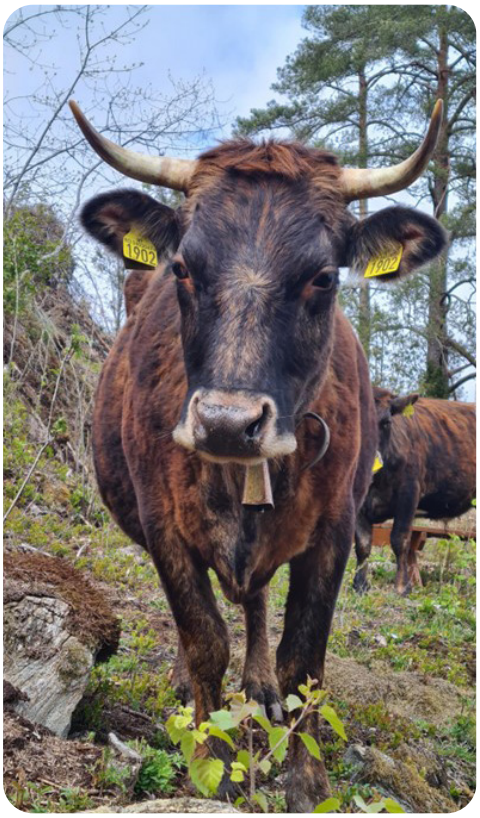
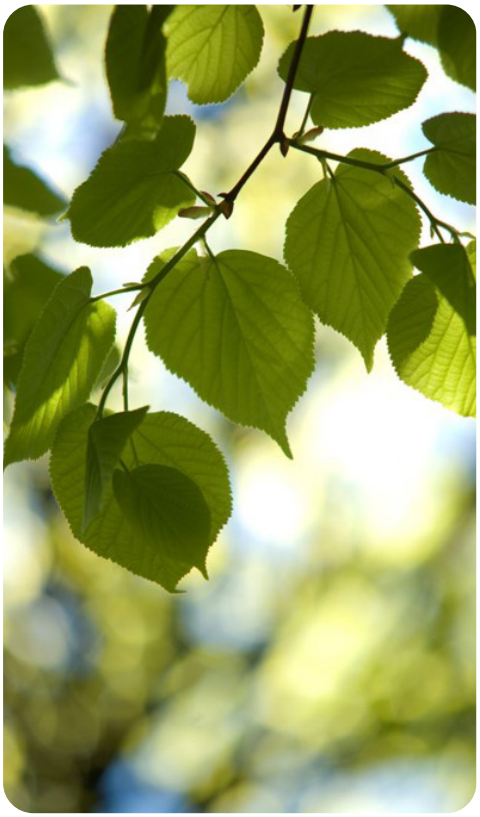
Norwegian Ministry
of Agriculture and Food

Action Plan

National Action Plan for the Conservation and Sustainable Use of Genetic Resources for Food and Agriculture

Established by the Ministry of Agriculture and Food on 6 December 2023





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Preface

There is a lot of potential in agricultural genetic diversity. This includes opportunities for adjusting, improving and adapting agricultural production to changes in climate, disease pressure, production conditions and consumer preferences. Genetic variation within crop, livestock and forest tree species is thus an important resource for agriculture.

Securing this gene pool is primarily about our preparedness and our ability to feed the population in the future as well. Genetic resources are also a natural asset that can strengthen our capacity for effective and bio-based innovations in Norwegian food production and thereby contribute to increased value creation in Norway.

The importance of genetic diversity is also highlighted by the call for Norwegian agriculture and food production to contribute to society's needs for climate and environmental protection, good animal welfare, and safe and tasty food. New species and organisms, such as microorganisms and invertebrates, can also become important resources for future food production.

The global trend of genetic erosion and genetic diversity loss not only increases the vulnerability of agriculture and forestry to the effects of climate change, but also reduces opportunities for the future. Many of the plant varieties, livestock breeds, and tree species used in Norwegian agriculture are unique to Norway. If these variants disappear, cultural-historical values and production assets will also be lost. Loss of genetic variation limits agriculture's ability to develop and utilize adapted and high-performing livestock, crops, and forest trees, which provide us with high-quality food, energy, and wood products.

Over the past 20 years, the Ministry of Agriculture and Food has implemented a number of measures to secure endangered crops, livestock, and forest trees for the future. In 2019, the Ministry of Agriculture and Food adopted the national strategy for genetic resources for food and agriculture: Securing the Gene Pool for Future Agriculture and Food Production. The strategy builds on ongoing efforts and aims to secure the genetic pool by raising awareness and implementing an integrated approach, as well as ensuring the efficient division of responsibilities and resource utilization.

This national action plan operationalizes the national strategy by clarifying our national responsibility, providing priorities for the work, and highlighting stakeholder roles and responsibilities. The action plan specifies which genetic resources that are at risk in Norway and outlines a comprehensive national conservation program for these resources. The action plan also identifies measures for sustainable use, increased knowledge and outreach, and cooperation with other countries.

The Norwegian Genetic Resource Centre at Norwegian Institute of Bioeconomy Research (NIBIO) and the Norwegian Agriculture Agency assisted the Ministry of Agriculture and Food in the development of the action plan. The plan is based on contributions from stakeholders in genetic resource management through written and oral input during the winter/spring of 2021.

The action plan will be effective for 5 years from 2024 to 2028 and will be followed up by the Ministry of Agriculture and Food, the Norwegian Agriculture Agency, and the Norwegian Genetic Resource Centre at NIBIO. The plan will be implemented, among other things, through existing grant schemes. The foundation of the action plan is the continued extensive and successful cooperation between many stakeholders in Norway.

Geir Pollestad

Minister of Agriculture and Food

Summary

Norway has a particular responsibility for the management of genetic resources in livestock, forest trees, crops, microorganisms and invertebrates associated with Norwegian agriculture. Guidelines for the management of agricultural genetic resources have been established by the Ministry of Agriculture and Food through the National Strategy for the Conservation and Sustainable Use of Genetic Resources for Food and Agriculture (LMD, 2019). The overall goal of the national strategy is to secure the gene pool for future food and agricultural production. This action plan operationalizes the strategy by specifying objectives and identifying action steps that follow from the recommended measures within the strategy's five main areas.

A large number of public, private and NGO stakeholders contribute to the national efforts for the conservation and sustainable use of genetic resources for food and agriculture in Norway. Public authorities and administration contribute by providing scientific and technical support, policy frameworks as well as financial and other instruments. Chapters 1 and 2 discuss the cooperation and division of roles between the Ministry of Agriculture and Food, the Norwegian Agriculture Agency and the Norwegian Genetic Resource Centre at NIBIO in the formulation of a national strategy, management of policy instruments and monitoring of endangered genetic resources. This also includes specifying and defining the scope of which genetic resources are to be covered and an extended report documenting the annual status and trends of genetic resource conservation.

Chapter 3 describes the national conservation program for genetic resources in livestock, forest trees and crops. The program calls for a strengthening of and a clear setting of priorities for how endangered genetic resources are to be secured, maintained and made accessible to breeders and breeding organizations, researchers and farmers for sustainable use. The material shall, if possible, be preserved as living populations, either in natural environments, in planted stands or in production environments, and in gene banks that preserve valuable genetic material that can easily be made available to researchers, breeders, farmers and others. Relevant conservation measures adapted to the various genetic resources are described in the action plan. The most far-reaching new measures are those regarding the reorganization of the conservation system for vegetatively propagated plant material in Norway, and the establishment of suitable *ex situ* backup storage facilities for genetic material from livestock and vegetatively propagated plants. Appendix A specifies the tasks involved in the various conservation strategies and the corresponding stakeholder responsibilities.

The conservation of genetic resources requires systematic inventories and documentation of the material. The action plan refers to the importance of strengthening and updating public databases. This applies both to those maintained by the Norwegian Genetic Resource Centre or those used by the Genetic Resource Centre in cooperation with other countries and stakeholders (e.g., the Nordic-Baltic gene bank information system for plant genetic resources), and databases operated by breeding organizations or other national stakeholders.

If genetic resources are to contribute to solving future challenges, knowledge about these resources must be maintained and further developed. Value creation and sustainable use are discussed in Chapter 4. The goal is to increase the amount of endangered genetic resources that are actively used in value creation. This includes facilitating the use of the material in sustainable breeding programs, identifying benefits of using a wider range of genetic resources for production and marketing, and promoting increased diversity in Norwegian production systems. Sustainable use requires that the material and associated documentation are accessible to researchers, breeders and farmers. An important task is thus to facilitate increased access to the genetic material included in the conservation program, in those cases where such access is currently limited. The respective stakeholders' responsibilities must be clarified to ensure that access to genetic resources is ensured in accordance with international rules on fair benefit-sharing and in line with authorities' quality and health requirements.

Sustainable use requires extensive documentation and knowledge of the preserved material. This includes identifying and documenting the traits, characteristics and variation of the genetic resources, as well as providing access to this information to relevant stakeholders. Increased publicity and awareness of the importance of endangered genetic resources will contribute to a general understanding of the need to conserve these resources, and thereby increase consumer interest in products based on genetic diversity. This is discussed in Chapter 5. The action plan also mentions the importance of genetic diversity in microorganisms and invertebrates for agriculture and food production in Norway and refers to the need for measures that can increase our knowledge about and experience with such diversity.

Genetic resources used in Norwegian agriculture predominantly originate from other countries. International cooperation is therefore important to ensure the secure conservation and appropriate use of these resources. The action plan is based on the premise that Norway will continue to contribute to a well-functioning global system for the conservation and sustainable use of genetic resources by participating in international cooperation. This is discussed in Chapter 6, which points to the need for national follow-up of global action plans and agreements, participation in international processes and strengthened co-operation in the Nordic region. Following-up Farmers' Rights in Norway involves both improving farmers' involvement in the conservation of genetic resources and ensuring their right to use and sell farm-saved seed and farm-bred livestock. Strengthening global awareness and use of the Svalbard Global Seed Vault continues to be an important task for Norway in the coming period.

1 Introduction

Agricultural genetic diversity, defined as the overall genetic variation within livestock, crop and forest tree species, has the potential to strengthen agriculture's productive capacity, enable agriculture to adapt to changes in climate and other production conditions, and contribute to reducing greenhouse gas emissions from agriculture.

A high level of genetic diversity safeguards ecosystem functions and affects the geographical range of forest trees and crop wild relatives in Norway, where many of the species have their upper latitudinal and elevational limits. Over time, livestock breeds, crops and forest trees have influenced knowledge acquisition and landscape development. Thus, agricultural genetic resources are also important bearers of cultural values and traditions.

