Federal Ministry of
Food, Agriculture
and Consumer Protection

Biologische VIELFALT
Schutz durch Nutzung

Conservation of Agricultural Biodiversity, Development and Sustainable Use of its Potentials in Agriculture, Forestry and Fisheries

A Strategy of the German Federal Ministry of Food, Agriculture and Consumer Protection on Conservation and Sustainable Use of Biodiversity for Food, Agriculture, Forestry and Fisheries

The first part of this strategy defines the terms used, explains the role and development of agricultural biodiversity, sets out the basic policy approaches and outlines conservation measures taken so far.

The main part sets out the strategy's objectives, looks at general and cross-cutting issues related to agricultural, and describes measures available to ensure the conservation and sustainable use of agricultural biodiversity. It then describes the current situation, areas in need of improvement and measures that are necessary in each sector (crop production, livestock production, forestry, hunting and fishing) and as regards micro-organisms and other small life forms. The sub-sections that outline the various measures each begin with a vision that summarises the respective aims and priority measures.

The third and final part describes a series of 'flagship' projects whose implementation is of key importance to the strategy's success.

Preface

Dear Reader,

the United Nations declared 2010 as the International Year of Biodiversity in order to reaffirm the global importance of this issue at international level. Agricultural biodiversity – the term used to describe the diversity of plants and animals used in food, agriculture, forestry and fisheries – is a major part of the biological diversity that exists on Earth. This rich diversity provides the genetic resources needed for food and agriculture. Agriculture interacts closely with surrounding ecosystems: agricultural and other farming activities have long shaped our landscapes and created habitats for a wide range of flora and fauna.

Biodiversity is at risk everywhere, including in Germany. Overexploitation and economic greed threaten its sustainable use by humankind, so putting the basic resources needed for the survival of future generations at risk. We have an obligation, therefore, to strike the right balance between biodiversity use and biodiversity conservation, not least in light of the altered conditions arising from phenomena like climate change. Biological diversity provides a vital platform for varied agricultural practices and advancements in plant and animal breeding. These in turn are reliant on in-depth research into biodiversity and its environmental context. But consumers, too, must be better informed and be made more ecologically-aware. They must also be afforded greater market transparency (via certification and quality assurance schemes for example) to aid their purchasing decisions.

This strategy was devised with the aim of fostering the conservation and sustainable use of biodiversity in food, agriculture, forestry, and fisheries. With it, we aim to:

- Achieve long-term conservation and broader-based use of genetic resources;
- Achieve sustainable use of agricultural biodiversity while protecting natural ecosystems and threatened species;
- Strengthen international cooperation and a globally coordinated strategy for the management of global resources.

While these aims can be achieved in many ways, all action must ensure that precautionary measures and mitigation responses go hand in hand. The greater the number of organisations who work towards the common cause, the more people who get involved, the greater the chance of preserving biological diversity and securing a sustainable food supply for the world's population. Conservation and sustainable use of biological diversity are of equal importance. They are a shared responsibility and one we must give our utmost attention.

Ilse Aigner
Federal Minister of Food,
Agriculture and Consumer Protection

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Introduction

The Earth's biological diversity has suffered massive losses in recent decades, putting the resources vital to life on the planet at great risk.
The Convention on Biological Diversity (CBD), which was adopted at the 1992 UNCED Earth Summit and to which Germany and most other countries of the world are signatories, sets out three main goals:

- Conservation of biological diversity;
- Sustainable use of its components;
- Fair and equitable sharing of benefits arising out of the utilisation of genetic resources.

The Parties to the CBD have, among other things, agreed to:

- Develop national strategies, programmes and plans for the conservation and sustainable use of biological diversity;
- Integrate the CBD goals into their sectoral policies.

The International Treaty on Plant Genetic Resources for Food and Agriculture, which entered into force in 2004 and was ratified by Germany that same year, constitutes an international agreement that specifically focuses on agricultural biodiversity and restates the goals of the CBD in more concrete terms.

At the World Summit for Sustainable Development held in Johannesburg in 2002, the international community agreed to significantly reduce current rates of biodiversity loss by 2010. As its contribution to achieving this goal, Germany's National Biodiversity Strategy was approved by the German Cabinet on 7 November 2007.

The strategy set out in this publication targets a specific sub-section of biodiversity known as agricultural biodiversity and is designed to supplement and aid implementation of the National Biodiversity Strategy. Its main focus lies on the biodiversity used (directly and indirectly) for food, agriculture, forestry and fisheries. These resources serve in meeting the basic needs of the world's rapidly growing population, not least in ensuring the availability of food, clothing, energy and raw materials, and also in meeting cultural needs. The very different locational conditions and breeding activities involved result in great diversity, both in the species used and in genetic variability within them. This diversity is also threatened by the possibility of significant losses.

Agricultural management systems are highly dependent on interactions with their surrounding ecosystems. Thus, sustainable use of plant and animal genetic resources should involve not only the conservation of livestock species and their intraspecific diversity, but the conservation of agricultural biodiversity as an integral component of sustainable management practice.

One of the aims of this strategy, therefore, is to serve the implementation of Germany's Sustainability Strategy. As agriculture dominates and shapes the landscape in rural regions, including coastal areas, the contribution made by this strategy is also of particular relevance in efforts towards achieving sustainable *rural* development.

Ideally, the strategy will create a coherent framework within which the state can take action to achieve both medium and longer-term objectives. Conservation of agricultural biodiversity is generally reliant on pro-active, sustainable use of as many of its components and ecological functions as possible.

Developing and implementing the strategy is a cross-sectoral responsibility with the priority on measures with medium-term goals of between five and ten years. The goals and measures will be subject to regular monitoring. This in turn calls for the development of suitable indicators.

The ultimate aims of the strategy are to:

- Achieve transparency as regards the objectives being pursued and the measures deemed necessary to achieve them.
- Incite and encourage action in other areas of society.
- Foster dialogue and cooperation between key social actors and facilitate their participation in implementation of the strategy and that of the national action plan.
- Inform the general public about the role of agricultural biodiversity, the need to conserve and use it sustainably, and measures needed to do so.

1 Agricultural Biodiversity as a Component of Biological Diversity: The Environmental, Economic and Social Context

1.1 Definition of Agricultural Biodiversity

Biodiversity refers to the Earth's diverse life forms[1], ecosystems and species, and genetic variability within species. It plays a pivotal role in the life-giving systems that make up the biosphere (climate regulation, water replenishment and soil formation for example) and is thus vital to human survival. It is also indispensable in the processes of evolution and adaptation to changing conditions.

Primarily, **agricultural biodiversity** is understood to be the diversity in life forms used or able to be used directly or indirectly by humankind in efforts to secure the resources vital to survival: crops (including their wild relatives), forest plants, livestock, wildlife that can be hunted or otherwise made use of, fish and other aquatic life forms, microorganisms used in food technology and other processes, and other small life forms. Given that their traits are genetically prescribed and, as a result of breeding, can affect changes in the traits of whole populations, they are also described as genetic resources for food, agriculture, forestry and fisheries[2]. For reasons of simplicity, the term 'genetic resources for food and agriculture' is used throughout. Although only a relatively small part of the entire species spectrum is used in breeding, human activities that involve animal and plant breeding have resulted in tremendous diversity of varieties, breeds and lines *within* the species in question.

The use of these life forms in agriculture, forestry and fisheries, hereafter described as 'agricultural practice', manifests itself in management systems which involve many different actors ranging from producers to consumers. These management systems are embedded into the surrounding ecosystems in a variety of ways and with varying degrees of intensity. The life forms used interact with others and work in conjunction with the surrounding ecosystems, e.g. soil organisms that aid soil fertility, promotion of beneficial animals and insects, and pollination of plants by insects. For this reason, apart from the diversity of used and usable species and their genetic diversity, agricultural biodiversity also includes the associated biodiversity that fulfils the various functions on which its use depends.

Structured mountain region

1 The Convention on Biological Diversity (CBD) defines biological diversity as "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".

2 Along with the food, agricultural, forestry and fisheries sectors, this also includes horticulture, the timber industry, hunting, aquaculture, beekeeping and the use of wild plants.

1.2 The Role of Agricultural Biodiversity

Land use in Germany comprises 53 percent agriculture and 30 percent forestry. Another 2.3 percent of the land is covered by water. The country's cultural landscape is largely shaped by the interactions that take place between land use and the natural environment. Agricultural practice and all forms of human activity impact on the landscape's suitability as a habitat for flora and fauna. Many wild flora and fauna such as weeds and crop-dependent animals are reliant on land use practices, one example being the open landscapes caused by farming. Thus, the associated land uses, and especially extensive land management practices such as grazing of heathlands, contribute to their conservation. For species that require a variety of different habitats over the course of their lifetime, landscape interactions are of key importance. The situation is similar for species that populate large-scale landscape complexes. Many species are dependent on the fringe areas between forests and open land, such as those that primarily occur in highly structured cultural landscapes but are also characteristic of many near-natural river and lake landscapes, peatlands and uplands. Finally, landscape-changing practices play a role in a landscape's residential, leisure and recreation valu.

The components of biodiversity used in agriculture have a significant economic value due to the market price of products they are used for; their use provides jobs and incomes for numerous people. For example, the output of Germany's agricultural sector is worth €43 billion, that of its forestry sector around €3 billion and that of its fisheries approximately €0.2 billion. Upstream and downstream sectors also play a considerable economic role. In 2003, the food industry accrued sales of some €128 billion, the timber industry €100 billion and the food retail sector €200 billion. While around 1.3 million people still work in agriculture, the number of people working in 'agribusiness' as a whole amounts to about 4.3 million. Another million jobs are provided by the forestry and timber sectors (including furniture and paper production).

Resources are also saved and production costs reduced in that the use of resistant varieties, more frequent crop rotation and breeding of more hardy animals (say, for free range rearing) provides for savings in costs and supplies. This is also the case as regards mixed crops and mixed forests that boost self-regulating mechanisms to deal with pests, disease and climatic conditions.

Apart from the *current* economic benefit, the diversity of used and usable life forms and their heritable traits provides a valuable resource for *future* uses and forms a basis for *innovation* and greater economic activity.

But most of all, the associated biological diversity that is not directly used alongside biodiversity components has a fundamental ecological value. This includes the vital ecosystem services which ensure that the ecosystems we use and the processes they involve actually work: such things as metabolic cycles, regeneration of soil properties and the self-cleaning ability of water bodies.

Apart from these ecological services, which society does not honour in its product pricing mechanisms, consideration must also be given to cultural and aesthetic values – the latter being of direct economic importance in the case of ornamental plants. Old livestock breeds and traditional species and varieties of ornamental plants lay testimony to the cultural services of earlier generations and to the historical development of farming and animal husbandry in a given region. Traditional forms of cultural landscapes influenced by agriculture activities, forest landscapes and coastal areas have great adventure and recreation value. Described as 'diversification' in agriculture and forestry, this in turn is of regional economic importance in attracting business investment.

Forest landscape in autumn

„Tirschenreuther Teichlandschaft“ - a landscape shaped by carp ponds

Finally, alongside the benefits it offers as a resource for human survival, biodiversity is also of value to the extent that for ethical reasons its existence cannot be wilfully put at risk. It is this responsibility that gives rise to the calls and the criteria developed for sustainable consumption and lifestyles.

If agro-ecosystems are to be kept stable, biodiversity conservation is necessary to ensure the long-term availability of components that become regionally threatened by new pathogens and diseases. This is also the case as regards adaptation to altered conditions like climate change and trends in consumer demand. Diversity is the main prerequisite to secure future use of biodiversity and allow advancements in breeding practices. Once it is lost, biodiversity cannot be restored. For this reason, great caution is needed and all the more so given that many development-related causes and interrelationships are still largely unknown.

Agricultural biodiversity is of key importance to world food supply, both now and in the future. It is vital in ensuring food security for the approximately 1.3 billion small farmers in developing countries and emerging economies. Around 75 percent of the 1.2 billion poorest people in the world live in rural areas and are dependent on traditional agriculture practices. This makes agricultural biodiversity a strategic resource in the fight against poverty in those regions.

1.3 Biodiversity Trends and Causes of Biodiversity Loss

Biological diversity is the result of the long and ongoing history of evolution on Earth. The dramatic biodiversity losses that have occurred over the course of time, and especially since the middle of the last century, have put many wild animals and natural ecosystems under severe threat, either in terms of their existence or their ability to function. This in turn poses a risk as regards sustainable use of ecosystem services by humankind. In Germany, some 40 percent of wild animals, 30 percent of ferns and flowering plants, and around 70 percent of natural habitats are now under threat.

Key factors involved in biodiversity loss include the destruction of habitats (e.g. as a result of urban sprawl, transportation infrastructure, and trade and industry), a drop in quality (for example through fragmentation and pollution) and the effects of climate change. Intensification of agriculture, forestry and fishing practices and, to a lesser extent, abandonment of former extensive management practices can all contribute to biodiversity loss. This is a slow and creeping trend which in some ways is intensified by both targeted and unintentional introduction of species[3] from other regions and countries as a consequence of growing international trade and travel. In the longer term, wider dispersal of invasive alien species in domestic habitats can put native species and ecosystems (natural, near-natural and managed) at risk.

Similar trends to those observed in wildlife are also evident in components of biodiversity used in agriculture. This is largely the result of long-standing breeding practices and in agriculture especially there has been a serious decline in the great regional diversity of crop species, varieties and livestock breeds (especially in farming) of former times. Today, more than 50 percent of the nutritional energy needed in the human diet worldwide comes from just three crops (maize, rice and wheat). The switch from traditional landraces to more modern, widely available varieties is seen as the main cause of genetic erosion[4] in crops.

Diversity of bean seeds

According to the World Watch List for Domestic Animal Diversity issued by the UN Food and Agriculture Organisation (FAO) and the UN Environmental Programme (UNEP), of the 5,639 breeds for which population data exist, some 3,143 (55.7 percent) are at risk of extinction. These are being displaced by the few widely used species and breeds which, thanks to strict breeding selection, produce high yields and can thus secure the supply of food for the world's growing population.

The decline in genetic diversity has affected agricultural crops, forestry plants, livestock, fish, microorganisms and other small life forms, albeit to differing degrees. While in the case of livestock, the animals used are largely 'adapted' products of selected breeding programmes, many non-adapted wild and traditional varieties are still used in crop breeding. Although a significant increase has been evident in natural forest rejuvenation in recent years, in Europe forest plants are largely grown from seed taken from selected base material stock. Where only wild plants are used, for example in coastal and deep-sea fishing, genetic restrictions and the risk to available stock can be attributed to other causes such as over-fishing and specific catch methods. In the case of forest plants, wild animals and fish, harmful changes in the environment – for example, excessive nutrient and pollutant inputs, and loss and fragmentation due to housing construction, road and waterway infrastructure – can effect a decline in their biological diversity.

3 Species introduced outside their natural range and whose introduction and spread pose a threat to biodiversity are defined in the CBD guiding principles as "invasive alien species".

4 Genetic erosion is defined as the loss of alleles (the traits of a gene in a specific locus), the loss of specific allele combinations and the loss of locally adapted varieties and breeds).

Apart from consumers' nutritional habits and purchasing behaviour, the causes for the decline in agricultural biodiversity lie in environmental changes and altered management systems – the latter being mainly due to changes in the economic operating environment and their impact on production processes. These in turn result in larger field sizes, more frequent crop rotation, a decline in structural diversity (loss of structural elements), greater use of machinery and the application of productivity-boosting and yield-securing resources (including fertiliser and plant protection products). While in many cases, agriculture actually creates the conditions needed to facilitate biodiversity conservation, it also poses a threat to nature and the landscape. And agriculture is affected in its own right by the vast areas of land used for housing, transport infrastructure and other land-use activities such as leisure and recreation.

The risk of biodiversity loss increases with:

- Stricter selection using just a few productivity-related traits in breeding programmes for the life forms involved;
- More intensive use of those life forms to increase yields per unit;
- And/or the numbers taken in relation to stock regeneration capacity.

From a global standpoint, population growth and rising per capita consumption of natural resources, altered environmental conditions and climate change are the key causes for the adverse changes in management systems, the loss of biodiversity and the threat to global ecological stability.

While in Germany and other industrialised countries, the greatest losses in biological diversity were largely recorded in the last century, biodiversity decline in developing countries is increasing apace. With regard to agricultural biodiversity, one cause is that these countries' development efforts often concentrate on a few crops that are slated for export (known as cash crops). This leads them to neglect the regionally important plants (food crops) and animals vital to providing a food supply for their populations. The reason is that globalisation and liberalisation of international trade have provided developing countries with greater opportunities to participate in the growing world agriculture market, thus supporting their development efforts. However, greater international competition leads to greater competition between developing countries themselves and between the various economic sectors within them. This fosters a widening growth gap, not least between commercial and export sectors, and also between the small-scale industry and agriculture sectors and businesses that largely operate on a self-sufficiency basis.

Also, degradation of terrestrial (forest, savannah and grassland) and aquatic habitats, intensive use of timber, over-grazing and over-fishing lead to a loss of the basic resources required in food production and for sustainable resource management. The natural resource base can be wiped out in its entirety if, for example, pasture land and tropical rainforests are converted into arable land for large-scale production of cash crops like soya and maize, thus destroying the vital resources necessary to the survival of indigenous populations. This often results in migration and rapid urbanisation which, as a consequence of the associated land use, accelerates the loss of traditionally used genetic resources and the knowledge needed to use them.

These developments are also of great importance in industrialised countries because many of the components of agricultural biodiversity they use – especially crops – largely originate from and have their centres of diversity in the world's developing countries.

1.4 Basic Policy Approaches

The recently concluded United Nations Millennium Ecosystem Assessment found that in recent decades, concentration on specific resources has meant that the existing model for human well-being and economic development has been based on an extremely one-sided use of ecosystem services, not least for food and agriculture. This has led to a neglect of other key ecosystem functions in which biological diversity plays a vital role. These include regulatory, support and balancing functions, and also cultural and aesthetic functions. The ensuing developments thus call for greater national, European (EU) and international efforts towards conserving biological diversity in general and agricultural biodiversity in particular.

In general, it can be assumed that the market cannot provide for long-term conservation and sustainable use of biological diversity. This is because in many cases biological diversity takes the form of a public good[5] even though some *components* of agricultural biodiversity[6] have an economic value and are frequently subject to private rights of disposal. As public goods are linked with externalities, they are a dual cause of 'market failure'. On the one hand, no-one can be excluded from using such goods, meaning that there is no incentive for individuals to make them available at their own expense for others to benefit from free of charge. This includes services towards conserving the structural diversity of the cultural landscape and old varieties and breeds. On the other hand, the negative effects that consumer and production decisions have on public goods in general are not included in individuals' cost calculations. This means that the resulting external costs are borne by society at large and not by the individuals responsible.

The existence of externalities justifies state intervention. This was recognised with the inclusion in 1994 of environmental protection as a state objective in Germany's Basic Law[7] which applies to all areas of state activity – legislation, administration and justice – and to the various policy sectors in their capacity as decisionmaking authorities. These are thus also under obligation to observe environmental policy requirements, particularly the precautionary principle[8]. Conservation and sustainable use of agricultural biodiversity as a component of the resources vital to human survival is not a policy or legal area in its own right. Rather, it is driven by agricultural, forestry, fisheries and trade policy and by other policy areas such as environment protection, nature conservation, research and development cooperation.

The options available for state intervention can be divided between legislative and market-based approaches: among the traditional legislative instruments are bans, obligations and statutory provisions (the setting of thresholds, for example) designed to limit or reduce the release of specific pollutants to predetermined levels. In the broadest sense, this category includes technical regulations and rules relating to products and processes as set out in requirements for good practice[9].

5 By definition, public goods possess two characteristics that distinguish them from private goods. Firstly, the lack of competition in their use given that the utility gained by an individual through the use of a public good is in no way influenced by the number of other users. Secondly, the non-applicability of the exclusion principle which results in the fact that an individual can use a public good without making a reasonable contribution to its provision (the free-rider phenomenon). There are, however, few truly public goods that fulfil both criteria.

6 Where the strategy mentions "sustainable use of agricultural biodiversity", it strictly means use of components of agricultural biodiversity.

7 Article 22a of the German Basic Law (Grundgesetz) states that "mindful also of its responsibility toward future generations, the state shall protect the natural bases of life by legislation and, in accordance with law and justice, by executive and judicial action, all within the framework of the constitutional order."

8 The precautionary principle takes in the notions of risk prevention and resource management to ensure the availability of resources to support human activity and existence.

9 In agriculture and forestry, the rules of good practice concerning the use of fertilisers, plant protection, soil protection and nature conservation law must be observed.

Legislation governs how to deal with impacts on nature and the landscape where the causer is required to compensate for damage that occurs. For components of nature and the landscape that have high conservation value and for threatened animal and plant species, protective provisions are prescribed by law, in some cases based on international agreements and EU law (for example, where such components represent Germany's contribution to the EU-wide Natura 2000 network of protected areas under the Habitats [10] and Birds [11] directives). Agricultural practices can be made subject to restrictions in line with the purpose for which a protected area is designated or, in extreme cases, can be completely prohibited in a protected area. With the exception of the 'biosphere reserve' [12] protection category, conservation and sustainable use of agricultural biodiversity and genetic resources for food and agriculture are facilitated but not expressly provided for by the designation of protected areas.

Alongside legislative models, market-based approaches are aimed at internalising externalities by means of pricing and quantities. By creating certain institutional conditions, different areas of industry are required to integrate the external costs they cause into their own cost calculations. The use of public goods, either in the form of consumption or damage arising from their use, can be subject to charges or state-determined contingents can be set (e.g. catch quotas and allowance allocations). The latter can be made tradable as with emissions trading.

To promote private provision of public goods in the environmental sector, ecological services such as activities to conserve or reproduce public goods are rewarded in monetary terms. Where there is a lack of private demand, the state acts as the demand side. Such financial incentives are, for example, provided by various environmental and agricultural policy instruments, including promotion of quality assurance schemes for ecological services and of innovations to allow exploitation of potential for using genetic resources that have either not been used so far or are no longer used.

„Heidschnucken" used in landscape mangement of heath in the „Lüneburger Heide"

10 Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive).
11 Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds (the Birds Directive).
12 Article 25 (1), Item 3 of the Federal Nature Conservation Act (BNatSchG) provides for biosphere reserves which serve "the primary purpose of preserving, developing or restoring landscape shaped by traditional, diverse forms of use, along with its historically evolved diversity of species and biotopes, including wild forms and formerly cultivated forms of commercially used or usable animal and plant species".

This also gives consideration to the fact that *acceptance* of biodiversity conservation measures is a fundamental requirement for the success of state intervention. Measures that involve voluntary and cooperative nature conservation activities, such as the contract-based nature conservation that has played an ever-increasing role since the mid-1980s, often prove to be a better approach than legislative regulation and are thus seen as the model for the future. But, after considering all available options and working on the notion of a good instrumental mix, the most important thing is to ensure that the most promising and cost-effective model is chosen.

Given that in contrast to biological diversity in general, the uses of agricultural biodiversity are immediately apparent and its components are usually subject to private rights of disposal, appropriate state-provided stimulus and steering mechanisms are needed to boost and steer the market towards conservation and sustainable use of genetic resources for food and agriculture. In many cases the general economic and political conditions are more decisive regarding conservation and loss of agricultural biodiversity than legislation. In this connection, predictive assessment of environmental impacts, suitable education and public relations work, and greater market transparency to facilitate more informed consumer choices are playing an increasingly important role. This is because failure to consider external costs is often due to the fact that market players are either not aware, or not sufficiently aware, of the interrelationships involved. Another approach is for the state to improve conditions to increase the effectiveness of private initiatives that serve conservation of biodiversity (including in relation to economic activity).

