Bundesanstalt für
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Plant Genetic Resources for Food and Agriculture in Germany

Second German National Report

Agrobiodiversität

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Edited by

Federal Agency for Agriculture and Food
Information and Coordination Centre for Biological Diversity

Federal Ministry of Food, Agriculture
and Consumer Protection

Federal Agency for Agriculture and Food

Federal Ministry of Food, Agriculture and Consumer Protection

Preface

It is expected that by 2030 the world will have to feed an extra 2 billion people of whom 90% will live in developing countries. Food production and security for this increasing world population will highly depend on the conservation and sustainable use of agricultural biodiversity including genetic resources. Crops and their wild relatives thereafter referred to as plant genetic resources for food and agriculture provide the raw material that researchers and plant breeders use to improve the quality and productivity of crops in order to respond to environmental (e.g. climate change) and demographic changes.

It is estimated that about three-quarters of the genetic diversity once to be found in agricultural crops have been lost over the last century and that genetic erosion still continues. Today, only 150 crops feed most of the world's human population, and just 9 crops provide 75 percent of nutrition energy from plants, with rice, wheat and maize alone providing 50 percent.

There is a high international interdependence with regard to crops and their genetic diversity. *Ex situ* conservation, *in situ* conservation and on-farm management methods are complementary options to preserve the diversity of plant genetic resources for food and agriculture. Plant genetic resources are maintained *ex situ* in worldwide 1.500 genebanks conserving approx. 6 million accessions. This underlines that the future of agriculture depends on international cooperation and exchange not only of these resources but also of information related to these plant genetic resources for food and agriculture. *In situ* conservation and on-farm management are further important components of the conservation and management of genetic resources. They provide some important advantages as *in situ* conservation and on-farm management not only preserve potentially important and useful genes in there natural habitat but also allow further evolutionary adaptation to changing environments.

The Food and Agricultural Organisation of the United Nations (FAO) published the first State of the World's Plant Genetic Resources for Food and Agriculture in 1996, describing the status of plant genetic resources for food and agriculture, at the global level, and identifying gaps and needs for their conservation and sustainable utilisation, as well as for emergency situations. Based on this analysis, the Global Plan of Action for the conservation and sustainable utilisation of plant genetic resources for food and agriculture, which was adopted by 150 governments during the FAO's 4th International Technical Conference on Plant Genetic Resources held in Leipzig identified 20 priority activities which are to be implemented through national programmes.

Germany adopted its „National Programme for Genetic Resources of Agricultural and Horticultural Crops" in 2002. The programme aims at an appropriate implementation of the measures recommended in the Global Plan of Action in Germany.

Meanwhile, the development of the second State of the World's Plant Genetic Resources was agreed and National Reports are the primary source of information for its compilation. The Advisory and Co-ordinating Committee for Agricultural and Horticultural Crops prepared the second German National Report for the Federal Ministry of Food, Agriculture and Consumer Protection. This second Report is now focussing on the developments and changes which occurred since 1996.

Based on National Reports the second State of the World's Plant Genetic Resources will provide the up-to-date, comprehensive description and assessment of the global state of plant genetic resources for food and agriculture. The information compiled about conservation, characterisation and evaluation is a precondition to make better use of a broader range of the world's plant genetic diversity in research and plant breeding programmes. Achievements made in these areas will be crucial to meet future challenges in food security for a still growing world population, sustainability of agricultural production and development in times of climate change, conservation of agricultural ecosystems and rural development providing the livelihood of hundreds of millions of people worldwide.

It is hoped, that the information given in the second State of the World's Plant Genetic Resources will provide valuable guidance to researchers and institutions in both the public and private sectors, as well as to government and institutional policy- and decision-makers.

Finally, I would especially like to thank all members of the Advisory and Co-ordinating Committee for Agricultural and Horticultural Crops for their contributions to the German National Report and fruitful discussions during its preparation.

Dr. Frank Begemann

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Content

List of Abbreviations and Acronyms

ABDP	Association for Biodynamic Plant Breeding
AEGIS	A European Genebank Integrated System
AEGRO	An Integrated European *In situ* Management Workplan: Implementing Genetic Reserves and On farm Concepts
Approx.	Approximately
AVRDC	The World Vegetable Center
BAZ	Federal Centre for Breeding Research on Cultivated Plants (as of 01.01.2008 Federal Research Centre for Cultivated Plants – Julius Kuehn Institute)
BEKO	Advisory and Co-ordinating Committee for agricultural and horticultural crops of BMELV
BfN	Federal Nature Conservation Agency
BGB	German Civil Code
BIG	Federal Information System Genetic Resources
BLE	Federal Agency for Agriculture and Food
BMBF	Federal Ministry of Education and Research
BMELV	Federal Ministry of Food, Agriculture and Consumer Protection
BMJ	Federal Ministry of Justice
BMZ	Federal Ministry of Economic Cooperation and Development
BNatSchG	Federal Nature Conservation Act
BSA	Plant Variety Rights Office
CAP	Common Agricultural Policy
CBD	Convention on Biological Diversity
CGIAR	Consultative Group on International Agricultural Research
CGRFA	Commission on Genetic Resources for Food and Agriculture
CHM	Clearing-house Mechanism
COP	Conference of the Parties of CDB
CWR	Crop wild relatives
EAFRD	European Agricultural Fund for Rural Development
EC	European Community
ECCBD	European Central Crops Database
ECPGR	European Cooperative Programme for Plant Genetic Resources
EEC	European Economic Community
e.g.	for example
EPGRIS	European Plant Genetic Resources Information Infrastructure
etc.	et cetera
EU	European Union
EUREGIO	German-Dutch cooperating region
EURISCO	European Search Catalogue
EVA	National Evaluation Programme for Plant Genetic Resources
FAO	Food and Agriculture Organisation
FNR	Agency of Renewable Resources
GABI	Genome Analysis of the Plant Biological System
GAK	Improvement of Agricultural Structure and Coastal Protection
GBIS	Genebank Information System of IPK
GCDT	Global Crop Diversity Trust
GENRES	Information System Genetic Resources
Germany	Federal Republic of Germany
GFP	Association for the Promotion of Private Plant Breeding in Germany
GFU	Global Facilitation Unit for Underutilized Species
GG	German Constitution
GPA	Global Plan of Action for the Conservation and Sustainable Utilisation of Plant Genetic Resources for Food and Agriculture; short Global Plan of Action
GPZ	Society for Plant Breeding
GTZ	German Agency of Technical Cooperation
ha	hectares

IBV	Information and Coordination Centre for Biological Diversity of BLE
InWEnt	Capacity Building International
IOZ	Institute of Fruit Breeding of BAZ
IPEN	International Plant Exchange Network
IPK	Leibniz Institute of Plant Genetics and Crop Plant Research
IPGRI	International Plant Genetic Resources Institute, by now Bioversity International
KERN	Association for the Conservation, Regeneration and Use of Cultivated Crops
KULAP	Programme on Cultural Landscape in Brandenburg
Laender	Federal States of the Federal Republic of Germany
LBP	Bavarian State Research Centre for Agronomy
LTZ	Agricultural Technology Centre Augustenberg
MAB	Man and the Biosphere Programme of UNESCO
MCPD	Multi-Crop Passport Descriptors
MLS	Multilateral System of the Treaty
MTA	Material Transfer Agreement
NGO	Non-Governmental Organisation
NRW	Nordrhein-Westfalen
PGRDEU	National Inventory of Plant Genetic Resources
RCCPGR	Research and Coordination Centre for Plant Genetic Resources of BAZ
SMTA	Standard Material Transfer Agreement of the Treaty
SysTax	Botanical Garden Information System
Treaty	International Treaty on Plant Genetic Resources for Food and Agriculture
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UPOV	International Union for the Protection of New Varieties of Plants
VEN	Verein zur Erhaltung der Nutzpflanzenvielfalt e.V.
VERN	Verein zur Erhaltung und Rekultivierung von Nutzpflanzen in Brandenburg e.V.
WIEWS	FAO World Information and Early Warning System
WSSD	World Summit on Sustainable Development
ZADI	Centre for Agricultural Documentation and Information
ZALF	Leibniz-Centre for Agricultural Landscape Research
ZEFOD	Inventory of Biological Research Collections in Germany
ZVG	Central Horticultural Association

Executive Summary

The Second German National Report describes the state of agricultural and horticultural plant genetic resources (e.g. agricultural crops, pasture plants, vegetables, fruit crops, ornamentals, special crops and wild plants of potential use) in Germany, especially regarding changes that occurred between 1996 and 2006. It has been compiled by the Advisory and Co-ordinating Committee for Agricultural and Horticultural Crops (BEKO) for the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV).

Examples of relevant changes influencing the state of plant genetic resources for food and agriculture in Germany given in this report can be summarised as follows:

At international level, the most important regulation regarding plant genetic resources for food and agriculture, the **International Treaty on Plant Genetic Resources for Food and Agriculture** (Treaty), came into force in 2004. Germany has ratified the Treaty in 2004 and its national implementation is now well underway. In addition, Germany contributes financially and as a member of the Donors Council to the Global Crop Diversity Trust (GCDT).

In Germany, a major step towards a sustainable and efficient system for the conservation and utilisation of plant genetic resources for food and agriculture was the establishment of the **National Programme for Genetic Resources of Agricultural and Horticultural Crops**, which was adopted in 2002. The implementation of this programme is assisted by the BEKO, which is supported by two thematic working groups. Since 2005, additional financial support has been made available by BMELV for model and demonstration projects for the conservation and utilisation of agrobiodiversity.

In general, there is still further need for measures related to *in situ* and **on-farm conservation**, although the overall area of protected areas in Germany has strongly increased since 1996. One of the main reasons for this is the lack of comprehensive knowledge about the occurrence of plant genetic resources *in situ*. In order to assess the situation of *in situ* conservation, national inventories and surveys have been

conducted at Laender level. The National Inventory of Plant Genetic Resources (PGRDEU) has been restructured and is now documenting additional data on *in situ* measures compiled by the Laender. Furthermore, a List of Plant Genetic Resources of actual or potential value for use, has been published.

The *ex situ* **conservation** of plant genetic resources in Germany has been reorganised. The Genebank of the Federal Centre for Breeding Research on Cultivated Plants (BAZ) in Braunschweig has been transferred to the Genebank of the Leibniz Institute of Plant Genetics and Crop Plant Research (IPK) in Gatersleben. In the course of this reorganisation, the IPK genebank has been equipped with a new, efficient and comprehensive genebank management system (Genebank Information System GBIS). Furthermore, the fruit genebank of the IPK was transferred to the Institute of Fruit Breeding (IOZ) of the BAZ. In addition, the development of decentralised genebank networks, e.g. for *Fragaria*, *Malus*, *Prunus* and ornamentals, has been initiated. These combined efforts are targeted at an increase of efficiency with regard to *ex situ* conservation.

Of basic importance is the **utilisation of plant genetic resources**. Agrobiodiversity is best conserved when farmers and consumers use - and breeders further develop - crop plants. Outstanding opportunities for the utilisation of plant genetic resources in plant breeding were established in 2007 with the enhancement and concentration of the federal plant breeding research at the BAZ in Quedlinburg.

Within the framework of **international collaboration**, Germany has continued its support of activities of the United Nations Food and Agriculture Organisation (FAO), including its Commission on Genetic Resources for Food and Agriculture (CGRFA), the Consultative Group on International Agricultural Research (CGIAR), the Global Crop Diversity Trust (GCDT) and the International Treaty for Plant Genetic Resources for Food and Agriculture (Treaty) with regard to plant genetic resources. Corresponding national measures, like the implementation of the Standard Material Transfer Agreement under the Treaty, have been undertaken. At European level, another important activity supported by Germany took place within the European Cooperative Programme for Plant Genetic Resources (ECPGR) by the development of the European Search Catalogue for Plant Genetic Resources (EURISCO), the further improvement and operation of European Central Crop Databases (ECCDB), and the work towards the implementation of a European Genebank Integrated System (AEGIS).

Although considerable achievements have been made over the last ten years, there are still major problems to solve and new challenges (e.g. climate change) to meet, which will require joint efforts of all stakeholders in order to ensure the conservation and utilisation of plant genetic resources for food and agriculture in the future.

An Introduction to the Country and the Agricultural Sector

The Federal Republic of Germany (hereinafter referred to as Germany) is situated in central Europe and has a land area of 357,092 km^2. Germany is divided geographically into the Northern German Plain, the Central Upland Range, the South-West German Central Upland Scarps, the South German Alpine Foreland and the Bavarian Alps. The Bavarian plateau in the south-west averages 488 m above sea level, but it reaches 2,962 m in the Zugspitze Mountain, the highest point in the country. Germany's major rivers are the Rhine, the Elbe, the Oder, the Danube and the Weser. The climate is determined by its location in a zone of temperate climatic conditions with frequent weather changes. There is precipitation all year round. Progressing from the north-west to the east and south-east, the maritime climate gradually changes into a more continental climate. However, neither the daily nor the seasonal variations of temperatures go to extremes anywhere. The annual mean temperature is around 9°C and precipitation is on average 700 - 800 mm per year (subject to regional fluctuations).

Germany has approximately 82.4 million inhabitants, which corresponds to a population density of 231 inhabitants per square kilometre. However, over 80% of Germany is defined as rural area. Over 70% of the population live outside urban areas; more than three quarters of all municipalities have less than 5,000 inhabitants. The landscape of Germany is characterised by arable land, meadows, pastures and forests. Farmers manage more than half of the total national territory. Although the area devoted to agriculture has declined since the end of 1992 (-3%), those areas used for renewable resources (e.g. rape and sunflower oils, starch and sugar) have nearly tripled between 1995 and 2005 to comprise 1.5 million hectares, i.e.13.2% of arable land in 2005.

In 2006, Germany ranked fourth in a global comparison of exports of agri-food products with over 40 billion Euro, in contrast to agri-food imports of over 50 billion Euro. Compared to the past five years, farm incomes have been rising and the markets for renewable resources, organic products and timber are growing. In 2006 as well, the structural changes in agriculture followed the long-term trend. Changes in agricultural practices and structures towards intensified farming have posed and are still posing the greatest risk to the management of plant genetic resources. In 2006, the number of farms of over 2 hectares of utilised agricultural area amounted to around 366,000 and has thus decreased by 40% as compared to 1996. While the number of farms decreased over the last ten years, the average farm size increased. The average farm size comprised about 46 hectares of agricultural land, almost doubling since 1996. Compared to 1996, the number of workers in agricultural enterprises declined by 9.4%. Whereas the number of fulltime and part-time workers engaged in German farming in 2006 totalled approx. 1.3 million in almost 400,000 agricultural enterprises, the so-called agribusiness sector employs about 4.3 million workers.

In spite of its small share of 1.0% (2005; 1.3% in 1995) of the total economic output, agricultural production is of major importance as it enables the population to be supplied with a sufficient amount of food, feed and renewable resources, and plays a crucial role in rural development and for food production. More than 80% of the required foodstuffs can be obtained from domestic production.

Germany bears a great variation of natural conditions, the size and organisational structure of agricultural holdings, production methods as well as regional food and raw products available. Sustainable agriculture is the foundation for protecting natural resources - soil, water and air - and for maintaining agrobiodiversity.

The technological progress and advancements in breeding made in recent decades might lead to the situation that no longer all agricultural land is required for the production of food and animal feed. With energy prices rising, the use of regenerative sources of energy provides new opportunities for additional income. There is also growing industrial demand for renewable resources for non-energetic uses. This allows for the tapping of innovative potential, thereby providing alternative sources of income and also creating more jobs in rural areas.

