

COUNTRY REPORT ON THE STATE OF PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

THE NETHERLANDS



The Netherlands

Second National Report on Plant Genetic Resources for Food and Agriculture

A strategic policy document

**Country report for the FAO Second State of the
World's Plant Genetic Resources for Food and Agriculture**

**Ministry of Agriculture, Nature and Food Quality
The Hague, November 2008**

Note by FAO

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CONTENTS

FOREWORD	8
SUMMARY	9
1. Introduction	9
2. Context	9
3. The State of Diversity	10
4. The State of <i>In Situ</i> Management	10
5. The State of <i>Ex Situ</i> Management	10
6. The State of Use	11
7. The State of National Programmes, Training and Legislation	11
8. The State of Regional and International Collaboration	11
9. Access to PGRFA, Benefit-Sharing and Farmers' Rights	11
10. The Contribution of PGRFA Management to Food Security and Sustainable Development	12
PREAMBLE	13
INTRODUCTION	14
1. Summary	14
2. Geography and demography	14
3. Key aspects of agriculture	14
4. Value added of Dutch agricultural sector	15
5. Land use and biodiversity	16
6. PGRFA measures	17
7. The Dutch seed industry	18
8. Food processing and consumption	19
9. Trends	20
CHAPTER 1	
THE STATE OF DIVERSITY	21
1.1 Summary	21
1.2 Overview of Dutch agricultural production systems	21
1.3 State of diversity of major crops	23
1.4 State of diversity of other crops	24
1.5 Factors affecting the state of diversity	26
1.6 Trends	27
CHAPTER 2	
THE STATE OF <i>IN SITU</i> MANAGEMENT	28
2.1 Summary	28
2.2 <i>In situ</i> management of cultivated diversity under conditions of modern agriculture	28
2.3 Non-domesticated diversity	28
2.4 Related research	29
2.5 Trends	29

CHAPTER 3		
THE STATE OF <i>EX SITU</i> MANAGEMENT		30
3.1 Summary		30
3.2 Introduction		30
3.3 Policy developments		30
3.4 Recent trends in <i>ex situ</i> collections		31
3.5 Future trends in <i>ex situ</i> collections		33
CHAPTER 4		
THE STATE OF USE		34
4.1 Summary		34
4.2 Evaluation of germplasm		34
4.3 Synthesis of individual datasets		35
4.4 Changes in distribution of CGN germplasm		35
4.5 Technological and societal developments		36
4.6 Education and knowledge transfer		36
4.7 Uncertainty in estimating final use of germplasm in new varieties		36
4.8 Constraints in use		37
4.9 Effects of policies		37
4.10 Future needs and priorities		37
CHAPTER 5		
THE STATE OF NATIONAL PROGRAMMES, TRAINING AND LEGISLATION		39
5.1 Summary		39
5.2 The National Programme on Genetic Resources		39
5.3 Legislation		39
5.4 Training		40
5.5 Public awareness raising		40
5.6 Trends		41
CHAPTER 6		
THE STATE OF REGIONAL AND INTERNATIONAL COLLABORATION		42
6.1 Summary		42
6.2 European collaboration		42
6.3 International collaboration		42
6.4 Trends		43
CHAPTER 7		
ACCESS TO PGRFA, BENEFIT-SHARING AND FARMERS' RIGHTS		44
7.1 Summary		44
7.2 Access and Benefit-Sharing		44
7.3 Farmers' rights		44
7.4 Trends		44

CHAPTER 8

**THE CONTRIBUTION OF PGRFA MANAGEMENT TO FOOD SECURITY
AND SUSTAINABLE DEVELOPMENT**

45

8.1 Summary

45

8.2 Food Security

45

8.3 Sustainable Development

45

8.4 Trends

45

ABBREVIATIONS

46

FOREWORD

Worldwide, the conservation and sustainable use and management of plant genetic resources continue to be major issues from both a political and a policy perspective. The growth of the global population and the challenge to eradicate hunger requires a significant increase of global crop production in the coming decades. We also have a major responsibility to provide for durable and environmental - friendly solutions in agriculture and to reduce our CO₂ emission, ensure that our economies increasingly rely on green resources.

Plant breeding industries continue to play an important role in this development. The challenge for future generations is to find sufficient resources that enable breeders and scientists to generate novel solutions through new combinations of genes. This is why the conservation and sustainable use of plant genetic resources is very important.

The Netherlands government places major emphasis both nationally and internationally on sustaining natural and agro-based biodiversity.

In this context, this second national report is an important strategic policy document for the Netherlands covering the subject of plant genetic resources for food and agriculture. It has been completed under the authority of the Ministry of Agriculture, Nature and Food Quality and includes the contributions of a large number of stakeholders.

I trust that you will find this report an interesting read. May I also express the hope and expectation that it will result in further actions that make a substantial contribution to the conservation, development and sustainable use of genetic diversity.

Gerda Verburg
Minister of Agriculture, Nature and Food Quality of the Netherlands

SUMMARY



In March 2008, the FAO invited the Dutch Government to prepare a second national report on plant genetic resources in connection with the preparations for the Second State of the World's Plant Genetic Resources report. The Dutch National Report is designed to contribute to a global update on the status of plant genetic resources and in particular to identify trends that have developed since the publication of the first report in 1996. As such it also is a significant report for the Netherlands itself.

The National Report is considered a strategic policy document. After a general introduction on Dutch agriculture, it describes the state of diversity in the production system and the crop and variety levels due to ongoing developments in agricultural production. Chapters 2 and 3 focus on the *in situ* Management and *ex situ* Management of Plant Genetic Resources respectively, explaining why the *ex situ* approach is relatively important for the country given the current status of its agriculture. Chapter 4 describes the changes in the State of Use over the last decade. Additional information is contained in the chapters on National Programmes, Training and Legislation; Regional and International Collaboration; Access to PGRFA, Benefit-Sharing and Farmers' Rights, with a final chapter on the Contribution of PGRFA Management to Food Security and Sustainable Development. National stakeholder consultations have contributed to this report.

1. Introduction

Of the total land area (34 000 km²) of the Netherlands approximately 60% is used for agricultural purposes. Between 1995 and 2005 the Dutch agricultural sector witnessed a slight decrease in the acreage of land used for agriculture, a substantial decrease in the number of farms, and a concomitant increase in average farm size. Simultaneously, the agricultural labour force decreased by 16% from 1996 to 2005, a trend which has been accelerating in recent years. These trends are shared with other West European countries and reflect the close interdependencies of agricultural production between the countries in the region.

However, the relative economic strength of the agricultural sector is outstanding at both regional level and globally. All the facts and trends reported here follow from that position.

2. Context

The gross value added of the Dutch agricultural sector rose from 32.3 billion euros in 1995 to 41.9 billion in 2005. Worldwide, the value of agricultural exports ranks third, after the United States and France. The plant breeding industry contributes to these exports to a major extent.

The Dutch plant breeding industry is a sector with a long history. Some of the current companies were founded more than a century ago. Development and production of plant reproduction material is a major, highly developed economic activity in the Netherlands. The plant breeding sector provides jobs for 10 000 workers, including a relatively large number of higher-educated workers, and is supported by a high-quality academic infrastructure in the field of plant breeding and genetics.

Public breeding has largely disappeared and breeding activities have become concentrated in the private sector. Scientific developments have revolutionized crop breeding, in particular through the development of marker-assisted breeding and trends in genomics research. The public sector research institutions play a major role in the development of these enabling technologies and research products.

Decision-making by breeding companies is strongly influenced by the demands of other stakeholders in the product chain, in particular the retail sector. Product diversity is increasingly created by processing rather than by a diversity in the harvested product. However, niche markets for consumers with a keen interest in regional and traditional products or with an immigrant culture background, as well as organic production, are also slowly developing.

Genetic modification may have an influence on plant diversity, since genes from non-related species can be transferred to commercial crops, posing the question of how a much wider gene pool may be effectively conserved and utilized.

Climate change predictions forecast higher temperatures and wetter summers in Western Europe. This development may influence cropping patterns and crop yields, and require the development of germplasm adapted to future needs, as well as a corresponding widening of conservation objectives.

3. The State of Diversity

Whereas crop diversity is the focus of this national report, it is not the only component of biodiversity essential in agricultural production systems. Crop diversity can only be fully employed in a system in which other biodiversity components, in particular the life support functions provided by insects and soil organisms, are also well managed. Efforts aimed at the conservation of crop diversity should not be seen in isolation from the need for appropriate management of these other biodiversity components.

In analysing the state of crop diversity a distinction has been drawn between diversity actually utilized in production, diversity available in the market but not in demand, and diversity not present in the market or in farmers' fields, but conserved in *ex situ* collections.

The decrease in agricultural acreage in the Netherlands can be ascribed to a slowly but gradually decreasing grassland area over the last few decades. The area of arable crops has remained relatively constant, whereas the horticultural area increased slightly. While five commodities (wheat, barley, maize, sugar beet and potato) accounted for an acreage of over 25 000 ha, more than 41 additional food and feed crops are cultivated on an acreage of over 100 ha, adding to the total genetic diversity utilized in agricultural production. Twenty vegetable crops are extensively cultivated in the Netherlands. In terms of diversity, this group is richer than any of the other groups. In general, a large number of varieties for a substantial number of different crops is on offer in the market, and no indications exist that the diversity of these crops in the market is decreasing or threatened.

However, since 1970, a small number of crops has almost disappeared from production, including rye, oats, pulses, caraway, and fodder beets. The number of farms cultivating these crops and the number of varieties offered in the market have decreased to a similar extent. Whereas this trend commenced in the 1970s, a final reduction took place over the last decade.

In the absence of more direct and accurate data, the number of registered and recommended varieties in combination with data on acreages and number of farms for the crop concerned may form an indication for the remaining genetic diversity of a particular crop in production systems of the country at large.

The genetic diversity of these crops that have almost completely disappeared from the Dutch farming systems is largely maintained in *ex situ* collections in the country and abroad.

Over the past decade, crops such as rape seed, fodder maize, hemp, green manuring crops and catch crops, have gained in importance and added to the total genetic diversity employed in agricultural production.

4. The State of *In Situ* Management

Very few traditional varieties, especially of potatoes and fruit species, are still produced by commercial growers. Nevertheless, substantial traditional diversity is maintained in gardens, rather than on farms, and in-garden maintenance of traditional varieties has been shown to represent a robust conservation system.

The Netherlands is home to only a limited number of genera that can be regarded as more direct wild relatives of our cultivated crops. No specific policy has been developed to protect the species involved, but based on scientific research most can be assumed to survive in national parks and nature reserves.

Increasing attention for our bio-cultural heritage has been developing amongst the wider public.

5. The State of *Ex Situ* Management

The Centre for Genetic Resources, the Netherlands (CGN), botanical gardens, NGOs and private companies manage plant genetic resources collections of major importance for food and agriculture at a global scale. A substantial increase over the period 1996 – 2008 is reported for the size of the CGN collections (35%), the extent of documentation (50%), and even more the number of distributions (300%), indicating the importance of the collections. By adding a number of new relatively small crop collections, CGN's total holdings have now reached 24 000 accessions. Collecting missions have



continued but were sometimes hampered by the lack of agreement on the conditions for international missions. CGN's collections have been duplicated in the Svalbard Seed Vault.

Characterization and evaluation activities will increasingly dominate genebank activities, e.g. by the use of molecular markers and omic technology, where appropriate. Evaluation will continue to be performed exclusively in close collaboration with private breeding companies.

Enhanced documentation will facilitate and promote increased utilization of the collections by domestic and foreign users, and distribution figures are expected to grow further.

Botanical gardens manage large collections including wild relatives, whereas NGOs have focussed on traditional crop diversity. Over the past decade, holdings of plant genetic resources managed in the private sector have increased considerably in size.

6. The State of Use

The state of use is influenced by a number of quite divergent factors. The public-private collaboration between CGN and a large number of breeding companies in the Netherlands has contributed to the increased use of germplasm in breeding programmes, although it is often not (yet) possible to assess precisely to what extent this increased use has resulted in the incorporation of accessed germplasm in commercialized products.

Climate change and technological developments have each triggered and promoted novel use, and both trends may have a continued and profound effect on the utilization of plant genetic resources in the near future. Developments in information technology have revolutionized access to information on the available germplasm and the incorporated traits. All these factors have contributed to an increased use.

In the same period, however, new international policy developments have in a number of cases unintentionally resulted in a slowdown of international collecting missions, which in turn may adversely affect the use of genetic resources in breeding and research programmes.

Other trends that may have influenced use include the consolidation of the international breeding industry and the growing attention to organic agriculture.

7. The State of National Programmes, Training and Legislation

In 2002, the Netherlands' Parliament adopted a government policy on genetic resources: 'Sources of Existence'. Until now, no new legislation has been deemed necessary to implement this policy. Training as a form of capacity building at national and international level has obtained increased attention. Public awareness raising has become recognized as another major focus of activity.

8. The State of Regional and International Collaboration

At European level, the Netherlands has contributed to new developments in the framework of the European network ECPGR, namely the development of a web-based regional collection database, EURISCO, and an integrated European genebank system, AEGIS. At international level, the Netherlands has actively contributed to the further development and implementation of the CBD and the ITPGRFA. It has also supported projects aimed at the on-farm management of genetic resources as well as other capacity building initiatives.

9. Access to PGRFA, Benefit-Sharing and Farmers' Rights

No national Access to Genetic Resources and Benefit Sharing (ABS) legislation has been developed. Access to plant genetic resources found *in situ* in the Netherlands is essentially unrestricted. Current international ABS policies are regarded by the private sector as too strict and non-transparent and lacking in legal certainty to be effective.

