



Norwegian Ministry
of Agriculture and Food

Strategy

Securing the Gene Pool for Future Agriculture and Food Production

National strategy for the conservation and sustainable use of genetic
resources for food and agriculture



Preface

The utilization of genetic variation enables agriculture to develop well-adapted and high-yielding livestock, crops and forest trees, which in turn provide us with high-quality food, energy and wood.

Genetic diversity provides opportunities. **Opportunities** for adapting crops to different growing conditions. Opportunities for breeding strong and healthy farm animals. Opportunities for enabling our forests to cope with climate change. A long-term approach and balanced breeding goals contributed to the world-wide export of semen from Norwegian pig and cattle breeds. Grain from traditional cereal varieties and meat from native livestock breeds at risk are being developed as niche products with market potential.

Due to **climate change**, it is crucial that we continue to have access to a large gene pool. By securing this diversity, we can utilize the genetic traits that enable crops, livestock and forest trees to adapt to changing conditions, such as increasingly unpredictable weather and new harmful organisms, while at the same time reducing greenhouse gas emissions.

No country is self-sufficient when it comes to genetic resources. Norway plays an active role in **international cooperation**, and is committed to the conservation of its unique genetic resources. Norway has taken on a special global responsibility by establishing and operating the **Svalbard Global Seed Vault**, which provides backup storage for seeds from gene banks across the globe.

In many developing countries, smallholders play an important role in maintaining genetic variation due to their diversified production. These farmers are also especially vulnerable to the impacts of climate change. Norway is one of the countries promoting support for access to **climate-resilient seeds** for farmers in developing countries.

A diversity of stakeholders participate in the use and conservation of genetic resources in Norway. Together with publicly funded work, their efforts have contributed to such results as increasing the use of endangered crop varieties and livestock breeds, and maintaining populations of rare forest trees in natural populations.

In order to secure genetic diversity for the future, it must be managed wisely. This national strategy for genetic resources for food and agriculture¹ builds on all of the hard work that has been carried out so far. I hope it will contribute to **securing the genetic pool** by increasing awareness and promoting an integrated management approach that enables efficient division of labour and resource utilization. The strategy forms the basis for the management of Norway's genetic resources in the years ahead. It is based on a draft version prepared by the Norwegian Agriculture Agency on assignment from the Ministry of Agriculture and Food. Numerous experts and organisations contributed.

I would like to thank everyone who has contributed to the strategy, and I hope that we can roll up our sleeves in a joint effort to secure the genetic pool for future agriculture and food production.

Ms. Olaug Vervik Bollestad
Minister of Agriculture and Food

1. In this document, the term "genetic resources" is used synonymously with "genetic resources for food and agriculture", if not otherwise specified.

1. Background

During the first half of 2019, two comprehensive UN reports were published about the world's biodiversity. In February 2019, the Food and Agriculture Organization of the United Nations (FAO) published the first State of the World's Biodiversity for Food and Agriculture. In May 2019, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) published the first Global Assessment on Biodiversity and Ecosystem Services. With these two reports, we now have a comprehensive overview of the world's biological and genetic resources.

Whereas the FAO report focuses on biodiversity that contributes to food and agriculture, the IPBES report assesses the status and trends of global biodiversity, with emphasis on species diversity in natural ecosystems. The two reports can thus be seen as complementary accounts of how we treat our planet's overall biodiversity.

The FAO report's main conclusion is that the **world's biodiversity for food and agriculture is decreasing at the gene, species and ecosystem levels**. Global changes in land use, such as deforestation and agricultural intensification, are a significant driver of this trend. This development often goes hand in hand with declining numbers of species, breeds and varieties used in food production. These losses eventually reduce agriculture's ability to adapt crops, livestock and forest trees to climate change and its knock-on effects such as new pests and diseases. This development thus represents a threat to global **food security**.

The continued increase of the global agricultural area is mentioned as one of several drivers of decreasing biodiversity. Thus, whereas agriculture is significantly challenged by the world's diminishing biodiversity, the sector itself is also one of the main contributors to this trend.