1 The State of Diversity

Industrialisation of agriculture has led in general to a loss of biological diversity in fields and pastures. A large part of what farmers and breeders have created, maintained and preserved around the globe for millennia has either disappeared from farmers' fields or is threatened by genetic erosion. This trend is amplified by the increasing global competition and structural change in agriculture, leading to concentration on an ever smaller number of economically profitable, high-yielding varieties.

1.1 The state of diversity and relative importance of all major crops for food security

Of 7,000 cultivated plant species worldwide, only 30 are considered "crops that really feed the world". Only three species – rice, wheat and maize – provide almost 50% of the world's calorie needs (energy). With additional six crops (sorghum, millet, potato, sweet potato, soya, sugar cane and sugar beet), 75% of the world's calorie needs are covered.

In Germany, field crops cover some 70% of agricultural land, with only about 25 cash crops and 35 forage crops being used for arable farming. Since 1986, area, yield, and production of wheat, barley, rye and canola in Germany have shifted dramatically. The wheat area in eastern Germany has steadily increased, and yields have made progress toward becoming equal with those in western Germany. Despite the declining barley area in Germany, yields have increased, resulting in no change in production. Eastern German rye production has exploded since reunification due to an increase in yield, while the canola production is growing thanks to a broader usage.

At present, the most dominant crops grown are by far cereals (wheat, barley, maize, rye, triticale and oat), canola, potato and sugar beet. In 2006, cereals are cultivated o n more than 57% of the arable land (Table 1.1).

Tab. 1.1
Cultivation area of arable land by main groups of crops in Germany between 1995 and 2005 ("Statistisches Jahrbuch" 2006, page 80, Federal Statistical Office).

	Cultivation area			
	1995		2005	
Land use	Area 1.000 ha	[%]	Area 1.000 ha	[%]
Useable agricultural area	17344	100.0	17035	100.0
Arable Land, there of	11835	68.2	11903	70.0
Cereals	6527	55.1	6839	57.5
Fodder crops	1792	15.1	1805	15.2
Industrial cops*	1151	9.7	1462	12.3
Roots and tuber	857	7.2	705	5.9
Legumes	123	1.0	169	1.4
Vegetables and other horticultural corps	103	0.9	130	1.1
Fallow	1282	10.8	794	6.7
Grassland	5282	30.4	4929	28.9
Other permanent crops	228	1.4	203	1.1

* including oil crops, hop and others (e.g. grasses for seed production, medicinal plants, herbs)

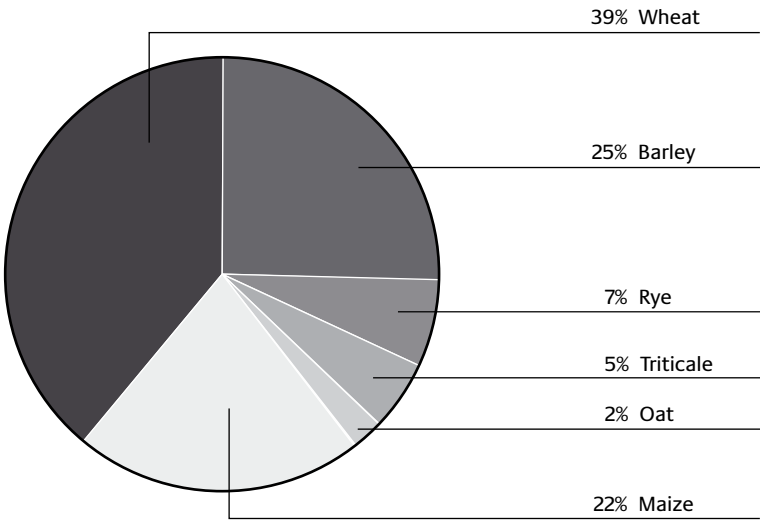

Fig. 1.1
Cultivation area of different cereals of the total cereal cultivation area in 2006 ("Statistisches Jahrbuch 2006", page 92, Federal Statistical Office).

As shown in Figure 1.1, wheat and barley cover the largest areas with 39% and 25% of the total cereal cultivation area respectively. Conversely, when compared to the relatively small area covered (around 1% of arable land), vegetables, fruits, medicinal plants and other speciality crops make an over-proportional contribution to agricultural diversity. There are some 70 vegetable crops, around 30 fruit crops and 70 medicinal and aromatic herbs cultivated in horticulture. Both field crops and commercially grown vegetables and fruits are dominated by modern high-yielding varieties.

1.2 The state of diversity of crop varieties

Genetic resources are fundamental for efforts to improve agricultural productivity. Thus, plant genetic resources, fortunately stored in genebanks around the world, evolved as an assortment of alleles needed for resistance and tolerance to diseases, pests and harsh environments found in their natural habitats.

Regarding the cultivation area of winter barley and winter wheat in 2006, the TOP 5 varieties cover a total area of 60.9% and 44.1% respectively. A corresponding concentration of the TOP 5 varieties of both winter crops covering almost 50% of the cultivation area was given in 1995. However, as varieties are subject to frequent replacement, non of these TOP 5 varieties of 1995 can be found within the TOP 5 varieties of 2006. These changes are driven by the market, which is additionally influenced by agricultural policy.

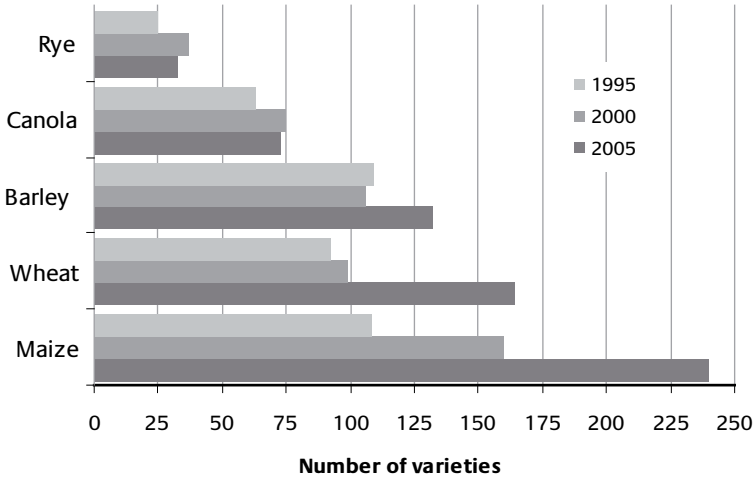

Fig. 1.2
Number of varieties of leading crops in production that have been registered and certified for marketing between 1995 and 2005 (Plant Variety Rights Office (BSA), Descriptive List of Varieties).

In Figure 1.2, serving as complement, the diversity in terms of the number of leading crops (maize, wheat, barley, canola, rye) between 1995 and 2005 is given. The number of varieties in production for maize (+123%), wheat (+78%) and rye (+32%) increased substantially within the last 10 years in contrast to barley (+21%) and canola (+15%).

In 2006, approx. 17 million hectares of land were used for agriculture in Germany, of which 11.9 million hectares were used to produce arable crops. 4.9 million hectares of this land served as permanent grassland or for permanent crops, consisting of grasses, legumes, shrubs and others (Table 1.1). Approximately 70% of the vascular plant species occur in meadows, pastures and ruderal vegetation. In contrast,

arable land as the most important land use today contributes less to the overall species richness of agricultural landscapes, e.g. 11% of vascular plants occur in arable land. Due to successful agricultural management schemes of the EU, a net increase of species-rich grassland in Germany can be observed in recent years.

1.3 The state of diversity and relative importance of minor crops and under-utilised species for food and agriculture

In Germany, plants used in horticulture, including fruits and vegetables as well as ornamental plants, can be considered to a large extent as minor crops as the total horticultural area is only approximately 1% of the arable land area. However, with a production value of almost 5.2 billion Euro, commercial horticulture contributed a share of 13.5% to the production value generated in agriculture as a whole, which underlines the importance of horticulture in the food and agricultural sector.

Tab. 1.3
Important vegetables according to cultivated area in Germany in 2005 ("Statistisches Jahrbuch" 2006, Federal Statistical Office).

	Acreage in hectares
Vegetable production area - Field crops (total)*	107,771
e.g.	
Asparagus	20,087
Carrots	9,858
White cabbage	6,108
Cauliflower	5,057
Fruit production area	66,150
Tree nurseries	22,500
Ornamental plants	9,000
Total horticultural area	225,000

* including non yielding acreage for asparagus cultivation

The area used for horticultural crops is approximately 225,000 hectares, with the largest acreage used for vegetable production (approx. 50%) and about 30% cultivated by fruit growers (Table 1.3). The most significant fruit species grown in Germany are apples (approx. 31,200 ha), strawberries (approx. 14,800 ha), sweet and sour cherries (approx. 9,600 ha), plums (approx. 4,500 ha) as well as pears (approx. 2,100 ha).

Commercial fruit crops comprise a few very old varieties – usually varieties that consumers know and like – along with new cultivars. The demand for regional products, e.g. specialities of regional importance, niche markets for old varieties or landraces of fruits or vegetables, is increasing. In contrast to most field crops, vegetables, fruits and herbs are also grown in private gardens. Hence, diversity of these grown in gardens or on-farm is likely to be higher.

The conservation and use of plant genetic resources is an important element of German policy aimed at sustainable horticulture. However, minor crops are of less interest to researchers, breeders and farmers due to their limited economic importance.

1.4 The state of diversity of wild plants harvested for food production

In Germany, the diversity of wild plants is generally subject to nature conservation. The occurrence of wild plants is monitored regularly (habitat mapping), and no problems due to over-use of wild plants for food production in the terrestrial sector are presently known.

Furthermore, subsistence farming and the use of wild plants for food and health purposes are of minor importance in Germany. However, there is a growing interest of gastronomy in typical regional diets including traditional crops and wild plants like herbs and berries, which provide a possible niche market.

Regarding the diversity of wild plants as a resource for food and agriculture, crop wild relatives (CWR, i.e. wild plants closely related to domesticated crop plants) are of importance, e.g. as resources for the improvement of agricultural crops. Some 19% of the CWR species are endangered, as stated on the National Red List. However, there is little knowledge about where distinct "hotspots" of crop wild relatives in German landscapes occur. The status of their *in situ* protection is not

known so far. However, regarding the *ex situ* conservation, the proportion of endangered crop wild relatives of the total number of CWR in the *ex situ* collection of the IPK genebank is about 100 of 540 accessions in total, i.e. approximately 19% (see chapter 3.3).

1.5 The main factors affecting the state of diversity

Agricultural structures including the state of genetic diversity have been shaped by a variety of factors comprising economic, cultural, historical, political, technological, and geographical conditions. These structural changes in agriculture consist in particular of the continuous adjustment to changes of consumers' preferences and supply as well as to technological progress.

Agriculture in Europe is undergoing pronounced structural changes. In 2003, the European Union adopted a comprehensive reform of the Common Agricultural Policy (CAP) with an emphasis on providing payments independently of the volume of production. This led towards a "market-driven" agricultural production with increased freedom of choices for farmers regarding the utilisation of genetic diversity. Thus, agricultural policy and legislation are important factors driving structural changes in agriculture which may affect the state of plant diversity.

Besides policy and legislation, economy is the strongest driving force affecting the state of plant diversity in farmers' fields. Except for fruit trees and grapevine, private plant breeding companies decide on the use of plant genetic resources in their breeding programmes, which is an economic decision based on an assessment of the anticipated needs for the next ten to twenty years. Significant increases in yields and productivity of some major crops have been achieved in plant breeding in recent decades, while crops of diminishing economic importance attract less interest for research and breeding as well as less public and private funding.

Moreover, climate changes will influence plant production and impact the state of diversity increasingly. As the impact on biodiversity is of major concern, it is essential to exploit the full range of uses of crop plants.

Therefore, some traditional uses are regaining their former popularity, e.g. textiles and paper made of flax and hemp, or management of extremely low-nutrient but landscape-typical heaths and marshlands.

Additionally, wild flora can often possess valuable yet undetected traits and characteristics. Research and breeding are opening up new uses for renewable resources, such as biodegradable plastics. Energy crops, plant and animal waste are increasingly used for decentralised energy production, e.g. in cogeneration power stations or biogas plants.

Given the uncertainty of the direction of environmental changes, it is difficult to exactly predict the traits needed for crop improvement in future. Therefore, the broadest possible range of agrobiodiversity needs to be ensured in order to meet future needs.

2 The State of *In situ* Management

In situ conservation is defined as 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. Traditionally, *in situ* protection and conservation is a priority activity of nature conservation. Species remain exposed to evolutionary processes within their ecosystems. This ensures natural selection and the adjustment to changing environmental conditions. In the particular case of on-farm management, landraces continue to evolve, influenced by natural selection as well as by selection pressures imposed by farmers and gardener, thus providing opportunities for continuous local crop adaptation and improvement.

The key features of *in situ* management in nature conservation are sustainability-focused agricultural and silvicultural land uses and nature and landscape conservation measures. These include species conservation and area-specific biotope conservation. Up to now, the conservation of genetic resources for food and agriculture plays no major role in management, maintenance and conservation measures of nature conservation. Little knowledge is available regarding the extent to which nature conservation measures contribute to the conservation of genetic resources. However, *in situ* conservation seems to be the most feasible measure for protecting both wild plant species with a potential use for food, feed or renewable resources as well as crop wild relatives.

Hence, *in situ* conservation is the central backbone of the conservation of plant genetic resources, accompanied by complementary *ex situ* conservation. Under the UNESCO programme "Man and the Biosphere" (MAB), conservation of genetic resources in biosphere reserves is cited as a pivotal task (see chapter 2.2 and Table 2.1).

2.1 Plant genetic resources inventories and surveys

The basis for any survey and inventory of plant genetic resources for food and agriculture is their definition, which determines the scope of such activities. In Germany, a first list of wild plants with current or potential value for food, agriculture and forestry was published within the first German National Report of Plant Genetic Resources for Food and Agriculture by the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV) in 1996. This list was substantially updated and extended in the framework of the National Programme on Plant Genetic Resources of Agricultural and Horticultural Crops in 2005. The current List of Plant Genetic Resources comprises 3.600 species with actual or potential value for use, of which almost 2.900 species are considered as crop wild relatives and growing wild. The list is published by the Information and Coordination Centre for Biological Diversity (IBV) and available at www.genres.de/pgrdeu. It provides for grouping the species into the following categories, according to their potential use:

- medicinal plants or spices
- plants with high protein content
- woody plants of the forest
- plants with high oil or fat content
- plants with high content of carbohydrates (starch, sugar, inulin etc.)
- fruits and vegetables
- forages
- pollen and nectar plants
- plants for technical uses (dyestuffs, fibres, energy, renewable resources except wood)
- plants for protection (wind, soil erosion, shadow plants etc.)
- ornamental plants
- plants used for breeding and breeding research

Few national surveys on the occurrence of plant genetic resources within and outside protected areas have been conducted, including the evaluation of available mapping data. Surveys conducted to date focus on specific areas only. Furthermore, there is little knowledge available on within-species variability of wild plants. Thus, to conduct an inventory of *in situ* plant genetic resources, the collection of rel-

evant data would be needed firstly. Up to now, this has only been done at Laender, communal or project levels and only to a limited extent for certain plant species.