10. The Contribution of PGRFA Management to Food Security and Sustainable Development

The Netherlands regards the maintenance and distribution of its national collections as a major contribution to the international conservation of plant genetic resources for food and agriculture. Its open access policy, to both its *ex situ* collections and genetic resources found *in situ*, is considered an important contribution to global food security. The breeding and development of plant varieties that are optimally adjusted to local circumstances and that do not exhaust the biological and other resources (such as water supplies) of the agricultural production system are considered of utmost importance. PGRFA form the basis for such breeding. A recent joint policy programme of LNV and DGIS has addressed this issue and dedicated efforts towards exploiting the options to improve agricultural production more effectively so as to improve food security at global level.

PREAMBLE

In March 2008, the Food and Agriculture Organization of the United Nations (FAO) requested the Dutch Government to contribute to the State of the World's Plant Genetic Resources process by preparing a strategic update on the status of plant genetic resources in the country.

The National Report's structure follows the FAO's guidelines, which aim at the worldwide collation of national reports and information. Based on an inventory and an analysis of the current situation, policies and priorities regarding plant genetic resources may be updated as foreseen in the rolling Global Plan of Action on Plant Genetic Resources for Food and Agriculture. Hence, the National Report is also of major importance for the Netherlands.

The current document is a report from the Minister of Agriculture, Nature and Food Quality. A diverse group of stakeholders have contributed to the report. These stakeholders are not merely interested in the subject; they bear a shared responsibility for the conservation, development and use of plant genetic resources in the Netherlands. Together, these stakeholders represent the Dutch position, knowledge and ambitions regarding the conservation and utilization of plant genetic resources. In a joint effort by the Ministry of Agriculture, Nature and Food Quality (LNV) and the stakeholders, the Netherlands intends to play a leading role justified by the size and importance of its plant breeding and seed production activities in an international context.

PGRFA in this report is defined as plant genetic resources that support agriculture at large. In this report we use this definition, but focus on PGRFA supporting food production. Hence, PGRFA used in forestry, for fuel production or other industrial purposes are not specifically addressed, nor are PGRFA in ornamentals.



INTRODUCTION

1. Summary

Of the total land area of the Netherlands (34 000 km²) approximately 60% is used for agricultural purposes. Between 1995 and 2005 the Dutch agricultural sector witnessed a decrease in the acreage of land in use for agriculture, in the number of farms, and a concomitant increase in average farm size. Simultaneously, the agricultural labour force decreased by 16% from 1996 to 2005, a trend which has been accelerating in recent years. Despite that decrease the gross value added of the Dutch agricultural sector rose from 32.3 billion euros in 1995 to 41.9 billion in 2005.

2. Geography and demography

The Netherlands is situated in Western Europe, in the delta of the rivers Rhine and Maas. It borders Belgium to the south, Germany to the east, and the North Sea to the west and north. It has a temperate climate as a result of the influence of the Gulf Stream, with an even rainfall throughout the year (approx. 800 mm per year). The total area of the Netherlands is 41 526 km². Of this area about 18% is wetland. Of the total land area (34 000 km²) about 60% is used for agricultural purposes, 10% is occupied by forest and the remaining 30% is used for human habitation and infrastructure. The total population is 16.4 million (2008). With 482 people per km² (land), the Netherlands is a densely populated country.

Climate change predictions forecast higher temperatures and wetter summers in Western Europe. This development may influence cropping patterns and crop yields, and require germplasm that will be better adapted to future needs.

3. Key aspects of agriculture

The Netherlands has about 2 million ha of agricultural land, of which about half is used for crop production, representing less than 1% of the total arable land in the European Union. Between 1995 and 2005 the Dutch agricultural sector witnessed a decrease in the acreage of arable land, a decrease in the number of farms of 40%, and a concomitant increase in average farm size. Simultaneously, the labour force in agriculture decreased from 282 000 in 1996 to 236 000 in 2005 (a fall of 16%), a trend which has been accelerating in recent years. Employment is concentrated in the greenhouse and open ground vegetable and flower sectors, accounting for almost 75% of all full-time and 90% of all part-time jobs. The share of foreign – mostly Central and East European – (seasonal) labourers has risen to 21%.¹

In spite of downward trends in acreage and labour force, the gross value added of the Dutch agricultural sector rose from 32.3 billion euros in 1995 to 41.9 billion in 2005 and 43.9 billion in 2006. About two-thirds (22.6 billion euros, see Figure 0.1) of the added value is based on the domestic production and processing of agricultural raw materials, and one-third on the processing, delivery and distribution of foreign-grown agricultural raw materials such as cocoa and tobacco.^{2/3}

¹ Berkhout, P., Bruchem, C. Van (2007), *Landbouw economisch bericht 2007*. Agricultural Economics Research Institute (LEI), The Hague. p. 122-124.

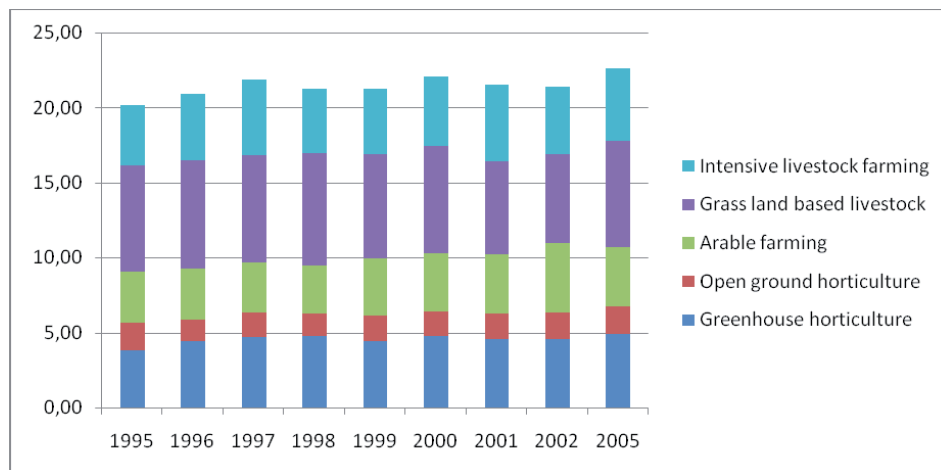
² Leeuwen, M.G.A. Van (2006), *Het Nederlandse agrocomplex 2006*. Agricultural Economics Research Institute (LEI), The Hague.

³ Ministerie van Landbouw, Natuur en Voedselkwaliteit, LNV (2004), *Het Nederlandse agrocluster in kaart*. Den Haag.

4. Value added of Dutch agricultural sector

FIGURE 0.1

Contribution of various sectors to total added value, € billion⁴



Compared with the other EU countries the Netherlands produces a relatively large share of root and tuber crops (potatoes and sugar beet), vegetables and in particular ornamentals (cut flowers, pot plants and flower bulbs)⁵. A significant proportion of Dutch agricultural exports consist of plants, flowers and bulbs, with the Netherlands exporting two-thirds of the world's total. The Netherlands also accounts for a quarter of global exports of tomatoes, and a third of the world's exports of sweet peppers and cucumbers. The Dutch rank third worldwide in the value of agricultural exports behind the United States and France, with earnings amounting to 54 billion euros in 2006⁶. These figures show the interest that the Netherlands has in the conservation and utilization of plant genetic resources.

The country's location gives it prime access to markets in the UK and Germany, with the port of Rotterdam being the largest in Europe. Horticulture (greenhouse and open ground vegetables and flower production) is the highest value sector in Dutch agriculture, followed by grassland-based livestock keeping.^{7/8} The Netherlands is experiencing increasing competition from other large agricultural exporters such as Spain (vegetables), Denmark, Germany and France (dairy products)⁹. In relative terms, the share of agricultural products in total Dutch exports decreased from one quarter in 1995 to one sixth in 2005. A combination of production restrictions, in particular in the livestock sector, falling world food prices, and fast expansion in some non-agricultural sectors formed the main causes for this relative decline.¹⁰

⁴ Van Leeuwen, M., De Kleijn, T., Pronk, B., Verhoog, D. (2008), Het Nederlandse agrocomplex 2007. Landbouw Economisch Instituut (LEI), The Hague, p. 15

⁵ Kamphuis, B.M. (2005), The seed sector in the Netherlands: an overview of production, trade and related institutions. Report 5.05.09. Agricultural Economics Research Institute (LEI), The Hague.

⁶ Berkhout, P., Bruchem, C. Van (2007), Landbouw economisch bericht 2007. Agricultural Economics Research Institute (LEI), The Hague, p. 59.

⁷ Ministry of Agriculture, Nature of Food Quality, LNV (2004), Het Nederlandse agrocluster in kaart. The Hague, p. 8.

⁸ Pinckaers, M. (2005), Netherlands agricultural situation: The Benelux horticulture market. GAIN Report. USDA Foreign Agricultural Service, Global Agriculture Information Network, p. 3.

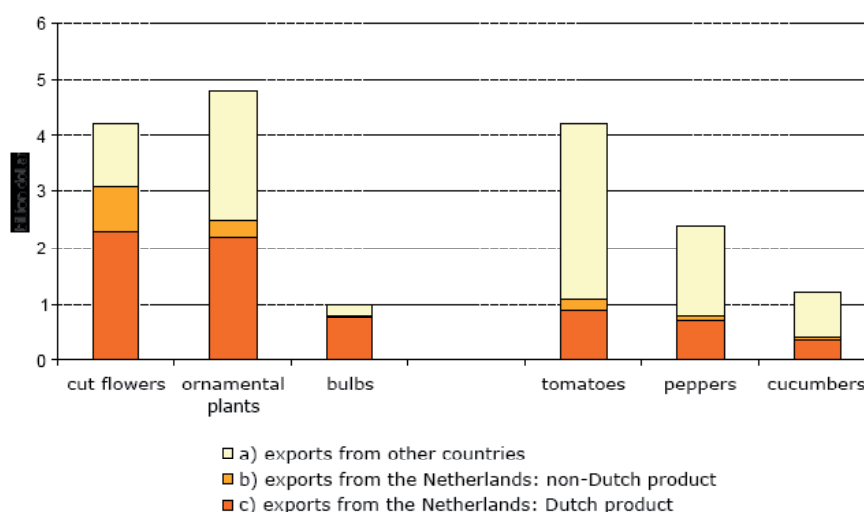
⁹ Ministry of Agriculture, Nature of Food Quality, LNV(2004), Het Nederlandse agrocluster in kaart. The Hague, p. 9.

¹⁰ Berkhout, P., Bruchem, C. Van (2007), Landbouw economisch bericht 2007. Agricultural Economics Research Institute (LEI), The Hague, p. 59.

¹⁰ Berkhout, P., Bruchem, C. Van (2007), Landbouw economisch bericht 2007. Agricultural Economics Research Institute (LEI), The Hague, p. 59.



FIGURE 0.2

Dutch share in world trade in selected horticulture products, US\$ billion, 2003¹¹

In 2007 organic farming accounted for 2.5% of the total agricultural area (1 465 farms)¹². Most organic arable and field vegetable production takes place in the province of Flevoland, where it makes up almost 8% of the area under arable and vegetable crops.

5. Land use and biodiversity

In the first half of the 20th century, nature areas in the Netherlands were been converted to agriculture on a large scale (see Fig 0.3). At the same time, small farms were transformed into large farms depending on high input and industrial management practices. Natural and semi-natural landscape elements, such as hedges, ditches and tree patches, were decimated. These developments had a negative impact on biodiversity. As a consequence of the intensification of Dutch agriculture, imports of external inputs such as animal feed and fertilizers have increased substantially. The ecological footprint (e.g. the area abroad needed to produce these imports) corresponds with an area 105% the size of the Netherlands.¹³

To counteract the loss of biodiversity, some remaining areas of traditional agricultural production systems are protected as nature reserves. In addition, biodiversity and other environmental management schemes have been put in place and organic farming is suggested as an alternative approach in need of a different and additional type of agrobiodiversity.¹⁴ In 1990, a policy to create the National Ecological Network was introduced in order to improve, interconnect and extend natural areas. It turned the nature loss into a slight nature gain, mostly by developing nature areas on former agricultural lands in order to connect up nature areas.¹⁵ Notwithstanding biodiversity-supportive agro-environmental schemes, total biodiversity in Dutch agro-ecosystems has still been declining over the last decade.¹⁶ Since the mid-1980s this trend has stabilized, possibly due to a reduction of chemical inputs and a decrease of ammonia and CO₂ output.

¹¹ Pinckaers, M. (2005), *Netherlands agricultural situation: The Benelux horticulture market*. GAIN Report. USDA Foreign Agricultural Service, Global Agriculture Information Network. p. 4.

¹² Biologica & Task force Marktontwikkeling Biologische Landbouw (2007), *BIO-Monitor: Cijfers en trends. 2007 Jaarrapport*. pp. 13-15

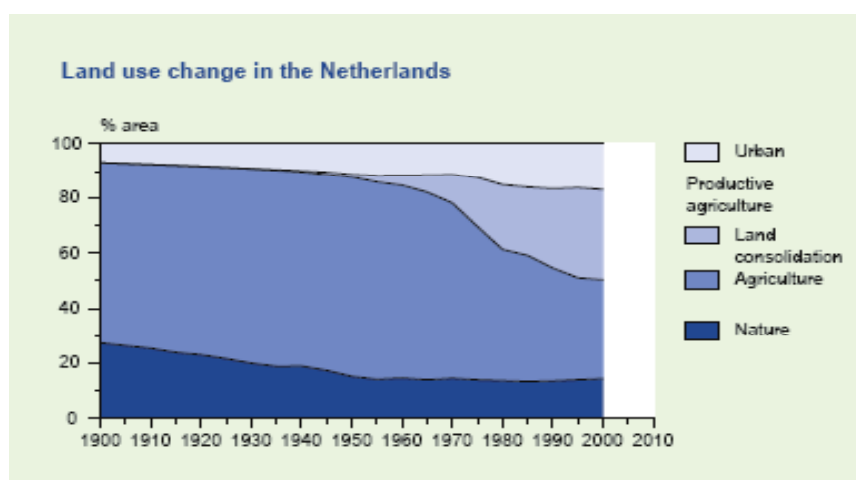
¹³ Netherlands Environmental Assessment Agency and Wageningen University and Research Centre (2008), *Halting biodiversity loss in the Netherlands. Evaluation of Progress*, p. 8.

