Agrobiodiversity – the key to food security, climate adaptation and resilience

Published by giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Agrobiodiversity – the key to food security, climate adaptation and resilience

Agricultural biodiversity (or agrobiodiversity) includes all components of biological diversity of relevance to food and agriculture, and all components of biological diversity that constitute the agricultural ecosystems: the variety and variability of animals, plants and micro-organisms, at the genetic, species and ecosystem levels, which are necessary to sustain key functions of the agro-ecosystem. Agrobiodiversity is the outcome of the interactions between genetic resources, the environment and the management systems and practices used by farmers and herders. It has developed over millennia, as a result of both natural selection and human interventions.

The conservation and sustainable use of agrobiodiversity is essential for the survival of humankind. Besides its supporting role in risk-management for millions of smallholder farmers around the globe by assuring their survival and livelihood, agrobiodiversity holds important keys for the future adaptation of agriculture to a changing environment, especially in terms of climate and diseases. Greater genetic diversity contributes to reducing climatic and disease-related risks and increases resilience.

However, in the last few decades agrobiodiversity has decreased at an alarming rate and these losses are still increasing rapidly, especially in developing countries where agricultural biological diversity is often very rich. The extinction of traditionally cultivated crop species and varieties as well as local animal breeds has many causes. Modernisation and intensification, mechanisation and monocultures, a lack of knowledge about and incentives for the conservation and sustainable use of agrobiodiversity, reduced access to genetic resources and their free use, and other processes of social and economic change all affect agrobiodiversity.

Essential approaches in slowing down the present rate of loss of agrobiodiversity are the active involvement of the rural population in *in situ* (on farm) conservation, considering the vital role of women, smallholders and pastoralists in the conservation process, traditional knowledge and local innovation. Key aspects are policy advice and legislation, capacity-building in governmental and non-governmental institutions, public awareness-creation, and supporting farmers in conserving and utilising their genetic resources in an economically sustainable way.

An important aspect is the 'public good' characteristic of agrobiodiversity due to the manifold services it provides. The question of how to value these services and the need for provision of incentives and payments for agrobiodiversity conservation services are yet to be addressed sufficiently. Measures to motivate and compensate farmers and livestock keepers for the conservation and sustainable management of agrobiodiversity are required.

Agrobiodiversity is not a mere agricultural issue – it also tackles aspects of the environment, nutrition, education, health, water and sanitation, infrastructure and markets as well as social sciences. Therefore, an integrated, mulit-sectoral and multi-level approach is needed, ranging from village interventions and capacity-building to providing policy advice and mainstreaming agrobiodiversity at local, national and international levels.

The main challenge for the agricultural sector is to simultaneously secure enough high-quality agricultural production for global food and nutrition security, conserve biodiversity and manage natural resources, as well as improve human health and well-being, especially for poor people in developing countries.

german cooperation
DEUTSCHE ZUSAMMENARBEIT

Published by:
giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

The GIZ Agrobiodiversity Factsheets – Overview

1. **Understanding agrobiodiversity**
   - What is agrobiodiversity?
   - How has agrobiodiversity developed?
   - Gender and agrobiodiversity
   - Present trends
   - Why is agrobiodiversity important?
   - The global governance of agrobiodiversity
   - *In situ* or *ex situ* conservation?
   - Conservation and sustainable use of agrobiodiversity – options for action in development cooperation
   - Outlook

2. Agrobiodiversity – plant genetic resources
   - Plants for food and agriculture and their genetic diversity
   - Global governance of plant genetic resources for food and agriculture
   - *In situ* and *ex situ* conservation
   - Neglected and underutilised species
   - Crop wild relatives
   - Wild plants for food and trade
   - Invasive alien species – a threat to plant genetic resources
   - Plant breeding and seed distribution
   - Outlook

Photos: © GIZ

Contact person

Friederike Kraemer
naren@giz.de

3. Agrobiodiversity – animal genetic resources
   - Animals for food and agriculture and their genetic diversity
   - Why are animal genetic resources important?
   - Present trends
   - Global governance of animal genetic resources for food and agriculture
   - The value of local breeds
   - *In situ* and *ex situ* conservation
   - Conservers of animal genetic resources
   - Outlook

4. International agreements on agrobiodiversity
   - Background
   - The Convention on Biological Diversity
   - CBD Protocols
   - The International Seed Treaty
   - Treaties on intellectual property rights
   - Implementation of international agreements on agrobiodiversity
   - Outlook

5. Incentives for agrobiodiversity conservation
   - Who conserves agrobiodiversity, and who benefits?
   - How to value agrobiodiversity?
   - Incentives for diversity
   - Payments for agrobiodiversity conservation services
   - Financing the conservation of agricultural diversity
   - Outlook

6. Adding value to agrobiodiversity
   - Market incentives for agrobiodiversity conservation
   - Value chains promoting agrobiodiversity
   - Niche markets
   - Development partnerships with the private sector
   - Standards and certification schemes
   - Geographical indications of origin
   - Outlook

7. Agrobiodiversity for survival
   - Features of agrobiodiversity for survival
   - Utilization of marginal land
   - Agrobiodiversity and climate change
   - Agrobiodiversity and human health
   - Agrobiodiversity and HIV/AIDS
   - Agrobiodiversity, disasters and emergency aid
   - Outlook

The factsheets can be downloaded at www.giz.de/expertise/html/7358.html under 'Genetic Resources in Agriculture'.
A printed version of the folder with factsheets can be ordered at i-punkt@giz.de.

Published by
Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

Registered offices
Bonn and Eschborn, Germany

Sector Project Sustainable Agriculture (NAREN)
Friedrich-Ebert-Allee 36+40
53113 Bonn
T +49 (0) 228 44 60-0
F +49 (0) 228 44 60-0

Dag-Hammarskjöld-Weg 1-5
65760 Eschborn, Germany
T +49 (0)6196 79 - 2359
F +49 (0)6196 79 - 1115

naren@giz.de
www.giz.de/sustainable-agriculture

Author: Dr Christine Martins

Design: Ira Olaleye

As at: November 2015

On behalf of
Federal Ministry for Economic
Cooperation and Development (BMZ)

Special unit: 'ONE WORLD – No Hunger'

Addresses of the BMZ offices

BMZ Bonn
Dahlmannstraße 4
53113 Bonn, Germany
T +49 (0)228 99 535 - 0
F +49 (0)228 99 535 - 3500

BMZ Berlin
Stresemannstraße 94
10963 Berlin, Germany
T +49 (0)30 18 535 - 0
F +49 (0)30 18 535 - 2501

poststelle@bmz.bund.de
www.bmz.de

german cooperation
DEUTSCHE ZUSAMMENARBEIT

Published by:
giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Understanding agrobiodiversity

At a time when a growing world population needs to be fed on limited resources in a changing climate, the conservation and sustainable use of agricultural biological diversity gains utmost importance. Agrobiodiversity plays a crucial role in food security and nutrition, as well as in the provision of environmental services and livelihoods. It is critical to the sustainability, resilience and adaptability of agricultural production systems. To promote awareness and share knowledge on conservation and the sustainable use of agrobiodiversity, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ), has published this series of agrobiodiversity factsheets.