Through a national inventory on fruit crops (see chapter 3.5), information about *in situ* stands of fruit crops (mainly apple, cherry, pear and plum) in scattered orchards (approx. 300 sites) could be compiled in 2006. Compared with an estimate of at least 300,000 hectares of scattered orchards in Germany, there is still a lack of knowledge about the occurrence of landraces of fruit crops *in situ* / on-farm.

Inventories of apple and grapevine wild relatives *Malus sylvestris* (L.) Mill. and *Vitis vinifera* subsp. *sylvestris* (C. C. Gmel.) Hegi are planned to start in 2007. These activities will also include the genetic evaluation and the improvement of measures for the *in situ* management of these species. In March 2007, a cooperation project on conservation of *Malus sylvestris* in the East Ore Mountains started in close collaboration with an associated group of the region. Different regional surveys about grapevine genetic resources in old vineyards (planted before 1950) conducted during the past years showed that, in grapevine, a considerable amount of landraces and old varieties/clones could still be found. Therefore, a 3-year project funded by BMELV has started in 2007, aiming at a national inventory of grapevine genetic resources on-farm and safeguarding valuable resources *ex situ*.

In addition, a first concept for red list data about crops, similar to the red list for wild species, was published in 2005 by the Brandenburg State Office for Environment of the Ministry for Rural Development, Environment and Consumer Protection.

For the central documentation of all *in situ* stands at national level, the structure and functionality of the National Inventory of Plant Genetic Resources (PGRDEU) was extended in 2007. It is intended that all data compiled in the framework of the above mentioned projects will be documented in PGRDEU. As a starting point, *in situ* data are documented in PGRDEU, using data which have been compiled by the Laender in the framework of the Council Directive 92/43/EEC (see below) as well as data from *ex situ* documentation (collection data) and from several crop specific projects. On-farm data (occurrences of landraces) are included on the basis of Laender specific programmes.

2.2 Conservation of wild plant genetic resources for food and agriculture in protected areas

In Germany, *in situ* conservation is a traditional area of nature conservation irrespective of the potential value of species for use in food and agriculture. Nature conservation gives priority to *in situ* protection and conservation, where species remain exposed to dynamic evolution processes within their ecosystems. This ensures natural selection and the need for adaptation to changing environmental conditions.

At national level, the legal basis for nature conservation policy is provided by the Federal Nature Conservation Act (BNatSchG), which is further specified and clarified by Laender specific nature conservation laws. The Act aims at protecting, maintaining and developing nature and the landscape in settled and non-settled areas so as to secure ecosystem functionality, usability of natural resources (including plants and animals) and diversity, uniqueness and beauty of nature and landscape as a sustainable life support system. Apart from the promotion of specific areas of national importance, responsibility for the implementation and funding of nature conservation measures lies with the Laender. For specific measures, co-funding is provided by the Federal Government and the EU. The amended Nature Conservation Act of 1998 introduced biosphere reserves as a new category of protected areas. Biosphere reserves “help to conserve, develop or recreate a landscape characterised by traditional, varied use and the historical species and biotope diversity that have developed there, including wild and earlier cultivated forms of commercially used or usable animal and plant species”. In its present form, the Act contains no specific provisions on the conservation of genetic resources for food and agriculture.

Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (Habitats Directive) establishes the Community-wide legal basis for the conservation of Europe‘s natural heritage and thus of wild genetic resources. The Habitats Directive is one of the key instruments in meeting the requirements of the CBD with regard to *in situ* conservation of biological diversity. Member States are required to create a coherent European ecological network of protected areas hosting valuable habitat types and rare and endan-

gered and/or unique species known as "Natura 2000". This Directive calls for efficiency evaluation of nature conservation management activities, surveillance of the conservation status and comprehensive reports. In 2006, approx. 9.3% of the total area of Germany belonged to protected areas under "Natura 2000"; however, the Directive does not require special measures with regard to genetic resources for food and agriculture.

The overall area covered by protected areas has strongly increased over the last decade as shown in Table 2.1, which provides an overview of data from selected reserves.

Tab. 2.1
Protected areas in Germany (Data on the Environment – The State of the Environment in Germany 2004, BfN).

Protected area category	Numbers as of		Area [ha]	Surface area [%] as of	
	1992/93	2004	2004	1992/93	2004
National Parks (§ 24)	8	15	194 136	0.5	0.54
Biosphere reserves (§ 25)	9	14	1 071 225	1.8	3.0
Nature Parks (§ 27)	67	87	7 985 511	15.6	22.4
Nature reserves (§ 23)	4 880	7 287	1 047 363	1.7	2.9
Landscape conservation area (§ 26)	6 206	7 181	10 600 000	25.3	29.7
Wetlands (Ramsar Convention)	29	32	841 000	0.4	2.3

Legend
Protected area category: Categories of protected sites are defined in the Federal Nature Conservation Act (BNatSchG). Therefore, protected areas by BNatSchG are specified by the paragraph which defines the category of the protected area. As defined in the BNatSchG, nature parks generally consist of nature and landscape protection area reserves. Thus, parts of a protected site, or even the whole area, may be protected under more than one category. These figures can overlap due to their definition, and grand total can not be deduced from these figures. Ramsar convention areas are wetlands of international importance, especially as waterfowl habitats.
Surface area: Statistical land area (exc. mudflats and marine areas)
Source: Federal Agency for Nature Conservation 2005

These protected areas thus serve as a vital function in terms of *in situ* conservation of biodiversity. In the context of reporting obligations, the Laender have to monitor the occurrence of selected species some of which are plant genetic resources for food and agriculture. These data are used for updating the information on *in situ* stands of plant genetic resources in protected areas in PGRDEU.

Up to now, there are no specific protected areas of crop wild relatives, nor is there a national strategy for *in situ* conservation of CWR. Some of these aspects will be addressed by the project "An Integrated European *In situ* Management Workplan: Implementing Genetic Reserves and On farm Concepts" (AEGRO) funded by the European Commission under Council Regulation (EC) No 870/2004 (see chapter 6.1) and coordinated by a German institution that will start its work in October 2007.

2.3 Ecosystem management for the conservation of plant genetic resources for food and agriculture and crop-associated biodiversity outside protected areas

There are no specific measures of ecosystem management aiming at the conservation of plant genetic resources for food and agriculture outside protected areas in Germany. In some instances, the conservation of plant genetic resources is partly addressed by the agri-environmental programmes of the Laender, e.g. extensification programmes for grassland or payments for scattered orchards.

2.4 On-farm management and improvement of plant genetic resources for food and agriculture

On-farm management is a specific type of *in situ* conservation, where conservation and improvement are an integral part of the agricultural production process itself. This concept originates from developing countries, where its importance with regard to the conservation and improvement of landraces is obvious. In countries with a highly specialised agriculture (e.g. Germany), where traditional landraces have

largely disappeared from farmers' fields and gardens, and seeds of high-yielding modern cultivars are easily accessible, the importance of on-farm management is less clear.

The most important objectives of on-farm management in Germany are: (1) increasing the diversity of cultivated plants by supporting particularly neglected and under-utilised crops, (2) increasing the genetic diversity within selected crops by cultivation of genetically divergent varieties or landraces, (3) promoting cultural diversity and maintaining traditional knowledge, (4) improving plant genetic resources of landraces in particular by utilisation of evolutionary processes, (5) safeguarding the availability of high quality agricultural products for human nutrition and (6) diversification of agricultural production through development of new products for specific market niches.

Quite a number of private initiatives and non-governmental organisations (NGOs) in Germany are aiming at conserving and improving the diversity of landraces (e.g. conservation varieties and amateur varieties), however, most of these activities are not well coordinated yet. In addition, the conservation and possible future development of landraces of agricultural and horticultural crops is secured, *inter alia* in agricultural history and open-air museums, in field flora reserves and in private and public gardens. Especially in horticultural crops with its great species diversity, detailed surveys on numbers of varieties and numbers of still existing and regionally favoured landraces are missing.

In 2000, a study commissioned by BMELV and conducted by the University of Goettingen was completed in which the methods of on-farm management of plant genetic resources were presented and analysed taking special account of the economic conditions in Germany. The study comprised 12 separate case studies on private on-farm management initiatives in Germany. A comparative analysis of these examples showed that successful on-farm management needs to be supported by additional measures. Such supporting measures are the evaluation of genebank material under practical conditions, the supply of seed, technical support for cleaning and storage of seeds, the development of new products and marketing strategies, and the establishment of networks of interested groups.

Adequate availability, reproduction and ongoing production of seed is one of the main problems in on-farm management. To improve access to larger quantities of seed and plant material, and to promote cooperation between the various initiatives, a network of cultivated plant initiatives (known as KERN) for the conservation, regeneration and use of cultivated plants in the field of on-farm management was established in 2000. The KERN-network includes a number of farmers and gardener groups as well as nature protection and ecologists associations with interest and practice in ecological breeding, nature protection, small scale use and private gardening.

At present, two Laender specifically support on-farm management of plant genetic resources for food and agriculture in Germany. In Brandenburg, the "Programme on Cultural Landscape" (KULAP 2000) offers amongst others support, in 2006, for the cultivation of approx. 40 landraces out of six crops which are endangered by genetic erosion.

In Nordrhein-Westfalen (NRW), a model project was conducted aiming at the evaluation of landraces, their reintroduction into agricultural production, the development of new products from these old varieties, and their marketing. The project was finished in 2006, but the work will be continued by a newly established Competence Centre for Conservation of Plant Genetic Resources at the Chamber of Agriculture at Muenster, which is responsible, among other things, for organising the production and distribution of seeds. It is linked to a cross-border project in the EUREGIO between NRW and the Netherlands dealing with the development and marketing of new products based on plant genetic resources.

In addition, several Laender provide support for on-farm management of scattered orchards in order to promote landraces of fruit crops and to protect endangered species living in such ecosystems. These activities are eligible for co-funding by the EU under Council Regulation (EC) No 1698/2005.

2.5 Assessment of major needs for *in situ* management of plant genetic resources for food and agriculture

Generally speaking, an efficient on-farm management requires integrative actions and combined efforts of all actors and organisations involved. In addition, there is still a large demand for research in this field, which should include both agronomic and genetic as well as socio-economic aspects.

Specific problems exist for crop wild relatives (CWR) and for landraces. CWR need increased attention within nature conservation (national parks and biosphere reserves) and related policies; there is a need for a national strategy for *in situ* conservation of CWR combining the authority, knowledge, strength and capacities of organisations at federal and Laender level. Furthermore, there is a gap of information about CWR, which has to be closed through an improved documentation (inventories) and better reporting systems.

For landraces, more case studies are needed to explore and develop market opportunities of innovative products. Regional centres of agrobiodiversity should be established to support seed supply, product development and marketing. The production and marketing of seed of landraces needs to be facilitated, and a legislative framework for the marketing of seeds of plant genetic resources is needed (see chapter 5.3).

3 The State of *Ex situ* Management

Ex situ conservation is conducted by genebanks and botanical gardens. After the reunification of East and West Germany, the collections in the major genebanks at the Federal Centre for Breeding Research on Cultivated Plants (BAZ)[1] in Braunschweig and the Leibniz Institute of Plant Genetics and Crop Plant Research (IPK) in Gatersleben had been reorganised. In the framework of a project on the fusion of the collections of BAZ and IPK (2002 - 2006) jointly funded by BMELV and BMBF, the collection of the BAZ genebank was integrated into the collection of the IPK, while the fruit collection of the IPK was transferred to the Institute of Fruit Breeding (IOZ) of the BAZ in Dresden-Pillnitz, resulting in an increase in efficiency with regards to *ex situ* conservation. Currently, the IPK runs *ex situ* collections at three locations, and the BAZ, for fruits and grapevine, at two locations. There are also a number of special collections that are primarily kept by Laender and communal institutions, including 95 botanical gardens. The latter conserve approximately 300,000 accessions of plant genetic resources including some of importance for agriculture and horticulture. Work in botanical gardens focuses first of all on global species diversity for research and training purposes, while the genebanks give priority to the intraspecific variability of crop species.

3.1 The state of collections

a) Genebank at the Leibniz Institute of Plant Genetics and Crop Plant Research, Gatersleben

The Federal *ex situ* collection of agricultural and horticultural plants forms the core of the genebank department of the IPK, which is structured into three programmes: Characterisation & Documentation, Management & Evaluation and Taxonomy & Evolution. The mandate of the genebank comprises the collection, conservation and

1 The federal research centres of the German Federal Ministry of Food, Agriculture and Consumer Protection (BMELV) have been re-organised. The three research centres which dealt with plants (Federal Centre for Breeding Research on Cultivated Plants (BAZ), Federal Biological Research Centre for Agriculture and Forestry and two institutes of the Federal Agricultural Research Centre) were merged at January 1st 2008. Its new name is Federal Research Centre for Cultivated Plants – Julius Kuehn Institute.

distribution of plant genetic resources. With a total of 148,128 accessions from 3,032 plant species and 773 genera, the IPK-Genebank holds one of the most comprehensive collections worldwide and provides a major contribution to the prevention of extinction (genetic erosion) of both cultivated plants and crop wild relatives (CWR). The collection is closely linked to research activities in other departments of the IPK. Outposts of the genebank are situated in Gross Luesewitz (potato collection; 5,894 accessions) and Malchow/Isle of Poel (oil and forage plants; 13,460 accessions).

As an international information centre for taxonomy of cultivated plants, the genebank possesses comprehensive reference collections including a herbarium with more than 390,000 specimen.

b) Grapevine Genebank at the Institute of Grapevine Breeding Geilweilerhof of the BAZ, Siebeldingen

Collection, conservation, documentation, characterisation and evaluation of genetic resources of grapevine are the main activities of this genebank. Within the institute, the genebank collection is used as a source for breeding grapevines with high resistance to pests, diseases and abiotic stress, and as a means to develop further breeding research on grapevine. The conservation of grapevine (*Vitis vinifera* L., varieties and other wild species) is conducted under field conditions. At present, stocks total some 3,800 accessions. The national and international documentation of grapevine genetic resources is supported by two databases, the European Vitis-Database and the International Vitis Variety Catalogue, which are both maintained by the genebank department.

c) Fruit Genebank at the Institute of Fruit Breeding of the BAZ, Dresden-Pillnitz

The tasks of the genebank comprise the collection, conservation, characterisation, evaluation and use of fruit genetic resources. The collection is held under field conditions and amounts up to some 3,000 accessions of apple, cherry, pear, plum and strawberry as well as accessions of wild species of the genera *Fragaria*, *Malus*, *Pyrus* and *Prunus*. Moreover, the establishment of a supplementary cryo-conservation (e.g. for *Malus* and *Fragaria*) is under development. In cooperation with the Information and Coordination Centre for Biological Diversity, the Institute of Fruit Breeding is responsible for the management of the Federal Register of Fruit Species and Cultivars in Germany.

d) Tobacco Genebank at the Agricultural Technology Centre Augustenberg (LTZ)

The collection held at the Tobacco Section of the Agricultural Technology Centre in Forchheim comprises some 750 tobacco accessions (*Nicotiana* sp.). Apart from landraces and varieties belonging to the five most common variety groups of *Nicotiana tabacum* L., the collection contains 20 specimens of *N. rustica* L. and 50 of the 76 known wild populations. The accessions of the genebank are used, amongst others, for the breeding programme of the institute, mainly for traits like resistance against pests and diseases as well as for low content of nicotine and condensate.

e) Special collections primarily kept by public Laender and communal institutions as well as private holders including non-governmental organisations

The Hops Section of the Bavarian State Research Centre for Agronomy (LBP) in Huell maintains a breeding nursery with a current stock of some 150 varieties, about 20,000 breeding lines and 200 wild hop accessions (*Humulus lupulus* L.).