¹⁴ Berkhout, P., Bruchem, C. Van (2007), *Landbouw economisch bericht 2007*. Agricultural Economics Research Institute (LEI), The Hague. p. IX.

¹⁵ Netherlands Environmental Assessment Agency and Wageningen University and Research Centre (2008), *Halting biodiversity loss in the Netherlands. Evaluation of Progress*, p. 6.

¹⁶ Netherlands Environmental Assessment Agency and Wageningen University and Research Centre (2008), p. 6.

FIGURE 0.3
Land use in the Netherlands¹⁷



Some 10 000 plant species occur *in situ* in the Netherlands. Of an estimated total of 1 400 indigenous vascular plant species, at least 240 taxa have economic value because of their relevance as progenitors or close relatives of human food plants, spices, feed and fodder crops, host plants of honey bees, medicinal plants, species for firewood and timber production, as providers of natural dyes, tannins, pesticides or perfumes, and for their ornamental value.

Because of their ecological value based on rarity on a global or national scale and their decline, 408 species of vascular plants ('target species') have been selected by the Dutch government for special protection. In addition to the vascular plants, some representatives of the 4 000 fungi taxa, 670 lichen species, 440 moss species and 120 liverwort species are also of actual or potential economic and ecological significance.¹⁸

Almost half the 240 vascular plant species mentioned above occur in forests and woodlands, i.e. in the tree layer or in the understorey layer. For the vast majority of these forest species, the Netherlands constitutes either a central or a marginal part of their distribution area. About a quarter of all forest species are considered to be under threat as they have been included in red lists.¹⁹

Invasive species and phytosanitary organisms may be unintentionally co-introduced, further damaging indigenous genetic diversity. Examples of such threats in the Netherlands include the floating pennywort (*Hydrocotyle ranunculoides*), the black and white Longhorn (*Anoplophora chinensis*), ramorum dieback (*Phytophthora ramorum*), greenhouse whitefly (*Trialeurodes vaporariorum*) and hogweed (*Heracleum sphondylium* L.).²⁰

6. PGRFA measures

Following the ratification of the Convention on Biological Diversity by the Netherlands, the need for additional policy and measures with regard to Plant Genetic Resources for Food and Agriculture (PGRFA) has been recognized and kept under review. In 2002, the Ministries of Environment, Agriculture, and Development Cooperation jointly submitted a policy document to Parliament entitled 'Bronnen van ons bestaan'²¹ ('Sources of existence'). A ministerial²² and sectoral working group called 'Biodiversity in Agriculture' investigated options for the more active and sustainable use of biodiversity, which has resulted in the National Policy Programme on Biodiversity²³. Scientific research on the role of biodiversity

¹⁷ Netherlands Environmental Assessment Agency and Wageningen University and Research Centre (2008), p. 6.

¹⁸ Ministry of Agriculture, Nature Management and Fisheries, LNV (1995), The Netherlands Country Report on the FAO International Technical Conference on Plant Genetic Resources in Leipzig, 1996. The Hague, p. 9.

¹⁹ See: [http://nl.wikipedia.org/wiki/Nederlandse_Rode_Lijst_\(planten\)](http://nl.wikipedia.org/wiki/Nederlandse_Rode_Lijst_(planten))

²⁰ Ministry of Agriculture, Nature Management and Fisheries, LNV (1995), p. 9.

²¹ Ministries of Agriculture, Environment, and Development Cooperation (2002), Bronnen van ons bestaan - behoud en duurzaam gebruik van genetische diversiteit. The Hague.

²² Involving the Ministry of Agriculture, Nature and Food Quality, and the Ministry of Housing, Spatial Planning and the Environment.

²³ Dijk, G. Van, Pater, C. De (2004), Quick Scan Agrobiodiversiteit in en buiten Nederland: Activiteiten op het gebied van agrobiodiversiteit met financiering of participatie van de Nederlandse overheid per 1 januari 2004 alsmede mogelijke prioriteiten voor de verdere uitvoering van het Beleidsprogramma Biodiversiteit Internationaal. Expertisecentrum LNV, Ede, The Netherlands.



in Dutch agricultural practice was recently summarized in: 'Agrobiodiversity: options for sustainable agriculture'.²⁴ Meanwhile, the Netherlands has traditionally been involved in collecting and maintaining a wide range of PGRFA, with the Centre for Genetic Resources the Netherlands (CGN) as the main organization responsible (see Chapter 3).

The total number of plant collections in the Netherlands is at least 90, of which 15 are under public, 67 under private, and 8 under NGO authority. The most important public collection of agricultural and horticultural crops is managed by CGN in Wageningen.²⁵ The plant breeding industry is an important user of these plant genetic resources, but increasingly relies on private working collections as well. No clear distinction in the species coverage of the private and public collections can be made.²⁶

7. The Dutch seed industry

The Dutch plant breeding industry is a sector with a long history. Some of the current companies were founded more than a century ago. Development and production of plant reproduction material is a major, highly developed economic activity in the Netherlands. The plant improvement sector provides jobs for 10 000 workers, including a relatively large number of higher-educated workers, and is supported by a good academic infrastructure in the field of plant breeding and genetics.²⁷ R&D is aimed mainly at deciphering the genetic structure of plants, the development of varieties with new traits such as resistances to pests and diseases, and the development of fast asexual propagation methods and quality improvement of the plant reproduction material. More recently, quality traits including taste have received increasing attention. The future position of the industry is supported by public-private R&D partnerships such as the Centre for Biosystems Genomics and the Top Technology Institutes. The turnover of the Dutch agricultural and horticultural breeding and propagating industry amounts to 2.5 billion euros a year.

Since the mid-1980s, a strong trend at global level towards economic liberalization has resulted in a concentration of knowledge and other assets, as well as market diversification. In turn, this process has stimulated economic growth and development. This has had its consequences for the Dutch seed sector, with an increased focus on vegetable seeds and ornamentals. Two Dutch companies are now owned by Monsanto, USA (Semini, De Ruiter Seeds) and one each by Syngenta, Switzerland (Sluis & Groot) and Bayer, Germany (Nunhem). Three of the world's 12 largest seed companies remain headquartered in the Netherlands and are family owned (Rijk Zwaan, Enza, Bejo)²⁸. The role of the Dutch seed sector in arable crops has declined markedly, with the exception of the potato seed sector. A single Dutch family-owned seed company in grasses (Barenbrug) remains in existence.

The Netherlands is the world's largest seed exporter, with 24% of the total world export value, surpassing the USA (19%) and France (15%). Eight out of ten of the world's largest vegetable seed companies have their main offices and/or important branches in the Netherlands.²⁹



²⁴ Vosman, B. *et al.* (2007), *Agrobiodiversiteit: kansen voor een duurzame landbouw*. Wageningen University and Research Centre (WUR), Wageningen.

²⁵ Netherlands CBD Focal Point for Access and Benefit Sharing related to Genetic Resources. <http://www.absfocalpoint.nl>

²⁶ The private sector manages major collections of ornamental species.

²⁷ Dons, H. J.M. and Bino, R.J. (2008), *Innovation and knowledge in the Dutch Horticultural System*. In: *Pathways to High-tech Valleys and Research Triangles. Innovative Entrepreneurship, Knowledge Transfer and Cluster Formation in Europe and the United States*. Wageningen UR Frontis Series, Vol. 24. Wageningen. pp. 119-137.

²⁸ Global Seed Industry Concentration – 2005, ETC Group Communiqué. September/October 2005 Issue # 90.

²⁹ Kamphuis, B.M. (2005), *The seed sector in the Netherlands. An overview of production, trade and related institutions*. Report 5.05.09. Agricultural Economics Research Institute (LEI), The Hague. pp. 19-21.



More than half of Dutch seed exports go to other EU countries, especially Germany, France, Italy, the United Kingdom and Spain. The USA and Japan are the most important customers outside the EU. The export value of Dutch plant reproduction material is about 1.6 billion euros per year. Recent growth has mainly stemmed from vegetable seeds and plants and rooted cuttings. The Dutch in particular set the tone for seed potatoes and flax seed. In the EU, 100 000 ha of seed potatoes are under cultivation, with 40% of this area being in the Netherlands. Moreover, Dutch companies account for 75% of the international trade in seed potatoes.

Commercial agriculture in the Netherlands is almost totally based on the use of modern varieties supplied by commercial plant breeding and seed production. In addition, home gardens rely mainly on these commercial varieties. The organic sector is a growth market, although currently accounting for just 2.5% of the Dutch fresh food market³⁰. The sector relies on seed from organic seed production programmes of the mainstream plant breeding industry³¹, as well as seed from specialized organic seed companies, such as Vitalis, De Bolster, Bioselect (Agrico) and ACM, and on organic seed imports from Germany.

8. Food processing and consumption

The food processing sector is the largest industrial sector in the Netherlands with a turnover over 54 billion euros in 2004. With a growth of 20% since 2000, the sector is growing rapidly and increasingly invests abroad. In 2005 about 32 billion euros was invested in foreign processing companies (17 billion in 1997), especially in the USA (6.5 billion), Central and South America (3.9 billion) and Switzerland (3.9 billion). Foreign investors are also investing increasingly in the Netherlands (22 billion in 2005 vs. 8 billion in 1997).³²

At the consumer end of the chain, supermarkets have come to dominate the retail distribution of food. Vegetable breeding companies increasingly consult players in the entire food chain in order to identify new crop characteristics for targeted in breeding programmes.

The Dutch currently spend about 65% of their food budget in supermarkets, totalling about 24 billion euros per year³³. Four supermarket holdings dominate the market (85%), with Royal Ahold (27.5%) in the lead³⁴. Experts predict more mergers and takeovers. The concentration allows a strong negotiating position vis-à-vis producers, processors and other suppliers. Long-term contracts are used to secure product quality year round.

Consumption patterns show a tendency towards ready-made, processed food at the cost of unprocessed fresh fruit and vegetables. Simultaneously, a growing interest in health products and the quality of products has stimulated the consumption of both organic products and regional products.³⁵ For example, the Slow Food movement originating from Italy, which combines a growing awareness of the value of tradition, biodiversity, culture, taste in food production, preparation and consumption, has been gaining ground in the Netherlands since 2000. The ageing of the Dutch population and the growing demand for high quality food from catering companies and restaurants adds to this development.

Sales growth of organic products is still considerable: 2007 saw an increase of 13,3 % (from 457.9 m. to 518.9 m. euros): almost twice the increase in non-organic sales. Sales of organic products now account for about 2.5 % of the total fresh market. About 40% of organic products (200 million in 2006) is sold in (specialty organic) supermarkets³⁶. The market share of regional products (i.e. products that are produced in a specific region or according to a specific traditional, regional production process) is not known. Estimates of the market size of these products date from 2002 (45 million)³⁷. Another noticeable development is the growing market for food products consumed by Surinamese, Moroccan and Turkish immigrants. Together they constitute about 10% of Dutch consumers, and these groups spend a relatively large share of their income on food.³⁸

³⁰ Biologica & Task force Marktontwikkeling Biologische Landbouw (2007), BIO-Monitor: Cijfers en trends. 2007 Jaarrapport, p. 6.

³¹ Bijman, J., Eaton, D. (2003), *Conservering van genetische bronnen voor de landbouw in Nederland: Organisatie en institutionele inbedding*. Rapport 7.03.14. Landbouw Economisch Instituut (LEI), The Hague, p. 35.

³² Berkhout, P., Bruchem, C. Van (2007). *Landbouw economisch bericht 2007*. Agricultural Economics Research Institute (LEI), The Hague, pp. 61-63.

³³ Berkhout, P., Bruchem, C. Van (2007), p. 68.

³⁴ Berkhout, P., Bruchem, C. Van (2007), p. 73.

³⁵ Bijman, J., Pronk, B. (2003), *Wie voedt Nederland? Consumenten en aanbieders van voedingsmiddelen 2003*. LEI, The Hague, p. V.

³⁶ Berkhout, P., Bruchem, C. Van (2007), *Landbouw economisch bericht 2007*. Agricultural Economics Research Institute (LEI), The Hague, p. 71.

³⁷ Broekhuizen, R. Van, Tacke, G. (2004), *Koepelproject kennisontwikkeling streekgebonden productie en vermarkting. Rapportage voor de co-innovatieprogramma's Professionalisering Biologische Afzetketen en Duurzame Agro Foodketens*. Wageningen University and Research Centre (WUR), Wageningen. pp. 38-39

³⁸ Bijman, J., Pronk, B. (2003), *Wie voedt Nederland? Consumenten en aanbieders van voedingsmiddelen 2003*. LEI, The Hague, p. 31.

9. Trends

Major trends characteristic of agriculture in most developed countries can also be observed in the Netherlands. In particular, developments in the Netherlands reflect those of other West European countries. A decrease in the acreage of arable land has occurred simultaneously with an intensification of production characterized by higher yields per hectare, combined with a shift towards horticulture and intensive livestock farming. The number of farmers has declined still further, whereas the average farm size has substantially increased.

Although already a trend in the 1980s, breeding activities in the public sector have now all but disappeared and have become exclusively concentrated in the private sector. Private breeders are increasingly concentrating on crops with a high added value, notably vegetables and potato seeds. Basic research in the public sector has continued. Scientific developments have revolutionized crop breeding, in particular through the development of marker-assisted breeding and developments in genomics research. Decision-making in the product chain has changed, and breeding companies closely follow the specifications required by parties at the end of the chain, in particular the retail sector.