As concerns grow regarding the threat to biodiversity and its status as an increasingly scarce environmental resource, interest is growing at a similar rate regarding individual rights of disposal relating to economically valuable (commercialisable) components of biodiversity and associated knowledge on their use. One of the main problems faced is that biological material is often easy to reproduce and controlling distribution of reproductive material is extremely difficult. At the same time, breeding programmes are often reliant on easy access to a large range of biological material. This can give rise to conflict as has been seen, for example, in the debate on access to genetic resources and the use of patents and intellectual property rights on biological material. The question then arises as to how the indigenous knowledge so vital to sustainable use of biological diversity can be secured and safeguarded from unauthorised use.

"Braunvieh alter Zuchtrichtung" – an endangered breed

The fact that externalities associated with certain public goods often stretch beyond national borders highlights the need for supra-national strategies and has led to the term 'global public goods' being introduced into the development policy debate. Adverse effects on global public goods must be tackled by means of binding international agreements. Successful cooperation efforts require that all involved champion the common cause in the belief that they can benefit from joint action.

From a policy perspective, the various instruments and measures aimed at conserving agricultural biodiversity can be categorised into three different approaches:

At the forefront of all activities to conserve biodiversity is the conservation of natural habitats in which the respective species can survive, evolve and adapt (*in situ*[13] conservation). In the case of life forms that are utilised, this refers largely to wild species and their cultivated relatives that occur in natural conditions.

In situ conservation efforts include on-farm[14] management. This is an important strategy towards protecting threatened crop plants and farm animals and is designed to facilitate conservation through the use of species, varieties and breeds on farms and in the horticultural sector, and sometimes in agricultural history and open-air museums.

Cultivated species and wild species are conserved outside their natural habitats *ex situ*. This involves their transfer to special collections in gene banks, botanical and zoological gardens, arboretums and aquariums (*ex situ*[15] conservation). Historically, such *ex situ* collections were mainly created for crops. It was only much later that the importance of conservation measures to protect natural habitats came to light.

Because many components of agricultural biodiversity are directly dependent on human influence, conservation using appropriate management systems is vital to their sustainable use.[16] Thus, alongside the conservation approaches in the strict sense already outlined, sustainable management is a fundamental requirement for long-term conservation of biodiversity. Establishing *sustainable management approaches* is, however, an highly complex matter. The instruments available to facilitate their implementation are extremely diverse and, seen from a sectoral standpoint,[17] take in the entire spectrum of the above-mentioned strategies. Finally, it can be assumed that management systems are not only shaped by the available resources and management structures that have evolved over time, but to a large extent by changing conditions, which must therefore be given special consideration. Technology and technological advancement play a key role in that they can influence both the efficiency and environmental compatibility of resource management practices.

13 Under the CBD, in situ conservation means “the conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties”.

14 On-farm management is a special form of in situ conservation involving the conservation and further development of locally and regionally adapted farm and land varieties in the area in which they developed their particular traits, meaning on farms in the broader sense of the term.

15 Ex situ conservation is the conservation of genetic resources outside their natural habitats, e.g. the maintenance of generative and vegetative reproductive material (seeds, embryos, cuttings, cell cultures). Conservation can take the form of planting (say, in arboretums and stock raiser gardens) and in controlled conditions (at low temperatures, perhaps using in-vitro cultivation, cryoconservation and low humidity).

16 According to the CBD, sustainable use means “the use of components of biological diversity in a way 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”. A conscious link has thus been made between the terms sustainable use and sustainable development. According to the definition used in the WCED’s Our Common Future Report published in 1987, sustainable development is development that would “satisfy the needs of the present without compromising the ability of future generations to meet their own needs”.

17 Council Regulation (EC) No 2371/2002 of 20 December 2002 on the conservation and sustainable exploitation of fisheries resources under the Common Fisheries Policy defines, for example, sustainable use as the “exploitation of a stock in such a way that the future exploitation of the stock will not be prejudiced and that it does not have a negative impact on the marine eco-systems”.

1.5 Role and Development of the Regulatory Framework

Apart from targeted measures that have a direct impact, existing policy and economic conditions at international, EU and national level also play an important role in the conservation and sustainable use of biological diversity. This is why it is so important to create the right conditions to facilitate the conservation and sustainable use of agricultural biodiversity and to break down existing barriers, including those that hinder innovation.

This has been increasingly recognised in recent multi-level agricultural, forestry and fisheries policy reforms. With the common agricultural and fisheries policies (CAP and CFP), the European Plant Protection Organisation (EPPO), regional agreements on marine environment protection, the decisions made by meetings of European ministers in charge of forestry, and EU nature conservation and environment protection law, Germany and the EU have a broad range of approaches aimed at integrating environmental needs (including conservation and sustainable use of biological diversity) into the catalogue of measures applied to the respective sectoral policies. These approaches must be subject to ongoing advancement and, in the face of global competition, be underpinned at international level.

Effective international provisions are already in place, especially as regards environmental treaties and World Trade Organisation (WTO) rules, which include the Agreement on Trade-Related Intellectual Property Rights (TRIPs Agreement) – although in some respects the relationship between these and multilateral environment treaties is a point of contention.

Greater integration of national economies into the global market and the impact of globalisation and market liberalisation, particularly in the food and agriculture industries, see these sectors facing significantly heightened international competition and considerable pressure to adapt to structural change. Intensified international competition harbours the risk that in reducing or minimising production costs, public goods – such as natural ecosystems and biological diversity – are subjected to even greater pressures and are used beyond their natural regeneration capabilities. This risk is especially evident where exports of agricultural goods are high, agricultural raw materials are extensively refined and processed, and public goods enjoy only marginal protection.

In the first pillar (market and pricing policy) of the Common Agricultural Policy (CAP), Germany sets great store by the recent decoupling of price compensation payments from production and the phased switch to a uniform land-based premium. This gives farms greater economic scope in which to focus production on locational, agronomic and market-related conditions. Improving the conditions to foster innovation can, among other things, increase the market opportunities available to farmers.

The associated increase in competition harbours a risk that regions and low-yield management methods that play a key role in biodiversity conservation become obsolete or partially obsolete, thus posing a threat to conservation of the open cultural landscape. This is why the cross compliance provisions of the CAP place farmers under obligation to keep their land in good agricultural and environmental condition. They do not, however, promote conservation of valuable habitats and their species inventory.

Of direct importance are measures contained in the CAP second pillar on rural development, particularly the agricultural and forest environment measures whose legal basis is provided by the EAFRD Regulation[18] of September 2005. In particular, this promotes land management practices such as open orchard meadows, extensive pasturing and organic farming, all of which are of benefit in biodiversity conservation. The positive effects of CAP second pillar measures on biological diversity could be further enhanced with improved funding modalities and broader-based measures which take in other important structural elements of the cultural landscape and associated agricultural biodiversity.

These trends could be boosted in future by, for example, amending the WTO rules to provide for better integration of environmental needs once the 'Doha round' initiated by the WTO Conference of Ministers in 2001 has been concluded and by further restructuring of the CAP reforms for the period beyond 2013. Plus, against the backdrop of increasing energy crop cultivation in response to changed energy policy requirements, there is a need for research on the land use structures that can be expected in the future and their implications for conservation and sustainable use of biological diversity. Global trends and challenges, such as population growth and climate change, must be taken into account in this research.

18 Council Regulation (EC) No 1698/2005 of 20 September 2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD).

Moist meadows are an important habitat for many species. Management of these meadows is funded by EU agri-environmental programmes

Conservation of biological diversity is subject to a complex mesh of environmental, economic and social issues. It involves and affects a wide range of actors, both directly and indirectly. This calls for integrated thinking and action, and for the promotion of coherent state-led measures which include things like intensive cooperation between state-run agencies. It also gives rise to the need to solve or compensate for specific conflicts of interest. The first step here is to identify the parties and interests involved.
In the development and implementation of the necessary approaches, consideration must also be given to the varying areas of responsibility and policy levels (international, EU, national – in Germany, the federal and state (*Länder*) governments and local authorities). Close cooperation must be ensured between the various policy areas. In Germany, account must also be taken of the fact that when it comes to agricultural biodiversity, an increasingly important role is played by global economic and policy issues and their integration into EU legislation and other international law, while the powers of enforcement largely lie with the various German *Länder*. While cofinancing between differing levels can be used to support individual measures and activities, it can also reduce efficiency and diminish the degree of responsibility at the various levels involved.

Thus, in the interests of effective division of responsibility, the German federal government assumes specific coordination and monitoring functions.

Given the interrelationships between rights of disposal and areas of responsibility, cooperation between state and private actors and institutions is of key importance. This is especially the case at local level, the level at which conflicts of interest must ultimately be threshed out. Germany's landscape management associations (*Landschaftspflegeverbände*) could serve as a tried and tested model for use in the integration of differing interests and claims.

Numerous private initiatives and groups play a vital role in conserving agricultural biodiversity. These must receive ongoing support.

Finally, greater coherence is needed between environmental, agricultural and trade policy.

1.6 Measures Taken So Far

Against the backdrop of the situation described above, efforts have been made at all levels to conserve biodiversity and agricultural biodiversity and to use them in a more sustainable manner. Conservation activities focused on plant genetic resources for food and agriculture go back to the early 20th century. Measures taken more recently include:

International level

- As early as 1983, the FAO adopted the non-binding International Undertaking of developing a global system for plant genetic resources for food and agriculture and designated an FAO commission with its implementation. The Commission's mandate was later expanded to take in farm animal genetic resources. The International Board for Plant Genetic Resources (IBPGR) was founded at about the same time. Based in Rome, this later became the International Institute for Plant Genetic Resources (IPGRI) and now operates as Bioversity International.

- At the UN Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992, the Convention on Biological Diversity (CBD) was agreed along with Agenda 21, a sustainability-focused global action plan for the 21st century. Responsibility for monitoring implementation was designated to the UN Economic and Social Council (ECOSOC).

- The UNCED in 1992 also sparked intensive international dialogue on forests. This gave rise to the ECOSOC Intergovernmental Forum on Forests, which was replaced in 2001 by the UN Forum on Forests. The aim is to achieve sustainable use of forests at global level. In 2007, the UN Forum on Forests (UNFF) signed an international forest agreement (a non-binding instrument covering all forest species) on sustainable management of the world's forests and forest conservation. Under the provisions of the CBD, and on the occasion of the Sixth Conference of the Parties to the CBD (in The Hague, 2002), a sectoral programme of work was adopted on the basis of the ecosystem approach to forest conservation and sustainable use of forest biodiversity.

- To implement the CBD and Agenda 21, at a conference in Leipzig in 1996 the FAO agreed to produce a report on the state of the world's plant genetic resources and to develop the first global plan of action for the conservation and sustainable use of plant genetic resources for food and agriculture. It adopted the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGR) in 2001. The treaty entered into force in 2004. In the same year, at the initiative of the FAO and the IPGRI, the Global Crop Diversity Trust was called into being, taking the form of an international foundation designed to establish a global gene bank network to secure the availability of genetic resources.

- In 1998, the FAO published its Global Strategy for the Management of Farm Animal Genetic Resources. It also began ad hoc publication of the World Watch List for Domestic Animal Diversity. Complementing the Red Lists of threatened wild species, the ad hoc list was designed to provide a global overview of the state of threatened agricultural animal breeds. In 2007, at an International Technical Conference of Animal Genetic Resources for Food and Agriculture held in Interlaken, Switzerland, the first report on the status of the world's animal genetic resources was adopted. Based on this report, a Global Plan of Action was agreed which contained measures for enhanced conservation and sustainable use of animal genetic resources for agriculture. It contains a section on implementation and funding of priority measures set out in the Global Plan of Action for Animal Genetic Resources which focus on characterisation and inventory, monitoring of trends and risks, sustainable use, development and conservation, policies, institutions and capacity building.

- Measures for the conservation of biological diversity have been developed and agreed by various international organisations such as the FAO (FAO Code of Conduct for Responsible Fisheries, 1995) and by regional fisheries organisations like the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR).

- The FAO agreed international plant health standards and adopted an International Plant Protection Convention (IPPC) which was amended in 1997.

- At the World Summit for Sustainable Development (WSSD) in Johannesburg in 2002, it was agreed that current rates of biodiversity loss should be significantly reduced by 2010 and an international regime developed to ensure fair and equitable sharing of benefits arising out of the utilisation of genetic resources.

As early as the summit meeting in Gothenburg in 2001, the EU had agreed measures to stop biodiversity loss by 2010.

The CBD requires Contracting Parties to take comprehensive measures towards conserving biological diversity (both *in situ* and *ex situ*) including associated indigenous knowledge, sustainable use of its components and ensuring fair and equitable sharing of benefits arising out of the utilisation of genetic resources. The Contracting Parties must develop national strategies, programmes and plans for the conservation and sustainable use of biological diversity and integrate the CBD objectives into their sectoral policies. At the same time, they must introduce educational programmes and use the media to raise public awareness of the role of biodiversity and the need for its conservation.

The International Treaty on Plant Genetic Resources requires the Contracting Parties to conserve (both *in situ* and *ex situ*) and ensure sustainable use of plant genetic resources for food and agriculture. As part of a multilateral system, the Parties agree between themselves a simplified route of access to genetic resources of agricultural crop species (as listed in an annex) for research and breeding purposes and to balance the benefits of their utilisation using a standardised material transfer agreement (SMTA). This includes collections of plant genetic resources held in the International Agricultural Research Centres. A key role is played by the farmers' rights set out in the Treaty's Article 9. It is left to the individual member states to determine how farmers' rights are protected in their respective countries. One important question in all this is whether farmers in developing countries will be allowed to continue their practice of storing their own seed and plant material, reuse it, develop it further and exchange or sell it in transactions with other farmers.

The IPPC is designed to protect crops, wild plants and plant products and thus makes a vital contribution to biodiversity conservation. To aid their implementation at international level, the CBD and the IPPC entered into a Memorandum of Cooperation. In 2002, the Conference of the Parties to the CBD adopted guidelines on invasive alien species. These have largely been implemented for plants under the IPCC.

European level

At EU level, to implement the European Union's commitments as a Contracting Party to the CBD, the EU Commission developed a biodiversity strategy in 1998 and a sectoral action plan in 2001 which also focused on agricultural biodiversity. The strategy is currently under review. Council Regulation (EC) No 870/2004 of 24 April 2004 establishing a Community programme on the conservation, characterisation, collection and utilisation of genetic resources in agriculture, which promotes EU-wide projects, is another important policy instrument. However, considerable deficits are evident in its enforcement and the low level of funding allocated. The EU has provided environment-related subsidies since 1987 and, starting with the agricultural reforms in 1992, these have since evolved into today's agri-environment measures. At pan-European level, a range of programmes and measures are in place for crops, livestock, forests and marine environment protection. For the implementation of the 1997 version of the amended IPPC and of decisions made under the CBD, the European and Mediterranean Plant Protection Organisation (EPPO) began a programme of work in 2002 which was based on a resolution passed by unanimous member state vote and is explicitly designed to protect biodiversity from organisms harmful to plants (including invasive plants).

Diversity of seeds

German national level

At national level in Germany, the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV) founded the Federal Centre for Breeding Research on Cultivated Plants (BAZ) in 1992. This came in recognition of the importance of sectoral research in German plant breeding, including on conservation and use of plant genetic resources[19], as had already been emphasised by the German Science and Humanities Council (WR).

In 1998, a strategy for genetic resources for food, agriculture and forestry[20] was developed to aid biodiversity conservation. This involved a national programme with sector-specific programmes for the various components of genetic resources (forest plants, plants used in agriculture and horticulture, livestock animals, fish and – still under development – micro-organisms[21]. Each programme has a detailed catalogue of measures. These are coordinated with the various Länder governments and with the parties involved and are implemented and advanced with their help. The strategy also provides for improved organisational structures in the management of genetic resources and for greater informational, advisory and coordination responsibilities at national level. Responsibility for the latter falls to the Information and Coordination Centre for Biodiversity (IBV) at the Federal Agency for Agriculture and Food (BLE). In the course of restructuring efforts aimed at securing and sustainably using plant genetic resources for food and agriculture, the BMELV designated research and advisory responsibilities for in situ and on-farm management of plant genetic resources to the BAZ Gene Bank Working Group in Braunschweig and also commissioned it with ongoing information management work[22]. The BMELV also set up an interdisciplinary National Advisory Board for Biodiversity and Genetic Resources to ensure the provision of advice on general, fundamental and cross-sectoral issues.

A great number of research, model and demonstration projects, surveys and non-scientific studies on biological diversity are also being conducted. With regard to forestry management, an integrated strategy for forest biodiversity was adopted in 2000 in cooperation with the various German Länder and applicable associations. In its strategy for sustainable sectoral research dated 21 March 2007, the BMELV describes research on conservation, evaluation and use of plant and animal genetic resources as a cross-cutting research activity and one that must be afforded more attention within its mandate.

19 Wissenschaftsrat (German Science and Humanities Council) (1992), Stellungnahmen zu den außeruniversitären Forschungseinrichtungen der ehemaligen DDR auf dem Gebiet der Agrarwissenschaften (Statements on non-tertiary agricultural research institutes in the former GDR), Cologne 1992, pp. 29, 202, 203.

20 See Federal Ministry for Food, Agriculture and Forests (BML) (Eds) (1998): Genetische Ressourcen für Ernährung, Landwirtschaft und Forsten, (Genetic Resources for Food, Agriculture and Forestrs, Applied Science), Angewandte Wissenschaft Vol. 487, Münster/Hiltrup.

21 Further information, including on related activities and measures, is available on the GENRES website at http://www.genres.de/.

22 The designation of responsibilities is based on a cooperation agreement between the IPK and BAZ dated 27 June and 23 July 2001, in which they agreed to divide the work to be performed with the aim of achieving comprehensive conservation and use of genetic resources for crops used in agriculture and horticulture.

2 Conservation and Sustainable Use of Agricultural Biodiversity: Objectives, Current Situation and Action Needed

2.1 General Issues

2.1.1 General aims

Vision for the conservation and innovative, sustainable use of agricultural biodiversity

The vision is to conserve agricultural biodiversity as a basic resource for food and agriculture, innovatively exploit its potential and sustainably use its components.

This involves:

- *Securing and expanding biodiversity conservation infrastructure;*
- *Further advancement of existing management systems;*
- *Strengthening international cooperation.*

The strategy has three primary action-based objectives:

1. **As a precautionary strategy, improve the conditions for long-term conservation and finding sustainable innovative uses for genetic resources for food, agriculture, forestry and fisheries.**

   This largely entails measures to create or expand the necessary infrastructure, including conservation and evaluation institutions, documentation and information systems, a broad knowledge base and an adequate legal framework.

2. **Better linkage between conservation and use of biological diversity as part of an innovation strategy towards sustainable development in rural regions.**

   This entails developing existing management systems with the help of those involved and of other interested parties to actively and sustainably use as many components of agricultural biodiversity as possible and to promote the conservation of natural and near-natural ecosystems and wild species.

3. **Strengther international cooperation to foster a cooperative, equity-based approach to global management of biological resources for food, agriculture, forestry and fisheries.**

   This calls for better coordination of national measures and of EU activities at international level along with further development of the international regime.

The mutual dependency of the objectives outlined above gives rise to a need for strategic linkage of existing approaches in a way that takes account of limited capacities and financial resources yet provides for an effective and efficient conservation regime in the form of an integrated strategy.

This is based on the principle that the best way to conserve agricultural biodiversity is to *sustainably use as many of its components and ecological functions* as possible. Further development of the various management practices to provide better linkage of biodiversity conservation and use calls not only for targeted funding measures but for greater consideration of this objective when revising applicable law and when altering the overall economic, policymaking and legal frameworks.

Measures taken to protect genetic resources by conserving them can only ever be of a precautionary nature. Because for economic reasons sustainable use-based conservation of globally available agricultural biodiversity is only possible in part, there is a need for an efficient conservation infrastructure that supports *in situ* and on-farm conservation efforts and serves long-term conservation of usable potential *ex situ*. An adequate conservation infrastructure requires not only the maintenance and expansion of such institutions and thus the availability of genetic resources, but the acquisition of vital information on the traits and potential uses of such resources (characterisation and evaluation).

Evaluation and research activities and retention of indigenous knowledge play a key role in this regard. Inventories must be drawn up and documentation, information and monitoring systems devised and enhanced in an ongoing process. An efficient knowledge management system is indispensable.

Appropriate institutions and measures could be organised and implemented both centrally and on a decentralised basis, including in the form of networks. The latter option has the advantage of using existing structures and allowing better coordination of programmes and measures to create synergies.

When developing such measures, the activities of existing private initiatives such as those of interest groups representing enthusiasts of specific ornamental plants and domestic animal breeds must be taken into account to improve existing conditions, make their activities more effective and, where possible, integrate them into the newly created networks.

In terms of increased efficiency and the need for EU and international-level cooperation, infrastructural measures should be coordinated as national, centralised activities and, where possible, linked with appropriate European and international structures. Where such structures are not available, their establishment should be promoted. Greater national capacity at regional level is a prerequisite for such action. This can be used to establish centres of excellence designed to implement the measures regionally and provide sufficient capacity for centralised coordination at national level. The broadened funding options under the EU Rural Development Fund (EAFRD) and Seventh European Research Framework Programme should be used to establish the research infrastructure needed for the European Research Area.

The great mutual dependence of the world's countries on globally available and threatened genetic resources for food and agriculture makes intensified international cooperation on these issues absolutely vital, for example in the form of conservation measures that focus on things like establishing a global gene bank network[23] and in particular by promoting sustainable management practices. While cooperation of this kind has already begun, it must be stepped up with a view to combating hunger, malnutrition and rural poverty, and as regards achieving sustainable development to secure mutual benefits. The question of access to and fair and equitable sharing of the benefits arising out of the utilisation of genetic resources is also of importance in this regard. This calls for enhanced knowledge and technology transfer and for research cooperation as components of a global agreement. At global level in particular, there is an increased need for generally accepted standards and for the development and implementation of new policy instruments to promote more sustainable management of biological resources. Models for balanced use of the various ecosystem services must also be devised, one example being the World Network of Biosphere Reserves established under the UNESCO Man and the Biosphere (MAB) programme.

Action needed to achieve the three objectives outlined above primarily involves all types of use relevant to the strategy, but at differing degrees depending on the prevailing situation and the peculiarities of individual sectors. This problem is addressed on a sectoral basis in Sections 2.3 to 2.8.

There is also a need for *cross-sectoral* action with regard to:

- **Research;**
- Public information and education, with particular focus on **consumer demand and food consumption patterns;**
- The challenges brought by **climate change;**
- The introduction and dispersal of **invasive alien species;**
- Use of **regional provenances in the open landscape;**

This is taken up further in Section 2.2.

To monitor success in implementing the strategy and achieving its objectives, suitable indicators and monitoring instruments must be devised. In doing so, account must be taken of the respective activities initiated at national level in line with the requirements set out in the sustainability and biodiversity strategies, at EU level (for example, by EUROSTAT and in the evaluation of the implementation of the EAFRD Regulation) and at international level, by organisations such as the OECD and the IPPC.

23 There appears to be an urgent need for an international gene bank because worldwide conservation of a significant percentage of ex situ collections is threatened due to a lack of financial, technological and legislative resources.