In addition to the collection of the Grapevine Genebank in Siebeldingen, Laender institutes in Freiburg, Geisenheim, Lauffen/Neckar, Neustadt a. d. W and Veitshoechheim are maintaining five grapevine collections with a total of 3,700 accessions.

Besides the Fruit Genebank at the BAZ (Dresden-Pillnitz), numerous collections of fruits exist in Germany. A 2006 inventory indicated more than 14,000 accessions belonging to 42 fruit species, which are maintained by more than 50 institutions/holders in approx. 90 collections. Based on these results, a concept for a more cooperative and efficient organisational structure for the conservation of fruit genetic resources in Germany was developed, the implementation of which is now underway. Core elements will be crop specific networks of relevant collections organising the conservation in a decentralised way, but

with a central coordination by the Fruit Genebank in Dresden-Pillnitz. Preliminary networks for *Fragaria*, *Malus* and *Prunus* are under development.

f) Collections of ornamental plants

Ornamental plants play a key role in the economy of horticulture. It is estimated that more than 80,000 species and varieties of ornamentals are cultivated in Germany, either outdoor or in greenhouses, by a large number of highly specialised growers. Collections and breeding activities are strongly decentralised in this area. There are no overall organisational structures, and collection registers are only partly available. To improve the situation in this sector, the Central Horticultural Association (ZVG) and IBV jointly hosted a symposium in September 2000. One of the main outcomes was a resolution passed by participants calling for the survey and evaluation of existing ornamental plant collections in Germany as well as, based on the outcome of that survey, the establishment of a decentralised ornamental plant genebank in the form of networks of existing collections with a central coordination unit. A first research project was carried out between 2002 and 2005, providing a comprehensive overview of organisational structures and existing collections. A second project, aiming at the implementation of a Genebank for Roses based on a network of major rose collections in Germany, started at the end of 2005. Similar activities for other ornamental crops are under preparation (e.g. Genebank for Rhododendron).

3.2 Collecting

Collecting missions to the primary and secondary centres of diversity of the most important crops pursue the aim of preserving the greatest possible range of traits and making it accessible for use. Another important aim is to safeguard locally endangered diversity of agricultural and horticultural species *ex situ*. Furthermore, identified gaps in the *ex situ* collections underline the need for collecting missions. In addition, valuable working collections were included by genebanks for long-term conservation. A short overview of collecting activities of IPK and BAZ during the last ten years is given below:

Tab. 3.1
Overview of collecting activities of IPK and BAZ between 1997 - 2006

Year	Collecting activities of IPK	Collecting activities of BAZ
1997	- for forages in Croatia - for cereals in Croatia - for vegetables in Croatia - for potato in Mexico - for allium in Asia - for multi-crop in Italy - for multi-crop in Kazakhstan	
1998	- for forages in Bulgaria - for cereals in Bulgaria - for vegetables in Bulgaria - for multi-crop in Italy - for multi-crop in Sardinia (Italy) - for multi-crop in South Korea	
1999	- for wild potato accessions in Peru - for forages in Spain - for cereals in Spain - for vegetables in Spain - for multi-crop in Italy	- for *Beta lomatogona* in Aserbaidschan - for *Beta lomatogona* in Iran - for *Hypericum perforatum* in Germany
2000	- for forages, Azores - for multi-crop in Italy	- inventory of old vineyards in Germany until 2003
2001	- for forages, cereals and vegetables in France - for wild Malus species in China - for *Lactuca serriola* in Germany - for multi-crop in Italy	
2002	- for *Lolium perenne* (diversity of traits) from permanent grassland areas in Ireland	- for Malus spp in China
2002	- for *Lactuca serriola* in Germany	
2003	- for *Lactuca serriola* in Germany	
2006	- for Poa diversity in Germany - for Poa diversity in the Czech Republic	- for *Malus sylvestris* in Poland

3.3 Types of collections (major and minor crops)

The collection of IPK is multi-crop, covering 3,032 species of 773 genera, but focuses on major food crops and forages. 40% of all accessions belong to major cereals (*Avena*, *Hordeum*, *Secale*, *Triticum*, x*Triticale* and *Zea*), and the TOP 30 genera (major food crops and forages) add up to 85% of all accessions. The other German genebanks have a clear focus on major food or cash crops, e.g. fruit, grapevine, tobacco, hop and ornamentals. Minor crops and CWR are represented in the *ex situ* collections by much less accessions per species; so for instance for 540 CWR species, which are endangered according to Red List criteria, there are on average less than two accessions per species held in German genebanks.

3.4 Storage facilities

In Germany, the storage facilities for the conservation of plant genetic resources for food and agriculture are decentralised as described above.

Most accessions of the genebank of IPK at Gatersleben are conserved in long-term storage facilities whose capacity is approximately 150,000 samples. A substantial part of the collection is stored as seeds at temperatures of 0°C or -15°C. Vegetatively propagated material is conserved either by permanent field culture or through in vitro cultures and/or cryo-conservation under liquid nitrogen. Due to the reorganisation of the Federal *ex situ* collection, the size of the cooling cells was expanded as well as the greenhouse and field area. At present, the genebank has around 2,400 m² greenhouse area, additional 170 small "isolation greenhouses" (2,600 m²) and approximately 65 hectares of field area.

The potato collection at the local branch at Gross Luesewitz is maintained in in vitro culture and cryo-preservation. The seeds of the oil and fodder crop collection at Malchow/Isle of Poel are maintained in cold storage chambers, with the active collection at -5°C and the base collection at -20°C.

The collections of the BAZ for fruit and grapevine are mainly maintained as field collections. For *Malus* and *Fragaria*, methods for cryo-conservation under liquid nitrogen are under development.

3.4.1 Security of stored material

The objective of safety-duplication of the accessions is a matter of concern for each genebank. Quality standards (guidelines) for safe germplasm movement ensure the security of stored material, which includes holding a base and an available active sample of the accession as well as storing samples as safety-duplicates at partner genebanks. Running only a part of the collection as an active collection enables the genebank not only to increase the safety of stored material but also to reduce the workload and the regeneration costs significantly.

In addition, a different approach of increasing the safety of stored material is under development by a European Genebank Integrated System (AEGIS) under the European Cooperative Programme for Plant Genetic Resources (ECPGR). The overall goal of AEGIS is to ensure conservation and continuing use of existing crop genetic diversity in Europe.

Another initiative to provide for the security of stored material will be the establishment of the Arctic Global Seed Vault in Svalbard (Norway) as an international safety storage facility under permafrost conditions.

3.5 Documentation and characterisation

In general, passport, characterisation, evaluation and management data are well documented for most of the genebank samples, according to international standards like the Multi-Crop Passport Descriptors (MCPD), which were jointly developed by Bioversity International (formerly IPGRI) and FAO and published in December 2001.

Characterisation and primary evaluation are mostly carried out by the genebanks in the course of introduction and regeneration. In particular, the secondary evaluation activities are carried out by a large number of Federal and Laender research institutions as well as universities and private breeders.

a) Information and Coordination Centre for Biological Diversity (IBV), Bonn

The IBV, established in 1991 in Bonn at the Centre for Agricultural Documentation and Information (ZADI) and transferred in 2005 to the Federal Agency for Agriculture and Food (BLE), has been dealing since its establishment, *inter alia*, with the development of documentation systems for plant genetic resources in Germany.

For the central documentation of all *ex situ* collections in genebanks and other important collections as well as *in situ* stands of Germany, IBV is running the National Inventory of Plant Genetic Resources (PGRDEU). It contains passport data of approx. 155,000 accessions of the Federal *ex situ* Genebank at the IPK, the Federal Centre for Breeding Research on Cultivated Plants (BAZ) and other specialised collections for plant genetic resources for food and agriculture. PGRDEU provides, *inter alia*, the National interface for the European Plant Genetic Resources Information Infrastructure (EPGRIS) with its European Search Catalogue (EURISCO), for the FAO World Information and Early Warning System (WIEWS) and reporting requirements related to the International Treaty on Plant Genetic Resources for Food and Agriculture (Treaty).

Besides local information systems at numerous research institutions containing freely accessible evaluation data on plant genetic resources across Germany, existing and newly added evaluation data from genebanks and other collections are, in cooperation with private breeders, systematically collected and processed by the BAZ and then presented to users in an on-line system (EVA). So far, EVA comprises valuable evaluation data for barley, potato and some fruit crops. A further development of EVA towards a National Information System on Characterisation and Evaluation Data including, amongst others, structural refinement and data update are planned by BAZ in consultation with the major stakeholders in Germany.

In order to integrate the information of relevant data - of different databases - on genetic resources for cultivated and wild flora in Germany, the Federal Information System Genetic Resources (BIG) was developed in 1998 by four partner institutions with extensive databases on wild and cultivated plants (IBV, IPK, the Federal Agency for Nature Conservation (BfN), the Department of Special Botany and the Botanical Garden of the Ruhr University Bochum on behalf of the Association of Botanical Gardens) in Germany. The information system allows easy and central access to distributed information.

The Inventory of Biological Research Collections in Germany (ZEFOD) provides *inter alia* a comprehensive overview about botanical gardens and herbaria in Germany. It includes information on the respective institutions and summarised information on their living and herbaria as well as other voucher collections.

b) Genebank at the Leibniz Institute of Plant Genetics and Crop Plant Research (IPK), Gatersleben

As part of the above mentioned fusion project of the genebank collections of IPK and BAZ (from 2002 - 2006; see chapter 3.1), a new Information System (GBIS) was developed covering the IPK genebank collection. GBIS centralises the genebanks' data management, supports the daily workflow of the genebank staff and allows extracting relevant information about genebank material as well as to order seed samples from IPK via a shopping-basket interface.

c) Botanical Gardens

Collections in botanical gardens are increasingly documented through computerised online information systems, replacing the traditional print versions of seed catalogues (*Indices seminum*) which are published on a regular basis and exchanged between institutes. For example, the Botanical Garden and Botanical Museum Berlin-Dahlem is running a Garden Accessions Database. More than 40 botanical gardens in Germany are documented through the Botanical Garden Information System (SysTax) comprising more than 190,000 accessions from more than 50,000 taxa. SysTax is operated by the University of Ulm on behalf of the Association of German Botanical Gardens.

3.6 Germplasm movement

Over the last 52 years, the IPK genebank, including its branches, has provided for different users a total of more than 710,000 samples. In 2006, more than 13,000 samples were distributed, 50% thereof were requested by research institutes, 25% by non-governmental organisa-

tion or private individuals, 12% by research institutes of IPK and 8% by plant breeders. Between 1985 and 2003, the number of germplasm requested at the BAZ genebank summed up to approximately 140,000. Within the last ten years, the BAZ grapevine genebank at Siebeldingen has distributed over 2,350 samples, whereof 40% and 34% have been ordered by public institutes from foreign countries and Germany respectively, and 25% by NGOs and private individuals from Germany as well as from abroad. Between 2003 and 2006, the BAZ Fruit Genebank in Dresden-Pillnitz has provided for different users a total of 2,226 samples, over 50% of which have been requested by research institutes of BAZ, 30% by external research institutes and almost 20% by NGOs or private individuals (see chapter 4.3, Table 4.1).

There are no comparable data for botanical gardens.

3.7 Roles of botanical gardens

Collection, storage, reproduction, description and documentation of agricultural and horticultural crops is also performed in botanical gardens. Germany has some 95 botanical gardens, some of which have a long tradition. Together, they conserve approximately 300,000 plant specimens belonging to more than 50,000 taxa. Along with indigenous species, botanical gardens also conserve many exotic plants and play a part in naturalising and re-introducing endangered species. In general, work in botanical gardens focuses on global species diversity, while the genebanks give priority to intraspecific variability of crop species. Most botanical gardens are part of universities. They play a major role in teaching, research - that is in particular taxonomic research - and training.

Recently, the conservation approach to biological diversity becomes increasingly an issue of some botanical gardens.

3.8 Assessment of major *ex situ* needs

Although important achievements have been made in the past regarding the quality of *ex situ* conservation and the extent of conservation capacities, further efforts are needed:

One important issue is the ongoing effort in enhancing the efficiency of *ex situ* conservation. For seed collections (genebanks), this means primarily the further elimination of duplicates. This work needs to be supported by the use of molecular marker techniques and based upon available data. Especially for crops that are propagated vegetatively, the further development and implementation of up-to-date conservation techniques (e.g. cryo-preservation) should be pursued.

Relevant collections of species held in living collections should be concentrated in a minimum of 5 Botanical Gardens to ensure that the material will be safe in case of calamities. There are still many species kept as a single individual or a very low number of individuals in only one single botanical garden. While recent accessions are generally very well documented, this does not apply for old accessions. A serious problem is due to the fact that most botanical gardens are run by institutions which are not obliged to get involved with conservation. The national bodies responsible for conservation are not in the position to give instructions to botanical gardens. In many botanical gardens, this may be a serious risk or even obstacle to a continuous work in this field.

Another main contribution to the advancement of *ex situ* conservation can be accomplished by improving the conservation of underrepresented species (minor crops, ornamentals and CWR), *inter alia* by the establishment and enlargement of conservation networks based on existing capacities, e.g. in Federal and Laender institutes and botanical gardens, as well as by involving the non-governmental and private sector.

Major efforts are needed to increase evaluation activities with regard to plant genetic resources for food and agriculture, and to improve the collection, processing and availability of relevant data in order to broaden the utilisation of material stored in *ex situ* collections and managed *in situ*. In this regard, the focus should also be on the sharing of responsibilities and cooperation at national, European and international level. In Germany, this will be addressed by participation in the European project “A European Genebank Integrated System” (AEGIS). In addition, cooperation at a worldwide level should be a core element in promoting a rational *ex situ* conservation based upon global conservation strategies developed in particular by the GCDT and the Governing Body of the Treaty.

In this respect, the establishment of the Arctic Global Seed Vault in Svalbard (Norway) for safety duplications as "black-box"-capacity has to be seen as an important supporting component in a future global integrated conservation system.

4 The State of Use

Plant genetic resources are an important factor of agricultural production systems. In Germany, as a rule, plant breeding and seed marketing of the main agricultural crops are well-organised activities of a specialised sector of the agricultural economy, and comprise mainly modern cultivars. With the exception of fruit and some vegetables, there are hardly any old varieties used in commercial production.

4.1 The importance of utilisation

Germany is the world's fifth leading export country for seed as propagating material. Worldwide, nowhere else are so many breeding activities carried out independently by private plant breeding companies. There are about 100, mostly medium-sized, private companies active in breeding, 50 of which run independent plant breeding programmes for agricultural crops that are highly dependent on plant genetic resources as raw material for their breeding activities. Major breeding programmes exist for cereals, especially for maize, wheat, barley, rye and triticale. Furthermore, there are breeding programmes for sugar beet, potato, canola and some fodder crops like ryegrass. The production of seeds as propagating material is done in two ways: either on the own premises of breeding companies or through licensing of specialised farms and firms.

Another 30 companies are specialised in plant breeding for horticultural crops with the emphasis on vegetables and ornamentals. Small stations at diverse locations under diverse climatic and soil conditions allow for a quick response to regional agricultural demands. The competition is complemented by cooperation, as many plant breeders share a marketing cooperative. Presently, 51 breeding companies and researchers of various institutions are organised in the Association for the Promotion of Private Plant Breeding in Germany (GFP), which also promotes and funds research projects in plant breeding (see chapter 4.2).