Product diversity is increasingly created by processing rather than by diversity in the harvested product. However, niche markets for consumers with a keen interest in regional and traditional products or with an immigrant culture background, as well as organic production, are also slowly developing.

THE STATE OF DIVERSITY



1.1 Summary

In the Netherlands, the area of grassland has slowly but steadily been decreasing over the last few decades. The area of arable crops has remained relatively constant, whereas the horticultural area has increased slightly. Over 41 different food and feed crops are cultivated on an acreage of over 100 ha, whereas five commodities (wheat, barley, maize, sugar beet and potato) made up an acreage of over 25 000 ha. Twenty vegetable crops are extensively cultivated in the Netherlands. In terms of diversity, this group is richer than any of the other groups. Since 1970, a number of crops have almost disappeared from production, including rye, oats, pulses, caraway, and fodder beets. The number of farms cultivating these marginalized crops has decreased to a similar extent. The number of registered and recommended varieties of rye, oats, and pulses has decreased, whereas for caraway (and also for the major crop of sugar beet) such a decline could not be observed against decreasing production figures. The number of registered and recommended varieties in combination with data on acreages and number of farms for the crop concerned may form an indication for remaining genetic diversity of that crop in the country at large. Rapeseed originally faced the same fate of marginalization, but the acreage has been restored to some extent during the last decade since it fitted in well into the crop rotation in the northern province of Groningen. Other crops, specifically those used for green manure and capture crops, gained in acreage over the last decade.

1.2 Overview of Dutch agricultural production systems

Of the total agricultural area in the Netherlands of 1 914 331 ha (2005), just over half is in use as grassland. Roughly 45% is in use for arable crops. A typical feature for the Netherlands is the relatively large area in use for horticultural crops (110 000 ha), of which a substantial part is cultivated under glass (10 500 ha). The grassland area has been gradually decreasing over the last few decades. The area of arable crops has remained relatively constant, whereas the horticultural area is increased slightly.

A large variety of food and feed crops is cultivated in the Netherlands, which may be divided into agricultural and horticultural crops (vegetables and fruit). Many of these crops are bred and propagated by the major Dutch breeding and seed production sector. Plant breeding in the Netherlands is performed in the context of the UPOV regulations³⁹. The Dutch Seeds and Planting Material Act underlies regulations concerning Plant Breeder's Rights and the National List of Varieties for Vegetables and Field Crops⁴⁰. Only varieties registered on the National List can be commercialized. A Recommended List of Varieties for Field Crops (except potatoes) is also published at the request of the industry. Over the years this list has formed a valuable source of information for the field crop varieties grown in the Netherlands, and has been extensively used to collect data for the current report.

Dutch agricultural production, aggregated according to FAO definitions, is summarized in Table 1.1. The table includes both agricultural and horticultural crops, but excludes grasses and non-food crops such as fibres, flowers and bulbs.⁴¹

In the Netherlands, the most important (by area) aggregated crop groups are fodder crops, cereals, and roots and tubers, followed by vegetables and sugar crops. The crop acreage of the main crops has remained fairly constant over the last decade. Only the sugar crops (sugar beet) acreage is decreasing rapidly. This is due to the liberalization of the global sugar market, rendering the cultivation of sugar beet commercially less attractive. The decrease in acreage has however been moderate, since sugar beet also forms a major crop in the Dutch rotation system practised to a significant extent

³⁹ UPOV International convention for the protection of new varieties of plants of December 2, 1961, as Revised at Geneva on November 10, 1972, on October 23, 1978, and on March 19, 1991.

⁴⁰ H. Bonthuis, D.A. Donner and A. van Vlieghe (2005): 80e Rassenlijst: Field crops: recommended list of varieties and national list of varieties.

⁴¹ The FAO aggregation rules were chosen to facilitate comparison with other countries, although the system in use by the Dutch authorities deviates somewhat from the FAO system. For example, until 2005, green beans have been considered pulses in the Dutch system, but vegetables in the FAO classification.

in arable crop cultivation (mostly a 3-year rotation with potato, cereals and sugar beet). The acreage of pulses decreased in the mid-nineties after a peak in the mid-eighties. Both the peak and the decline were caused by the cultivation of dry peas, driven by EU subsidy policies on proteins.

TABLE 1.1

Area harvested (ha x 1000) of crops in the Netherlands over the last decades

	1990	%	1995	%	2000	%	2006	%
Cereals	195.30	23.4	193.70	23.6	219.10	26.5	214.70	26.5
Fruit	25.49	3.1	25.97	3.2	23.95	2.9	20.84	2.6
Roots and Tubers	175.00	21.0	179.00	21.8	180.20	21.8	156.00	19.2
Pulses	20.00	2.4	3.83	0.5	3.00	0.4	2.71	0.3
Vegetables	66.49	8.0	71.20	8.7	72.20	8.7	93.34	11.5
Sugarcrops	125.00	15.0	116.10	14.1	111.00	13.4	84.00	10.4
Fodder crops	211.96	25.4	224.84	27.4	211.60	25.6	231.50	28.6
Oilcrops	15.26	1.8	6.89	0.8	5.77	0.7	7.75	1.0
Total	834.50	100.0	821.53	100.0	826.81	100.0	810.83	100.0

Source FAO-Stat⁴²

The number of crops within an aggregated group varies. The 'Root and Tubers' group contains only potatoes, whereas the 'Vegetable group' includes 18 crops.

In total, over 41 different food and feed crops are cultivated in the Netherlands, with a production area of over 100 ha (Table 1.2). Only five of those (wheat, barley, maize, sugar beet and potato) have an acreage of over 25 000 ha. The latter crops are considered *major crops* in this report. However, major crops (in area) are not necessarily the most important in terms of plant diversity. Although limited in acreage, the vegetable group includes almost 20 crops and hence is richer in diversity than any of the other groups.

TABLE 1.2

Number of crops within commodity groups. Within brackets the acreage (ha x 1 000) is indicated

	Number of crops with a cultivated area of:		Crops
	> 100 ha	> 25,000 ha	
Cereals	6	2	Wheat (141) Barley (44)
Fruit	7	0	
Roots and Tubers	1	1	Potato (156)
Pulses	3	0	
Vegetables	18	0	
Sugarcrops	1	1	Sugarbeet (84)
Fodder crops	2	1	Maize (224)
Oilcrops	3	0	
Total	41	5	

Source FAO Stat

In addition to the developments indicated above, some a number of changes in cultivation patterns can be observed. Some minor crops have decreased in importance in Dutch production, as clearly evident when developments are followed over a longer period. In particular, a number of crops have almost disappeared just in the past few decades, including rye, oats, caraway, and fodder beets. The number of farms cultivating these crops has decreased to a similar extent. These figures on production systems are only weakly correlated with figures on registered and recommended varieties as a more direct indicator of remaining diversity, some crops showing a concomitant decrease of varieties and others not.

TABLE 1.3
Acres and number of farms of marginalized crops

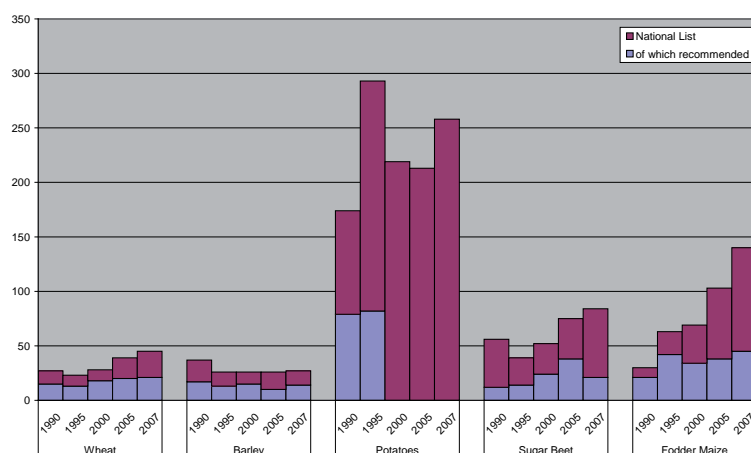
Crop	Acreage (x 1000 ha)			Number of farms (x 1000)		
	1970	1996	2007	1970	1996	2007
Rye	55.3	6.9	2.8	33 642	2 170	772
Oats	55.1	1.7	1.7	22 465	718	404
Dry beans	4.0	2.1	1.1	2 572	825	253
Caraway	1.7	0.6	0	453	121	8
Fodder beets	9.3	1.4	0.3	28 401	1 691	357

Source LEI

1.3 State of diversity of major crops

With the exception of potatoes, the varieties of the major crops cultivated in the Netherlands are recorded in two lists: the National List of Varieties, and the Recommended List of Varieties, containing a sub-set of the National List. Although not always commercially used, varieties on the National List are still propagated and preserved by the assigned breeder or agent. In contrast, varieties on the Recommended List of varieties are often commercially important and widely grown by Dutch farmers. For potatoes, the Recommended List was abandoned in 1999. The National List describes many different characteristics of the different potato varieties, leaving it to the grower to make their choice for specific purposes under specific conditions. Varieties on either list contribute to total plant diversity in use in the country. Both the National and Recommended lists are of importance for explaining total plant diversity. The National List shows the varieties that are maintained in the Netherlands, and which are therefore relevant for an analysis of total crop diversity. When varieties are not recommended, their use is generally low, and they are at risk of disappearing completely. Varieties on the Recommended List are generally commonly cultivated and better preserved. Figure 1.1 summarizes the number of varieties of the major crops on both lists. The figures reflect the *number* of varieties as they appear on each list, not their *acreage*. In terms of cultivation, the varieties on the recommended list generally account for around 95% of the total production area.

FIGURE 1.1
Number of varieties of the major crops on the National List of Varieties and the Recommended List of Varieties over the last decades



The registered varieties of potato are grown for consumption or industrial use, or as seed potatoes for export. A number of breeding companies specialize in potatoes. Most of them make use of so-called associated breeders: farmers that select and test new varieties. This participatory breeding system adds to the development of new varieties and hence to the diversity of potatoes registered in the Netherlands.

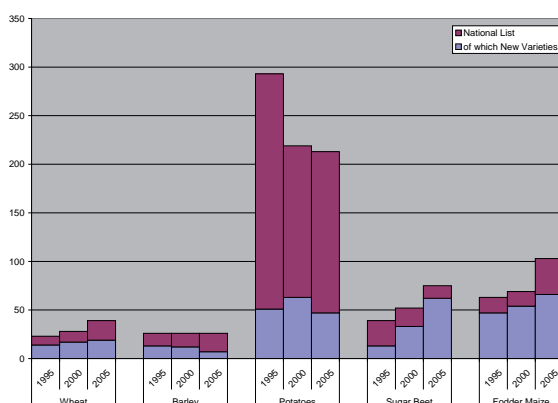


In contrast to the other major crops, potato is a tetraploid, heterozygous plant that is vegetatively propagated. This enables continuous new genetic arrangements within a fairly constant gene pool. The number of varieties therefore does not necessarily reflect a high genetic variation. New variation is brought in by companies or research institutes from wild ancestors, often originating from the Centre of Diversity (e.g. Latin America). This introgression is a time-consuming process, but considered to be necessary to improve potatoes beyond the current quality. The time-consuming breeding process makes potato an interesting object for genetic modification. Consequently, this approach is pursued in collaboration by companies, the Dutch government and research institutes and may add to the genetic diversity of potato in the near future.

Sugar beet cultivation in the Netherlands still depends on European subsidies. Its future depends largely on European and global policies, as currently negotiated in the Doha Round of the WTO. To compensate for decreasing profits, many breeding efforts are undertaken to increase the profitability of sugar beet cultivation. On average, this has resulted in a yearly sugar content increase in new varieties of 2%. Sugar beet cultivation is also confronted with sometimes rapidly evolving plant diseases. To enable a quick response, pathogen resistance is one of the major breeding targets. These breeding efforts continuously result in new varieties, accumulating new resistances. Both the rapidly increasing sugar content and rapid response to plant diseases account for the relatively short lifespan of each variety (Figure 1.2).

FIGURE 1.2

Number of varieties of the major crops on the National List of Varieties and the number of new varieties added to the list in the 5 previous years



Both wheat and barley varieties may be divided into winter and summer types. Both are cultivated in the Netherlands. For wheat the winter types prevail, whereas barley is mostly cultivated as a summer crop. New varieties are developed elsewhere in Western European and are derived from a common gene pool.

Fodder maize has grown in importance in recent decades, as reflected in the increasing number of varieties. While the acreage remained almost constant since 1990, the average yield per ha (dry weight) has increased by almost 20%. As with sugar beets, the life-time of each variety is relatively short.

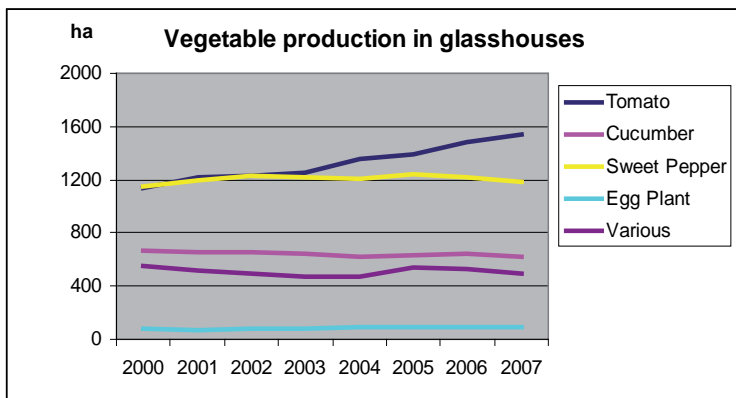
1.4 State of diversity of other crops

Vegetables are of great economic importance in the Netherlands. Although the acreage is small compared to that for major arable crops, the diversity in this group of crops is considerable. Over 20 different crops are cultivated both in the open field and in greenhouses. Major greenhouse vegetables are tomatoes, sweet peppers, cucumbers and eggplant (Figure 1.3).⁴³

⁴³ LEI and CBS (2008): Land- en tuinbouw cijfers. <http://www3.lei.wur.nl/ltc/index.aspx>



FIGURE 1.3
Production of the main vegetables in glasshouses since 2000



Of those, tomatoes have shown a rapidly increasing acreage. This is a result of recent product diversification; the increase may be attributed completely to small-fruited tomatoes. With an acreage of 24 000 ha, (dry) onion is the most important open field vegetable, followed by various types of cabbages and carrots (both 8 000 ha).

