Federal Ministry
of Food
and Agriculture

Strengthening Biodiversity

National Strategy on Genetic Resources for Food, Agriculture, Forestry and Fisheries

bmel.de

CONTENT

Summary

The climate crisis, species extinction, increasing pollution and excessive consumption of resources are endangering our natural resources and therefore also our food security. We must find solutions to these crises and at the same time realize the right to food worldwide. These tasks are among the most pressing of our time. The many different crops, livestock, woody plants in forests and fish and other species in water bodies are genetic resources that are part of biological diversity. They are the basic building blocks for supplying a growing world population with food and renewable raw materials.

This diversity is indispensable for the necessary adaptations to climate change, the stability of agriculture and food systems, and the promotion of regional identity and provides an opportunity to create sustainable, regional value chains. It is also the basis for breeding, innovations in agricultural production, climate-adapted forest conversion and the sustainable management of our water bodies.

“Strengthening Biodiversity. National Strategy on Genetic Resources for Food, Agriculture, Forestry and Fisheries” – with this strategy, the Federal Ministry of Food and Agriculture (BMEL) outlines ways and measures to contribute to resilient, sustainable and circular production of food and raw materials with a broad diversity of genetic resources. The strategy shows that we need a sufficiently large gene pool of genetic resources: A “Pool of Options” of traits that may be essential in the future in order to adapt to various crises.

Implementation includes, among other things:

- Conserving the diversity of genetic resources in their living environment, i.e. in the forest, in water bodies, through diversity of landscapes, on the field, on the farm; and where this is not possible, to financially support conservation bodies such as gene banks or conservation initiatives, to strengthen these bodies and, if necessary, to research methodologies to include additional species in these bodies.
- Increasing knowledge of special traits and strengthening breeding research
- Promoting research into sustainable and diversified production systems, including practical trials in production systems
- Expanding the monitoring of diversity at the genetic level
- Promoting synergies and cooperation at international, European and national level and to ensure the necessary transfer of knowledge

The strategy was developed in close cooperation with expert committees and relevant associations in order to pick up on political developments and framework initiatives initiated during recent decades and to integrate and supplement relevant national action paths in the area of genetic resources, as well as to link and coordinate national and international activities in a targeted manner. It is aimed in particular at decision makers at the federal and state level, who can contribute to the long-term protection and sustainable use of genetic resources and will promote cooperation in this area by setting political frameworks, approving funding and allocating resources and budgets. The strategy also aims to address private stakeholders, consumers and farmers. Their contribution through their knowledge, activities, purchasing decisions and farm management is crucial to the long-term conservation and sustainable use of genetic resources.

1

Introduction

1.1 Why this strategy?

Biodiversity is the foundation of our living earth. How we treat it has profound effects on the lives of future generations.

The climate crisis will exacerbate extreme weather events and sea levels will inevitably rise. The number of people experiencing hunger and starvation around the world will increase dramatically. At the same time, the extinction of species is continuing almost unabated and is also being exacerbated by climate change. The climate and species crisis and food security are therefore key challenges of our time. Germany is working intensively to overcome these challenges proactively by implementing suitable measures involving all the essential stakeholders.

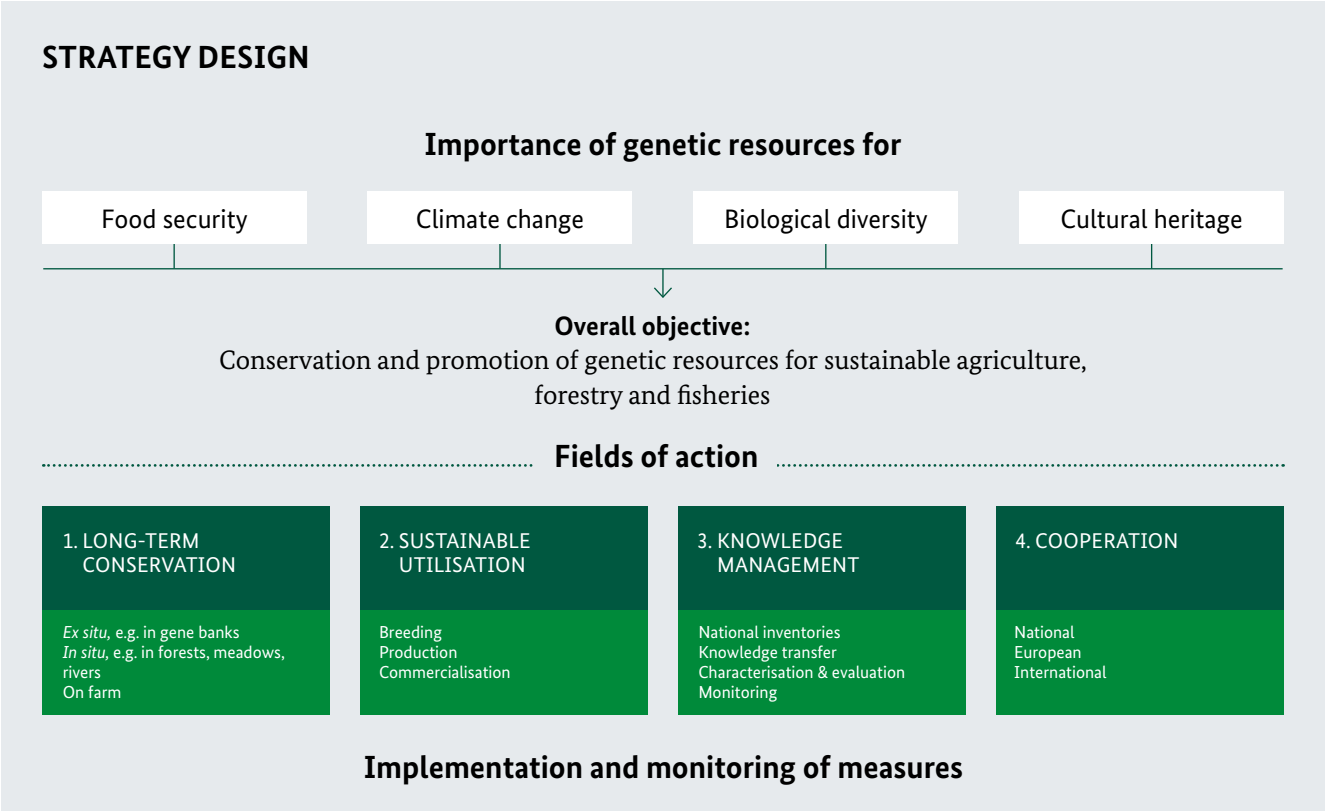
Current production and consumption patterns in agriculture and food are not always sustainable (see: *Final Report of the Commission on the Future of Agriculture, BMEL 2023a*). The condition of forests in Germany is alarming and thus forest conversion is an urgent priority (*Forest Condition Survey, BMEL 2023b*). Water bodies as habitats are also coming under increasing pressure, e.g. due to the impact of the climate crisis and the introduction of invasive species.

The common goal underlying all efforts is therefore the promotion of resilient, sustainable and circular practices in agriculture, forestry, fisheries and food industry that secure the supply of food for people in the long term. This means that production systems must on the one hand be adapted to the climate crisis and must on the other hand also contribute to mitigating climate change and protecting biodiversity (BMEL 2021b and 2022b). This requires a change that relies on the support of all stakeholders involved.

Genetic resources for agriculture, forestry, fisheries and food, i.e. plants, animals and other organisms that are important for providing the basis of human life, are key to bringing about this change towards sustainable development. This is because they are the indispensable foundation for adapting food and raw material production to climate change and changing environmental conditions and demand.

In order to successfully restructure agriculture and food systems – in Germany as well as globally – the national and global diversity of genetic resources will be indispensable. In order to be able to implement the necessary adaptations for greater sustainability, all stakeholders need appropriate options for action. This strategy shows what needs to be done to preserve the diversity of genetic resources for agriculture, forestry, fisheries and food production and to make them available for sustainable use.

Establishment of flowering strips is an agri-environmental measure that promotes biodiversity in agriculture.



1.2 Which aspect of biological diversity does this strategy focus on?

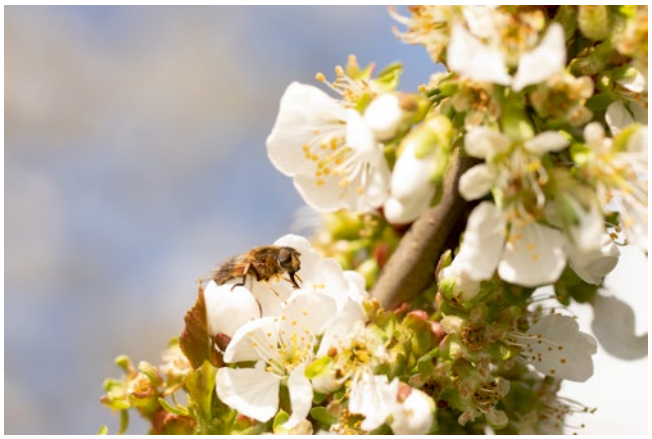
The earth's biological diversity, also known as biodiversity, comprises the diversity of ecosystems, the diversity of species and the genetic diversity within species. Biological diversity is valuable in itself and must be protected (see also Chapter 2).

The Federal Ministry of Food and Agriculture is responsible for the aspects of biological diversity that are important or potentially important for agriculture, forestry, fisheries and the food industry. These aspects of biological diversity are also referred to as **biological diversity for food and agriculture** or **agro-biodiversity.**

According to the Food and Agriculture Organization of the United Nations (FAO), this diversity includes not only domesticated crops and livestock, trees and shrubs planted in forests, and fish that are important to fisheries, but also the diversity of living organisms that contribute in different ways to land cultivation and food production.

These include microorganisms that are relevant to food processing, plant and animal health, soil organisms and pollinators (FAO 2019). The FAO distinguishes between three categories, although these can overlap to a large extent:

- **Genetic resources for food and agriculture** (the term "For Food and Agriculture" is a simplification of the FAO, it includes forestry as a form of land management as well as capture fishing and aquaculture)
- **Food from the wild** (wild food), i.e. food that comes from non-domesticated species (e.g. venison or mushrooms collected in the wild)
- **Associated biodiversity,** i.e. components of biological diversity that occur within the production systems (forest, arable land, pasture land, ponds and rivers) and can contribute in various ways to ecosystem function or production.



Pollination is an important ecosystem service which – as here in orcharding – is crucial for good yields and the good quality of harvested products.

This strategy focuses on genetic resources for food and agriculture, meaning:

- Plant genetic resources (PGR), i.e. crops and their wild relatives
- Animal genetic resources (AGR), i.e. domesticated native livestock breeds
- Forest genetic resources (FGR), i.e. tree and shrub species for forestry
- Aquatic genetic resources (AqGR), i.e. fish and other animals and plants important in capture fisheries and aquaculture
- Microbial and invertebrate genetic resources (MGR), i.e. microorganisms used in food production, soil organisms and pollinators

Murnau-Werdenfelser cattle are an endangered species on the red list of native livestock breeds. They are suitable for keeping suckler cows and are also used in landscape management.

Because of their importance as food, the strategy also addresses the topic of huntable and other utilisable wild animals.

Pollinators and soil organisms belong to the group of "genetic resources of microorganisms and invertebrates", but are also important as "associated biodiversity" due to their ecosystem function in production systems.

The terms and concepts of biodiversity and genetic resources used in this strategy paper essentially follow those of the FAO's Commission on Genetic Resources (CGRFA) and are based on the definitions of the *Convention on Biological Diversity (CBD)*.

These and other terms used in this strategy paper can be found in the glossary and list of abbreviations (see Annex).

In the following, the term "genetic resources" is often used to make the text easier to read. In the context of this strategy, this always refers to the genetic resources mentioned in the list above. The strategy is abbreviated to "Genetic Resources Strategy" ("GR Strategy").

1.3 What is the political framework?

Biodiversity as a whole is under threat and with it the genetic resources that are so important to human life. To counteract this threat, Germany has committed to numerous international goals. These include:

- The United Nations Sustainable Development Goals (SDGs)
- The goals of the Convention on Biological Diversity (CBD) with the Kunming-Montreal Global Biodiversity Framework adopted at the end of 2022
- The goals of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA)
- The goals and recommendations of the FAO Commission on Genetic Resources (CGRFA); in particular, the Global Action Plans for Plant Genetic Resources (2011), for Animal Genetic Resources (2007), for Forest Genetic Resources (2014) and for Aquatic Genetic Resources (2021)
- The objectives of the EU Green Deal, including the EU Biodiversity Strategy for 2030, the Farm-to-Fork Strategy and the associated legally binding directives and regulations

- The objectives of the *Ministerial Conference on the Protection of Forests in Europe* (MCPFE), now *Forest Europe)*

A pivotal instrument for implementing the path taken by Germany to transition to sustainable and resilient agriculture and food systems and create attractive rural areas is the *National Strategic Plan for the Implementation of the EU Common Agricultural Policy* (CAP Strategic Plan). For the conservation and sustainable use of biodiversity, the *Strategic Plan* contains the Specific Objective 6 "Contribute to halting and reversing biodiversity loss, enhance ecosystem services and preserve habitats and landscapes". The *National Biodiversity Strategy* is central to the conservation of biodiversity as a whole in Germany (BMU 2007; currently under revision, see BfN 2023). This strategy supplements both the CAP Strategic Plan and the National Biodiversity Strategy with measures specifically for genetic resources.

In addition, numerous European directives and regulations, national and federal-state implementing laws and other legal acts are relevant to the conservation and sustainable use of genetic resources.

This strategy builds on the political developments and framework initiatives of the last 15 years. It embodies the framework for the national technical programmes, in which the specific measures for the protection and sustainable use of genetic resources in the individual areas are described in detail. The following national technical programmes are currently in force:

- National program for plant genetic resources for food and agriculture (BMEL 2024, *Resolution of the Ministerial Conference of Ministers of Agriculture* (AMC Resolution) of 09/2023)
- National programme for the conservation and sustainable use of animal genetic resources in Germany (BMEL 2024; AMC Resolution of 02/2021)
- National programme for the conservation and sustainable use of forest genetic resources in Germany (BMEL 2010)
- National programme for the conservation and sustainable use of aquatic genetic resources (BMEL 2022a ; *AMC Resolution* of 02/2021)

The GR Strategy is intended to contribute to other existing national strategies and/or complement them with regard to genetic resources:

Strategy	Synergies with the "Genetic Resources" Strategy
2023–2027 CAP Strategic Plan	The national CAP Strategic Plan forms the basis for the implementation of EU agricultural policy in Germany from 2023 onwards. With regard to biodiversity, the CAP Strategic Plan contains the CAP's Specific Objective 6 "Contribute to halting and reversing biodiversity loss, enhance ecosystem services and preserve habitats and landscapes". Synergies exist in particular with the National Requirement "F.4 Conservation, restoration and sustainable use of biodiversity in agriculture and forestry and their ecosystem services", which defines this specific objective to the effect that genetic diversity and genetic resources in agriculture, forestry and horticulture should be promoted and rare and region-specific cultivated plants, wild plants and livestock breeds should be actively used.
National Strategy on Biodiversity 2030 (NBS 2030, BMUV 2024)	The NBS encompasses the entire spectrum of biodiversity and thus synergies exist in particular in the context of the conservation of associated biodiversity and wild plants, animals, fungi, etc., that can be used as food. The measures addressed in the GR Strategy complement the NBS, particularly in the areas of conservation and sustainable utilisation of the genetic diversity of genetic resources that are important for agriculture, forestry and fishing.
2035 Arable Farming Strategy (BMEL 2021a)	The synergy effects of the Arable Farming Strategy lie in particular in the diversification of cultivation systems and the provision of the necessary plant genetic resources, the strengthening of breeding research, the development of suitable cultivation methods for crops that have not yet been used in production, the development of markets to ensure stable demand for these crops and the promotion of biodiversity, including soil biodiversity.