4.2 Utilisation activities and deployment of genetic diversity

The German agricultural sector sees its future role both in providing healthy and safe food of high quality and in producing biomass for technical and energetic purposes, thus combining economic and ecological factors. Plant breeding and breeding research plays a key role and genetic diversity is the most important and valuable natural resource for these processes.

Germany has a well-developed public and private plant breeding sector (see chapter 4.1). Moreover, basic research is carried out at universities and government institutions, partly sponsored by private plant breeders.

a) Association for the Promotion of Private Plant Breeding in Germany (GFP)

The GFP was founded by breeders in 1965 and carries out and promotes basic research to assist in practical breeding work (e.g. at universities and public research institutes) and in the introduction of new biotechnology. It comprises 50 small and medium-sized plant breeding companies throughout Germany, which operate mostly independent breeding programmes on cultivated crops for agriculture and horticulture. The GFP provides for discussion on and active support of joint research activities. It is a nonprofit organisation whose funds are used exclusively for research purposes. The GFP's goal is to tackle the problems linked with the genetic improvement of industrial and food crops and to cooperate in finding suitable solutions. It coordinates and supports research projects at university and non-university research institutes. The GFP is also involved in the distribution of research findings, their integration into breeding practice and the development of recommendations for future research activities. The Association raises targeted public funds, which are used in conjunction with private funds made available by its member companies, to work on research topics in plant breeding. Its key research objectives include:

- resistances (fungus, viruses, bacteria, animal pathogens, abiotic stress and adaptation to climate change)
- yield improvement (nutrient efficiency and security)
- quality assurance and enhancement
- development of new crops with diverse potential uses (e.g. renewable resources, energy)

The GFP is structured into crop-specific sections whose work focuses on key cultivated crops: beets, fodder plants, vegetables, medicinal and spice plants, cereals, potatoes, maize, oil and protein crops. Superordinate and multi-crop issues are handled by the general breeding issues department. These are supported by the GFP Genebank Commission.

b) Association for Biodynamic Plant Breeding (ABDP)

The ABDP is an association of plant breeders who breed cultivated plant varieties for the organic sector, working with a biodynamic background. Goals are to breed varieties suited for organic growing conditions, and which are (a) appropriate for human nutritional needs and (b) adapted to local conditions, thereby enhancing regional diversity. Breeding activities focus on vegetables (e.g. bean, carrot, cabbages, chicory, cucumber, pepper, leek, radish, red beet, salad, tomato) and cereals (e.g. barley, maize, oats, rye and wheat).

c) National Evaluation Programme for Plant Genetic Resources (EVA II)

While passport data of genebank accessions provide primary information about their properties, breeders and researchers are highly interested in more detailed characterisation and evaluation data of the germplasm. Within a public-private-partnership for evaluation of plant genetic resources, a cooperation network consisting of the respective administrative bodies, research institutes (public sector) and plant breeding companies (private sector) coordinated by the Institute of Epidemiology and Resistance Resources of BAZ implemented in 2001 the National Evaluation Programme for Plant Genetic Resources of Cereals (EVA II). For this purpose, genebank material, national and foreign varieties and current breeding strains of barley and wheat (summer and winter forms) are evaluated by means of standardised evaluation methods for the resistance to major pathogenic fungi and viruses at different locations (breeding stations of the network partners) throughout Germany. The results are compiled and internally distributed by an intranet information system of its partners which is linked to the Information System Evaluation Data of Plant Genetic

Resources (EVA; see chapter 3.5). The exclusive usage of these data is terminated after three years and the data are freely accessible and available for the wider public.

d) Federal Centre for Breeding Research on Cultivated Plants (BAZ)

The BAZ is a public research institution under the aegis of the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV). Aiming to improve its efficiency, enhance its research capacity and use modern and up-to-date technologies in plant breeding research, the BAZ headquarters were relocated to a new research campus in Quedlinburg (Sachsen-Anhalt). This new location provides an outstanding environment that offers scientists optimal conditions for research and an adequate forum for the communication of achievements. In addition, the BAZ has three further locations throughout Germany. The BAZ contributes to a programme of sustainable agricultural production of high quality food and ecological compatibility. The activities of the BAZ are primarily concerned with breeding research conducted across the entire spectrum of cultivated plants, except forest trees. Its mission comprises research in the breeding of healthy, high-quality plants for food and non-food applications (a) to provide advice to the policies of the BMELV and (b) to disseminate scientific knowledge and promote the public understanding in important areas of agricultural and life sciences. Furthermore, the development and provision of breeding methods and the implementation of basic research achievements into practice are a main part of its mission. The latter includes also the characterisation and evaluation of plant genetic resources as well as pre-breeding activities.

The BAZ Institute of Fruit Breeding in Dresden-Pillnitz is breeding new cultivars of apple, cherry including rootstocks, strawberry and raspberry using methods of biotechnology and genetic engineering, molecular biology (markers), cytogenetics and quality analysis. The main focus in fruit breeding is on high product quality, improved resistance to pathogens and high tolerance to abiotic stress. To attain these aims, the genetic resources of the Fruit Genebank (see chapter 3.1 a), amongst others, are extensively used. The use of genetic resources requires their evaluation and characterisation, which is undertaken exceedingly. A specific topic is the search for new resistance genes, and great efforts are made to identify and characterise new resistance donors from the Fruit Genebank.

The Institute of Grapevine Breeding Geilweilerhof of BAZ in Siebeldingen is aiming at breeding grapevines with high resistance to pests, diseases and climatic stress factors as well as with an eminent wine quality, and at developing further breeding research on grapevine, using, amongst others, resources from the collection of its Grapevine Genebank (see chapter 3.1 b). For this purpose, much effort is directed at the characterisation and evaluation of these grapevine genetic resources and at the constant enlargement of the collection.

The Institute of Agricultural Crops of BAZ is charged with characterising and unlocking plant genetic resources for food, feed and agriculture by the use of the current repertoire of approaches in plant breeding research. This work, which can be referred to as Genetic Enhancement, is directed at broadening the genetic diversity of selected crops with regard to plant health, quality aspects and renewable resources. The spectrum of agricultural crops considered is a function of long-term requirements of breeding research in Germany. It currently comprises potato, rye, barley, triticale, oat, ryegrass, narrow-leafed lupine and oilseed rape as well as other Brassicaceae. The Institute of Abiotic Stress Tolerance has the task to investigate and characterise the influence of abiotic stress factors on the performance of crop plants, taking into consideration different genetic resources. Both institutes are located in Gross Luesewitz, while the following BAZ institutes and a coordination centre for plant genetic resources are situated in the new building in Quedlinburg.

The BAZ Institute for Horticultural Crops carries out breeding research aimed at providing the conditions for an economically efficient plant breeding and an ecologically balanced horticulture. At present, the main focus regarding vegetable is on the groups of vegetable cabbage (Brassica) and related species (Raphanus) as well as carrot (Daucus), regarding medicinal and aromatic plants on caraway (*Carum carvi*), fennel (*Foeniculum vulgare*), thyme (*Thymus vulgaris*) and summer savory (*Satureja hortensis*), and regarding ornamental plants on the genera Pelargonium, Hydrangea, *Erica* and *Rhododendron simsii*. The Institute of Plant Analysis is engaged in the whole spectrum of quality research in fruit and vegetable crops as well as medicinal and aromatic plants. It is screening wild plant material and genebank accessions for

the industrial use of agricultural products and supports the breeding aims of BAZ by sensorial and analytical investigations. Research of the Institute of Resistance Research and Pathogen Diagnostics and the Institute of Epidemiology and Resistance Resources aims at improving the resistance of crop plants by analysing the virulence of pathogens of agronomic importance (fungi, viruses, bacteria, insects) and evaluating plant genetic resources of important crop species (wheat, barley, canola, apple etc.) for resistance. Based on results of genetic analyses of resistance, strategies for an efficient use of qualitative and quantitative resistances including molecular techniques are developed in order to broaden the genetic base of resistances and create durable resistances. Results of these studies are the basis for a long-term improvement of the resistance level of plants of agricultural or horticultural importance respectively. Additionally, plant breeding companies in Germany benefit from these results which are broadening the genetic base for resistance breeding.

More general aspects of plant genetic resources are addressed by the BAZ Research and Coordination Centre for Plant Genetic Resources (RCCPGR), which supports the shaping of the development of national strategies, programmes and plans for conservation and sustainable use of plant genetic resources as well as of the joint development of the European and international cooperation in this field. Research of the RCCPGR is focused on the development of information systems and the development of plant genetic resources management strategies that complement *ex situ* conservation. The group has specific expertise in oat (*Avena*) and beet (*Beta*) genetic resources. Currently, there is a National Information System on Characterisation and Evaluation Data of Plant Genetic Resources under development (see chapter 3.5 a).

e) German Plant Genome Research Programme

The German Plant Genome Research Programme (GABI - Genome Analysis of the Plant Biological System) supported by the Federal Ministry of Education and Research (BMBF) and private enterprises refers to the analysis of plant genomes, which comprises physical mapping of the genome, genome sequencing and annotation (prediction and identification of genes), and the elucidation of the (biochemical) functions of the identified genes and gene products and their roles in determining the characteristics of major crop plants and model organisms. Plant genomics in general aim at providing a detailed and comprehensive knowledge of the fundamental molecular processes of plant life. They provide the basis for the development of useful tools for the protection of biodiversity. Furthermore, plant genomics aim at understanding and improving the rational use of existing genetic diversity. Focussing mainly on the genetic diversity of crop plants, they also influence the comprehensive understanding of the genetic diversity in nature in general. The tremendous work load of plant genomic research explains the growing need for international cooperation. Therefore, GABI supports networking with many other national plant genomic research programmes in Europe and beyond.

f) Universities and other public research institutes

University institutes for plant breeding and related matters are to be found at the universities of Bonn, Gießen, Göttingen, Halle-Wittenberg, Kiel, München (Weihenstephan), Stuttgart-Hohenheim and Kassel, the latter focussing on agrobiodiversity. Some universities of applied science hold institutes of agriculture and offer education and training in plant breeding and biodiversity-related fields (e.g. in Nürtingen-Geislingen, Osnabrück, Westfalen/Soest, Wiesbaden/Geisenheim etc). Depending on the specific focus of each institute, activities like the characterisation, evaluation, pre-breeding and genetic enhancement take place in the framework of numerous research projects, mainly in the form of bachelor, masters and doctoral theses. A comprehensive compilation of these activities does not exist in Germany.

Within the Max-Planck-Society (e.g. Max-Planck-Institute for Plant Breeding Research, Max-Planck-Institute for Molecular Plant Physiology), the Leibniz Association (in particular the Leibniz Institute of Plant Genetics and Crop Plant Research (IPK) and the Leibniz-Centre for Agricultural Landscape Research (ZALF)) as well as in the Helmholtz Association, several institutions are engaged in plant breeding and biodiversity-related research.

A specific forum for scientific breeding is the German Society for Plant Breeding (GPZ; see chapter 5.1 e) with its working groups on genetic resources, biometrics, biotechnology, breeding theory, cytology, genomics and resistance breeding of various crops (e.g. cereals, maize, potatoes, beet, oil and fodder plants, vegetables and ornamentals).

4.2.1 Seed supply systems and the role of markets

In Germany, the seed supply system is highly organised and controlled. It covers all areas and can be described as very satisfactory for almost all crops. Plant breeders provide the agricultural and horticultural sectors with modern varieties and the possibilities to benefit from genetic gain (high level of output, good resistance to diseases and animal pathogens, clear tolerances regarding stress) by supplying certified seed, guaranteed and controlled quality (inner and outer form, identity of varieties) as well as increased efficiency. Therefore, most of the agricultural enterprises purchase seed and plant material, at least periodically. Nevertheless, during the last few years, the importance of farm saved seed and propagating plant material has increased, particularly with regard to self-pollinated crops.

The breeders themselves or German or foreign firms specialised in this field take the first steps to propagate one variety (pre-basic and basic seed). For most of the cultivars, the last step of propagation (certified seed) is undertaken by farm-orientated companies or farmers under the control of one of the authorities for seed certification organised by the various Laender. The seed and propagating plant material is distributed in a decentralised way via agricultural trade and cooperatives.

The German Seed Act provides the legal framework for the National Lists of registered varieties. It serves to protect the consumer and ensures the provision of high-quality seed and planting stock material of resistant and high performance varieties for farmers and horticulturists. Registration in the National and/or European List is a prerequisite of commercialisation of agricultural species and vegetables (see chapter 5.3 a). The Plant Variety Rights Office (BSA) in Hannover is responsible for both entering new plant varieties as well as seed and planting stock into the National List. New varieties are registered and protected after successfully passing three years of official testing for agronomic value, homogeneity, stability and novelty.

A legal basis for the trade of seeds of landraces, which are not yet listed in the National or European Lists, is under preparation.

4.3 Utilisation of conserved plant genetic resources and major constraints to their use

Within the last year, approx. 13,300 samples of the Federal *ex situ* genebank at IPK and 782 samples of the genebanks of BAZ have been distributed to research institutes, plant breeders, private users and others (Table 4.1).

Tab. 4.1
Use of the main *ex situ* genebanks

Genebank at the Leibniz Institute of Plant Genetics and Crop Plant Research (IPK), Gatersleben	
Samples provided 2006	13,300
Of these belonging to crop groups [%]:	
Cereals	40
Vegetables	31
Potato	11
Medical and aromatic plants	8
Oil crops	4
Legumes	4
Forages	2
Type of users [%]	
Research (inc. IPK-Institutes)	62
Non-governmental organisations / private individuals	25
Breeding	8
Other	5

Fruit Genebank at the Institute of Fruit Breeding of the BAZ, Dresden-Pillnitz	
Samples provided 2006	455
Type of users [%]	
Research (incl. BAZ-Institutes)	85
Non-governmental organisations / private individuals	15

Grapevine Genebank at the Institute of Grapevine Breeding Geilweilerhof of the BAZ, Siebeldingen	
Samples provided 2006	327
Type of users [%]	
Domestic public institutions	67
Foreign private individuals	19
Foreign public institutions	14

The newly developed information system of the Federal *ex situ* collection (GBIS; see chapter 3.5) is a freely accessible internet search portal and order system for external users of the genebank material. It allows access to the genebank material in Gatersleben and its outposts and stimulates their usage. Furthermore, the utilisation of conserved plant genetic resources for food and agriculture is strongly supported by National information and documentation systems like the National Inventory of Plant Genetic Resources (PGRDEU; see chapter 3.5 and 5.1.1), which covers all *ex situ* collections of German genebanks.

4.4 Assessment of needs to improve utilisation

- Raising public knowledge on plant genetic resources and understanding (historical use, traditional use like herbs as medicine) and awareness of their importance in order to increase their use
- Further development of public-private-partnerships for the evaluation of plant genetic resources
- Further development of a National Information System for the documentation of characterisation and evaluation data
- Implementation and further development of legal instruments to improve the seed trade of plant genetic resources and the commercialisation of products made of them
- Promotion of plant genetics and breeding research to cope with the expected increasing demand for genetic solutions of problems in agriculture arising from climate change

5 The State of National Programmes, Training and Legislation

The Federal Ministry of Food, Agriculture and Consumer Protection (BMELV) drew up its first draft programme for plant genetic resources in 1990. Changed conditions brought about by reunification and developments in international law made it necessary to update this plan. The update took place in 1998 as part of the overall Plan for Genetic Resources for Food, Agriculture and Forestry. This plan provides the basis for work programmes for each sector of genetic resources for food and agriculture (agricultural and horticultural crops, woody plants, farm animals and aquatic organisms).