Increasing genetic diversity in agriculture can increase the stability and resilience of production systems. Using a larger share of the genetic diversity in livestock, crops and forest trees also creates opportunities for establishing new industries and products, as well as further developing current farming systems.

1.1 Genetic resources for which Norway is particularly responsible

Norwegian agriculture is largely based on biological material of foreign origin, which has gradually been adapted to the natural conditions and farming systems in Norway. Norwegian agriculture also uses many plants and forest trees that are native to or have been bred in Norway. Norway cooperates with other countries to ensure global systems for the conservation and sustainable use of genetic resources for food and agriculture. For example, Norway is a member of the FAO's Commission on Genetic Resources and a Contracting Party to the International Treaty on Plant Genetic Resources for Food and Agriculture.

a National genetic resources

Norwegian genetic resource management is especially responsible for national genetic resources, i.e., genetic resources that are native to Norway, or that have been introduced by and adapted to Norwegian agriculture.

National genetic resources are widely used in today's agriculture. Notable examples include Norwegian Red, the predominant cattle breed used by Norwegian dairy farmers, domestically-bred forage seed varieties and Norwegian spruce, a mainstay in the forest industry.

Boxout 1. Definition of national genetic resources

National genetic resources are:

Breeds, cultivars, varieties, genotypes and populations of livestock, crops and forest trees that:

originate from native flora or have been adapted through breeding or natural selection to the climate, farming methods, usage, etc. in Norway

and

have cultural-historical significance and/or potential importance for the agri-food sector and food security in Norway

and

have been developed in or imported to Norway before 1950[1]

[1] Material imported after 1950 can be considered a national genetic resource if the other criteria are met.

b National genetic resources at risk

National genetic resources are considered to be in need of conservation when classified as 'at risk'. Genetic resources are considered at risk when they no longer are in active use, are few in number, exposed to land-use and climate change, or when documentation regarding status is insufficient. Genetic resources at risk are included in the national conservation program for livestock, crops and forest trees. The Norwegian Genetic Resource Centre monitors the status of the genetic resources at risk and presents its findings in the annual report Nøkkeltall fra Norsk genressurssenter (Key figures from the Norwegian Genetic Resource Centre)[2].

Boxout 2. Definition of national genetic resources at risk (endangered genetic resources)

National genetic resources at risk (endangered genetic resources) are:

National genetic resources (see definition in Boxout 1) that are considered at risk of extinction because they are few in number, exposed to threats, inadequately documented or no longer in active use.

Photo 1. The Jærhøns («Hen from Jæren») is the only domestic chicken breed with roots back to the Norwegian landrace chicken. The breed is being conserved in the gene bank for laying hens at the Hvam school of agriculture together with historical breeds and breeding stock previously used in the Norwegian laying hen breeding programs. The other breeds were imported to Norway around 1900. Photo: Anna Holene, NIBIO.

[2] Se www.gen-nokkeltall.no

1.2 Action plan

The action plan operationalizes the National Strategy for the Conservation and Sustainable Use of Genetic Resources for Food and Agriculture; *Securing the Gene Pool for Future Agriculture and Food Production* (2019)[3]. The strategy provides an integrated approach to the management of Norwegian agriculture's genetic diversity across the livestock, crop and forest sectors. The action plan aims to facilitate the contribution of these genetic resources to increased self-sufficiency, climate change adaptation and a more climate-friendly agri-food production in Norway for current and future generations.

The action plan also ensures that Norway fulfils its international obligations regarding intergovernmental cooperation on genetic resources, strengthens the prioritization of national efforts and allows for the inclusion of work on microorganisms and invertebrates that are important for food and agriculture.

The action plan will be in effect until 31 December 2028 and will be implemented within current public policies, regulations, annual allocations and grant schemes.

In order to achieve the national strategy's overall goal of securing as many of the national genetic resources for food and agriculture as possible, objectives and action steps are set out in five priority areas:

1. National cooperation and prioritization
2. National conservation program
3. Value creation and sustainable use
4. Knowledge and outreach
5. International cooperation

2 National cooperation and prioritization

At the national level, the task of conserving and sustainably using national genetic resources at risk in the sectors livestock, crops and forest trees is carried out and managed by a number of public, private and voluntary participants and stakeholders. These include public authorities and administrative bodies, research and educational institutions, breeding and plant multiplication enterprises, NGOs and interest groups.

2.1 Public-sector stakeholders

The Ministry of Agriculture and Food (LMD) is the responsible authority for the management of endangered genetic resources for food and agriculture. The Norwegian Agriculture Agency manages various grant schemes, and the Norwegian Genetic Resource Centre at NIBIO is the centre of expertise on genetic resource management.

The Ministry of Climate and Environment is the responsible authority for the management of areas protected under the Nature Diversity Act. The Norwegian Environment Agency manages the establishment of new protected areas on the mainland and on Svalbard, and has the overall responsibility for the management of protected areas.

There are also other public-sector stakeholders with important roles and responsibilities regarding the management of endangered genetic resources for food and agriculture. These include the county governors, the Norwegian Food Safety Authority, the Ministry of Foreign Affairs, the Ministry of Trade, Industry and Fisheries, the Ministry of Climate and Environment, the Norwegian Environment Agency, the Norwegian Biodiversity Information Centre, the Directorate of Cultural Heritage, the Nordic Genetic Resource Centre (NordGen) and the Nordic Council of Ministers.

In order to ensure successful cooperation between public authorities it is crucial to have good routines for coordination and a clear and mutually-agreed upon understanding of roles and responsibilities.

[3] See Securing the Gene Pool for Future Agriculture and Food Production - regjeringen.no

Boxout 3. Management of endangered genetic resources for food and agriculture – Division of responsibilities:

The Ministry of Agriculture and Food:

- Formulates Norwegian genetic resource policies, adopts relevant strategies and action plans. Lays down regulations when necessary and is the appeals body for genetic resource management grants.
- Adopts the national conservation program and ensures that rules and procedures facilitate for access to agricultural genetic resources.
- Establishes Norwegian positions for participation in intergovernmental cooperation.
- Collaborates with other authorities on genetic resource management when needed.

The Norwegian Agriculture Agency:

- Contributes to achieving the goals for genetic resource management within the main priorities of Norway's agricultural and food policies.
- Manages several relevant policy instruments, including grants for genetic resource management activities and production subsidies for endangered livestock breeds.
- Helps to ensure that policy instruments are implemented reliably and efficiently in accordance with the regulations.
- Disseminates knowledge and results obtained from the above-mentioned policy instruments.
- Acts as a support and assessment body for the Ministry of Agriculture and Food (LMD).
- Provides scientific expertise and consultancy on issues related to the management of genetic resources.

The Norwegian Genetic Resource Centre:

- Is a centre of expertise for the management of national genetic resources for food and agriculture at risk, and provides scientific and technical assistance to all stakeholders involved in national efforts for the conservation of genetic resources.
- Monitors the status and trends of Norway's national genetic resources and reports the findings to national and international bodies.
- Has a coordinating role in the national efforts for the conservation of genetic resources.
- Manages and owns genetic resources at risk in national backup storage facilities on behalf of the government.
- Disseminates knowledge and contributes to increased awareness of the value of genetic resources.
- Is responsible for scientific and technical follow-up of and participation in relevant international work, including European and Nordic forums.

2.2 Other stakeholders

Stakeholders participating in and contributing to the national efforts for the conservation and sustainable use of genetic resources of endangered livestock, crops and forest trees include private and public research and educational institutions, breeding organisations, seed and plant multiplication enterprises, NGOs and interest groups.

The action plan underlines that it is crucial to continue this important work and the broad commitment of all involved parties. Clearly describing the division of responsibilities and enabling long-term cooperation agreements with the public administration will help to strengthen, highlight and prioritize the contributions of the various stakeholders. Appendix A describes the roles and responsibilities of important stakeholders in the management of Norway's genetic resources.

Boxout 4. Management of genetic resources in Norway – Important stakeholders

Public institutions with living collections of endangered crops, livestock and forest trees,

such as botanical gardens, rural museums, vicarage gardens, schools and other places with collections of heritage plants or demonstration herds.

Business associations and trade unions,

such as the Norwegian Farmers' Union, Norwegian Farmers' and Smallholders' Association, Norwegian Forest Owners' Association, Norskog, Norwegian Horticultural Society and others.

Interest groups and individuals,

who are particularly active in the conservation and use of genetic resources, such as livestock breed societies, community seed banks and other professional and thematic networks.

Institutions involved in relevant research and education,

such as the Norwegian University of Life Sciences (NMBU) and other universities, the Norwegian Institute of Bioeconomy Research (NIBIO), regional colleges, the Fridtjof Nansen Institute, the Norwegian Agricultural Advisory Service, upper secondary schools and other R&D institutions.

Private stakeholders with activities linked to the management of national genetic resources,

such as Geno SA, Graminor AS, the Norwegian Beekeepers' Association, the Norwegian Equine Centre, the Norwegian Kennel Club, the Norwegian Association of Sheep and Goat Farmers, Norsvin SA, Overhalla Clonal Breeding Centre AS, Sagaplant AS, the Norwegian Forest Seed Centre, tree and plant nurseries, and other seed producers and traders.

2.3 Objectives and action steps for national cooperation and prioritization

Objectives

Well-coordinated cooperation, a clear and mutually-agreed upon understanding of roles and joint, targeted efforts by all stakeholders involved in the management of genetic resources at risk.

Action steps

A. The Ministry of Agriculture and Food will:

   i. Monitor and evaluate the implementation of the action plan.
   ii. Follow up the action plan in regular dialogue meetings between the Ministry of Agriculture and Food, the Norwegian Agriculture Agency and the Norwegian Genetic Resource Centre.
   iii. Incorporate the consideration of genetic diversity into relevant policy instruments and administrative processes in cooperation with other authorities.

B. The Norwegian Agriculture Agency will:

   i. Administrate relevant policy instruments in line with current regulations, national strategy and action plans, and enable access to reports, knowledge and information about the results from genetic resource management.
   ii. Regularly assess the prioritization of policy instruments in cooperation with other public administration stakeholders.

C. The Norwegian Genetic Resource Centre will:

   i. Follow up the action plan through sector-specific action plans, technical cooperation agreements, stakeholder coordination and outreach activities.
   ii. Prepare the annual report *Key figures from the Norwegian Genetic Resource Centre on the status of genetic resources at risk* as a basis for the management of genetic resources in Norway.

3 National conservation program

Through international cooperation, Norway has made a commitment to preserve its national genetic resources for the future and facilitate the sustainable use of and access to these resources pursuant to international regulations. The purpose of genetic resource conservation is to ensure that the material is safeguarded, maintained and available for future use. International standards and guidelines describe how to safeguard genetic resources through a set of tailor-made conservation methods. This work requires long-term and continuous efforts.