2.1.2 General measures

Expanding a cross-sectoral conservation infrastructure

- Greater information, advisory and coordination efforts towards conservation and sustainable use of agricultural biodiversity at German national level, particularly in light of increasing European and international cooperation:
  - Further expansion of the Information and Coordination Centre for Biodiversity (IBV) at the Federal Agency for Agriculture and Food (BLE).
  - Consideration of the need for decision-making tools to aid evaluation, conservation and sustainable use of agricultural biodiversity as a growth segment of the research sector (for more on the need for research, see Section 2.2.1).

TGRDEU is the web based central documentation for animal genetic resources in Germany

- Completion and regular updating of the inventory of available in situ and ex situ components of biodiversity for food, agriculture, forestry and fisheries in Germany and their entry into the GENRES[24] information system.

- Targeted implementation, regular monitoring and greater integration of specialist sectoral programmes on genetic resources; this includes establishing a joint information and communication platform and a monitoring tool for the sectoral Advisory Committees and the Advisory Board for Biodiversity and Genetic Resources at the Federal Ministry of Food, Agriculture and Consumer Protection.

- Assessment of available options for better use of existing foundations and the establishment of an agency for agricultural biodiversity using private and possibly public funds to promote national and international conservation activities, research and evaluation projects, and other promotional measures to foster sustainable use of agricultural biodiversity.

- National use of the cofinancing options provided by the 2007 EAFRD Regulation (Regulation (EU) No. 1698/2005), including for targeted *ex situ* measures and conservation-focused breeding programmes.

- Better use of existing monitoring systems to improve the documentation of status and development potential of agricultural biodiversity. This can be implemented by means of greater cooperation between the competent national and *Länder* authorities responsible for agriculture and the environment, more focused reporting, activities that make available data and methodologies more accessible and comparable, and initiatives to close information gaps.

- Development of an integrated communications strategy using existing instruments for holistic, target group-oriented public education on the role of agricultural biodiversity, its conservation and appropriate use in achieving sustainable development.

Improved management systems

- Give greater consideration to issues involving sustainable use of biodiversity when reviewing agriculture, forestry and fisheries legislation, including the development of new policy instruments to compensate for impacts on and damage to nature and the landscape and to reward outstanding services for their conservation in terms of secured knowledge on the effects of specific production processes on biodiversity conservation and its sustainable use.

- Evaluate funding measures implemented in the agriculture, forestry and fisheries to prevent negative and increase positive effects on the conservation and sustainable use of biodiversity.

24 Among other things, GENRES comprises the XGRDEU specialist databases, XGRDEU being a collective term, of the national inventories (databases listing in-situ and ex-situ stocks; http://www.genres.de/) of plant, animal, forest, aquatic and microbial genetic resources (PGRDEU, TGRDEU, FGRDEU, MGRDEU und AGRDEU).

- Promote measures that allow better linkage between conservation and use of agricultural biodiversity and foster innovation, including the implementation of model and demonstration projects to develop integrated conservation and management strategies along with promotional instruments for innovation towards more sustainable use of components of agricultural biodiversity, including suitable marketing forms and consumer information and education.

- Organisation and implementation of social dialogue on the institutional and normative obstacles that prevent broader use of genetic resources to allow their innovative, sustainable use, while avoiding a softening of environmental and safety standards.

- Expand monitoring instruments and devise technical solutions to allow better alignment of harvest and catch quantities to prevailing stock trends.

Strengthen international cooperation

- Work to change the political and economic framework at international level with the goal of achieving better conservation and broader and more sustainable use of biodiversity and genetic resources for food and agriculture, the ultimate aim being to secure food supply, combat rural poverty and achieve sustainable development.

  This involves:
  - Giving greater consideration to social and environmental needs in WTO activities.
  - Devising systems for origin labelling and quality assurance.
  - Improved protection of the indigenous knowledge needed in the conservation of agricultural biodiversity.
  - Devising instruments and supporting measures to aid implementation of farmers' rights in developing countries in recognition of their development policy role.

- Promote access to genetic resources for food and agriculture and the fair and equitable sharing of benefits arising from their use and the use of associated indigenous knowledge. Among other things, this means declaring the origin of the biological material used in inventions when applying for patents, engaging in technology transfer and greater research cooperation within a global framework.

- Support the international network of *in situ* and on-farm conservation initiatives.

2.2 Cross-cutting Issues and Measures

2.2.1 Science and research

Vision for science and research

The vision is to achieve a better understanding of the complex relationships between the dynamics of biodiversity, its conservation and human activity, particularly in agriculture, and to use the knowledge gleaned in efforts towards sustainable development.

It is therefore vital that:

- *Basic biodiversity and ecosystem research be stepped up as regards conservation and sustainable use of agricultural biodiversity.*
- *More be known about the structure and functions of agricultural biodiversity and of the ecosystem processes that are both driven by interactions between different species and their use.*
- *The development of management structures be analysed and evaluated in light of changed economic conditions and global challenges, and suitable indicators and monitoring and forecasting procedures be devised for this purpose.*
- *The value and potential of genetic resources be exploited with a view to future trends in land use and fisheries, consumer needs and expected changes in the climate and the environment.*
- *Future-focused integrated sustainable management strategies be developed.*
- *Biodiversity-related activities be stepped up in sectoral and cross-sectoral research, and the results be consolidated and integrated into national, EU and international research programmes.*

The causes of and the complex linkages involved in the dynamics of biodiversity in the context of human activity, not least with regard to soil, are unknown in many instances. This is why more targeted and sound research is needed with regard to conserving, promoting and making available for use the biodiversity in the natural environment and the cultural landscape. In particular, knowledge of the ecological capacity of life forms that are used either directly or indirectly, and their cohabitant species, their interactions among themselves and with the environment, and their conservation status is a prerequisite for targeted structuring of necessary measures and adequate responses to changes that occur in the future. Research is also needed on potential changes in management structures due to altered conditions and in consideration of other global trends and problems. At the same time, the potential of biodiversity for innovation and the existing institutional, normative and administrative barriers that prevent such use must be investigated and conflicts between conservation and management objectives identified. Reaping the full benefit from biodiversity primarily entails general access to resources and to information on resource characteristics whose harvesting and exploitation requires research.

The urgent need for research corresponds with the worldwide acceleration in biodiversity loss in habitats of all types.

Against this backdrop, scientific analysis of agricultural biodiversity and processing the associated, complex research questions calls for a broad range of research disciplines that take in natural, social, economic and engineering sciences. The research approaches used must span the full spectrum, from the molecular level to that of ecosystems and entire landscapes. It is thus vital that research activities be stepped up and better networked within the German, European and international research environments, and that activities in education and further training be intensified.

The need for decisionmaking tools in BMELV departmental research involves researching the structure and functions of all the components of agricultural biodiversity in the area of conflict between users' claims and conservation needs. A scientific basis must be created on which the greatest possible variety of components of agricultural biodiversity can be actively and sustainably used while promoting conservation of threatened ecosystems and species. This calls for greater cooperation within BMELV departmental research, between it and other research institutes and research teams in other government departments (as set out in the government's Coalition Agreement), and a network of research activities involving cross-sectoral programmes.

Worthy of note in this regard are the Federal Ministry of Education and Research (BMBF) programmes, BIOLOG: Biodiversity and Global Change; BioTeam; Social and Ecological Research (SÖF) and *klimazwei* (see Sections 2.2.2 – 2.2.4, 2.3.1.1 and 2.5), at European level, the various EU research programmes and at international level, the agroBiodiversity science and implementation plan which is a component of the DIVERSITAS biodiversity science plan.

Petri dish

Priority measures in research

- Assessing the current status of agricultural biodiversity, future trends and potential uses:
  - Inventorisation and collection of genetic resources for food and agriculture, and identification of their value and potential for innovative, sustainable use.
  - Development of monitoring procedures and indicators for used and associated biodiversity.
  - Approaches and models for forward-looking analysis of management trends in the face of ever-changing conditions to enable development of appropriate strategies.

- Research into ecosystem resources for the conservation and sustainable use of agricultural biodiversity, including activities such as:
  - Investigation and quantification of the functional relationships and feedback mechanisms between directly used life forms and cohabitant organisms in various management systems, taking particular account of soil organisms to secure soil functions and promote soil processes.
  - Studies and forecasting models on changes in ecosystem services provided by associated biodiversity.
  - Studies on the effects of use-related and climate-related changes in the structure and function of agricultural biodiversity and its ability to adapt.
  - Establishment of a scientific basis for risk analyses regarding the threat to biological diversity from invasive alien species
  - Research on the development of new and sustainable management strategies for organisms harmful to plants covered by legislation.

- Development of innovative methods and technologies for the conservation of agricultural biodiversity and its ecosystem services in the interest of adopting sustainable management practices.

- Establishment of an agricultural biodiversity knowledge network as part of a cross-cutting German knowledge network for biodiversity research (in preparation), the aim being to:
  - Coordinate new cross-sectoral scientific investigations and consolidate the research results.
  - Take an interdisciplinary and transdisciplinary approach (to include institutions belonging to the BMELV mandate for non-tertiary and tertiary research, vocational training and education centres, user and practitioner groups, the competent national and *Länder* authorities, and policymakers).
  - Integration into a network of excellence for agricultural biodiversity research in the European Research Area.

- Analysis of the changing use structures given altered conditions and the development of recommendations for action regarding further drafting, implementation and structuring of funding measures at national and EU level to aid conservation and sustainable use of agricultural biodiversity.

- Interdisciplinary and transdisciplinary investigations, e.g. on the social, economic, environmental and political aspects of biodiversity, healthy diets and sustainable rural development.

- Development of transfer strategies at the interface between science and government to ensure the inclusion of research findings in policy measures.

In light of international obligations, BMELV departmental research is closely involved in bilateral and multilateral research cooperation activities and networks. These include bilateral agreements, EU research programmes, the FAO, the IPPC, the EPPO, the OECD and the Consultative Group on International Agricultural Research (CGIAR). Through greater research cooperation with developing countries and emerging economies on issues that link ecosystem, technology and socio-economic issues, a significant contribution can be made to the conservation and sustainable use of agricultural biodiversity beyond national borders.

2.2.2 Consumers, food and sustainable consumption

Vision for consumers, food and sustainable consumption

The vision is to empower consumers to exert greater influence over the conservation and sustainable use of agricultural biodiversity through their purchasing decisions. The food industry supports this endeavour by offering a highly diverse range of products.

In particular, this calls for:

- *Greater integration of conservation and sustainable use of agricultural biodiversity into social dialogue on sustainable consumption.*
- *Better consumer information on the underlying relationships and the role of biodiversity in things like achieving a balanced, satisfying and healthy diet.*
- *More market transparency, particularly by means of certification and quality assurance schemes.*
- *Winning over the food industry to the cause of sustainable use of agricultural biodiversity and to making an appropriate contribution in the production and processing of food.*
- *Purchasing decisions to take adequate account of the international issues involved in conservation and sustainable use of agricultural biodiversity.*

Labels for products from sustainable production support consumers decision. Here you see FSC-Certification in a forest near Berlin (Grunewald)

"Moorschnucken" – endangered sheep breeds

At the 2002 World Summit for Sustainable Development in Johannesburg, agreement was reached on a ten-year framework plan on Changing Unsustainable Patterns of Consumption and Production.
It was recognised that to achieve global sustainable development, fundamental changes in society were needed, not least as regards production and consumption. The countries of the world, and primarily the industrialised nations, must promote sustainable production and consumption patterns for the benefit of all.

More and more consumers are starting to realise that their behaviour has an effect on the environment, on society in general and on future generations. But when it comes to conservation and sustainable use of agricultural biodiversity, they often lack the knowledge needed to understand the complex relationships involved and the market is not transparent enough for them to play an active role in achieving sustainable consumption. Only when these conditions are in place can consumers have the necessary influence to force production decisions towards serving conservation and sustainable use of biodiversity. To boost consumers' roles and achieve greater value creation for farms and regions, appropriate programmes on consumer information, education and advice are needed along with labelling and quality assurance schemes. Examples of the latter include Germany's Biosiegel for organic produce, labelling of products derived from sustainable forest management, environmentally sound fisheries, special product origin labels and regional market brands.

In the age of mass media, in which consumers are swamped by a flood of information, dialogue and action-focused measures that raise awareness and help people to form their own opinions are vital. Alongside the media, the country's education institutions can play an important role.

In the face of globalisation and increasing international trade, consumer behaviour is having serious effects on global biodiversity. Calls for sustainable consumption patterns have given rise to a number of certification schemes such as Fair Trade for coffee, tea and cocoa, and others for things like tropical timber from sustainably managed forests.

The range of food products on offer today is extremely diverse and consumers are often unaware of the related problems. The variety is achieved by means of imports of exotic products and by diversification in production and processing activities that

largely use what are essentially standardised raw materials. Thus, in their purchasing decisions consumers give little consideration to the issue of conservation and sustainable use of biological diversity because, given their increasing consumption of processed foods and convenience products, many of them lack the opportunity to learn about alternatives. Consumers are therefore unaware of the variety of quality, enjoyable products that are derived from the use of biodiversity, particularly from traditional varieties and old breeds.

Biological diversity is a key component in supplying a varied, balanced and healthy diet. Demand for the right food products can serve in promoting it in agriculture. Biodiversity harbours great potential in efforts to provide health-focused products. That potential can be boosted further through the use of innovative management methods.

In research carried out from 2002 to 2007 as part of its *Sozial-ökologische Forschung* (Social and Ecological Research, or SÖF) funding programme, the Federal Ministry of Education and Research (BMBF) took an interdisciplinary approach to sustainability problems in the food sector. The aim was to achieve a better understanding of the issues involved and find workable solutions. The results of seven interdisciplinary research projects answer questions on things like the role of agricultural, processing and trade and retail businesses in producing sustainable food products, how consumers can be supported in adopting sustainable consumption patterns and eating habits, and how policy debate and public discourse can help in finding ways to meet these challenges (see: http://www.sozial-oekologische-forschung.org/de/154.php).

„Schwäbisch-Hällische“ – an endangered pig breed

Action needed

- Better consumer information about the interrelationships between biological diversity and a varied, balanced diet of fresh and healthy produce, taking account of species and varieties of fruit and vegetables that have been adapted to local and seasonal conditions, regional origin and taste and other forms of sensory appeal.
- Consideration of agricultural biodiversity issues in the development of a strategy for sustainable eating habits. The food industry must be involved and won over to the cause of considering agricultural biodiversity in food production and processing, and to exploiting the opportunities for innovative diversity in the products they offer.
- Development of new and use of existing certification and quality assurance schemes, including origin labelling, with the aim of promoting biological diversity and achieving better market transparency.
- The integration of conservation and sustainable use of agricultural biodiversity into national dialogue on sustainable consumption and production patterns, the aim being to promote this approach at national, EU and international level, including in fair trade schemes.
- Greater involvement of consumers, farmers and other social groups in decision-making on the development of agricultural management systems such as state-funded breeding programmes.
- Support measures to promote neglected crops and animal breeds as a basic resource to ensure the supply of food for local populations in developing countries, in particular through the activities of International Agricultural Research Centres (IARCs) and as part of bilateral projects on food security in conjunction with the FAO.

2.2.3 Climate change

Vision for climate change

The vision is to conserve agricultural biodiversity and use its potential in a future-focused way to cope with and mitigate the effects of climate change by promoting the ecosystem services provided by agricultural biodiversity and engaging in sustainable management practices.
It is thus vital that:

- *A broad base of genetic resources be maintained and their traits and the ecological interrelationships involved in their use be subjected to future-focused analysis and evaluation to identify the potential demands and effects of climate change.*
- *Environmental monitoring relative to the status of forests be further advanced and expanded in scope to ensure adequate response times in terms of the process and speed of climate change.*
- *Forests be prepared for climate change now by conserving and planting the greatest possible mix of trees.*
- *Agricultural management systems and use practices be developed that have been adapted to climate change in order to conserve and ensure the availability of agricultural biodiversity under changed conditions.*
- *Climate-related emissions from agricultural management systems be analysed and evaluated with regard to developing precautionary strategies and models for sustainable development and, where possible, reduced through greater use of the potential harboured by agricultural biodiversity.*
- *Use of renewable resources be promoted with the aim of saving fossil fuels and developing sustainable agricultural methods in order to prevent any negative effects on biological diversity.*

The projected climatic changes can have significant effects on agricultural management systems. Climate change mitigation is an integral component of Germany's sustainability policy. The German government has therefore called for reductions in emissions of harmful greenhouse gases at international level and for other measures to prevent climate change having an adverse effect on people's quality of life. The government has agreed to implement such measures via national policy. This involves, for example, approval of national measures to reduce greenhouse gas emissions in line with the provisions of the 1997 Kyoto Protocol.

The effects of climate change on agricultural biodiversity

Germany's temperate climate provides the right conditions for rich biodiversity and high yields. The projected degree of climate change, especially the increase in extreme weather conditions, shifting temperatures and changing rain patterns, pose unpredictable risks to biological diversity and to yield security and potential in forest and agricultural management systems.

According to available knowledge, there is a direct relationship between the dynamics of agricultural biodiversity and the climate change process. The limits regarding variability and adaptability at differing levels (from genotype to the full species spectrum and population size, to ecosystem functions) and factors such as substance input, water supply, temperature amplitudes and radiation, are all directly related to climate change. Thus, under certain circumstances, climate change can result in sudden changes in biological diversity, foster shifts in its functions and services, and change the entire ecological network of habitats and landscapes. Along with plants and soil organisms, aquatic life can also be significantly affected.

The climate change process can likewise alter the role of pathogens. The increase in formerly insignificant or newly introduced (alien) pathogens can lead to a new situation in plant protection and animal health that must be analysed and evaluated. Changes are also possible as regards the conditions to allow dispersal of invasive alien species.

Changes in land use practices are thus expected in response to climate change.

Role of agricultural biodiversity in climate protection

Services provided by species and ecosystems, such as carbon storage and regulation of water and energy supply, can make a significant contribution to harnessing climate change.

Sustainable production systems can serve to reduce greenhouse gas emissions in agriculture. Also, long-term storage of carbon reserves in forests and in farmed soil harbours potential for emission reductions. Apart from serving climate change mitiga-

Climate change may cause serious risks to agriculture

tion, such measures are environmentally sound and contribute to biodiversity conservation.

For energy, climate, forestry and agricultural policy reasons, renewable resources play a key role – not least because they can be used as a substitute energy source in place of fossil fuels. Consideration must, however, be given to the fact that greenhouse gases are emitted during the production and processing of renewable resources. Thus, climate change mitigation that relies on renewable resources must look at the carbon balance relative to the entire production process and take account of the materials used and any joint products.

Breeding research can be of great service in adapting to climate change, especially in agriculture. The evaluation and use of biodiversity is a precondition of breeding research to allow development of new varieties designed to cope with changed climatic and environmental conditions. Achieving yield security today ensures that new varieties will be resistant to a large number of pathogens and climate change effects. Abiotic stress factors such as heat, frost, drought and poor nutrient supply play an increasing role with climate change, as do new pathogens. They are already taken into account in breeding activities to ensure availability of a wide range of varieties with differing traits for use in supplementing existing resources of regional species and varieties.
In livestock husbandry, the climate change-related rise in vector-borne disease poses a risk to diversity in breeds and types. One example is the spread of blue tongue disease in sheep, cattle and goats. The disease originates from Southern Europe and is transmitted by mosquitoes.

Research effort involving forest management and resources must be stepped up and the knowledge gained transferred into forestry practice. The various monitoring systems used to assess the status of forests will be given a new, higher-level priority.

Existing knowledge on the risks arising from climate change remains inadequate. For example, in certain regions, rising temperatures can be expected to result in a drop in the carbon content in soil, loss of soil fertility and rising greenhouse gas emissions. Little is known about how this might affect soil organisms and their diversity. There is thus a need for better understanding of the complex interrelationships between climate change and biodiversity.

With its *klimazwei*: Research and Practice for Climate Change and Adaptation programme, which started in 2006 and ends in 2009, the Federal Ministry of Education and Research (BMBF) promotes cooperative projects on climate change. Sub-projects focus on mitigation (development of new technologies, and processes and strategies to reduce emissions of climate-damaging gases) and adaptation (development, implementation and distribution of technologies and strategies for effective and efficient adaptation to climate change and extreme weather conditions). The programme portfolio also includes practice-related projects on land use. For example, the Strategies for Peatland Management project looks at the trace gases in peatland areas, the aim being to assess the climate change mitigation potential offered by suitable peatland management practices. Another project concentrates on advancing wheat breeding activities to prevent crop losses in the face of increasingly dry early summer months. Other projects include KLiO: Climate Change and Fruit Growing in Germany, BatroS: Soil Amelioration and Cultivation Technologies for Arable Land Exposed to Draught, DSS-WuK: Decision Support System Forest and Climate Change, and LandCaRe 2020: Land, Climate Resources: Foresight and Potentials in Rural Areas under Regional Climate Change (see http://www.klimazwei.de).

Action needed on the interrelationships between agricultural biodiversity and climate change

- Identification and assessment of the impacts of climate change on agricultural biodiversity and its ecosystem services in agriculture, forestry and aquatic ecosystems.
- Inventory and assessment of related emissions and sinks/storage functions arising from agricultural and forestry management systems.
- Coordination of new cross-sectoral research investigations, consolidation of the results and subsequent public information work.
- Integration of climate change and agricultural biodiversity issues into environmental impact assessments and risk analyses.
- Contributions from agriculture, forestry and fisheries sectors, including the processing industry, to climate change mitigation efforts. For example, in the form of emissions reductions and increased CO2 sequestration in biomass production.
- Development of a strategy to deal with the impacts of climate change, including adaptation of forests to altered climatic conditions.
- Coordination, cooperation and reporting at international level to enable better positioning and implementation of appropriate strategies and action plans.
- Promotion of innovation in the development of agricultural practices in response to climate change (soil protection and water-saving schemes).
- Studies on the development of biodiversity following altered use and management practices.
- Promotion of climate change-focused innovation in plant breeding to achieve:
  - Better adaptation to climate change, more nutrient-efficient crops and enhanced resistance and quality traits.
  - Improved natural yield potential and crop genetic diversity to expand the scope for crop rotation.
  - Assessment and exploitation of genetic resources.

2.2.4 Invasive alien species and plant health

Vision for invasive alien species and plant health

The vision is to prevent the introduction and spread of invasive alien species and their associated negative effects.

This calls for:

- *Improved scientific knowledge and data.*
- *Performance and improvement of risk analysis.*
- *Development and implementation of monitoring measures to observe the occurrence, spread and impact of invasive alien species.*
- *Adoption of effective measures.*
- *Public information work regarding the associated risks.*
- *Greater international cooperation to foster the exchange of information, development of standards and performance of risk analyses.*

Cross-regional transport of plants and animals

With the increasing flows of international transport and goods, the risk of organisms being unintentionally transported across the borders of their natural ranges has risen significantly. There has also been a rise in cases of intentional introduction of plants and animals. This can pose a threat to native biodiversity in that it can lead to a rapid spread of non-native or alien plants (neophytes) that are planted in the wild. About half of the neophytes that have become established in Germany were introduced intentionally, mostly for use as ornamental plants (around 30 percent of the overall neophyte population) and the remainder as agricultural and forestry crops (20 percent of the neophyte population). Only a fraction of them are invasive, however. Of the animals intentionally introduced or released from fur farms, only a few have become invasive (e.g. the raccoon and the raccoon dog). It can be expected that the risks from invasive alien species will increase in future.

Potential impacts from invasive alien species

The spread of invasive alien species can pose risks to human, animal and plant health, and to agricultural production, the cultural landscape and biological diversity. It can also harm the environment and the economy and cause serious damage to genetic resources. If the introduction and spread of such species is not stopped in time by means of suitable measures, it can result in the need for intensive and costly mitigation activities.