The FAO report shows how the agricultural sector can do its share to safeguard the world's overall biodiversity and secure food and agricultural production. The FAO underlines the importance of **maintaining and increasing the diversity of our crops, livestock and forest trees**. At the same time, we have to secure the integrated management of the habitats of crop wild relatives, soil organisms and pollinators. This approach aims to ensure agriculture's adaptability to changing natural conditions, facilitate business development and promote sustainable diets. Increasing biodiversity was also mentioned as a way to manage the risks associated with climate change in the Special Report of the Intergovernmental Panel on Climate Change (IPCC) on Climate Change and Land, published in August 2019.

This strategy for the conservation and sustainable use of genetic resources for food and agriculture follows up on Norway's national status report on biodiversity for food and agriculture of 2016, which was Norway's contribution to the FAO's 2019 global status report. The strategy provides guidance on the continuation and enhancement of the joint national work on genetic resources for food and agriculture, according to recommendations in the above-mentioned UN reports, amongst others.

What are genetic resources for food and agriculture?

The term 'genetic resources' is defined as a living organism's genetic material with 'actual or potential value'. Genetic diversity for food and agriculture includes all genetic resources in our crops, livestock and forest trees. These resources range from local and heirloom species, varieties and breeds with limited commercial interest to the most widely used commercial plant varieties, livestock breeds and tree species, and also include crop wild relatives. Microorganisms and invertebrates are important for agriculture and food production.

The gene pool is the sum of all genes and combinations of genes within a species that is available to agriculture at a given time. We do not exactly know which genetic resources could be of value in the future. It is thus important to secure a large and diverse gene pool. Genetic resources are renewable, but can be lost if not used.

The overall goal of this strategy is to secure the gene pool for future agriculture and food production.



Since the official opening in 2008, more than one million seed samples have been shipped to the [Svalbard Global Seed Vault](#) for backup storage.

Photo: Matthias Heyde

2. International and national cooperation

Genetic resources in Norway represent a significant actual and potential value. It is our responsibility to secure these resources. Through the Convention on Biological Diversity, the International Treaty on Plant Genetic Resources for Food and Agriculture (Plant Treaty) and cooperation within the United Nation's Commission on Genetic Resources for Food and Agriculture, the world's nations have agreed on common goals and commitments to conserve genetic resources for food and agriculture.

International cooperation and exchange of genetic resources for food and agriculture are crucial for our food security. The conservation of genetic resources requires global cooperation and a division of labour that allows the efficient use of resources by assigning each country the responsibility for managing its own genetic resources.

Norway has pushed for numerous international initiatives regarding genetic resources for food and agriculture, most notably through the establishment and operation of the **Svalbard Global Seed Vault**. The Seed Vault's goal is to secure the large genetic diversity of the world's food and forage crops for the future. So far, one million seed samples from gene banks around the world have been deposited, but the vault can hold considerably more. There is an ambition to increase the share of major food and forage crops whose seeds are stored at the Svalbard Global Seed Vault.

Norway participates actively in the United Nation's Commission on Genetic Resources for Food and Agriculture, and is involved in promoting farmers' rights to genetic resources. The Plant Treaty has provisions on such issues as **Farmers' Rights** to access genetic resources, the protection of traditional knowledge, participation in decision-making processes and fair and equitable sharing of the benefits arising from the use of genetic resources. Norway's support to other countries on the implementation of the Plant Treaty's provisions on Farmers' Rights should be continued.

The Convention on Biological Diversity recognises that countries have the sovereign rights over their genetic resources, and the authority to regulate access to these resources. The FAO's Commission on Genetic Resources for Food and Agriculture has developed guidelines to assist member states in adapting international commitments to national regulations on access and benefit sharing from the use of genetic resources for food and agriculture. The Plant Treaty has established a global system to secure that all countries have equal access to plant genetic resources. Norway has implemented an innovative approach to benefit sharing by providing an annual contribution to the Plant Treaty equal to a share of its annual domestic seed sales. Norway will continue to contribute to international cooperation on the facilitation of **efficient access to genetic resources**.

Norway also takes part in joint **European initiatives** on research and inventory of plant², animal³ and forest genetic⁴ resources. This cooperation will continue.