5.1 National Programme for Plant Genetic Resources

Under the leadership of the BMELV, a working group of representatives from the Federal and Laender governments, relevant research institutes, the private sector and NGOs started in 2000 to develop the National Programme on Plant Genetic Resources of Agricultural and Horticultural Crops. It is based upon the structure of the FAO Global Plan of Action (1996) and its four main areas (1) *in situ* conservation and development, (2) *ex situ* conservation, (3) utilisation and (4) capacity building. The programme was formally adopted by the Conference of Agricultural Ministers in 2002.

The National Programme on Plant Genetic Resources of Agricultural and Horticultural Crops has the following objectives:

- To achieve long-term conservation of the diversity of wild and cultivated plant genetic resources *in situ* and *ex situ* in a scientifically well-founded and cost-effective way.
- To make the diversity of plant genetic resources utilisable by appropriate measures, e.g. by characterising, evaluating, documenting and tapping the breeding potential.
- To make sustainable economic use of a greater variety of agricultural and horticultural crop species and varieties (including ornamental plants).

- To contribute to the preservation and restoration of ecosystems characterised by agriculture and horticulture, including fruit cultivation and grassland ecosystems.
- To achieve more transparency concerning the distribution of competencies, responsibilities and activities of Federal, regional and local governments, and among individuals, organisations and institutions involved in the conservation and use of plant genetic resources.
- To use and promote synergies that may result from increased cooperation at national, supranational, European Community and international level.

Given the complexity of the current situation, an integrative approach is chosen on the basis of *in situ* conservation, on-farm management and *ex situ* conservation. This includes:

- surveying and inventorying plant genetic resources
- promoting *in situ* conservation of related wild species of crops and of wild plants suited to use as food
- promoting on-farm management of agricultural and horticultural crops
- developing monitoring and management concepts
- collection and *ex situ* conservation of agricultural and horticultural crops, including valuable special collections, mainly of fruit, grapevine and ornamental plants

The programme will be reviewed and updated on an ad hoc-basis by means of a participative process that includes all stakeholders. Improving the flow of information and communication between stakeholders is the key to ensuring the transparency, coherence and efficiency of the programme. Because of the high number of institutions involved, the National Programme is increasingly recognised and supported by the relevant stakeholders.

The National Programme will be implemented through the combined efforts and individual contributions of the Federal Government, the Laender governments and the various public and private institutions, bodies and other stakeholders. In fulfilling its responsibilities for the implementation of the programme as designated by the Federal Government, the BMELV is assisted by the Advisory and Co-ordinating Committee for Agricultural and Horticultural Crops (BEKO). The BEKO consists of 18 representatives of the Federal and Laender governments as well as research institutions, breeders and non-governmental organisations. The work of the BEKO is supported by thematic working groups - one for *in situ* and on-farm conservation, and one for the *ex situ* conservation, including the coordination of the national participation in the European Cooperative Programme for Plant Genetic Resources (ECPGR) - and by a Secretariat located at the Information and Coordination Centre for Biological Diversity (IBV) of the Federal Agency for Agriculture and Food (BLE). Where appropriate, the Laender support the National Programme by establishing specific regional programmes or by integrating specific measures into other programmes.

Coordination and representation in international fora rests with BMELV. Additionally, BMELV has established in 2005 a programme for model and demonstration projects for the conservation, sustainable use and innovative approaches to the utilisation of agrobiodiversity, and is providing financial means by an annual budget specifically dedicated to conducting surveys and inventories in the area of biodiversity. Furthermore, there are special programmes in place to promote research, development and demonstration projects on renewable resources (Agency of Renewable Resources, FNR) and organic farming, as well as a new programme (2006) on innovations in agriculture, which supports *inter alia* the sustainable use of plant genetic resources in plant breeding or crop production.

At an administrative and technical level, the coordination and cooperation activities of BMELV are supported by IBV. IBV is *inter alia* responsible for supporting the development and monitoring of the enforcement of the National Programme on behalf of BMELV.

A central task of IBV is the support of the development and execution of programmes for genetic resources for food, agriculture, forestry and fisheries. The IBV is the central information facility networking to support efforts made by science and research, the private sector, administration and the public sector, taking advantage of synergies and increasing the efficiency of measures in the field of agrobiodiversity. IBV gives technical advice on supportive measures of BMELV and the EU as well as on collaboration opportunities.

5.1.1 Information systems

One of the most important supporting components of the National Programme on Plant Genetic Resources of Agricultural and Horticultural Crops is the central documentation and provision of comprehensive information on plant genetic resources held *ex situ* and *in situ* / on-farm by the National Inventory (PGRDEU). PGRDEU is supported by different other specialised information systems as described in detail in chapter 3.5 of this report.

In addition to the above mentioned information systems for scientific data, IBV is running the Information System Genetic Resources (GENRES), which provides an overview of relevant documents, facts, projects and other measures for the conservation and sustainable utilisation of genetic resources for food and agriculture in Germany as well as at European and international level. GENRES includes *inter alia* the serial "Schriftenreihe Genetische Ressourcen", in 2006 renamed as "Agrobiodiversität" and published by IBV.

Furthermore, GENRES supports the implementation of the BMELV plan for the conservation and sustainable utilisation of genetic resources for food and agriculture as well as the execution of the National Programmes for Plant, Animal, Forest and Aquatic Genetic Resources. On this basis, GENRES is moving into the direction of a monitoring instrument for these programmes.

5.1.2 Networks

The implementation of the National Programme on Plant Genetic Resources of Agricultural and Horticultural Crops is supported by different networks:

a) Federal-Laender-Coordination

Given the existing division of responsibilities and coordination requirements, the joint Federal-Laender-Committees play an important role in activities related to plant genetic resources for food and agriculture. This is especially the case with committees whose work concerns crop production, horticulture, grapevine production, rural development, research planning and coordination, and joint missions like GAK (Improvement of Agricultural Structure and Coastal Protection) issues. Therefore, representatives of the Laender participate also in the BEKO.

The Federal-Laender-Committees are permanent fora for the discussion of all relevant questions which are of common interest to the Federal and Laender governments, including conservation of plant genetic resources for food and agriculture. They submit recommendations to the Federal and Laender governments.

b) Association for the Promotion of Private Plant Breeding in Germany

The Association for the Promotion of Private Plant Breeding (GFP; see chapter 4.2) coordinates and supports research projects at university and non-university research institutes. Furthermore, the GFP is involved in the dissemination of research findings, their integration into breeding practice and the development of recommendations for future research activities. It participates also in the BEKO.

c) Association of Botanical Gardens

The Association of Botanical Gardens comprises both botanical gardens as institutional members and their leading research and horticultural staff as private members. The Association's goals and objectives are described as follows:

- The Association promotes specialist interests, cooperation and exchange of experience between botanical gardens and similar institutes and their staff on issues concerning collection, cultivation and conservation, teaching and research, and training in horticulture and botany. It holds seminars and specialist conferences.
- The Association aims at ensuring that botanical gardens receive adequate funding and staff. It advises its members and competent authorities, bodies and associations, and prepares or makes available expert reports concerning issues of general importance.
- The Association is committed to the conservation of biodiversity and contributes to the conservation of endangered plants. To this end, it cooperates closely with the respective regional, national and international authorities and associations, and actively supports them in the fulfilment of their species protection efforts.
- The Association supports educational work performed by botanical gardens. It aids the dissemination of knowledge on the plant world and aims at awaking and promoting public awareness of plant protection and conservation needs.

In the course of its work, the Association has provided the Federal Information System Genetic Resources (BIG) with a significant volume of data. This has involved creating significant sections of the taxonomic reference system. It currently holds some 140,000 accessions and its collection is growing steadily. The Association will not be in a position to make the collections of all botanical gardens accessible online in the foreseeable future, the primary cause for that being that many botanical gardens do not have sufficient technical and staff resources to cope with collection management. Botanical gardens work towards establishing simplified and CBD-compliant rules for material acceptance and release and play a leading role in creating cross-institutional rules for these activities in Europe. A representative of the association is member to the BEKO.

d) Association for the Conservation, Regeneration and Use of Cultivated Crops (KERN)

Founded in 2000, KERN acts as the NGO focal point for plant genetic resources in implementing the Convention on Biodiversity, the Treaty and the Global Plan of Action for the Conservation and Sustainable Utilisation of Plant Genetic Resources for Food and Agriculture. KERN is an umbrella organisation of different NGOs which develop and implement ideas, plans, projects and working methods for successful on-farm management of plant genetic resources in Germany. Its member organisations focus on the following areas of activity:

- identifying and inventorying the diversity of cultivated crops
- promoting on-farm management of agricultural and horticultural crops
- using cultivated crop diversity for the diversification of agricultural and horticultural production
- strengthening public relations and education with regard to conservation and use of plant genetic resources

A representative of KERN takes part in the BEKO.

e) German Society for Plant Breeding

In 1991, the Society for Plant Breeding (GPZ) was founded as the scientific forum for plant breeding in Germany. Its members comprise scientists and plant breeders from scientific and applied research institutions, public agencies and private breeding enterprises. The GPZ holds a scientific congress every two years, and there are numerous meetings of its 20 working groups (including one on genetic resources) on a regular basis each year. These meetings serve for specific discussions and the demonstration of the state of the scientific work, e.g. in biometrics, biotechnology, breeding theory, cytology, genomics and resistance breeding. For the promotion of young scientists the GPZ is awarding the Kurt-von-Rümker-Award; GPZ is organising seminars for technicians and common events with other related associations. Results of meetings, seminars and congresses are documented by the serial "Vorträge für Pflanzenzüchtung".

5.2 Education and training

Long-term protection and sustainable use of plant genetic resources require that society develops a basic understanding of the relationships between plant genetic resources for food and agriculture and the availability of well-trained specialists with a broad knowledge base in research, agriculture and breeding to drive the integration of plant genetic resources into existing land use systems. A complete overview of the various training and study courses dealing with these topics cannot be given. The following examples give an insight into the variety of authorities, institutions and organisations involved in this area.

The aspects of botany, agro-botany, breeding, seed production, seed quarantine, hygiene, phytosanitary, environmental management and molecular studies are taught at several universities and universities of applied science throughout Germany, as mentioned in chapter 4.2 f. In addition to the plant breeding institute at the Stuttgart-Hohenheim university, there is the "F. W. Schnell Endowed Chair for Crop Diversity and Breeding Informatics" at Hohenheim, which is co-funded by the KWS Saat AG and the university.

Some universities of applied science hold institutes of agriculture and offer education and training in plant breeding and biodiversity-related fields (e.g. in Nürtingen-Geislingen, Osnabrück, Westfalen/Soest, Wiesbaden/Geisenheim etc).

In collaboration with universities, governmental research institutions such as the Federal Centre for Breeding Research on Cultivated Plants (BAZ) and the Leibniz Institute of Plant Genetic and Crop Plant Research (IPK) take part in the generation of human resources at the academic level.

In recent years, there has been a marked decline in the number of students studying agricultural sciences. There is currently a lack of trained staff in plant genetic resources and agricultural science who specialises in plant and seed research, plant breeding, taxonomy, systematics, and agrobiodiversity and bio-informatics. At almost all agricultural and horticultural faculties in Germany, restructuring is either ongoing or already completed, involving the following activities:

- Alignment of academic qualifications to the more international Bachelor/Master of Science degrees.
- Integration of agricultural sciences into other areas due to the downturn of student numbers (e.g. life sciences in Weihenstephan).
- Specialisation of individual study locations with strong breeding-related focus (e.g. Hohenheim), e.g. modules for specialisation in breeding methods or biotechnology and genetic engineering.

Especially in botanical gardens, the conservation of plant genetic resources requires additional qualifications that are rarely called for in standard horticultural training or the individual sectors of the gardening profession. Training for custodians of live collections in botanical gardens is largely based on 19th century principles of taxonomy that do not allow a suitable response to modern-day requirements. By way of contrast, "contemporary botany" (largely molecular biotechnology) provides specialists who have no experience regarding whole organisms and are for the most part unable to perform even elementary identification work.

Therefore, further action is needed to develop special education and training courses for subjects such as taxonomy, systematics, agrobotany, agrobiodiversity, bio- and biodiversity-informatics, and plant genetic resources for upcoming researchers in biology, horticulture and agriculture.

In international cooperation and development, the Federal Ministry of Economic Cooperation and Development (BMZ) provides technical, financial and educational aid including support for capacity building in the field of agrobiodiversity. On behalf of BMZ, Capacity Building International (InWEnt) is engaged in human resources development. InWEnt runs an environment and natural resources programme helping foreign trainees, specialists and junior employees to obtain advanced qualifications in Germany. The German Agency of Technical Cooperation (GTZ) provides support in the area of technical cooperation for sustainable development including activities in the field of agrobiodiversity and plant genetic resources. GTZ also supports the development of training modules on plant genetic resources management (e.g. on Farmers' Rights) in cooperation with international institutions.

The Chambers of Agriculture are providing training and further education within the framework of the professional training of farmers and gardeners in the form of seminars and courses. Several plant breeding companies (e.g. KWS Saat AG) offer trainee positions for plant breeding on an irregular base. Furthermore, trainee positions are offered, on an irregular base, by various actors in the field of conservation of plant genetic resources for food and agriculture (e.g. Stiftung Kaiserstühler Garten, VERN e.V.). In addition, various institutions and scientific societies as well as several NGOs (e.g. Dreschflegel, KERN) provide information and arrange meetings and seminars for the public (consumers) as well as for specialists (farmers), dealing for example with "How to propagate old varieties of vegetable" or "cutting" fruit trees.

5.3 National legislation

Within Germany at the Federal Government level, BMELV is responsible for the conservation and sustainable use of plant genetic resources. This encompasses international cooperation and coordination of activities of the Laender, which are responsible for the implementation of conservation activities, including research, education and training. Because of the close interrelation with other policy areas, some responsibility at the federal level also lies with the Federal Ministry for the Environment (BMU), the Federal Ministry for Education and Research (BMBF), the Federal Ministry for Economic Cooperation and Development (BMZ) and the Federal Ministry of Justice (BMJ).

Federal responsibility for the conservation and use of genetic resources arises where the Federal Government makes use of its powers to issue competing legislation to promote agricultural and forestry production, control trade in seed and plants, and ensure food security. The Federal Government is also responsible for external relations to countries where EU programmes exist, and the Federal Republic of

Germany participates in international programmes and agreements. The resulting national representation and, additionally, the constitutional responsibility to provide equitable living conditions in all regions of the country make coordination a federal responsibility. Responsibilities also arise from joint funding by the Federal and Laender governments of research organisations and projects of national and supra-regional importance under Article 91b of the German Constitution (GG). Whereas nature conservation and landscape management in Germany are regulated by the Federal Nature Conservation Act (BNatSchG; see chapter 2.2), the implementation of related measures is up to the Laender. Additionally, the biotope and species protection programme defines the actions and objectives necessary in respect of Germany's wild flora and fauna and their habitats. The demands made by nature conservation of the environment must be integrated into all types of land use ("Natura 2000" and Habitats Directive; see chapter 2.2).