The occurrence of alien pathogens can damage species to such an extent that their existence becomes threatened. The loss of elm trees to elm disease across Europe is a prime example. The fungus that causes the disease is introduced with imported timber and has decimated domestic elms to such an extent that the common elm has been placed on Germany's Red List of threatened species.

On a broader scope, the impacts of invasive alien species include damage to resources used by people, such as water, recreation facilities, tourism destinations and hunting grounds. Ragweed introduced from North America competes with other plants and produces the strongest and most aggressive asthma-causing pollen allergen in late summer and autumn. One of the ways it is introduced is with contaminated bird food. In coastal fisheries, a current problem involves the spread of the Pacific oyster, which is driving native blue mussels from their habitats. This poses a threat to mussel cultivation and thus to one of the key sources of income in coastal fisheries.

Assessing the risks posed by alien species

There is no hard and fast method that can be used to forecast invasive behaviour and its associated effects. If immediate harmful effects are known, for example from pathogens and harmful insects, then it is usually easier to conduct a risk assessment.
Where such information is lacking, as is certainly the case for non-native plants and other 'indirectly' harmful organisms, assessment and risk analysis can be difficult. With the help of enhanced risk analysis methods, the probability of introduction and spread of specific organisms and their risks can be more reliably assessed and more detailed management opportunities developed.

A key contribution towards achieving this goal comes in the form of the INVASIONS: Invasion Potential of Alien Species project conducted by the Helmholtz Centre for Environmental Research in Leipzig-Halle and funded by the Federal Ministry of Education and Research under its BioTeam: Biodiversity Research and Practice research programme between 2003 and 2006 (http://www.ufz.de/index.php?de=2773). The work already begun will be continued for the period 2007 to 2009 as part of the INVASION II: Evolutionary, Environmental and Social Impacts of Biological Invasion project at the University of Osnabrück and will be funded under the BMBF BIOLOG: Biodiversity and Global Change programme (see http://www.biolog-online.info).

Improved conditions for risk analysis and information exchange

Risk analysis methods and standardised procedures are already in place as regards plant health. However, deficits exist in the availability of data and exchange of information. This makes the following measures necessary:

- Expand existing databases on invasive alien species and make them accessible to the specialist public.
- Set up an invasive species website to educate and advise the general public.
- Conduct research to obtain scientific data for use in risk analysis on invasive species.
- Conduct research to aid the development of new approaches and sustainable management strategies.
- Develop, standardise and apply quality assurance criteria to diagnosis methods for plant pathogens regulated by law.
- Monitor activities on the occurrence and impacts of invasive species.
- Establish and enhance existing early warning systems and use contingency measures to deal with threat situations.

The Ambrosia (Ambrosia artemisiifolia) is an invasive species with high allergic potential.

Measures to conserve agricultural biodiversity

- Targeted implementation of risk analyses for intentional and unintentional introduction, taking account of seed and plant materials, feedstuffs and modes of transport (aircraft, freight vehicles, ships, etc.) as transfer paths for unintentional introductions.
- Further development of existing and development of new risk reduction strategies.
- Use of existing systems to prevent introduction and transport of invasive alien species, and identification and development of opportunities to improve cooperation between plant protection, agricultural and nature conservation authorities.
- Definition of terms and further development of the provisions contained in plant protection product law with the aim of protecting ecosystems from invasive alien species and pathogens that thrive disproportionately on the benefits of climate change.
- National implementation of measures to combat invasive species in accordance with international regulations and agreements.
- Prevention measures and marketing and shipment or transportation bans for highly problematic species.
- Consumer information on which plants and animals pose a problem with suggestions for less problematic alternatives.
- Targeted promotion in the horticultural sector of the use of native species in private and market gardens in line with EU and WTO regulations.

Strengthen international cooperation

Measures taken at national and international level can affect trade and so must be properly justified. In the case of plant health, justification is provided for by means of an internationally standardised risk analysis procedure as set out in the International Plant Protection Convention (IPPC).

- Better coordination of measures concerning invasive alien species in international agreements, including the CBD, IPPC, Bern Convention, UN Convention on the Law of the Sea, International Maritime Organisation and OSPAR Biodiversity Committee.
- Implementation and application of international standards (e.g. the IPPS International Standards for Phytosanitary Measures).
- Support for the memorandum of cooperation on invasive alien species agreed between the IPPC and the CBD.
- Support for the EPPO work programme on invasive alien species.
- Ongoing alignment of existing and development of new measures to prevent the introduction of problematic species in things like timber packaging, seed material and animal feedstuffs.
- Implementation and application of the ICES Code of Practice on the Introductions and Transfers of Marine Organisms.

2.2.5 Use of regional provenances

Vision for use of regional provenances

The vision is, in all planting, sowing and stocking activities conducted in the open landscape[25] (taking account of EU and WTO legal restrictions), to use where necessary and possible plants and animals with regional provenance which as components of functioning species communities have become genetically adapted to regional environmental conditions.
This calls for:

- *The designation of appropriate regions of origin.*
- *Proof of provenance for plant, seed and stock materials.*
- *Further investigative research to provide clarity regarding provenance requirements.*

Large numbers of organisms are released into the open landscape for a variety of reasons. These include the planting of shrubs and bushes in the course of land clearance, compensatory measures, recultivation, roadside greenery and the sowing of grassland areas. Animal organisms are released for example as fish spawn in inland fisheries to reinforce stocks of commercial fish species. In species promotion programmes, specially bred specimens are introduced into existing natural stocks. Thus, in biodiversity conservation, plants or animals with regional provenance should be used to avoid adapted wild populations from being altered or displaced by planting, sowing and transferring large quantities of organisms into the open landscape.

A number of arguments support the use of species with regional provenances:

- Greater resistance resulting from adaptation to local conditions;
- Conservation of regional populations that have evolved over long periods of time;
- Conservation of naturally occurring genetic diversity in the respective regions;
- Conservation of functioning species communities;
- Stronger regional identities.

In general, reproductive material is deemed regional if it originates from the region in which it is also used. However, this definition requires species-specific differentiation between natural habitats in specific areas of origin, or in waterbodies in the case of aquatic organisms. Account must also be taken of the environmental and economic considerations that allow economically viable employment, e.g. tree nurseries, seed production and fish breeding enterprises.

Planting of a hedge as structure element in the landscape

25 These conclusions apply to the open landscape beyond forests and developed municipal land; the Act on Forest Reproductive Material (Forstvermehrungsgutgesetz) applies to sowing and planting in forests.

Demands for proof of regional provenance in the release into the open environment of shrubs, seeds, fish and other organisms give rise to the need for measures to secure regions of origin. Public administrations are under obligation to designate suitable crop stocks, organise protected regions of origin and award public contracts which use regional species (such as in planting roadside greenery) to boost demand for such material from growers and breeders. Action is also needed as regards research to create the right conditions to allow science-based use of regional species.

Use of regional provenances in forests

In forest management and planting activities in which forests could develop, the provisions of the German Act on Forest Reproductive Material must be observed. This only allows seeds of conservationally important tree species to be produced, marketed, exported or imported if they are derived from approved basic material. For forests and commercial tree species that grow in forests, an established infrastructure is in place for the use of regional provenances. These are not addressed in this section.

Use of regional provenances when releasing wild seeds and plants into the open landscape

When planting in the open environment (for example grasslands, nutrient-poor grasslands, wet grasslands and fringe areas) and performing engineering work (e.g. securing slopes in road-building activities) seed and plant materials from regional wild plants should be used to avoid dramatic changes in or displacement of wild regional grassland species and loss of regional genetic diversity. The formulation of nationally coordinated recommendations on achieving this goal is currently being discussed by seed producers, users and researchers. The main areas of focus are to develop measures to secure the origins of regional seeds and to draw up regional lists of local species that must be taken into account in regional propagation activities.

The Federal Ministry of Food, Agriculture and Consumer Protection (BMELV) thus supports efforts at European level to create a legal basis under seed trading law to make it easier to market seeds, plant material and seed mixtures with regional provenance that are both subject to EU seed law and earmarked for use in the open environment.

Parr

Use of regional provenances in stocking activities in the fishing sector

Many migrating fish species are seriously threatened or, as in the case of the Rhine salmon, have already become extinct in Germany. For decades now, fisheries and more recently nature conservationists have primarily focused on restocking and renaturalisation measures and on reintroducing regionally extinct species to compensate for population decline in and collapse of a range of different species.

Apart from measures to compensate for recruiting deficits and to reintroduce regionally extinct species, conservation measures provided for in *Länder*-specific fisheries law also allow introduction of appropriate alternative species.

However, fish stocking activities do not necessarily improve the situation regarding aquatic genetic resources: if they are not implemented correctly, they can have negative impacts. For example, it cannot be ruled out that the release of fish with alien provenances could influence genetic diversity due to changes in the local gene pool.

In the fisheries sector in particular, little is known about the genetic differences in stocks of small non-commercial fish species and there is thus a need for ongoing research. Rules on the use of alien species in aquaculture have been adopted at EU level under Council Regulation (EC) No. 708/2007 and were published on 11 June 2007.

Measures to be taken

- Clarification of terms and review of the provisions of the Federal Nature Conservation Act (BNatSchG) and subordinate, Länder-specific legislation on the use of regional provenances in the open environment.
- Creation of a simplified process at EU and national level for the marketing of seed mixtures containing regional provenances that belong to the species listed in seed trading law.
- Review of the species listing contained in EU seed legislation with the aim of removing commercially less important species from its area of application to allow simplified marketing of seeds for use in the open environment.
- Development of methods to prove the origin of regional provenances which incorporate the parties concerned and the research activities needed.
- Review and amendment of the rules concerning public calls for tender for gardening and landscape gardening services and the associated scope of work and specifications.
- Integrate the need for action into EU Single Market and WTO rules.

2.3 Agriculture: Crop Production

2.3.1 Objectives, current situation and action needed

Plants are of fundamental importance for agricultural production due to their ability to use the sun's energy to produce a variety of substances and energy sources that can be utilised for such things as nutrient and energy supply for other life forms, including livestock and people. Of the approximately 250,000 plant species on Earth, about 30,000 are edible and about 7,000 are used in some way or other by humans. Nonetheless, only a small number of plants are cultivated today in activities such as farming, grassland management, horticulture, wine-growing and the production of renewable resources. In contrast, the use of wild plants – berry bushes, medicinal plants and herbs, for example – plays only a subordinate role but can still be of regional importance. Apart from autochthonous grasslands, cultivated plants are usually a result of breeding. This makes the availability of genetic resources as a base material for breeding and breeding research especially important.

While the services provided and the ecosystem functions performed by non-cultivated plants are the result of prevailing local conditions (for example, water and nutrient supply), those of cultivated plants are largely the outcome of human activity such as soil amelioration and ploughing, the use of plant protection products and fertilisers, and artificial irrigation. In some cases, such activities take the place of natural ecosystem functions and have led in the main to a significantly better use of productive capacity, although in many cases this has become dependent on a given level of factor input. This also affects associated biodiversity and other species and ecosystems.

In the past few decades, large collections have been established around the world to aid the conservation of crop genetic resources. These largely involve ex situ gene banks conserving of varieties / taxa that are threatened by genetic erosion. They contain an impressive amount of material from the most important crops. Worldwide, approximately 1,500 gene banks house around 6 million. In addition, the traditional genetic resources used in in situ and on-farm activities in countries of origin provide an important basis on which to secure the world's food supply. Germany maintains key collections of plant genetic resources (see Table 1).

Table 1: Gene banks in Germany: *Ex situ* conservation of plant genetic resources.[26]

Institute	Collection
Leibniz Institute of Plant Genetics and Crop Plant Research (IPK), Gatersleben: Gene bank situated at various locations in Gatersleben and the Nord outpost for potatoes and fodder plants, Groß-Lüsewitz, Malchow	Agricultural and horticultural plants and their wild relatives: Approx. 3,000 species and 150,000 specimens
Federal Research Centre for Cultivated Plants – Julius Kuehn Institute (JKI) – Institute for Breeding Research on Horticultural and Fruit Crops: Fruit gene bank, Dresden-Pillnitz.	Various fruit species with the main focus on apples (Malus): 18 species and approximately 3,000 specimens
JKA – Institute of Grapevine Breeding (IRZ), Geilweilerhof: Grapevine gene bank, Siebeldingen.	Wine (Vitis): 35 species and approximately 3,900 specimens
Centre for Agricultural Technology (LTZ), Augustenberg: Outpost in Forchheim with main focus on tobacco breeding.	Tobacco (Nicotiana sp.): Various wild and cultivated species, and approximately 750 specimens

26 Apart from the IPK genebank, which is one of the largest collections of reproductive material in the world, public institutes run by the various Länder and municipalites (botanical gardens and so on) and also private institutes maintain collections of crop plants used in agriculture and horticulture (including speciality crops like tobacco, hops and ornamental plants). The Federal Office of Plant Varieties (BSA) keeps comprehensive reference collections for plant variety testing purposes. Reproductive material from woody plants, especially fruit and vines, is kept by BMELV departmental research bodies. In addition to the fruit genebank in Dresden-Pillnitz, the national inventory lists another 18 institutes that maintain their own fruit collections. Apart from the BMELV facilities, Germany's vine genetic resources are maintained by five separate Länder-based institutes.

Storing of seeds in the IPK genebank in Gatersleben

Apart from the direct service these collections provide to research and breeding, their maintenance is also necessary on grounds of international obligations[27] and the national responsibility arising from adherence to the precautionary principle. Gene bank maintenance is also important because the old varieties and species they contain are an integral component of human cultural history. However, meaningful use of the material contained in gene banks calls for its characterisation and evaluation and for the establishment of central identification and documentation systems in which existing and newly obtained evaluation data are systematically collected, processed and made accessible in a user-friendly way. Considerable deficits exist in this regard.

Use of gene bank resources is fully in line with Articles 9 and 10 of the CBD regarding *ex situ* collections and sustainable use of biodiversity. Apart from actual conservation, there is a special responsibility to safeguard the resources from becoming contaminated with genetically modified organisms (GMOs). In accordance with Article 8 of the CBD, which requires measures to prevent *in situ* stocks from being contaminated with genetically modified organisms, *ex situ* collections must also be safeguarded from unintentional cross-breeding with GMOs.

Gene banks and other collections are, however, no substitute for the diversity found in everyday agriculture and horticulture. Hence, suitable conditions must be created and existing barriers removed. This is especially the case concerning rules on the trade of seeds and plant genetic resources (conservation varieties) of species that fall under the provisions of German seed trading law, thus making on-farm conservation difficult.

Breeding provides an ongoing supply of new varieties – including those for use in environmentally sound production practices such as organic farming and growing renewable resources that have been adapted to specific growing and processing methods. Breeding research[28] allows biodiversity to be evaluated and made available for use. The measures in place to enable identification and evaluation of the traits of specific genetic resources must be enhanced and better linked.

Such linkage and cooperation is also needed at European and international level. Under the European Cooperative Programme for Plant Genetic Resources (ECPGR), member states aim to achieve synergies by means of coordinated conservation activities and expert-level collaboration. The objective is to establish an integrated European gene bank system where the responsibilities are spread and coordination is centralised (the AEGIS Initiative). In addition, existing conservation and evaluation activities at national, regional and international level will be incorporated into cross-cutting programmes. Finally, the provisions for a multilateral system for access to genetic resources and fair and equitable sharing of benefits arising out of their utilisation – as set out in the International Treaty on Plant Genetic Resources for Food and Agriculture – need to be implemented at national, regional and international level.

27 This applies especially for cultivated plants because many (including our own crops) originate from what are now described as developing countries, where their diversity centres are located.

28 Breeding research is conducted at the Federal Research Centre for Cultivated Plants –Julius Kuehn Institute (JKI), at universities and at Max Planck research institutes. In contrast to many other countries, plant breeding of the main cultivated crops in Germany is still conducted by a large number (approximately 70) of small and medium-sized, independent breeding enterprises that run their own breeding programmes and are thus able to provide a wide variety of plants. The breeding companies are members of the Association for the Promotion of German Private Plant Breeding and thus participate in publicly funded joint projects to promote breeding research.

2.3.1.1 Arable farming and grassland

Vision for crops and grasslands

The vision is to achieve long-term conservation of the diversity of agricultural cultivated species and varieties to meet future demands, make them more widely accessible and use a wider variety of plant species and varieties commercially, with the ultimate aim of contributing to the conservation of threatened species, ecosystems and cultural landscapes and, in the use of grasslands, to take account of their special role in conservation of natural species diversity and traditional cultural landscapes.

This calls for:

- *Expansion of the infrastructure to allow conservation (ex situ), characterisation and evaluation of plant genetic resources, an improved legal framework for their in situ and on-farm conservation, and greater innovation in plant breeding activities.*
- *Greater consideration to be given to conservation and sustainable use of agricultural biodiversity when revis-ing and amending agricultural law.*
- *Further development of agri-environmental measures and securing funding for them.*
- *Promotion of landscape structure diversity as part of rural development activities.*
- *Promotion of more varied crop rotation and soil-protecting management practices, and implementation of the Chemical Plant Protection Reduction Programme and of the Nitrates Directive.*
- *Rapid national implementation and active participation in the implementation and further development of agreements and programmes at European and inter national level for the conservation and sustainable use of plant genetic resources.*

Characteristics and role

Around half of Germany's land area is used for crop-growing and as permanent grassland. Due to the large area involved, these land use forms play a key role in conserving biodiversity, ecosystem functionality (both of the ecosystems used and those in close proximity) and cultural landscapes. Of the land used for agriculture, arable land takes up around 70 percent (11.9 million ha) and 30 percent (4.9 million ha) is grassland (as of 2005). Considerable regional differences are evident in regional distribution of the different types of land use and the intensity in which they are practiced. These can be separated into typical grassland areas (coastal areas, river floodplains, Alpine foothills and pastures, etc.), with further differentiation being made between lowland and upland areas, areas with little structure and forest coverage but with high-quality soil and intensive crop-growing activity (e.g. Germany's Börde landscape regions) and small-structured park landscapes in Germany's upland areas where the soil is of a lesser quality and there is little intensive crop-growing and grassland pasturing.

Around two-thirds of available arable land is dominated by wheat, barley, maize and rapeseed crops each measuring over one million hectares. Rye, triticale, oats, sugar beet and potatoes also play an important role in terms of the area of land used. While planting of rye, root crops and fodder beet has declined dramatically compared with earlier times, rapeseed crops have significantly increased in recent years.

In contrast, grassland pasturing which is closely linked with livestock management is a fundamentally species-richer form of land use. Local variation in species diversity is largely dependent on the intensity of prevailing land management practices. The most species-rich areas are extensively grazed grassland in marginal locations. While some grassland species (grasses and legumes) are subject to breeding programmes and are used as rotation crops and for sowing and re-sowing, there are still regions with semi-natural and natural grasslands. In other words, they have a broad range of local native species, some of which are protected, that have evolved over time to become 'ecotypes'.

Challenges, problems and action needed

The number of cultivated plant species grown and the area of land they cover in a given region can serve as an indicator for the diversity of agricultural production systems. Since the 1950s, there have been substantial shifts in weighting among the various crop species, and this has been paralleled by a process of extreme concentration. This has led to only nine crop species being grown on 85 percent of all available arable land. The share of wheat, barley and maize amounts to over 50 percent. A direct comparison with the situation in 1925 and in 2000 highlights the changes in cultivated species diversity (see Table 2).

Table 2: Comparison of Arable Land Use in Germany in 1925 and 2000 (after Piorr and Lehmann 2003)

Crop	% Arable Land	
	1925	2000
Wheat	7.2	22.5
Barley	6.4	18.6
Maize	2.0	12.8
Winter rapeseed	0.9	7.9
Rye	21.4	7.1
Spelt, other	3.1	6.7
Sugar beet	2.0	4.3
Oats	16.4	2.5
Clover/grass	9.4	1.9
Legumes	3.2	1.5
Other oil crops	0.7	0.8
Alfalfa	3.1	0.3
Forage roots and tubers	5.2	0.1
Remainder	5,6	10,4

Clear increase Dramatic decline

Dramatic declines are evident in rye, oats, potatoes, fodder crops and legumes. Among the most common plant species are a large number of approved and available varieties. However, only a limited range are actually grown on a large scale. The seed market and crop-growing activities are largely dominated by just a few high-productivity varieties. Genetic erosion is thought to be particularly high in cereals.

As early as the beginning of the twentieth century, large collections of agricultural genetic resources were started. Today, the main task in such efforts is to achieve better characterisation and evaluation of these resources.

In-situ conservation is the key approach taken in grassland species conservation. Particulary in wild species it involves identification of threatened and conservationally important populations.

On-farm conservation of cultivated crops plays an increasing role, the main focus being on yield security which is based on years of adaptation to local conditions, broad-based resistance and marginal need for fertilisers and plant protection products. These crops can serve as base material for innovation and, where market potential is sufficient, as an alternative source of income. So far, however, on-farm conservation has only been used in isolated cases involving landraces, and in organic farming, demonstration projects and the growing of special crops. For some of the species covered by German seed trading law, there are

still no rules as regards the placing on the market of conservation varieties. While as a general rule, on-farm conservation methods may be promoted under agri-environmental measures, little experience has been gathered in this area so far and further research is needed.

Since the middle of the last century, improved breeding and the use of productivity-boosting and yield-securing methods have led to a dramatic increase in yields of all cultivated crops. This intensification of land use was accompanied by a loss of diversity in commercial crops[29] and an increase in the use of crops whose planting and harvesting were easily mechanised and which met changes in consumer demand, responded positively to the use of fertilisers and plant protection products, and were better protected against competition from overseas by means of market regulation.

Altered farming and land use methods also led to a dramatic loss in species diversity in field flora and fauna[30]. Not only does this alter species and population composition, it causes shifts and changes in entire ecosystems (including soil organisms) and the landscape.

The decline and isolation of near-natural structures and habitats in the agricultural landscape and the associated loss of species can be seen as a result of this intensification process (e.g. loss of structure following field consolidation).

Intensification also affects biodiversity in permanent grassland. For example, increased use of nitrate fertiliser leads to a shift in species composition because it causes a spread of nitrate-loving grasses, herbs and legumes, and a decline in non-nitrate-loving species. This generally results in a loss of biological diversity. Ploughing up and seeding or re-seeding and draining along with a switch to crop-growing on former grassland areas leads to losses of adapted species and ecosystems. Problems are also caused by the abandonment of often valuable, extensively managed grasslands in marginal yield areas.
Hence, the measures already implemented with agricultural and agri-environmental policy reforms aimed at halting biodiversity loss must be continued, reviewed and, where necessary, fine-tuned to take account of differing local conditions. This is especially the case as regards implementation and advancement of agri-environmental measures aimed at protecting specific biotic resources. Such measures must, however, differentiate between structurally rich varied upland landscapes and less-structured, intensively farmed regions. With a view to the increasing constraints on funding, the measures involved must not only be optimised in terms of goal attainment, but extended for example by incorporating them into larger environmental impact mitigation schemes – in other words, conscious effort is needed to seek alternative funding and implementation approaches.

For example, as part of the BIOLOG research programme funded by the Federal Ministry of Education and Research (BMBF), a project on the links between biodiversity and spatial complexity (BIOPLEX) conducted by the universities of Giessen and Göttingen produced a new incentive system for the district of Northeim to foster sustainable use of arable land and thus promote biodiversity. This involves a voluntary system whereby farmers can volunteer to provide ecological resources such as species-rich meadows, hedges and field flora in order to boost agricultural biodiversity. The rules regarding the design and implementation of the incentive system were developed by a committee of nature conservationists, the competent authorities and policymakers from the Northeim region (http://www.uni-giessen.de/bioplex).