In contrast to the regulations for arable crops, no published National List of Varieties exists for vegetable crops. A National List of varieties is maintained and submitted to the EU annually. Commercial use is solely regulated at European level, as reflected in the 'Common Catalogue of Varieties of Vegetable Species'.⁴⁴ Consequently, no separate information is available on varieties grown in the Netherlands. However, the Common Catalogue lists the nationality of the maintainers of each variety. This forms an indication of the importance of the varieties in the different European countries and an indication of genetic diversity within the crop. Table 1.4 lists the number of varieties of different vegetable crops with Dutch maintainers.

Regarding the more marginalized crops discussed above, the number of registered and recommended varieties of rye, oats, and pulses has decreased, whereas for caraway (and also for the major crop of sugar beet) such a decline could not be observed against decreasing production figures. The number of registered and recommended varieties in combination with data on acreages and number of farms for the crop concerned may form an indication for remaining genetic diversity of that crop in the country at large.

⁴⁴ EU: Common catalogue of varieties of vegetable species (2008). http://ec.europa.eu/food/plant/propagation/catalogues/comcat_vegetable2008/index_en.htm

TABLE 1.4

Total number of vegetable varieties in the Common EU Catalogue and the number with a Dutch maintainer

Species Name	Varieties			Species Name	Varieties			Species Name	Varieties		
	Dutch	Total	%		Dutch	Total	%		Dutch	Total	%
Tomato	1205	3117	39	Gherkin	121	363	33	Chinese Cabbage	38	97	39
Lettuce	889	2088	43	Radish (black & normal)	121	496	24	Turnip	32	192	17
Chili/Pepper	605	1769	34	Endive (curled & plain)	108	316	34	Broadbean	32	144	22
French Bean (climbing & dwarf)	459	1458	31	Leek	104	268	39	Gourd	25	68	37
Cucumber	415	870	48	Egg Plant	97	272	36	Fennel	25	94	27
Onion	379	1028	37	Savoy Cabbage	95	230	41	Curly Kale	23	43	53
Cauliflower	351	796	44	Brussels Sprouts	88	121	73	Lamb's Lettuce	17	65	26
White Cabbage	282	706	40	Sprouting Broccoli	80	168	48	Rhubarb	16	18	89
Carrot	245	671	37	Chicory	57	256	22	Shallot	13	35	37
Melon	225	935	24	Celery	43	125	34	Celeriac	13	61	21
Spinach	199	341	58	Red Cabbage	40	116	34	Asparagus	11	83	13
Peas (round, sugar & wrinkled)	193	808	24	Kohlrabi	39	128	30	Artichoke	10	36	28
Marrow or Courgette	128	574	22	Beetroot	39	182	21	Spinach Beet	9	71	13
Watermelon	126	381	33	Runner Bean	39	97	40	Other vegetables	8		

1.5 Factors affecting the state of diversity

The Common Agricultural Policy (CAP) is a major factor shaping the future of agriculture in the Netherlands. The policy aims at a reasonable standard of living for farmers as well as high quality and fair prices for consumers. However, the current European policy is to reduce the budget considerably. One of the crops extensively subsidized by the CAP is sugar beet. In 2005, the European Union decided to cut the minimum beet price by 39% from 2006 onward, over a period of four years in total.⁴⁵ This will enable new countries to market sugar on the European market, with probable effects on local production elsewhere. Since sugar beet is an important rotation crop in the dominating farming system in the Netherlands, this policy will probably affect agricultural practices in the Netherlands.

Innovation has always formed a cornerstone of the Dutch agricultural policy. Recently, the Dutch Innovation Platform acknowledged Dutch agriculture as a key area for innovation and economic development under the name Flowers & Food.⁴⁶ By mentioning flowers before food, where flowers stand for high-added value agriculture, the platform signifies that in their opinion high-added value will be the future trend for Dutch agriculture. This trend capitalizes on the excellent logistic and infrastructure options in combination with relatively high costs of land and labour in a densely populated country.

Many horticultural crops may be regarded as high-added value crops. In addition, the new emphasis on a bio-based economy (biofuels, bio-plastics and other products) also opens up new opportunities for arable crops, especially as a source for bulk or fine chemicals. Diversification of the use of sugar, or the production of sugars other than sucrose in sugar beet, may counteract the above mentioned threat to Dutch sugar beet cultivation.

Climate change will influence Dutch agriculture as well. Higher temperatures, changing rainfall patterns and newly emerging plant diseases will change the suitability of the Dutch environment for specific crops and drastically change agricultural production systems. It is beyond the scope of this report to speculate about any increasing or decreasing effect on plant genetic diversity.

Some plant pathogens tend to adapt to resistant plant varieties, evoking a rat-race between breeders and adaptation. This can result in a rapid follow-up of new varieties, with – apart from the resistance gene – sometimes minor genetic differences. Even less genetic difference can be expected in Genetically Modified Organisms (GMOs). At global level, the acreage of GMOs continues to grow linearly by each year. This development is unlikely to change and may offer new opportunities for Dutch agriculture. In general, genetic modification may have a big impact on plant diversity, since this technology allows gene sources for breeding far beyond the sources available for conventional approaches like cross-breeding. Genes from non-related species can be transferred to commercial crops, raising the question as to whether policies are needed to conserve and protect a much wider pool of species of potential relevance for food and agriculture, and under which conditions genetically modified varieties may be included in crop collections in future.

A distinction may be drawn between the crop diversity that is available in the market, and that is in fact in cultivation. Whereas the latter is an indicator for actual diversity in the field, the former reflects which diversity can be easily mobilized for further breeding and production at any time. In addition, crop diversity that is no longer available in the market is partly maintained in *ex situ* collections (see chapter 3).

⁴⁵ EU: Reform of the sugar sector (2007). http://ec.europa.eu/agriculture/capreform/sugar/index_en.htm

⁴⁶ Rens van Tilburg en Florian Bekkers (2004): Van dijkgraaf tot art director: voorstellen tot actie van het Innovatieplatform.

1.6 Trends

Agriculture in the Netherlands tends to focus on high value crops, marginalizing staple crops and promoting horticultural crops. The shares of cultivated crops are highly sensitive to European policies. New crops have come into production for specific purposes, like green manure crops and capture crops.

An absolute decline in acreages in the production system (an indicator for on-farm genetic diversity) is often but not always followed by a decrease in the number of registered and recommended varieties (an indicator for available genetic diversity at large). Maize has replaced fodder beets as fodder crop.

Many potato varieties are mainly developed and registered for commercialization in distant markets. Future drivers for change may be formed by climate change and novel applications of biotechnology, including genetic modification.



THE STATE OF *IN SITU* MANAGEMENT

2.1 Summary

Very few traditional varieties – especially potatoes and fruit species – are still produced by commercial growers. Traditional diversity is maintained in gardens, rather than on farms. The Netherlands is home to only a limited number of genera that can be regarded as more direct wild relatives of our cultivated crops. No specific policy has been developed to protect the species involved, but many are assumed to survive in national parks and nature reserves.

2.2 *In situ* management of cultivated diversity under conditions of modern agriculture

The Netherlands experienced an almost total change from traditional agriculture to high-external-input modern agriculture in the first half of the 20th century. This change resulted in a high level of uniformity of cropping systems and a consequent loss of genetic diversity from farmers' fields. The varieties associated with production systems preceding the change to modern agriculture are called 'traditional' varieties. A number of these varieties are still planted, often on a very limited scale. Very few traditional varieties – especially potatoes and fruit species – are still produced by commercial growers. Traditional diversity is maintained in gardens, rather than on farms. Whereas individual gardeners may only grow a very limited number of varieties, as a group they still maintain a large number of traditional varieties of vegetable and fruit crops. The largest association of Dutch hobby gardeners has a membership of many thousands. Both large seed companies and specialized seed producers cater to the needs of these gardeners by offering small packages of seeds of over 1 000 different varieties, although not all of Dutch origin. In addition, the Historische Groentenhof (Historical Vegetable Court) in cooperation with Vreken Zaden maintains 350 traditional vegetable varieties and 70 varieties of herbs of various species of Dutch origin, whereas a number of enterprises have specialized in organic seed production. As an example of the latter category, De Bolster offers another set of over 100 traditional Dutch vegetable varieties for sale.

Although still marginal in size, sales of traditional and regional products through farm shops and other niche markets increasingly contribute to the conservation and utilization of *in situ* managed crop genetic diversity.

2.3 Non-domesticated diversity

Naturally occurring Plant Genetic Resources for Food and Agriculture (PGRFA)⁴⁷ of relative importance to plant breeding are by and large restricted to a number of grass and fodder species, including *Lolium perenne* L. and *Trifolium* spp. (clover), for which the Netherlands forms part of a secondary region of diversity. Recent research has indicated that genetic diversity of *Lolium perenne* and probably other grass and fodder species is adequately maintained in existing natural and protected grassland vegetation. A number of naturally occurring species related to crops, such as *Lactuca*, *Brassicacae*, *Prunus*, and various legumes are of minor significance as PGRFA.⁴⁸

In 1998, an extensive survey by the Centre for Genetic Resources, the Netherlands (CGN) revealed the location of only fifty remaining traditionally managed grasslands still in agricultural use. Since then, the number of these traditional grasslands has continued to decrease. Future survival of traditional grasslands and hence any unique genetic diversity contained in such systems can be considered unlikely. There are no specific *in situ* conservation activities directed at such

⁴⁷ PGRFA is usually defined as plant genetic resources that support agriculture at large. We have used this definition in this report, but focus on PGRFA supporting one aspect of agriculture, namely food production. Hence, PGRFA used in forestry for fuel production or other industrial purposes are not included.

⁴⁸ Treuren, R. Van & Visser, B. 2005. Traditional grasslands: conservation measures needed? Genetic Resources Policy Brief, Centre for Genetic Resources, the Netherlands, Wageningen.



species since conservation is assumed to take place effectively through nature conservation programmes.⁴⁹

The Netherlands is home to only a limited number of genera that can be regarded as more direct wild relatives of our cultivated crops, including species in the genera *Agrostis*, *Allium*, *Avena*, *Brassica*, *Festuca*, *Hordeum*, *Lactuca*, *Malus*, *Poa*, *Ribes*, *Rubus*, *Trifolium* and *Vaccinium*. No specific policy has been developed to protect the species involved, but many can be assumed to survive in national parks and nature reserves.

Similarly, a pilot study by Van Treuren *et al.*⁵⁰ showed that the genetic diversity of three semi-domesticated crops *Lolium perenne*, *Trifolium repens* and *Poa pratense*, for which the Netherlands forms a secondary centre of diversity, was well conserved in a number of Dutch nature reserves.

2.4 Related research

The Dutch Species Catalogue⁵¹ provides a current and comprehensive overview of Dutch biodiversity. It is based on the data gathered by experts in various aspects of flora and fauna. Dutch biodiversity is among the best investigated in the world. The Dutch Species Catalogue combines this species-level information for the first time in history, and, in this way, contributes to international biodiversity networks such as Fauna Europaea and GBIF. It currently describes 35 116 species, of which only a small number bear relevance for food and agriculture.

The European initiative PGR Forum⁵² has undertaken a diversity assessment of European crop wild relatives. A crop wild relative (CWR) is defined as a taxon related to a species of direct socio-economic importance. Socio-economically important species include food, fodder and forage crops, medicinal plants, condiments and ornamental and forestry species, as well as plants used for industrial purposes, such as oils and fibres. Results of data analysis carried out by PGR Forum show that approximately 79% of the Euro-Mediterranean (Europe plus the Mediterranean) flora consists of crop wild relatives and other utilised species, as well as the crops themselves; in other words, more than three-quarters of the plant species in the region have a current or potential direct use for humankind.

2.5 Trends

Against the backdrop of large-scale, high-external input and uniform crop production, traditional genetic diversity of vegetables and fruits in particular is maintained by home gardeners and a small number of NGOs that have gradually strengthened their positions. Greater attention to our bio-cultural heritage has gradually been developing amongst the wider public.

⁴⁹ Idem.

⁵⁰ Van Treuren *et al.* 2005. Genetic diversity in perennial ryegrass and white clover among old Dutch grasslands as compared to cultivars and nature reserves. *Molecular ecology* 14: 39 – 52.

⁵¹ <http://www.nederlandsesoorten.nl/get?site=nlsr>

⁵² http://www.pgrforum.org/CWR_Species.htm

THE STATE OF *EX SITU* MANAGEMENT

3.1 Summary

The Centre for Genetic Resources, the Netherlands (CGN), botanic gardens, NGOs and private companies manage plant genetic resources collections of major importance for food and agriculture. A substantial increase over during the period 1996 – 2008 is reported for the size of the CGN collections (35%), the extent of documentation (50%), and even more the number of distributions (300%), indicating the importance of these collections. A number of new relatively small crop collections has been added to CGN's total holdings, which have now reached 24 000 accessions. Collecting missions have continued, although agreements on the access and benefit-sharing conditions for some international missions could not be reached. CGN's collections have been duplicated in the Svalbard Seed Vault. Botanical gardens manage large collections including wild relatives, whereas NGOs have focussed on traditional crop diversity. Holdings of plant genetic resources managed in the private sector have increased considerably in size.