Norway has chosen to apply a decentralized conservation program for its endangered genetic resources. The program involves a diversity of stakeholders across the country who provide a set of adapted and complementary conservation measures. An overview of tasks, procedures and principles for these activities and stakeholders is summarized in Appendix A.

3.1 Identification, inventory and data storage

The first step of this process is the identification and inventory of the genetic material. Identification and inventory require a high level of expertise, access to documentation and/or DNA analysis of the material.

Official lists of genetic resources at risk are to be prepared and updated as necessary. Undocumented or inadequately documented material can be included in the list, based on the precautionary principle. Ideally, cultivars, breeds, varieties or species included in official lists of genetic resources at risk should be identified and characterized.

Various databases and data catalogues have been established to document genetic resources at risk. In Norway, both public and private databases are used to store and systematize genetic resource information. Databases are also helpful for researchers, breeders and others who wish to access the material and its documentation for use in research, education, breeding or production. Appendix B provides an overview of databases with information about genetic resources at risk.

NIBIO owns and operates the Kuregister («Cow Register») with kinship data of breeding animals of endangered cattle breeds, the Høneregister («Hen Register») with kinship data from the gene bank for laying hens and the database of protected areas in forests. The national conservation program also plans to register the inventory of vegetatively propagated plants at risk in the Nordic and Baltic Gene Bank Information System (GeNBIS)[4], which is managed by NordGen and holds data on plant genetic resources in the joint Nordic gene bank. GeNBIS has also been opened for use by the national conservation programs of the Nordic countries.

Work remains to be done regarding the identification and inventory of Norwegian forest genetic resources and crop wild relatives at risk.

3.2 Conservation methods

Endangered genetic resources in Norway are safeguarded through a set of various conservation methods that are adapted to the purpose of conserving specific genetic resources and their respective characteristics. The conservation methods can be divided into two main categories, i.e., dynamic and static conservation approaches (see description below). The conservation of genetic resources also includes long-term safety backup strategies. The Svalbard Global Seed Vault is an example of a global safety storage facility that offers long-term backup of seeds from gene banks across the globe, including Norway.

[4] https://www.nordic-baltic-genebanks.org/gringlobal/search.aspx

a Dynamic conservation methods

Dynamic conservation implies that genetic material is maintained in living populations either *in situ* (under natural conditions), in planted populations or in production systems. In a dynamic conservation approach, populations are maintained through natural selection or sustainable breeding. This conservation strategy enables the continued development and adaptation of genetic variation to changes in the environment, climate, farming systems and other production conditions.

The goal of dynamic conservation is to ensure that the population is maintained as a whole and gradually adapts to the production system or ecosystem of which it is a part.

In-situ conservation

Crop wild relatives and forest genetic resources are best maintained in natural populations *in-situ* within areas that are specifically set aside for long-term protection, e.g., in existing protected areas. In such cases, genetic variation within populations is a prerequisite for future climate adaptation and evolution. Knowledge about the populations' internal variation and how they respond to changes in land use, landscape fragmentation, overgrowth, grazing, climate change, etc., is important for sound genetic resource management and selection of the most appropriate conservation strategy.

When establishing conservation areas for populations of forest trees and crop wild relatives at risk, the identification and inventory of the genetic resources in question must be carried out. Furthermore, considerations for their management and protection must be included in the management and protection plans of the respective areas (cf. Boxout 1 and Boxout 10 in Appendix A).

Photo 2. Sand leeks (Allium Scorodoprasum) in the Færder National Park. Photo: Linn Borgen Nilsen, NIBIO

Photo 3. Naturally regenerated stand of Silver birch in Saltdal. Photo: Arne Steffenrem, NIBIO/Skogfrøverket.

Conservation in production systems

Livestock breeds at risk are best conserved by inclusion in pure-bred production herds that follow the principles of sustainable breeding in small populations. The primary breeding objective for endangered livestock breeds is to increase the size of the breeding populations until they are no longer considered at risk, while at the same time keeping the inbreeding rate at a moderate level. Another important breeding objective is to ensure that functional traits such as health and fertility do not degenerate.

Breeding organizations approved by the Norwegian Food Safety Authority are responsible for the breeding of their respective breeds. However, breed societies that are not responsible for breeding also contribute to the breeding work, e.g., by suggesting the selection of breeding animals and disseminating important knowledge about the breed to herd owners. The Norwegian Genetic Resource Centre has cooperation agreements with relevant breeding organizations and breed societies. The kinship data in the Cow Register are used as a basis for providing herd-level breeding advice. The Norwegian Genetic Resource Centre can provide professional assistance in the selection of AI studs and is also the approval body for breeding plans used by the Norwegian Food Safety Authority to grant exemptions from their restrictions on moving sheep and goats across the authority's own regional borders. As a result of long-term efforts, the inbreeding rate of cattle breeds has been low for the past 30 years[5].

Photo 4. All endangered cattle breeds were classified as critical breeds in the late 1980s. Sound breeding strategies, including the use of many bulls in breeding, have ensured that the breeds have shown a tolerable inbreeding rate, while the populations have increased in size. In 1990, there were 49 registered breeding cows of Western Fjord Cattle, whereas this figure rose to 1,292 in 2022. Photo: Nina Svartedal, NIBIO.

Endangered crops can also be conserved in production systems, in which farmers and hobby growers maintain the plant material through continuous cultivation. This type of on-farm management ensures that the genetic material and its production capacity are maintained. However, over time the material will change and adapt, based on local production conditions and the grower's selections (see Boxout 2 in Appendix A). On-farm management can be a very useful form of conservation for maintaining heirloom varieties and the knowledge about them. It can also contribute to the development of climate-adapted plant diversity. A number of

[5] Refer to report by the Norwegian Genetic Resource Centre and the NMBU report published in 2021, https://nibio.brage.unit.no/nibio-xmlui/handle/11250/2763348

individual farmers and hobby growers contribute to on-farm management of genetic resources. However, there is a need to draw up common principles for this conservation strategy.

Using conservation stands of forest genetic resources is a suitable form of safeguarding valuable seed sources that are no longer actively used in forest tree breeding. The conservation stand needs to be mapped and large enough to ensure natural regeneration. Conservation stands are based on documented knowledge of the seed source and ensure the adaptation to climate change and other variations (see Boxout 9 in Appendix A).

Conservation stands secure access to valuable genetic diversity for future use and research. As of writing (2023), eight conservation stands have been established for selected seed sources of spruce. For these stands, forest owners have signed long-term conservation agreements that allow the Norwegian Forest Seed Centre to collect seeds in collaboration with the forest owners. Conservation stands are also suitable for other forest tree species, which are actively used in breeding programs.

b Static conservation methods

The purpose of a static conservation approach is to keep the genetic material as intact as possible, and to document and provide access to the genetic material for researchers, breeders and producers. Examples of static conservation measures include field gene banks with living collections of vegetatively propagated plants and forest trees, gene banks that preserve seeds in cold storage or semen/embryos/vegetative tissue in liquid nitrogen (cryopreservation), or vegetative tissue grown *in vitro* on a growth medium in the laboratory. These forms of conserving genetic resources require well-defined storage procedures, well-documented material, good data storage routines and procedures that enable curators to identify and fill gaps in the collections. Unambiguous agreements on ownership, access and rights to further use of the material are also required.

Conservation of crops

Cold-tolerant seeds are preserved in seed banks that freeze the seeds, preferably at -18 ˚C. NordGen manages the Nordic gene bank for seed-propagated crops. In addition, there are seed banks in botanical gardens for wild crops. The conservation of vegetatively/clonally propagated plants is a national responsibility.

In Norway, vegetatively propagated plants are preserved in field gene banks or so-called clone archives. To ensure an optimal system for the conservation of such plants, the current setup will be strengthened and restructured. National clone banks will be identified and given responsibility for the conservation of all vegetatively propagated plants at risk within the respective crop groups (see Appendix A, Boxout 3). The main task of the clone banks is to preserve and maintain the collection in accordance with international gene bank standards and coordinate back-up storage in associated clone archives. They will also assist and organize technical networks for the various crop groups (see Appendix A, Boxout 6). Each accession is to be secured in at least two clone banks at other locations (see Appendix A, Boxout 3). When appropriate, clones shall also be kept in a national backup facility (see Appendix A, Boxout 8).

Photo 5. Bags containing seeds of crops and crop wild relatives in the Nordic Gene Bank at the Nordic Genetic Resource Centre (NordGen) in Alnarp, Sweden. Photo: Linn Borgen Nilsen, NIBIO

Photo 6. Clone collection of heirloom fruit tree varieties at the rural museum in Lier. Photo: Linn Borgen Nilsen, NIBIO.

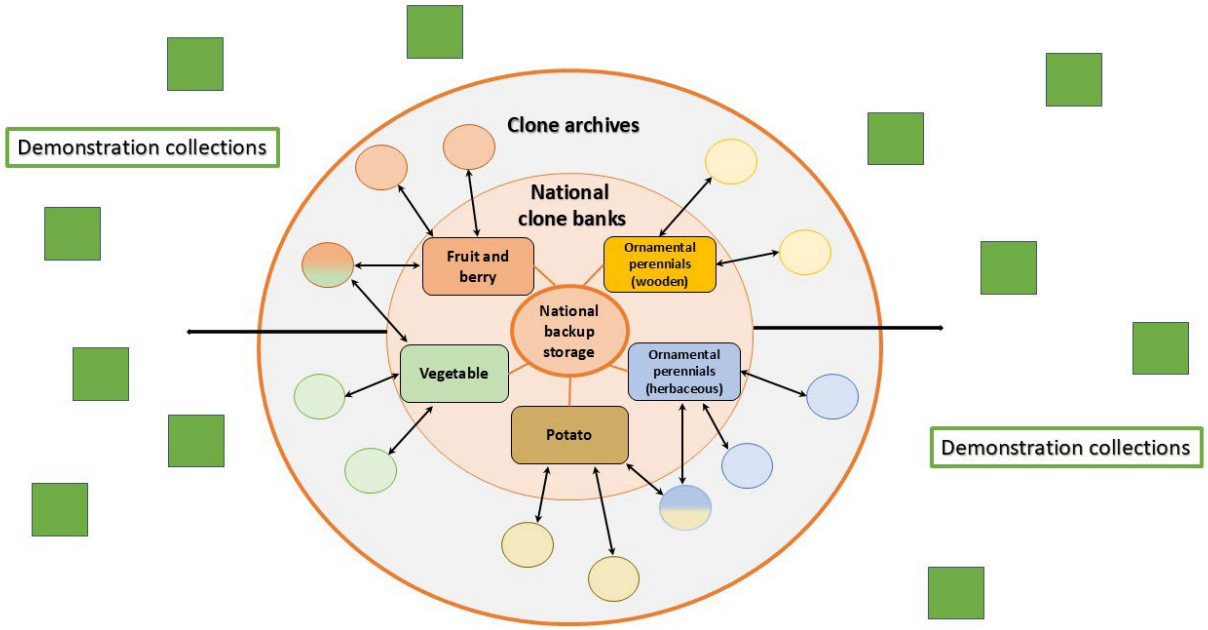

***Figure 1**. Diagram of the conservation setup for vegetatively propagated plants in Norway, centered around five National clone banks – one for each crop group. Each clone bank collaborates with at least two clone archives that provide the necessary back-up of the material. An individual clone archive can be linked to several clone banks if appropriate. Assuming it is technically possible, all accessions are eventually to be stored in a national backup storage. The arrows show the flow of genetic material and associated information. In addition, demonstration gardens and other collections will play a major role in the dissemination of information and knowledge about the clonal material (see Chapter 6.2 and Appendix A Boxout 5). A collection can serve as both a clone archive and a demonstration collection.*