Protein Crop Strategy (BMEL 2012)	The GR strategy helps to ensure that a wide range of plant genetic resources are available for the breeding research required as part of the Protein Plant Strategy, the breeding improvement of protein crops and the development of previously under-utilised species. Conversely, regional value chains and sales markets for protein crops with stable demand can also play a part in promoting endangered indigenous genetic resources and thus in preserving them.
2050 Climate Action Plan, Climate Action Plan and Climate Action Plan for Food and Agriculture (BMEL 2020)	Synergies arise *inter alia* in the diversification and adaptation of production systems to climate change, such as by strengthening breeding research to improve the stress tolerance and resource efficiency of crop plants and livestock; research into the adaptability and suitability of forest ecosystems, tree species and origins with a particular focus on forest genetics, the expansion and further development of silvicultural recommendations using digital site data (climate change projections); and knowledge transfer and the networking of pilot farms. There are also synergies regarding the conservation and sustainable utilisation of genetic resources in the planned measures for the management and utilisation concept for Germany's landscape water balance.
National Bio-economy Strategy of the Federal Government (BMBF and BMEL 2020)	Synergies can be utilised, for example, in the expansion and application of biological knowledge and in research into the "potential of the bio-economy within ecological limits". The provision of genetic resources and associated characterisation and evaluation data may be relevant here; conversely, research results in the field of bio-economy can lead to the sustainable use of a greater diversity of genetic resources. Synergies can also arise in the area of research funding and in the strengthening of research collaborations.
Forest Strategy 2050 (BMEL 2021b, currently developing a new forest strategy for the Federal Government)	Synergy effects arise in the conservation and sustainable utilisation of native tree and shrub species, the provision of forest reproductive material for forest conversion and the diverse ecosystem services provided by the forest. Strengthening regional value and supply chains for wood as a resource could also help to promote rare native tree species through valorisation.
Future strategy for organic farming, currently in further development, see Organic Strategy 2030 (BMEL 2023c)	The strengthening of breeding research and the inclusion of a broad diversity of genetic resources supports the improvement of the efficiency of organic agricultural systems. This also enables the use of endangered native livestock breeds or crop varieties in organic production, which has a positive effect on the conservation of these resources.
National Strategic Plan for Aquaculture in Germany 2021–2030 (AG NASTAQ 2020)	Synergy effects can arise, for example, in increasing the sustainable production of fish and other aquaculture organisms through the development of new breeding programs for economically important aquaculture species and for research projects on established breeding lines. In the breeding adaptation of aquaculture-relevant species to climate change, the promotion of breeding work in propagation farms can help maintain regionally adapted stocks.

2

Importance of genetic resources for securing livelihoods

Genetic resources are the basis for sustainable food production, food security and the supply of renewable raw materials worldwide. They can be the basis for climate change mitigation and for adapting production to climate change. At the same time, they are themselves threatened by the climate crisis to varying degrees. As an important part of biodiversity and our cultural heritage, they have a high conservation value. The interactions and interdependencies between the individual components of biodiversity are complex and can cause conflicts of interest. For example, there is interaction at many levels in ensuring global food security with healthy and diverse foods, renewable raw materials, climate change mitigation and adaptation and the conservation of biodiversity.

Environmental changes such as climate change can have dramatic effects on the habitat and living conditions of plants, animals and humans. Where moisture-loving plants or fungi still thrive today, only those that can survive longer periods of drought may survive tomorrow. Animals and other creatures will also disappear if they no longer find food or suitable habitats. On the other hand, new organisms may colonise vacated biological niches. This harbors opportunities for new crops and livestock, but also risks – for example if this involves the introduction pathogens and if pests are involved.

Production systems must be able to adapt to changing conditions. These include environmental changes and changing demand for food or other supplies. Changing production conditions in turn have an impact on the conservation, use and diversity of genetic resources.

The following chapters describe the importance of genetic resources for food security and their role in the context of climate change, as part of both biological diversity and our cultural heritage.

IMPORTANCE OF GENETIC RESOURCES

2.1 Genetic resources and food security

Genetic resources are of essential importance to sustainable food security worldwide. For this reason, they are considered to play a central role in the implementation of the United Nations Sustainable Development Goal *"A world without hunger"*. These resources are indispensable for responding to challenges such as changing environmental conditions, malnutrition and consumer behavior (Rawal et al. 2019).

The right variety is important: Farmers all over the world need suitable crop varieties that produce good harvests.

Genetic diversity is necessary as a basis for breeding new varieties and breeds when it comes to improvements in tolerance and resistance traits, the quality and quantity of products and resource efficiency. This can increase productivity and make agricultural production systems more stable and resilient.

Concentrating on just a few crops in arable farming makes food systems vulnerable to risks (FAO 2021, Chapter 2). A diversified range of crops, both globally and regionally, is therefore an indispensable component of sustainable food systems. In Germany, for example, five crops alone dominate around 75 percent of the total agricultural area (Federal Statistical Office 2022).

In order to diversify cultivation systems that support the protection of biodiversity, it will be increasingly important and necessary to have a wide range of plant species and varieties available in the future. Only then can arable farming meet the requirements of resource-efficient production under changing environmental conditions and continue to provide the basis for the production of high-quality food. Specifically, for example, varieties are needed that continue to deliver good yields with reduced use of fertilisers or pesticides.

The comeback of legumes: They expand crop rotation and are valuable foods, especially when it comes to a more plant-based diet.

Resource- and land-efficient food systems require the development of functioning circular economy approaches. For example, the production of plant-based food can be combined with animal-based food on the same area of land by using byproducts (e.g. rapeseed cake in the production of rapeseed oil) as animal feed.

Diverse genetic resources also make an important contribution to the quality of food. Diversity can be utilised to combat malnutrition or better counteract food intolerances. Breeding can provide new solutions, such as by increasing the nutrient content (micro and macronutrients), eliminating undesirable substances such as solanine in potatoes, adapting for greater robustness or better health of food crops or by improving the shelf life of food (FAO 2020; FAO, IFAD, UNICEF, WFP & WHO 2021).

The same applies to changing consumer behaviour, which cannot be reliably predicted. International expert groups and the German Nutrition Society recommend a more plant-based diet overall (Breidenassel et al. 2022). In Germany, there is a recognisable trend towards a more plant-based diet. A variety of genetic resources can support such a trend with a diverse range of products.

2.2 Genetic resources and climate change

For thousands of years, agriculture, forestry and fishing have been adapting to changing environmental conditions. However, environmental changes, such as climatic changes, are occurring much faster today. This is a major challenge for ecosystems and global production methods (FAO 2022).

Current climate scenarios predict different regional changes for Germany: rising average temperatures, more frequent and more intense heat waves, changing precipitation patterns and higher CO2 concentrations in the air. Extreme weather events are already having a negative impact on agricultural, forestry and fisheries production in Germany and Europe (DWD 2022, IPCC 2022).

The Intergovernmental Panel on Climate Change (IPCC 2022) and the Global Assessment Report on Food Security (FAO, IFAD, UNICEF, WFP and WHO 2021) conclude that diversification of production systems can reduce the risks of climate change. The diversity of species, varieties, breeds, lines and strains under cultivation and their variation at the genetic level therefore play a special role in adapting production systems to climate change (FAO 2022).

Diversification in plant production includes a varied crop rotation, in animal husbandry the breeding adaptation of the breeds used and also the keeping of a broader range of livestock breeds and species. A balanced diet with more plant-based foods, supplemented by animal-based foods from sustainable production systems, offers great opportunities to achieve better adaptation of production systems to climate change and climate protection (IPCC 2022).

Adapting agricultural crops and livestock to climate change requires an increase in breeding efforts. This concerns, for example, breeding for resistance to new or increasingly prevalent pests and diseases, for stronger tolerances with regard to heat or drought stress and for improved resource efficiency. Breeding requires a large gene pool to ensure that the desired traits are available at a genetic level. This means that in addition to the genetic resources currently used in production, a large variety of these must be available that can be used for future climate-related adaptations.

The climate crisis and its consequences: Heat waves and low water levels can pose a threat to fish and other aquatic life.

Forests are complex ecosystems. Due to the longevity and long reproduction time of trees, forests generally react slowly to changing conditions. The rapid pace of environmental change in the climate crisis is therefore a major challenge for forests. A broad genetic diversity is essential for the adaptability of forest ecosystems. It forms the basis for adapting to future environmental conditions. The situation is exacerbated by the fact that the main tree species have a comparatively low dispersal potential through seeds. Active management of genetic diversity in forests is therefore necessary and an essential task for forest managers, forest genetic research, forest nurseries and the seed trade. A prerequisite for this is research into the genetic diversity of tree species, including, for example, tree species from regions with similar climate scenarios to those that have been forecast for Germany, such as southeastern Europe. This active management can also affect species-rich forests, if they are not genetically diverse within the different species. This is because forest ecosystems should be both highly adapted to current conditions and adaptable to future environmental conditions.

Both aquaculture and wild aquatic genetic resources are strongly affected by climate change, e.g. through water shortages and higher water temperatures. It is therefore important to investigate the impact of the climate crisis on these genetic resources and respond accordingly, such as through conservation measures for endangered fish species or the development of species adapted to climate change for aquaculture (FAO 2019).

In addition to the genetic resources used, a great variety must also be available to be used for future climate-related adaptations.

Sustainable forest management is a key measure for climate change adaptation of forests, as it promotes resilient, stable, structurally rich and thus climate-adapted mixed forests.

2.3 Genetic resources as an important part of biodiversity

Biodiversity is under threat worldwide (IPBES 2019). Ongoing and global biodiversity loss must be halted. What applies to biodiversity in general also applies to genetic resources for food and agriculture.

The genetic resources used by humans to produce food and renewable raw materials are a subset of total biodiversity, which includes both domesticated and wild species. To a large extent, these resources are subject to the same stress factors as biodiversity as a whole, although how, and how intensively, the resources are used can also be a stress factor for biodiversity. The main stress factors are pest and disease infestation, population growth, watercourse development, excessive land use, overfishing, intensive agriculture, pollution, invasive species and climate change (IPBES 2019, FAO 2019, Brämick and Schiewe 2021, IPCC 2022, FAO 2022). The global trend of biodiversity decline correlates to the loss of genetic diversity. On the one hand, this increases the vulnerability of agricultural, forestry and fish production systems and, on the other, reduces the capacity to adapt to changes in the future.

Through selection and human-conducted breeding activities, an enormous diversity of breeds and varieties has been and continues to be produced worldwide. This diversity forms the basis for the further development and adaptability of agricultural production systems and for achieving progress and innovation on the way to more sustainable and resilient agriculture and food systems. It is therefore important to preserve the broad spectrum of this diversity.

The genetic resources of species and populations that have not been cultivated are also an essential prerequisite for the adaptability of production systems. The woody species that represent the characteristic elements of forest ecosystems in the context of sustainable forest management are largely undomesticated and therefore genetically very diverse at the population level. Forestry uses these wild populations as a basis for production and at the same time must ensure the conservation of these genetic resources. The same applies to fisheries.

The genetic resources of agricultural, forestry or fishery production systems are embedded in surrounding ecosystems in different ways and to varying degrees. The living organisms used are in connection with other living organisms and the productive outcomes desired by humans often benefit from the diverse functions and services of the respective ecosystems.

The genetic resources used in production also influence the surrounding ecosystems through their special characteristics. Typical agricultural landscapes have developed in this way and often require typical regional genetic resources for their preservation. Examples of this are the heath sheep, as typical “caretakers” of the heaths, brown cattle for the permanent grassland in the Alps, orchards with regionally typical and adapted fruit varieties or carp pond farming as a nature-friendly and biodiversity-promoting form of aquaculture. The existence of many wild plants and animals, such as arable wild herbs or animal species that follow crops, is

Carp pond landscape, a production system with positive effects on biodiversity.

linked to utilisation systems that are characterised by specific genetic resources (such as poppies or cornflowers in cereals).

Conversely, there may also be conflicts of interest in the conservation and sustainable use of different components of biodiversity, for which joint solutions are needed in the respective context. Two examples are given here.

PROTECTION OF THE WOLF AND CONSERVATION OF INDIGENOUS ENDANGERED LIVESTOCK BREEDS:

The return of the wolf is a success of species conservation policy and protective measures in the agricultural landscape. As the wolf population increases and spreads, so does the potential for conflict, which makes dealing with this strictly protected species increasingly difficult and controversial. The protection of livestock – and this can also affect animals of native endangered breeds – must therefore be further improved. If too many grazing animals are harmed or if suitable protective measures are no longer economically viable or reasonable, there is a risk that grazing livestock farming will be abandoned in affected areas. The Federal Center for Grazing Animals and Wolves set up by the BMEL deals with this issue.

CONSERVATION OF WILDLIFE POPULATIONS IN FORESTS AND FOREST REGENERATION:

If wild animal populations in forests become too large and prevent forest regeneration or reforestation due to extensive browsing damage, appropriate solutions are required. This issue is addressed, for example, in the BMEL's Forest Strategy.

2.4 Genetic resources as cultural heritage

In Mitteleuropa haben die Menschen durch ihre Nutzungstätigkeiten über Jahrtausende die Landschaften geprägt. Aus Naturlandschaften sind sehr unterschiedliche und auch regional typische Kulturlandschaften entstanden.

Tier- und Pflanzenarten, wie Feldhamster, Feldhase oder Ackerwildkräuter, konnten in Deutschland einen Lebensraum in den Agrarlandschaften finden. Andere, vorher einheimische Arten, wie beispielsweise bestimmte Waldarten, wurden in Folge der landwirtschaftlichen Nutzung zurückgedrängt.