2. European Cooperative Programme for Plant Genetic Resources (ECPGR)
3. European Regional Focal Point for Animal Genetic Resources (ERFP)
4. European Forest Genetic Resources Programme (EUFORGEN)

At the **Nordic level**, Norway is part of the Nordic Genetic Resource Center (NordGen), under the Nordic Council of Ministers. Cooperation within NordGen aims to secure the diversity and promote the sustainable use of genetic resources for food and agriculture. The collaboration on genetic resources between the Nordic countries should be strengthened.

At the **national level**, a coherent national genetic resource policy requires broad cooperation between a wide range of public and private stakeholders, as well as a common understanding of the importance of genetic resources for food and agriculture. Such a joint approach involving a diversity of public authorities, institutions and other stakeholders can result in synergy effects and efficient resource utilization. Above all, this applies to cooperation between agricultural and environmental authorities. Long-term and productive management of genetic resources for food and agriculture is enabled when the consideration for these resources is integrated within overall public administration and policy-making. Efficient and enhanced management of genetic resources requires well-defined **goals and action plans** that are based on global cooperation and the division of tasks between countries. This implies that each country is responsible for its own genetic resources.

The **Norwegian Agriculture Agency** implements food and agriculture policies, and provides professional support and advice to the Ministry of Agriculture and Food. The agency manages numerous subsidy schemes, including one for projects on genetic resources.

The **Norwegian Food Safety Authority** ensures the safety of food and drinking water, and promotes plant and animal health, eco-friendly production and ethical animal husbandry. The agency's jurisdiction includes seed legislation and plant variety protection.

3.

How do we conserve our genetic resources for food and agriculture?

Genetic resources can be conserved in different ways, not only in the sense of “storage” or “saving for later”. For example, conservation can be done by maintaining live plant collections or livestock herds and by using these actively for production purposes, so-called conservation through use. No matter how they are conserved, genetic resources must be **identified, characterized and documented**. Conservation of genetic resources also includes their monitoring and maintenance.

There is an extensive network of **volunteers**, who devote their efforts, know-how and dedication to the conservation and sustainable use of genetic resources in Norway. The interest in the conservation of traditional and rare crops is kept alive by seed and plant swapping clubs, garden associations and other plant enthusiasts. When it comes to livestock, there are several breed associations as well as committed individuals who keep conservation herds, thereby contributing to the conservation of endangered farm animal breeds.



The **Jærhøns** is a descendent of the original Norwegian landrace chicken. The Norwegian landrace was close to extinction, when the efforts to preserve and improve the breed began in the Jæren region in 1916. Norway's programme for breeding laying hens was discontinued in 1995. The Jærhøns is now preserved in the Poultry Gene Bank at the Hvam agricultural school.

Photo: Anna Holene, NIBIO



Remains of the **European wild (or crab) apple** have been found that date back to the Stone Age. Local hybridization between wild and domestic apples has had considerable importance for the development of our apple varieties. The genetic resources of Norway's wild apple population are threatened by unintentional hybridization. Wild apples are associated with the cultural landscape and need lots of light and open space to thrive. Conserving wild apples will help to increase the national gene pool for potential future use.

Photo: Egil Michaelsen, NIBIO

The conservation of genetic resources requires a long-term perspective. The work must be methodical in order to be efficient, and the various measures must be sustained over time. To secure genetic resources for the future, the risk of losing genetic material must be reduced. The use of multiple conservation strategies in parallel contributes to reducing this risk. There is a need for well-defined **strategies for the long-term backup** of genetic resources.

The genetic resources of our **crops** are conserved in different ways, depending on whether they are propagated by seed or clones. Seed-propagated crops from Norway are stored in the joint Nordic gene bank at NordGen in Alnarp, Sweden. Safety backups of the accessions are kept in the Svalbard Global Seed Vault. Vegetatively propagated plants have to be conserved as living collections of plants (field gene banks) or in deep-freeze storage (cryopreservation). A limited number of clone banks, managed in accordance with international gene bank standards, should be given status as national gene banks for vegetatively propagated crops, while museums and botanical gardens can continue to maintain their active collections in their natural surroundings. These collections help to preserve and disseminate local knowledge about the plants and inspire visitors, while also serving as safety backups.