As a principle, responsibility for the implementation and monitoring of Federal legislation falls to the Laender unless prescribed otherwise by the relevant legislation. At present, neither Federal nor Laender legislation provide a specific legal basis for the conservation of plant genetic resources. Nevertheless, national obligations arising from the International Treaty on Plant Genetic Resources for Food and Agriculture (Treaty) of 2003 as well as the Convention on Biological Diversity of 1993 have to be fulfilled within the existing legal framework.

a) Seed and variety protection legislation

It is the EU seed and variety protection legislation that is relevant, and which also has importance for the conservation and use of plant genetic resources. The marketing of seed is governed by crop-specific seed directives (Directives 2002/54/EC, 66/401/EC, 66/402/EC, 2002/56/EC, 2002/57/EC, 2002/55/EC and 2002/53/EC on the marketing of beet seed, fodder plant seed, cereal seed, seed potatoes, seed of oil and fibre plants, vegetable seed and on a common catalogue of varieties of agricultural plant species). Seed of agricultural plant species may generally only be marketed on a commercial basis as certified seed. Seed certification requires official approval of the plant variety from which the seed was harvested. Varieties are only approved if they are distinct, homogenous and stable, and, in the case of agricultural species, if they are of specific value for cropping and further use. Council

Directive 98/95/EC amending the seed directives provides, among other things, for special rules on the marketing of seeds of genetic resources. At present, the EU is finalising the issuance of appropriate implementing regulations. These seed directives have then to be transposed into German law through an amendment to the Seed Act. Probably in 2008, implementing regulations will be available that legalise the marketing of seeds of plant genetic resources for food and agriculture by introducing special seed categories like conservation varieties or amateur varieties.

At Community level, industrial property rights for plant varieties are granted in accordance with Regulation (EC) No 2100/94 on Community plant variety rights. The regulation applies in parallel with the relevant national variety protection legislation.

b) Promotion of conservation of plant genetic resources for food and agriculture

The European Union (EU) adopted the Council Regulation on "support for rural development by the European Agricultural Fund for Rural Development" (EAFRD) in September 2005. This Regulation sets the general framework for rural development policy in the next funding period 2007 - 2013, reorganises this policy, and improves the political strategy for rural areas at European level. In Germany, the implementation of the EAFRD-Regulation at national and Laender level, which took place in 2006, supports a sustainable rural development through a variety of measures including the conservation of genetic resources in agriculture. The new regulation provides for co-funding of various measures to enhance the environment and countryside (biotope and nature conservation, long-term set-aside of arable land for environmental purposes) and for the promotion of organic farming. Payments (premiums per hectare) can also be made for the cultivation of crop varieties threatened by genetic erosion as well as for specific action supporting the conservation and sustainable use of it. The implementation has to take place by special programmes of the Laender, like the Programme KULAP 2000 in Brandenburg (see chapter 2.4).

5.4 Public awareness

During the last years, public awareness of the loss of biological diversity with regard to cultivated species has grown due to, for example, expanded media coverage. However, there is still a substantial lack of knowledge about the importance of plant genetic resources for food and agriculture. Therefore, public relations efforts have been initiated in order to promote awareness of the value of plant genetic resources for food and agriculture and the aims of the National Programme on Plant Genetic Resources of Agricultural and Horticultural Crops in Germany.

The improvement of public relations work on the conservation and use of plant genetic resources for food and agriculture has been achieved at all levels by different actors (Federal, Laender, communal, industry, associations), e.g. by creating photo exhibitions, slide presentations, informational brochures and other educational material, public gardens and demonstration facilities. Private efforts to raise the awareness of plant genetic resources for food and agriculture from NGOs (e.g. VERN, VEN, Kultursaat, Kartoffelvielfalt, Slow Food), business associations and the private sector are to be included as well. One of the well-established public relations events in Germany is the yearly announcement of the crop plant of the year ("Kulturpflanze des Jahres") by VEN. However, as most of the public relation activities with regard to plant genetic resources lie with NGOs (e.g. days of promoting special crops like apples or potatoes etc.), no comprehensive overview can be given.

Of national importance for different actors interested in matters of plant genetic resources for food and agriculture is the Information System Genetic Resources (GENRES) and related databases like PGRDEU.

To get a picture of current public awareness, a pilot study has been commissioned by BMELV on the need and opportunities for a "communication strategy" for biological diversity and genetic resources for agriculture, forestry, fisheries and food including horticulture. The study revealed that genetic resources and agrobiodiversity are a vague term in the public perception in Germany, which is often being mis- or not understood. Nevertheless, some categories of people defined by their specific lifestyles are aware of the importance and necessity of agrobiodiversity without using the term itself. Still, it is concluded that there is not sufficient awareness of the value of agrobiodiversity and genetic resources for food and agriculture within the German society. According to the study, communication is a key tool to overcome this lack of awareness. Numerous NGOs conduct information and public relations activities on plant genetic resources, but suffer from insufficient financial resources and capacities, whereas economic sectors depending on genetic resources, like plant breeders, do not sufficiently communicate these issues.

Therefore, it is most important to increase public awareness of the value of agrobiodiversity and genetic resources for food and agriculture based on synergies arising from the improved cooperation between competent stakeholders (e.g. NGO, media).

Furthermore, BMELV, BAZ, BMZ, IBV, NGOs and others are routinely involved in raising awareness of the importance of plant genetic resources for food and agriculture conservation through demonstrations and publications directed at the public at large, policy makers and users of plant genetic resources.

5.5 Assessment of major needs for national programme development, training and legislation

Apart from the above mentioned activities, it is essential to strengthen capacities and infrastructure, like centres of competencies, for the coordination of activities at regional level for the implementation of Laender specific programmes and to secure and expand the Information and Coordination Centre for Biological Diversity (IBV) for the longer term as a central coordination agency for genetic resources for food and agriculture at federal level.

Likewise, the capacities of genetic and breeding research as well as capacities for the management of germplasm holdings, data repositories for primary research data, and information systems meeting the needs of science need to be secured and expanded within the research sector of BMELV.

Improved public relations on the conservation and use of plant genetic resources are needed, involving different actors at all levels as mentioned above (see chapter 5.4), e.g. by making increased use of mass media for targeted actions and creating multimedia presenta-

tions. Based upon the pertinent pilot study, BMELV will endeavour to develop a sound communication strategy for agrobiodiversity in general, including plant genetic resources for food and agriculture.

There is also a need to secure and strengthen the information systems for *in situ* / on-farm and *ex situ* information about plant genetic resources for food and agriculture for the longer term and promote the further integration of German information systems into European and international information networks like EURISCO and related to the Treaty.

Finally, existing funding programmes for research, development and model projects on biodiversity at federal and Laender level should be improved giving special consideration to agrobiodiversity and, *inter alia*, the increased use of plant genetic resources.

Regarding training and education at universities, existing curricula should be reviewed. Moreover, a comprehensive programme for trainees in the field of plant genetic resources open for applicants from Germany and other countries should be developed and offered by the public and private sector.

Opportunities should be explored to review or complete the pertinent legal framework with a view to improve the conservation and sustainable use of plant genetic resources (crops and crop wild relatives for food and agriculture).

6 The State of Regional and International Collaboration

In Germany, the Federal Government plays an important role in shaping developments at regional and international level. A general objective of regional and international cooperation is to promote prosperity, social justice, environmental protection and food safety throughout the world.

Relevant regional and international agreements Germany is involved in as well as national programmes for genetic resources aim at maintaining crop varieties that meet the national needs of agriculture and at the same time contribute to global food security.

6.1 Regional and sub-regional networks, international crop-specific networks and subregional collaboration for maintaining *ex situ* collections

With regard to regional and sub-regional cooperation concerning plant genetic resources, the following regional programmes are of particular importance:

a) Council Regulations (EC) No 1467/94 and No 870/2004

In 1994, the Council Regulation (EC) No 1467/94 on the conservation, characterisation, collection and utilisation of genetic resources in agriculture established a community programme on *in situ*, on-farm and *ex situ* conservation, characterisation, collection and utilisation for improving the management of genetic resources for food and agriculture. Under this regulation, 16 projects on crop genetic resources were selected for co-funding, eight of which included German participation regarding *Avena*, *Barley*, *Beta*, *Brassica*, *Cucumis melo*, *Daucus*, *Solanum* (Eggplants) and *Vitis*.

In order to support the maintenance of biological and genetic diversity further on, this regulation was followed by a second regulation for agricultural genetic resources (EC No 870/2004 establishing a Community programme on the conservation, characterisation, collection and utilisation of genetic resources in agriculture), which was adopted by the Council of the European Union in 2004. A total of 17 projects were selected for co-funding, including 10 projects on crop genetic resources. Germany participates in plant genetic resources projects for *Avena*, *Allium*, *Vitis*, *Ribes*, small Berries, leafy vegetables and in an *in situ* management strategy. Almost all crop genetic resources projects are carried out in cooperation with relevant ECPGR Working Groups or Networks (see chapter 6.1 c).

A substantial contribution towards the utilisation of plant genetic resources in Germany was achieved through focusing on evaluation and characterisation data and close collaboration in these multi-national projects. Both of these regulations had an important impact on German plant genetic resources management as German institutions were involved in almost half of the co-funded plant projects. However, as the majority of co-funded plant genetic resources projects dealt with *ex situ* conservation measures, *in situ* and on-farm activities should receive more attention in prospective regulations.

b) European Agricultural Fund for Rural Development (EAFRD)

The council regulation (EC) No 1698/2005 of 20 September 2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) creates a single instrument to finance the rural development policy. For the first time, EAFRD introduces the conservation and sustainable use of genetic resources for food and agriculture as part of the rural development plans and provides co-funding by the EU for activities carried out by the Member States. In Germany, EAFRD is presently in its implementing stage (see chapter 5.3 b).

c) European Cooperative Programme for Plant Genetic Resources

Germany is actively involved in the European Cooperative Programme for Plant Genetic Resources (ECPGR). This collaborative programme for plant genetic resources, which most European countries

are involved in, is aiming at facilitating the long-term *in situ* and *ex situ* conservation on a cooperative basis as well as improving the utilisation of plant genetic resources in Europe.

ECPGR is structured into nine networks (six Crop Networks and three Thematic Networks), three of which (Cereals Network, Sugar, Starch and Fibre Crops Network and the Documentation and Information Network) are chaired by German experts. The activities of the networks are implemented by Working Groups and Task Forces belonging to the Crop and Thematic Networks respectively. German representatives are nominated for all Working Groups and Task Forces and participate actively in almost all groups. Fifty-two European central crop databases have been established through the initiative of individual institutes and ECPGR Working Groups and are hosted by institutes throughout Europe. The European central crop databases for *Avena*, *Beta*, *Hordeum*, *Poa* and *Vitis* are maintained by German institutions.

The thematic working group ECPGR of the Advisory and Co-ordinating Committee for Agricultural and Horticultural Crops (BEKO) of the National Programme on Plant Genetic Resources of Agricultural and Horticultural Crops has the task of coordinating the German participation in the ECPGR, preparing forthcoming meetings, reporting back on the results and contributing to the further development of ECPGR. Moreover, the working group gives the BEKO advice on crop-specific and thematic questions as described in chapter 5.1.

One important activity within the ECPGR collaboration is the implementation and further development of the European Search Catalogue for Plant Genetic Resources (EURISCO), which is strongly supported by Germany. EURISCO is a web-based catalogue that provides information about *ex situ* plant collections across Europe. It currently contains so-called passport data for more than one million samples of plant diversity held in nearly 200 European institutes in 33 countries. One of the key elements of EURISCO is the network of National Focal Points responsible for the respective National Inventory and the data flow between the National Inventory and EURISCO. Each country has full responsibility and sovereign rights of the data availability, accuracy and uploads of its national inventories. At present, 40 countries have nominated a focal point and 31 National Inventories are part of EURISCO. The conditions for the collaboration are laid down in a Memorandum of Understanding between Bioversity International

(formerly IPGRI) and the German National Focal Point for the National Inventory, which, in Germany, is the Information and Coordination Centre for Biological Diversity (IBV) of the Federal Agency for Agriculture and Food (BLE). The last update of the German National Inventory data in EURISCO took place in May 2007.

Another important activity of ECPGR supported by Germany is the implementation of AEGIS. The ECPGR conducted an AEGIS feasibility study between 2004 and 2006. The analysis was made within four pilot crop working groups (*Allium*, *Avena*, *Brassica* and *Prunus*). Germany is actively participating in the further development of AEGIS, especially in the ongoing work on *Allium* and *Avena* and in the AEGIS Advisory Committee.

6.2 International programmes

Issues of agricultural policy at international level are dealt with, in particular by the United Nations Food and Agriculture Organisation (FAO). Of primary importance regarding plant genetic resources are the International Treaty on Plant Genetic Resources for Food and Agriculture (Treaty) and the FAO's Global Plan of Action for the Conservation and Sustainable Use of Plant Genetic Resources for Food and Agriculture (Global Plan of Action, or GPA) of the FAO Commission on Genetic Resources for Food and Agriculture (CGRFA). The plan includes priority measures for implementation in the framework of national programmes. Furthermore, Germany supports the following international programmes and organisations focused on genetic resources:

a) Global Crop Diversity Trust (GCDT)

The GCDT is one element of the Funding Strategy of the Treaty in relation to the *ex situ* conservation and availability of plant genetic resources for food and agriculture. Germany supports the GCDT by contributions of 1.5 million Euro in 2006 as well as in 2007 and intends, subject to the approval of the federal budget by the German Federal Parliament, to continue its support up to a total amount of 7.5 million Euro until 2010. Amongst others, Germany participates in the GCDT's Donor Council, and German experts were leading the global crop conservation strategies for oats (*Avena*) and are involved in the elaboration of a strategy for *Fragaria* in the context of the GCDT.

b) Consultative Group on International Agricultural Research (CGIAR)

Germany was a founding member of CGIAR and, in 2006, contributed 14.5 million Euro to the research centers supported by the CGIAR and other international institutions such as AVRDC – The World Vegetable Center. Funding is provided through a budget line in the Federal Ministry for Economic Cooperation and Development (BMZ). One of the six priorities of German project funding established in 2006 is "Promoting conservation and characterisation of under-utilised plant genetic resources to increase the income of the poor". Since 2002, support is provided to the Global Facilitation Unit for Underutilized Species (GFU), hosted by Bioversity International in Rome.

c) German Agency of Technical Cooperation (GTZ)

GTZ operates as a private-sector enterprise, owned by the Federal Republic of Germany, in the field of worldwide development cooperation with the aim to make sustainable improvements regarding the living conditions of people in partner countries, and to conserve the natural resource base on which life depends. Currently, GTZ implements a supraregional project of 2.3 million Euro on food security and agrobiodiversity. Amongst other activities, it is concerned with Farmers' Rights in selected countries and cooperates in this field with a Norwegian research institute which has a focus on Farmers' Rights and capacity building in view of the implementation of the Treaty. It also supports the development of improved value chains for neglected crops and breeds in technical cooperation projects. In addition, GTZ supported between 2000 and 2006 the establishment of a regional Network for the Promotion of Plant Breeding and Seed Production with regard to on-farm management.

Furthermore, bilateral projects on the sustainable management of agrobiodiversity are supported with 3.5 million Euro between 2005 and 2009, e.g. in cooperation with different provinces in China. Another bilateral project in Afghanistan, funded with 1.3 million Euro from 2007 to 2009, aims at the sustainable use of the local diversity of wild plant species for nutrition and commercialisation.