The present factsheet presents the basics of agrobiodiversity – what it is, why it is important, what causes it to diminish and why this is happening so rapidly, how it can be developed, and its relation to traditional knowledge and local innovations. It also covers gender issues, the global and national governance of agrobiodiversity, *in situ* and *ex situ* conservation methods, and, finally, options for action for conservation and sustainable use of agrobiodiversity in development cooperation.

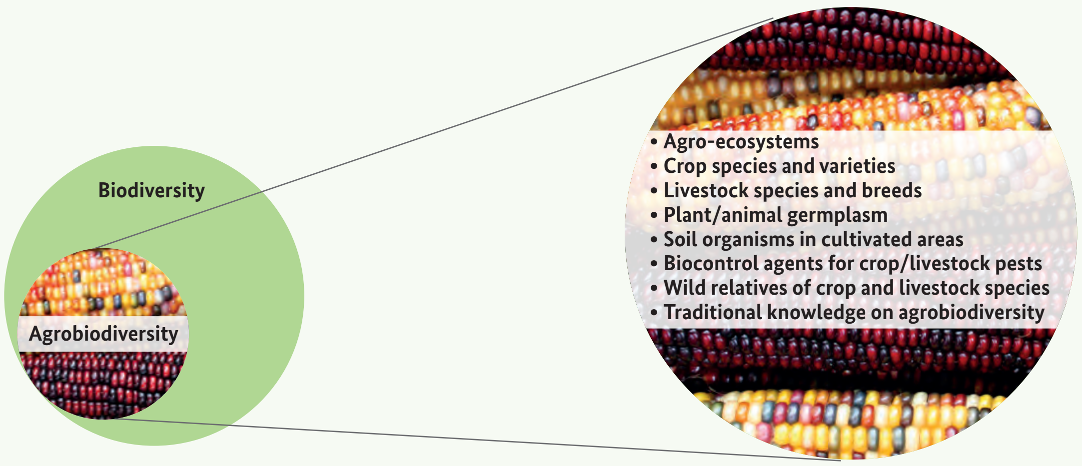
What is agrobiodiversity?

Agricultural biodiversity includes all components of biological diversity of relevance to food and agriculture, and all components of biological diversity that constitute the agricultural ecosystems: the variety and variability of animals, plants and micro-organisms, at the genetic, species and ecosystem levels, which are necessary to sustain key functions of the agro-ecosystem. Agrobiodiversity is the outcome of the interactions among genetic resources, the environment and the management systems and practices used by farmers and herders. It has developed over millennia, as a result of both natural selection and human interventions.

According to the Convention of Biodiversity (CBD), agrobiodiversity is comprised of four dimensions:

1. **Genetic resources for food and agriculture:**
   - Plant genetic resources, including crops, wild plants harvested and managed for food, trees on farms, pasture and rangeland species.
   - Animal genetic resources, including domesticated animals, wild animals hunted for food, wild and farmed fish and other aquatic organisms.
   - Microbial and fungal genetic resources.

   These constitute the main units of production in agriculture, and include cultivated and domesticated species, managed wild plants and animals, as well as wild relatives of cultivated and domesticated species.
2. **Components of biodiversity that support ecosystem services upon which agriculture is based** (Note: Ecosystem services are processes by which the environment produces benefits useful to people). These include a diverse range of organisms that contribute to nutrient cycling, pest and disease regulation, pollination, pollution and sediment regulation, maintenance of the hydrological cycle, erosion control, carbon sequestration and climate regulation.
3. **Abiotic factors**, such as local climatic and chemical factors and the physical structure and functioning of ecosystems, which have a determining effect on agrobiodiversity.
4. **Socio-economic and cultural factors.** Agrobiodiversity is largely shaped and maintained by human activities and management practices, and a large number of people depend on agrobiodiversity for sustainable livelihoods.



Agrobiodiversity is an important part of biodiversity

Adapted from: FAO, 2005

The Irish potato famine – a lack of genetic diversity

The Irish potato famine of 1846–1850 illustrates the importance of agrobiodiversity and a broad genetic base in agricultural production. During that time, the population of Ireland decreased by two million, or 25 %. One million died of starvation or diseases associated with the famine and one million emigrated to North America or parts of England. To this day, the country has never recovered its population levels of 1845.

What happened? People had mainly lived off subsistence farming and the potato was the country's most important staple food. But only two varieties were under cultivation. A potato disease broke out, potato late blight, caused by the fungus-like microorganism *Phytophthora infestans*. Because both potato varieties were susceptible to this disease, it was able to spread unhindered, wiping out large parts of the crop.

Sustainable Development Goals (SDGs) and (agro-)biodiversity

Several SDGs touch the issue of conservation and sustainable use of agrobiodiversity, such as:

- SDG 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture.
- SDG 12: Ensure sustainable consumption and production patterns.
- SDG 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

This last dimension includes traditional and local knowledge of agrobiodiversity, cultural factors and participatory processes, as well as tourism associated with agricultural landscapes.

Biodiversity means the diversity of life in all its forms, and agrobiodiversity is an important part of it (see diagram p. 1). Biodiversity is comprised of three crucial dimensions: genetic diversity, which is the diversity of different genes and/or genomes (in other words, the genetic variability within each species), species diversity, which is the diversity of different species, and the ecosystem diversity, which is the diversity of different ecosystems. The same categories are applicable to agrobiodiversity – genetic diversity within a certain agricultural species, species diversity between agricultural species, and agricultural ecosystem diversity between agricultural ecosystems.

How has agrobiodiversity developed?

Agrobiodiversity is the outcome of more than 10,000 years of efforts by farmers and herders in selection and breeding, and in developing appropriate production systems and methods. Farmers and herders all over the world have been constantly improving the genetic resources of their crops and livestock. The result is a diversity of crops and livestock adapted to local conditions. It is this diversity that has enabled people to settle in almost all the regions of the Earth and to provide food for themselves under even the harshest of conditions.

Our major crops and most livestock species have their origins in the tropics and subtropics. Scientists have identified at least twelve major geographic 'centres of diversity' – regions, or hotspots, that harbour a high percentage of plant, livestock, and cultural diversity. 'Centres of diversity' refer both to regions where crops and livestock were originally domesticated from their wild ancestors, and regions of subsequent spread where ongoing adaptation to their environment and selection by farmers and herders takes place. That is why a specific crop can be listed in more than one centre of diversity (see Seedmap). A map displaying the major centres of livestock domestication will be published in the FAO's Second Report on the State of the World's Animal Genetic Resources for Food and Agriculture in November 2015.