3.2 Introduction

The Ministry of Agriculture, Nature and Food Quality established a national genebank in 1986, the Centre for Genetic Resources, the Netherlands (CGN), which is administered by Wageningen University and Research Centre. Until 1999, CGN was only active in the domain of plant genetic resources, but since 1999 and 2004 respectively, CGN has also acquired the mandate to contribute to the conservation of farm animal species and indigenous trees and shrubs.

In addition to CGN's national plant collections in the public domain, other collections have been established and maintained as well. These include collections established in the private sector (67), mainly plant breeding companies, collections maintained by botanical gardens and other public institutions, often associated with universities (15), and collections maintained by non-governmental organizations (8). The total number amounts to 90 collections. An overview of all these collections is provided on the website of the National Focal Point on Access and Benefit-Sharing under the Convention on Biological Diversity, administered by CGN on behalf of the Ministry (www.absfocalpoint.nl).

3.3 Policy developments

As a major development since the country report for the First Report on the State of the World's Plant Genetic Resources, the government of the Netherlands has ratified the International Treaty on Plant Genetic Resources for Food and Agriculture. As a follow-up to ratification, CGN in 2007 adopted the Standard Material Transfer Agreement (SMTA) which was concluded at the First Governing Body meeting of the International Treaty in 2006 in Madrid, and in the process has opted for a click-wrap signature procedure, by which the requester of genebank accessions signifies agreement on-screen with the conditions of the SMTA. Furthermore, the Netherlands has placed the collections of four different collection holders in the Multilateral System of the International Treaty, i.e. all collections of CGN listed in Annex 1 of the International Treaty, the *Solanaceae* collection of the botanical garden of the Radboud University in Nijmegen, and the apple collections of the Northern Pomological Society and the North Holland Pomological Society. Finally, the Ministry has agreed that CGN will make its collections of non-Annex 1 crops acquired before the entry into force of the Convention on Biological Diversity available under the terms and conditions of the Standard Material Transfer Agreement.

3.4 Recent trends in *ex situ* collections

The total size of the CGN collections has grown from 18 000 in 1996 to 24 000 in 2008 (see Table 4.1). The total size of its collections is expected to stabilize eventually at 30 000 through deliberate rationalization measures. New collections of flax, cucumber, melon, lily, apple and the three grasses *Poa*, *Agrostis* and *Festuca* spp. have been established, and an existing research collection of garlic has also been adopted. Furthermore, the collections of potato (wild relatives), pepper and eggplant have increased in size considerably.

TABLE 3.1
Key data on CGN collections

Crop	No. of accessions in 1996	No. of accessions in 2008	No. of characterization and evaluation data in 1996	No. of characterization and evaluation data in 2008	No. of distributed samples over the period 1985 - 1996	No. of distributed samples over the period 1997 - 2008*
Wheat	5 246	5 551	27 413	43 166	1 917	6 973
Barley	3 414	3 458	39 686	46 300	651	3 762
Flax		952	2 863	14 354		363
Peas	986	1 001	12 572	15 699	867	940
Oats	536	536			247	314
Lettuce	2 118	2 571	53 737	91 168	6 752	18 716
<i>Cruciferae</i>	1 560	1 780	16 547	24 649	3 882	8 089
Maize	488	488	5 076	5 076	73	167
<i>Lolium</i>	134	394			156	34
Faba beans	607	728	8 533	8 831	118	146
Clover	137	263			7	566
Spinach	381	387	13 391	14 446	3 859	3 994
<i>Allium</i>	242	384	5 229	10 204	137	2 575
Timothy	34	105			3	10
Cocksfoot	28	42			2	20
Lupin	69	69	109	109	10	15
Tomato	1 025	1 275	40 147	44 905	61	2 068
Pepper	343	978	23 719	43 719	75	3 556
Eggplant	293	488	10 301	18 344	1	559
Cucumber		922	1 088	12 467		1 855
Potato	787	1 311	6 703	7 042	222	4 862
<i>Poa</i>		78				59
<i>Fescue</i>		73				
<i>Agrostis</i>		11				
Melon		2				4
Lily		46				
Apple		175				
Total	18 428	24 068	267 114	400 479	19 040	59 647

* data until July 2008

Overall the changes reflect CGN's strategy of specializing in vegetable crops and potatoes. In order to improve the crop coverage of the collections, collaborative collecting missions with local partners were organized in Peru (potato), Uzbekistan and Kyrgyzstan (lettuce, onion), and Uzbekistan and Tajikistan (spinach).

The germplasm of CGN's collections originates from a total of 169 countries, whereas its accessions have been distributed to recipients in 64 countries over the period 1996 - 2008.



Documentation of the CGN collections, based on increased characterization and evaluation, has improved substantially. Whereas in 1996 24 000 data on the germplasm in CGN's collections had been entered in the publicly accessible documentation system, the number of data has increased to 40 000 in 2008. It is believed that increased evaluation and documentation of the results in the database has contributed considerably to the major increase in distribution figures.

Almost all CGN's germplasm is stored in base collections at -18° , and at $+4^{\circ}$ or -18° in active collections, with the exception of the living collections of apple, perennial kale (*Brassica*) and garlic. Introduction and regeneration backlogs are small and limited to the potato collection of CGN (which is solely maintained in the form of seeds), mainly due to the high costs involved in passing Andean materials through quarantine and the limited facilities for regenerating the materials with a low probability of outcrossing.

The regeneration of a number of crops is undertaken by collaborating private breeding companies based in the Netherlands. Part of the regeneration under this collaboration scheme takes place in foreign facilities owned by these companies, e.g. in Morocco, Turkey and Spain.

Viability testing is routinely performed largely in line with ISTA protocols according to agreed intervals that vary per crop between 10 and 30 years.

On average, 400 accessions of the total holdings of 24 000 (less than 2%) are annually regenerated due to exhaustion of stocks or loss of viability of the accession.

All the collections have been safety duplicated in a number of other genebank facilities, in particular at IPK Gatersleben and Gross Lüsewitz, Germany, Horticulture International in Wellesbourne, UK, and the Austrian genebank in Linz. Furthermore, since February 2008 18 000 accessions have also been stored in the Svalbard Seed Vault in Norway, as a triplicate database.

CGN's activities are funded under a five-year agreement between Wageningen University and Research Centre and the Ministry of Agriculture, Nature and Food Quality, which is due for renewal by 1 January 2009. Net funding levels have substantially decreased over the last five years due to budget constraints.

The Dutch State Forestry Service manages a 3 175-accession collection of indigenous trees and shrubs of 75 species belonging to 24 genera, including some PGRFA, in particular *Malus*, *Prunus*, *Pyrus*, *Ribes*, *Mespilus*, *Corylus*, *Juniperus* and *Taxus* spp.

CGN has adopted a quality management system, and has developed a quality handbook, which has been largely translated into English and is available from its website.⁵³ Since 2003 CGN has been certified according to ISO 9001:2000.

The botanic gardens in the Netherlands maintain samples of more than 2 600 genera with almost 56 000 accessions,⁵⁴ including materials that are wild relatives of our crops and originate from tropical countries. Since botanic gardens are increasingly seen by their host universities as a burden rather than as an asset, the maintenance of a number of botanic gardens has come under threat, forcing botanic gardens to generate income from non-traditional sources such as visitor fees. Many botanic gardens are members of Botanic Gardens Conservation International.

The botanic gardens have developed an exchange system for the non-commercial exchange of plant material, based on the CBD, called the International Plant Exchange Network (IPEN) within the framework of the European Consortium of Botanic Gardens. The IPEN network facilitates the exchange of plant material between the member gardens while respecting the Access and Benefit-Sharing regulations of the CBD. It aims to create an atmosphere of confidence among the countries from which the genetic resources originated and the botanic gardens.

NGOs involved in the maintenance of plant genetic resources have increasingly organized themselves. In particular, a number of apple organizations (17) are active in the country, together maintaining approximately 1 450 apple varieties in the form of 2 400 accessions in their field genebanks. A major share of these accessions has now been DNA-fingerprinted by CGN in order to identify duplications within and between collections. Smaller numbers of other fruit crops, e.g. pear and plum trees as well as berries, are maintained by the same organizations.

CGN has also stored a safety backup of the collection of De Nieuwe Akker (The New Farm Field) in order to secure this collection of traditional Dutch varieties and new lines developed from such varieties. The NGO De Nationale Proeftuin (the National Experimental Garden) operates as its major activity a website where seeds of more than 2 000 rare and often traditional varieties are offered for exchange by individual hobbyists.

Whereas the NGOs receive technical and logistic support for their operations, no direct financial support is provided.

The Dutch botanic gardens maintain a very wide array of plant species for many reasons, e.g. for research, education, conservation, display and maintenance. To that end, the Dutch gardens agreed in the past to avoid unnecessary duplication, achieved through specialization. Each participating garden maintains one or more of these specializations,

⁵³ http://www.pgrforum.org/CWR_Species.htm

⁵⁴ See Netherlands CBD focal point for access and benefit sharing. <http://www.absfocalpoint.nl/>

resulting in rich collections with special emphasis on (mostly) particular plant families or genera. All the specializations put together form the Dutch National Plant Collection (www.nationale-plantencollectie.nl/UK/intro.htm). Currently, over one hundred specializations (plant families or genera) are included. The quality of these specializations is maintained through the regular application of quality criteria, and both criteria and assessments are carried out by an independent foundation, the Dutch Botanic Gardens Collections Foundation, founded in 1988. This cooperative system of specialization and quality assessment is unique in the world.

It is estimated that the National Plant Collection constitutes about 25% of the combined plant collections maintained by the Dutch Botanic Gardens. A detailed assessment of the holdings of the Dutch gardens has never been made, but the total size of the collections is estimated at between 200 000 and 250 000, constituting perhaps 50 000 species or 100 000 taxa assuming that subspecies, varieties and cultivars are counted as distinct taxa. These holdings also include many globally, regionally or nationally threatened species, wild relatives of crops and many accessions originating from tropical countries. Several botanic gardens maintain specializations on useful plants, e.g. *Citrus* (jointly by Delden & Apeldoorn), *Solanaceae* (Nijmegen), and *Zingiberaceae* (jointly by Arnhem, Delft & Utrecht), while Delft even has a strong focus on useful plants for its entire plant collection. Many other botanic gardens also maintain useful plants.

Approximately 25 botanic gardens are members of the Dutch Botanic Gardens Collections Foundation and/or the Dutch Association of Botanic Gardens (NVBT: (www.botanischetuinen.nl)), and 22 botanic gardens have joined the International Plant Exchange Network (IPEN: www.bgci.org/abs/ipen). Approximately a quarter of the gardens are also a member of Botanic Gardens Conservation International.

Private collections have presumably grown in size and importance over the last decade, although there are no data on this development. A motivation for such increased efforts is provided by growing difficulties (real or perceived) in obtaining access to germplasm held by genebanks and other public collection holders across the world.

A number of research institutions, especially at Wageningen University and Research Centre, maintain working collections. No detailed data on the composition of these collections are available, with the exception of the collection of tree provenances and varieties (size 1 531 accessions), the collection of Dutch Nursery Stock products (trees; size 2 519) and an *Arabidopsis* collection (size 700), all maintained by Wageningen University and Research Centre.

3.5 Future trends in *ex situ* collections

The total size of the national collections held at CGN is expected to grow slowly but will not exceed 30 000 accessions in the long run. Limited gap-filling in existing collections through dedicated collecting missions, incorporation of commercial varieties with an added value that have been withdrawn from the market and opportunistic acquisition of threatened collections in-country or abroad will form the major contributions to this anticipated size increase.

Characterization and evaluation activities will increasingly dominate genebank activities, including through the use of molecular markers and omic technology, where appropriate. To guarantee the relevance of evaluation efforts, these will continue to be performed exclusively under the guidance of and in close collaboration with private breeding companies and research institutions.

Enhanced documentation will facilitate and promote increased utilization of the collections by domestic and foreign users, and distribution figures are expected to grow further. The identity of user groups is expected to shift further towards a larger share by biotechnologists and foreign users.

Some breeding companies in the Netherlands have increasingly invested in the development of private working collections in order to lessen dependence on external genetic resources. It is estimated that the size of the private collections currently exceeds the size of CGN holdings. Continuation of this trend will to a large extent be influenced by the results of the negotiations on the International Regime for Access and Benefit Sharing under the auspices of the CBD. A stricter regime is likely to promote policies under which companies secure access to germplasm by establishing their own collections. No detailed data on private holdings are available.



THE STATE OF USE

4.1 Summary

The state of use is influenced by a number of quite divergent factors. The public-private collaboration between CGN and a large number of breeding companies in the Netherlands has contributed to the increased use of germplasm in breeding programmes, although it is often not (yet) possible to assess to what extent this increased use has resulted in incorporation of accessed germplasm in commercialized products.

Climate change and technological developments have each triggered and promoted novel use, and both trends may have a continued and profound effect on the utilization of plant genetic resources. Developments in information technology have revolutionized access to information on available germplasm and the incorporated traits.

In many cases, new international policy developments have unintentionally resulted in a slowdown of international exchange. Each of these trends demonstrably had its effects on the use of plant genetic resources in the Netherlands. Other trends that may have influenced use were formed by the consolidation of the international breeding industry and the growing attention for organic agriculture.

4.2 Evaluation of germplasm

The collections of CGN are routinely evaluated within the framework of collaborative agreements with the breeding industry. For important crops, breeders participating in CGN's crop advisory committees indicate jointly which traits they are interested in from a users' perspective. On that basis, contracts, usually running for one or two seasons, are concluded between (i) the sector organization PLANTUM NL and the breeding companies willing to participate in a given evaluation and (ii) CGN. Under the conditions of the contract as well as the SMTA, CGN provides seeds to the breeding companies, which evaluate the materials for the agreed traits using standard agreed protocols. The results are documented by CGN and after a maximum embargo period of five years are made publicly accessible through its website. The agreed embargo period provides an incentive for the private breeding companies to invest in these joint evaluation efforts by offering them a modest R&D gain over competitors, while at the same time guaranteeing the long-term availability of all the results. At any one time, at least three such evaluation schemes will be in operation. Most evaluations concern pest and disease resistance traits. Until now, a total of 5341 accessions have been evaluated for one or more traits, as specified in the table below.

