benefit Sharing the concept of Farmers' Rights includes recognition of traditional knowledge and the possibilities for farmers to participate in decisions regarding plant breeding and legislation. The Norwegian decision of 2005 to uphold membership of the UPOV Convention Act 78 has been motivated by the increased possibilities for farmers to use their own seeds and transplants.

Norwegian farmers also have reasonable opportunities to influence Norwegian policies and decision making in the field of plant genetic resources. New laws and regulations are formally passed by way of open hearings before the resolutions are made. Norwegian farmers are well organised and they express their views in relevant cases. For example opinions expressed by farmers through an open hearing were partly the reason why a new act on plant breeders' rights complying with UPOV 91 was never resolved.

The basic principle for Norwegian plant breeding is that such breeding projects should be profitable. However, the government provides support for the breeding of minor, but important crops with limited markets, and the scope for these subsidised breeding programmes are partly negotiated with the farmers' unions. The Norwegian breeding company Graminor is also partly owned by farmers' cooperatives, and strategies for breeding can be influenced through this ownership.

Traditional knowledge held by farmers is to some extent recognised and documented through the conservation of germplasm. Collected seeds and plants are as far as possible followed by information about the varieties given by the donors. The national programme experiences that farmers are enthusiastic about sharing their knowledge and wish this

disseminated. The Norwegian Genetic Resource Centre acknowledges maintenance of knowledge and diversity by awarding the “Plant Heritage Prize” to individuals who have made valuable contributions in this field.

Governmental incentives with the aim to promote organic farming and traditional farming of agricultural landscapes can also be considered to be a part of the national policies recognising traditional knowledge and to preserve old varieties.

A Farmers' Rights Project conducted through the Norwegian based Fridtjof Nansen Institute, aims at supporting the implementation of Farmers' Rights as they are recognised in the Plant Treaty. The project is a long term project with many different components, comprising research and surveys as well as more operational activities. It started up in 2005.

A website on Farmers' Rights has been created at http://www.farmersrights.org/about/fr_in_itpgrfa_3.html.

At the international level, Norway has supported initiatives to strengthen the concept of farmer's rights in the negotiation and implementation of the International Treaty, especially in relation to developing countries, cf chapter 6.4.

8. Contribution to Food Security and Sustainable Development

Norwegian authorities consider the conservation of genetic resources to be of great importance for the future food supply, and this is the reason for the significant commitment and contributions to plant genetic resource activities, both national and international.

A well functioning system for conservation of and access to plant genetic resources is important for the future food safety also in Norway. Plant breeding to meet global developments such as climate change, the spread of pests and plant diseases and other health and environmental challenges will require the input of a broad diversity of accessible genes.

Norway will continue to support the development of international systems for conservation and use of plant genetic resources.

For short term domestic developments, the role of plant genetic resources in economic development (e.g. new products and niche production) and the contribution regarding agricultural sustainability (e.g. organic farming) are considered to be the most important issues.



*Image 33. Agricultural landscape in Birkenes, Aust-Agder county.
Photo Oskar Puschmann*