Conservation of forest trees

Selected seed sources of tree species that are part of the forest tree breeding program in Norway are stored in the Norwegian Forest Seed Centre's seed bank. In addition, clone archives keep collections of forest trees that can be used in greeneries and revegetation projects. A considerable share of the material is preserved at the Landscape Laboratory of the Norwegian University of Life Sciences (NMBU). Forest genetic resources are also preserved in arboreta and botanical gardens, even if genetic resource conservation was not their primary focus when collecting and cultivating the material. The inclusion of some of this collected material in the national conservation program for forest tree genetic resources will be assessed continuously.

Conservation of livestock breeds

The semen of livestock breeds at risk is preserved in sperm banks. These are important both for conservation purposes and sustainable breeding in active production herds of the respective breeds (see Appendix A, Boxout 11). Norway has sperm banks for cattle, sheep and goats. These are owned and managed by the respective breeding organizations. There is also a sperm bank for dogs that is managed by the responsible breeding organization in cooperation with the Norwegian Genetic Resource Center.

Photo 7. A GENO employee demonstrates semen collection from a Telemark bull at an agricultural show in 2023.

Frozen semen of cattle, sheep and goats can be used for long-term storage and in active breeding in populations of the various breeds at risk. Photo: Nina Svartedal, NIBIO

AI-sires of endangered sheep breeds and the Norwegian coastal goat are selected in collaboration between the breeding organization and the respective breed societies, which in turn have cooperation agreements with both the breeding organization and the Norwegian Genetic Resource Center. The breed societies propose AI-sire candidates, and the breeding organization makes the final decision on which animals to purchase for semen production.

A 'bull committee' decides on the purchase of AI-bull candidates, based on proposals from the breed societies of four of the cattle breeds at risk and the Norwegian Genetic Resource Centre. The two remaining breeding organizations for cattle breeds at risk are responsible, among other things, for breeding and selection of AI-bulls for their respective breeds. The semen is owned by the respective breeding organizations.

c Backup storage

Backup storage is the long-term and secure storage of safety backups of endangered genetic resources. The purpose of backup storage is to replace genetic resources if genetic material in the other collections is lost. Backups are important for material preserved with both dynamic and static conservation methods, as an insurance for the future.

Backup storage facilities should be placed in secure locations and at a sufficient distance from the original collection. The Svalbard Global Seed Vault is a global backup facility for seeds, primarily of cultivated crops. It also provides backup storage of seeds of Nordic forest trees at risk. Safety backups of semen and clonal plant material of endangered genetic resources involve the use of cryopreservation techniques (see Appendix A, Boxout 8 and Boxout 17). For a number of species and populations, methods for cryopreservation still need to be further developed.

Backup storage of endangered genetic resources is a public responsibility, and there must be public access to the stored material in accordance with national regulations.

3.3 Summary of the national conservation program

The national conservation program for genetic resources provides a comprehensive framework for the conservation of endangered genetic resources in crops, livestock and forest trees in Norway.

As much as possible of the genetic material at risk shall be secured through both dynamic and static conservation measures, in addition to long-term backup storage. Boxout 5 shows an outline of the various conservation strategies and their current status.

Boxout 5. Summary of strategies and measures for the conservation of genetic resources at risk in Norway. (Color codes: RED – measure not yet established. BLUE – measure initiated, but needs further development. GREEN – measure established and will be continued.)

Conservation strategy	Crops at risk	Livestock breeds at risk	Forest trees at risk
Dynamic conservation	On-farm management and conservation at selected farms.	Owners of active livestock herds who cooperate with the respective breeding organizations and breed societies.	Conservation stands of valuable forest genetic resources at risk for which the forest owner has a cooperation agreement with the Norwegian Genetic Resource Centre.
	Established conservation areas for crop wild relatives.	Conservation herds on farms that have a cooperation agreement with the Norwegian Genetic Resource Centre.	Established *in situ* conservation areas for representative populations of forest trees in protected areas.
		Gene bank for laying hens (live animals).	*Ex situ* populations of tree species with marginal distribution, which cannot be adequately managed in protected areas.
Static conservation	Joint seed storage for Nordic countries at the Nordic Genetic Resource Centre (NordGen).	Gene banks containing frozen semen (cattle, sheep, goats and dogs).	Seed bank at the Forest Seed Centre.
	National clone banks and clone archives for all crop groups.	Gene bank containing frozen semen (horses, laying hens and bees).	Clone bank/archive for trees used in greeneries and revegetation.
Long-term national backup storage (static)	Svalbard Global Seed Vault (seeds).	National backup storage for long-term cryopreservation of semen (cattle, horses, sheep and goats).	Svalbard Global Seed Vault (seeds).
	National backup storage of vegetatively propagated plants (cryopreservation).	National backup storage for long-term cryopreservation of semen (dogs, European dark bee and laying hens.	

3.4 Private, local and public partners

The conservation of genetic resources requires professional expertise about the characteristics and management of genetic resources at risk.

Important sources of relevant knowledge and skills for the various stakeholders involved in the Norwegian conservation program for genetic resources include research institutions, plant and livestock breeding organizations, agricultural and environmental authorities, county governments, professional networks and societies.

Norway has a tradition of broad cooperation and exchange of information in both formal and informal networks. Professional networks, breed societies and similar associations serve as professional arenas and contribute to disseminating crucial know-how about sustainable breeding, plant and animal health and other important aspects of genetic resource conservation. Such networks also facilitate contacts with public authorities. As a national centre of expertise and coordinator of conservation efforts, the Norwegian Genetic Resource Centre is a point of contact for these professional networks, and helps to build bridges across the board. Measures aimed at developing skills and knowledge include arranging joint professional meetings, courses, demonstrations, exhibitions and excursions.

Most livestock breeds at risk have their own breeding organization or breed society. For Norway's crop and forest genetic resources, there is a need to strengthen and further develop such professional networks (see Boxout 6 in Appendix A).

3.5 Objectives and action steps for the national conservation program

Objectives

Crops, livestock and forest trees at risk have been identified, inventoried and safeguarded through conservation measures in a comprehensive, long-term and well-ordered conservation setup.

Action steps

A. The Ministry of Agriculture and Food will:

   i. Ensure good integration of the national conservation program for endangered genetic resources in appropriate documents, strategies, grant schemes, etc.
   ii. Approve lists of endangered genetic resources, certain conservation procedures and institutions included in the conservation program.
   iii. Establish regulations for grants and, when necessary, provide guidelines for earmarking funds in the annual allocation letter to the Agriculture Agency.
   iv. Make efforts , in cooperation with the appropriate authorities, to increase the number of management plans that include genetic resources, when such inclusion is compatible with the protection objective of the specific protected area.
   v. Ensure that seeds from Norwegian genetic resources at risk are stored in the Svalbard Global Seed Vault.

B. The Norwegian Agriculture Agency will:

   i. Manage grants for the conservation of genetic resources for food and agriculture in accordance with current regulations and the letter of allocation annually issued by the Ministry of Food and Agriculture.
   ii. Base its work on information from the Key Figures report issued by the Norwegian Genetic Resource Centre, final project reports submitted by grantees and other relevant sources.
   iii. Consider and assess adjustments to subsidies and grant schemes, when needed, including an increase in the share of endangered livestock breeds used in pure-breeding.

C. The Norwegian Genetic Resource Centre will:

Registers and databases

i. Establish and update lists of national genetic resources at risk.
ii. Maintain and, when needed, further develop public databases and registers containing data on genetic resources at risk. Examples include the Kuregister ('Cow Register'), the Hønseregister ('Hen Register'), the database of protected areas in forests and the Nordic Baltic Gene Bank Information System (GeNBIS).

In-situ conservation

i. Make an inventory of relevant populations of crop wild relatives and assess their management needs.
ii. Develop a procedure for designating *in situ* conservation areas for forest trees at risk and crop wild relatives, and establish new conservation areas when appropriate.

Conservation in production systems

i. Continue to provide professional support for sustainable pure-breeding in small populations of livestock breeds at risk by advising the respective breeding organizations, breed societies and farmers, as well as for the operation and updating of the kinship databases for cattle and laying hens.
ii. Establish procedures and principles for on-farm management of plant genetic resources.
iii. Consider the establishment of new conservation herds for livestock breeds at risk and conservation stands of forest trees.
iv. Enter into agreements with relevant institutions on the access to kinship data of livestock breeds at risk.

Conservation in gene banks

i. Initiate the reorganization of clone banks and clone archives for vegetatively propagated crops in cooperation with the Ministry of Food and Agriculture and the Norwegian Agriculture Agency.
ii. Establish formal agreements on *ex situ* conservation of endangered genetic resources with relevant stakeholders, such as clone banks, breeding organizations and the Norwegian Forest Seed Centre.
iii. Assess suitable *ex situ* backup storage facilities for genetic material from livestock and vegetatively propagated plants.
iv. Establish routines for backup storage of forest tree seed at risk in the Svalbard Global Seed Vault.

Networking

i. Assist the breeding organizations and breed societies of livestock breeds at risk by providing the necessary breeding expertise and breeding tools.
ii. Initiate the setup of technical networks for the various crop groups; ref. Appendix A.

4 Value creation and sustainable use

Value creation and sustainable use of genetic resources are closely linked to the conservation of genetic resources per se. The objective of genetical resource conservation is to ensure that the genetic material can contribute to production improvements and sustainable solutions in the food and agricultural sector. This requires providing scientists, breeders and farmers with access to the material. The sustainable use of national genetic resources also contributes to preserving both the resources themselves and the knowledge needed for their upkeep and further development.