Traditional knowledge and local innovations

Closely associated to the development of local varieties and breeds is the development of related knowledge. Such traditional knowledge has been developed over the centuries and is a collective asset of the local communities; it is passed on from generation to generation in various forms. Just as local innovations have played a crucial role in the development of agricultural biodiversity in the past, farmers' and herders' current activities in domesticating wild species and in selecting and breeding plants and animals in view of changing conditions and new opportunities are still important. Whether to limit risk, enhance food security or improve their livelihoods, farmers and herders are constantly exploring new ways of using agrobiodiversity sustainably – they are innovating in order to increase their options to cope with variable environmental conditions and to exploit micro-environments (niches) in their agro-ecosystems. Such processes, local creativity and energies help to conserve and develop agrobiodiversity. At the global level, the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA, see box page 5) recognizes farmers' traditional knowledge of plant genetic resources ('Farmers' Rights'). For further information, see Prolinnova (2009) and the following GIZ factsheets (Note: In the present text, GIZ factsheets, hyperlinked, are marked with ▶):

- ▶ *GIZ, 2009: Traditional knowledge relating to the conservation and sustainable use of biodiversity*
- ▶ *GIZ, 2010: The role of intellectual property rights in agriculture*

Links between cultural and biological diversity

Traditional local communities and indigenous peoples often have a profound understanding of their environment and its ecology. Such traditional knowledge – for example about the use of wild plants and animal products for food, medicine and dyes – is of importance to the conservation and sustainable use of agrobiodiversity. However, indigenous peoples suffer from the destruction of the environments in which they live. In line with this trend, the great wealth of traditional knowledge will disappear – it is lost to these peoples themselves and humanity as a whole.

Closely related to traditional knowledge and indigenous communities is the right to free, prior, and informed consent (FPIC) – the right of indigenous peoples to make free and informed choices about the development of their lands and resources. It is enshrined in the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) and in ILO Convention 169. It ensures that indigenous peoples are not coerced or intimidated, that their consent is sought and freely given prior to the authorisation or start of any activities, that they have full information about the scope and impacts of any proposed developments, and that ultimately their choices to give or withhold consent are respected.

Gender and agrobiodiversity

Men and women play different roles in agrobiodiversity management and use. This is due to their different roles in production and reproduction. In most farming systems, there is a fixed division of labour. Men and women may be responsible for different crops or livestock species or for different tasks related to a crop or an animal. In many cases, for example, men plough the fields while women prepare the seedbeds with hoes. Weeding is often a task for women and children, while pesticide spraying or fertiliser application is mainly carried out by men. For harvesting, all available hands are needed. Home gardens are usually run by women. Men tend to focus on market-oriented cash crop production, while women are often responsible for the family's subsistence needs.

As family nutrition and health are in most cultures under the responsibility of women, their knowledge about related crop or animal product characteristics is often higher than that of men. They know better about issues such as taste, cooking characteristics, storability, and healing power.

Through their daily activities, experience and knowledge, women have a major stake in conserving agricultural biodiversity. In many countries, women are the custodians of agrobiodiversity. However, they are often limited in their decision-making power and access to and control over the resources that they rely on to meet their needs. Improvement of women farmers' access to land and water resources, and to education, advice, training, credit and appropriate services and technology as well as the decision-making structure is essential if agrobiodiversity conservation is to be improved.

- *GIZ, 2006: Women, men and agrobiodiversity*
- *GIZ, 2006: Gender – Gender relations and biodiversity*
- *GIZ, 2015: Gender and agrobiodiversity*

Gender and agrobiodiversity in Timor-Leste

The project 'Promotion of Sustainable Use of Agrobiodiversity' forms part of the BMZ-funded programme 'Sustainable Management of Agrobiodiversity in Timor-Leste' (2012 – 2016). It promotes the protection of biodiversity in agriculture by applying a gender-specific methodology (see GIZ, 2015). Sustainable use of local species, varieties, and landraces as well as the application of biodiversity-friendly farming practices are implemented whilst taking into account specific needs of women and men. A gender-based approach was chosen for the following reasons:

- To provide gender-segregated space for men and women, (a) to articulate needs and priorities, (b) to create selfconfidence, (c) to participate in decision-making and prioritize project activities.
- To include senior male and female farmers in order to appreciate their traditional knowledge regarding agrobiodiversity and pass it on to younger generations, e.g. the cultivation and use of ancient nutritious and climate-resilient crops such as job's tears *(Coix lacryma-jobi).*
- To allow both sexes to participate in and benefit from non-monetary effects of sustainable agrobiodiversity management (e.g. improved food security, balanced nutrition) and monetary impacts (e.g. value chain development of native species, such as wild mint, traditional rice varieties and the wild sugar palm).
- To create gender awareness at the project partners' level, leading to the provision of services and new technologies in a gender-balanced way.

Women play an important role in the conservation of agrobiodiversity.

Photos, l.t.r.: © GIZ, © Ilse Köhler-Rollefson, © GIZ/Ursula Meissner

Photo: © Christine Martins

Instead of analysing and improving the genetic potential of their local cattle breeds, many local governments focus on cross-breeding with Holstein-Friesian and other exotic high-performance breeds.

Present trends

In the last 100 years, agrobiodiversity losses have increased at an alarming rate and these losses are still increasing rapidly, especially in developing countries where agricultural biological diversity is often very rich. Throughout history, out of the estimated 250,000 plant species, about 7,000 have been used as food crops by humans. At present, only three of them, maize, rice and wheat, account for about 60 % of the calories and 56 % of the protein people derive from plants. Twelve crops together with five animal species provide most of the modern world's food. Besides general species diversity, the diversity within species – genetic diversity – is also reducing dramatically. Since the middle of the 20th century, the diversity of crop varieties is estimated to have declined by 75 %. In Mali, for example, 60 % of local varieties of sorghum have disappeared in one region over the last 20 years.

Similar trends are observed in farm animals. For example, the highly productive dairy breed Holstein-Friesian now makes up 60 % of European and 90 % of North American dairy cattle. Many developing countries are supporting cross-breeding programmes using Holstein-Friesian and other exotic high-performance breeds. The advantages of local breeds such as hardiness, disease resistance, and productivity even under difficult conditions are insufficiently explored and exploited. In many countries, local cattle breeds well adapted to their specific conditions are being replaced at a fast rate. With each breed going extinct, the genetic resources of this breed are inevitably lost for future breeding. In addition, the related traditional knowledge may be lost if the breed is extinct.