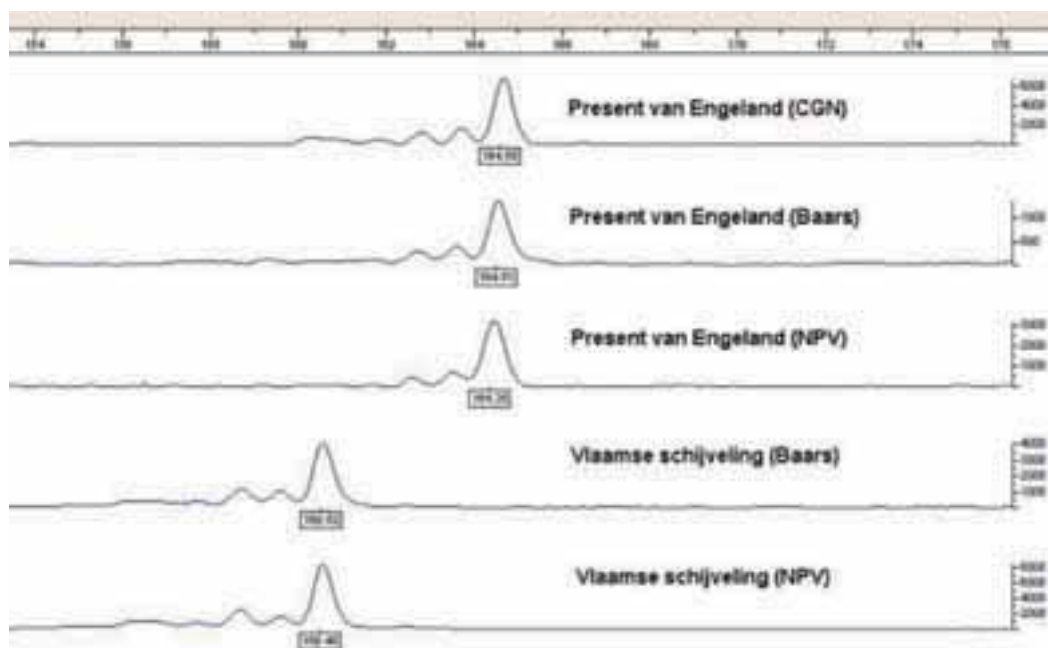
TABLE 4.1

Overview of accessions evaluated in public-private partnerships

Crop	Numbers of acc. evaluated (total crop collection size)
Lettuce	1 197 (2 571)
Spinach	387 (387)
<i>Allium</i>	315 (384)
Wheat	1 415 (5 559)
Cucumber	929 (929)
Potato	968 (1 311)
Total	5 341

4.3 Synthesis of individual datasets

For the interested user assessing the evaluation data on the CGN website, it is often very difficult to compare the results of different evaluation experiments carried out by different users with different protocols in different years and under different climatic conditions. For a number of years now CGN curators have invested in harmonizing the data of various datasets for direct comparison purposes. The harmonized data are searchable online on CGN's website. Such harmonized datasets are now available for the collections of potato, lettuce, cucumber, capsicum, tomato, spinach, and wheat. It allows breeders and other users independently to select the most appropriate accessions from the collection in question.



As a consequence of the improved information technology, it is now possible for distant users independently to assess and order CGN germplasm on-line. This has led to a shift in user background, with CGN's collections now attracting a much wider group of users than a decade ago.

4.4 Changes in distribution of CGN germplasm

The number of accessions distributed annually has grown from 19 040 over the period 1985 – 1996 to 59 647 over the period 1997 – 2008, an increase of more than 300%. Of the total, 32 000 samples were distributed to recipients in the private sector, whereas 28 000 samples were distributed to the public sector and NGOs. The most widely distributed collection was the lettuce collection, followed by the collections of *cruciferae*, wheat, potato and spinach.

The number of accessions distributed has not been influenced by the introduction by CGN of the Standard Material Transfer Agreement, although a small number of foreign private sector users now no longer request material from CGN.

Table 3.2 provides a breakdown of the trends in distribution figures between arable and horticultural crops, private and public sector recipients, and domestic and foreign users over the years 1994 – 1996 and 2005 – 2007, showing a substantial relative increase of private sector and foreign users, as well as the strong bias towards horticultural crops.

TABLE 4.2

Distribution figures by type of crop and type of users

Type	Private	Public	Arable crop	Hortic crop	Domestic	Foreign
1994 - 1996	4 095	5 862	1 594	8 363	6 316	3 641
2005 - 2007	8 177	7 427	2 627	12 977	7 848	7 756



4.5 Technological and societal developments

Technological change has resulted in novel use types and novel user groups. As a result of the rise of plant biotechnology, large numbers of accessions have now been used in genome mapping and association genetics, providing insight into the genetic relationships between individual accessions and the relationship between certain molecular markers and traits of interests. In particular, the CGN collections of lettuce (2 700 acc), and (partly) Brassica (300 acc.) and potato (300 ac.) and a selection of 8 Dutch apple collections (800 acc.) have been screened in order to improve insight into the collection structure, whereas part of the potato collection (800 acc.) has been analysed by molecular means for the presence of certain potential resistance genes.

In future, genome sequencing will play an increasing role in assessing the potential usefulness of germplasm accessions. Also, biotechnologists will form a growing user group complementing the traditional user group of breeders.

As a consequence of concentration in the international breeding sector, the total number of breeding companies has decreased and this has had a downward effect on the number of private users. Whereas in some cases this effect was deceptive, since various breeding programmes continued under a single new entity, in other cases breeding programmes were merged or discontinued, leading to a lower number of requests.

A modest request has come from the organic sector to select germplasm that is better adapted to organic growth conditions (resistance, rooting, earliness, general vigour), and CGN has supported the organic sector in the selection of the best individuals in segregating populations in onions.

In 2007, the botanic gardens of Delft and Amsterdam initiated an *ex situ* conservation project to conserve the Dutch threatened flora, in the context of the Global Strategy for Plant Conservation (www.cbd.int/gspc/targets.shtml). In particular this project aims to meet the first part of target 8 of this Strategy by 2010: '60% of threatened plant species (included) in accessible ex-situ collections, preferably in the country of origin' through the uptake of at least 60% of the Dutch Red List species in the plant collections of the participating gardens. In addition, the botanic gardens of Delft and Utrecht will set up a seed bank for the long-term storage of seeds of Dutch Red List species.

The consortium of botanic gardens leading this project consists of the Hortus Botanicus of Amsterdam, the Botanic Garden of Delft University of Technology, the Hortus Botanicus Leiden, and Utrecht University Botanic Gardens, while another six Dutch botanic gardens are also participating in the project. The project will be accompanied by educational activities about the necessity to conserve our wild flora, and the strategic targets to be achieved.

4.6 Education and knowledge transfer

In the understanding that utilization can be enhanced not only by improved services to direct users of germplasm, but also by triggering the interest in diversity in our food (both within and between crop species) amongst a wider audience, education schemes fitting formal requirements have been developed to raise the interest of pupils and students as well as a wider audience in the attractiveness and cultural history of crop genetic diversity and the value of crop genetic resources for the variety in daily food. Moreover, for both categories a number of folders have been produced, e.g. on the Dutch history of breeding in cabbage, the Dutch history of potato breeding, and Forgotten Vegetables, as well as an explanation of « How genetic resources came to the Netherlands ». An on-line knowledge bank making genetic resources literature widely available for students has been developed for the animal domain and is now planned for the plant domain.⁵⁵

4.7 Uncertainty in estimating final use of germplasm in new varieties

Whereas approximately half of all distributed materials is provided to private sector users, it has been impossible to trace if and which germplasm ended up in commercial varieties. Information from public sector users on their work with the germplasm appears less relevant for this purpose since this user group operates more upstream and hence information on upstream use is less instructive on the final use of genetic resources concerned. Some exceptions, where use can be traced back to CGN collections or their immediate predecessors, are tobacco mosaic virus resistance in pepper, *Cladosporium* resistance in tomato, *Bremia* and *Nasonovia* resistances in lettuce, *Peronospora* resistance in spinach and onion, and *Puccinia* resistance in wheat.

⁵⁵ See <http://library.wur.nl/cgn/> or CGN website.



This lack of information on use in commercial varieties may change as a result of the introduction of the SMTA in early 2007, which obliges all parties to inform the Secretariat of the International Treaty of all transfers of germplasm incorporating germplasm obtained from the Multilateral System. In addition, various breeding programmes are still in progress, and final products are still to be awaited, as in the case of potato breeding programmes that take more than a decade to deliver.

In a limited number of cases, resistance genes have been identified and patented (e.g. a *Phytophthora* resistance gene) and in future the potential exploitation of such genes in new varieties can be easily confirmed.

Finally, in exceptional cases, traditional varieties themselves display an interesting phenotype that allow the marketing of such materials, often after some selection steps. In the case of CGN, examples are probably formed by the use of squash-like eggplant varieties of African origin and of an unusual foreign cucumber type, which are now serving a niche market.

4.8 Constraints in use

Major constraints in use concern the wide gap between (i) most of the genebank accessions consisting of old commercial varieties, traditional farmers' varieties and landraces or wild relatives, and (ii) the high-producing modern commercial varieties and elite breeding materials on the other hand. This genotypic and phenotypic gap causes breeders to only use improved germplasm in breeding programmes if possible, and to revert to the germplasm mentioned above where no solutions are available from the improved materials.

Many genebanks have recognized this gap, and proposals for pre-breeding (i.e. transferring interesting traits to a modern genetic background) and genetic enhancement (combining several interesting phenotypes in a single population) have been developed and sometimes implemented. No investments in such efforts to increase the use of genetic resources have as yet been made in the Netherlands.

To prevent genetic gap from increasing unnecessarily, CGN has adopted the policy of also incorporating hybrid varieties in its collections, fully acknowledging that hybrids cannot be maintained true-to-type without access to the parental lines.

4.9 Effects of policies

Use has been affected by recent developments in policy and law. In particular, the access and benefit-sharing policies of the CBD have had a major impact on the international exchange of plant genetic resources.⁵⁶ Whereas access to germplasm in a number of countries has remained unhindered albeit increasingly regulated, in other cases national legislation has resulted in very strict access provisions. For yet another group of countries, responses and decisions to requests for access to germplasm are simply lacking. In turn, lack of access has sometimes resulted in suboptimal utilization of germplasm in research and breeding programmes, and has forced breeding companies to resort to existing collections in the public domain to complement their own breeding materials. Over the past decade, CGN and breeding companies have each experienced failures in efforts to obtain access to germplasm for which fair benefit-sharing provisions according to international standards were offered. Failures involved both crops listed in Annex 1 of the International Treaty and crops not listed.

4.10 Future needs and priorities

The growth of the global population, shifting diets and the challenge to eradicate hunger require a doubling of global crop production in the coming decades. This demand might be even much larger if the current trend for biofuels persists. Rather than expanding the agricultural area, the world will face the challenge of increasing land productivity considerably. This, as well as climate change, will require novel solutions based on new combinations of genes. These genes must be conserved and made available. Increasingly, the genes may be present in private collections. However, since information is lacking and industrial parties tend to protect the genes by patents or otherwise, these collections cannot be relied on solely for future food needs. Public collections will continue to play an essential role.

⁵⁶ See for example Fowler, C., Hodgkin, T. (2004), Plant Genetic Resources for Food and Agriculture: Assessing Global Availability. Ann. Rev. Environ. Resour. 29, pp. 143 – 179.

Part of the genes searched for may be found in germplasm occurring abroad in the wild or in traditional farmers' varieties, and access and benefit-sharing regimes need to facilitate international exchange answering future germplasm requirements. The future International Regime on Access and Benefit Sharing should facilitate such exchange, taking into account the specific requirements for genetic resources for food and agriculture.

THE STATE OF NATIONAL PROGRAMMES, TRAINING AND LEGISLATION



5.1 Summary

In 2002, the Netherlands' Parliament has adopted a government policy on genetic resources entitled: 'Sources of Existence'. Until now, no new legislation has been deemed necessary to implement this policy. Training as a form of capacity building at national and international level has obtained increased attention. Public awareness raising has become recognized as another major activity area.

5.2 The National Programme on Genetic Resources

In response to the requirements of the CBD and the International Treaty, which have both been ratified by the Netherlands, the government of the Netherlands has developed a national policy on genetic resources, entitled Sources of Existence, that was adopted by Parliament in 2002.⁵⁷ The policy document covers the following topics: legislation and regulations, *in situ* and *ex situ* management, commercial and non-commercial applications of genetic resources, and international cooperation.

In the framework of the policy adopted by Parliament the government has signed a 5-year agreement with Wageningen University and Research Centre, the Centre for Genetic Resources, the Netherlands, to execute a work programme contributing to the conservation and utilization of genetic resources in international collaboration. The programme allows for the maintenance of the collections and the related information and documentation tools, as well as support of *in situ* conservation by other actors, regional collaboration in the European networks, policy support for the government and certain educational activities aiming to reach a wider public.

5.3 Legislation

In the context, the country has not opted for novel legislation regarding conservation and utilization of genetic resources, including access and benefit-sharing. Access to the country's genetic resources found *in situ* is essentially unregulated and unrestricted. It is the policy of the Dutch government that all essential measures for the conservation of genetic resources and the promotion of their use as well as the sharing of benefits from their use can be taken based on existing (framework) laws, in particular laws on nature management, phytosanitary measures, intellectual property rights, and biotechnology. The government will regularly monitor the need for specific legislation in the future.