Livestock production in Norway is predominantly based on a limited number of national breeds. A few cooperative enterprises and membership organisations ensure the conservation of many of these breeds in sperm banks. Breeding associations for endangered breeds and small-scale producers contribute to maintaining genetic diversity, for example, in conservation herds and in-situ gene banks, as well as through niche production and local activities. The broad range of stakeholders and their mutual synergies are crucial for securing and developing the national animal genetic resources for food and agriculture.

About 35 tree species are considered to be native to Norway. The genetic resources of **forest trees are conserved** in natural populations, e.g. in protected areas or genetic conservation units. However, forest genetic resources can also be conserved outside of their native environment (ex situ), e.g., in arboreta, botanical gardens, research plots and seed plantations. In addition, some spruce and pine seeds are deposited in the Svalbard Global Seed Vault for backup storage.

Our gene banks (sperm banks, seed banks and field gene banks), conservation herds and **genetic conservation areas** are owned and operated by a combination of publicly funded or co-funded institutions and enterprises, cooperatives, membership organizations and individuals. The conservation of genetic resources should continue to be a shared responsibility **between public, commercial and private stakeholders**. The commitment and engagement of private, local and public partners in this work should thus be encouraged.

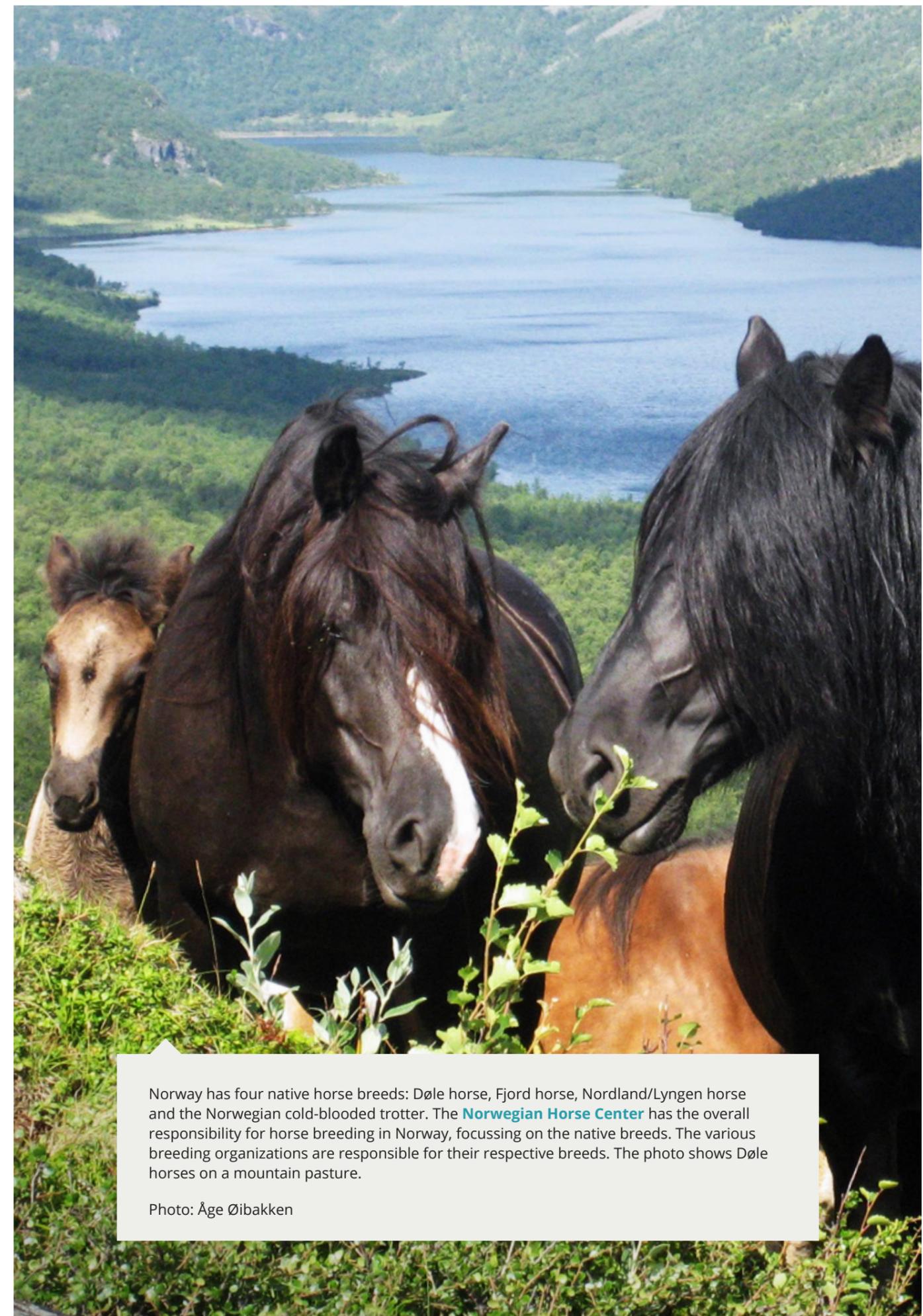
To ensure the further development, success and efficiency of the cooperation between the stakeholders, **their roles and responsibilities must be more clearly defined**. The rights and responsibilities of the public authorities and cooperating partners must be specified and regulated by contracts to ensure the long-term conservation of genetic resources. A review of the stakeholders, activities and methods of genetic resource conservation is needed. Based on such an assessment, a **comprehensive plan for the organization and funding** of conservation work should be prepared, including **safety backup strategies**.