Utilizing endangered genetic resources in value creation and sustainable use can improve sustainability in agriculture and forestry. The endangered genetic resources that are not used in current plant and animal breeding programs are nevertheless important as a genetic pool for various niche productions and future agriculture. These genetic resources might have valuable traits when it comes to meeting both national and international challenges in the future.

4.1 Sustainable plant and animal breeding

Sustainable plant and animal breeding involves the development of healthy and robust material with improved production traits, while at the same time not depleting the gene pool within a species or population, e.g., through a rapidly increasing inbreeding rate. Through selection, plant and animal breeding can provide increased productivity, strengthened resilience to climate-related and other changes, as well as adaptation to consumer preferences and the market in general. Norwegian breeding organizations and companies supply breeding material for the production of high-yielding, healthy livestock, improved plant varieties and tree seeds that provide fast-growing and climate-adapted forests.

As a result of climate change, the range in which agricultural crops and forests can be cultivated will shift to higher latitudes and elevations. Meticulous use of genetic variation in breeding can help to adapt various production systems and ensure agricultural diversity in Norway's northern and mountain regions. Sustainable breeding can also contribute to climate change mitigation in agriculture, e.g., by improving feed utilization in livestock.

Photo 8. A spruce breeding station. Photo: Arne Steffenrem, NIBIO/Skogfrøverket.

The use of endangered genetic resources in breeding requires thorough documentation and characterization of the preserved material. Identifying useful traits within such material often requires costly research and evaluation. An example of how such work nevertheless can be realized is the collaboration between Nordic research institutions and breeding companies, in which relevant plant genetic resources are identified and prepared for further use in breeding. The goal is to identify genetic traits that provide increased disease resistance, drought tolerance and other important properties. One of the crops this cooperation has focused on is spring wheat.

Boxout 6. Special features of crop, livestock and forest tree breeding in Norway

Livestock

In sustainable livestock breeding, breeding animals are selected and mated to improve economic, animal-welfare and breed-specific characteristics, while maintaining genetic breadth in the breeding population. In the large breeding populations of Norway's main production livestock, there are significant improvements in the desired production, fertility and health traits. Norway provides excellent access to data on animals' kinship, production, fertility and health traits. This access is highly valuable for Norwegian livestock breeders. In sustainable breeding within small populations, the most important breeding goal is to avoid rapidly increasing rates of inbreeding while at the same time increasing the size of the population.

Crops

Approved plant varieties are genetically stable populations and genotypes that must be replaced after several years, partly due to the need for increased resistance to diseases and other harmful organisms. Graminor AS is constantly developing new varieties with new properties and thus has a continuous need for access to genetic material.

Forest trees

Forest trees have a very long rotation cycle from seedling to mature forest. The choices made in terms of seed sources and tree species thus have long-term consequences. It is important to conduct mapping, inventorying and have sufficient knowledge of the trees that are used as seed sources. The Norwegian Forest Seed Centre is responsible for ensuring a nationwide supply of high-quality forest seed.

4.2 Agricultural diversity

By utilizing a larger share of the genetic diversity available in livestock, crops and forest trees, value can be added to both conventional and alternative production systems. Urban farming, organic production, community supported agriculture, Green Care Farms, landscape management, school gardens and hobby growing are examples of production types that can benefit from using more diversity. This includes the use of endangered genetic resources, which can add new characteristics, be better adapted to a variety of production types and contribute to increased value creation. However, it is important to increase awareness about genetic diversity to ensure the increased use of these resources by commercial and hobby growers.

To increase the utilization of endangered genetic resources, there must be distribution channels for good-quality products based on these resources. Plant and animal health regulations, any legal issues and other sales and marketing requirements must be met. Furthermore, it is important to document the identity of the specific genetic material, either through kinship databases, variety labeling or other identification procedures.

4.3 Product diversity

Sales of niche products based on local/regional plant varieties or livestock breeds can be achieved through direct sales and local outlets such as farmers' markets, food courts, local food distribution groups, etc. New opportunities for direct sales and increased profits contribute to increasing the number of businesses developing products based on endangered crop varieties and livestock breeds. At the same time, this helps consumers become familiar with a greater diversity of agricultural products and local food traditions.

The production of meat from cattle breeds at risk has increased significantly in recent years. This trend has contributed to the steady growth of these populations. The meat is sold through ordinary distribution channels, as specialty meat to the food service industry, and directly from producer to consumer. Meat from cattle

breeds at risk is perceived to be of good quality. Especially its tenderness is highlighted by consumers and renowned chefs alike. Such meat can thus achieve a significantly higher farm gate price than meat sold through the regular distribution channels.

Flour and a variety of products based on older cereals, such as einkorn wheat, emmer wheat, spelt, and the old Nordic rye variety svedjerug can be found on the market. These have different baking properties and nutrient contents than flour from today's cereal varieties. Several mills specialize in the production of flour from older and heirloom Norwegian cereal varieties.

A large number of trees and shrubs are planted along roads, in parks and other greeneries in Norway. Domestic trees and shrubs that are adapted to Norway's climate are preferred to be increasingly used by the landscaping industry. This will help to increase diversity, reduce the use of alien species and preserve the variation of Norwegian flora.

Photo 9. Cider made from heirloom apple varieties at NIBIO's research facility in Ullensvang. Photo: Linn Borgen Nilsen, NIBIO.

The PLANTEARVEN trademark

PLANTEARVEN® (Norweg.: Plant Heritage) is a trademark used to advertise and market traditional Norwegian plants that are now considered national genetic resources at risk and are no longer in widespread use. This includes older varieties of vegetables, fruit trees, roses or perennials that either originated here or are considered historically important in Norway. The trademark is managed by the Norwegian Genetic Resource Centre and can be used by community gene banks, nurseries and others who sell or share plant material of registered PLANTEARVEN varieties.

A trademark like this can confirm that a certain plant originates from genetic resources at risk and thereby contribute to increased awareness and perhaps also increased sales of the plant material. It could be appropriate to consider the establishment of a similar, publicly owned trademark for livestock breeds at risk.

4.4 Regulating access to genetic resources

In compliance with international commitments, Norway is obliged to facilitate access to genetic resources. This is regulated by the Nature Diversity Act and the Ministerial Declaration on Access and Rights to Genetic Resources (the Kalmar Declaration), adopted by the Nordic Council of Ministers in 2003.

a Nature Diversity Act

In Norway, the Nature Diversity Act regulates access to genetic resources in the natural environment and states that foreign genetic material can only be used in Norway in accordance with the provisions of the country of origin or in line with the principles of the Plant Treaty's Multilateral System. The Nature Diversity Act also states that genetic material obtained from the natural environment is a common resource belonging to Norwegian society as a whole and managed by the state in accordance with internationally agreed principles.

b Kalmar Declaration

Through the Kalmar Declaration (*Declaration on Access and Rights to Genetic Resources*[6]) adopted by the Nordic Council of Ministers in 2003, the ministers of the five Nordic countries state that the genetic resources held by NordGen are under common Nordic management, freely accessible and in the public domain. Access to the seeds in the joint Nordic gene bank in NordGen is provided in accordance with internationally agreed principles, as decided by the Nordic Council of Ministers.

c International principles

To ensure that the genetic pool in agriculture can contribute to the development of the food and agriculture sector, it is crucial that farmers, scientists, breeders and breeding companies are given access to the genetic resources managed in Norway and other countries. The principles for such access are regulated by international agreements, i.e., the Convention on Biological Diversity and its Nagoya Protocol as well as the International Treaty on Plant Genetic Resources for Food and Agriculture (Plant Treaty).

These agreements regulate the exchange and use of genetic resources and associated traditional knowledge. The agreements also set out rules for sharing benefits that arise from the use of genetic resources, e.g., by returning a share of the profits from seed sales to the country of origin. The Plant Treaty facilitates access to the genetic diversity of important food crops through the establishment of a multilateral system for access and benefit-sharing. Participants in all countries have access to the material included in the multilateral system through a standard material transfer agreement that governs both legally binding and voluntary benefit-sharing.

d National practices for ensuring access to genetic resources at risk

In Norway, the sharing of endangered genetic resources for use in research, breeding and production is facilitated by the institution in charge of preserving the respective material. Access to material is limited by institutions' capacities, quality standards and animal and plant health regulations. The Norwegian Community Gene Bank plays an important role in distributing seed-propagated plant material to producers. In order to meet demand, it could also be necessary to consider the establishment of community gene banks for vegetative material at risk, e.g., for selected fruit and potato varieties.

[6] The Kalmar Declaration from 2003: https://www.nordgen.org/media/3vfhcoeq/the-kalmar-declaration.pdf. The Nordic Council of Ministers has recently adopted an updated declaration: Kalmar II Declaration on Access and Rights to Genetic Resources: https://www.norden.org/en/publication/access-and-rights-genetic-resources-2023-kalmar-ii-declaration

Photo 10. Testing and multiplication of cereal varieties by the Norwegian Community Gene Bank. Photo: Linn Borgen Nilsen, NIBIO.

Plant material preserved in Norwegian clone banks/archives, together with associated information, must be made available to users in accordance with international regulations. To avoid the spread of plant pests, specific plant health requirements must be met when providing planting material of apples, pears, Prunus (plums, cherries, etc.), Rubus (raspberries, blackberries, etc.), strawberries, onions, potatoes and some ornamental plants. These requirements are described in the *Regulations relating to plants and measures against plant pests*[7]. Among other things, the regulations require that clone banks and archives that distribute vegetatively propagated plant material must implement internal control for plant health and document these routines in writing.

Photo 11. Dahlias in the clone archive at the Old Hvam Museum. Photo: Linn Borgen Nilsen, NIBIO.

[7] Forskrift om planter og tiltak mot planteskadegjørere (Forskrift om plantehelse) | Mattilsynet

To facilitate the increased use of genetic resources that are conserved in Norway, a comprehensive assessment is needed to establish rules and procedures for access to the genetic resources and associated documentation in the national conservation program.

Boxout 7. Accessible genetic resources at risk that can be used in production

Livestock

Farmers' sales of live animals are also a common form of livestock trade for breeds at risk. Breeding organizations and breed societies contribute by acting as mediators and providing knowledge about their respective breeds. The breeding organizations provide semen of cattle, goat and sheep breeds at risk on the same terms as for other breeds. The gene bank for laying hens sells hatching eggs and live animals.

Crops

Community gene banks and plant societies propagate and distribute plant material, including crop varieties that are subject to conservation, to interested farmers and hobby growers. The Norwegian Food Safety Authority can also approve the marketing of traditional, seed-propagated crop varieties at risk that are naturally adapted to local or regional conditions - either as 'endangered' or 'heirloom' (for vegetables) varieties. Some nurseries also sell horticultural plant varieties that are no longer in widespread use.

Forest trees

Primarily, Norwegian tree nurseries, the Forest Seed Centre and other distribution channels provide access to forest genetic resources of the mainstream, commercial tree species. There are only few commercial distribution channels for seeds and plant material of other national forest genetic resources for use in forestry, greeneries or revegetation projects.

4.5 Farmers' Rights

Nationally and internationally, there is an increased focus on Farmers' Rights to plant genetic resources. The term "Farmers' Rights" is a recognition of the role farmers have had and have in the management of plant genetic resources. In line with the Plant Treaty, such recognition implies increased participation in relevant forums and processes, and enabling farmers' access to genetic resources and benefit-sharing. Another implication is that the right of farmers to use, exchange and sell their own seed should not be restricted. Such recognition may also be relevant for the management of genetic resources of livestock and forest trees.

Norway has a long tradition of ensuring that farmers' organizations are involved in the preparation of economic and agronomic incentives, e.g., in the annual agricultural negotiations. Farmers are also invited to participate directly or through professional associations and networks in the ongoing efforts to manage national genetic resources at risk. Norway has secured its farmers the right to use farm-saved seed and farm-bred livestock, and is also working internationally to ensure that such rights can be secured.

Boxout 8. Operationalizing Farmers' Rights in Norway

The operationalization of Farmers' Rights is up to the individual country. For Norway this involves such strategies as:

- Facilitating access to good-quality breeding material (e.g., seeds and clones), which is adapted to local production conditions and meets farmers' various needs and preferences,
- Increasing farmers' possibilities to be involved in and have influence on priorities in plant and livestock breeding,
- Supporting measures to preserve, protect and develop traditional knowledge associated with genetic resources,
- Increasing farmers' possibilities to participate in relevant decision-making processes,
- Securing the right to use farm-saved seed and farm-bred livestock, and promoting Farmers' Rights to store, use, exchange and sell farm-saved seed.

4.6 Objectives and action steps for added-value creation and sustainable use

Objectives

Increased number of genetic resources at risk utilized in production, breeding and business development.

Action steps

A. The Ministry of Agriculture and Food will:

   i. Strengthen livestock and plant breeding based on national genetic resources and thereby contribute to climate-friendly and sustainable food production.
   ii. Promote a diversity of production types and systems, e.g., through the increased use of endangered species, varieties and breeds.
   iii. Continue joint projects in research and plant breeding aimed at promoting the development and use of adapted plant material.
   iv. Facilitate farmers' access to documented and healthy propagation and breeding material of endangered livestock breeds, crops and forest trees by, among other things:

      a. expanding current grant schemes,
      b. developing principles and procedures for access to endangered genetic resources that are part of conservation collections,
      c. ensuring systematic reporting on the use of this material.

   v. Strengthen and safeguard Farmers' Rights to use and sell farm-saved seed and farm-bred livestock, in appropriate regulations and through the negotiation and development of international agreements on this issue.

B. The Norwegian Agriculture Agency will:

   i. Support initiatives to identify market and production benefits based on the use of national genetic resources at risk and thereby promote the development and commercialization of these resources.
   ii. Manage all relevant grant scheme designed to strengthen added-value creation and sustainable use, with the aim of considering the increased inclusion of national genetic resources.

C. The Norwegian Genetic Resource Centre will:

   i. Provide scientific support for measures aimed at increasing the sustainable use of national genetic resources at risk, such as:

      a. breeding advice,
      b. genetic characterization projects,
      c. establishment and operation of community gene banks.

   ii. Ensure that the Plantearven® trademark can be used when marketing plant varieties that fulfill relevant criteria.
   iii. Involve farmers and their representatives in the preparation of action plans for national genetic resources.

5 Knowledge and outreach

Awareness of and knowledge about genetic resources at risk are crucial for the use and efficient conservation of these resources. This requires a high level of scientific expertise, purposeful research and targeted outreach activities.

5.1 Capacity building, research and knowledge creation

It is essential to have access to scientific expertise and to document the traits, characteristics, kinship data and variation of the endangered genetic resources to secure their usage potential and ensure their systematic conservation. Information about the genetic resources' cultural-historical importance represents an added value for relevant users.

Research is continuously developing and provides access to updated knowledge and new technology. This provides new opportunities for utilizing endangered genetic resources, e.g., in plant and animal breeding or business development. There is a trend towards increased research on products, such as studying the nutritional contents or properties of either flour from heirloom cereal varieties or milk and meat from livestock breeds at risk. Furthermore, knowledge about geographical range and status of the genetic variation, development and adaptation of forest trees is crucial for the sound management of forest genetic resources.

For several years, schools, colleges and universities have seen declining numbers of applications to traditional agricultural programs. In spite of this trend, local initiatives are showing a growing interest in utilizing more of the genetic diversity found in endangered plant varieties and livestock breeds. These initiatives also wish to develop their knowledge and skills about the processing of products based on these genetic resources. Such increasing interest from throughout the entire value chain could result in an increased number of applicants to relevant fields of study.

Regarding forest trees in natural stands, it is important to monitor stand development and climate adaptation over time, and to be able to locate potentially valuable genetic material at risk.

Photo 12. A forest in Dovre. Photo: Oskar Puschmann, NIBIO.

5.2 Information and communication

The increased transfer of knowledge to relevant target groups about the importance of endangered genetic resources will help to raise awareness about these resources' crucial role in national food security and sustainable agriculture. It is important to secure broad involvement and support for the work among politicians, public administrators, consumers and other stakeholders.

All stakeholders involved in the conservation of genetic resources have important responsibilities related to information and communication. As coordinator and centre of expertise for the management of genetic resources for food and agriculture, the Norwegian Genetic Resource Centre has a particular responsibility for communicating information about genetic resource conservation with a high level of scientific precision.

The breed societies have key roles in terms of transferring knowledge about livestock breeds at risk, both to new keepers of these breeds and to the general public. Comparable functions can be performed by the similar networks that are being established for the conservation of plant and forest genetic resources.

The decentralized national conservation strategy outlined by the Norwegian conservation program has many advantages, including local involvement, knowledge transfer and capacity building. Having plant collections and conservation areas in different parts of the country will enable the sharing of information and knowledge with a variety of user groups.

The Norwegian Genetic Resource Centre established the annual PLANTEARVEN award to honor persons who have made extraordinary contributions to the conservation and sustainable use of plant diversity. The PLANTEARVEN award is useful for reaching out to the media and thereby getting publicity about the conservation of plant genetic resources.

Botanical gardens, arboretums and other plant collections play a highly important role in the sharing of information and knowledge about different species and varieties, their biology, use and history. For example, there are demonstration collections of endangered forest trees and crops in small and large arboretums and gardens all over the country. Some of these collections are thematically focused and contain local material of historical interest, while others have a broad diversity of different species, etc. Demonstration collections (see Appendix A, Boxout 5) are primarily intended for the general public, and can be managed by museums, visitor centers, interest groups, etc. The establishment of demonstration collections for livestock breeds at risk and endangered greenery plants could also be considered.

Photo 13. A bed of heirloom perennials at the Old Hvam Museum. Photo: Linn Borgen Nilsen, NIBIO.

Genetic mapping of domestic reindeer could provide important information for use in research, e.g., to study health-related issues in reindeer husbandry. Also, DNA mapping would help to track changes in the material over time. Combined with traditional knowledge, such methods could contribute to the successful adaptation of the reindeer industry to climate change.

5.3 Microorganisms and invertebrates

Genetic diversity in microorganisms and invertebrates includes bacteria, fungi, insects and other soil organisms that can be vital for food and agriculture. Such organisms include soil decomposers, pollinating insects, the rumen microbiota, and microorganisms used in the production of cheese, beer, cider, etc. Increased knowledge about these organisms can be useful for adapting to climate change, developing new food products and preserving cultural history and traditional knowledge.

5.4 Objectives and action steps for knowledge and outreach

Objectives

Increased awareness and knowledge among stakeholders in public administration, R&D, education and the agri-food sector of the importance of endangered genetic resources throughout the value chain.

Action steps

A. The Ministry of Agriculture and Food will:

   i. Raise awareness of genetic resources at risk by highlighting the issue in relevant documents, priorities, etc.
   ii. Facilitate and give priority to participating in relevant outreach activities.
   iii. Enable the inventory of microorganisms and invertebrates vital to food and agriculture, thereby being able to prioritize measures for the conservation and sustainable use of microorganisms and invertebrates.

B. The Norwegian Agriculture Agency will:

   i. Secure support for projects that focus on assessing useful traits and genetic variation of genetic resources at risk (within the framework of existing grant schemes).
   ii. Ensure the follow-up of and share the results from inventory and prioritization projects regarding microorganisms and invertebrates.

C. The Norwegian Genetic Resource Centre will:

   i. Increase access to data and research-based knowledge about endangered livestock, crops and forest trees by relevant stakeholders in research, breeding and public administration.
   ii. Regularly inform politicians, public administration, the agri-food sector and the general public about the importance and value of national genetic resources for food and agriculture.
   iii. Establish arenas, professional associations and interdisciplinary meetings for stakeholders involved in genetic resource conservation and other interested parties for discussion of relevant topics.
   iv. Facilitate the establishment of demonstration collections of endangered clone plants, e.g., with a focus on locally-valued plants, specific species, etc.
   v. Continue to hand out the PLANTEARVEN award.
   vi. Prepare information material on genetic resources at risk.

6 International cooperation

Global international cooperation is needed to secure genetic resources for food and agriculture. Successful cooperation is crucial to ensure food security, and enable the development of sustainable and climate-friendly agriculture.

Photo 14. In the Food and Agriculture Organization of the United Nations (FAO), all countries meet to cooperate and negotiate on global work for the conservation and sustainable use of genetic resources. Photo: Linn Borgen Nilsen, NIBIO.

6.1 Regional cooperation

Norway cooperates with the other Nordic countries on the management of endangered genetic resources in the Nordic region. This cooperation includes a joint gene bank.

The Nordic Council of Ministers established the Nordic Genetic Resource Centre (NordGen) as the Nordic centre of expertise for genetic resources. NordGen's mission is to safeguard genetic resources and promote the sustainable use of crop, livestock and forest diversity of importance for agriculture in the Nordic region. NordGen operates a joint Nordic gene bank, and ensures professional cooperation between the Nordic countries on the management of livestock and forest genetic resources. NordGen's head office, its crop department and the seed bank are located in Alnarp, Sweden. NordGen's departments for farm animals and forest genetic resources are located in Ås, Norway.

Norway is a member of three European technical networks for genetic resources. Through EUFORGEN[8] (forest trees), ECPGR[9] (crops) and ERFP[10] (livestock), the European countries cooperate professionally on knowledge development, joint databases, etc. The European Commission has funded the project GenRes Bridge (Genetic resources for a food-secure and forested Europe), which in November 2021 presented a draft Genetic Resources Strategy for Europe and a draft action plan involving all three networks. Norway's national action plan is largely based on the same principles as the European Genetic Resources Strategy.