6.3 International agreements

Plant genetic resources activities in Germany are embedded in the international political framework. Besides the Convention on Biological Diversity (CBD) as legal instrument including its internet-based clearing-house mechanism (CHM), the most important international agreement coming up within the last 10 years is the International Treaty on Plant Genetic Resources for Food and Agriculture. The Treaty was adopted by the thirty-first session of the FAO Conference on 3 November 2001 and entered into force on 29 June 2004. Germany has ratified the Treaty on 31 March 2004 and is fully supportive of its objectives. The Treaty defines the legally binding global framework for the conservation of plant genetic resources. The national implementation of the Treaty is underway (see chapter 7.1 and 7.2).

6.4 Assessment of major needs to improve international collaboration

- The global information system for plant genetic resources for food and agriculture as provided in Art. 17 of the Treaty should be based on existing information systems. Therefore, the further development of FAO's World Information and Early Warning System (WIEWS) towards the global information system of the Treaty is recommended. It should be based upon regional systems and SINGER of the CGIAR.
- The involvement of crop experts, crop working groups, and centres of excellence in the development of information systems for plant genetic resources as well as the links between information networks and crop networks should be reinforced. Evolving crop portals may provide tools for the development of crop conservation strategies and the management of characterisation, evaluation and collecting activities.
- As access to plant genetic resources found *in situ* and held on-farm is provided according to national legislation or - in the absence of such legislation - according to standards to be developed by the Governing Body of the Treaty as foreseen in Article 12.3 (h), the issue of the International Code of Conduct for Plant Germplasm Collection and Transfer should be considered by the Governing Body of the Treaty.
- The collaborative and efficient conservation under high quality standards and the sharing of conservation responsibilities for Annex I crops of the Treaty and further crop plants needs to be improved. It should be built on the global crop conservation strategies developed by the GCDT and AEGIS.
- The rolling Global Plan of Action provides the structure and the operational framework for activities for the conservation and sustainable utilisation of plant genetic resources. As there is a strong link between the implementation of the Global Plan of Action and the Treaty, the Global Plan of Action needs to be updated as soon as possible as foreseen by the CGRFA in its Multi-year Programme of Work.
- Regional programmes supporting cooperative targeted actions for the conservation, characterisation, evaluation and use of genetic resources as the EU initiatives (EC) No 1467/94 and No 870/2004 should be continued and expanded.
- The concentration of agricultural research on plant genetic resources for food and agriculture needs to be reinforced in order to promote their utilisation and ensure food security.
- National programmes, which should provide transparency with regard to shared competencies and responsibilities of all involved institutions and actors, and support synergies from an intensified collaboration at national and international level need to be strengthened.
- Capacity building at national level is a prerequisite for European and international cooperation in the field of information exchange.
- The collaboration and partnerships, especially between researchers and policy makers and between public and private institutions (Public-Private-Partnership), need to be enhanced.

7 Access to Plant Genetic Resources for Food and Agriculture and Sharing of Benefits Arising out of their Use, and Farmers' Rights

Plant genetic resources for food and agriculture occur in Germany either *in situ* (wild plants or crop wild relatives), where they are used for food and feed, on-farm (landraces) or *ex situ* (accessions of wild plants and crops) as described in chapter 2 and 3 respectively. According to national law, regulations on access to plant genetic resources for food and agriculture and benefit sharing depend on by whom the plant genetic resources are held. Ownership of biological resources *in situ* is not directly defined under German law. In Germany, there is no constitutional norm or principle attributing the ownership of natural and / or biological resources to the State. Consequently, biological and genetic resources may be owned publicly or privately. Generally, the owner of the land (or water) area will be considered to own the biological / genetic resources found on that area. However, some sectoral laws specify the possible forms of ownership, e.g. the forest laws of the German Laender.

Therefore, in general, access to plant genetic resources in private property (*in situ* or *ex situ*) is at the discretion of the owner. Plant genetic resources for food and agriculture in the public domain can be accessed according to the regulatory framework as described below.

7.1 Changes in the international legal and policy framework in relation to access and benefit sharing for genetic resources

The Convention on Biological Diversity (CBD), which entered into force on 29 December 1993, contains several provisions on access to genetic resources and the sharing of benefits arising from the utilisation of these resources. Germany is Contracting Party to the CBD since 1994. The CBD affirms the national sovereign rights of States over their natural resources, but calls at the same time on the countries of origin of genetic resources to grant a facilitated access to their genetic resources to other contracting parties. Prerequisite and consequence of access to genetic resources is the fair and equitable sharing of benefits arising from the utilisation of genetic resources. A major achievement of the CBD process was, in 2002, the adoption of the Bonn guidelines on access to genetic resources and the fair and equitable sharing of the benefits arising from their utilisation. Germany supports the development of an international regime on access and benefit sharing as agreed at the WSSD 2002 in Johannesburg as well as COP 8 (CBD) as early as possible before 2010. In this process, amongst others, the International Treaty on Plant Genetic Resources for Food and Agriculture (Treaty) has to be taken into account.

Germany has ratified the Treaty (see chapter 6.3) and is fully supportive of its objectives, which are the conservation and sustainable use of plant genetic resources for food and agriculture and the fair and equitable sharing of the benefits arising from their use, in harmony with the Convention on Biological Diversity. A core element of the Treaty is the "Multilateral System of Access and Benefit Sharing" (MLS), referring to plant genetic resources of major crops as defined in Annex I of the Treaty. While the CBD requires bilateral negotiations to grant access to genetic resources on the basis of a prior informed consent and mutually agreed terms within the framework of the Treaty, Contracting Parties grant facilitated access to the plant genetic resources in the MLS according to mutually agreed terms (as defined in the Standard Material Transfer Agreement; SMTA).

7.2 The state of access to plant genetic resources

Germany, like most EU Member States, did not yet develop specific regulations on access to genetic resources on its territory within the scope of the Convention on Biological Diversity. Instead, Germany recognises the private property and relevant legislation for plant genetic resources. However, there is no requirement for a prior informed consent by the Federal Government in Germany or need to draft mutually agreed terms.

Hence, depending on the location of a genetic resource within the sovereign territory of the Federal Republic of Germany, the regulation of access is governed by the German Civil Code (BGB), the Federal Nature Conservation Act (BNatSchG) as well as the nature conservation laws of the Laender. Thus, in Germany, anybody is allowed to collect plants growing *in situ* while respecting nature conservation, species and other special protection, ownership and phytosanitary regulations.

To provide sufficient and transparent information about regulations on access and benefit sharing within the scope of the CDB, Germany nominated a National Focal Point and established an "Access and Benefit-Sharing Information Website" (www.abs.biodiv-chm.de).

With the ratification of the Treaty, an efficient and transparent process has been established in order to facilitate the access to important food crops in Germany. Material under direct control of the Federal Government is being registered to the Multilateral System, and the main genebanks are introducing the Standard Material Transfer Agreement (SMTA) for the germplasm transfer of crops which are listed in Annex I of the Treaty.

Farmers, like breeders, scientists and others, have access to seed and propagating material from genebanks according to their needs, but most of the German farmers use modern commercial varieties. Either they buy seed or part of the harvest is saved and re-used as seed or propagating material for the next harvest. Landraces are not grown on a large scale and only few accessions of landraces are conserved in German genebanks (see chapter 3.3). For the main agricultural crops, small-scale farmers are allowed to save and re-use freely seed or propagating material form their harvests. All other farmers are also allowed to save and re-use seed or propagating material from their harvest, but they have to pay royalties to the breeder of the respective variety; the amount due depends on the proportion of saved and bought seed or propagating material. In general, seed supply is no problem in Germany. The marketing of seed and propagation material of vegetables and a number of other agricultural products is subject to the German Seed Trade Act, which in turn implements the corresponding EC Directives. The Seed Trade Act of the European Union aims at ensuring the supply of high-quality seed and propagating material. Only seeds that have been controlled, certified and authorised can be marketed. Variety Protection is granted on the basis of national laws in accordance with the International Convention for the Protection of New Varieties of Plants (UPOV Convention).

The plant supply of botanical gardens depends basically on the exchange of plant material between the gardens and on access to plant material from the wild. As an instrument to fulfil the access and benefit sharing provisions according to the CBD, the International Plant Exchange Network (IPEN) has been established by the Association of Botanical Gardens (see chapter 5.1.2 c). The IPEN was developed by several research projects financed by the Federal Ministry for Environment, Nature Conservation and Nuclear Safety, and initialised by the Association of Botanical Gardens. The network allows its members a facilitated mutual transfer of living plant material in compliance with the provisions of the CBD. For this purpose, a Code of Conduct was developed that obligates its members with regard to the non-commercial use of the plant material. Material is only transferred for commercial use if the potential user has received the prior informed consent by the country of origin and can plausibly evidence the consent. By the introduction of IPEN numbers (Annex 3 of the Code of Conduct) that accompany the circulating plant material and that are saved in the databases of the participating gardens, the country of origin of a plant can always be traced back, and benefits can thus be passed on to the country of origin. The Plant Exchange Network therefore helps controlling the adherence to the CBD provisions and concurrently provides a system for facilitated access to plant material, supporting the important work of botanical gardens. Over 60 botanical gardens from Germany, Austria, Luxembourg, the Netherlands and Switzerland are already members of the Plant Exchange Network IPEN.

7.3 Benefits arising out of the utilisation of plant genetic resources for food and agriculture

Benefits arising from the utilisation of plant genetic resources for food and agriculture with regard to the Treaty include non-monetary benefits, such as free access to material. These benefits shall be shared fairly and equitably through the exchange of information, access to and transfer of technology and capacity building as well as through sharing of benefits arising from commercialisation.

Furthermore, farmers as well as breeders, breeding research and breeding companies benefit indirectly from improved varieties which have been bred using *inter alia* plant genetic resources.

7.4 Financing plant genetic resources activities

According to the German federal structure, the responsibilities with regard to financing plant genetic resources activities are divided as described in chapter 5.3.

Examples of programmes funding the utilisation of plant genetic resources, e.g. landraces or the support for the infrastructure for conservation (see chapter 2.4), were mentioned before. Presently, there is no programme in place for the protection of farmers' traditional knowledge in Germany.

7.5 Implementation of Farmers' Rights

Plant Breeders' Rights as a sui generis system of intellectual property rights are the most common way of protecting varieties, and they allow, to some extent, the saving of seeds for the next season by farmers as well as the utilisation of protected varieties for research purposes and the breeding of new varieties. The international legal instrument for the protection of varieties, the UPOV agreement, has been signed by Germany as well as 60 other countries.

Besides, the Treaty introduces the Farmers' Rights as a recognition of the contribution of local and indigenous communities and farmers in the past, present and future.

In Germany, Farmers' Rights are realised as necessary. The responsibility for realising Farmers' Rights as they relate to plant genetic resources rests with the Federal and Laender governments. The opportunities of farmers to participate in decision-making processes on the conservation and use of plant genetic resources, in particular in pre-breeding and breeding activities, are still limited.

The German government emphasises the sovereignty of all countries over their local genetic resources, their commitment to the protection of traditional knowledge relevant to these resources as well as the balanced and equitable sharing of benefits arising from the utilisation of these resources. The Treaty states that the national governments are responsible for the realisation of Farmers' Rights as they relate to plant genetic resources for food and agriculture, and describes the measures that should be taken by national governments in accordance with their needs and priorities, and subject to their national legislation to protect and promote them. Through its cooperation with the F. Nansen Institute (Norway), the GTZ supports the implementation of Farmers' Rights at national level. The following issues are therefore, *inter alia*, considered in German technical cooperation projects:

- documentation and maintenance of farmers' traditional knowledge pertaining to agricultural plant varieties or landraces
- access to seed and propagating material and related information
- participatory plant breeding (in collaboration between farmers, breeders, research and extension service)
- strengthening agricultural research
- strengthening breeding and seed sectors at national level, in particular in developing countries
- strengthening farmers' seed systems
- enhanced utilisation of farmers' varieties / landraces, including market access
- technical cooperation and capacity building
- raising awareness of the importance of agrobiodiversity for the world's food supply and the reduction of poverty.

8 The Contribution of Plant Genetic Resources for Food and Agriculture Management to Food Security and Sustainable Development

The conservation of biodiversity and in particular of plant genetic resources is of outstanding importance as it is a precondition for safeguarding the world's food supply, enabling future innovations and increasing quality of life. Bridging the gap between agricultural production and sustainable development towards food security is of major importance as food production and security depend on the sustainable management of ecosystems including the sensible use and conservation of plant genetic resources.

An important element in order to reach food security and sustainable development is the precautionary principle. The utilisation of the precautionary principle in agriculture and food production aims at assuring local food production whilst countering environmental degradation as well as the exposition of humans to environmental or health hazards in the production. This principle provides an important policy basis to anticipate, prevent and mitigate threats to food security and sustainable development. The best precondition for the conservation of agrobiodiversity is an effective and sustainable utilisation of these resources. An improvement of the infrastructure for the long-term conservation and sustainable, innovative utilisation of plant genetic resources for food and agriculture is part of the precautionary principle. A broad knowledge base and a suitable legal framework enhances the efficiency and effectiveness of existing conservation institutions as well as of the systems used for documentation, monitoring and information.

8.1 Contribution to agricultural sustainability

The sustainability of agriculture is emerging as one of the most relevant global issues. Agriculture must take up the challenge of sustainability, e.g. must guarantee economic and social viability, food security and safety while conserving and even improving local and global plant genetic resources and safeguarding the environment.

Within Germany, the establishment of a conservation infrastructure and the enhancement of utilisation systems for plant genetic resources are of major importance. Agricultural sustainability consists of conservation, future-orientated management and sustainable utilisation resulting in food security. Besides the need to increase global food production, the main objectives of agricultural sustainability are the preservation of natural resources and the maintenance of the environment in terms of risk management. This will guarantee the flexibility and opportunity to meet changing challenges, e.g. climate, demand, diseases and pests. Furthermore, the conservation of agrobiodiversity is a precondition for future utilisation purposes, for innovation and breeding progress.

8.2 Contribution to food security

The diversity of crop genetic resources has long been viewed as a means of increasing both global and local food security. The protection of agrobiodiversity is indispensable for food security. Without the treasure of plant genetic resources that has been safeguarded for centuries, less progress would have been possible in the area of plant breeding. The goal is to enhance global food security through the efficient and effective conservation of plant genetic resources and their use in crop improvement. Within Germany, the improvement of conditions of long-term and sustainable conservation and sustainable innovative utilisation of plant genetic resources is supported. Furthermore, the conservation of plant genetic resources in terms of risk management is essential in order to have them at disposal in case of need under changed future conditions. Therefore, these resources are the basis for the future utilisation regarding their innovation poten-

tial. At the national level, risk management for an effective food safety and security is conducted in order to improve food quality, sustainable consumption and production.

8.3 Contribution to economic development

Safeguarding the genetic diversity of crops is necessary as they are a vital resource for the future agricultural and economic development. This diversity is needed to overcome current and future production problems and thus ensure the sustainability of agriculture.

Better synergies between the conservation and utilisation of plant genetic resources as part of an innovation strategy towards sustainable development is seen as a major objective in terms of precautionary measures in Germany.

8.4 Contribution to poverty alleviation

Germany supports the strengthening of the international collaboration in order to reach a equitable global management of agrobiodiversity.

Within poverty alleviation programmes, a strong focus should be on poverty reduction, food security and natural resource sustainability. Therefore, innovations should, as alternatives, become part of a sustainable, global agricultural policy. In consideration of the global coherencies and interdependencies, the international collaboration based on international equity needs to be strengthened, particularly with regard to the management of biodiversity as resource for food and agriculture. This should be taken into account in bilateral as well as multilateral cooperation.

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