These losses of traditionally cultivated crop species and varieties as well as local animal breeds have many causes. Modernization and intensification, mechanization and monocultures, missing knowledge on and incentives for the conservation and sustainable use of agrobiodiversity, reduced access to genetic resources and their free use (intellectual property rights protection), and other processes of social and economic change all affect the agricultural biological diversity. In addition, social change – particularly the migration of male and younger people – often leads to a shortage of family labour, the loss of traditional knowledge of crop cultivation and livestock husbandry practices as well as of means for processing and utilization of products.

Another factor influencing agrobiodiversity is climate change. As production conditions change (temperature, rainfall, winds), crop varieties and breeds may be abandoned by farmers and livestock keepers, and may be lost forever if steps are not taken to ensure their conservation. In addition, extreme weather events such as floods and droughts pose an immediate threat to the survival of varieties and breeds that are raised only in specific small geographical areas and to crop wild relatives.

Agricultural policies and market conditions often focus exclusively on 'modern' varieties that dominate the market. The informal seed system in which farmers freely cultivate, exchange and further develop seeds is being increasingly affected by the commercial seed sector. The world's genetic resources are increasingly privatized. In addition, there is a growing market concentration in the commercial seed sector: today, three corporations control more than 50 % of the world's commercial seed market, leading to more uniform agricultural production, thus reducing agrobiodiversity.

Why is agrobiodiversity important?

Plant and animal genetic resources are the basis for the further development of crop varieties and animal breeds by farmers and breeders. The small farmers and herders of Africa, Asia and Latin America – and among them in particular women and marginalized groups – are especially dependent on the diversity of genetic resources. A rich diversity of native plant varieties and locally adapted animal breeds contributes to strengthening these farmers' and herders' resilience in the face of difficult climatic conditions and marginal locations, e.g. in arid or upland regions. Traditional crops and livestock breeds can be utilized with minimum agricultural input, have quality characteristics that correspond to local needs and, in addition, often play an important role in the culture of the rural population. In addition, agrobiodiversity can be the basis for the development of new products, such as it was in the case of stevia or quinoa, which have considerable market potential in the middle class in developing countries as well as in advanced economies.

Agricultural biodiversity provides environmental services (soil, water, habitat, and pollinators) and supports the sustainability and resilience of agricultural systems; it can provide a diverse and nutritious diet, contribute to health, and support the maintenance of traditional knowledge and cultural identity. Considering this, agrobiodiversity is a key asset to improve the livelihoods and productivity of poor smallholder farmers. Of course, rich agrobiodiversity alone is not sufficient, but needs to be enhanced by other factors such as a supportive policy environment or well-functioning infrastructure. See also Bioversity International (2013).

Agrobiodiversity, with its abundance of local crop varieties and livestock breeds as well as crop and livestock wild relatives, hides many still-unknown genetic characteristics, which could be important for the survival of humankind. As the potential basis for new varieties and breeds, it could be our insurance for the future – it can help us to manage pests and diseases, climate change, nutrition and health. It is of especial importance for people dependent upon agriculture in marginal rural areas – see also FAO (2015) and

- *GIZ, 2001: Agrobiodiversity – Genetic resources for food and agriculture*
- *GIZ, 2006: Agrobiodiversity – the key to food security*
- *GIZ, 2013: Briefing Note Agrobiodiversity*
- *GIZ: 2015: Agrobiodiversity for survival*

Why agricultural biodiversity matters

1. Agricultural biodiversity is the foundation of agriculture.
2. Agricultural biodiversity can provide a cost-effective. way for farmers to manage pests and diseases.
3. Agricultural biodiversity gives farmers options to manage climate risks.
4. Agricultural biodiversity can contribute to health and nutrition.
5. Agricultural biodiversity can play a role in sustaining soil health, food and habitat for important pollinators and natural pest predators that are vital to agricultural production.
6. Traditional knowledge and culture is often based on local species diversity and its use.

Source: Biodiversity International

The global governance of agrobiodiversity

The Convention on Biological Diversity (CBD), hosted by the United Nations Environment Programme (UNEP), provides the global framework for the conservation and sustainable use of biodiversity. The CBD collaborates closely with the Food and Agriculture Organization of the United Nations (FAO) in the implementation of the CBD programme of work on agrobiodiversity. FAO's Commission on Genetic Resources for Food and Agriculture (CGRFA) is the only intergovernmental permanent forum for governments to discuss and negotiate matters specifically relevant to agrobiodiversity. It monitors the status of genetic resources for food and agriculture and takes action as appropriate, including through global action plans, codes of conduct and guidelines. FAO's International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) ensures the continued global exchange of plant genetic resources essential to agriculture and food security.

In most countries, the Ministry of Environment is responsible for biodiversity, while the Ministry of Agriculture deals with agrobiodiversity. For agrobiodiversity research, Bioversity International has been set up under the Consultative Group on International Agricultural Research (CGIAR).

Information on important organisations dealing with plant and animal genetic resources for food and agriculture and on international agreements on agrobiodiversity is available in

- *GIZ, 2015: Agrobiodiversity – plant genetic resources*
- *GIZ, 2015: Agrobiodiversity – animal genetic resources*
- *GIZ, 2015: International agreements on agrobiodiversity*

The CBD

The Convention of Biological Diversity (CBD) is an international legally-binding treaty with three main goals: conservation of biodiversity; sustainable use of biodiversity; and the fair and equitable sharing of the benefits arising from the use of genetic resources. It was opened for signature at the Earth Summit in Rio de Janeiro on 5 June 1992 and entered into force on 29 December 1993. To date, there are 196 parties.

The ITPGRFA

The International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) is a legally binding instrument adopted by the FAO Conference in 2001. It entered into force on 29 June 2004 and has at present 134 contracting parties. Member states are obliged to conserve their plant genetic resources for food and agriculture in accordance with the CBD, to ensure their sustainable use, and to share equitably the benefits arising from their use. The treaty recognizes 'Farmers' Rights': the traditional rights of farmers as producers, maintainers and developers of agrobiodiversity.

In situ or *ex situ* conservation?

Agrobiodiversity can be conserved *in situ* ('on site') or *ex situ* ('off site'), within or outside of the original habitat. *In situ* conservation is the conservation of agrobiodiversity in its area of origin, in the surroundings where the plants or animals have developed their distinctive properties. *Ex situ* conservation is the conservation of agrobiodiversity outside its area of origin, which can be done by maintaining live populations or by storing frozen genetic material; *in vivo* (alive) conservation is done in botanical or zoological gardens or on government-owned farms, *in vitro* ('in glass') conservation in gene banks, in the form of seeds, tissue, sperm, embryos, or somatic cells.