In certain areas, the inventory and conservation of genetic resources for food and agriculture overlap with the jurisdiction of the environmental authorities. Examples include the conservation of crop wild relatives and forest trees in various types of protected areas. Inventory of genetic resources and the development of protection and management plans should be continued and strengthened through **cooperation between the agricultural and environmental sectors**.

Information from the inventory and characterization of our genetic resources should be stored in **databases** that are compatible with corresponding international databases. This information should be accessible for anyone wishing to utilize the genetic resources. To facilitate the use of genetic resources and enable added-value creation, the databases should contain as much information as possible, for example, about the resources' properties and potential use.

The **Norwegian Community Seed Bank** was established in 2018 to preserve the genetic diversity of seed-propagated crops in Norway. It aims to fill the gap between non-commercial conservation and commercial use, and contributes to establishing a list of conservation and amateur varieties.

In 2016, the various Norwegian "plant clubs" were merged to establish **KVANN - Norwegian Seed Savers**, a national interest organisation for the sustainable use of plant diversity. The organisation works to preserve heirloom crops, but also tests new species and varieties, with a focus on climate-friendly local food production.



Norway has four native horse breeds: Døle horse, Fjord horse, Nordland/Lyngen horse and the Norwegian cold-blooded trotter. The **Norwegian Horse Center** has the overall responsibility for horse breeding in Norway, focussing on the native breeds. The various breeding organizations are responsible for their respective breeds. The photo shows Døle horses on a mountain pasture.

Photo: Åge Øibakken

4. Creating added value from genetic resources for food and agriculture

The genetic diversity of crops, livestock and forest trees enables the creation of added value. This value creation covers a broad range of possibilities; from the development of commercial, high-yielding livestock breeds and crop varieties to niche and other small-scale, 'hobby' production based on old livestock breeds, local crop varieties and lesser-used species of forest trees. Larger, commercial enterprises depend on ever more efficient plants and animals for their production. This constant improvement is achieved through breeding, which in turn depends on access to abundant biodiversity. The use of old and rare plant varieties, animal breeds and forest trees can contribute to local business development while at the same time conserving genetic resources that could be useful for commercial breeders in the future.

Plant breeding provides us with varieties that are adapted to different farming systems and the varying natural conditions found throughout Norway. As new, more productive plant varieties are developed, there is a risk of losing the old ones, which could have useful traits such as disease resistance or adaptability to changing natural conditions. To be able to tackle future challenges such as climate change, population growth and changing consumer trends, plant breeding should be based on broad genetic diversity.