Over the entire area used for agriculture, reducing the risks from the use of plant protection products and encouraging needs-focused use of nitrate fertilisers is of particular importance. Reducing discharges into water bodies is a goal of the EU's Nitrates Directive[31] and Water Framework Directive[32]. Lessening the risks arising from the use of plant protection products is also served by the Federal Ministry for Food, Agriculture and Consumer Protection's Chemical Plant Protection Reduction Programme and the various measures it contains. Using suitable measures implemented jointly by the national and Länder governments, approaches are developed which aid the advancement of integrated plant protection activities. Similar effects are achieved by promoting integrated agriculture, organic farming and resistance breeding. Preventing the introduction and spread of pathogens also helps reduce the use of plant protection products.

29 In Germany, the greatest use of biodiversity in agricultural landscapes occurred between 1925 and 1935. Significant changes came with the introduction of intensified farming in the 1960s. This trend peaked between 1980 and 1985. While the use of nitrate-based commercial fertiliser in business year 1954/1955 was only 31.7 kg pure nutrient/ha, it rose to 133.9 kg/ha in 1987/1998 and then dropped to 109.5 kg/ha in 2004/2005.

30 Despite the sharp drop in the use of commercial fertiliser in response to changed legislative and economic conditions, Germany still has a nitrate excess of between 80 and 110 kg which cannot be completely avoided. Run-off-related nitrate input, from emissions from sources such as incineration plants, engines and livestock husbandry (ammonia), is estimated to average between 30 and 40 kg N/ha.

31 Council Directive 91/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources.

32 Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy.

2.3.1.2 Horticulture

Vision for horticulture

The vision is to promote innovative, sustainable use of plant diversity in ornamental plants, shrubs, bushes, medicinal plants and herbs, vegetables and fruit, and to encourage their use in order to secure a broad genetic base.

This calls for:

- *Public and private collections of genetic resources of horticultural cultivated plants to be supplemented and linked, and for nationally coordinated conservation activities.*
- *The promotion of management methods that make a significant contribution to biodiversity conservation, particularly in vegetable and fruit growing.*
- *Breeding of threatened wild plants and their use in parks and gardens and as indoor plants to aid their conservation.*
- *Diverse, situationally appropriate use of plants in private and market gardens, and in public parks and green areas.*

Characteristics and role

In 2004, commercial-scale horticulture accrued sales of almost €5 billion. This represents around 11.5 percent of total output value in agriculture and comprises €1 billion for fruit, €1.4 billion for vegetables, €1.5 billion for flowers and ornamental plants, and €1 billion for tree nurseries. Horticultural services that are not included in agricultural output value calculations accrued another €5.1 billion (€3.9 billion for gardening and landscaping services, and €1.2 billion for cemetery maintenance services). Commercial-scale horticulture in Germany used some 224,300 ha of land in 2004, representing about 1.3 percent of all land used in agriculture. While the cultivated plants used in horticulture fall into three general groups – fruit, vegetables and ornamental plants (including trees and shrubs in nurseries) – far greater differentiation is called for when evaluating the current status and the problems faced.

Although horticultural and orchard products only play a marginal role in terms of the area of agricultural land used, they make a disproportionately large contribution to species diversity and variety and thus to agricultural biodiversity. While in crop-growing a total of just 25 plant species are grown in any volume, fruit-growers use around 30, vegetable-growers 35 and medicinal plants and herb growers about 80 species. Of the 2,000 to 3,000 ornamental plant species grown, around 400 are of significant commercial value. In contrast to most field crops, vegetables, fruit and medicinal plants and herbs are also grown in private gardens (and in market gardens), so that diversity of varieties among these plant species remains relatively high. Private gardeners and allotment holders, especially since their main motivation is not usually commercial, can make a valuable contribution to conserving biodiversity by growing traditional, regionally characteristic fruit varieties, and should be encouraged to do so.

Open orchard meadows are an extremely important crop-growing method in safeguarding biodiversity and agricultural biodiversity. This highly extensive management practice no longer plays a role in commercial fruit-growing. There are thus no official statistics on the area of land used, although the competent *Länder* authorities generally maintain data in respect of habitat protection measures. Yields from open orchard meadows, which are used commercially for example in juice-making, are estimated to be only half those from market orchards. Open orchard meadows are particularly prevalent in southwest Germany, where they contribute towards a cultural landscape that is highly valuable in terms of biodiversity. Their conservation is promoted by agri-environmental programmes and they are the most important form of on-farm conservation of plant genetic resources in Germany.

Riche diversity can sometimes be found in private gardens

Diversity of rhododendron

Only a few fruit and vegetable species are bred commercially in Germany. Breeding of medicinal plants and herbs is still in its teething stages. Conservation breeding is still practised for a broad range of vegetable species. By way of contrast, Germany's ornamental breeding sector is extremely active. Somewhere between 70,000 and 80,000 varieties and species of ornamental plants are on the market in Central Europe. There are at least as many again in public and private collections. The range is subject to constant change, especially as regards types and colours. The search for suitable resistance resources and traits is of great importance. New varieties and species are constantly entering the market, thus driving breeders' interest in acquiring unrestricted access to well-documented and evaluated materials in internationally accessible gene banks. Apart from commercial breeding, propagation and trading, a large number of interest groups and private breeders also play an active role in biodiversity conservation and promotion.

The amount of land used for commercial horticulture is dwarfed by the area given over to growing ornamental plants and shrubs. In Germany, private gardens alone take up around 930,000 ha (every second home has a garden). Thus, apart from their social and utility value, gardens harbour considerable biodiversity potential. This can evolve especially well when gardens are managed in environmentally sound ways, when plants are chosen to suit local conditions, gardeners refrain from using invasive plants, and species and varieties are used that have an ecological function beyond their ornamental and utility value.

Challenges, existing problems and action needed

There is no reliable information on the volume and importance of ex situ collections of permanent and speciality crop varieties, special and working collections, and collections of commercial plants in botanical gardens and arboretums. Some varieties such as berry-producing plants and shrubs are under-represented and their systematic safe storage only occurs in isolated cases.

Little is known about the status of and threat to genetic diversity in ornamental plants. It can however be assumed that very few traditional varieties remain available. The strategy developed by botanical gardens to establish conservation collections is hampered by the fact that it relies heavily on cooperation from private collectors and their willingness to publish their data.

There is a need for action as regards linking existing collections to ensure long-term conservation of biodiversity in horticultural plant species and varieties that are already used and those with potential for use.

In the case of vegetables, efforts largely concentrate on long-term ex situ conservation of seed varieties in the IPK gene bank in Gatersleben. If the Federal Office of Plant Varieties (BSA) withdraws approval for a seed vegetable variety, a breeder may agree to store part of the last officially approved specimen being stored along with the variety description in the IPK gene bank. For sustainable use and on-farm conservation of genetic resources of vegetables, the planned amendment to EU seed trading law is important in that it allows, for example, seeds of old vegetable varieties which involve species covered by seed trading law to be marketed for the hobby garden sector and by vegetable growers who want to sell rare and exotic vegetables.

In contrast to vegetables, ongoing conservation of fruit genetic resources cannot be secured in a central establishment in Germany because the varieties and origins must be planted out as trees and shrubs. A multi-level conservation approach is thus necessary which, apart from the existing national conservation institutes (see Table 1), takes in *Länder*-specific and private collections, and on-farm conservation resources, for example in the form of open meadow orchards. Starting from the BAZ fruit gene bank in Dresden-Pillnitz, it is intended to establish a country-wide decentralised network of fruit gene banks (Genbanknetzwerk Obst). This will involve the actors mentioned earlier in an effort to secure ongoing conservation of fruit genetic resources in Germany, both as a precautionary measure and to enable their sustainable use. Of utmost importance in their maintenance, especially that of old and regional varieties, is the conservation of open meadow orchards. The various *Länder* have appropriate funding measures in place to foster conservation of fruit genetic resources, secure their ongoing use and encourage active marketing of products derived from them (e.g. juices and spirits). Relative to their importance and threat status, some varieties will be transferred to the new fruit gene bank network mentioned above to allow their long-term conservation and availability for fruit breeding programmes.

At national level, there are no central conservation institutions for ornamental plant genetic resources. As in the case of fruit, ornamental plants are largely propagated vegetatively so that their conservation is only possible in plant collections and not as seeds. The federal government thus plans to provide the necessary support to enable as many as possible of the existing and in some cases extremely comprehensive collections in private and public hands to be linked to decentralised gene bank networks as a vital component of Germany's agricultural biodiversity. Specific functions and services needed for the gene bank network (e.g. documentation, provision of information, international cooperation, and development of conservation and submission standards) could be coordinated and provided by a central establishment. Central coordination for individual plant genera could be performed by a leader institute for each genus. To establish the necessary base, the BMELV is promoting a range of different projects. With the large number of species of German wild flora used as ornamental plants, similarly intense efforts are needed in respect of *in situ* conservation measures.

2.3.1.3 Viticulture

Vision for viticulture

The vision is to conserve genetic resources of grapevines, expand use of the genetic basis of the grape varieties in use, boost the consumer value placed on grapevines and varieties, and take account of the special demands placed on vineyard management as regards the characteristic wild plants and animals that live there, and in terms of soil and landscape conservation requirements.

This calls for:

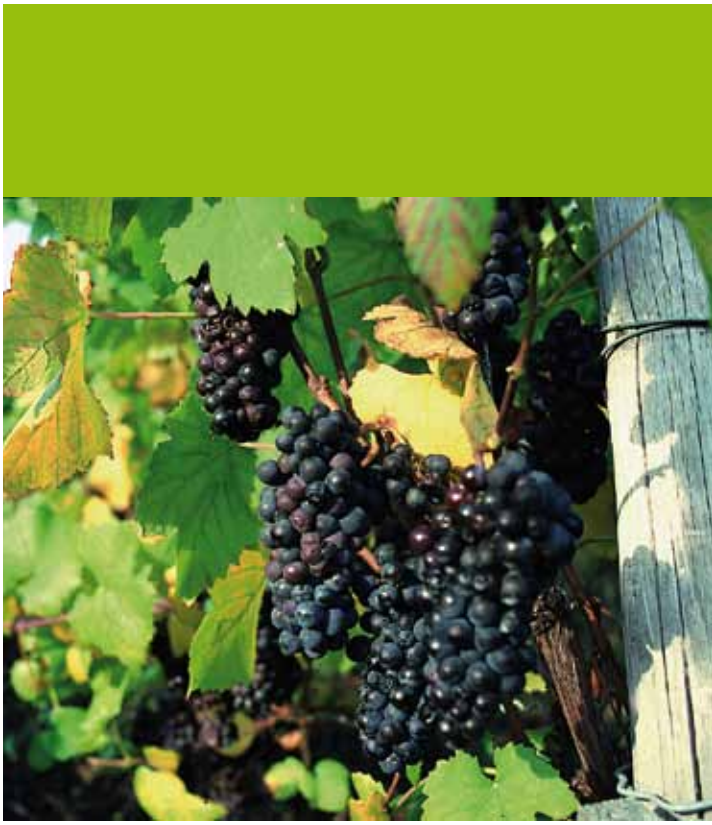
- *Supplementing and linking of existing collections of , genetic resources of grapevines, better coordination of conservation activities (ex situ and in situ) and more intensive evaluation activities.*
- *Improved quality assurance measures for existing collections, i.e. conservation of healthy, original-variety vines.*
- *Promotion of management methods that make a special contribution to biodiversity conservation in vineyards.*

Characteristics and role

In contrast to many other plant species used in agriculture, consumers consciously recognise and demand the varieties that represent the genetic diversity of grapevines (and the respective vineyards). Wine growing is also an important component of cultural and culinary identity in the different wine-growing regions. Following the last wine growing census in 1999 (one is conducted every ten years), Germany had vineyards measuring some 104,233 ha, although the average size of a wine-growing holding was only 2.9 ha. The output of Germany's wine growing sector is valued at €1.4 billion. Production is almost exclusively focused on wine grapes. A particular characteristic of Germany's wine-growing sector involves the strict statutory regulation of production conditions, protection of source of origin descriptions and the importance placed on variety-specific marketing which can be described as exemplary as regards the use of genetic resources. Due to the concentration of wine growing in specific, mainly southwestern regions of Germany, it is of great importance to regional economies and the production methods used are instrumental in shaping local landscapes in those regions. Under certain circumstances, vineyards can also provide valuable habitats for numerous wild and in some cases threatened flora and fauna.

Challenges, existing problems and action needed

According to estimates by the BAZ Institute of Grapevine Breeding (IRZ), Geilweilerhof, some 300 grape varieties have played a role in German-speaking countries in the past. Of these, between 15 and 20 varieties are still approved for wine growing. Consolidation of vineyards and the switch to modern wine-growing methods have made old vineyards and mixed-grape vines something of a rarity in Germany. Old grape varieties and clones were ripped out and replaced with plant material that had been modified in clone-breeding to produce higher yields and sugar content. This has depleted the varieties and clone diversity achieved in Germany's wine-growing industry over the centuries. In clone breeding, vine material that is still likely to provide a certain genetic range can only be taken from old, non-selected vineyards. Given their high ecological quality as habitats for associated and other wild species, these are of extreme conservational value. Germany's one and only native natural vine (Vitis vinifera ssp. sylvestris) is seriously threatened because there are only small remaining stocks kept in in situ collections and is rarely found in trade.



Apart from conserving older vineyards and vineyard landscapes, which includes maintaining traditional management methods, it is important to secure the genetic basic for traditional grape varieties. This is especially the case as regards the remaining landraces that have survived in very small numbers among the grapevines available today. The aim is to find robust genotypes with excellent quality traits and to make them usable for breeding and in wine-growing. The collection of old native grape varieties and valuable clones of traditional grape varieties and their systematic evaluation and documentation is vital in this work. Existing structures in grapevine genetic resources must be transferred to a geographically decentralised but centrally coordinated gene bank network. Germany's *ex situ* collections must first be systematically reviewed as regards the grape varieties they contain and to identify their genetic fingerprints and document their current status. A reliable conservation strategy must then be implemented with the participation of all relevant actors.

In the organic wine sector, further improvements are necessary in resistance breeding to combat fungal disease. This will further reduce the use of copper-based fungicides and thus promote soil conservation. Expanding the genetic basis will serve such efforts.

2.3.1.4 Renewable resources

Vision for renewable resources

The vision is to increase crops of renewable resources in line with the diversity of the plant species used and in such a away as to conserve the diversity of the cultural landscape.

This calls for:

- *Promotion of planting and use of the largest possible range of crops as renewable resources and making their products market-ready.*
- *Consideration of biodiversity conservation when promoting renewable resources.*

Characteristics and role

In plant production, an increasingly important role, not least on account of energy, climate and agricultural policy grounds, is played by crop-growing of renewable resources. This involves agricultural and forestry raw materials derived from plants[33] for use not in the food and fodder sectors, but for raw materials supply and energy generation. The area of land used to grow RRM crops has been on the increase since the late 1980s. There has, however, been a rapid rise in recent years, particularly as a result of EU law, national requirements and state funding measures. In 2007 some 2 million hectares of RRM were grown, taking up 17 percent of all available arable land. A further increase is expected, with long-term estimates indicating up to 5 million ha of potential usable land. The biggest increase has occurred in the production of biomass as an *energy* source. At present, rapeseed (largely for biodiesel production) is by far the most important cultivated crop species in agriculture. In the coming years, a rise is also expected in cereal crops for use in bio-ethanol production. With the increase in biogas production, the cultivation of energy crops (especially maize) for use as biogas has risen. This trend is expected to continue. For heat generation and second-generation biofuels, crops of fast-growing tree species may gain in importance. The use of RRM for raw materials supply is also on the increase, albeit on a lesser scale. Currently, the German chemicals industry uses around 2.1 million tonnes of renewable resources in the form of plant oils, starch,

33 This also applies to raw materials of animal origin although they are not taken into account in this instance.

sugar and cellulose, representing around 11 percent of processed raw materials. This figure could rise to as much as 20 percent, although two-thirds of the raw materials used at present are imported.

Challenges, existing problems and action needed

Given the increase in land used for RRM crops and the associated potential dominance of just a few crop species, further crop ratio trends must be carefully observed in terms of their impact on agricultural biodiversity. On the one hand, there is an opportunity to broaden the spectrum of usable plant species and thus to positively influence agricultural biodiversity by adopting less concentrated crop rotation practices. On the other, crop-growing strategies could be problematic if they involve mostly short-term crop rotation and monocultures. While existing provisions on the conservation of permanent pasture in line with cross-compliance requirements can prevent increased ploughing up of permanent pasture to make way for RRM crops, there is still a higher risk of species-rich and extensively used permanent pasture being ploughed up, resulting in the loss of valuable habitats for a variety of flora and fauna. The existing agri-environment and contract-based conservation provisions must thus be put to greater use and, where necessary, be amended to allow a more targeted approach.

Because RRM crops in Germany are grown in line with best practice principles, no problems are expected as regards concentration on crops for biomass production and the associated risks of biodiversity depletion and adverse environmental impact. Nevertheless, regional differences must be considered and timely action taken to avoid undesired effects. Particular attention should be paid to achieving a good humus balance by means of crop rotation, especially when the entire biomass crop is harvested without leaving any remaining plant parts in the soil (as is the case when using biomass for energy production) and no soil replenishment measures are taken (spreading fermentation substrates, for example). This situation is similar regarding biomass imports and the environmental footprint they leave behind.

Development potential is also harboured in crops of new agricultural plants and ones that have largely gone out of use (e.g. triticale, flax and linseed, hemp, dyeing plants, fast-growing tree species, linseed dodder or false flax, *Crambe abyssinica*, stinging nettle, kenaf, *Miscanthus*, various medicinal plants, and *Euphorbia lathyris* or caper spurge).

In certain circumstances, these can make a significant contribution to biodiversity conservation and promotion. Mixed crops and multiple crops grown within a given year, using annual crops of legumes and sunflowers or perennials, thus offer promising solutions[34]. Under the BMELV campaign to promote renewable resources, a range of different projects have been initiated by Fachagentur Nachwachsende Rohstoffe e. V. (FNR) with the aim of broadening the species and varieties spectrum and encouraging crop diversification. There remains a need for research and development however, not least in breeding research, to improve yield potential in desirable crops whose use is on the decline.

In developing innovative approaches to producing biomass-generated energy and providing raw materials for use in the chemicals and industrial sectors, adapting cultivated plants in breeding programmes plays a key role. This gives rise to the question as to whether the supply of genetic resources is sufficiently secured to meet future demands for crop-growing and renewable resources supply (including for biotechnology-based processing and refinement). When compared with food crops and energy crops, plants grown to supply raw materials for direct use have a completely different requirements profile in terms of the substances needed. Thus, when devising measures for the evaluation and conservation of genetic resources, it must be ensured that the basis for sustainable supply of renewable resources is secured for the longer term.

34 TAB-Bericht „Alternative Kulturpflanzen und Anbauverfahren". Bundesdrucksache 16/3217 dated 01.11.2006. (TAB report on alternative crops and crop-growing methods).

2.3.2 Measures needed in crop production

Securing and improving the infrastructure

- With breeders' involvement, expand networks to identify and evaluate the traits of genetic resources of agricultural and horticultural cultivated plants.
- Protect ex situ collections from becoming contaminated with GMOs.
- Support the establishment and expansion of regional centres of excellence at *Länder* level, for example with model projects on conserving traditional, region-specific and threatened cultivated crops – both in on-farm conditions and in their wild forms *in situ*.
- Devise European and national rules on the marketing of seed genetic resources (conservation and 'amateur' varieties) and of seed mixtures of regional origin where species cited in the species lists contained in seed trade law are involved.
- Establish a decentralised network for the conservation of fruit and grapevine genetic resources, and of genetic resources of ornamental, medicinal and aromatic plants and herbs, and key speciality crops. The network would be coordinated by a central body whose work would include documentation and information.
- Support the activities of private persons and groups vital to conserving crop diversity.

Improved management systems

- Review and, where appropriate, further development of the requirement under the Luxembourg decisions on agricultural reforms that agricultural land must be kept in good agricultural and environmental condition.
- Greater consideration must be given to diversity in landscape structures as a basis for the conservation and sustainable use of biodiversity in rural development activities.
- Further development of a broad spectrum of agri-environmental measures to provide adequate responses to varied problems and specific regional situations. Also, broad-based measures must be ad-

vanced to provide a wide range of positive effects on biodiversity while complying with prevailing standards (such as those applied in organic farming) and voluntary self-commitments (e.g. contract-based conservation). Finally, adequate funding must be secured for such agri-environmental activities.

- Review and, where appropriate, amendment of the principles of good agricultural practice in applicable law with the aim of supporting ecosystem functions relevant to agricultural use and biodiversity in agriculture.

- Soil-friendly management practices to preserve the soil's natural biodiversity and promote its regulatory functions.

- Timely implementation of the BMELV Chemical Plant Protection Reduction Programme to reduce the use of plant protection products to the necessary minimum. Efforts must also be made to promote the use of non-chemical plant protection methods.

- Further improvements in nutrient efficiency, especially as regards nitrate, with the aim of reducing current nutrient surpluses.

- Promote technological innovation to reduce the pressures on ecosystems used in agriculture.

- Under the federal government's innovation campaign, promote innovative breeding initiatives, including those aimed at increasing resistance in cultivated crops.

- Take greater account of variety-specific traits and characteristics in marketing activities.

- Where possible, give greater consideration to maintenance services provided by agriculture (e.g. agri-environmental and contract-based conservation activities) in order to balance or compensate for negative impacts as set out in the impact mitigation rules contained in German nature conservation law.

- Promote innovation in breeding and in growing renewable resources for energy and raw materials supply, to include consideration of risk-based cultivation strategies to prevent unintentional spread of invasive plants.

- Consideration of biodiversity conservation when promoting renewable resources in the course of implementing climate change measures.

- Development of sustainability standards for the use of fossil fuels, consideration of good practice in the use of renewable resources and renewable energy sources, and implementation of certification systems.

- In the biofuel production sectors, develop a set of requirements for sustainable management of agricultural land using existing best practice models for habitat conservation and the provision of proof that the energy generated offers a certain CO2 reduction potential, as called for in the planned statutory sustainability regulations to be issued in accordance with the provisions of Germany's Energy Taxation Act (Energiesteuergesetz) and Biofuel Quota Act (Biokraftstoffquotengesetz).

Strengthen international cooperation

- Rapid national application of and active support in the implementation at international level of the International Treaty on Plant Genetic Resources for Food and Agriculture and the Global Action Plan on Plant Genetic Resources for Food and Agriculture.

- Provision of partial funding from the federal budget for the Global Crop Diversity Trust and promotion of voluntary services provided by industry.

- Further development of the European Cooperative Programme for Plant Genetic Resources (ECPCR) with the aim of establishing a European network (known as the AEGIS Initiative – *A European Genebank Integration System*) and its integration into an FAO-coordinated global network for plant genetic resources.

2.4 Agriculture and Animal Husbandry

2.4.1 Objectives, current situation and action needed

Vision for animal husbandry

The vision is to conserve the genetic diversity of livestock, and particularly of animal breeds threatened with extinction, to employ those breeds more intensively in innovative, sustainable uses including landscape maintenance, and to reduce the harmful effects that livestock husbandry has on biodiversity.