In situ and *ex situ* conservation are two different, but complementary approaches to agrobiodiversity conservation; each plays a distinct and important role. *In situ* conservation helps to guarantee the survival of a species in its natural habitat and

Photos: © Beate Quilitzsch-Schuchmann



Learning together in Farmer Field Schools in Timor-Leste.

allows it to adapt to a changing environment. *Ex situ* conservation preserves the genetic material in its present state and prevents extinction. Examples of *in situ* and *ex situ* conservation can be found in the 2015 GIZ factsheets on plant and on animal genetic resources mentioned above.

Conservation and sustainable use of agrobiodiversity – options for action in development cooperation

By ratifying the Convention on Biological Diversity (CBD), the parties commit to conserve biological diversity within their own country as well as to support other countries, in particular developing countries, to achieve the convention's objectives. Germany has assumed this task and assists its partners to implement the CBD through different development cooperation activities. Many projects deal with the protection of biodiversity in general and some have a component on agrobiodiversity; a few projects focus on agrobiodiversity (see BMZ and BMUB, 2014).

Key factors for the success of agrobiodiversity support measures are appropriate targeting of audiences, and a proper mix of activities and approaches. These can be generally divided into the three categories of: producers, consumers, and politicians; or 'field level', 'general public' and 'political level'.

Field level

Pilot activities in agrobiodiversity-rich areas for awareness-raising and capacity-building at field level should be based on a documentation of agrobiodiversity and traditional knowledge as well as village development plans developed in a participatory way, which include agrobiodiversity and other measures. Activities could comprise Farmer Field Schools for biodiversity-friendly farming, community seed banks, home gardens, and activities for awareness-raising such as village posters and project calendars, focussing on the local agricultural biodiversity. Seed fairs as well as livestock exhibitions and markets support the exchange of genetic material and highlight the importance of agrobiodiversity issues; they can be combined with providing information on improvement of local varieties and breeds and made more attractive by emphasising local culture. Other important considerations are the value-amelioration (valorisation) of under-utilized crop varieties or domestic animal breeds and inventing other incentives for conserving and using the local agrobiodiversity, such as payment for ecosystem services and other direct or indirect compensation payments, monetary or non-monetary.

General public

Public information, sensitisation and awareness-raising on the importance of agrobiodiversity are important for the conservation and the sustainable use of agrobiodiversity. Television films, campaigns, posters, articles, brochures, internet blogs/websites, as well as local competitions and exhibitions focussing on agrobiodiversity, may all be of use. The International Biodiversity Day, May 22, can be used for special campaigns focussing on agrobiodiversity. Incorporating agrobiodiversity into school and university curricula are further important steps for increasing public knowledge. In addition, agro-tourism can create awareness on agrobiodiversity. A good example for this is the BMZ-funded programme Conservation of Agrobiodiversity in rural Albania (CABRA) which combines the conservation of (agro-)biodiversity with the promotion of sustainable agriculture and tourism.

Farmer Field Schools

Farmer Field Schools (FFS) provide a perfect platform to enhance the sustainable use and conservation of agrobiodiversity. The approach is based on active participation of local female and male farmers. Instead of just transferring knowledge, FFS helps build skills and confidence. FFS members can share experience of agricultural production, traditional knowledge of biodiversity-friendly agricultural practices, improvement of local plant varieties, as well as the marketing of traditional agrobiodiversity crops.

Livestock Farmer Field Schools and Pastoralist Field Schools allow livestock farmers and pastoralists to improve their respective management skills – these are adjustments of the FFS approach as means of empowering livestock farmers and pastoralists to develop their own solutions to problems that research and extension could not provide answer for. See also FAO website and FAO (2014).

Conserving agrobiodiversity in P.R. China

From 2005 to 2011, funded by BMZ, EU and the Chinese Government, the Chinese Ministry of Agriculture and GIZ implemented a project on sustainable management of agrobiodiversity in mountain regions in Southern China. In 26 pilot villages, the status of agrobiodiversity, including related traditional knowledge, was assessed. Subsequent village-level activities for *in situ* conservation of agrobiodiversity were planned in a participatory way, with activities such as small habitat protection, training on biodiversity-friendly farming techniques in newly established Farmer Field Schools, improved seed maintenance, seed fairs, and developing a village-level code of conduct for agrobiodiversity management.

In addition, small rural infrastructure measures were planned as incentives or compensation. In order to provide economic returns on agrobiodiversity conservation, agrobiodiversity crops with economic potential were identified, their value chains analysed and areas for improvement highlighted and supported. Farmers' production and marketing skills were strengthened, cooperatives for agrobiodiversity products established and farmers supported to participate in food exhibitions such as the Shanghai BioFach to present their agrobiodiversity products.

Capacity-building at farmers' as well as at the institutional level was key to project success. Study tours to places significant to agrobiodiversity conservation proved an efficient means for transferring knowledge. Numerous project activities served to raise awareness, such as a project's documentary film broadcast by local television channels, a travelling exhibition, and various publications. Such measures also made agrobiodiversity knowledge more readily available and easily accessible. Project results were incorporated into government policies and plans, the establishment of new institutions was facilitated, and agrobiodiversity courses were introduced at universities. See also Waldmueller (2011) and Seib (2011).

Political level

The international resolutions and regulations on agrobiodiversity need to be translated at national level into laws, policies and implementing activities. In this, it is important to facilitate coherence among the various sectors – for example environment, agriculture, trade, education and health. Constraining factors, such as promotion of input-intensive agriculture through subsidies and use of high-yielding breeds at inappropriate locations, need to be identified and removed or reduced. Supportive policies need to be established considering the experiences made at field level. National seed laws should include the topic of Farmers' Rights, thus allowing farmers access to and use of genetic resources. Workshops, conferences, and national and international study trips on agrobiodiversity contribute to exchange, learning and networking. Locally adjusted training and awareness-building materials can enhance the capacity of politicians, officials and field staff. Other measures at political level are linking different stakeholders, for example, in multi-stakeholder platforms, and spreading success stories. At the international level, assistance for the conservation and sustainable use of agrobiodiversity is needed. The German government, for example, is participating at the international negotiations of the ITPGRFA and relevant commissions on agricultural genetic resources.

Outlook

The conservation and sustainable use of agrobiodiversity is essential for the survival of humankind. Besides its supporting role in risk-management for millions of smallholder farmers around the globe, assuring their survival and livelihood, agrobiodiversity holds important keys for the future adaptation of agriculture to a changing environment, especially in terms of climate and diseases. Greater genetic diversity contributes to reducing climatic and disease-related risks and increases resilience. The value of agrobiodiversity in agro-ecosystems needs to be unlocked – insufficient conservation of agrobiodiversity would be biting the hand that feeds us.

World food security depends on a broad genetic basis, supported by a smart combination of *in situ* and *ex situ* measures. Essential in agrobiodiversity management are the active involvement of the rural population in *in situ* conservation, considering the vital role of women in the conservation process, and adding economic value to products derived from agricultural genetic resources ('use it or lose it'). Key aspects are policy advice and legislation, capacity-building in governmental and non-governmental institutions, public awareness-creation, and supporting farmers in conserving and utilizing their genetic resources in an economically sustainable way.



Photos, l.t.r.: © Christine Martins, © Christine Martins, © Ding Jinwu

Photos: © GIZ

Contact person

Friederike Kraemer
naren@giz.de

A multi-level approach is needed, ranging from village interventions and capacity-building to providing policy advice and mainstreaming agrobiodiversity at local, national and international levels. Successful and sustained efforts will contribute substantially to the conservation and sustainable management of agrobiodiversity worldwide.

The main challenge for the agricultural sector is to simultaneously secure enough high-quality agricultural production for global food and nutrition security, conserve biodiversity and manage natural resources, as well as improve human health and wellbeing, especially for poor people in developing countries.

Important links

- Bioversity International: www.bioversityinternational.org
- Commission on Genetic Resources for Food and Agriculture: www.fao.org/nr/cgrfa/cgrfa-home/en
- Convention of Biological Diversity: www.cbd.int
- Sector Project Sustainable Agriculture (NAREN): www.giz.de/sustainable-agriculture

Further information

- Bioversity International, 2013: Diversifying food and diets: Using agricultural biodiversity to improve nutrition and health. www.bioversityinternational.org/uploads/tx_news/Diversifying_food_and_diets_1688_02.pdf
- BMZ and BMUB, 2014: Committed to Biodiversity – Germany's International Cooperation in Support of the Convention on Biological Diversity for Sustainable Development. www.bmz.de/en/publications/type_of_publication/information_flyer/information_brochures/Materialie238_Biodiversity.pdf
- FAO, 2015: Coping with climate change – the roles of genetic resources for food and agriculture. www.fao.org/3/a-i3866e.pdf
- Lossau, Annette von, and Qingsong Li (eds.), 2011: Sourcebook on Sustainable Agrobiodiversity Management. star-www.giz.de/dokumente/bib-2010/gtz2010-0834en-sustainable-agrobiodiversity.pdf
- Lossau, Annette von, and Johannes Kotschi, 2011: Agrobiodiversity – The key to food security and adaptation to climate change. www.giz.de/expertise/downloads/giz2011-en-agrobiodiv-food-security-a-climate-change.pdf

The GIZ Agrobiodiversity Factsheets

GIZ has updated its issue papers and factsheets on agrobiodiversity, which have been produced during the last 15 years, and has so far produced seven new factsheets on agrobiodiversity:

1. Understanding agrobiodiversity
2. Agrobiodiversity – plant genetic resources
3. Agrobiodiversity – animal genetic resources
4. International agreements on agrobiodiversity
5. Incentives for agrobiodiversity conservation
6. Adding value to agrobiodiversity
7. Agrobiodiversity for survival

The factsheets can be downloaded at
www.giz.de/expertise/html/7358.html
under 'Genetic Resources in Agriculture'.
A printed version of the folder with factsheets can be ordered at i-punkt@giz.de.

Published by — Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Registered offices
Bonn and Eschborn, Germany

Sector Project Sustainable Agriculture (NAREN)
Friedrich-Ebert-Allee 36+40
53113 Bonn
T +49 (0) 228 44 60-0
F +49 (0) 228 44 60-0

Dag-Hammarskjöld-Weg 1-5
65760 Eschborn, Germany
T +49 (0)6196 79 - 2359
F +49 (0)6196 79 - 1115

naren@giz.de
www.giz.de/sustainable-agriculture

Author — Dr Christine Martins

Design — Ira Olaleye

As at — November 2015

GIZ is responsible for the content of this publication.

On behalf of — Federal Ministry for Economic Cooperation and Development (BMZ)

Special unit — 'ONE WORLD – No Hunger'

Addresses of the BMZ offices

BMZ Bonn
Dahlmannstraße 4
53113 Bonn, Germany
T +49 (0)228 99 535 - 0
F +49 (0)228 99 535 - 3500

BMZ Berlin
Stresemannstraße 94
10963 Berlin, Germany
T +49 (0)30 18 535 - 0
F +49 (0)30 18 535 - 2501

poststelle@bmz.bund.de
www.bmz.de

german
cooperation
DEUTSCHE ZUSAMMENARBEIT

Published by:

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Agrobiodiversity – plant genetic resources

At a time when a growing world population needs to be fed on limited resources in a changing climate, the conservation and sustainable use of agricultural biological diversity gains utmost importance. Agrobiodiversity plays a crucial role in food security and nutrition, as well as in the provision of environmental services and livelihoods. It is critical to the sustainability, resilience and adaptability of agricultural production systems. To promote awareness and share knowledge on conservation and the sustainable use of agrobiodiversity, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ), has published this series of agrobiodiversity factsheets.

The present factsheet gives attention to plant genetic resources as an important part of agrobiodiversity. (Note: One of the other factsheets deals with animal genetic resources). It explains the importance of genetic diversity in our food crops. After introducing relevant key events and institutions as well as *in situ* and *ex situ* conservation, attention is given to the potentials which exist in neglected and underutilized species, crop wild relatives and wild plants for food and trade, but also to threats for agrobiodiversity through invasive alien species. Besides conservation of plant genetic resources, their further development needs to be assured. Focus is given to local plant breeding and seed distribution, for example, through participatory plant breeding, seed fairs, and community seed banks. Finally, the paper lists key principles for conserving plant genetic resources for food and agriculture.

What is agrobiodiversity?

Agricultural biodiversity includes all components of biological diversity of relevance to food and agriculture, and all components of biological diversity that constitute the agricultural ecosystems: the variety and variability of animals, plants and micro-organisms, at the genetic, species and ecosystem levels, which are necessary to sustain key functions of the agro-ecosystem. Agrobiodiversity is the outcome of the interactions among genetic resources, the environment and the management systems and practices used by farmers and herders. It has developed over millennia, as a result of both natural selection and human interventions.

Plants for food and agriculture and their genetic diversity

Of the 250,000 globally identified plant species, about 7,000 have historically been used in human diets. At present, however, only about 30 crops form the basis of world's agriculture and just three species – maize, rice and wheat – supply more than half the world's daily calories. Within each plant species, a high number of varieties and great genetic diversity may be found. Unlike modern improved varieties (cultivated varieties, abbreviated 'cultivars'), traditional varieties (also known as farmers' varieties or landraces) are genetically much more variable.