Graminor Ltd is responsible for developing new varieties of field crops and horticultural plants suitable for Norwegian and Nordic growing conditions. Graminor breeds cereals, forage crops, potatoes, fruits and berries, and also produces pre-basic seeds for further multiplication and marketing by seed companies. The picture shows field observations of winter wheat trials on the Staur farm near Lake Mjøsa.

Photo: Graminor

The **livestock breeding** goals of high productivity combined with good health, fertility and welfare have given good results. Norwegian livestock breeding is based on the active involvement of farmers from all parts of the country. As a result, livestock husbandry in Norway is robust and able to tackle such challenges as increased infection pressure due to climate change.

Norwegian **tree breeding** uses the genetic variation within tree species as the basis for increased productivity and improved timber quality in forestry. An important element in tree breeding is to maintain a large number of unrelated families, both in order to preserve the genetic variation in the breeding population and as a basis for future breeding programmes. A long-term goal is to ensure full coverage of seeds from domestic seed orchards for Norway spruce and sub-alpine fir, and to increase the supply of improved pine seeds. Programmes for breeding spruce, and in the future also pine, result in forests with high CO2 uptake and adaptability to climate change. Furthermore, increased use of a wider range of native tree species in forestry and climate-resilient, native species in urban green spaces should be encouraged. This would stimulate the development of a more versatile forest industry and contribute to the conservation of genetic diversity.

There is growing interest in combining the use of traditional crop varieties and livestock breeds with organic agriculture and issues linked to local identity and cultural history. Increasingly, marketing arrangements are being developed that enable producers to sell agricultural products directly to consumers. Active use is one of the keys to the conservation of genetic diversity and its associated cultural-historical importance. The **increased and sustainable use of Norway's genetic resources in breeding programmes, and business development** based on these resources should be encouraged.

Active use requires access to genetic resources. The access to Norway's genetic resources should be secured in accordance with international and national standards and guidelines.

The ability of farmers to influence and participate in the conservation, improvement and use of genetic resources forms the basis for present and future agriculture and food production. Farmers in Norway generally have sufficient access to take part in decision-making processes, for example in the annual agricultural negotiations between the government and the farmers' unions. Farmers are also involved in crop, livestock and tree breeding through ownership and representation in cooperatives and breeding enterprises. The work on **Farmers' Rights** in Norway should be continued, for example through securing the easy access to genetic resources and continued participation in decision-making processes. Norway's farmers should continue to be able to use farm-saved seeds and their own live animals in their production.



The mission of the **Norwegian Forest Seed Center** is to secure the nationwide supply of high-quality forest seed. Among the center's responsibilities are the establishment, operation and management of seed orchards throughout the country. Pictured here: Norway spruce flower.

Photo: Arne Steffenrem, NIBIO

5. Knowledge and awareness raising

In order to preserve and use genetic resources for food and agriculture in a safe, efficient and sustainable way, we need sufficient knowledge. **Research about and development of** Norway's genetic resources is crucial for improving our knowledge about genetics, characteristics and utilization. Increased knowledge also helps to ensure the efficient conservation of species, breeds and varieties.

Knowledge about the useful properties of crops, livestock and forest trees can also contribute to increasing their use and creating added-value from these resources. Products that are based on traditional or rare genetic resources are easier to market if they can be accompanied by information about, for example, their cultural-historical background or nutritional value.

There is increasing national and international focus on the importance of **microorganisms and invertebrates** for food production. Some countries have already included microorganisms and invertebrates in their strategies for the conservation and sustainable use of genetic resources for food and agriculture. As a starting point for further work, microorganisms and invertebrates that make important contributions to food and agriculture in Norway should be identified.



Seeds of old Norwegian tomato varieties are stored at the **Nordic Gene Bank** in Alnarp, Sweden.

Photo: Pawel Chrominski



Geno SA is the breeding organization of Norwegian Red (NRF), the main dairy breed in Norway. NRF is a crossbreed based on several old Norwegian dairy breeds. The NRF breeding programme has kept a broad breeding goal, which has resulted in a healthy, fertile and high-yielding cow. NRF is one of the most sold red dairy breeds in the world. Geno also supplies semen of old Norwegian dairy breeds.