Die naturräumlichen Unterschiede und die daraus resultierenden spezifischen Standorteigenschaften haben im Zusammenspiel mit der kulturellen Vielfalt der Bewohnerinnen und Bewohner und ihrer Lebensweise dazu beigetragen, dass eine Vielfalt an Tierrassen, Pflanzensorten oder Zuchtstämmen bei Fischen entstanden ist. Rinderrassen, die speziell an Mittelgebirgslagen oder Küstenstandorte angepasst sind, Teichlandschaften mit traditioneller Karpfenwirtschaft, Schafe, die Moorstandorte beweiden können, Roggensorten für die sandigen Böden Brandenburgs – zahlreiche Beispiele zeugen vom Zusammenspiel der Region und ihren typischen genetischen Ressourcen. Sie sind ein kulturelles Erbe, das In Central Europe, humans have shaped the landscapes through their activities over thousands of years. Very diverse cultivated landscapes typical of the respective regions have developed from natural landscapes.

Animal and plant species such as hamsters, hares and wild herbs have found habitats in Germany's agricultural landscapes. Other, previously indigenous species, such as certain forest species, have been pushed back as a result of agricultural use.

Landscape conservationists at work: Heidschnucken sheep ensure that the typical heath landscape is preserved.

Traditional varieties are enjoying great popularity again if they are successfully marketed. Pictured here: drinks made of fruit from meadow orchards.

The natural differences and the resulting specific site characteristics, in combination with the cultural diversity of the inhabitants and their way of life, have contributed to the emergence of a variety of animal breeds, plant varieties and breeding lines of fish. Cattle breeds that are specially adapted to low mountain ranges or coastal locations, pond landscapes with traditional carp farming, sheep that can graze on moorland, rye varieties for the sandy soils of Brandenburg – numerous examples bear witness to the interaction of the region and its typical genetic resources. They are a cultural heritage that is worth preserving, just like listed buildings, for example. For society today, the agricultural landscapes with their special features contribute to the recreational value and regional identity.

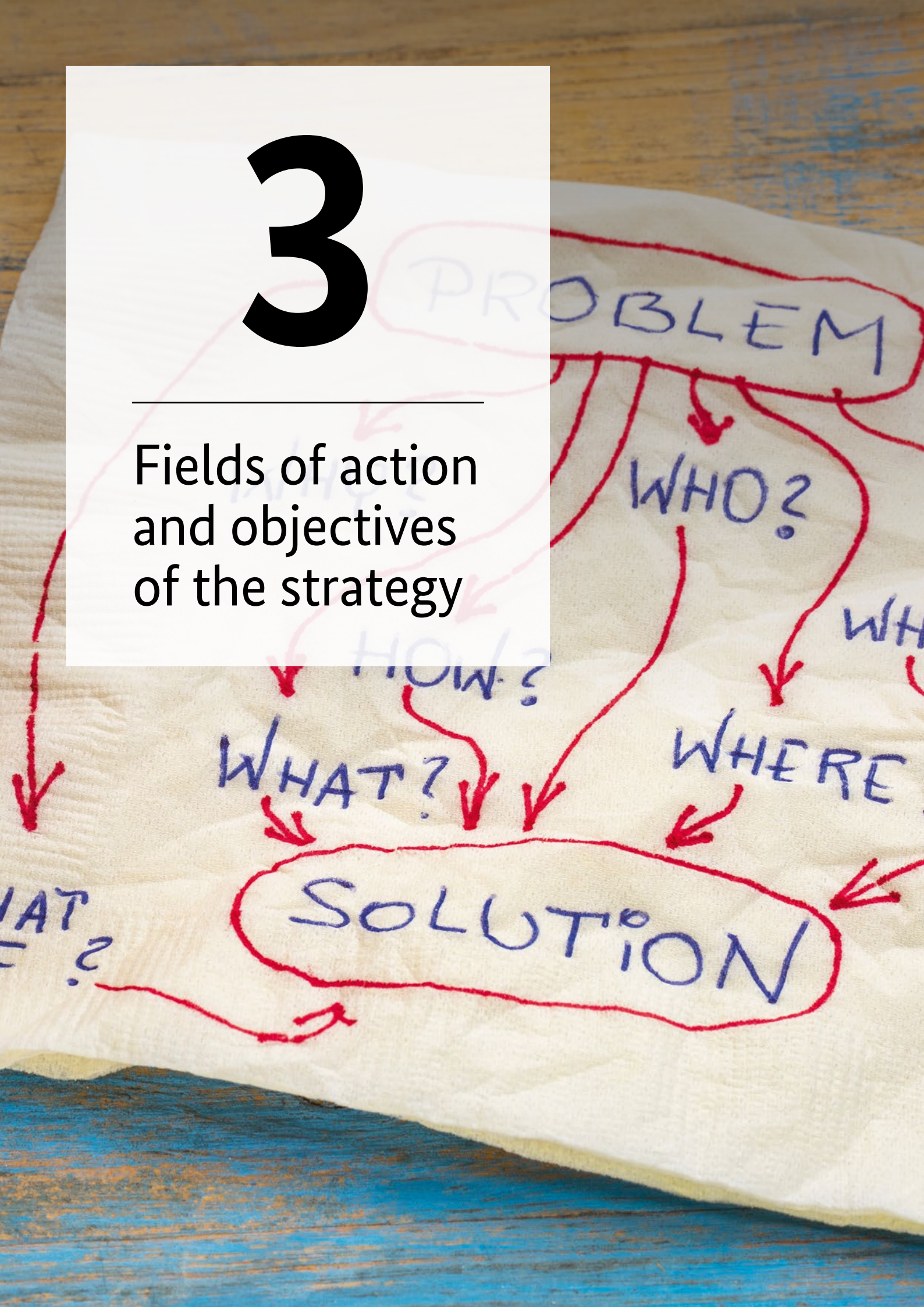
The marketing of typical regional products based on this diversity offers opportunities for complementary or new value chains (see also Chapter 3.2). The production of typical regional products is often also associated with benefits for biodiversity and environmental protection. This is particularly true if the products originate from organic farming.

The production, processing and marketing of such "diversity products" are often a challenge, and the stages of the value chain must be closely interlinked. This requires the maintenance or creation of an infrastructure and an appropriate legal framework for regional processing. This includes slaughterhouses, dairies, bakeries and wool processing facilities that can meet both conventional and organic requirements. A particular challenge for the processing of products from old or traditional varieties and breeds is dealing with the often special characteristics, such as specific baking properties. This requires craftsmanship and experience.

In addition, intensive communication about the value of these products and their contribution to biodiversity is necessary. A transparent presentation of the advantages of such products in terms of biodiversity and resource conservation is required, especially in comparison to internationally competing goods.

3

Fields of action and objectives of the strategy



The federal government attaches high priority to the protection and sustainable use of biodiversity. It is pursuing the goal of a future-proof, resilient, sustainable and circular agriculture, forestry, fisheries and food sector.

Genetic resources are an essential basis for this. The conservation and sustainable use of this genetic diversity is therefore an essential building block for supplying a growing world population under changing climatic conditions.

The overall objective of this strategy is therefore the conservation and promotion of genetic resources for sustainable agriculture, forestry and fisheries.

This goal is complex and involves a large number of different protected assets – from wild species to the diversity of man-made breeding lines, animal breeds and plant varieties. Human use can drive the loss of biological and genetic diversity, but it can also contribute to its conservation.

The answers to the existing problems are therefore also complex. With this strategy, the BMEL is making it possible to find adequate solutions for the various areas. To this end, the existing specialist programmes must be implemented and continuously developed.

Four fields of action can be identified to achieve the overall goal:

- Long-term conservation
- Sustainable use
- Knowledge management
- Cooperation

View into a cold storage facility at the IPK gene bank in Gatersleben – one of the world's largest gene banks. Over 150,000 seed samples are stored here for the long term.

Area of Action 1: Long-term conservation

Genetic resources for nutrition and agriculture, whether cultivated or wild, are found in both cultivated and uncultivated landscapes and habitats. Their conservation therefore requires different measures. Whether and how conservation is possible in the living environment or in conservation facilities has different prerequisites. Cultivated plant varieties, for example, have different requirements for *ex situ* conservation than the genetic resources of farm animals.

The form and extent of the respective conservation approaches differ depending on the type of genetic resources:

For **plant genetic resources,** *ex situ* conservation is the most important form of conservation. For most seed-propagated species, seed samples are stored at −18 C°. Species that are not suitable for seed storage are preserved as permanent crops in the field (e.g. fruit, ornamental plants) or as in vitro cultures or cryo-preserves (e.g. potatoes). More than 150,000 samples are preserved in the largest German gene bank, the federal gene bank at the *Leibniz Institute of Plant Genetics and Crop Plant Research.* Over the last 15 years, decentralised gene bank networks for fruit, vines, tobacco, ornamental plants and wild plants for nutrition and agriculture have been established. In addition to *ex situ* conservation, on-farm management is also of particular importance. Cultivated plants are preserved through agricultural or horticultural use. *In situ* conservation is particularly important for wild species related to crop plants (Crop Wild Relatives, WEL). The aim is to preserve and restore viable populations in their natural environment. The German Network of Genetic Reserves was established to improve and coordinate the *in situ* conservation of crop wild relatives (CWR).

DISTINCTION BETWEEN *EX SITU* AND *IN SITU* CONSERVATION:

Ex situ conservation: Conservation takes place outside the natural or managed habitat, in special *ex situ* facilities such as gene banks, seed orchards, botanical gardens, zoos or aquariums. As a rule, no further genetic development (evolution) takes place here due to the small population sizes. For long-term conservation, efforts must therefore be made to prevent inbreeding or genetic impoverishment.

In situ conservation: *In situ* conservation focuses on preserving the respective habitat, preventing harmful external influences and ensuring that the genetic resources can be maintained and further developed in sufficiently large populations. Conservation therefore takes place within the natural habitat, the cultivated landscape or the cultivated area or farm (“on farm”).

The conservation of **livestock breeds** largely takes place on-farm. The animals are kept on farms and used accordingly. In addition to the 81 native livestock breeds of horses, cattle, pigs, sheep and goats defined in the Animal Breeding Act, conservation measures are currently being supported for 31 endangered native poultry breeds and 29 endangered rabbit breeds. Reproductive material from farm animals cannot be easily stored in conservation facilities. The German Gene Bank of Farm Animals (Institute of Farm Animal Genetics) at the Friedrich-Loeffler-Institute in Mariensee currently stores material from domestic horse, cattle, pig, sheep, goat and chicken breeds. This is mainly sperm, i.e. genetic material from the paternal side of the respective species and breeds.

According to Schmidt et al (2003), 188 species of **woody plants** are native to Germany. These are divided into 77 tree species and 111 shrub species. The majority of these are forest trees and shrubs. Here, the primary approach to the conservation and sustainable use of genetic resources is *in situ* conservation. This takes place within the framework of sustainable forest management in the natural habitat and over a large area. Throughout Germany, more than 10,000 conservation holdings have been designated for *in situ* conservation on a total area of around 35,000 ha in order to maintain the broadest possible genetic diversity of woody plants.

Ex situ measures, of which seed orchards and clone collections are the most common, are used as an additional instrument to protect endangered populations and provide further genetic variants for forest management. As forests adapt to climate change, the importance of "assisted gene flow" through human-assisted migration for the conservation of forest genetic resources is increasing. This can also be seen as a combination of *in situ* and *ex situ* conservation. *The Forest Reproductive Material Act* (FoVG) and the corresponding regulation at EU level ensure the availability of high-quality reproductive material as a basis for reforestation and the forest conversion required as a result of climate change. The long-term *ex situ* storage of forest reproductive material in conservation facilities (forest gene banks) plays only a secondary role.

In the case of **wild aquatic genetic resources**, conservation measures to date have concentrated on preservation in the natural habitat. In addition, there are various parent fish farms for reintroduction projects as part of species conservation measures, e.g. for Baltic and Atlantic sturgeon, allis shad and Atlantic salmon. These parent fish farms represent *ex situ* conservation measures and in principle fulfill the function of a living gene bank. In the BfN Red List of established fish and lampreys in marine waters and the Red List of lampreys and fish reproducing in freshwater, a total of 179 fish species and four lamprey species are counted among the native fauna. Of the fish, eleven species are considered extinct or lost and 39 species are endangered. The National Inventory of Aquatic Genetic Resources (AGRDEU) currently lists 133 fish and lamprey species as well as 15 mollusk and 12 crustacean species. In Germany, around 15 fish species, one mussel species and one shrimp species are produced in aquaculture on a significant scale. The aquatic genetic resources managed in aquaculture as spawning fish stocks can only be preserved in the long term through economically viable management and use – e.g. at pond farms (i.e. on-farm).

In most cases, **microorganisms and invertebrates** are wild organisms. Therefore, *in situ* conservation of the genetic resources of microorganisms, fungi and invertebrates is much more important than *ex situ* conservation. Live collections of invertebrates exist only sporadically and can only make a marginal contribution given the very high number of species (e.g. the 33,000 insect species). Wild organisms can be promoted primarily through the conservation of their habitat. For the *in situ* conservation of invertebrates, such as pollinators, beneficial organisms for biological pest control and natural antagonists of harmful organisms, the reduction or prevention of the loss of their habitats is of particular importance. The preservation and restoration of habitats and retreats for invertebrates (also known as refugial areas) are of central importance, as is reducing the use of pesticides. In the case of microorganisms, the *German Collection of Microorganisms and Cell Cultures* (DSMZ) plays an important role in *ex situ* conservation.

Wild animals that are subject to the Federal Hunting Act and whose game is suitable for human consumption are mainly hunted in the wild, but some are also kept as game in enclosures in human care. Conservation therefore mainly takes place *in situ* in the case of huntable game (e.g. red deer) and on farms in the case of game kept in enclosures.