Legislation affecting the conservation and utilization of genetic resources includes new laws on intellectual property rights regimes, at both national and EU level.

The EU Biotechnology Directive 98/44/EC allows dual protection of plant varieties and the incorporated genes, through plant breeder's rights on the variety and patents on a gene if introduced by biotechnological means. The Netherlands has adopted the Act of 1991 of the UPOV Convention. Plant breeder's rights allow the use of protected plant varieties for further research and breeding by third parties and the commercialization of new products, but do prohibit the marketing of propagating material of the protected varieties and limit the options for farmers to save and use seeds of the protected varieties on the farm.

⁵⁷ See <http://www.absfocalpoint.nl/>

The National Seeds and Planting Material Act regulates market access as well as the implementation of the UPOV 1991 Act. For market access, arable crop varieties have to fulfil the Value for Cultivation and Use requirements.

The new EU Directive on Conservation Varieties 2008/62/EC allows an exemption of some of the VCU and DUS requirements for traditional local varieties under the conditions of limited volumes of seed production in a restricted geographic area representing the region of origin of that variety.

The national phytosanitary regulations govern the import and export of genetic resources. Based on this Act, CGN is obliged to test for the occurrence of quarantine diseases during regeneration and in its seed stocks. As a result, CGN will provide a plant passport with distributed seed samples specifying for which diseases the sample has been tested. One of the consequences of the Act and the limited available funds is the slow regeneration of the CGN potato collection, of which only 55% is now available for distribution.

Over the years, PLANTUM NL in collaboration with the Ministry of Agriculture, Nature and Food Quality and CGN has organized various information meetings on the consequences of the new international agreements regarding access and benefit-sharing for its private sector members.

5.4 Training

Wageningen University offers regular MSc courses in plant and animal breeding including modules on genetic resources.

In addition, since 2003 Wageningen International, in collaboration with CGN and Bioversity International and with financial support from the Netherlands Organisation for International Cooperation in Higher Education (NUFFIC) has yearly organized short international postgraduate courses on genebank management, genetic resources policies, participatory plant breeding, and marketing of local products. For each topic a two-week course is offered and 25 professionals on average participate in each course that is held in Wageningen. In addition, since 2006 the courses on genebank management and genetic resources policies have also been offered in a second location and with additional partners, in Iran and Ethiopia respectively, whereas an adapted course on genebank management has been organized for genebank staff from the Balkan region. In addition, CGN has developed long-distance web-based training modules on participatory plant breeding and on genetic resources policies in the framework of the global Community Biodiversity Development and Conservation (CBDC) programme. These modules have also been used to provide courses in Africa locally.

In the framework of the regional PEDIGREA project, based in South East Asia and executed in Indonesia, Cambodia and the Philippines, and in a similar project in Ethiopia, farmer field schools have been organized on participatory plant breeding⁵⁸. To that purpose, Trainings of the Trainers were regularly held. With the help of local experts, including from public institutes, more than 2000 small-scale farmers have been trained in seed propagation, selection and crossing techniques and have been provided with new seed sources to which they otherwise had no access. CGN has been a founding partner in these projects and is actively participating in their execution.

The Ministry of Foreign Affairs through the Directorate for International Cooperation (DGIS) together with the German GTZ, has co-financed capacity building effort for countries in Sub-Sahara Africa on Access and Benefit-Sharing issues in order to support the African region in its preparations for the negotiations on the International Regime for Access and Benefit-sharing⁵⁹. The DGIS-funded project PREDUSA, carried out by Wageningen University and partners in Latin America, has focussed on the post-graduate familiarization of formal sector stakeholders with participatory approaches.

5.5 Public awareness raising

In order to increase awareness amongst a wider public about the value of genetic resources, various activities have been undertaken. CGN has followed a two-pronged approach by targeting both regular education (from primary schools to dedicated agricultural education) and a wider interested public. For regular education, new modules on genetic resources have been developed, offered, tested and integrated in various programmes in close collaboration with sector organizations and teachers. To reach a wider public, attractive folders have been produced and distributed on such topics as forgotten vegetables, and the history of breeding of cabbage and potatoes in the Netherlands.

⁵⁸ See <http://www.pedigreea.org/>

⁵⁹ The Dutch-German Capacity Building Initiative for Africa, see also <http://www.cbd.int/abs/project.shtml?id=30935>

Traditionally the Dutch botanic gardens pay attention to genetic resources such as vegetables, fruits, dye plants, and medicinal plants. Several gardens have permanent thematic sections addressing these plant groups, their wild relatives and the issue of their conservation needs. The Botanic Garden of Delft University of Technology has a very strong focus on useful plants, and features education programmes on these plants for both primary and secondary schools. In addition, many other botanic gardens prepare exhibitions on useful plants within their programmes.

Various NGOs in the Netherlands regularly organize field days so as to reach out to a wider public and to distribute seed and planting material to interested hobbyists. Local governments sometimes support these activities financially.

5.6 Trends

The government of the Netherlands has recognized the need for policy development in the area of genetic resources, but has taken the position of not developing new legislation if that can be avoided by relying on existing legislation, soft law and effective existing practices.

Training as a means of capacity development in the area of genetic resources has become a major activity area, at both national and international level. This is based on expertise in the area of genetic resources and motivated by the conviction that an effective global system of germplasm exchange is essential for agricultural production.

Finally, raising public awareness concerning the importance of the conservation and utilization of genetic resources has assumed increasing importance. NGOs are playing a major role in reaching the wider public, although the NGO sector still needs a lot of support and strengthening.



THE STATE OF REGIONAL AND INTERNATIONAL COLLABORATION

6.1 Summary

At regional level, the Netherlands has contributed to new developments in the framework of the European network ECPGR, namely the development of a web-based regional collection database, EURISCO, and an integrated European genebank system, AEGIS. At international level, the Netherlands has actively contributed to the further development and implementation of the CBD and the ITPGRFA. It has also supported projects aimed at on-farm management of genetic resources and other capacity building initiatives.

6.2 European collaboration

The Netherlands is a member of the European Collaborative Programme on Plant Genetic Resources ECPGR, a regional network in which almost all European countries are participating. In this context the country has actively contributed to the functioning of the network, in particular to activities aimed at agreed standards and protocols for genebank activities, improved use of information technology, and task sharing in collection management. The Netherlands has also contributed to the development of AEGIS, the European germplasm system which aims at the development of (virtual) European crop collections consisting of all unique germplasm held in the region that are to be managed under agreed conditions.

The EU-supported development of EURISCO, a web-based European database containing the passport data of over a million European accessions, formed another hallmark of the developments in the region over the last decade. EURISCO may serve as a model for other regions.

The specific European Directive 870/2005 as well as the general EU Framework Programmes have offered modest funding opportunities for collaborative projects in plant genetic resources, and Dutch institutions have participated in a substantial number of such projects.

6.3 International collaboration

The Netherlands has actively contributed to the development and adoption of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), as well as to the further operationalization of the Convention on Biological Diversity. In that context, CGN has participated in many international initiatives in policy development, genebank management and on-farm management of plant genetic resources.

The government has supported the Community Biodiversity Development and Conservation (CBDC) programme, a global project on the management of genetic resources on-farm, and projects in South-East Asia and in Ethiopia on participatory plant breeding as a means of enhancing the on-farm management of plant genetic diversity.

The Netherlands has been a major financial contributor to a number of CGIAR centres. Wageningen UR has participated in the CGIAR-based GENERATION programme, focusing on the exploitation of plant genetic resources by means of biotechnology, and has collaborated actively with Bioversity International on various topics of genebank management and information technology.

6.4 Trends

The Netherlands will support the further development of AEGIS and EURISCO. It has also supported and participated in various international activities, realizing that new issues such as the implementation of the ITPGRFA and the development of the International Regime on Access and Benefit Sharing will require increased emphasis. In that context, an integrated approach to the conservation and utilization of all the components of biodiversity for food and agriculture is regarded as an increasingly important prospect.



ACCESS TO PGRFA, BENEFIT-SHARING AND FARMERS' RIGHTS

7.1 Summary

No national ABS legislation has been developed. Access to plant genetic resources found *in situ* is essentially unrestricted in the Netherlands. Current international ABS policies are regarded by the private sector as too strict to be effective.

7.2 Access and Benefit-Sharing

The Netherlands has actively contributed to the development and adoption of the Bonn Guidelines on Access and Benefit-Sharing of the Convention on Biological Diversity. It has also ratified the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). In 2007, it has adopted the use of the Standard Material Transfer Agreement for access to the collections of the Centre for Genetic Resources, the Netherlands (CGN). In 2008, it has notified the secretariat of the International Treaty, that four Dutch collections have been brought into the Multilateral System of the International Treaty, i.e. all collections of CGN belonging to Annex 1, the *Solanaceae* collection of the botanical garden of the Radboud University in Nijmegen, and the apple collections of the Northern Pomological Society and the NorthHolland Pomological Society.

The Netherlands has adopted the policy that access to the country's genetic resources found *in situ* is essentially unregulated and unrestricted.

The government of the Netherlands regards benefit-sharing as an essential component of access and benefit-sharing (ABS) systems, and has supported capacity development in the area of ABS in developing countries as essential for further development and implementation of such systems. It has therefore been engaged in capacity building through a project of the Directorate of International Cooperation of the Ministry of Foreign Affairs in Sub-Saharan Africa and regular training programmes run by Wageningen International and CGN. In close collaboration with the private sector organization PLANTUM NL, it has also supported domestic awareness raising in the private and public sectors concerning the international agreements bearing on ABS that have been adopted.

7.3 Farmers' rights

The Netherlands has given due consideration to the development and operationalization of farmers' rights in an international context. It currently supports a project on the further development of the concept of farmers' rights to prepare for the discussion of this issue in the third meeting of the Governing Body of the International Treaty. This project explores the best ways of creating the necessary legal framework for the preservation of traditional and current practices in small-scale agriculture that maintain and create genetic diversity on-farm, including new approaches such as participatory plant breeding.

7.4 Trends

Thanks to the efforts of the private sector, increasing awareness has been realized in the plant breeding sector about the agreed ABS arrangements in the context of the CBD and the International Treaty. As a consequence, the private sector follows agreed policies, but also takes the view that in various ways the aforementioned ABS laws and regulations have become too tight and burdensome to be effective. Decreasing dependence of foreign germplasm has been chosen as a coping strategy that is not in the long-term interest of conservation and utilization of plant genetic resources and the fair and equitable sharing of the use of its components.

THE CONTRIBUTION OF PGRFA MANAGEMENT TO FOOD SECURITY AND SUSTAINABLE DEVELOPMENT



8.1 Summary

The Netherlands regards the maintenance and distribution of its collections in combinations with its open access policy as an important contribution to global food security and sustainable development.

8.2 Food Security

The collections of CGN originate from over a hundred countries and cover both staple crops and a large number of vegetable crops of importance for a varied and balanced human diet. Samples of the collections are distributed to a large number of countries. The Netherlands regards the maintenance and distribution of these collections as its contribution to the international conservation of plant genetic resources for food and agriculture. Its open access policy, both to its *ex situ* collections and to genetic resources found *in situ* is considered an important contribution to global food security. However, the government realizes that other factors, such as global food prices and accessibility of food, as well as capacity for breeding high-yielding varieties adapted to local circumstances, determine food security to a large extent.

8.3 Sustainable Development

Sustainable development applies to agricultural production. Sustainable production is supposed not to exhaust the biological resources on which agricultural production itself relies and to maintain optimal conditions for production in the future. The breeding and development of plant varieties that are optimally adjusted to local circumstances and that do not exhaust the biological and other resources (such as water supplies) of the agricultural production system are considered of utmost importance. PGRFA form the basis for such breeding, and – in the last decade – have in particular been used to improve pest and disease resistance in our crops.

In addition, energy use for the purposes of crop production (i.e. fuel for transport and mechanized activities, artificial fertilizer) needs to be reduced for agricultural production to be economically and socially sustainable, and again PGRFA may be able to contribute to the achievement of that goal.

Sustainable development also applies to our plant genetic resources for food and agriculture themselves and the underlying funding. It means that *ex situ* and *in situ* conservation measures themselves should be sustainable and that programmes should be developed in such a way that the loss of genetic diversity can be stopped completely. The development of such policies is seen as a major challenge at both national and international level.

8.4 Trends

For the first time in decades international food security has decreased. Many factors have contributed to this unacceptable development, and suboptimal conservation and use of PGRFA only form one such factor. A recent joint policy programme of LNV and DGIS has addressed this issue and has dedicated efforts towards the improved exploitation of the available options for improving agricultural production in order to increase food security at global level.

ABBREVIATIONS

ABS	Access and Benefit-Sharing
AEGIS	A European Genebank Integrated System
CBD	Convention on Biological Diversity
CGN	Centre for Genetic Resources, the Netherlands
CWR	Crop Wild Relative
DUS	Distinct, Uniform and Stable
ECPGR	European Cooperative Programme on Plant Genetic Resources
EURISCO	European Web Catalogue
GMO	Genetically Modified Organism
IPEN	International Plant Exchange Network
NGO	Non-Governmental Organization
PGRFA	Plant Genetic Resources for Food and Agriculture
SMTA	Standard Material Transfer Agreement
UPOV	International Union for the Protection of New Varieties of Plants
VCU	Value for Cultivation and Use
WTO	World Trade Organization
PGRFA	Plant Genetic Resources for Food and Agriculture
LNV	Ministry of Agriculture, Nature and Food Quality
DGIS	Directorat General for International Cooperation
LEI	Agricultural Economics Research Institute
CBS	Central Bureau for Fungal Collections
PLANTUM NL	Dutch plant breeding and plant propagation sector organization
GBIF	Global Biodiversity Information Facility
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture

