

Conservation and sustainable use of Animal Genetic Resources for Food and Agriculture

Country report of the Netherlands for the 2nd State of the World's Animal Genetic Resources for Food and Agriculture

Executive Summary

Ministry of Economic Affairs, the Hague



CGN Report 31



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Table of contents

Foreword	1
Lead	3
1. The livestock sector in the Netherlands	5
2. Key trends and driving forces affecting AnGR management in the Netherlands	7
Global food security	7
Specialization and scale enlargement	7
Sustainable breeding programs and breeding for sustainability	7
Technology revolution	8
Standardisation vs diversification	8
3. State of implementation of the Global Plan of Action on Animal Genetic Resources	9
Characterization, Inventory and Monitoring of Trends and Associated Risks	9
Sustainable use and Development	10
Conservation	11
Policies, Institutions and Capacity-building	12
4. Priorities and strategic directions for future action	14
Key principles	14
Strategic priority 1 - Implementation of “national plan <i>in situ</i> ”	14
Strategic priority 2 - Conserve what we still have, in <i>ex situ in vitro</i> collections	14
Strategic priority 3 - Application of genomic and reproductive technologies	15
Strategic priority 4 - Better characterization of between and within breed genetic diversity	15
Strategic priority 5 - Sustainable breeding programs and sustainable development of breeds	16
Strategic priority 6 - International capacity building and knowledge exchange	16
Strategic priority 7 - Development and implementation of policies and regulations	16
Colofon	18

Foreword

FAO requested countries to update their national reports on Animal Genetic Resources for Food and Agriculture contributing to the 2nd State of the World's Animal Genetic Resources. The 1st national report on animal genetic resources of the Netherlands was presented to FAO in 2002¹.

The first national report was updated by the Centre for Genetic Resources, for the Ministry of Economic Affairs. The process of updating and analysis was guided by an Advisory Committee.

This Executive Summary of the updated information from the Netherlands will allow national and international stakeholders to gain a quick overview of the developments and current situation in the Netherlands and the national policy priorities in this area.

I hope that the Dutch views and priorities presented in this Executive Summary will contribute to increased awareness in the Netherlands and internationally, and will support the conservation and sustainable use of Animal Genetic Resources.

I would like to thank the members of the Advisory Group for their valuable input in the report and the Centre for Genetic Resources, the Netherlands (CGN) for their work to update the first national report and to compile this Executive Summary.

dr. mr. J.P. (Hans) Hoogeveen MPA
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¹ Landenrapport Nederland over dierlijke genetische bronnen. Een strategisch beleidsdocument. <http://edepot.wur.nl/30234>.

Lead

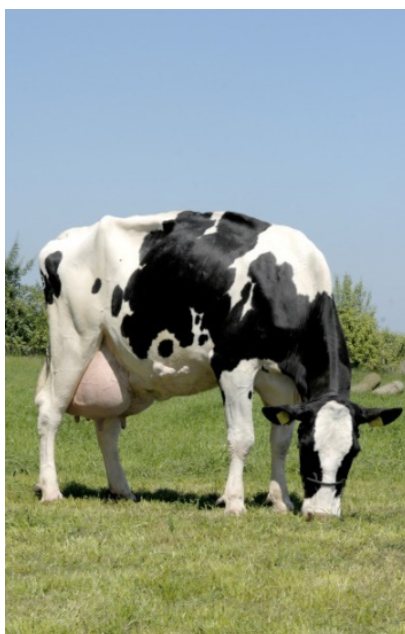
The updated Dutch national report on conservation and sustainable use of Animal Genetic Resources summarizes the state of national implementation of the Global Plan of Action for Animal Genetic Resources. Seven strategic priority areas have been identified, dealing with remaining or future challenges. At national level conservation strategies will be strengthened to halt the loss of farm animal genetic diversity and to protect our bio-cultural heritage. New technologies will be adopted and further developed for characterization, conservation and breeding purposes. The Netherlands will contribute to the global agenda by generating knowledge and development of improved breeding material for sustainable development of the livestock sector and future food security.

1. The livestock sector in the Netherlands²

The Netherlands is well known for its efficient animal production sectors, and as a global supplier of high quality animal products. The agricultural sector is an important component of the Dutch national economy. The Netherlands is one of the largest exporters of agricultural products.

The economic value of livestock production is a substantial part of the total production value of the agricultural sector. The specialized dairy cattle, pig and poultry sectors are considered as the main livestock production sectors in the Netherlands. But sheep, goats and horses are also among the key farm animal species in the country. Productivity and efficiency per animal has gradually increased during the past decades, in particular for dairy cattle, pigs, broilers and laying hens. For example, the productivity per milking cow has further increased by 10% over the last decade.

The Netherlands has a long history in animal breeding and has been a source of improved genetics for the global livestock sector over the past century. Major Dutch breeding companies are global players and Dutch genetic material and breeding stock are being distributed globally.



² Livestock, Meat and Eggs in the Netherlands (PVE, 2013), Dutch Dairy Board (PZ, 2013)

2. Key trends and driving forces affecting Animal Genetic Resources management in the Netherlands

The following national and international trends are particularly relevant for conservation and sustainable use of AnGR in the Netherlands.

Global food security

The demand for animal products at global level is expected to increase substantially, with the rising global human population and increasing incomes. At the same time we expect an increasing scarcity of resources. Global food security and increasing demand for animal products requires improvement of resource efficiency, also in the context of the global feed-food-fuel competition.

The Dutch livestock and breeding sector can play an important role dealing with this global challenge. Further exploitation of germplasm of high productive and efficient breeds is a key component of the global food security ambitions. Sustainable intensification has already been a key objective for the Dutch livestock sector during the past decades and is also relevant from a global perspective (“two times higher production, two times less use of resources”). The Netherlands will further contribute to development of the global livestock sector, through gaining and exchanging knowledge, capacity building, and development and trade of germplasm, breeding stock, equipment and other supply materials.

We realize that there is a large diversity of production systems at global level, ranging from pastoralists, smallholders and back yard farming to large scale, intensive or extensive production systems.

One size does not fit all; specific development strategies are needed for the diversity of production systems and agro-ecosystems at national, European and global level. This underlines the importance of farm animal genetic diversity and targeted breeding programmes.

Specialization and scale enlargement

The Dutch livestock sector went already through a process of specialization which is not expected to stop in due time. The dominant animal production systems work with a limited number of specialized breeds. As a result of ongoing and accelerating scale enlargement in the livestock sector, the number of farms has decreased and is expected to decrease further.

Sustainable breeding programs and breeding for sustainability

Societal concerns about animal health and welfare have had and will have further impact on breeding programs in the Netherlands. The Dutch livestock sector, NGO's and government promote breeding for a sustainable livestock sector³, that is implemented by breeders associations and private breeders. Dutch breeding organisations are member of the European Forum of Animal Breeders, that recently launched an updated “Code EFABAR”⁴.

³ National initiative to promote sustainable breeding <http://www.uitvoeringsagendaduurzameveehouderij.nl/werken-aan-verduurzaming/initiatieven/initiatiefgroep-duurzame-fokkerij/>

⁴ Code-EFABAR. European Forum of Farm Animal Breeders. www.responsiblebreeding.eu

Technology revolution

Genomic selection already had and will have further impact on efficiency and organisation of the animal breeding sector. In particular commercial breeds and sufficiently large populations can benefit from genomic selection, and breeds that have smaller population size will further lag behind. However, local breeds that have smaller population size may also benefit in the future from further development of genomics selection methodology across breeds or may be used for the introgression of “lost” traits. Next to the genomic revolution, reproductive technologies are also developing rapidly. Genomic and reproductive technologies provide new opportunities for breeding and conservation of genetic diversity.

Standardisation vs diversification

We notice the continuing trend of increased uniformity of products at global level and more interest of consumers and citizens in sustainability issues. As a result of changing consumer demands and societal concerns about animal welfare, retailers have become more demanding and the power of retailers is increasing. At the same time, we also notice that consumer preferences are changing and there is a trend towards diversification of food products. There is an increasing interest in regional products, “*local to local*”, and typical, quality products. This may provide new opportunities to further exploit farm animal genetic diversity, to support the conservation of our bio-cultural heritage, and to promote diversification of breed and agro-ecosystem related food products and services.



3. State of implementation of the Global Plan of Action on Animal Genetic Resources

Characterization, Inventory and Monitoring of Trends and Associated Risks

Regular breed inventories and updates of the European (EFABIS) and global (DAD-IS) databases have been undertaken in the Netherlands during the past decades. These inventories include farm animal species of economic importance and/or of bio-cultural value. The Centre for Genetic Resources, the Netherlands (CGN) of Wageningen University and Research Centre is responsible for updating (inter)national breed databases. Baseline breed survey data about status and trends has been collected by CGN, in close collaboration with breed societies, breeding industry, and with the Dutch Rare Breeds Society (SZH). In addition, SZH has developed a database tool to provide information to the national authorities about the exact location of rare breeds. This information can be used immediately in case of disease outbreaks in order to take appropriate emergency response measures.

Breed societies and breeding organisations are responsible for phenotypic characterization and pedigree registration. All breeds have been phenotypically characterized, however for many breeds phenotypic information of individual animals is limited, which is not the case for the mainstream breeds. In addition, for many breeds there is also genetic characterization data available. Continuation of efforts is needed to collect, analyse and use phenotypic and genetic characterization for breeding purposes.

The major species of economic importance in the Netherlands are cattle (dairy and dual purpose milk and beef), pigs (pork), poultry (meat and eggs), sheep (meat and also milk), goat (milk) and horses (sports). In addition, breeds have been identified, which we recognize as valuable bio-cultural agricultural heritage (species: duck, geese, pigeon, rabbit, dog).

There is a large variation of breeds and breeding lines in the Netherlands. Part of the breeds have been bred for a long time in the Netherlands. Other breeds have been created or introduced in the country more recently. Although from a use perspective all breeds and all genetic diversity are equally relevant, the Dutch government plays an active role in promoting conservation and sustainable use of the Dutch native/locally adapted breeds. Table 1 shows the number of locally adapted/native breeds⁵, including the breeds that have status “critical”, “endangered” or “vulnerable”⁶.

There is a substantial number of locally adapted/native breeds which have a small population size. This was already the case at the end of the 20th century. The contribution of locally adapted/native breeds to total livestock production in the Netherlands did not substantially change during the last decade. The major specialization already happened during the last decades of the 20th century. Currently, part of the breeds which have small population size show increasing number of breeding animals, while others are (still) decreasing in numbers.

Particularly in the pig and poultry breeding industry a major consolidation has taken place. The number of breeding companies decreased and breeding lines were merged.

⁵ According to FAO terminology, locally adapted breeds have been in the country for sufficient time to be genetically adapted to one or more traditional production systems or environments in the country.

⁶ FAO. 2013. *In vivo* conservation of animal genetic resources. FAO Animal Production and Health Guidelines. No. 14. Rome.

Table 1. Major species of economic importance - Total number of breeds, Number of locally adapted/native breeds, and Number of locally adapted breeds which have status “critical”, “endangered” or “vulnerable”.

Species	Locally adapted/native breeds ⁷	Locally adapted/native breeds Status: critical, endangered or vulnerable	All breeds
Cattle	10	7	40
Sheep	12	9	70
Goats	5	4	14
Pigs	14	1	21
Chicken	70	39	225
Horse	7	5	40

Besides information about the number of breeds, the number of breeding animals per breed, the genetic and phenotypic differences between breeds, and the within breed genetic diversity are important indicators. In recent years officially recognized⁸ breed associations became obliged to monitor inbreeding rates and within breed genetic diversity. Moreover breeding industry adopted a voluntary Code-EFABAR⁹, which also includes their responsibility to maintain genetic variation.

Sustainable use and Development

The Netherlands has a well-developed animal breeding infrastructure. All necessary capacities and infrastructure to develop and implement efficient breeding programs are available. In the previous century, organised breeding activities first started within the existing breeding associations. Breeding associations and breeding organisations are officially recognized by the national government, based on EU zootechnical legislation.

Leading internationally operating breeding companies in dairy cattle, pigs and poultry have their head offices in the Netherlands. These private actors are commercially driven by national and global market developments. They exchange germplasm and breeding stock “within company” between countries and regions, they distribute genetic material globally and contribute to global food security, efficiency and sustainability of the livestock sector.

The involvement of the government in animal breeding is very limited. The Dutch government is primarily responsible for the national identification and registration system for farm animals. Through its policies the government promotes sustainable breeding programs and sustainable development of breeds.

During the past decade breeding organisations clearly have put more emphasis on sustainability traits in their breeding goals, such as feed-efficiency, robustness, longevity and health traits. Both market developments and societal concerns are expected to have further impact on the breeding goals of breeding organisations, e.g. to contribute to better health and welfare, improved resource efficiency and reduction of the use of antibiotics.

In particular breeding associations and NGO networks are active in supporting the *in situ* conservation of locally adapted/native breeds. For them, development of market oriented strategies for products derived from local breeds is an important priority.

⁷ Including breeding lines and breeds for which the breeding organisation has a head office in the Netherlands and a breeding programme managed in the Netherlands (e.g. TOPIGS, CRV, Hendrix Genetics).

⁸ National implementation of EU Zootechnical legislation by Product Board for Livestock and Meat <http://www.pve.nl/pve?waxtrapp=hwtFsHsu0nbPTEcBPPqB>

⁹ Code-EFABAR. European Forum of Farm Animal Breeders. The voluntary code of good practice for responsible farm animal breeding. www.responsiblebreeding.eu

Technology development already had influence on animal breeding in the past, but genomic selection is expected to have a further major impact on animal breeding. In particular mainstream breeds will benefit from this development and local breeds are lagging behind. On the other hand, genomics also provides opportunities for characterization, more effective conservation strategies and potentially genomic selection across breeds. This was already a priority research area for Wageningen University and Research Centre in the last decade.

Conservation

The state of between and within breed diversity in the Netherlands has been regularly assessed. Information about breed population size is collected from breed societies and breeding organisations, for updating the EFABIS and DAD-IS databases. Officially recognized breed societies and breeding organisations have to report about inbreeding rates. Moreover, targeted research projects provided information to breeding organisations about within breed genetic diversity and the sustainability of their breeding programs.

There is a substantial number of locally adapted/native breeds in the Netherlands which have status “critical”, “endangered” or “vulnerable”. The contribution of this group of breeds to total livestock production became already “marginal” in the last 30 years of the 20th century. There are no breeds which got extinct, but there are still threats to some locally adapted/native breeds. For example, small populations are threatened by potential outbreak of diseases. Another important trend is that for many breeds, hobby breeding became dominant, which will finally change the breed characteristics and may not guarantee sustainable conservation. Moreover, the average age of farmers is high. There is a need to involve a new generation of farmers in breeding of locally adapted/native breeds.

Maintenance of farm animal genetic diversity is influenced by a variety of stakeholders. Breeders, breed associations and breeding industry are primarily responsible for sustainable development and conservation of their breeds or lines. Breeders/farmers in the Netherlands do not receive direct subsidies from the national government to financially support the *in situ* conservation of breeds. Some breeds, in particular herds of “heath sheep” benefit from subsidies from regional governments and/or nature/landscape protection organisations.

CGN and SZH receive public funding to support *in situ* and *ex situ* conservation. CGN is responsible for long term conservation of farm animal genetic diversity and development/maintenance of the national gene bank (*ex situ in vitro* conservation). In good cooperation SZH and CGN support breed associations and networks of breeders to develop their breeding programmes and *in situ* conservation strategies. In particular, promoting market oriented strategies to conserve and sustainably use farm animal genetic resources has a high priority. It is considered to be crucial to exploit and to add value to the variety of functions, products and services of locally adapted/native breeds. There is a need to raise further awareness and interest in society and among farmers about the values of these breeds. As a result of more awareness and interest in society and among consumers, new opportunities will arise for diversification of food and for maintaining our bio-cultural heritage and living environment. In recent years, initiatives have been taken to add value to locally adapted/native breeds through development of specific supply chains and niche products and through better valuation of different functions.

The Netherlands has a well-established gene bank infrastructure (*ex situ in vitro* conservation). The Dutch national gene bank has been developed in close collaboration with breed associations, breeding industry and SZH. The Dutch national gene bank is hosted by CGN, that has state of the art infrastructure and knowledge about conservation genetics, genomics, cryobiology and reproductive technologies. Table 2 summarizes the gene bank collections in terms of number of breeds, number of donors and number of semen doses stored per species. There are substantial semen collections for locally adapted/native breeds *at risk* and also for mainstream breeds and commercial lines. For a few breeds there are also some embryo’s (cattle) or oocytes (horse) stored in the national gene bank collection. The collections are stored at two separate locations (Wageningen and Utrecht).

Table 2. Summary of Dutch national gene bank semen collections (2014)

	Cattle	Pig	Sheep	Goat	Chicken	Horse	Duck	Geese	Dog
Number of breeds	18	14	8	5	31	8	3	1	5
Donor animals/breed (range)	1-5086	3-83	8-71	8-33	1-20	1-37	14-34	10	1-8
Total number of doses	232649	15016	30050	6364	18828	2474	1588	150	410

Use of Dutch gene bank collections is gradually increasing. Gene bank collections are an important source of genetic variation to support *in situ* conservation of endangered (cattle) breeds. And there is an increasing number of requests to use gene bank material for research and characterization purposes.

The Dutch national gene bank for animal genetic resources collaborates in EUGENA, the European Gene Bank Network for Animal Genetic Resources. The objective of this platform is a rational, efficient, regional, integrated *ex situ* conservation approach across countries in Europe.

Policies, Institutions and Capacity-building

The Netherlands has a national strategy for genetic resources¹⁰, including animal genetic resources, but there is no specific national law on genetic resources. On the other hand, there is European Union zootechnical (including animal breeding) legislation that is implemented in the EU Member States. The aim of the legislation is the promotion of free trade in breeding animals and their genetic material, considering the sustainability of breeding programs and preservation of genetic resources. Other relevant policies at EU level which have impact on animal genetic resources conservation and sustainable use are for example the EU Biodiversity Strategy, the EU Common Agricultural and Rural Development Policies. Moreover, the Nagoya Protocol on Access and Benefit Sharing will be implemented nationally following EU ABS legislation.

The Netherlands has a world class research and education system and an active graduate program. The Animal Breeding and Genomic Centre (ABGC) of Wageningen University and Research Centre offers a strong international training program for capacity building in the domain of animal breeding and conservation, including international cooperation in joint/double degree programs at MSc and PhD level. As a result of initiatives of CGN education programs for primary schools, secondary schools and professional training all include biodiversity and genetic resources issues. Sustainable conservation methods for farm animal populations are an integral part of animal breeding courses in agricultural (high) schools and in Wageningen University.

The Netherlands also has a long track record regarding international cooperation, including the assistance of developing countries and countries with economies in transition.

There is a good cooperation between the breeding sector, NGO's and the research community. Leading internationally operating breeding companies and Wageningen UR have created a public-private-partnership program "Breed4Food" to enhance innovations and capacity building in animal breeding programs.

¹⁰ Sources of Existence. <https://www.wageningenur.nl/en/Expertise-Services/Statutory-research-tasks/Centre-for-Genetic-Resources-the-Netherlands-1/Centre-for-Genetic-Resources-the-Netherlands-1/ABS-Focal-Point/Netherlands-policy-on-Access-and-Benefit-Sharing.htm>



4. Priorities and strategic directions for future action

Key principles

For the Netherlands, the following strategic principles are leading for the identification and implementation of priorities for future action:

- Conservation through utilization as the preferred conservation strategy;
- Joint responsibility of a variety of actors and stakeholders for conservation and sustainable use of animal genetic resources;
- Public responsibility to secure long term conservation of farm animal genetic diversity;
- Promoting sustainable breeding programs and breeding for sustainability, at national and international level;
- Adopting the latest genomic and reproductive technologies for better characterization and to enhance efficiency of conservation and breeding;
- Contributing to global challenges through capacity building, knowledge development and exchange and strategic public and/or private partnerships.

Strategic priority 1 - Implementation of “national plan in situ”

The aim of the national plan¹¹ for *in situ* conservation is to reduce the risk of losing traditional Dutch breeds and varieties (animals, plants, trees) and to promote their use. The main components of the “national plan *in situ*” are: i) development and implementation of market-oriented strategies, promoting traditional breed related products and (ecosystem) services, ii) to better characterize traditional breeds and varieties, and iii) to disseminate and exchange knowledge. Key challenge is to turn the societal value of bio-cultural heritage into economic profitability through better valuation and marketing by combining different functions, products and services. Although there is increasing awareness in society about the value of traditional resources and bio-cultural heritage, continuous education and awareness raising are still needed, e.g. about the values of traditional breeds in relation to food diversity and attractive landscapes.

Strategic priority 2 - Conserve what we still have, “in *ex situ in vitro* collections”

Further development and maintenance of the national gene bank is important to guarantee long term conservation of farm animal genetic diversity, for future breeding or research purposes. Gene bank collections are important for future food security, considering the challenge to adapt to changes in climate, production systems and markets. Secondly, “*ex situ in vitro* collections” are important to secure our national bio-cultural heritage. Core gene bank collections will be established and updated, for all locally adapted/native breeds and for other national strategic breeding populations, in close collaboration with breed societies and private breeders. Besides semen collections,

¹¹ National plan for *in situ* conservation and for stimulating the use of Dutch cultural living heritage. Stichting de Oerakker (DOA), Stichting Zeldzame Huisdierrassen (SZH), Vereniging van bos- en natuurterreineigenaren (VBNE), supported by the Centre for Genetic Resources, the Netherlands (CGN).

other types of germplasm or tissue will be stored in the national genebank in order to efficiently capture both male and female genetic diversity within populations.

The Netherlands will continue to support the development of EUGENA, the European network of animal genetic resources, in order to increase efficiency at European level.

The use of gene bank collections to support *in situ* conservation of endangered breeds (e.g. cattle breeds) and for scientific research purposes will be stimulated.

Strategic priority 3 - Application of genomic and reproductive technologies

The genomic revolution offers opportunities and also threats for both conservation and breeding. Genomic selection created already a revolution in the commercial animal breeding sector. Currently, small populations do not benefit from genomic selection. This may lead to decreased use of these populations "*in situ*". This development may change when genomic selection across breeds would become feasible. Introgression of unique characteristics from a local breed to a high productive breed could also be facilitated by genomic selection.

In addition, genomic technology will be used for: i) rationalization of gene bank collections, ii) to better balance short term and long term genetic gain in breeding programs, and iii) to analyse and conserve genetic diversity within and between animal populations. Genomic characterization and the use of novel reproductive technologies will make the management of gene bank collections more efficient, and will contribute to the efficiency of breeding and management of genetic variation within populations.

New developments in cryobiology and reproductive technologies offer opportunities to store genetic material in many different forms and for regeneration of individuals from cryopreserved material. The national gene bank and the private breeding sector will mutually benefit from these developments.

Research is needed to analyse opportunities and risks of new technologies in the context of conservation and sustainable use of animal genetic resources.

Strategic priority 4 - Better characterization of between and within breed genetic diversity

There is a need to better (phenotypically and genetically) characterize gene bank collections and breeding populations, in particular locally adapted/native breeds. Advances in genomic research will provide new opportunities to identify important genomic regions across breeds, which is important for the commercial breeding sector and for breeders of locally adapted/native breeds.

International (European and global) collaboration is needed to characterize and to prioritize breeds in the context of food security and adaptation to the changing climate and changing production systems and markets.

Strategic priority 5 - Sustainable breeding programs and sustainable development of breeds

The principle “conservation by utilization” requires long term sustainability of breeding programs and sustainable development of breeds. Sustainability of the livestock sector and sustainable breeding goals are important policy issues in the Netherlands¹². In comparison to 10 years ago, breeding goals of Dutch breeding industry are currently much broader. On the other hand, welfare, health and sustainability traits seem to be less important at global scale. Nevertheless, sustainability is seen as an opportunity for the Dutch livestock sector and for export. The livestock sector can benefit economically from improved animal welfare and health. The potential use of data from different actors in the livestock production chain (e.g. farms, slaughterhouses, dairy industry), linking genomic and phenotypic data, offers new opportunities.

Zootechnical legislation is considered as an important framework to stimulate and monitor the sustainability of breeding and conservation programs, carried out by breed societies and breeding organisations.

In this context of sustainable breeding it is also important to note that four Netherlands based breeding companies collaborate with the ABGC in “Breed4Food”, a public-private-partnership programme for pre-competitive research in the livestock breeding sector. This initiative will contribute to the development of sustainable breeding programs.

Strategic priority 6 - International capacity building and knowledge exchange

The Netherlands will support other countries and global regions to conserve and sustainably use farm animal genetic diversity, in the light of livestock sector challenges and continuing threats to lose farm animal genetic resources in less developed countries or regions. It is recognized that capacity building through development of research, training and education is the most effective contribution of the Netherlands to support implementation of the Global Plan of Action for AnGR at European and global level. Initiatives have been and will be further taken by the Animal Breeding and Genomics Centre of Wageningen University and Research Centre (ABGC) to develop and implement joint Master and Graduate Programs together with European partner universities.

The Dutch breeding sector will contribute to global livestock sector development, through distribution of breeding stock and genetic material and knowledge. The aim of the Dutch breeding sector is to develop long term relationships with other countries, including with less developed countries. Both the Netherlands and developing countries will benefit from knowledge exchange, including local knowledge. Joint investment in local breeding programs anticipating local needs and production environments is one of the options to contribute to local livestock breeding and sustainable livestock sector development in developing countries.

Strategic priority 7 - Development and implementation of policies and regulations

In 2002, the Netherlands Parliament adopted a government policy on genetic resources: “Sources of Existence”. Until now, no new national legislation has been deemed necessary, specifically for genetic resources, to implement this policy.

¹² National initiative to promote sustainable breeding <http://www.uitvoeringsagendaduurzameveehouderij.nl/werken-aan-verduurzaming/initiatieven/initiatiefgroep-duurzame-fokkerij/>

Both animal breeding and research in the Netherlands benefit from smooth international exchange of animal genetic resources. Proper implementation of the Nagoya Protocol on Access and Benefit Sharing (ABS) and EU ABS legislation is very important to regulate global exchange. In this context, we also consider that genomic and phenotypic information about breeding populations and gene bank collections are of strategic importance for the breeding and livestock sector in the Netherlands. Conservation of farm animal genetic resources is a potential benefit for the future, and a reason for the Netherlands to strategically invest in long term conservation of between and within breed genetic variation for future breeding or research.

The Global Plan of Action for Animal Genetic Resources will be further implemented nationally through a national policy and regulatory framework. Among other relevant livestock related policies, regulations and institutions, this framework includes ABS legislation, zootechnical (animal breeding) legislation and Statutory Research Tasks of the Centre for Genetic Resources, the Netherlands (CGN).



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