FAO estimates that more than 75 % of global crop diversity has disappeared irrevocably over the 20th century. Not only has the diversity of species reduced, but also the diversity of varieties within the species. With the advent of modern agriculture, untold numbers of locally adapted crop varieties were replaced by genetically uniform, high-yielding modern varieties. In South Korea, for example, 74 % of the most common crop varieties in 1985 had been replaced by 1993. Farmers in India once grew 30,000 rice varieties – today, 75 % of India's rice crop comes from just ten varieties. In Mexico, only 20 % of the maize varieties known in 1930 are still in use.

Many risks – including crop failure and commodity price variability – go along with relying on a limited number of



Photos, l.t.r.: © Feng Yingli; © GIZ; © Ute Grabowsky/photothek.net crops. The genetic diversity contained in traditional varieties and crop wild relatives but also in improved cultivars provides a crucial basis for food production; it has potential for the valorisation of products derived from agrobiodiversity and offers greater possibilities for adaptation and resilience in the face of climate change. All countries in the world depend and interdepend on plant genetic resources and there is a continuous need to conserve, exchange and transfer healthy genetic material, and to develop new material based on the traditional varieties. This is the foundation for sustainable agriculture and strong, dynamic agro-ecosystems. Plant diversity is also necessary for the delivery of ecosystem services such as pollination, pest-predator balances, carbon sequestration and water conservation.

One out of 6723

In Asia in the 1970s, a disease emerged that affected the productivity levels of rice: the rice grassy stunt virus (RGSV) and its carrier, the brown plant hopper, infested rice crops in much of Asia. The virus prevents the rice plant from producing flowers and grain. Asia was on the brink of catastrophe.

The International Rice Research Institute (IRRI) desperately began looking for a solution to the problem. IRRI maintains a seed bank of many thousands of types of rice, including recently developed hybrids and wild varieties. They used this resource to search for a variety that had a natural resistance to the disease. After screening 6,723 accessions of cultivated rice and several wild species of rice, one accession of *Oryza nivara* was found to be resistant, a wild rice species from Orissa, India (Note: An accession is a distinct, uniquely identifiable sample of seeds in a gene bank). The gene that carried the resistance to RGSV was immediately crossed into new varieties, which were then dispersed to replace the earlier IRRI rice cultivars.

Since then, the RGSV resistance gene has been incorporated into numerous cultivars developed at IRRI as well as by different national rice improvement programs. Today millions of farmers across Southeast Asia grow RGSV-resistant rice varieties originating from *Oryza nivara*. By crossing rice varieties with this wild relative, rice cultivation in Asia could be saved. This was only possible because economically useless wild rice had been preserved. For more information, see IRRI (2010) and www.cwrdiversity.org.

Genetically diverse plant populations and species-rich ecosystems have greater potential to adapt to climate change and develop resilience.

However, the increasing demands for food combined with socio-economic development efforts threatens the existence of traditional varieties and can lead to the destruction of natural habitats of wild species. This results in narrowing of the genetic base – 'genetic erosion' and 'genetic wipe-out'. To ensure food security, proper attention to manage plant genetic resources is necessary.

Global governance of plant genetic resources for food and agriculture

The domestication of plants started about 10,000 years ago, but only about 150 years ago, plant genetic resources began to be used in a more scientific manner. Thanks to advances in genetics following Darwin's theory of evolution, the discovery of Mendel's laws, and Vavilov's description of the centres of origin of cultivated plants, the value and potential of genetic diversity was discovered (see also seedmap.org). The Irish potato famine of 1846 dramatically demonstrated the need for genetic diversity in agriculture. In the 1960s and 1970s, the Green Revolution boosted productivity, but also contributed to the loss of genetic diversity. Only then, concerns regarding genetic erosion and vulnerability of our agricultural production systems led to scientific and institutional developments in plant genetic resources for food and agriculture.

Over time, different organizations have evolved with the mandate to advance the international agenda on plant genetic resources for food and agriculture. A key actor is the Food and Agriculture Organisation of the United Nations (FAO). Its Commission on Genetic Resources for Food and Agriculture (CGRFA) covers all five subsectors – plant, animal, aquatic and forest genetic resources as well as micro-organisms and invertebrates.

Bioversity International is the research-for-development organisation concentrating on plant agrobiodiversity of the Consultative Group for International Agricultural Research (CGIAR). Other CGIAR centres have crop gene banks under their custody. They generally represent the major repositories for germplasm of their mandate crops. For example: the world's major wheat (13 % of the total) and maize (8 % of the

Photo, l.t.r.: © Heinz-Josef Heile, © GIZ, © Li Qingsong total) collections are held at CIMMYT, that of rice (14 % of total) is at IRRI, and CIAT is responsible for the world's largest collections of beans (14 %) and cassava (17 %; FAO, 2010). Germany has made considerable financial contributions to develop these gene banks and support the maintenance of selected banks.

The Global Crop Diversity Trust is funding the world's most important agricultural gene banks, which is supported financially by the German government amongst others. The Trust maintains the ultimate failsafe for these seed collections in the Svalbard Global Seed Vault (see box page 4). Important steps and key events concerning plant genetic resources for food and agriculture are given in the timeline below. For further information, see also the GIZ factsheets (in the present text, GIZ factsheets, hyperlinked, are marked with ▸):

- *GIZ, 2015: Understanding agrobiodiversity*
- *GIZ, 2015: International agreements on agrobiodiversity*

In situ and *ex situ* conservation

There are two complementary responses to the loss of global crop diversity: *in situ* and *ex situ* ('on site' and 'off site') conservation. *In situ* conservation helps to guarantee the survival of a species in its natural habitat and allows it to adapt to a changing environment. *Ex situ* conservation preserves the genetic material artificially and prevents extinction.

In situ conservation

Home gardens – treasure troves of agrobiodiversity

In many countries, home gardens play a significant role for *in situ* conservation because they contain a great combination of trees, shrubs, vegetables, root crops, grasses and herbs that provide food, spices, medicines and construction materials. In home gardens of Vietnam, which are on average a quarter of a hectare, an overall total of 646 plant species and varieties were identified. These systems do not only secure food and income, but also often have important nutritional and cultural value. Crop composition and use in home gardens are constantly changing according to the needs of the owners.

In most cases, women decide what plants are grown in the home garden, because in many societies they are mainly responsible for food and healthcare within the family. They select, experiment with, and further develop species and varieties. The women own the knowledge of cultivation practices that are suited to the local environment, local species, preparation of food, and selection of medicinal plants. Often they also have a great awareness of the nutritional properties of plants and crops. In many countries, women are referred to as the custodians of agrobiodiversity.