This calls for:

- *General monitoring of livestock, targeted, cross-regional breeding programmes for breeds threatened with extinction, and establishment of cryoconservation reserves, among others things as a precautionary measure for the event of epidemic diseases.*
- *Extensive management practices using breeds that are either rare or threatened with extinction for the purposes of conservation and to boost the experience and recreation value of cultural landscapes.*
- *Greater consideration of regional-specific conditions with a view to promoting closed nutrient cycles in ongoing structural development of livestock husbandry.*

Characteristics and role

Of the 1.3 million people who work in agriculture, by far the biggest group work in livestock husbandry. A main point of focus is labour-intensive keeping of dairy cattle and sows. Among the approximately 345,000 agricultural holdings in Germany, about 50 percent are cattle-rearing farms. Dairy cattle are kept on about 30 percent of all holdings. Significant regional differences are evident when it comes to livestock density and farm structures.

Livestock husbandry represents the key source of income in German agriculture. Of the almost €40 billion in annual sales achieved, around 50 percent are accrued from animal products. Milk leads the field with over 20 percent. The sale of cattle for breeding also plays a role, particularly as regards exports of breeding cattle from high-productivity breeds.

Today, economically less important and thus threatened breeds can be of high yet difficult to estimate economic value if they possess traits that can be introduced into modern breeding programmes. These include resistance traits such as trypano tolerance in African N'Dama cattle, heightened hoof stability and endoparasite resistance in some land races of sheep, quality traits such as the intramuscular fat content of Duroc pigs, and breeding suitability (for example, crossing Hampshire with Pietrain pigs to produce robust breeding pigs). These breeds can all be significant in regional niche programmes like those involving the supply of Heidschnucken and Rhön sheep to local restaurants or the use of Schwäbisch-Hällischer and Bunte Bentheimer pigs in the production of quality meats.

Then there are the external services involved in livestock husbandry. These include maintenance of agriculturally less-developed, low-yield regions with attractive landscapes using, for example, specific races of sheep (Heidschnucken, Skudden and Bergschaf) which are kept on dykes, bare heathlands, nutrient-poor grasslands, peatlands and other low-yield areas, or specific cattle breeds such as Hinterwälder, Limpurger, Rotes Höhenvieh and certain undemanding breeds of beef cattle. The extensively grazed areas used by these breeds are of key importance in the conservation of natural biodiversity because many plant and animal species are dependent on such management practices. Many holdings contribute towards the conservation of threatened breeds by means of hobby-based livestock husbandry that focuses on special niche production.

In Germany, the breeding of horses, cattle, pigs, sheep and goats is governed by the Animal Breeding Act (*Tierzuchtgesetz*). This covers pure breeds produced by recognised breeder associations and cross-breeding programmes and is based on EU animal breeding

" Rotes Höhenvieh" - an endangered breed

„Deutsches Sattelschwein“ an endangered pig breed

law. Its provisions relate in particular to breeding activities and documentation, and prescribe the type and scope of performance tests used in breeding programmes. The degree of organisation in breeding differs according to the animal species involved. In the case of cattle, around 61 percent of cows are registered as breeding animals with recognised breeding organisations, about 82 percent are documented as being used for artificial insemination purposes, and 83 percent of dairy cows are subject to official performance tests. As regards pigs, some 93 percent of young sows sold are hybrids or cross-breeds from breeding businesses or breeders' associations. About 87 percent of pigs are sired using artificial insemination. With sheep, around 6 percent of ewes are herd book animals. Only recognised commercial breeder organisations are permitted (and are under placed obligation) to breed animals in accordance with the provisions of the Animal Breeding Act. Implementation of pure-breed programmes is the sole domain of breeders' associations.

The new Animal Breeding Act of 21 December 2006 deems conservation of genetic diversity in the breeding of agricultural livestock as a mandatory requirement. Prior to the act coming into force, no legal provisions on this aspect had been in place. At present, only isolated activities are conducted by the various Länder and these are not coordinated nationally. The CBD, however, gives rise to a requirement for measures towards conservation and sustainable use of animal genetic resources. The new Animal Breeding Act also provides for monitoring of genetic diversity in agricultural livestock. The competent authorities will in future collect data at regular intervals on stock numbers and statistics relating to population genetics. These will then be processed centrally, at national level, by the Information and Coordination Centre for Biological Diversity (IBV) at the Federal Agency for Agriculture and Food (BLE) to allow the threat status to be assessed for the various breeds involved.

The Animal Breeding Act also confers powers to lay down principles for the collection and storing of seeds, embryonic cells, embryos and other genetic materials (cryoconservation reserves) for the purposes of long-term conservation of and access to threatened breeds.

In contrast to the provisions on large animals, German animal breeding law does not apply to agricultural poultry species and cannot therefore be applied to ensure conservation of poultry genetic resources. The same applies as regards rabbits. In the case of poultry, the situation differs from that of large animals in key areas because the development of commercial poultry breeding has led to an almost complete separation between a small number of commercially used breeding lines and a wide range of breeds that are used almost exclusively by hobby breeders[35]. The conservation of threatened breeds of large animals and the genetic diversity of poultry and rabbits is thus largely reliant on private initiatives and particularly those of clubs and associations.

One area of livestock husbandry that plays a role, primarily on account of its external environmental services, is beekeeping. Apart from the revenue accrued from the sale of products derived from beehives, pollination of cultivated plants and wild-growing flowering plants by honey bees (alongside wild bees and bumble bees) is essential. The role of beekeeping in honey production is way behind its domestic market potential, however. Around 80 percent of honey used in Germany is imported. In 2005, some 750,000 beehives were kept by about 85,000 beekeepers. Less than one percent of beekeepers make honey commercially, the vast majority being hobby beekeepers. Broad-based pollination is largely secured by the even dispersal of beehives and beekeepers around the country. However, beekeepers tend only to keep up the interesting and attractive yet demanding pastime of beekeeping if they can work with relatively unproblematic, healthy bees and earn an adequate income from the honey they yield. The introduction of diseases like varroatosis makes domestic beekeeping difficult. Plus, the declining number of beekeepers and beehives threatens pollination of agricultural crops and many wild flowering plants.

35 In the case of hens, specialisation has been given over completely to fattening and laying hens. Breeding of laying hens involves three business groups (with between one and three breeding enterprises) that cover the entire world market for laying hybrids that produce white and brown eggs. Where fattening hens are concerned, there are also three businesses that cover 90 percent of the world market. Turkeys are bred by just three globally operating businesses. Around the world, there are about 20 breeding companies that produce water fowl, less than five of which produce the vast majority of parent lines.

Challenges, existing problems and action needed

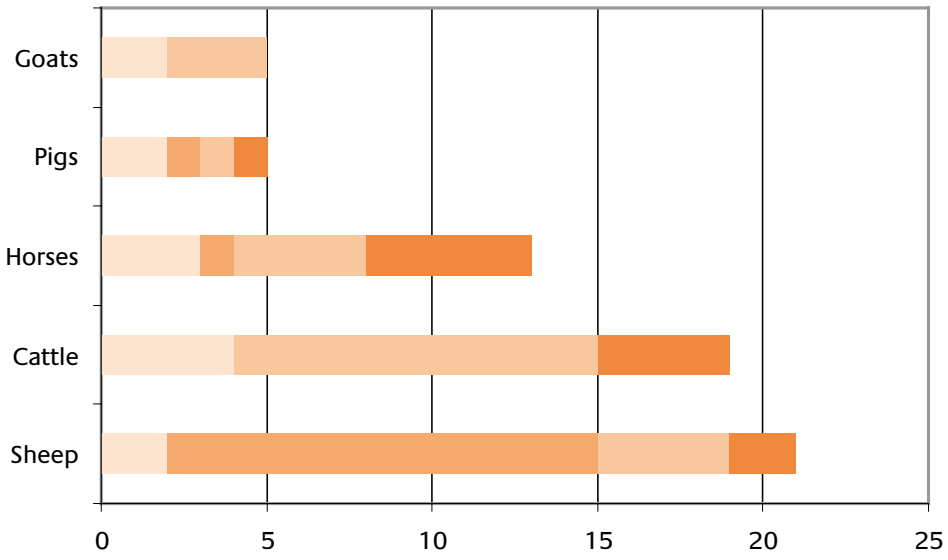
Developments in modern industrialised society lead to an unintentional increase in the threat to domestic livestock breeds. For example, only two breeds play a significant role in dairy production in Germany (Holstein-Schwarzbunt with 57 percent and Fleckvieh with 25 percent). The extinction of breeds, the dwindling size of populations of specific breeds and a high degree of inbreeding among breeds with larger-sized populations has resulted in the irretrievable loss of alleles (genetic diversity). This in turn lessens the genetic diversity among commercial livestock overall. State intervention is vital in efforts to stop this trend.

With regard to the almost 300 breeds among the animal species covered by the Animal Breeding Act, the Advisory Committee for Animal Genetic Resources (Fachbeirat für Tiergenetische Ressourcen) says that 50 of Germany's 63 native breeds are threatened. The figures vary among species (see Figure 1).

The use of scarce public funds and obtaining additional private sponsorship for conservation activities requires that the social value of these breeds be made visible regardless of their current market value and that cost-effective, efficient, sustainable and safe conservation methods be developed.

Further globalisation of livestock breeding programmes for what are largely standardised management practices calls for separate breeding activities to produce livestock populations that are adapted to particular environmental and production conditions. To ensure the upkeep of animal production at marginal yield locations, the use of extensive management methods in less-developed regions and the availability of specific products, livestock animals are needed which differ genetically from the dominant intensive populations and can be bred where necessary by using better-adapted land races.

Fig. 1: Threatened native livestock breeds in Germany relative to agriculturally used breeds overall (status 2007)



	Sheeps	Cattle	Horses	Pigs	Goats
PC = Phenotypical conservation	2	4	5	1	0
CP = Conservation population	4	11	4	1	3
OP = Observation population	13	0	1	1	0
NT = Not threatened	2	4	3	2	2

„Westfälische Totleger“ - an endangered breed

In terms of management methods, a distinction must be drawn between land-based animal husbandry where the supply of fodder largely comes from the farm and non-land-based animal husbandry in which fodder is mostly bought in. When it comes to animal stocks per unit of land, extensive management methods (such as sheep, mother cows, cattle-breeding and horse-keeping) must be separated from more intensive ones. In general, a large percentage of fodder used in animal husbandry in Germany is covered by imports. In connection with non-land-based intensive animal husbandry and the growing separation of animal husbandry and crop production in the course of farm specialisation, this leads to open nutrient cycles (both on farms and regionally) with considerable nitrate and phosphorous inputs and the associated negative impacts on biodiversity and ecosystems. The Federal Nature Conservation Act calls for good agricultural practice in which a good balance is achieved between animal husbandry and crop production. The problem of nutrient surpluses is also being tackled through the switch from per-animal premiums to area-based premiums, both under the CAP reforms and through other measures to reduce animal stocks and livestock-related emissions.

The necessary cuts in ammonia emissions are to be achieved through determined implementation of a government scheme to reduce such emissions in agriculture. The broad-based measures this contains primarily involve CAP reforms, promotion of organic farming, implementation of recommendations for good agricultural practice, promotion of clean technology, support for agri-environmental activities and amendment of Germany’s fertiliser legislation (*Düngeverordnung*), the latter having already taken place. These measures are designed to reduce the negative effects of harmful emissions on biological diversity.

2.4.2 Measures needed in animal husbandry

Securing and improving the infrastructure

- Expand the German animal genetic resources database (TGRDEU) to include data from the yet-to-be-established national cryoconservation programme, data on additional animals and further data on population genetics with the aim of improving the reliability of stock monitoring results.
- Establish a regular, nationwide stock monitoring programme comprising a countrywide network of breeding books for livestock breeds belonging to the large animal species listed in the Animal Breeding Act, for small animals (poultry and rabbits) and for wild animals held in similar conditions to livestock kept for agriculture. Where available, data from hybrid and cross-breeding programmes must also be included.
- Establish a national cryoconservation programme for threatened livestock breeds and include documentation of these breeds in the TGRDEU.
- Develop provisions on animal epidemics as a precautionary measure for the conservation of valuable animal genetic resources, especially in the case of threatened livestock breeds.
- Inventorisation, evaluation and development of measures to reduce relevant emissions from livestock husbandry with the aim of conserving agricultural biodiversity in the face of climate change.
- Promote the key role and involvement of conservation initiatives in their efforts to conserve biodiversity of livestock breeds.

Improved management systems

- Establish nationally coordinated and targeted conservation breeding programmes and explore the options for integrating them into national promotion initiatives launched as part of the cofunding measures provided for as of 2007 under the EAFRD Regulation (Regulation (EU) No. 1698/2005).
- Promote extensive animal husbandry using measures to maintain and preserve the cultural landscape by means of extensive management of threatened livestock breeds as an integral component of conservation breeding programmes, including in the form of premiums for holding threatened livestock breeds as part of national use of the cofunding options provided for as of 2007 under the new EAFRD Regulation.
- Promote great diversity in honey bees (which among other things are important pollinators) using measures to secure an adequate food supply and incentivise beekeepers.
- Implement a breeding research programme under the BMELV innovation promotion scheme.
- Reduce nitrogen inputs through technological advancements in the treatment of animal residues and wastes and their use in energy production.
- Prevent the introduction of parasites and diseases that threaten domestic honey bee populations (the small hive beetle and Tropilaelaps mites, for example).

Strengthen international cooperation

- Support implementation of the FAO Global Action Plant for Animal Genetic Resources.
- Participate in relevant European and international bodies (such as the EAAP, FAO, CBD, OIE and the WTO) with the aim of coordinating activities for the conservation and sustainable use of animal genetic resources.
- Support the establishment of the European Regional Focal Point (ERFP) to facilitate an effective EU cooperation programme on animal genetic resources.

Beekeeping provides additional to honey production substantial pollination services

2.5 Forestry

2.5.1 Objectives, current situation and action needed

Vision for forest management

The vision for forest management comprises the use of near-natural forest management practices on as much managed forest area as possible while ensuring that it remains viable for forestry enterprise. This is vital for sustainable and multifunctional forestry. The aim of forest management should thus be to achieve stable, healthy, productive forests that are suited to local conditions.
Forests play a key role in biodiversity conservation, in the nutrient and water cycles, and in providing recreational areas for people to enjoy. To preserve forest's diverse functions over time, Germany must ensure its forestry and timber sectors remain productive and competitive.

This means:

- *Biodiversity conservation and sustainable use of forests should be secured in combination and on a lasting basis over as large an area and with as few restrictions as possible.*
- *Conserving the diversity of locally adapted tree and shrub species and adopting sustainable management practices to ensure the use of within-species diversity.*
- *Conserving and reintroducing viable populations of threatened tree and shrub species.*
- *Enhancing forest industry approaches to sustainable forest management.*
- *Improving forest biodiversity conservation instruments and making particular use of contract-based conservation.*

Characteristics and role

In terms of land area used, Germany's forestry sector is second only to agriculture as the most important form of land use. Taking in more than 11.1 million hectares, it represents some 31 percent of total land area. Today, the main forest areas are in the central uplands, the Alps and parts of the north German lowlands. With the exception of a few areas, these have been shaped by centuries of human activity. Without this influence, most areas would be dominated by deciduous and mixed forests, mostly containing beech. The natural range of coniferous forests is restricted to the middle-altitude and higher uplands (spruce, fir and larch) and to extremely dry or wet locations with nutrient-poor soil (pine).

According to the findings of the second Forest Inventory in 2002, Germany's timber stocks amount to 3.4 billion m^3. In a European comparison, Germany takes the lead with its vast forest areas. Model calculations[36] performed by the Johann Heinrich von Thuenen-Institute (vTI) – Federal Research Institute for Rural Areas, Forestry and Fisheries indicate reserves will allow greater use of wood without posing a risk to sustainable forest management. Additional potential was identified to allow between 13 million m^3/year and 35 million m^3/year of timber with a diameter above 7 cm to be used in the coming years for energy production and as a raw material resource. Another 9 to 10 million m^3/year of timber below this diameter (including branchwood, sticks and brushwood) was identified for use as an energy source. The reserves largely comprise deciduous wood and forest waste-wood. In light of diverse efforts to expand the use of wood as a raw material resource, both in Germany and elsewhere in Europe, the use of forest waste wood for energy is growing in importance. Along with improved management of reserves, for example through the provision of better advisory services and management of reserve-rich, small-scale private forests, there are adequate reserves available to allow greater use of wood as a raw material and energy resource. Finally, timber sales make up over 80 percent of forestry income and thus provide the economic base needed to ensure sustainable forest management.

Apart from supplying reserves of raw timber, forests also have an important social function. Their trees, soil and products capture CO_2 over time. Forests protect soil from erosion, provide people with a place to relax and enjoy nature, aid regeneration of air and water, and provide habitats for a wide range of animals and plants. In terms of conservation and sustainable use of biodiversity, awareness of the forest's diverse functions is of key importance.

Another characteristic involves forest ownership, which despite regional differences is extremely small-structured and fragmented. In Germany, around two million private forest owners own a total of 4.8 million ha, representing some 44 percent of total forest area. Most private owners have land measuring less than 20 ha. In many ways, private ownership – which is closely linked to small-scale enterprise – supports conservation of the diverse forest structures and thus of forest biodiversity.

36 The calculation is based on an assumed timber consumption of 65 million m^3 (figures for western Germany are based on the Federal Forest Inventory for 1987 and 2002, while the figures for eastern Germany are estimated) and potential consumption forecasts using the base year 2002.

Challenges, existing problems and action needed

The world's forest biodiversity is at serious risk. This is especially the case as regards tropical forests and some forest areas in northern regions (boreal forests) which are at risk of being either completely destroyed or depleted due to slash and burn activities and overuse of their resources. Germany's forests no longer face such threats. For centuries, forest clearance (especially of deciduous forests) has largely focused on better locations to make way for agriculture and other activities.

The introduction of regulated forest management about 250 years ago saved what were at the time the overexploited and in many cases damaged forests from complete destruction. Large-scale reforestation measures have increased the amount of forest coverage to achieve the 'green' third of total land area already mentioned. Nonetheless, centuries of use and external pressures such as pollution, fragmentation and groundwater depletion have changed the forests in terms of their species composition and population structures[37]. In managed forests, the age and decay phases that occur in unused forests lead to lower yields for the forestry sector and are thus under-represented. Use of contract-based conservation could help to integrate these phases into forest management strategies. Plus, the partial dominance of pure stands and non-native coniferous trees (spruce, pine and, on a lesser scale, Douglas fir) in relation to the 'naturally' prevalent deciduous trees deviate from the composition of natural forests. But then again, compared with other large-scale compartments of the landscape (land used for agriculture, housing and transport, etc.), the forests usually constitute near-natural habitats with rich biodiversity. This is highlighted by the fact that most of Germany's Natura 2000 sites are forest areas.

Timber production is of great economic importance

At the beginning of 2000, the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV), the Federal Forest Administration and the forest administrations in the various Länder announced a joint sectoral strategy for forestry and biodiversity which was extremely well-received by nature conservation organisations, forest ownership associations and forest-related NGOs. The strategy is based on an analysis of the current situation, presents the key threat factors and sets out eleven areas of focus and more than 40 measures for implementation. The Länder implement the measures according to their resources and expertise.

One of the main challenges in forest management approaches aimed at conservation and sustainable use of biodiversity is to promote large-scale implementation of the near-natural forest management. This management approach uses the processes that take place in a natural ecosystem and give forests the greatest possible resistance and vitality. Diverse forests provide the full range of forest services and thus offer the best conditions for coping with potential climate-related change and other external pressures. This management approach also aids conservation of animal and plant species diversity and associated habitats, and boosts the competitive standing of forest enterprise. There is an additional need for contractual conservation agreements with private owners of forest land. This approach is also seen as instrumental in Germany's National Sustainability Strategy.

Further knowledge on environmentally sound forest conversion is provided by the Technische Universität Berlin's FOREST: *Biologische Vielfalt und deren Bewertung am Beispiel des ökologischen Waldumbaus in den Regionen Solling und Lüneburger Heide* project (Biodiversity and its Value in The Example of Environmentally Sound Forest Conversion in the Solling and Lüneburger Heide Regions). The project was funded under the Federal Ministry of Education and Research BioTeam research programme which ran from 2003 to 2006 (http://www.landschaftsoekonomie.tu-berlin.de/196.html?&L=0).

37 Ecosystem diversity is shaped by the available horizontal and vertical structures, e.g. the number and stratification of the vegetation layers, the occurrence and spatial distribution of dividing components (such as relief, streams, woodland, inner forest edges, glades, forest tracks and aisles) and small structures (deadwood, uprooted tree stumps, etc.).

Efforts must also be made to reduce external threat factors. These include monitoring of changes in the forest ecosystem as a result of pollution and climate change, and appropriate measures to reduce them. The results of the Forest Soil Survey (BZE) conducted in 1996 and the forest environment monitoring programme show air pollution as a serious threat to the forests. Ground and water pollution leads to soil acidification and nitrogen saturation.

The role of forest genetic diversity as a basis for adaptability and thus survival, especially of long-lived species, became evident following the damage caused to forests by air pollution. While in contrast to agricultural crops, forest tree and shrub species were not domesticated through breeding, human activity has nonetheless influenced their populations as a result of selection, overuse and the transport of seeds. The most important measures to secure forest genetic resources over the largest areas involve natural rejuvenation of suitable stands and the use of provenance-proven, adapted reproductive material for when planting. These are supplemented by special gene conservation measures taken by the national and Länder governments as part of the programme for conservation and sustainable use of forest genetic resources. In situ conservation lies at the forefront of such activity, for example in the conservation of populations and individual trees. To this is added ex situ conservation of populations and individual trees in seed plantations and the storage of forest seeds in forest gene banks.

In the face of climate change, implementation of provenance trials will gain in importance. The issue at hand is to find out how native trees from regions where the climate is similar to that expected in Germany in fifty or a hundred years' time will fair here. After all, forests that are shaped by long-lived, sedentary plants (trees) will be severely affected by climate change.

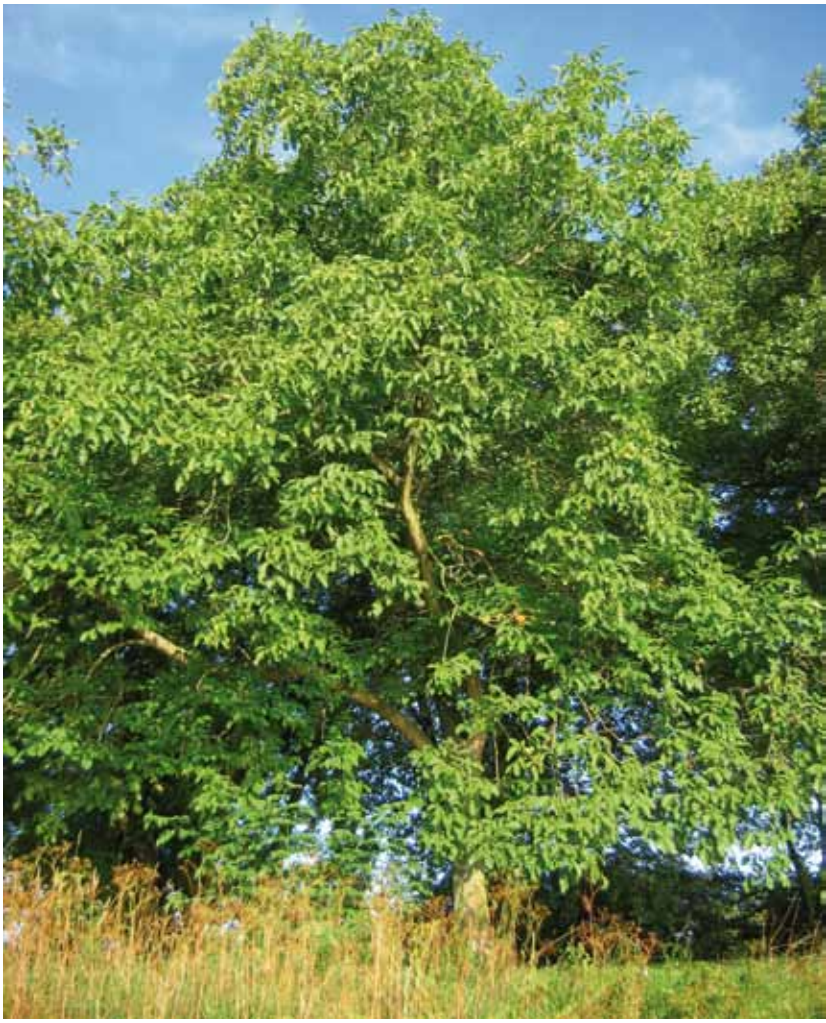
Given that air pollution and climate change do not stop at national borders, action at international level is vital. In Europe, the European Forest Genetic Resources programme (EUFORGEN) was launched to implement Strasbourg Resolution S2 (Conservation of Forest Genetic Resources) of the first Ministerial Conference on the Protection of Forests in Europe (MCPFE), while the FOREST FOCUS scheme was established to provide for EU-wide forest status monitoring by the end of 2006. Implementation of the measures agreed in these two initiatives is conducted by and in the participant countries.

The use of timber plays a key role in efforts to conserve forest biodiversity. Germany's per capita timber use is far below its potential to ensure a sustainable supply of resources, in fact it is even below the EU average. Greater use of timber from domestic forests is thus linked with job creation and economic growth, particularly in rural regions, and brings societal benefits in climate, energy, environment and resource management policy terms. The Timber Promotion Charter (*Charta für Holz*) initiated by the German government and adopted in 2004 as a joint government, industry and industry association strategy, thus aims to achieve a 20 percent increase by 2014 in the use of wood and wood products from sustainable forest management in Germany. However, if available reserves are to be mobilised, existing strategies must be further developed along the entire value chain. The measures set out in the Timber Promotion Charter, to which members of the forest and timber industry are signatories, must therefore be well coordinated and implemented. Given the changed energy policy framework, considerable new investment in the timber sector and rising timber prices, existing timber potential must be better exploited and be tapped into by innovative mobilisation activities that consider local conditions. Potential negative impacts on forest ecosystem diversity must be avoided where possible.

Fruits of a littleleaf linden tree (Tilia cordata Mill.)

As early as 2003, the EU adopted an action plan on Forest Law Enforcement, Governance and Trade (FLEGT). This gave rise to the implementation of a FLEGT approval or licensing scheme for timber imports into the European Union using a voluntary partnership agreement (VPA) approach. The licensing system is designed to prove and certify the legality of timber production in the partner countries. Consumers can also play their part by choosing to purchase wood products labelled as being derived from sustainable forest management. International certification schemes like the Forest Stewardship Council (FSC) and the Programme for the Endorsement of Forest Certification Schemes (PEFC) are growing in importance. Wanting to lead by example, the German government has made the purchase of wood products derived from sustainable forest management and proof that they were legally produced an integral component of its procurement policy.

The importance of using domestic timber stocks is also relevant to global forest policy. While, as in other parts of Europe, Germany's forests and timber reserves are growing, in some regions around the world the forests are still overexploited. Large-scale clearance, changes in land use practices, illegal timber logging and trade are the main causes of global forest destruction on a scale somewhere in the region of 15 million hectares a year. Sustainable management of forests is the only way to secure a lasting supply of raw materials everywhere in the world. Germany and Europe are thus under obligation to play their part. This is all the more reason to ensure that Germany uses its existing timber potential and, where possible, creates additional potential. The national forest and woodlands programme provides for social dialogue on the future of forest utilisation and management, the aim being to achieve better linkage between global and national woodlands and forest policy.



2.5.2 Measures needed in the forestry sector

Securing and improving the infrastructure:

- Use and where appropriate further development of existing instruments as a basis for monitoring biodiversity conservation (e.g. Federal Forests Inventory, soil surveys and forest management procedures).
- Establishment of a genetic resources monitoring programme for forest tree species.
- Further development and improvement of forest environment monitoring activities.
- Continuation of ex situ measures for the conservation and documentation of forest genetic resources of valuable and threatened tree species.
- Improved conditions for conservation and monitoring of forest genetic resources.
- Secure proof of provenance for forest trees and shrubs.

Improved management systems

- Securing and promoting as far as possible near-natural forest management across the country.
- Conservation and maintenance of valuable forest habitats and edges.
- Leaving a necessary percentage of old trees and deadwood to secure habitats for species that thrive on them.
- Mitigation of external harmful effects on forests. Such measures would include emission reductions and would be implemented as part of the National Sustainability Strategy.
- Boosting the viability and competitiveness of forest enterprise as a prerequisite for sustainable management and lasting availability of forests and their functions, including biodiversity.
- Exploit new business areas, additional sources of income and new jobs available in the forestry sector while conserving biodiversity.
- Devise decision-making tools for forestry enterprises to ensure better balance between wood use, forest conservation, fulfilment of conservation functions and assessing the impacts of climate change.

„Wetterfichten“ (Picea abies) on the „Brocken“, the highest mountain of the region Harz

- Promote accelerated adaptation of forests to the effects of climate change with the aim of securing forest functions, including biodiversity.

Strengthen international cooperation

- Support the implementation of international standards in forestry (e.g. in the form of criteria and indicators for sustainable forest management) to protect the world’s forests from over-exploitation and to protect the multifunctional forestry industry, which in Germany involves large areas of near-natural forest, from the adverse effects of non-sustainable use of timber.
- Support international efforts to increase the value placed on forests, towards sustainable forest management and to implement the UN’s Non-Legally-Binding Instrument on All Types of Forest.
- Active participation in joint activities to conserve and improve forest biodiversity in Europe under the auspices of the Ministerial Conference on the Protection of Forests in Europe (MCPFE).
- Cooperate with the European Forest Genetic Resources Programme (EUFORGEN), in particular on restructuring of tree species-related networks and creation of a forest management network.
- Support implementation of the EU FLEGT action plan.

2.6 Hunting

2.6.1 Objectives, current situation and action needed

Vision for hunting

The vision comprises the conservation and sustainable use of wild animal species covered by hunting law. Hunting serves conservation of species diversity and secures habitats, including for wild species that enjoy special protection status (game that has no hunting season). It thus contributes to the conservation and development of biological diversity. Hunting is permissible as long as the conservation status of wild animal species allows their sustainable use and it is necessary to prevent significant economic and environmental harm in the cultural landscape.

It is therefore vital that:

- *Hunting be better aligned to the needs of near-natural forest management.*
- *The existing monitoring programmes for animal species covered by hunting law be enhanced and a coordinated monitoring programme be devised and implemented for selected threatened wild species.*
- *International cooperation be promoted as regards recolonisation and reintroduction programmes.*

Characteristics and role

While in the past, wild animals were primarily hunted to secure a supply of food, the situation today is quite different. Apart from sustainable management of game, hunting also involves things like conservation of species-rich, healthy game stocks and the conservation and enhancement of wildlife habitats. This includes prevention of over-population of certain types of hoofed game to avoid damage to agricultural crops and forestry plants. The material value of Germany's annual 'bag' (animals shot) for the year 2006/2007 amounted to €180 million, of which €76 million involved wild boar, €57 million roe deer and €18 million red deer.

With around 32 million ha, Germany's hunting grounds take in some 90 percent of its entire land area. The main characteristics include the system of hunting territories and the game management obligation arising from hunting law, the aim being to preserve a species-rich, healthy game stock that is adapted to landscape and cultural conditions and to maintain and secure the resources they need for survival. The hunting territory system makes land owners and hunters responsible for the conservation and sustainable use of wildlife and habitats that are subject to hunting law. In 2006 some 348,000 people had a hunting license. Hunting thus plays a great role in rural development.

Challenges, existing problems and action needed

Ecosystem-friendly game management that uses effective and humane hunting methods is vital to sustainable use of natural game resources. Modern game management also takes in protection and promotion of wild species whose stocks are at risk. This includes hunting predators to protect vulnerable and protected species. Hunting law plays a key role by placing hunters under obligation to perform game management and by prescribing open and closed seasons.

Hunting involves close interaction with other issues that influence numbers, structure and diversity of game stocks. Apart from climate-related change and, for example, its effect on reproductive behaviour in some bird species, it is largely habitat change which affects stocks and diversity in huntable species. This is especially the case for species that thrive in open cultural landscapes – for example hare, grey partridge, quail and pheasant.

Looked at from a different angle, the ways in which wild animals and hunting affect biodiversity are equally as varied. A particular role is played by regionally excessive hoofed game stocks: with their selective browsing habits, deer can damage natural rejuvenation growth and crops, thus leading to less-mixed young growth, a reduction in forests' structural diversity and depletion of ground vegetation. Regulation of game stocks by means of hunting is thus vital in achieving near-natural forest development.

The conservation and enhancement of wild species' habitats, for example through the planting of hedges and field shrubs and creating small biotopes, is also a component of modern hunting management. In addition, hunting in protected areas can assume management tasks to advance the objectives for which protected areas are designated, and can provide an important service as regards natural recolonisation, reintroduction and stock conservation of extinct and threatened wild species.

Given the wide-ranging responsibilities involved in modern-day hunting, its public acceptance has become more important than ever. But such acceptance can only be achieved if hunting is conducted in compliance with nature and species conservation and animal welfare requirements. New knowledge supported by the findings of game biology and game ecology research and gleaned from everyday hunting practice must be taken into account. Existing hunting law provisions must be fully applied in the pursuit of hunting.

Sustainable management of game resources is reliant on information on the size, structure and development of game populations, and this in turn is dependent on reliable game biology and ecology research. The Federal Ministry for Food, Agriculture and Consumer Protection (BMELV) has thus initiated monitoring activities to observe population trends of wild animal species in cooperation with the Brandenburg State Institute for Forest Science (*Landesforstanstalt*) in Eberswalde. The aim is to boost monitoring activities and coordinate them with those conducted by other organisations (and particularly *Länder* organisation). The WILD (wild animal information) system operated jointly by the various *Länder* and the German Hunting Association (Deutsche Jagdschutzverband) is to be integrated into the monitoring programme.

At international level there is a need for greater exchange of appropriate knowledge, particularly as regards wild migratory species. In March 2006, the European Council launched wide-ranging efforts to develop a European Charter on Hunting and Biodiversity under the Bern Convention. The charter will contain a set of principles for sustainable hunting, outline the components of good hunting practice and set out rules on hunting tourism in Europe. Presentation of the first draft is expected in 2008.

2.6.2 Measures needed in hunting

Securing and improving the infrastructure

- Improved monitoring of the wild animal species covered by hunting law, including centralised compilation of hunting bag data at national level and information on population trend monitoring and genetic diversity in wild animal populations from *Länder* institutions, the aim being among other things to identify the effects of climate change on huntable species.

- Use of geo-information systems in game biology research.

Improved management systems

- Align hunting to the changed management systems used in agriculture.

- Support modern hunting strategies by means of wild animal monitoring programmes.

Strengthen international cooperation

- Greater exchange of ecological knowledge on wild animals at international level, especially as regards cross-border migrating species.

- Greater cross-border cooperation in recolonisation and reintroduction of wild animal species covered by hunting law and development of conflict solution strategies with participation of all those affected (where appropriate in the form of cross-border efforts – and particularly as regards the rise in problematic wild animal species like lynx and elk).

- Greater bilateral cooperation in hunting and participation in international agreements, in EU committees (e.g. the ORNIS Committee) and within the scope of the International Council for Game and Wildlife Conservation.

- Cooperation in drawing up the European Charter on Hunting and Biodiversity under the auspices of the European Council.

2.7 Fisheries

2.7.1 Objectives, current situation and action needed

Vision for fisheries

The vision is to preserve natural diversity in German waters, secure and develop sustainable management of marine and freshwater fish stocks, conserve and replenish stocks that have been affected or which are threatened by anthropological pressures, preserve diversity in fish genetic resources for aquaculture and secure their supply over time.

This means:

- *Calling for the EU Common Fisheries Policy to require comprehensive monitoring and management of fish stocks with the aim of replenishing and conserving them to achieve sustainable, environmentally sound fisheries.*
- *Reducing the adverse impacts of fishing on the marine environment to protect species and habitats.*
- *Supporting, supplementing and coordinating monitoring, conservation and reintroduction activities in inland waters.*
- *Documentation and expansion of the resources available to aquaculture.*
- *Supporting activities towards protecting, conserving and restoring natural habitats at national and international level.*

Aquatic life forms provide a key source of protein in people's diets everywhere[38]. Germany is far from self-sufficient when it comes to fish supply, providing only 25 percent of the fish catch and yields needed to meet domestic demand.

Germany's fisheries can be divided into a limnic sector with inland fishing and a marine sector with coastal and deep sea fishing. This mirrors the dependency of aquatic species on their specific habitats and is a factor of key importance, both in conservation measures and in achieving sustainable and environmentally sound management. While the marine environment often appears homogeneous and, due to its vast dimensions, contains huge numbers of organisms of a given species (especially those that frequent open waters such as herring, sprat and mackerel), inland waters are characterised by their smaller-scale, more structured habitats and thus smaller fish stocks.

Good conservation status of habitats and migration corridors is vital to the survival of species whose life cycles are reliant on marine and inland water habitats. The fact that these needs are not met everywhere is the cause of serious threat to stocks of migratory fish which include salmon, allis shad and sturgeon (as examples of anadromous fish species) and eel (as an example of catadromous fish species).

Aquaculture[39] can engage in limnic and in marine habitats. In Germany, it is almost exclusively carried out in freshwater conditions and is thus traditionally seen as an inland water fishing practice. Management of mussel banks is, by way of contrast, thought of as part of coastal fisheries.

Many aspects of German fisheries policy have been integrated into the EU Common Fisheries Policy, which has exclusive regulatory power in this area. Legislative authority regarding inland fisheries falls to the German *Länder*, who also enforce legislation on coastal fisheries. They are also responsible for implementing nature conservation and water management law along with appropriate international and EU law such as the Habitats and Birds directives and the Water Framework Directive. The EU Member States are responsible for implementing the Common Fisheries Policy. In Germany, responsibility for fisheries is shared by the federal and *Länder* governments as designated by the German Basic Law.

At national level, the Federal Ministry for Food, Agriculture and Consumer Protection (BMELV) launched its German National Technical Programme on the Conservation and Sustainable Use of Aquatic Genetic Resources (NFP AGR) in 2006. The programme's implementation is overseen by the AGR Advisory Board.

38 Fish provide the main source of protein for about a billion people, especially in developing countries. In 30 countries around the world, populations are largely dependent on fish as a source of protein.

39 Aquaculture is the breeding and keeping of aquatic organisms using the necessary technical means with the aim of boosting productivity beyond what would be achievable under normal conditions; the organisms involved remain the property of a natural or legal entity for the duration of the breeding period or for as long as they are kept in aquaculture, including during harvesting or fishing.

2.7.1.1 Inland fisheries, including aquaculture

Characteristics and role

In 2004, almost 250,000 ha of lakes, reservoirs and rivers were managed by approximately 800 fisheries enterprises in primary and secondary employment. A wide range of anthropogenic influences have resulted in an almost total demise of this once-important river fishing sector. Inland commercial fishing is now largely concentrated in the lake-rich states of Mecklenburg West-Pomerania, Brandenburg, Bavaria, Baden-Württemberg (mainly Lake Constance) and Schleswig-Holstein. While the value attached to commercial fisheries remains stable, angling and recreational fishing are gaining in importance. These are valuable in terms of leisure and relaxation value and also as regards the nature conservation activities involved in water body management and fish-related gamekeeping.

Aquaculture is a key source of income in Germany's inland fisheries sector. Most of the country's aquaculture facilities focus on trout and carp breeding. The most important segment involves trout breeding, which makes up around 38 percent of total output in aquaculture. Trout breeding was only really started with the introduction of the rainbow trout in the second half of the 19th century. Germany's carp pond fisheries are a centuries-old tradition.

In contrast to traditional pond and trout farms, aquaculture involving technical management approaches and cage farms makes up as little as two percent of total production in inland fisheries. Many of these facilities are still in the testing and implementation phase. A growing trend can be expected in this sector. Given the forecasted rise in demand, it is also being promoted by the EU, not least because the growing demand cannot be met through additional yields from marine fishing catches[40].

Challenges, existing problems and action needed

As intermediate and terminal links in the food chain, fish are closely linked through predator-prey relationships and symbiosis with other species communities in inland water ecosystems and fulfil a range of different functions. Changes in the qualitative and quantitative composition of fish species communities thus affect other components of the ecosystem. Conversely, changes in habitats and in the composition of species communities impact on fish fauna.

Besides poor water quality (which is still a problem despite considerable improvements), the main sources of threat to limnic biodiversity comprise loss of structure in lakes and rivers, changes in their morphology, banks and shorelines, and a huge increase in fish-eating birds (especially cormorants). Other key sources of threat include river widening, artificial barriers and hydropower facilities[41]. Negative influences are also caused by shipping, water management, tourism and water-based leisure activities. Fish are thus the most threatened vertebrate group in Germany.

The various *Länder*-specific fish registers list around 90 freshwater fish and lamprey species. Half of these are utilised directly in professional and hobby fishing (19 exclusively as fishing target species and 26 as both fishing and stock specimens). Another 10 species are stocked but not utilised and 28 species are neither used directly nor promoted. Migratory fish and reintroduction programmes are in operation along with

40 See A Strategy for the Sustainable Development of European Aquaculture (COM(2002) 511 final).
41 Turbines, artifical barriers, and pumping stations continue to pose an as yet unresolved problem. In hydropower facilities, work is needed to ensure that the minimum quantities of water are available for the fish fauna involved. Also, turbine-related fish mortality is considerable and must be reduced without delay.

species promotion programmes to reintroduce extinct native species and supplement stocks of threatened species. Stocks of salmon, sturgeon, sea trout, sterlet and houting can only be restabilised if watercourses are made passable again and other habitat factors are improved to such an extent that fish can find suitable conditions for survival and reproduction. There is thus an urgent need for regional coordination of the various programmes.

Restocking activities in open waters are needed to replenish populations. They must be conducted in such a way as to ensure that the genetic base remains unchanged. This means using only fauna that are from the waters in question and have been reproduced in ex situ conditions, a measure provided for by fisheries legislation already in place in most German Länder. Biodiversity can also be threatened by species that were introduced either intentionally or unintentionally through human activity and have since become established (neozoans). As is the case with fish species in general, it is virtually impossible to remove neozoans from water bodies in their entirety. Population management is the only option in such circumstances.

While the provisions of the EU Water Framework Directive and the Habitats Directive require comprehensive monitoring of certain fish species, there remains a need to assess the extent to which these monitoring programmes cover all significant fish stocks.

In aquaculture, a biodiversity-related distinction must be drawn between the production of fish for replenishment and for food. When producing fish for stock replenishment, the criteria which apply to stock management in lake and river fisheries must be observed.

In contrast to other commercially used species, Germany has no monitoring programme or conservation measures in place to protect the genetic base of species kept for aquaculture. Given that aquaculture is seen as a growth sector, urgent action must be taken to obtain an overview of existing resources and their conservation status. This can then be used to assess whether it is necessary to promote the genetic base for aquaculture and if so, to identify the type of measures needed. Escapes of fish from aquaculture must be prevented to exclude the possibility of genetic infiltration of wild populations. This is already provided for in *Länder*-specific fisheries policy.

Alevin of a fish farm

2.7.1.2 Marine fisheries

Characteristics and role

In terms of the fishing fleet, fishing opportunities and fishing methods, Germany's ocean fisheries are extremely diverse. The German fleet makes up about three percent of EU vessel capacity and more than nine percent of catches of quota species subject to requirements for common management of stocks. The fleet's catch areas take in the North and Baltic seas and the waters of the north-east, north-west and central East Atlantic. Germany's coastal waters are also fished by a large number of secondary-employment and hobby fishers.

By virtue of their nature, fisheries and down-stream industry sectors are generally found in coastal areas. The majority of inland catches falls to coastal fisheries which, with their small enterprise structure, are distributed across many small harbour towns and villages. Looking beyond the fishing industry, therefore, coastal fisheries also play a key role in the tourism trade.

Challenges, existing problems and action needed

The fact that many ocean fish stocks have declined and that some species and their genetic diversity are threatened can be apportioned both to natural (climate change) and anthropogenic causes. Two anthropogenic causes are largely to blame in coastal seas such as the Baltic. The first involves marine pollution from industrial wastewater, private households and nutrients from agriculture, and the second over-exploitation of fish stocks. This primarily affects within-species genetic diversity, although it also impacts on species composition in specific ecosystems. While the large numbers of individuals and the size of habitats make it almost impossible to wipe out a particular fish species, the example of cod and herring in the North Atlantic (Labrador, Norwegian Sea and North Sea) has shown that fisheries can dramatically reduce numbers of specific stocks and even of entire fish species.

Apart from the extraction of biomass of target fish species, marine fishing can have negative effects on other marine species and habitats. Its direct effects include the damage caused by bottom trawl nets to the sea bed and associated species communities, and bycatch of marine mammals and sea birds. Fishing of pelagic shoal fish for industrial use can be a source of competition for fish-eating sea birds and marine mammals in a given region.

Climate change is seriously affecting the composition of species communities as a result of large-scale shifts in temperature, salt distribution and flows. While this could even have positive effects on some fish stocks, recovery might be difficult for those fish stocks that are already subject to over-fishing and have poor conservation status.

There is an urgent need, not just in national and EU fisheries policy but above all at international level, for greater adherence to the principles of sustainability and ecosystem-friendly use of fisheries resources. This is the only way to secure marine biodiversity over time. The EU Common Fisheries Policy was restructured along these lines with the reforms enacted in 2002. Since then, as a basis for sustainable use of fish stocks, measures have been implemented in the form of targeted replenishment plans for stocks with reduced reproduction capacity and which are not sustainably managed (cod, for example). Management plans are also needed for healthier stocks threatened with reduced reproduction capacity in the near future if conditions remain unchanged. These replenishment and management plans must be rigorously implemented. Further, discards of undesirable bycatch must be restricted and illegal, unreported and unregulated fishing (IUU fishing) stopped. Countermeasures are provided for at EU, bilateral and multilateral level (see, for example, the FAO Code of Conduct[42] for Responsible Fisheries (1995) and UN Resolution 61/105 on Sustainable Fisheries (2006)). Also of importance is the further development and use of exclusively

42 The Code sets out principles and international standards of behaviour with a view to ensuring the effective conservation, management and development of living aquatic resources, with due respect for the ecosystem and biodiversty.

environmentally sound fishing methods which are selective enough to prevent bycatch of juvenile fish and other marine life forms (e.g. marine mammals and sea birds) and avoid damage to sensitive marine organisms and habitats (such as cold water coral reefs and seamount species communities.

With regard to marine mammals, the German government actively promotes protection of whales and seals through participation in the International Whaling Commission (IWC) and other bodies responsible for advising and deciding on whale conservation (e.g. under the Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS) and the Convention on the Protection of the Marine Environment of the Baltic Sea Area (Helsinki Convention)).

Efforts are also underway to establish more marine protection areas in the exclusive economic zones of riparian states and in open waters. The aim is to ensure the conservation of specially protected species and habitats and to afford marine life forms the opportunity to develop undisturbed. Protected areas can also serve the recovery of commercially used fish stocks by, for example, safeguarding key spawning sites and areas with high occurrence of juvenile fish.

A particular area of action involves conservation of the Wadden Sea with its high bioproductivity and species diversity, and its function as a hub for bird migration and as a nursery school for North Sea fish. Many factors (dredging, oil and gas extraction, offshore wind farms, shipping, fishing, tourism, coastal protection and nutrient and pollution inputs) put pressure on the Wadden Sea ecosystem. Individual and cross-cutting measures to foster this sensitive ecosystem should be promoted under the joint German government and Länder programme on improving agrarian structures and coastal protection (GAK).

2.7.2 Measures needed in the fisheries sector

Inland fisheries, including aquaculture

Securing and improving the infrastructure

- Support for and coordination of measures and programmes to reintroduce extinct domestic species and to replenish stocks of threatened species. This calls for improved monitoring of existing stocks.

- Develop and implement a neozoan management programme aimed at restricting the spread of neozoans, lessening their impact on domestic fauna and preventing their introduction.

- Scientific research into how escapes of fish from aquaculture impact on the genetic basis of wild stocks.

- Document fish species and breeding lines kept in aquaculture. Where necessary, devise promotional measures.

Improved management systems

- Promote near-natural water management in the implementation of the EU Water Framework Directive, Habitats Directive and Birds Directive, using the measures provided under the GAK. Implementation should take in a mix of measures in line with fisheries, nature conservation and water management legislation at national and Länder level.
- Promotion of measures under the GAK to reduce agriculture-related nutrient inputs into water bodies.
- Promotion of effective, environmentally sound coastal protection measures contained in the GAK.

- Advance aquaculture with the aim of further reducing nutrient loads in aquaculture effluent.

Marine fisheries

- Actively call for the EU to:
  - Determine and maintain, through ongoing controls, maximum allowable catches for commercially used species based on reliable research findings and recommendations in line with the precautionary principle.
  - Protect and conserve non-commercial fish species and marine habitats through further development of environmentally sound fishing methods.
  - Further development and stringent implementation of multi-year replenishment plans for fish stocks outside their safe biological limits.
  - Further development and stringent implementation of multiyear management plans for fish stocks which would develop beyond their safe biological limits unless conditions change.
  - Development of multi-species management strategies.
  - Approval and implementation of further technical conservation measures, especially as regards the design of fishing gear and the choice of fishing method, to designate protected areas and determine closed seasons in the interests of sustainable and environmentally sound fishing.
  - Rules to prevent and ban discards in fisheries sectors where it is possible.

- Review and, where necessary, expand the scope of monitoring programmes and documentation procedures used in coastal and deep sea fishing, including for non-commercial fish species.

Fishpass and fish monitoring station

Lesser Black-backed Gulls following a trawler

Strengthen national and international cooperation

- Efforts to promote cross-border river catchment area-specific and cross-catchment area cooperation using existing and tried and tested cooperation models such as the International Commission for the Protection of the Rhine (ICPR), International Commission for the Protection of the Elbe (ICPE), International Commission for the Protection of the Danube (ICPD), International Commission for the Protection of Lake Constance (IGKB) and International Commission for Fisheries Management in Upper Lake Constance (IBKF) because many measures have been implemented by the various *Länder*, professional fishers and fishing clubs – either in isolation or with minimal coordination.
- International coordination of national measures to reintroduce or replenish stocks of migratory fish species such as eel, salmon and sturgeon.
- Greater international cooperation in breeding, conservation and cultivation of aquaculture organisms.
- The German government should actively call for greater consideration of biodiversity, both in the work of international organisations (the UN and FAO for example) and under the Common Fisheries Policy as regards:
  - The decisions of regional fisheries management organisations (CCAMLR, ICCAT, NAFO, NEAFC, NASCI, etc.).
  - The approval of deep-sea fishing activities in waters outside the jurisdiction of regional fisheries management organisations.
  - Fisheries management agreements between the EU and third countries.

2.8 Micro-organisms and Other Small Life Forms

2.8.1 Objectives, current situation and action needed

Vision for micro-organisms and other small life forms

The vision comprises long-term conservation of the diversity of micro-organisms and other small life forms that can be used in agriculture and the food industry or which in their capacity as associated biodiversity provide useful ecological services, making them usable for product and process innovation, and promoting sustainable management practices.

This calls for:

- *A documentation and information system for micro-organisms and other small life forms valuable to agriculture and the food industry.*
- *Conservation of large-scale habitat diversity along with the incumbent diverse micro-organisms and other small life forms, and protection of terrestrial and aquatic ecosystems from pressures such as pollution and soil disturbance.*
- *Development and implementation of a national programme of measures for the conservation and sustainable use of micro-organisms and other small life forms.*

Characteristics and role

The term micro-organisms takes in fungi (e.g. mycorrhizae), yeasts, protozoa, bacteria, archaebacteria and viruses, including mycoplasma. To these are added 'other small life forms' such as microalgae and some lower organisms like worms, nematodes and insects. Many of these organisms provide valuable and useful services and must therefore be conserved. A distinction should be drawn between micro-organisms and other small life forms used in cultivation and technology, those used exclusively for research purposes (for example, in the study of pathogens involved in disease, damage and decay) and those that provide useful ecosystem services. The latter are largely unknown, including in terms of the functions they perform, and are only in the early stages of cultivation.

Micro-organisms and other small life forms are used in food and fodder production and in processing, plant protection, animal welfare, soil enhancement, air purification, exhaust fume cleaning, extraction of raw materials and generation of electricity. These organisms also include pathogens which in some cases are responsible for significant economic loss. They are kept for the development of plant protection and conservation strategies, and for animal medication and vaccines. Research institutions under the Federal Ministry for Food, Agriculture and Consumer Protection maintain comprehensive collections of organisms (approximately 15,500 specimens held at various research institutes) which are of value to agriculture and the food industry. Another 13,000 specimens are held by Deutsche Sammlung von Mikroorganismen und Zellkulturen GmbH (DSMZ). These include bacteria, fungi and viruses that are primarily used in medicine and industry, but which are also of relevance to agriculture and the food industry. It can be assumed that along with numerous public institutions, private industry also holds comprehensive collections for which no complete overview is available.

Many species of micro-organisms and other small life forms that cohabit with species which inhabit commercialised ecosystems play a fundamental role, both in ensuring that these systems function and in the control of the processes involved, e.g. soil micro-organisms.

Challenges, existing problems and action needed

A better overview of existing collections of micro-organisms and other small life forms is key in the development of effective *ex situ* conservation strategies for micro-organisms and other small life forms of value to agriculture and the food industry. The aim is to integrate these sometimes comprehensive collections into a yet-to-be-established national network.

Other priority action needed involves the identification and characterisation of traits and functions of relevant organisms and organism communities. Their functions within the respective ecosystems are both diverse and complex. In many cases, little is known about these functions and mechanisms. Exact details of their productivity potential, including the various genotypes, their threat status and their interactions among one another and with other directly used species comprise one of the main prerequisites for their sustainable use, especially as regards soil and water, on which all production systems are based. These micro-organisms also harbour further great potential for innovation in industrial production and processing in the 'white biotechnology' sector.

Key sources of threat to useful groups of micro-organisms and other small life forms include eutrophication, acidification, the accumulation of toxic substances in soil and water, soil compaction, changes in land use and the introduction of alien organisms. Also, biodiversity loss in higher flora and fauna can lead to a loss of adapted micro-organisms. Findings regarding the destruction of mycorrhizae in forest trees due to changes in the soil (acidification) and the fact that many domestic fungi are seriously threatened are thus a cause for considerable concern.

Given the ecosystem services that micro-organisms and other small life forms provide as associated biodiversity in agricultural ecosystems, particularly regulation of processes and nutrient cycles, measures to protect these organisms must concentrate on reducing pressures on terrestrial and aquatic ecosystems and conserving the greatest possible habitat diversity. They should also include mitigating the risk posed by pollution of terrestrial and aquatic ecosystems with antimicrobial substances (e.g. antibiotics and anti-infection drugs).

43 Als Mykorrhiza wird die Symbiose von Pilzen und Pflanzen im Feinwurzelbereich der Pflanzen bezeichnet. Mehr als 80 % aller Pflanzenarten bei ca. 5.000 mykorrhizabildenden Pilzarten nutzen diese, viele sind sogar zwingend darauf angewiesen und könnten ohne die Mithilfe des Pilzes nicht überleben.

Special yeast are used in wine production

2.8.2 Measures needed in managing micro-organisms and other small life forms

Securing and improving the infrastructure

- Establish a documentation and information system for collections of genetic resources of micro-organisms and other small life forms of value to agriculture and the food industry, taking account of the collections kept by BMVEL departmental research bodies.

- Develop a national programme for the implementation and coordination of measures for the conservation and management of micro-organisms and other small life forms.

Improved management systems

- Further development of sustainable management systems to protect the soil and its micro-organisms and fauna, and to support regeneration of functionally valuable associated biodiversity in terrestrial and aquatic ecosystems.

- Greater information and education on the relationships and interactions between associated biodiversity in soil and water and increasingly important factors such as renewable resources, genetically modified organisms (GMOs) and invasive alien species, and the consideration of these relationships and interactions in the further development of management strategies.

- Promotion of innovation to foster greater use of micro-organisms in agriculture and the food industry.

Strengthen international cooperation

- Exchange of knowledge and implementation of strategies for the conservation and promotion of associated biodiversity and its ecosystem services under international agreements (for example, the CBD programme of work on agricultural biodiversity).

- Membership of international micro-organism networks and involvement in the development and implementation of rules on access to and equitable sharing of the benefits arising out of the utilisation of agricultural biodiversity genetic resources.

3 Priority Measures: Flagship Projects

3.1 Developing New and Improving Existing Promotional Instruments to Enhance Agricultural Practices in Line with the Needs of Nature and the Landscape

A series of studies look at the efficiency and cost-effectiveness of existing instruments designed to promote agricultural biodiversity. Yet other studies and debates provide interesting new approaches and strategies towards improving existing ones.

Agri-environmental measures play a key role in such efforts. Germany's National Rural Development Strategy 2007 to 2013 requires that agri-environmental measures be advanced while taking account of altered conditions. A review is thus necessary to determine the extent to which such measures can pay greater attention to nature conservation and environmental services and be integrated into efforts aimed at conservation and sustainable management of genetic resources of value to agriculture and forestry.

A review of potentially necessary substantive and financial adjustments to the funding programme for agri-environmental measures, however, will only take place in conjunction with the *Länder* as part of the GAP 2008 'health check'. Subsequently, an assessment must be made regarding the need to modify and further develop agri-environmental measures on a per-hectare basis under the GAK and the various *Länder*-based programmes.

In principle, responsibility for implementing agri-environmental measures lies with the *Länder*. Because the GAK results in the federal government contributing towards *Länder*-based measures and contains a review clause which provides for an assessment of the spending structure contained in the funding forecast for 2008/2009, it is vital that the national and *Länder* governments cooperate to help identify viable solutions as far in advance as possible. Given the limited funds available, this means finding alternative approaches to promoting agricultural biodiversity.

3.2 Public Campaign: Agricultural Biodiversity as a component of an integrated communication strategy

In pursuing the societal objective of conservation and sustainable use of agricultural biodiversity, the various social groups and actors play a range of different roles. There is nonetheless agreement that communication in the form of education and awareness-building is of key importance.

Direct users of agricultural biodiversity, such as farmers, breeders, foresters and fishers, are primarily interested in the economic viability of using specific components of that biodiversity and less so in communicating to society the need to conserve and use them sustainably. By way of contrast, interest groups with special obligations concerning the conservation and promotion of agricultural biodiversity have a narrow focus, their activities are regional in scope and they are rarely geared to communicating their message to a broad public. The general public play a key role in that they can support conservation efforts in different ways, be it through political activity or, in their capacity as consumers, in influencing local economies by demanding specific products and services in rural areas. A study conducted by the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV) has shown that it has not yet been possible to publish and present scientific findings which support conservation and sustainable use of biodiversity in a transparent and understandable way, to gain acceptance for important state action and to exploit consumers' potential in efforts towards achieving sustainable consumption patterns.

„Iss mal was aus der Region" Pomotion of regional products in the agricultural museum Lindlar, Germany

Informing the public about the importance of biodiversity is an important task

To gain broader social acceptance of measures towards conservation and sustainable use of agricultural biodiversity, a cooperative approach should be taken (based on the findings of the above-mentioned study) to develop an integrated communication strategy to inform different social actors about the issues in question and to win support for the measures involved. The ultimate aim is to raise public awareness of the importance and value of agricultural biodiversity. Because social awareness is seen as the key starting point when attempting to bring about lasting change, it makes sense to prioritise both chronologically and thematically to ensure timely implementation of an effective, *high profile* campaign to promote agricultural biodiversity. In keeping with the findings of the study, the campaign should target specific segments of the population who lead certain lifestyles and can be identified as 'strategic' target groups (Post-Materialists, Traditionals, Establisheds, Modern Performers).

3.3 Exploiting Alternative Income Sources in the Forestry Sector

Forests are usually part of a forestry enterprise and must therefore generate income. Over 80 percent of forestry income stems from the sale of timber. Land leasing also generates income, as does hunting which is a source of income that should not be underestimated. Land is leased at an average €15 per hectare per year, making for annual leasing income of around €400 million.

Although the use of other forest products provides additional sources of income, such uses receive little attention. This is despite the broad range of alternative forest uses available. These include:

- Special uses (riding, tourism, forest experience, etc.);
- Contract-based conservation activities;
- Fresh water supply;
- Medicinal plants, mushrooms and berries.

Action is thus needed in the following areas:

- The potential harboured in alternative forest uses has yet to be fully exploited.
- Forest owners should be supported in the development of marketable products and in bringing them to market.

Recommended measures:

- Create a forest products information platform. Using a dedicated website, forest owners and consumers can read about successful projects and learn about the marketing of non-wood products. Existing web-based resources should be taken into account.
- Initiate model projects. An assessment should be made as to whether and how the BMELV can support model and demonstration projects that offer promising strategies for the development of innovative forest products.

Petri dish

3.4 Agricultural Biodiversity Network

Given the increasing interdependencies involved both in resource use and resource conservation, the creation of an agricultural biodiversity network as recommended in this strategy provides a key cross-sectoral infrastructure. The network would take in all components of agricultural biodiversity, including the associated research disciplines.

The network is envisioned as a modular sub-component of a cross-cutting German biodiversity research network for which the Federal Ministry of Education and Research (BMBF) is currently assessing the options for start-up funding. In many respects, not least in the interest of information and communication, it should also become part of Germany's CBD Clearing House Mechanism. The agricultural biodiversity module can be coordinated by the Information and Coordination Centre for Biological Diversity (IBV) at the Federal Agency for Agriculture and Food (BLE).

To ensure equal consideration is given to the various aspects mentioned above, the network must comprise a range of different components with specific goals and objectives, with the main components taking the form of a research network, a knowledge network and a dialogue forum.

The aim of the *research network* is to intensify research dialogue, improve national-level research co-operation and foster agricultural biodiversity research in general. It will be used to identify future research needs in order to prepare the way for medium and long-term research policy. Another important aspect involves better integration of Germany's research environment into international research cooperation activities, preparation of EU-level projects and acquisition of EU funding for research work.

The *knowledge network* is designed to improve the transfer of research knowledge and findings into everyday practice, i.e. to the work performed by the various user groups – policymakers, government administrations, industry, NGOs, interest groups, experts, the media and the interested public. It will also be used to bring issues and problems arising in everyday practice to the attention of researchers.

The *dialogue forum* will raise public awareness to the importance of agricultural biodiversity and to the policy action needed for its conservation and sustainable use, and foster broad social acceptance of related activities. While the dialogue will involve actors from research and development and from the user groups mentioned earlier, policymakers will play the greatest role. The aim, however, is not solely to make research results more transparent and easier to communicate. The reverse effect is also desired, that is of introducing everyday knowledge to the research sector as a source of new stimulus.

4 Outlook

With this strategy, the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV) tackles, for the policy areas it serves, the challenges arising from its mandate and from global development of the Earth's biological diversity, especially as regards the conservation and sustainable use of agricultural biodiversity.

The ultimate aim is to achieve **better linkage between conservation and use** of agricultural biodiversity to foster **sustainable development**. The strategy is designed to encourage active and sustainable use of the greatest possible range of components of agricultural biodiversity, while fostering conservation of threatened ecosystems and species. In doing so, unexploited potential for sustainable, environmentally sound management of agricultural biodiversity is to be used and the risks posed by invasive alien species and climate change minimised. Finally, the strategy aims to secure a socially desirable, diverse cultural landscape. The production-steering function of consumer demand must thus be boosted by means of education and improved market transparency.

Given the current situation and prevailing trends, a **precautionary approach** must be taken which focuses on improving the infrastructural conditions to allow the conservation and sustainable use of biodiversity.

This involves:

- Performing inventories and setting up collections, databases and information systems;
- Promoting, linking and consolidating research activities;
- Greater efforts to boost education, training and public relations work.

Given the world-wide interdependencies that now exist, especially in relation to other global environment and development problems, and the need for the right conditions to be in place at global level, intensive **international cooperation** will be sought in the management of genetic resources used in the agricultural, forestry, fisheries and food sectors – the ultimate aim being to achieve global justice in access to biodiversity.

Implementation of the necessary measures calls for targeted multi-level action in many different areas. Action taken at government level is reliant on cooperation with social actors. The Federal Ministry of Food, Agriculture and Consumer Protection (BMELV) aims to improve existing conditions to allow social dialogue and cooperation (including cross-sectoral cooperation) and to develop them so they support and foster both individual and joint activities to achieve the desired goals.

Abbreviations

ABS	*Access and Benefit Sharing*
AEGIS	*A European Genebank Integration System* (EU Cooperative Programme for Plant Genetic Resources (ECPGR))
AGR	*Aquatic Genetic Resources*
AGRDEU	Aquatic Genetic Resources in Germany (National Inventory of Aquatic Genetic Resources)
ASCOBANS	Agreement on the Conservation of Small Cetaceans of the Baltic and the North Seas
BBodSch	Bundesbodenschutzgesetz (Federal Soil Protection Act)
BJagdG	Bundesjagdgesetz (Federal Law on Hunting)
BLAG	Bund-Länder-Arbeitsgruppe (Joint German Government-Länder Working Group)
BLE	Bundesanstalt für Landwirtschaft und Ernährung (Federal Agency for Food and Agriculture)
BMBF	Bundesministerium für Bildung und Forschung (Federal Ministry of Education and Research)
BMELV	Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz (Federal Ministry of Food, Agriculture and Consumer Protection)
BNatSchG	Bundesnaturschutzgesetz (Federal Nature Conservation Act)
CAP	EU Common Agricultural Policy
CBD	Convention on Biological Diversity
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources
CO2	Carbon dioxide
DSMZ	Deutsche Sammlung von Mikroorganismen und Zellkulturen GmbH (German Collection of Microorganisms and Cell Cultures)
ECOSOC	UN Economic and Social Council
ECP/GR	European Cooperative Programme for Crop Genetic Resources Networks
EC	European Community
EAFRD	Council Regulation (EC) No 1698/2005 of 20 September 2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD)
EPPO	European and Mediterranean Plant Protection Organisation
EU	European Union
EUFORGEN	European Forest Genetic Resources Programme
EUROSTAT	Statistical Office of the European Commission
EVA	Informationssystem für Evaluierungsdaten pflanzengenetischer Ressourcen (Information System for Evaluation Data on Plant Genetic Resources)
EEC	European Economic Community
FAO	UN Food and Agriculture Organisation
FFH Directive	EU Habitats Directive
FGRDEU	Forest Genetic Resources in Germany (National Inventory of Forest Genetic Resources)
FLEGT	Forest Law Enforcement, Governance and Trade
FNR	Fachagentur Nachwachsende Rohstoffe e. V. (Agency for Renewable Resources)
FSC	Forest Stewardship Council
GAK	Gemeinschaftsaufgabe „Verbesserung der Agrarstruktur und des Küstenschutzes“ (Joint German Government and Länder Programme on Improving Agrarian Structures and Coastal Protection (GAK))
GENRES	Information System on Genetic Resources
GFP	Gemeinschaft zur Förderung der privaten deutschen Pflanzenzüchtung (Association for the Promotion of German Plant Breeding)
GG	Grundgesetz (German Basic Law)
GMO	Genetically Modified Organisms
HELCOM	Helsinki-Commission (Baltic Marine Environment Protection Commission)
IARCs	International Agricultural Research Centers
IBKF	International Commission for Fisheries Management in Upper Lake Constance)
IBV	German Centre for Documentation and Information in Agriculture – Information Centre for Biodiversity
ICPD	International Commission for the Protection of the Danube
ICPE	International Commission for the Protection of the Elbe

ICPO	International Commission for the Protection of the Odra
ICPR	International Commission for the Protection of the Rhine
IGKB	International Commission for the Protection of Lake Constance
IPK	Leibniz Institute of Plant Genetics and Crop Plant Research (IPK), Gatersleben
IPGRI	International Board for Plant Genetic Resources (IBPGR)
IPPC	International Plant Protection Convention
ITPGR	International Treaty on Plant Genetic Resources
IUU	Illegal, unregulated and unreported [fishing]
IWC	International Whaling Commission
IV	Artificial insemination
JKI	Federal Research Centre for Cultivated Plants – Julius Kuehn Institute
MaB	UNESCO Man and the Biosphere Programme
MCPFE	Ministerial Conference on the Protection of Forests in Europe
MGRDEU	Microbial Genetic Resources in Germany (National Inventory of Genetic Resources of Microorganisms)
N	Nitrate
NAFO	Northwest Atlantic Fisheries Organization
NASCO	North Atlantic Salmon Conservation Organisation
NEAFC	The North East Atlantic Fisheries Commission
NGO	Non-Governmental Organisation
OECD	Organisation for Economic Cooperation and Development
ORNIS	ORNIS Committee established under Article 16 of the EU Birds Directive
OSPAR	Oslo-Paris Commission for the Protection of the Marine Environment of the North-East Atlantic
PEFC	Programme for the Endorsement of Forest Certification Schemes (formerly Pan-European Forest Certification)
PGR	Plant Genetic Resources
PGRFA	Plant Genetic Resources for Food and Agriculture
PGRDEU	Collections of Plant Genetic Resources in Germany (National Inventory of Plant Genetic Resource)
TGR	Animal Genetic Resources
TGRDEU	Central Documentation of Animal Genetic Resources in Germany (National Inventory of Animal Genetic Resources)
TRIPs	Agreement on Trade Related Aspects of Intellectual Property Rights
UN	United Nations
UNCED	United Nations Conference on Environment and Development (Rio de Janeiro 1992)
UNEP	United Nations Environmental Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNFCCC	United Nations Framework Convention on Climate Change
UNFF	United Nations Forum on Forests
vTI	Johann Heinrich von Thuenen-Institute
WCED	World Commission on Environment and Development
WIPO	World Intellectual Property Organisation
WSSD	World Summit on Sustainable Development (Johannesburg 2002)
WTO	World Trade Organisation
XGRDEU	Collective term for holdings and collections of genetic resources for food, agriculture, forestry and fisheries in Germany

Editor
Federal Ministry of Food, Agriculture and Consumer Protection
(Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz, BMELV)
Postfach 140270

53107 Bonn, Germany

Editorial department
Division 522, Biodiversity and Biopatents
(Biologische Vielfalt und Biopatente)

Rochusstraße 1
53123 Bonn, Germany
Tel.: ++49-228-99529-3616

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