6.2 Global cooperation

Through the Convention on Biological Diversity and the associated Nagoya Protocol, Norway has committed itself to the sustainable management of biodiversity, including genetic resources.

Global cooperation on genetic resources for food and agriculture is coordinated by the FAO's Commission on Genetic Resources for Food and Agriculture. This work is based on sector-specific global status reports, action plans, standards and guidelines. The International Plant Treaty focuses on the conservation and sustainable use of plant genetic resources. Together with other international mechanisms, the Plant Treaty provides rules for

[8] European Forest Genetic Resources Programme

[9] European Cooperative Programme for Plant Genetic Resources

[10] European Regional Focal Point for Animal Genetic Resources

on access to and fair sharing of benefits from the use of plant genetic resources, as well as on national implementation of Farmers' Rights, conservation and sustainable use, etc.

6.3 Svalbard Global Seed Vault

The Svalbard Global Seed Vault is a secure backup facility for seeds. The Seed Vault offers storage of duplicates of accessions kept by seed banks around the world. After 15 years of operation, 98 gene banks have entered into backup storage agreements and more than 1.2 million seed samples have been deposited for long-term storage. The Seed Vault is owned by the Norwegian government and operated by the Ministry of Agriculture and Food (LMD) through a lease contract with Statsbygg and a partnership agreement between LMD, NordGen and the CropTrust. The Svalbard Global Seed Vault is an important contribution from Norway to the global efforts on preserving genetic resources for food and agriculture. There is considerable confidence in Norway's role, as is shown in the widespread global support and involvement in the Global Seed Vault initiative.

Photo 15. Svalbard is home to the Svalbard Global Seed Vault, the world's backup facility for seeds. Photo: Ricardo Gangale, Svalbard Global Seed Vault.

6.4 Objectives and action steps for international cooperation

Objectives

A well-functioning global system for the conservation and sustainable use of genetic resources and active cooperation at Nordic and European level.

Action steps

A. The Ministry of Agriculture and Food will:

   i. Follow up international agreements and implement international commitments regarding the conservation and sustainable use of genetic resources for food and agriculture.
   ii. Identify forums and processes within Nordic, European and international cooperation in which Norway will contribute, and appoint national contact persons for the various tasks.
   iii. Ensure that there are national guidelines for delegations to Nordic, European and global forums and that these have updated and sufficient professional expertise when this is relevant for the follow-up of Nordic, European and global forums and processes.
   iv. Continue the operation of the Svalbard Global Seed Vault in accordance with the tripartite agreement with NordGen and the Crop Trust and the lease contract with Statsbygg, and:

      a. Follow up on the Global Seed Vault's communication strategy and information plan
      b. Report to relevant intergovernmental bodies
      c. Make efforts to increase support and participation by gene banks around the world
      d. Establish good security procedures in line with updated security audits

B. The Norwegian Agriculture Agency will:

   i. Stay up to date on international work and, if necessary, participate in relevant international processes.
   ii. Monitor Norwegian membership in relevant international forums, including the payment of membership fees.

C. The Norwegian Genetic Resource Centre will:

   i. Follow up global action plans, international standards and guidelines in the conservation and sustainable use of genetic resources in Norway.
   ii. Participate in and provide input to Norwegian delegations and positions with regard to relevant international work.
   iii. Prepare draft national reports for international forums, including data on the status of endangered genetic resources in Norway.
   iv. Report on the work in Nordic, European and global forums and processes and make this information available to relevant national organizations and networks.
   v. Participate in relevant scientific and technical cooperation on genetic resources between the Nordic countries through the Nordic Council of Ministers.

7 Conclusions and follow-up

The action plan will be followed up through the action steps assigned to the respective public-sector stakeholders, i.e., the Ministry of Agriculture and Food, the Norwegian Agriculture Agency and the Norwegian Genetic Resource Centre at NIBIO. The measures are to be implemented within the current budget framework and in accordance with other national guidelines.

The implementation of the action plan also depends on the many different private and public-sector stakeholders and institutions that are engaged in the work and have contributed actively for a number of years. The action plan has a time frame of 5 years, from 2023 -2028. Some measures have already been initiated, while others will be implemented in due time. Certain other measures involve a continuation of existing practice. Many of the measures require increased funding.

In addition to the implementation of a number of individual action steps, the action plan and its appendices provide both a framework and guidelines for the ongoing work. The clarification of roles and division of responsibilities will also promote cooperation between all stakeholders.

The Norwegian Genetic Resource Centre at NIBIO will prepare a timetable for the implementation of the action plan, with input from the other stakeholders. The timetable is to include a mid-term evaluation and will be presented to a meeting of the three main public-sector stakeholders.

Photo 16. Old Norwegian is a short-tailed sheep breed that closely resembles the first sheep types found in Norway almost 5,000 years ago. The sheep should be small-framed, light-footed and have a short tail (spæl). The animals can show considerable variation in both colors and patterns. The two-layered fleece consists of a dense, fine undercoat covered by coarse outer wool. Photo: Nina Svartedal.

8 Appendices

Appendix A Descriptions of stakeholders, responsibilities, procedures and principles in the national conservation program.

a Crops

Boxout 1) Conservation areas for crop wild relatives (in situ) - Routines and principles for establishment and operation:

i. The Norwegian Genetic Resource Centre initiates the establishment of conservation areas within existing protected areas. The conservation areas are established in consultation with the Norwegian Environment Agency, the Norwegian Agriculture Agency and the County Governors.
ii. At least one conservation area or population should be established per climate zone within the species' geographical range, possibly for special genetic variation within the species.
iii. Conservation areas are to be located in areas:
    a. with long-term protection status and covered by the protection objective.
    b. that meet minimum requirements in terms of number of plants, size of the area, potential for regeneration and competition from other species.
    c. where the necessary maintenance needs are in line with the protection objective and could be laid down in regulations or management plans.
iv. Monitoring of the conservation areas is followed up by the Norwegian Genetic Resource Centre in cooperation with the administrative authority of the protected area and in line with the protection regulations.
v. The administrative authority of the protected area regulates the scope of extraction, i.e., allows the harvest of seeds or other genetic material in accordance with the protection regulations, e.g., for back-up storage and/or research, education and further development of the material.

Boxout 2) On-farm management of crops[11] – Routines and principles for establishment and operation:

i. On-farm management and conservation is operated according to principles approved by the Norwegian Genetic Resource Centre.
ii. Crop cultivation is contractually stipulated in a conservation agreement with the Norwegian Genetic Resource Centre. The agreement specifies, among other things, which crop and cultivation data need to be registered.
iii. The grower is to be involved in a technical network.
iv. Cultivation data is made available and included in the annual reports.
v. The grower preserves reproductive material and contributes seeds/plants to their own and any other growers' continued cultivation of the material.
vi. The grower contributes to making the material and knowledge about its production traits, etc. available to other growers, as well as for conservation, breeding and research purposes.

[11] In Norway, the concept of on-farm cultivation is currently being developed and the principles will be continuously revised.

Boxout 3) National clone– Tasks and obligations:

i. Ensure long-term protection of plant material that are considered a national genetic resource at risk, within the respective crop groups.
ii. Identify gaps in the collection and consider the addition of new crops at risk.
iii. Identify, characterize and document the material.
iv. Contribute to updating information about the collection's material in the GeNBIS database.
v. Provide adequate accession maintenance and ensure good plant health.
vi. Renew the material when necessary and ensure its genetic stability.
vii. Make agreements with clone archives on back-up storage of the material.
viii. Ensure access to healthy plant material for scientific, breeding and educational purposes, for use by hobby and commercial growers, for demonstration collections, and for back-ups in clone archives and storage facilities.
ix. Ensure that access to vegetatively propagated material is provided in line with the Norwegian Food Safety Authority's requirements and the Plant Treaty's Standard Material Transfer Agreement (SMTA).
x. Submit annual reports to the Norwegian Genetic Resource Centre (by agreement).
xi. Coordinate the technical networks within the respective crop groups.
xii. Respond to inquiries from scientists, the general public, etc. related to the crop group(s) held by the clone bank.

Boxout 4) Clone archives– Tasks and obligations:

i. Ensure long-term backup storage of accessions in the national clone bank.
ii. Receive healthy planting material from the respective clone bank.
iii. Submit annual reports to the clone bank on the status of the back-up collection.
iv. Are obliged to provide material to the clone bank as needed.
v. Provide access to the material in accordance with regulations and on terms agreed with the Norwegian Genetic Resource Centre.
vi. Participate in technical networks within the respective crop groups.
vii. Ensure that the clone archives can be used as demonstration collections.

Boxout 5) Demonstration collections (thematic collections in clone archives, vicarage gardens, museum collections, arboretums, botanical gardens, etc.)- Tasks and obligations:

i. Create interest among the public and perhaps hobby and small-scale growers for the plants in the collection.
ii. Maintain the material / possibly replace it with healthy material from the national clone bank.
iii. Make sure to label the plants appropriately, including information about biological, cultural-historical (and perhaps nutritional) and other characteristics.
iv. Can participate in and contribute to the technical crop group networks.
v. Report to the clone banks as needed.
vi. Contribute to the sharing of information and knowledge.

Boxout 6) Technical crop group networks – Tasks and obligations:

i. Coordinated by the clone bank responsible for the respective crop.
ii. Provide technical advice to clone archives and demonstration collections.
iii. Provide advice about the plants in their respective crop group, including identifying gaps, crops at risk, etc.
iv. Can provide advice about the management of genetic resources.
v. Should be comprised of competent representatives from clone banks, clone archives, demonstration collections, community gene banks, the Norwegian Genetic Resource Centre and other stakeholders.

Boxout 7) Community gene banks– Tasks and obligations:

i. Provide healthy and good-quality reproductive material (according to the Norwegian Food Safety Authority's requirements) of plant genetic material at risk.
ii. Inform and provide sound documentation about plant traits.
iii. Use source material from the Nordic Gene Bank, clone banks and/or clone archives.
iv. Gather and share information and documentation with relevant institutions, such as the Nordic Genetic Resource Centre (NordGen) and via participation in the professional crop groups.
v. Can participate in technical crop group networks.
vi. Are permitted to use the PLANTEARVEN trademark for marketing material by agreement with the Norwegian Genetic Resource Centre.
vii. Ensure propagation and distribution of plant material.