Goals of long-term conservation

→ **The conservation of a broad diversity of genetic resources for food and agriculture is ensured in the long term**
→ ***Ex situ* and *in situ* conservation measures complement each other adequately**

MEASURES SUPPORTED BY THE BMEL:

***Ex situ* conservation**

→ Secure long-term funding for conservation facilities such as gene banks, gene bank networks, collections, etc.
→ Increase the availability of *ex situ* stocks for sustainable use through improved information management, digitisation, expansion of gene banks into resource centers (e.g. for crops), establishment of reference centres or similar measures
→ Strengthen research and further development of long-term *ex situ* conservation methods for genetic resources where *ex situ* measures may be required (e.g. for forest genetic resources or aquatic genetic resources)
→ Support standardised survey, collection, evaluation, characterisation and documentation of genetic diversity, e.g. of relevant microorganisms and invertebrates for their conservation and sustainable, innovative use (including sustainable expansion of existing collections and their networking)

***In-situ*/On-farm Conservation**

→ Maintain and expand funding opportunities for the conservation of genetic resources
→ Advance the development, implementation and promotion of practical instruments for the establishment of cross-site and cross-state networks of *in situ* conservation units for all relevant woody forest species
→ Establish genetic conservation areas for Crop Wild Relatives (CWR) species and regularly monitor CWR populations in the areas
→ Support the networking of private conservationists, associations and initiatives, such as through dialogue forums and information material (see also Cooperation)
→ Promote the conservation of genetic resources with synergies in species and nature conservation (e.g. landscape management with native livestock breeds, crossing aids for animals as part of biotope networking measures to prevent the isolation of populations and genetic impoverishment, etc.)
→ Finding solutions to conflicts/prioritising conservation goals and associated measures (e.g. cormorants and fish fauna, wolves and livestock grazing, protected forests and seed production)

Integrative Measures

→ Develop concepts to adequately complement *ex situ* and *in situ* conservation measures and update them where necessary
→ Promote exchange and cooperation in cross-border European and international *ex situ* and *in situ*/on-farm conservation (see also Area of Action 4: Cooperation)

Area of Action 2: Sustainable use

SUSTAINABLE USE OF GENETIC RESOURCES

BY BREEDING	IN PRODUCTION	THROUGH COMMERCIALISATION
– For climate adaptation – Breeding of previously under-utilised species – Utilisation of special traits or characteristics	– Diversification of farms – Ecologisation of production systems – Heterogeneous landscapes	– Regional marketing – Variety products – Consumer information

In the context of *Genetic Resources for Food and Agriculture,* "sustainable use" means maintaining and making available **sufficient genetic diversity** in varieties, breeds or populations of crops and livestock **in production and/or in their habitat.**

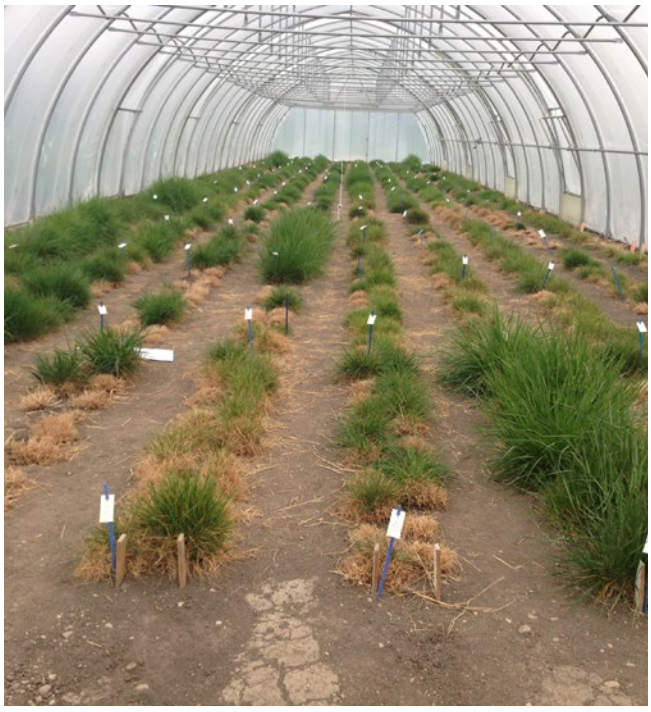
Sustainable use through breeding

Breeding is essential to providing a sufficiently large diversity of varieties or breeds, such as for today's production conditions and to adapt existing genetic resources to new, future requirements. Various techniques are used for this purpose.

Selection is the basis of plant and animal breeding. Animals or plants used for breeding are selected on the basis of certain characteristics that correspond to a specific breeding objective. The breeding objectives depend on the current framework conditions and the expected future requirements.

In animal breeding, selection for better health and robustness of animals is playing an increasingly important role. In many breeding programs, a great deal of effort is made to record the health status of individual animals and to use the information obtained effectively to select healthy and adapted animals. The classic production traits are also taken into account in order to achieve a balanced profitability of the animals with good health and a high degree of animal welfare.

In plant breeding, selection is done in the context of breeding or at location in order to adapt populations of crops, including woody species, to changed environmental conditions in the medium term (e.g. selection processes in on-farm conservation, see also "Sustainable use in production").



An important breeding goal is tolerance of temporary drought stress. The picture shows experiments with different genotypes of ryegrass that are artificially exposed to drought stress.

The Thuringian Forest Goat was bred in Thuringia around 1900. Its population is endangered and is therefore on the Red List of native livestock breeds in Germany.

Genetic sequence analyses in plant and animal breeding make it possible to identify genetic characteristics and integrate them into breeding strategies. Techniques such as the ones listed below are available:

- → High-throughput phenotyping (also of [yield] physiological processes)
- → Genetic mapping
- → Development of synthetic lines
- → Identification of candidate genes
- → Marker-assisted/genomic selection
- → Cell and tissue culture methods (e.g. embryo rescue)

In this way, targeted recording of genetic variations can be achieved, variations can be developed and utilisation can be improved. The objective of this work is to ensure the greatest possible diversity of genetic resources.

Knowledge about the specific properties of genetic resources also increases the benefits for breeding. Examples include information on resistance and tolerance characteristics as well as quality characteristics such as secondary constituents, which are becoming increasingly important for nutrition and material use.

An important prerequisite for this is access to genetic resources, genetic sequence data and information on research and breeding. Intellectual property rights and industrial property rights as well as the international regulatory regime on access and benefit-sharing for genetic resources play a major role in the availability of genetic resources (see Area of Action 4: Cooperation).

A look into the “PhenoSphere” at the Institute of Plant Genetics and Crop Plant Research: In this special greenhouse, conditions for current and future climate scenarios are simulated.

Sustainable use in production

The sustainable use of genetic resources is achieved when a wide variety of genetic resources, in the sense of different species and varieties or breeds, are integrated into operational production processes. This leads to the diversification of agricultural, forestry and fisheries production and has a positive impact on biodiversity as a whole and on ecosystem services.

In terms of sustainability, diversified production systems and business sectors minimise the risk of total losses. This means that the animal or plant population is not equally affected by disruptive events such as pest infestations, invasive species, extreme weather events or the like.

Another important factor for the sustainable use of genetic resources in production is their integration into the appropriate ecosystems. In forests, forest management with species-rich stands is the basis for the conservation and promotion of genetic resources. Diverse and small-scale agricultural landscapes also contribute to the promotion of biodiversity (Tscharntke 2022). Transition areas to other near-natural forms of land use such as forest edges or pond farming can also be particularly diverse in terms of flora and fauna.

Diversity-rich production systems in plant cultivation (e.g. species-rich grassland or multi-crop cultivation) often place different demands on harvesting and processing technology, so that innovative developments in management (e.g. robotics) and aimed at improving harvesting technology must be driven forward. The same applies to digital applications. Knowledge of traditional cultivation or processing options and the handling of smaller harvest quantities can also be important here. Diverse production systems can have positive effects on beneficial insect and pest control, for example.

Cultivation of protein plants (here, for example, alfalfa) extends crop rotation, provides valuable animal feed and enriches the soil with nitrogen.

Sustainable use through commercialisation

Supply and demand have a strong influence on the sustainable use of genetic resources. The aspects of "sustainable consumption" and "diversity products" are considered here.

When it comes to tomatoes, diversity is taking over the market. This is just one of several hundred tomato varieties.

Sustainable consumption
Consumers can generate diverse demand with their consumption behavior and their preferences for organic, environmentally friendly, resource and biodiversity-conserving products. One of the Federal Government's goals (BMEL 2022b, BMU, BMJV, BMEL 2019) is therefore to create a healthy and sustainable eating environment and to promote appropriate food consumption patterns. The aim is to make it easy for people to eat healthily and sustainably.

If there is a demand for products that promote biodiversity, the diversity of genetic resources offers great potential to meet this demand, such as through traditional, regionally produced products that conserve resources. These could be products from diverse production systems that, for example, include less utilised crop species and varieties in crop rotation. Local venison or products from native livestock breeds are also included. Transparent information on environmentally friendly and biodiversity-promoting products supports purchasing decisions for such products.

Diversified range of products
In Germany, there is a large variety of regional animal breeds or crop varieties that have great potential for marketing as regional specialties. These are often no longer competitive with the breeds and varieties that have been intensively bred and are widely used today. On marginal, extensive sites (e.g. moorland, low mountain ranges), however, they can have a location advantage due to their better adaptation to the specific environmental conditions. The keeping of an endangered animal breed (e.g. Rhön sheep) in conjunction with the maintenance and site-adapted grazing of protected areas not only serves to preserve the breed, but also the habitat with the plants and animals that occur there in the wild.

Marketing these regionally produced products can be an opportunity for farms (Menger et al. 2020). Some consumers are willing to pay a higher price for products from regional breeds if they are sufficiently informed about their importance (Bantle and Hamm, 2014). It is crucial that consumers should be adequately informed about the fact that they can contribute to the preservation of diversity by purchasing products of typical regional species, varieties and breeds. Many regions and biosphere reserves already use indigenous breeds and varieties for their tourism marketing.

THE EXAMPLE OF LIMPURGER CATTLE

Limpurger cattle originate from Württemberg and were very popular in the 19th century due to their fine meat quality, before the population of this regional breed declined drastically. Limpurger cattle were mainly used as draft animals with good milk yields. With the specialisation and mechanisation of agriculture, the breed was increasingly supplanted by other breeds.

With the project "Limpurger Weideochsen", a regional speciality was developed and protected throughout the EU as a Protected Designation of Origin (PDO). This label may only be used for products from the endangered "Limpurger Cattle" breed.

Regional specialities are usually only available in small quantities and are often seasonally limited. Regional and/or organically certified marketing is suitable for this, particularly via local restaurants or local retailers. However, it is usually necessary to first network the different producers, establish processing structures and train all those involved along the value chain in the

special features of the specialities. Regional processing companies in particular, which can also process smaller quantities of products and, ideally, enable appropriate marketing, can provide support. Special labeling of these "diversity products" or "biodiversity-promoting products" should create an opportunity to transparently communicate the benefits for environmental and biodiversity protection.

Objectives of sustainable use of genetic resources

- → **Genetic resources are part of a diversified, sustainable and resilient agricultural, forestry, fisheries and food sector**
- → **Endangered, indigenous genetic resources are valued and appreciated**

MEASURES SUPPORTED BY THE BMEL:

Sustainable use through breeding

- → Strengthen breeding research with the aim of providing resistant, efficient, robust, resource-conserving and climate-adapted plant varieties, animal breeds and forest reproductive material for sustainable production systems
- → Improve the collection and availability of characterisation and evaluation data of genetic resources, e.g. also research funding for method development, development of new concepts and techniques for data infrastructure (see Area of Action 3: Knowledge management)
- → Promote the breeding of new and underutilised crops and livestock breeds
- → Identify barriers to the availability of genetic resources (including regulatory regimes for access and benefit-sharing for genetic resources) and seek solutions

Sustainable use in production

- → Research genetic resources with the aim of strengthening diversified agricultural, forestry and fisheries production
- → Develop and test sustainable production methods that are both commercially successful and contribute to strengthening biodiversity and resource conservation, including climate-friendly land use, and promote research approaches such as real-world laboratories/landscape experiments/living labs for this purpose
- → Promote sustainable forest management and climate-adapted forest conversion using high-quality reproductive material
- → Improve the provision of advice to agricultural, forestry and fisheries enterprises on diversified production systems
- → Promote non-productive areas in agriculture as a contribution to habitat connectivity and as refuges for wildlife

Sustainable use through commercialisation

- → Supporting regional marketing channels for diversity products by promoting examples of innovative projects and initiatives that strengthen the regional processing and marketing of food and other products (including wood from rare native tree species, hay from species-rich grassland, pellets from wool, etc.) and promotion of (organic) value chains, also involving tourism, gastronomy and handicrafts
- → Providing reliable consumer information on locally adapted and indigenous genetic resources (labeling)
- → Creating business networks for diversity products

Area of Action 3: Knowledge management

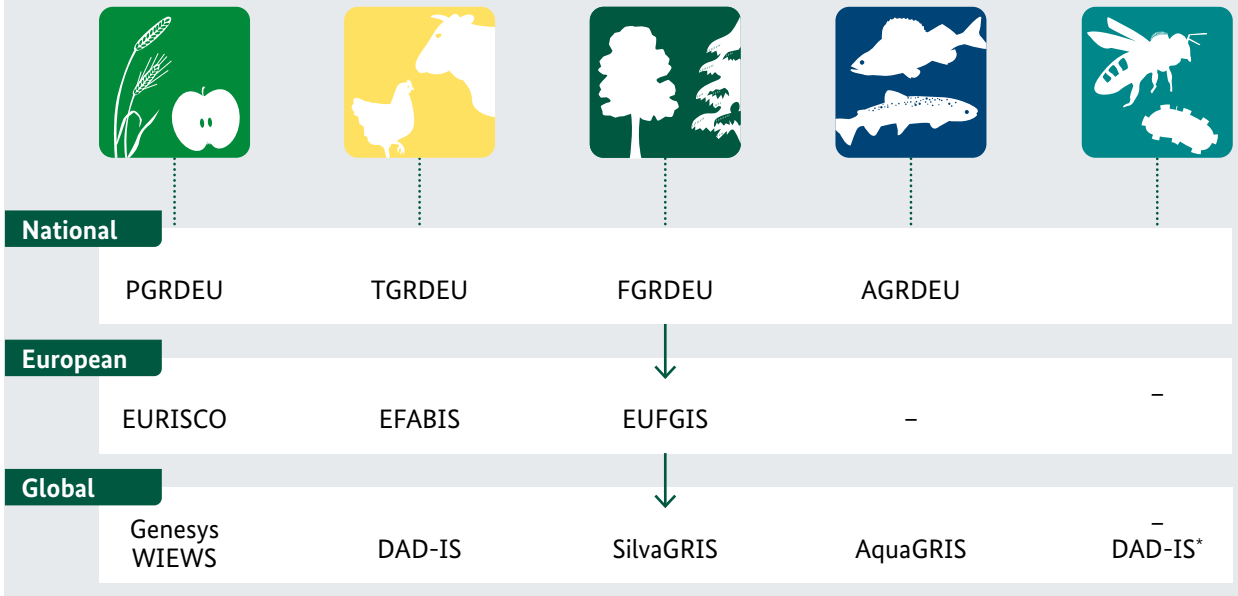
For the conservation and sustainable use of genetic resources for food and agriculture, it is important that relevant information is available both in Germany and at European and international level. Relevant information includes data on prevalence, passport data, information on origin, taxonomy and threat status. Characterisation and evaluation data of genetic resources for breeding, including genome and sequence information, are also becoming increasingly important. Knowledge management also includes education and training measures that raise awareness of the importance of genetic resources for food and agriculture.

National inventories

Germany has established national inventories for plant, animal, forest and aquatic genetic resources which document the stocks of the respective genetic resources available in Germany. They are maintained by the Information and Coordination Centre for Biological Diversity (IBV) at the Federal Office for Agriculture and Food (BLE) on behalf of the BMEL. At national level, information on the structure of breeders and breeding programmes is also collected. The data is transferred from the German inventories to existing international information systems. In the field of invertebrates, the honey bee (Apis mellifera) is listed as a farm animal in the FAO's DAD-IS information system.

These information systems are also of central importance for reporting on the implementation of international commitments, e.g. as part of the FAO's Global Action Plans, the UN Sustainable Development Goals (SDGs) or the Convention on Biological Diversity (CBD). They are an important source of information at all levels for the planning and implementation of conservation measures and for the sustainable use of genetic resources.