Photo: Liv Kristin Sola, Bondevennen

Some of the plant and animal breeding communities in Norway are small and vulnerable. To ensure the conservation and sustainable use of genetic resources, it is crucial to educate enough experts for research, public administration, breeding and practical farming, and to provide the skills needed at botanical gardens and museums. Agricultural **universities, colleges and vocational schools** should increase their focus on the genetic resource perspective as part of their curriculum in sustainable agriculture and food production.

Knowledge and awareness about the importance of our genetic resources is mainly limited to those who are working or otherwise involved in the field. For most people, concepts such as «genetic resources» or «genetic diversity» are rather abstract. However, consumers are becoming increasingly interested in the nutritional value, properties and stories behind their food and other agricultural products. **Farmers, consumers, scientists, students and hobby growers have different needs for information**, regarding both form and content. The importance and potentials of genetic resources must therefore be communicated to a much greater extent through information that is customized to the various target groups.

The **Norwegian Genetic Resource Center** is part of the Norwegian Institute of Bioeconomy Research (NIBIO). The center is responsible for coordinating the conservation and use of Norway's genetic resources. It monitors the status and contributes to the efficient management of the genetic resources of livestock, crops and forest trees in Norway.



The Norwegian Institute of Bioeconomy Research, **NIBIO**, conducts research and provides expertise in such areas as food and crop production, environmental science, genetic resources, geomatics, land use, forestry and economics. NIBIO's portfolio also includes the Norwegian Genetic Resource Center and several field gene banks, like this collection of hop varieties at NIBIO Apelsvoll.

Photo: Mette Goul Thomsen, NIBIO

6.

Strategy

The overall goal of this strategy: to secure the gene pool for future agriculture and food production.

Securing the gene pool is a long-term effort, which requires continuity. The strategy should be updated as and when required, and no later than after five years.

On the way to achieving the overall goal, the following strategic measures will be implemented:

National cooperation and prioritisation

- Further develop clear thematic goals and action plans for the national work on genetic resources.
- Strengthen cooperation between stakeholders such as public administration, research institutions, extension services and farmers, for example by creating arenas for the different stakeholders to meet, engage and agree on prioritised efforts.
- Integrate the consideration for conservation and sustainable use of genetic resources within general public administration and policy-making.

Conservation and access

- Assess the structure of genetic resource conservation with the aim of developing a comprehensive plan for the organization and funding of the work, including safety backup strategies.
- Encourage commitments and involvement from private, local and public partners.
- Map and ensure the conservation of crop wild relatives and forest trees through the development of management plans and cooperation between the agricultural and environmental authorities.
- Secure access to Norway's genetic resources in accordance with international and national standards and guidelines.

Added-value creation and sustainable use

- Encourage the development of climate-resilient crops, livestock, and forest trees that are adapted to the growing conditions and farming systems in all parts of the country.
- Continue the work on Farmers' Rights in Norway, for example through ensuring that farmers have easy access to genetic resources and can keep on participating in decision-making processes. Norway's farmers should continue to be able to use farm-saved seeds and their own live animals in their production.
- Encourage the increased use of genetic resources for food and agriculture and promote business development based on these resources.

Knowledge and outreach

- Strengthen the stakeholders' skills and knowledge base and continue research on genetic resources.
- Raise awareness for the value and importance of genetic resources for food and agriculture by disseminating customized information to specific target groups.
- Consider assessing the status of current knowledge about the importance of microorganisms and invertebrates for food and agriculture in Norway.

International cooperation

- Strengthen cooperation on genetic resources between the Nordic countries via the Nordic Council of Ministers and by working closely with NordGen.
- Continue to participate in European cooperation on forest, livestock and crop genetic resources.
- Continue to participate in international cooperation on genetic resources, with an emphasis on access and benefit sharing and Farmers' Rights.
- Increase the share of major food and forage crops whose seeds are stored at the Svalbard Global Seed Vault.

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