Boxout 8) National backup storage facilities for vegetatively propagated crops – Tasks and obligations:

i. Safeguard endangered genetic resources provided by the clone bank.
ii. Preserve duplicates of the material using in vitro and cryopreservation techniques.
iii. Should be established at a secure and suitable location at sufficient distance from national clone banks.
iv. Secure both genetic material as well as associated information.
v. Have access to the resources and expertise needed to maintain the collection.
vi. Have good expertise and routines for the management of the storage facilities, including regular liquid nitrogen refills and adequate storage of information about the preserved material.
vii. Replace material in the clone bank if necessary.
viii. Participate in technical crop group networks.
ix. Enable public access to the material in accordance with national regulations.

b Forest trees

Boxout 9) Forest conservation stands - Routines and principles for establishment and operation:

i. The Norwegian Genetic Resource Centre initiates the establishment of forest conservation stands.
ii. Are contractually stipulated in the cooperation agreement between the Norwegian Genetic Resource Centre and the Norwegian Forest Seed Centre and conservation agreements between the Norwegian Genetic Resource Centre, the Norwegian Forest Seed Centre and the forest owner.
iii. Based on documented information about seed source and mapped stands.
iv. Are large enough to ensure natural regeneration.
v. Entails the landowner's obligation to provide information and the responsible manager's right to collect seeds.

Boxout 10) Conservation areas for wild populations of forest trees at risk (in situ) – Routines and principles for establishment and operation:

i. The Norwegian Genetic Resource Centre initiates the establishment of conservation areas within existing protected areas. The conservation areas are established in consultation with the Norwegian Environment Agency, the Norwegian Agriculture Agency and the County Governors.
ii. At least one population/conservation area should be established per climate zone within the species' geographical range, as well as for special genetic variation.
iii. Conservation areas are to be located in areas:
    a. with long-term protection status and covered by the protection objective.
    b. that meet minimum requirements for the number of trees/plants, size of the area, potential for regeneration and competition from other tree species.[12]
iv. The need for silvicultural measures is laid down in regulations or management plans.
v. Monitoring of the conservation areas is followed up by the Norwegian Genetic Resource Centre.
vi. The administrative authority of the protected area regulates the scope of extraction, i.e., allows the harvest of seeds or other genetic material in accordance with the protection regulations, e.g., for back-up storage and/or research, education and further development of the material.

[12] Pan-European minimum requirements for dynamic conservation units of forest tree genetic diversity: https://www.sciencedirect.com/science/article/pii/S0006320712003436

c Livestock

Boxout 11) Barns, stables and other conservation herds of livestock breeds at risk - Tasks and obligations:

i. Carry out sustainable breeding in small populations in consultation with the Norwegian Genetic Resource Centre.
ii. Implement pure-breeding.
iii. Accept advice and technical input from breed societies, breeding organizations and centers of expertise.
iv. Contribute available data to reporting and monitoring activities, e.g., by registering breeding animals of breeds at risk in appropriate kinship databases.
v. Participate in a technical network and/or are members of a breed society/breeding organization/centre of expertise.
vi. Provide breeding/reproductive material to other livestock owners and for *ex-situ* conservation.
vii. Provide breeding material and share knowledge about production traits, etc. with other livestock keepers, breeders and researchers.

Boxout 12) Sperm and gene banks for livestock breeds at risk - Tasks and obligations:

i. Ensure long-term storage of breeding material of national value.
ii. Ensure continual buildup of the gene bank so that breeding material from new breeding animals becomes available for use in production herds.
iii. Satisfy the demand for purebred and healthy breeding material, such as frozen semen from cattle, sheep and goat breeds at risk, and disease-free hatching eggs and live animals from the gene bank for laying hens.
iv. Have access to resources and expertise to maintain the collection.
v. Contribute documentation and material to research and breeding.
vi. Provide relevant material for safeguarding in national backup storage facilities (with or without compensation).

Boxout 13) Overview of ex-situ gene banks for animal genetic resources at risk - Ownership and operational status:

Sperm banks for cattle, sheep and goats: The breeding organizations Geno and the Norwegian Association of Sheep and Goat Farmers (NSG) own and operate the gene banks containing frozen semen of cattle, sheep and goats in Norway, respectively. (See Appendix A, Boxout 16 for a description of the breeding organizations' obligations.)

Gene bank for laying hens: The gene bank for laying hens at the Hvam school of agriculture in Nes preserves live animals of laying hen breeds at risk (*in vivo*). The gene bank is annually renewed according to a fixed breeding plan based on the gene bank's own breeding material.

Sperm bank for chickens: A technique has been developed for cryopreservation of rooster semen, and two attempts were made to freeze semen from roosters at the gene bank at Hvam. However, these attempts were not successful as the fertilization rate after thawing was nearly zero. Sperm from the last trial is stored at the Norwegian Genetic Resource Centre/NIBIO.

Sperm bank for dogs: The Norwegian Kennel Club is responsible for the sperm bank for the national dog breeds. The sperm bank is responsible for long-term storage of semen from the national dog breeds at risk. Semen must be stored for at least ten years before it is used. Deposits to the sperm bank from new dogs and the use of semen from long-term storage requires approval by the Norwegian Genetic Resource Centre.

Sperm bank for horses: The Norwegian Equine Centre is responsible for the conservation of the national horse breeds. A plan has been drawn up for the cryopreservation of genetic material from the national horse breeds. However, there is currently no gene bank for frozen semen of the national horse breeds.

Sperm bank for the European dark bee: The Norwegian Beekeepers' Association is in the process of establishing a cryo sperm bank for the European dark bee.

Boxout 14) Breeding organizations for cattle breeds at risk - Tasks and obligations:

i. Approved by the Norwegian Food Safety Authority as the responsible breeding organizations for their respective breeds.
ii. Have technical cooperation agreements with the Norwegian Genetic Resource Centre.
iii. Responsible for selecting and purchasing AI bulls.
iv. Give farmers advice on the breeding and keeping of the respective breed.
v. Act as livestock brokers.
vi. Raise awareness of the breed, and thereby increase its numbers.
vii. Provide guidance on sustainable breeding in small populations, pass on advice from the Norwegian Genetic Resource Centre as needed.

Boxout 15) Breed societies for livestock breeds at risk – Tasks and obligations:

i. Have technical cooperation agreements with the Norwegian Genetic Resource Centre.
ii. Recommend AI sires to the responsible breeding organization.
iii. Give farmers advice on husbandry practices for the respective breed.
iv. Act as livestock brokers.
v. Raise awareness of the breed, and thereby increase its numbers.
vi. Provide guidance on sustainable breeding in small populations, pass on advice from the Norwegian Genetic Resource Centre as needed.
vii. Have a technical cooperation agreement with the responsible breeding organization (applies to sheep and goats). Give advice to their respective breeding organization.
viii. Approve and register animals with a locked breed code, applies to the sheep and meat goat performance recording systems.

Boxout 16) Breeding organizations approved by the Norwegian Food Safety Authority to be responsible for the production and distribution of frozen semen - Tasks and obligations with regard to the livestock breeds at risk:

i. Are responsible for also including livestock breeds at risk when selecting AI sires.
ii. The selection of AI sires from livestock breeds at risk that do not have their own breeding organization is done in close cooperation with the breed society that has a technical cooperation agreement with the Norwegian Genetic Resource Centre.
iii. Are responsible for supplying semen of livestock breeds at risk on the same terms as for other national livestock breeds.

d National backup storage facilities

Boxout 17) National backup storage facilities for genetic material from livestock and clonal plants – Tasks and obligations:

i. Store healthy material provided by the sperm bank/clone bank.
ii. Safeguard duplicates of the genetic material using in vitro/cryopreservation methods.
iii. Secure genetic material and corresponding essential information.
iv. Enable public access to the material in accordance with national regulations.
v. Have good expertise and routines for the follow-up of the storage facilities.
vi. Ensure adequate storage of information about the preserved material.
vii. Ensure good security procedures and certified storage conditions.

Boxout 18) Svalbard Global Seed Vault for crop and forest seeds – Tasks and obligations:

i. Secure the preservation of good quality seeds.
ii. Safeguard duplicates of seeds on behalf of gene banks.
iii. Owns seeds and a publicly accessible database that identifies the material.
iv. Enable public access to the material in accordance with national regulations.
v. Have good expertise and routines for seed deposits and storage.
vi. Ensure good security procedures and certified storage conditions.

Appendix B List of databases with information about endangered genetic resources

a Crops

- The Norwegian Genetic Resource Centre's "Plant Register" provides an overview of the accessions in the various clone archives based on their annual reports. The register can be accessed at the genetic resource centre's website.[13]
- Nordic Baltic Genebanks Information System (GeNBIS), operated by NordGen[14].
- Fruit variety database: www.fruktsorter.no
- World Information and Early Warning System on Plant Genetic Resources for Food and Agriculture (WIEWS), FAO
- European Search Catalogue for Plant Genetic Resources (EURISCO) Genesys PGR
- Naturbase (database of protection areas, habitats and recreational use) and Artskart (Species Map)
- Global Biodiversity Information Facility (GBIF)

b Forest trees

- European Information System on Forest Genetic Resources (Eufgis)
- Atlas for the conservation of Forest Genetic Resources (MAPFORGEN)
- Kilden: Map with information about tree species in protected areas, owned and operated by NIBIO.
- The Norwegian Forest Seed Centre's databases
- Naturbase (database of protection areas, habitats and recreational use) and Artskart (Species Map)

c Livestock

- Kuregisteret («Cow Register») is the kinship database for cattle breeds at risk, which is owned and operated by the Norwegian Genetic Resource Centre.
- Hønseregisteret («Hen Register» with kinship data of chicken breeds/breeding lines kept at the gene bank for laying hens), owned and operated by the Norwegian Genetic Resource Centre.
- Dairy cow performance recording system, owned and operated by TINE.
- Beef cattle performance recording system, owned and operated by Animalia
- Sheep performance recording system, owned and operated by Animalia
- Meat goat performance recording system, owned and operated by Animalia
- Livestock register, owned and operated by the Norwegian Food Safety Authority
- The Norwegian Trotting Association's and the Norwegian Equine Centre's kinship databases
- DogWeb – The Norwegian Kennel Club's kinship database
- DAD-IS, the FAO's Domestic Animal Diversity Information System, a database of the world's livestock breeds
- Price and production subsidy database of the Norwegian Agriculture Agency
- Statistics Norway (SSB).

[13] https://www.nibio.no/tema/mat/plantegenetiske-ressurser/bevaring-av-plantemateriale/bevaring-i-klonarkiv-feltgenbank/planteregister?locationfilter=true

[14] https://www.nordic-baltic-genebanks.org/gringlobal/search

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Coverphotos: Apple variety Prins (photo: Finn Måge), Døla Cattle (photo: Anna Holene) and linden trees (photo: Lars Sandved Dalen) are examples of genetic resources for food and agriculture that are preserved in Norway.

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