DATA FLOW OF THE DIFFERENT INFORMATION SYSTEMS AT NATIONAL, EUROPEAN AND GLOBAL LEVEL



** Only data on honey bees*

A glimpse of the show garden of the Association for the Conservation and Recultivation of Crop Diversity in Germany (VERN e.V.). More than 100 old varieties from the gene bank have been brought back into use. The show garden is also used for VERN's educational work on old varieties.

Transfer of knowledge on genetic resources

The conservation of genetic resources is also a responsibility for society as a whole. It is therefore crucial to inform the public about the importance of genetic diversity and to raise awareness of the need to conserve it. Many institutions are already active in this area, particularly at local level. These include associations, forestry and agricultural businesses, companies, fish producers, regional development/marketing stakeholders, nature parks and botanical gardens. In addition to the numerous projects and initiatives, there is still greater potential to expand the existing activities in the areas of education, advice and information to include content on the topic of "Genetic resources for food and agriculture".

One starting point is the transfer of knowledge in vocational and academic education. So far, there are a few courses on offer, such as biodiversity consulting and management at the *Weihenstephan-Triesdorf University of Applied Sciences (HSWT),* the *Bingen University of Applied Sciences (THB)* and the certificate programme on *"Biodiversity in Agricultural Landscapes"* at the University of Kassel.

In vocational training for the "green professions", the importance of genetic resources for food and agriculture has not yet been included in the framework curricula. It depends on the decision of individual teachers as to whether they cover this topic in their lessons. Greater integration of the topic of "Genetic resources" into general school education must take place not only in the classroom, but also in the field in order to impart knowledge and understanding. To support in-farm training, information is available to interested parties, such as guidelines for vocational schools. There are new materials available on the topic of biodiversity, e.g. on "Planning and creating flowering strips" and "Biodiversity potential on the farm". The guidelines are published by the *Federal Information Centre for Agriculture (BZL)* and were developed in cooperation with the Federal Agency for Nature Conservation (BfN). In addition, some federal states offer information on biodiversity.

To ensure that scientific findings are put into practice and that not every farm has to start from scratch, the transfer of knowledge should be taken into account in research projects wherever possible. Networking (see also: Cooperation) and opportunities for practical testing (see also: Sustainable use) are important for this.

Collection and making available of characterisation and evaluation data

Knowing the characteristics of genetic resources is a basic prerequisite for assessing their potential for adaptation to climate change and their contribution to greater sustainability and resilience. This requires characterisation and evaluation data, including genetic information. This comprises all breeding and adaptation measures within agricultural production systems, forests and water bodies. In the case of endangered livestock breeds, for example, pedigree-based ancestry data and genotype data are required.

This data is used, for example, to improve conservation strategies, analyse agronomic traits and develop methods that can predict the benefits of a genetic resource for breeding based on all available information (predictive breeding).

In the face of climate change, long-term research programmes are needed for conservation measures and forest conversion as well as to increase breeding progress in the context of more sustainable agriculture. These must be interdisciplinary in nature and range from biodiversity research, functional genome analysis and genotype-environment-management interaction to the further development of breeding methods. For example, the development and provision of efficient and transferable phenotyping techniques is required in order to be able to reliably record complex characteristics. Genotyping methods also need to be further developed, such as to advance genome sequencing of the relevant genetic resources. Metagenomics, i.e. the extraction of genetic material directly from environmental samples, is also becoming increasingly important. This process supports, for example, the identification of characteristics associated with bacterial communities that are not viable under laboratory conditions.

Across all areas, there is also an urgent need to develop new concepts, strategies and a data infrastructure in order to efficiently and effectively manage the growing volumes of "big data" from phenotyping, including remote sensing and genome analysis, to analyse it using innovative methods and to integrate it into new breeding methods.

Ensure monitoring of the status of genetic resources and their utilisation

Regular monitoring is required for the management of measures in the areas of agriculture, forestry and fisheries in order to assess the status and use of genetic resources (*in situ* and *ex situ*). Monitoring makes it possible to recognise in good time whether there is a threat to, or loss of genetic diversity. This enables evidence-based policy advice that leads to targeted measures. Nationally coordinated indicators and monitoring systems are required in order to map the trend of the threat status or the effect of conservation and funding measures. So far, these have only been established for animal genetic resources in the indicator report on the National Biodiversity Strategy.

EXAMPLE OF GENETIC MONITORING AS PART OF THE 2021–2022 FEDERAL FOREST INVENTORY

Every ten years, the National Forest Inventory examines how much forest there is in Germany, what condition it is currently in and how it is changing. Genetic studies will help to answer these questions in even greater detail in the future. In the 2021-2022 National Forest Inventory, DNA was therefore systematically sampled, stored and made available for genetic inventories of the main tree species beech, English oak, sessile oak, pine, spruce, silver fir and Douglas fir for the first time. A total of over 20,000 DNA samples were collected. The aim was to obtain a representative sample of the genetic composition of the seven tree species mentioned. Repeated genetic inventories are required to record changes in the genetic composition of the tree species and to identify driving forces. To this end, this sampling must be permanently established in the National Forest Inventory. In addition, the samples must be stored in such a way that the material can be used by federal and state institutions for genetic studies over several decades.

AI-based Insect Detect camera trap for the continuous automated detection of flower-visiting insects in the study areas. Used as part of the project for monitoring diversity in agricultural landscapes (MonViA).

The aim of monitoring genetic diversity is to be able to map the development and trends in the diversity of genetic resources – including current threats and genetic erosion. In the case of forests, monitoring includes the surveillance of natural source populations. The data can be used to make threat assessments. Evaluation of the threat status is an important indicator for the development of the status of wild and cultivated genetic resources and provides important findings for the design of conservation measures and the impact of support measures.

National and international monitoring systems and their indicators must be regularly developed further. Detailed recording at the molecular-genetic level is becoming increasingly important in order to be able to recognise the risk of genetic impoverishment within populations.

Knowledge management objectives:

- → **Information and knowledge management concerning genetic resources for food and agriculture is expanded**
- → **Characterisation and evaluation data on genetic resources for food and agriculture are available**
- → **Monitoring of the occurrence and sustainable use of genetic resources for food and agriculture takes place and allows conclusions to be drawn about the threat status**

MEASURES SUPPORTED BY BMEL:

National Inventories

- → Continue and, where necessary, expand the databases on genetic resources (known as national inventories) and network them at the European and international level (see also Area of Action 4: Cooperation)
- → Participate in national and international committees that set standards for the recording and documentation of genetic resources

Knowledge transfer on genetic resources

- → Promote knowledge transfer from science/research to practice
- → Intensify public relations work on the importance of and threats to genetic resources
- → Inform individuals and institutions that conduct research using genetic resources for food and agriculture or develop products from them about their obligations regarding access to genetic resources and benefit-sharing
- → Produce information materials on genetic resources for vocational training at agricultural vocational and technical schools
- → Strengthen the production and availability of information materials on genetic resources for food and agriculture for general education schools (teaching modules, school gardens, etc.)

Collect and make available characterisation and evaluation data

- → Strengthen the collection and availability of characterisation and evaluation data of genetic resources, promote method development, development of new concepts and techniques for data infrastructure
- → Establish systematic and nationwide genetic inventories to ensure the nationwide standardised collection, evaluation and selection of conservation units of forest genetic resources in the long term

Monitoring des Zustands genetischer Ressourcen und ihrer Nutzung gewährleisten

- → Establish, strengthen and ensure long-term monitoring of genetic diversity in agricultural landscapes, forests and water bodies
- → Continuously expand monitoring to include molecular-genetic monitoring programmes
- → Further develop threat classifications for genetic resources for food and agriculture
- → Promote exchange with the National Monitoring Centre for Biodiversity (NMZB) on the overall concept of national biodiversity monitoring, and incorporate the interests of genetic resources for food and agriculture into committee work at the NMZB
- → Examine the contribution of the “Wildlife Information System of the German Federal States” (WILD) to the monitoring of genetic diversity in agricultural landscapes, forests and water bodies

Area of Action 4: Cooperation

Cooperation at all levels – from local to global – is important for efficient conservation measures, knowledge management and the promotion of the sustainable use of genetic resources for food and agriculture.

This cooperation includes, for example, an optimal exchange of information and data, coordinated procedures, the uncomplicated exchange of genetic resources and research results and the interlinking of individual components in the value chain.

Numerous players are involved in this. They come from politics, administration, research, information management, practice (agricultural, forestry and fishing businesses), gene banks and protected area management, breeding (breeding associations, breeding companies and their associations), training, consulting and capacity building as well as product development, marketing and sales.

National Cooperation

In Germany, the *Information and Coordination Centre for Biological Diversity (IBV)* at the BLE is a structure that provides coordinating support for communication and cooperation between stakeholders and advises representatives of the federal states and their administrations, the BMEL and other ministries on genetic resources. The different responsibilities in Germany between public and private stakeholders and the various levels of government and administration in the area of the conservation and sustainable use of genetic resources for food and agriculture can be brought together centrally by the IBV (Begemann et al. 2021).

The IBV is the **interface between national activities and activities** at European and international level. The IBV represents the BMEL in international cooperation bodies and creates links to national activities through its function as the secretariat for the national advisory boards and for the BMEL's Scientific Advisory Board on Biodiversity and Genetic Resources.

SPECIAL FORMS OF COOPERATION: GENE BANKS AND GENE BANK NETWORKS

Over 5.8 million samples of plant genetic resources are preserved in gene banks worldwide for the medium and long term, mostly in the form of seeds or other reproducible material. These resources are made available to all interested parties for future use in research, breeding and training for food and agriculture. For typical agricultural crops, this conservation system has become well established internationally over the last 50 to 80 years. Nevertheless, there are crops that are underrepresented in collections, especially horticultural crops. Over the last 15 years, the BMEL has successively closed these gaps for Germany. Today, in addition to the national gene bank for agricultural and horticultural crops at the "Leibniz Institute of Plant Genetics and Crop Plant Research" (IPK), there are a total of four decentralised gene bank networks for fruit, vines, ornamental plants and crop wild relatives. The special feature of these gene bank networks is that, in addition to the classic gene bank collections at university or state institutions, other conservation structures such as botanical gardens, arboreta, rosaria, collections of hobbyist societies and many more can also participate.

In addition to these centrally established structures, many non-governmental initiatives are active in the conservation and sustainable use of genetic resources in Germany. Some of these are already active in conservation associations, networks and organisations and are thus having an increasingly broad impact. Examples include the Association for the Conservation and Re-cultivation of Crops (VERN e. V.), the Association for the Conservation of Crops (Verein zur Erhaltung der Nutzartenvielfalt (VEN e. V.)), the Association of Pomologists (Pomologen-Verein e. V.) and the Society for the Conservation of Old and Endangered Breeds (Gesellschaft zur Erhaltung alter und gefährdeter Haustierrassen (GEH e. V.)).

TECHNICAL ADVISORY BOARDS AND SCIENTIFIC ADVISORY BOARD FOR BIODIVERSITY AND GENETIC RESOURCES

For crops, livestock, aquatic genetic resources and forest genetic resources, the BMEL has set up **expert advisory councils** in which representatives from the federal and state governments, administration, science, practice and other relevant institutions and organisations work together depending on their areas of responsibility. They define the measures for the conservation and sustainable use of the respective genetic resources in the **national technical and specialist programmes**. The IBV serves as the office of the respective advisory boards.

The **"Scientific Advisory Board for Biodiversity and Genetic Resources"** advises the BMEL on overarching issues relating to the conservation and sustainable use of genetic resources and biodiversity. It consists of twelve members appointed by the BMEL who have expertise in various specialist areas ranging from agricultural and environmental economics to animal ecology, law and bioethics. The chairs of the advisory boards and the heads of the Thünen Institute of Biodiversity and the Information and Coordination Centre for Biological Diversity (IBV) are also members of the BMEL Scientific Advisory Board. This composition facilitates the exchange between the scientific domain and the implementation level.

European and international cooperation

No country is autonomous in the conservation and sustainable use of its genetic resources. This is why cooperation at the European and international level is fundamental. The German government has signed important international agreements to this end. These include agreements that regulate access to genetic resources and the sharing of the benefits resulting from their use (Access and Benefit-Sharing, ABS).

Important international cooperation agreements are:

- Commission on Genetic Resources of the Food and Agriculture Organization of the United Nations (CGRFA of the FAO)
- International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA)
- Global Crop Diversity Trust
- Convention on Biological Diversity (CBD)
- Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilisation as an additional protocol under the CBD

At the Commission on Genetic Resources of the United Nations Food and Agriculture Organization (FAO), the 178 member states coordinate the Global Plans of Action for Genetic Resources.

REGULATIONS AFFECTING ACCESS TO GENETIC RESOURCES

A) Access and benefit-sharing of genetic resources: The **Nagoya Protocol** on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity (ABS) stipulates that access to genetic resources may only take place with the consent of the country of origin and on mutually agreed terms. The same applies to traditional knowledge associated with genetic resources, such as the usefulness of certain plants and animals for food or medical purposes.

The conditions agreed to with the country of origin may, for example, include the stipulation that the benefits arising from the utilisation of genetic resources must be shared fairly and equitably with the country of origin. As each country has sovereign rights over its genetic resources, ABS regulations differ from country to country. This makes research and breeding with genetic resources from other countries complicated, as many individual permits and contracts with different countries may be required. The bureaucratic effort required to comply with the regulations is very high.

Under the **International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA),** ABS is regulated in a multilateral system (MLS). In this system, access to seed samples worldwide is governed by a standard contract with defined conditions for benefit-sharing. This is easier to implement for researchers and breeders because there is no need to negotiate different and separate individual contracts.

In all international ABS agreements, the topic of **"Digital Sequence Information on Genetic Resources" (DSI),** also known as genetic sequence data, has been under discussion for several years. This concerns the question of how to deal with genetic sequencing data (e.g. data concerning nucleic acid sequences in the DNA of genetic resources), which can be searched in publicly accessible databases and used freely for research, in terms of access and benefit-sharing. The Parties to the Convention on Biological Diversity have agreed in December 2022 to develop a multilateral benefit-sharing instrument for the use of DSI.

B) Intellectual property rights: Free access to genetic resources is an important condition for their use. Access can be restricted by intellectual property rights. Although the **German Patent Act** expressly excludes the patenting of plant varieties and animal breeds, patents can still be granted for inventions "the subject matter of which is plants or animals if the implementation of the invention is not technically limited to a specific plant variety or animal breed" (so-called bio-patenting). This means that, under certain conditions, it is possible to patent a manufacturing process (invention) for individual products (e.g. plants with certain properties) in order to obtain not only direct product protection but also what is known as derived property protection, which can extend to all subsequent generations. This may mean that plant genetic resources can no longer be used without restriction in research and breeding.

Plant variety protection is a specific commercial property right for plant varieties. The conditions for plant variety protection and the resulting claims were agreed upon in the International **Convention for the Protection of New Varieties of Plants** (UPOV Convention). Under both the German Plant Variety Protection Act and the EC Regulation on Community Plant Variety Rights, plant variety protection is granted in accordance with the UPOV Convention. The aim of the plant variety protection system is to promote the development of new plant varieties for the benefit of society and to protect the intellectual property of newly bred plant varieties. The aim of plant variety protection is to promote the necessary progress in breeding and the balance of interests between breeders and farmers. Plant variety protection rights enable a return on investment, e.g. via licence fees, for the breeding of a new variety, which often takes 10 to 15 years. The duration of plant variety protection is 25 years, and 30 years for hops, potatoes, vines and tree species. Plant variety protection does not extend to the breeding of new varieties and their commercial use. The varieties are available for further breeding without restriction (so-called breeder's privilege). A further restriction of plant variety protection is the so-called farmer's privilege. This means that, for certain species, the harvested material of a protected variety obtained on the farmer's own farm may be used for replanting, subject to payment of a "replanting fee" to the variety protection holder.

European Networks:

- European Cooperation Program for Plant Genetic Resources (ECPGR)
- European Regional Focal Points for Animal Genetic Resources (ERFP)
- European Forest Genetic Resources Program (EUFORGEN)

Networks have been established at European level to strengthen cooperation. The European networks offer the opportunity to bring together stakeholders from science and research, non-governmental organisations and governmental institutions and to work together on the conservation and sustainable use of genetic resources in Europe.

European cooperation increases Europe's influence at global level, e.g. in the FAO's international negotiations at the *Commission on Genetic Resources for Food and Agriculture (CGRFA)* and the ITPGRFA. It also contributes to the transfer of knowledge to the Global South. On behalf of the BMEL, the IBV coordinates international cooperation on the conservation and sustainable use of genetic resources for food and agriculture in Germany.

POSSIBLE EUROPEAN STRATEGY FOR THE PROMOTION AND CONSERVATION OF GENETIC RESOURCES

To further improve European and international cooperation, the BMEL supports a European strategy on genetic resources for food and agriculture. In November 2021, the draft of a "Genetic Resources Strategy for Europe" was presented to the EU Commission, members of the European Parliament and national policy makers. This draft was developed as part of the EU Horizon 2020 project "GenresBridge" by 17 project partners, including the IBV of the BLE, from eleven European countries and with the close involvement of the three European programmes for plant, animal and forest genetic resources (ECPGR, ERFP and EUFORGEN).

The recommendations of this European draft strategy are worth emphasising:

- Establishing a policy framework for genetic resources within Europe to better coordinate activities for the conservation and sustainable use of genetic resources
- Coordination and networking of measures for the identification, conservation (*ex situ* and *in situ*), characterisation, sustainable use and valorisation of genetic resources within Europe
- Establishment of a coordination and information center for agricultural genetic resources at the European level

A European strategy could thus lead to a harmonised framework for action within the EU, create synergies in conservation and generally improve sustainable use of genetic resources.

At the EU level, it is also important to strengthen genetic resources as a basis for a resilient, sustainable and circular-oriented agriculture, forestry, fishery and food industry. Germany is contributing to this with the help of this strategy.

The objective of cooperation:

→ **Good national, European and international cooperation in all areas of activity**

MEASURES SUPPORTED BY BMEL:

National Cooperation

→ Continue and, where necessary, expand the Information and Coordination Centre for Biological Diversity (IBV) at national level and as an interface to the European and international level
→ Continue to support the work of the national advisory boards and the Scientific Advisory Board for Biodiversity and Genetic Resources of the BMEL (departments, meetings, public relations work, publications, scientific staff)
→ Expand support for already established networks (e.g. gene bank networks) and expand the networking of stakeholders in order to cover all relevant or prioritised genetic resources in the future
→ Establish and expand dialogue formats and networking structures on important topics for the conservation and sustainable use of genetic resources

European and international cooperation

→ Engage in international and European negotiations on access to genetic resources and equitable benefit-sharing
  – for easier access to genetic resources for food and agriculture
  – for open access to digital genetic sequence data (Digital Sequence Information, DSI) and easy-to-implement mechanisms for equitable sharing of the resulting benefits
  – for capacity building in developing countries
→ Strengthen cooperation in EU-funded, European and international projects on genetic resources
→ Secure national membership fees for European cooperation programs and for international alliances and organisations
→ Make more budget funds available for projects within the framework of European cooperation programmes
→ Support the establishment of a European strategy on genetic resources based on the results of the “Genres-Bridge” project and incorporation into the political decision-making process

4

Implementation and monitoring of measures

Implementation of measures

In accordance with the division of responsibilities between the federal and state governments in Germany, the BMEL is using this strategy to establish a framework for action that is important to strengthen genetic resources that are important to agriculture, forestry, fisheries and food production. The measures in this strategy are designed to complement the national strategies mentioned in Chapter 1.3.

Together with the federal states, the BMEL has appointed four expert committees with experts from the federal and state governments; these committees have developed the respective national specialist programmes for plant, animal, forest and aquatic genetic resources and also provide technical support for their implementation. The *Scientific Advisory Board for Biodiversity and Genetic Resources* of the BMEL also contributes to the implementation of the strategy and the national programmes with its opinions and recommendations. All committees are supported by the BLE's (Federal Office for Agriculture and Food) Information and Coordination Centre for Biological Diversity (IBV).

The implementation of this strategy is based on these structures and the distribution of tasks between the federal government and the federal states, as well as on the commitment of relevant groups and individuals to the conservation and sustainable use of genetic resources.

The BMEL has the following instruments at its disposal for implementation

- Setting the framework for funding opportunities under the Joint Task "Improvement of Agricultural Structures and Coastal Protection" (GAK), the European Agricultural Policy (CAP), Fisheries Policy (CFP), and the Forest Climate Fund for the promotion of forest-related research and development projects
- Funding of research projects, model and demonstration projects or nationwide surveys in the field of biodiversity as well as consideration of genetic resources in relevant research programmes of the BMEL and other federal ministries
- Infrastructure maintenance and development in federal institutions
- Funding of institutions and research projects of national and supra-regional importance at project level
- Events, provision of information, coordination
- Provision of a legal framework

In principle, it must be taken into account that the treatment of genetic resources in relevant research programs might be in competition with other issues. This must be considered in the context of respective planning and implementation of the programmes. For this reason, a key objective of the strategy is to view these sectors together and to identify and exploit synergies.

Monitoring of measures

The measures are to be monitored every five years in the form of a report on the status of implementation. The reports on the national specialist and technical programmes, the national reporting on the implementation of the global action plans at the FAO Commission on Genetic Resources and other relevant national reports relating to genetic resources are also included for this purpose.

The following table provides an overview of the objectives and measures of the strategy, together with the associated implementation instruments of the BMEL and the monitoring of measures.

	Area of Action	Implementation path/ instruments of the BMEL	Monitoring of measures (report every 5 years)
1	**Long-term conservation**		
	Goals → **The conservation of a broad diversity of genetic resources for food and agriculture (see Chapter 1.2) is secured in the long term** → ***Ex situ* and *in situ* conservation measures complement each other adequately**		
	***Ex situ* conservation measures**		
1.1	Secure long-term funding for conservation facilities such as gene banks, gene bank networks, collections, etc.	Infrastructure maintenance and development in federal institutions; funding of institutions and research projects of national and supra-regional importance at project level	Number of staff employed for conservation measures in departmental research institutes and extent of material resources; number of funded conservation facilities outside the federal administration, amount of funding used for this purpose
1.2	Increase the availability of *ex situ* stocks for sustainable use through improved information management, digitisation, expansion of gene banks into resource centers (e.g. for crops), establishment of reference centres or similar measures	Coordination of the expansion of gene banks into digital data centres; coordination of the development of the concept of the Animal Genetic Resources (AGR) reference centre	Results of coordination discussions and status quo achieved
1.3	Strengthen research and further development of methods of long-term *ex situ* conservation for genetic resources where *ex situ* measures may be required (e.g. for forest genetic resources or aquatic genetic resources)	Research funding	Funding volume and number of corresponding BMEL research projects
1.4	Support the standardised survey, collection, evaluation, characterisation and documentation of genetic diversity, e.g. of relevant microorganisms and invertebrates, for their conservation and sustainable, innovative use; this also includes the sustainable expansion of existing collections and their networking	Research projects, model and demonstration projects or nationwide surveys, including in the field of microorganisms and invertebrates; consideration of MIGR in relevant research programmes of the BMEL and other federal ministries	Funding volume and number of corresponding research projects and surveys; activities performed and description of the status quo achieved

	Area of Action	Implementation path/ instruments of the BMEL	Monitoring of measures (report every 5 years)
	***In situ* and on-farm conservation measures**		
1.5	Maintain and expand funding opportunities for the conservation of genetic resources for food and agriculture	Research projects, model and demonstration projects (MDPs); enable funding principles for the conservation and sustainable use of genetic resources via the GAK/GAP or the European Maritime, Fisheries and Aquaculture Fund (EMFAF) or successor funds	Funding volume and number of biodiversity MDPs and surveys; publish the number of funding opportunities for *in situ* and on-farm conservation at the beginning of each CAP funding period; number of federal states that promote the conservation and sustainable use of genetic resources via GAK or EMFAF or successor funds
1.6	Development, implementation and promotion of a practical set of instruments for the establishment of cross-location and cross-state networks *in situ* conservation units for all relevant woody species of the forests	Inclusion of the topic in the Bund-Länder Working Group on Forest Genetic Resources (BLAG-FGR)	Status of work on the instruments and their implementation
1.7	Establish genetic reserves for the CWR (Crop Wild Relatives) species and regularly monitor CWR populations in the areas	Coordinate the expansion of CWR genetic reserves in the German Network of Genetic Reserves; Legal framework: Examination of the inclusion of the protected status "Genetic Reserve as a binding protected area category and preservation of intra-species genetic diversity as a conservation goal for *in situ* conservation	Number of genetic reserves for CWR and the total number of CWR species that occur in these areas; examination of "protected status" inclusion in consultation with BfN/BMUV was carried out
1.8	Networking of private conservationists, associations and initiatives, such as through dialogue forums and information material (see also: Cooperation)	Continuation and expansion of knowledge transfer and information services in the IBV of the BLE	Number of relevant networking events organised by or on behalf of the BMEL
1.9	Promotion of conservation of genetic resources with synergies in species and nature conservation (e.g. landscape conservation with native livestock breeds, crossing aids for animals as part of biotope networking measures to prevent the isolation of populations and genetic impoverishment, etc.)	Coordination of expert discussions; events for networking the relevant persons/institutions	Number of corresponding events organised by the BMEL or on behalf of the BMEL

	Area of Action	Implementation path/ instruments of the BMEL	Monitoring of measures (report every 5 years)
1.10	Engaging in conflict resolution/prioritisation related to conservation objectives and associated measures (e.g. cormorant and fish fauna, wolf and livestock grazing, protected forests and seed production)	Coordination of expert discussions; events to network the relevant people/ institutions; research funding for conflict prevention	Number of corresponding events organised by the BMEL, or on behalf of the BMEL; funding volume and number of corresponding research projects
	Integrative measures		
1.11	Develop concepts to adequately complement *ex situ* and *in situ* conservation measures and update them where necessary	Implementation takes place via the national specialist programs and corresponding specialist committees; for microorganisms and invertebrates via coordination of expert discussions	Status of the availability of corresponding concepts
1.12	Promote exchange and cooperation in cross-border European and international *ex situ* and *in situ*/on farm conservation	See: Area of Action 4: Cooperation	See: Area of Action 4: Cooperation
2	**Sustainable use**		
	Goals → **Genetic resources are part of a diversified, sustainable and resilient agriculture, forestry, fisheries and food sector** → **Endangered domestic genetic resources are valorised**		
	Measures: "Sustainable use through breeding"		
2.1	Strengthen breeding research with the aim of providing resistant, efficient, robust, resource-conserving and climate-adapted plant varieties, animal breeds and forest reproductive material for sustainable production systems	Research funding, infrastructure maintenance and development in federal institutions	Funding volume and number of corresponding research projects
2.2	Improve the collection and availability of characterisation and evaluation data of genetic resources; e.g. also research funding for method development, development of new concepts and techniques for data infrastructure (see: Knowledge management)	See: Area of Action 3.8: Knowledge management	See: Area of Action 3.8: Knowledge management

	Area of Action	Implementation path/ instruments of the BMEL	Monitoring of measures (report every 5 years)
2.3	Promote the breeding of new and underutilised crops and livestock breeds	Research funding for breeding research on rare and neglected crops (example: legumes)	Funding volume and number of corresponding research projects
2.4	Identify obstacles to the availability of genetic resources for research and breeding (including regulatory regimes for access and benefit-sharing for genetic resources) and seek solutions	Conduct expert discussions with different user groups to identify different needs	Number of relevant expert discussions conducted by or on behalf of the BMEL; status of identified obstacles and examination of solutions
	Measures: "Sustainable use in production"		
2.5	Research on genetic resources with the aim of strengthening diversified agricultural, forestry and fisheries production	Research funding	Funding volume and number of corresponding research projects; number of agricultural and forestry enterprises implementing the funding measures
2.6	Develop and test sustainable production processes that are commercially successful and contribute to strengthening biodiversity and resource conservation, including climate-friendly land use, and promote research approaches such as farm networks, real-world laboratories/landscape experiments/living labs.	Research funding	Number of correspondingly funded farm networks, real laboratories/experimental fields, living labs
2.7	Promote sustainable forest management and climate-adapted forest conversion using high-quality reproductive material	Funding program for climate-adapted forest management; legal framework	Size of the funded farm area (ha) and number of farms implementing the funding measure
2.8	Improve the provision of advice to agricultural, forestry and fisheries enterprises on diversified production systems	Continue BZL information programmes in cooperation with partners; networking of stakeholders; Change the legal framework for counselling and networking, in particular → Joint task for agricultural and coastal protection → Common agricultural policy	Number of information services offered by the BZL; number of advisory services offered by the federal states as part of the GAK and GAP

	Area of Action	Implementation path/ instruments of the BMEL	Monitoring of measures (report every 5 years)
2.9	Promote non-productive areas in agriculture as a contribution to habitat connectivity and as refuges for wildlife	Legal framework → Joint Task for Agricultural and Coastal Protection → Common agricultural policy	Non-productive areas supported via GAK/GAP (ha)
	Measures: "Sustainable use through marketing"		
2.10	Support regional marketing channels for diversity products by promoting examples of innovative projects and initiatives that strengthen the regional processing and marketing of food or other products (including wood from rare native tree species, hay from species-rich grassland, pellets made from wool, etc.) and promote (organic) value chains, including those involving tourism, gastronomy and handicrafts	Coordination of relevant persons/institutions; BMEL funding programs	Funding volume and number of corresponding funding measures; information events
2.11	Provide reliable consumer information on locally adapted and indigenous genetic resources (labelling)	Research funding; infrastructure maintenance and expansion; information services; legal framework: examination and possible creation of a state label	Funding volume and number of funding measures; number of events, published information materials; status quo achieved with regard to a label for "native genetic resources"
2.12	Create farm networks for diverse products	Coordination of expert discussions; events to network the relevant people/ institutions	Number of corresponding events organised by the BMEL or on behalf of the BMEL

	Area of Action	Implementation path/ instruments of the BMEL	Monitoring of measures (report every 5 years)
3	**Knowledge management**		
	Goals → **Information and knowledge management on genetic resources for food and agriculture is expanded** → **Characterisation and evaluation data on genetic resources for food and agriculture are available** → **Monitoring of the occurrence and sustainable use of genetic resources for food and agriculture takes place and allows conclusions to be drawn about the respective endangerment status**		
	Measures: "National Inventories"		
3.1	Continue the databases on the stocks of genetic resources (national inventories), expand them where necessary and network them at European and international level (see also: Cooperation)	Infrastructure maintenance and expansion	Status of national inventories in terms of technical status and data exchange
3.2	Participate in national and international committees that set standards for the recording and documentation of genetic resources	See: Area of Action 4: Cooperation	See: Area of Action 4: Cooperation
	Measures: "Knowledge transfer on genetic resources"		
3.3	Promote knowledge transfer from science/ research to practice	Research funding; events; publications	Funding volume and number of funding measures; number of events, published information materials
3.4	Intensify public relations work on the importance of and threats to genetic resources	Information offered by the IBV and Federal Information Center for Agriculture (BZL); coordination of expert discussions; events for networking the relevant persons/institutions	Number of events organised by the BMEL or on behalf of the BMEL
3.5	Inform individuals and institutions that conduct research with genetic resources for food and agriculture or develop products from them about their obligations regarding access to genetic resources and benefit-sharing	Collaboration with the responsible Federal Agency for Nature Conservation (BfN); enquiry about special information needs on genetic resources for food and agriculture and correspondingly continue and/or expand information services of the IBV	Result of demand enquiries and number of presentations and responses to user enquiries by IBV

	Area of Action	Implementation path/ instruments of the BMEL	Monitoring of measures (report every 5 years)
3.6	Create information materials on genetic resources for food and agriculture for vocational training at agricultural vocational and technical schools (school/practice/consumption)	Continue BZL information services in cooperation with partners	Number of information services offered by the BZL for training and further education
3.7	Strengthen information offered on genetic resources for food and agriculture for general education schools (teaching modules, school gardens, etc.)	Expand existing BZL/BZfE (Federal Centre for Nutrition) information services to include the topic of genetic resources	Extent of information offered
	Measures: "Collect and make available characterisation data"		
3.8	Strengthen the collection and availability of characterisation and evaluation (C+E) data of genetic resources, promote method development, development of new concepts and techniques for data infrastructure	Research funding	Available C + E data; number of nationwide surveys in the field of biodiversity; including research projects, development status of the data infrastructure
3.9	Establish systematic and nationwide genetic inventories to ensure the nationwide uniform collection, evaluation and selection of conservation units of forest genetic resources in the long term	Infrastructure maintenance and development in federal facilities	Number of tree species that are genetically recorded in conservation stands.
	Measures: "Monitoring of the status of genetic resources and their utilisation"		
3.10	Establish, strengthen and secure long-term monitoring of genetic diversity in agricultural landscapes (MonVia), forests and water bodies	Infrastructure maintenance and development in federal institutions; research funding (e.g. survey projects)	Indicators from "MonVia" (Monitoring biodiversity in agricultural landscapes) on genetic diversity and from "NaBioForest" (National biodiversity monitoring in forests) are regularly surveyed; number of other nationwide surveys with BMEL funds in the area of biodiversity

	Area of Action	Implementation path/ instruments of the BMEL	Monitoring of measures (report every 5 years)
3.11	Continuously expand monitoring to include molecular-genetic monitoring programs	Coordination of the development of concepts and their implementation; research funding	Status of the development of concepts and their implementation
3.12	Further develop threat classifications for genetic resources for food and agriculture	Infrastructure maintenance and development in federal institutions; research funding	Status of hazard classifications
3.13	Promote exchange with the *National Monitoring Centre for Biodiversity (NMZB)* on the overall concept of national biodiversity monitoring, incorporate the interests of genetic resources for food and agriculture into committee work at the NMZB	Infrastructure maintenance and expansion in federal facilities	Representation in committees by IBV and departmental research
3.14	Examine the contribution of the "Wildlife Information System of the German Federal States" (WILD) to the monitoring of genetic diversity in agricultural landscapes, forests and water bodies	Coordination of relevant persons/institutions	Audit completed
4	**Cooperation**		
	Goal → **There is good cooperation at national, European and international level in all areas of activity**		
	Measures for national cooperation		
4.1	Continue and, where necessary, expand the Information and Coordination Centre for Biological Diversity (IBV) at national level and as an interface to the European and international level	Infrastructure maintenance and development in federal facilities	Number of staff positions assigned to the coordination task
4.2	Continuously support the work of the national advisory councils and the Scientific Advisory Council on Biodiversity and Genetic Resources of the BMEL (departments, meetings, public relations, publications, scientific staff)	Continue to implement the IBV's coordination mandate Infrastructure maintenance and expansion	Number of meetings held; mention of important results

	Area of Action	Implementation path/ instruments of the BMEL	Monitoring of measures (report every 5 years)
4.3	Support already established networks (e.g. gene bank networks) and expand the networking of stakeholders in order to cover all relevant or prioritised genetic resources in the future	Continue to implement the IBV's coordination mandate, use or expand the IBV's information services for networking if necessary	Number of dialogue events on genetic resources and important results; number of other networking activities
4.4	Dialogue formats and networking structures for the conservation and sustainable use of genetic resources		
	Measures: "European and international cooperation"		
4.5	Advocate within the framework of international and European negotiations on access to genetic resources and fair and equitable benefit-sharing → for easier access to genetic resources for food and agriculture → for open access to digital genetic sequence data (digital sequence information, DSI) and easily implementable mechanisms for equitable sharing of the resulting benefits, and → for capacity building in developing countries	Provide personnel capacities for participation in the relevant committees	Status of progress on facilitated access in the respective negotiations
4.6	Increase participation in EU-funded, European and international projects on genetic resources	Provide competences and manpower capacities for participation in the relevant projects and committees	Number of participations in corresponding projects

	Area of Action	Implementation path/ instruments of the BMEL	Monitoring of measures (report every 5 years)
4.7	Secure national membership fees for European cooperation programmes and international alliances and organisations	Financing instruments for membership fees and project funding	Budgetary funds for international organisations (FAO mandatory contribution, funding of international organisations in the field of genetic resources, membership fees ECPGR, ERFP, EUFORGEN; BMEL funding GCDT; ITPGRFA) cover the contributions
4.8	Provide more budget funds for projects within the framework of European cooperation programs	Title “Cooperation with international organisations” (see also: Long-term conservation)	Number of projects and budgetary funds spent
4.9	Establish a European strategy on genetic resources based on the results of the Genres-Bridge project and support its incorporation into the political decision-making processes in the EU	BMEL advocates the importance of an EU strategy in relevant EU bodies	Status of the establishment of the European strategy


Insert
Annex
Shift

Literature

AG NASTAQ (2020): *Nationaler Strategieplan Aquakultur 2021–2030 für Deutschland.*

Bantle C. und Hamm U. (2014): *Der Bezug von Verbrauchern zu Agrobiodiversität – Grundlagen für eine zielgruppengerechte Kommunikation.* → *In: Berichte über Landwirtschaft. Zeitschrift für Agrarpolitik und Landwirtschaft. Band 92, Ausgabe 3. 24 Seiten.*

Begemann F., Thormann I., Sensen S., Klein K. (2021): *Effective Coordination and Governance of PGRFA Conservation and Use at the National Level-The Example of Germany. Plants (Basel). 2021 Sep 9;10(9):1869.* → *doi: 10.3390/plants10091869. PMID: 34579401; PMCID: PMC8465119.*

BMBF and BMEL (2020): *National Bioeconomy Strategy.* → *https://www.bmbf.de/SharedDocs/Publikationen/DE/FS/31617_Nationale_Biooekonomiestrategie_Langfassung_en.html*

BMEL (2010): *Forest Genetic Resources in Germany. Concept for the Conservation and Sustainable Utilization of Forest Genetic Resources in the Federal Republic of Germany, Berlin* → *https://www.genres.de/fileadmin/SITE_MASTER/content/Publikationen/Forest_Genetic_Ressources-2010.pdf*

BMEL (2012): *Beans, Peas & Co. – The Federal Ministry of Food and Agriculture´s Protein Crop Strategy for promoting the cultivation of pulses in Germany.* → *https://www.bmel.de/SiteGlobals/Forms/Suche/EN/Publicationssearch/Publicationssearch_Formular.html?gtp=42718_list%253D3&view=processForm*

BMEL (2020): *Addressing climate change - Measures to adapt agriculture, forestry, fisheries and aquaculture to climate change.* → *https://www.bmel.de/SharedDocs/Downloads/EN/Publications/climate-change.pdf?__blob=publicationFile&v=2*

BMEL (2021a): *Ackerbaustrategie 2035. Perspektiven für einen produktiven und vielfältigen Pflanzenbau. Berlin.* → *https://www.bmel.de/SharedDocs/Downloads/DE/_Landwirtschaft/Pflanzenbau/ackerbaustrategie2035.html*

BMEL (2021b): *Waldstrategie 2050. Nachhaltige Waldbewirtschaftung – Herausforderungen und Chancen für Mensch, Natur und Klima. Bonn.* → *https://www.bmel.de/SharedDocs/Downloads/DE/_Wald/Waldstrategie2050.pdf?__blob=publicationFile&v=10*

BMEL (2022): *Erhaltung und nachhaltige Nutzung aquatischer genetischer Ressourcen. Das nationale Fachprogramm in Deutschland.* → *https://www.genres.de/fileadmin/SITE_MASTER/content/Publikationen_IBV/aquatische-genetische-ressourcen.pdf*

BMEL (2023a): *The Future of Agriculture. A common agenda. Recommendations of the Commission on the Future of Agriculture (ZKL).* → *https://www.bmel.de/SharedDocs/Downloads/EN/_Farming/zkl-report-2024.pdf?__blob=publicationFile&v=6*

BMEL (2023b): *Ergebnisse der Waldzustandserhebung 2022.* → *https://www.bmel.de/SharedDocs/Downloads/DE/_Wald/waldzustandserhebung-2022.pdf?__blob=publicationFile&v=7*

BMEL (2023c): *Öko-Landbau stärken: Prozess zur Erarbeitung der Bio-Strategie 2030.*

BMEL (2024a im Druck): *Nationales Fachprogramm zur Erhaltung und nachhaltigen Nutzung tiergenetischer Ressourcen in Deutschland.*

BMEL (2024): *Nationales Fachprogramm für pflanzengenetische Ressourcen für Ernährung und Landwirtschaft.* → *https://www.genres.de/fileadmin/SITE_MASTER/content/Publikationen/BMEL_R522_Nationales_Fachprogramm_pflanzengenetische_Resso_M7_gesamt_bf.pdf*

BMU (2007): *Nationale Strategie zur biologischen Vielfalt. in Überarbeitung, Stand abrufbar unter* → *https://www.bfn.de/neuauflage-der-nationalen-strategie-zur-biologischen-vielfalt*

BMU, BMJV und BMEL (2019): *Nationales Programm für nachhaltigen Konsum. Gesellschaftlicher Wandel durch einen nachhaltigen Lebensstil.* → *https://nachhaltigerkonsum.info/sites/default/files/medien/dokumente/nachhaltiger_konsum_broschuere_bf.pdf sowie Beschluss Staatssekretärsausschuss zur Weiterentwicklung des NPNK (2021).* → *https://nachhaltigerkonsum.info/sites/default/files/medien/dokumente/beschluss-sts-ausschuss-5-2021-nachhaltiger-konsum-data.pdf*

BMUV (2024): *Die Nationale Strategie zur Biologischen Vielfalt 2030 (NBS 2030).* → *https://www.bmuv.de/download/die-nationale-strategie-zur-biologischen-vielfalt-2030-nbs-2030*

Brämick U. und Schiewe S. 2021: *Jahresbericht zur Deutschen Binnenfischerei und Binnenaquakultur 2021. Institut für Binnenfischerei e.V. Potsdam-Sacrow.* → *https://www.ifb-potsdam.de/veroeffentlichungsdatenbank/ansicht/17138/jahresbericht-zur-deutschen-binnenfischerei-und-binnenaquakultur-2021.html#publication_file*

Breidenassel C., Schäfer A.C., Micka M., Richter M., Linseisen J., Watzl B. for the German Nutrition Society (DGE): *The Planetary Health Diet in contrast to the food-based dietary guidelines of the German Nutrition Society (DGE). A DGE statement. Ernährungs Umschau 2022; 69(5): 56–72.e1–3.* → *https://www.dge.de//fileadmin/dok/wissenschaft/positionen/EU05_2022_PR_DGE_Position_en.pdf*

Bundesinformationszentrum Landwirtschaft (2021): *„Kulturpflanzen – Vielfalt erhalten". Bundesanstalt für Landwirtschaft und Ernährung (BLE).* → *https://www.landwirtschaft.de/einkauf/einkaufstipps/regional-und-saisonal/kulturpflanzen-vielfalt-erhalten*

DWD (2022): *Nationaler Klimareport; 6. überarbeitete Auflage, Deutscher Wetterdienst, Deutschland, 53 Seiten.* → *https://www.dwd.de/DE/leistungen/nationalerklimareport/download_report.pdf*

FAO (1996): *World Food Summit: Rome Declaration on World Food Security and World Food Summit Plan of Action. Rome.* → *https://www.fao.org/4/w3613e/w3613e00.htm*

FAO (2019): *The State of the World's Biodiversity for Food and Agriculture, J. Bélanger and D. Pilling (eds.). FAO Commission on Genetic Resources for Food and Agriculture Assessments. Rome.* → *http://www.fao.org/3/CA3129EN/CA3129EN.pdf*

FAO (2020): *How the world's food security depends on biodiversity. FAO Commission on Genetic Resources for Food and Agriculture. Rome.* → *https://www.fao.org/3/cb0416en/CB0416EN.pdf*

FAO (2021): *World Food and Agriculture – Statistical Yearbook 2021. Rome.* → *https://doi.org/10.4060/cb4477en*

FAO (2022): *The State of the World's Forests 2022. Forest pathways for green recovery and building inclusive, resilient and sustainable economies. Rome, FAO.* → *https://doi.org/10.4060/cb9360en*

FAO, IFAD, UNICEF, WFP and WHO (2021): *The State of Food Security and Nutrition in the World 2021. Transforming food systems for food security, improved nutrition and affordable healthy diets for all. Rome, FAO.* → *https://doi.org/10.4060/cb4474en*

IPBES (2019): *Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. Bonn, Germany. 56 pages.* → *https://files.ipbes.net/ipbes-web-prod-public-files/inline/files/ipbes_global_assessment_report_summary_for_policymakers.pdf*

IPBES (2023): *Glossary "ecosystem services",* → *https://www.ipbes.net/node/41074*

IPCC, 2022: *Summary for Policymakers. In: Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge, UK and New York, NY, USA, p. 3–33,* → *https://doi.org/10.1017/9781009325844.001*

Khoury C.K., Carver D., Greene S.L., Williams K.A., Achicanoy H. A., Schori M., León B., Wiersema J.H. and Frances A. (2020): *Crop wild relatives of the United States require urgent conservation action. Proceedings of the National Academy of Sciences, 117(52), 33351–33357.* → *DOI:10.1073/pnas.2007029117*

MCPFE (1998): *Third Ministerial Conference on the Protection of Forests in Europe (Lisbon/Portugal), RESOLUTION L2 Pan-European Criteria, Indicators and Operational Level Guidelines for Sustainable Forest Management.* → *https://foresteurope.org/wp-content/uploads/2016/10/MC_lisbon_resolutionL2_with_annexes.pdf*

Menger K., Feldmann A., Dorkewitz K. und Hamm U. (2020): *Vermarktungskonzepte für Produkte gefährdeter Nutztierrassen. Universität Kassel.* → *https://orgprints.org/37582/1/37582-15NA168-15NA028-geh-unikassel-feldmann-hamm-2020-vermarktung-gefaehrdeter-nutztierrassen.pdf*

Rawal V., Bansal V. and Thokchom D. (2019): *Biodiversity for Food and Agriculture and Food Security. An Exploration of Interrelationships, CGRFA/FAO Background Study Paper No. 69* → *https://www.fao.org/cgrfa/resources/background-studypapers/en/*

Statistisches Bundesamt (2022): *Statistisches Jahrbuch über Ernährung und Landwirtschaft* → *https://www.bmel-statistik.de/fileadmin/SITE_MASTER/content/Jahrbuch/Agrarstatistisches-Jahrbuch-2022.pdf*

Tscharntke T. (2022): *Agrarökosysteme und das Biodiversitäts-Management von Agrarlandschaften. Bioökonomie im Lichte der Nachhaltigkeit.* → *Chapter 1.1. p. 11-16. Bundesamt für Naturschutz.*

Glossary

"Agro-biodiversity" or biological diversity for food and agriculture:	This refers to the part of biodiversity that is or could potentially be significant for agriculture, forestry, fisheries and food production: Organisms that maintain ecosystem structures, functions and processes in and around production systems (→ Associated biodiversity) and those that provide food and other supplies (→ Genetic resources for food and agriculture; → Wild foods).
Animal genetic resources	"Material from animals used for agriculture and food production (farm animals)" (BMEL 2024a). Like the National Specialist Program for the Conservation and Sustainable Use of Animal Genetic Resources in Germany, the measures mentioned in this strategy are limited to the native breeds of the livestock species cattle, pigs, sheep, goats and horses that are regulated under animal breeding law. In addition, rabbits, the poultry species chicken, turkey, duck, goose and pigeon as well as the honey bee are taken into account.
Aquatic genetic resources:	"Genetic material of actual or potential value of plant, animal, microbial or other origin containing functional units of heredity". Aquatic genetic resources in this sense include all aquatic genetic resources." (BMEL 2022). Like the National Program for the Conservation and Sustainable Use of Aquatic Genetic Resources, this strategy is initially limited to fish, cyclostomes, bivalves, decapod crustaceans and their spawn or larval stages that are relevant to the German fisheries and aquaculture sector.
Associated biodiversity	Components of biodiversity that occur within production systems (forest, cropland and pastureland, ponds, rivers) and can contribute to ecosystem function or production in a variety of ways (FAO 2019).
Biological diversity/Biodiversity	"The variability among living organisms from all sources, including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems." [1]
Cultural landscape	"The landscape shaped by humans". The cultural landscape has therefore developed from the natural landscape over thousands of years. The agricultural and forestry utilization of the landscape has had and continues to have a particularly formative influence on the cultural landscape. Factors such as the mechanization of agriculture and forestry and the market-oriented production of agricultural and forestry products contribute greatly to the dynamic development of the cultural landscape.[2]
Ecosystem performance/ Ecosystem services	"The benefits that people derive from ecosystems".[3] A distinction can be made between four categories of ecosystem services: provisioning, regulating, supporting and cultural services. "Provisioning services" are the products obtained from ecosystems, i.e. food and raw materials of various kinds, including the products of agricultural and food systems. "Regulating services" are services resulting from the regulation of ecosystem processes, e.g. the regulation of climate, air and water quality, diseases and natural disasters. "Cultural benefits" are the non-material benefits that people derive from ecosystems through spiritual enrichment, cognitive development, reflection, recreation and aesthetic experiences. "Supporting services" are services that are necessary for the production of all other ecosystem services. Examples include photosynthesis and nutrient cycling. Supporting services are characterized by the fact that they have a less direct impact on human well-being.

1 Convention on biological diversity(CBD) (1992), see article 2.
2 https://www.landwirtschaftskammer.de/landwirtschaft/landentwicklung/kulturlandschaft/index.htm
3 Millennium Ecosystem Assessment (2005). Ecosystems and human well-being: synthesis. Washington DC, Island Press.

Forest genetic resources	"Genetic material of tree and shrub species with actual or potential value for sustainable multifunctional forestry" (BMEL 2010).
Genetic diversity	Variability within species, varieties, breeds, lines and strains.
Genetic resources	"Genetic material of actual or potential value". "Genetic material" is in turn defined as "any material of plant, animal, microbial or other origin containing functional units of heredity"[1]. Genetic resources may be embodied in living plants, animals or micro-organisms or in stored seeds, sperm, ova, embryos, somatic cells or isolated DNA (deoxyribonucleic acid).
Genetic resources for food and agriculture	The term "for food and agriculture" in this strategy (as in the FAO) also includes forestry, aquaculture and fisheries, i.e. it refers to genetic resources that are important for agriculture, forestry, fisheries and the food industry (see also Plant Genetic Resources for Food and Agriculture, Animal Genetic Resources, Forest Genetic Resources, Aquatic Genetic Resources and Genetic Resources of Microorganisms and Invertebrates).
Genetic resources of microorganisms and invertebrates	These refer to genetic resources of microorganisms (including viruses and fungi) and invertebrates of actual or potential value for food and agriculture. Among the insects, important groups are above all the pollinators wild bees and hoverflies as well as the honeybee, beneficial organisms for biological pest control, natural antagonists of harmful organisms, soil organisms and microorganisms that play a role in ruminant digestion and are important for food processing and agro-industrial processes, as well as biological pesticides and biocides.[4]
Genome and sequence information	The genome or genetic material of a living organism is the entirety of the heritable information of a cell, which is present as deoxyribonucleic acid (DNA) or ribonucleic acid (RNA). The genome contains the information necessary for the development and expression of the specific characteristics of the organism or virus. This information is contained in the base sequence of the DNA. Not officially defined term; in political discussions the term "digital sequence information (DSI)" or "genetic sequence data (GSD)" is used as a placeholder.
Monitoring	"Ongoing observation, monitoring and control of procedures or processes within a system with continuous collection, evaluation, interpretation and provision of relevant data, indicators or events as a basis for decisions".[5]
Nagoya Protocol	Supplementary Protocol to the Convention on Biological Diversity that regulates access to genetic resources and the fair and equitable sharing of benefits arising from their utilization.
Passport data	Passport data comprise the provenance and origin data of a gene bank accession or the occurrence data of a population, as well as the best possible taxonomic identification. They include the name and/or number of the accession/population, country of origin, scientific name of the taxon, the conserving institution, date of collection, acquisition or observation. Standardized methods exist to facilitate the description and exchange of information on genetic resources.
Pedigree	Origin/descent

4 FAO (2017). Sixteenth Regular Session of the Commission on Genetic Resources for Food and Agriculture. CGRFA/16/17/Report Rev.1. paragraph 79. Rome, 30 January – 3 February 2017. https://www.fao.org/3/ms565e/ms565e.pdf

5 Birkmann, J. (2005): Monitoring In: ARL (Hrsg.): Handwörterbuch der Raumordnung. Hannover, S. 668.

Phenotyping	Phenotyping describes a relatively new branch of plant research in which the appearance (phenotype) of plants is quantitatively analyzed and measured. Researchers record, for example, the architecture of roots or the number of leaves.[6]
Plant genetic resources	Any genetic material of plant origin that has actual or potential value for food and agriculture (BMEL 2024)
Production systems	Production systems include the crop production, livestock farming, forestry, fisheries and aquaculture sectors. According to the FAO definition, agriculture also includes forestry, fisheries and aquaculture.
Sustainable use	As defined in the CBD, "sustainable use" means the use of components of biological diversity in a manner and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations. For genetic resources for food and agriculture, "sustainable use" means maintaining and making available sufficient genetic diversity in varieties, breeds or populations of crops and livestock in production and/or in their habitat.
Venison	Meat of huntable wild animals that are regulated by the Federal Hunting Act and intended for human consumption.
Wild foods	Wild foods are foods that come from non-domesticated species (e.g. mushrooms or → venison). They can be gathered or hunted and occur within managed production systems or originate from other ecosystems. The group of wild species that provide food overlaps to varying degrees with the areas of genetic resources addressed. For example, capture fisheries are probably the largest single example of human utilization of wild species.

6 https://www.pflanzenforschung.de/de/pflanzenwissen/lexikon-a-z/phaenotypisierung-10020

List of Abbreviations

ABS	Access and Benefit Sharing (Nagoya Protocol)
AG NASTAQ	Working Group National Strategic Aquaculture Plan for Germany
AGR	Animal Genetic Resources
AGRDEU	National Inventory of Aquatic Genetic Resources
AMC-Resolution	Resolution of the Conference of Agriculture Ministers
AqGR	Aquatic Genetic Resources
AquaGRIS	Global Information System for Aquatic Genetic Resources
BfN	Federal Agency for Nature Conservation
BLE	Federal Office for Agriculture and Food
BMBF	Federal Ministry of Education and Research
BMEL	Federal Ministry of Food and Agriculture
BMUV	Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection
CBD	Convention on Biological Diversity
CFP	Common Fisheries Policy of the EU
CGRFA	Commission for Genetic Resources for Food and Agriculture
CWR	Crop Wild Relatives
DAD-IS	Domestic Animal Diversity Information System
DGE	German Nutrition Society
DNA	Deoxyribonucleic acid
DSI	Digital Sequence Information on Genetic Resources
DWD	German Weather Service
ECPGR	European Cooperative Program for Plant Genetic Resources
EMFAF	European Maritime, Fisheries and Aquaculture Fund
ERFP	European Regional Focal Point for Animal Genetic Resources
EUFGIS	European Information System on Forest Genetic Resources
EUFORGEN	European Forest Genetic Resources Program
EURISCO	European Search Catalogue for Plant Genetic Resources
FAO	Food and Agriculture Organization of the United Nations
FGR	Forest Genetic Resources
FGRDEU	National Inventory of Forest Genetic Resources
GAK	Joint Task “Improvement of the Agricultural Structure and Coastal Protection”
GAP	Common Agricultural Policy of the EU
GEH	Society for the Conservation of Old and Endangered Domestic Animal Breeds e. V.
Genesys	Online platform with information on plant genetic resources in gene banks worldwide
HSWT	Weihenstephan-Triesdorf University of Applied Sciences
IBV	Information and Coordination Center for Biological Diversity
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services

IPCC	Intergovernmental Panel on Climate Change (Intergovernmental Panel on Climate Change)
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
IPK	Leibniz Institute of Plant Genetics and Crop Plant Research
MCPFE	Ministerial Conference on the Protection of Forests in Europe (today: Forest Europe)
MDP	Model and Demonstration Project
MGR	Genetic Resources of Microorganisms and Invertebrates
MonVia	BMEL joint project on monitoring biodiversity in agricultural landscapes
NaBioForest	National Biodiversity Monitoring in Forests
NBS	National Strategy on Biological Diversity
NMZB	National Monitoring Centre for Biodiversity
PDO	Protected designation of origin
PGR	Plant Genetic Resources
PGRDEU	National Inventory of Plant Genetic Resources
SilvaGRIS	Global Information System for Forest Genetic Resources
TGRDEU	National Inventory of Animal Genetic Resources
UPOV	International Union for the Protection of New Varieties of Plants
VEN	Association for the Conservation of Crop Diversity
VERN e. V.	Association for the Conservation and Recultivation of Crop Plants
Wiews	World Information and Early Warning System on Plant Genetic Resources for Food and Agriculture
WILD	Wildlife Information System of the German Federal States
ZKL	Future Commission for Agriculture

PUBLISHED BY
Federal Ministry of Food and Agriculture (BMEL)
Division 522 – Biodiversity and nature protection
Rochusstraße 1
53123 Bonn
522@bmel.bund.de

AS OF
January 2024

TEXT
BMEL

DESIGN
Serviceplan Make GmbH & Co. KG, München

The publication can be downloaded from the BMEL homepage:
www.bmel.de/publikationen

PHOTO CREDITS
Front page: Rhönbergfoto/stock.adobe.com; p. 4: teddiviscious/stock.adobe.com; p. 6: Giuseppe Blasioli/stock.adobe.com; p. 7: Martin Grimm/stock.adobe.com; p. 9: UbjsP/stock.adobe.com; p. 9: Jürgen Lochbihler/MurnauWerdenfelser; p. 12: Sonyakamoz/stock.adobe.com; p. 14: Credit CIAT_Georgina-Smith; p. 14: Alessio Orrù/stock.adobe.com; p. 15: christiane65/stock.adobe.com; p. 16: Landesforstverwaltung Baden-Württemberg LFV BW/Archiv; p. 17: Georgenhausen/creativecommonswikipedia; p. 18: Ingo Bartussek/stock.adobe.com; p. 19: @ostmost; p. 20: MarekPhotoDesign.com/stock.adobe.com; p. 21: Leibniz-Institut für Pflanzengenetik und Kulturpflanzenforschung; p. 25: A. Wosnitza/LfL; p. 26: Ina/stock.adobe.com; p. 26: Leibniz-Institut für Pflanzengenetik und Kulturpflanzenforschung; p. 27: Agrar-motive/stock.adobe.com; p. 28: BLE; p. 31: BLE; p. 33: Maxsitt CC BY-SA 4.0; p. 36: ENB_CGRFA17_19Feb19_KiaraWorth-7; p. 39: Bauer Alex/stock.adobe.com; p. 40: sushytska/stock.adobe.com; p. 52: jd-photodesign/stock.adobe.com

For further information please visit
www.bmel.de/EN/Home/home_node.html
www.bmel.de/social-media