- *GIZ, 2005: Home gardens – treasure troves of diversity*

Time line of key international events in plant genetic resources

1974
Establishment of the **International Board for Plant Genetic Resources (IBPGR)** to coordinate an international plant genetic resources programme, FAO acting as secretariat. In 1991, transformation into the **International Plant Genetic Resources Institute (IPGRI)**, in 2006 into **Bioversity International.**

1983
Establishment of the FAO **Commission on Plant Genetic Resources (CPGR)** to address plant genetic resources.

1992
The UN adopts the **Convention of Biological Diversity (CBD).**

1995
Establishment of the FAO **Commission on Genetic Resources for Food and Agriculture (CGRFA).**

1996
Launch of the **Report on the State of the World's Plant Genetic Resources for Food and Agriculture** and adoption of the **Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture.**

2000
CBD Parties adopt the **Cartagena Protocol on Biosafety.**

2001
Adoption of the FAO **International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA)** as a legally binding instrument.

2004
Establishment of the **Global Crop Diversity Trust** for *ex situ* conservation.

2009
Launch of the **Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture.**

2010
CBD Parties adopt the **Nagoya Protocol on Access and Benefit-Sharing.**

CBD Parties adopt the **Strategic Plan for Biodiversity 2011 – 2020, including the Aichi Biodiversity Targets.**

CBD Parties adopt the **Global Strategy for Plant Conservation 2011 – 2020.**

Declaration of 2011 – 2020 to be the **UN Decade on Biodiversity** to support achievement of the objectives of the Strategic Plan for Biodiversity and the Aichi Biodiversity Targets.

2011
Adoption of the **Second Global Plan of Action for Plant Genetic Resources for Food and Agriculture.**

2014
Launch of the CBD **Plant Conservation Report 2014: A review of progress of the Global Strategy for Plant Conservation 2011 – 2020.**

The Committee on World Food Security (CFS) approves the **Principles for Responsible Investment in Agriculture and Food Systems.** Principles 6 and 7 explicitly refer to genetic resources.

Photos, l.t.r.: © Cary Fowler/Global Crop Diversity Trust, Flickr , www.flickr.com/photos/croptrust/4577268899;
© Global Crop Diversity Trust, Flickr, www.flickr.com/photos/croptrust/13841908855

The Svalbard Global Seed Vault, half way between mainland Norway and the North Pole, is a modern-day Noah's Ark for crops. Seeds and tissue samples are stored at -18° C, in an area of permafrost without tectonic activity, 150 m inside a sandstone mountain without measurable radiation.

Ex situ conservation

The Svalbard Global Seed Vault

The Svalbard Global Seed Vault is a secure seedbank on the Norwegian island of Svalbard, about 1,300 kilometres from the North Pole. It is maintained by the Global Crop Diversity Trust, the Norwegian government and the Nordic Genetic Resources Center. It acts as a safety net for the world's food plants, against accidental loss of unique crop genetic material in traditional gene banks, and as a safeguard against climate change and other disasters that can threaten the plant diversity vital for our survival. The seeds in Svalbard are safety duplicates of gene banks. They are stored free of charge and placed in Svalbard on black box terms – only the depositor of the seeds has the ability to withdraw them. Depositors retain ownership rights over the seeds sent to the facility. Officially opened on 26 February 2008, the vault currently holds more than 830,000 samples ('accessions') of crop diversity from more than 60 institutions and has the capacity to conserve 4.5 million seed samples.

Genesys – gateway to genetic resources

In order to link all information on crop genetic resources stored in gene banks all over the world, in 2008, Bioversity International, the Global Crop Diversity Trust and the Secretariat of the ITPGRFA established the germplasm information platform Genesys. It is the internet's largest gateway through which users can discover material in gene banks around the world; it provides access to an estimated one-third of gene bank accessions held worldwide. In September 2015, Genesys contained information about 2,775,608 accessions of the world's most important food crops, with a focus on 22 crops, coming from 446 institutes.

Neglected and underutilised species

In the past, most commercial plant breeding activities have concentrated on 'major' crops, leading to overdependence on a few plant species of worldwide economic importance. Left behind were (sub-)species, cultivar groups or local varieties with under-exploited potentials with regard to food and nutrition security, health, income generation and environmental services, so-called neglected and underutilized species. (See also Bioversity, 2013.)

The reasons for being underutilized are complex and entail economic and agro-ecological constraints as well as lack of knowledge, awareness and supportive policies. With the present erosion of cultural diversity, the traditional knowledge of cultivation and processing techniques for underutilized species and their diverse uses is increasingly being lost. For the sake of modernity, local traditions might suffer a negative reputation, for example, indigenous culinary traditions and local specialties may be dismissed as old-fashioned or poor man's food.

Enhancing the use of neglected and underutilized species to better tap their potential with regard to food and nutrition security, ecosystem sustainability and adaptation to climate change has been identified as an important strategic element for developing more productive, sustainable and resilient agricultural production and food systems. Programmes promoting neglected and underutilized species have to consider the multiple functions many of them fulfil in their specific socio-ecological and economic context.

▶ *GIZ, 2005: 'Underutilized' species – Rich potential is being wasted*

Quinoa – from the Andes to the world

Quinoa is a traditional grain crop from the Andes highlands. Adapted to marginal soils and to harsh climate, it is a source of high-quality protein and important minerals. Since the beginning of the 1980s, supported by national and international institutions, this neglected and underutilized species has been experiencing a remarkable revival. Quinoa products are now on the shelves of every organic supermarket. With the increasing prices the cultivation of quinoa extended considerably – in Peru, for example, quinoa exports doubled within two years. However, the higher prices had the effect that, firstly, quinoa production expanded from the Andes to lower areas in Peru, meaning the Andean farmers lost their markets; and, secondly, that national food security reduced as poor farmers could not afford quinoa any more. For more information, see GIZ, 2013: Quinoa – from the Andes to the world.

Crop wild relatives

Another plant genetic resource that needs to be protected is crop wild relatives. These are wild plant species which are closely related to cultivated crops, including their wild ancestors – the wild 'cousins' of our cultivated plants. For plant breeders, crop wild relatives are an enormously diverse and largely untapped source of raw material for crop improvement. They may serve as source of useful genes for new traits – pest and disease resistance, or tolerance to heat, drought and other stresses. The common ancestry with crops facilitates the use of their genes in traditional and commercial breeding and biotechnology.

Crop wild relatives have made significant contributions to modern agricultural production through the characteristics that they have contributed to plant cultivars. Wild relatives have increased worldwide the productivity of important plants such as barley, maize, oats, potatoes, rice and wheat. One example for this is a wild relative of tomato that had made it possible to increase the dry matter content in tomatoes by 2.4%. This had an economic worth of USD 250 million a year in the state of California alone. Other wild relatives have contributed resistance to pests and diseases (e.g. resistance to the grassy stunt virus in rice, see box page 2). Again other wild relatives have increased nutritional values such as protein and vitamin content.

The natural populations of many crop wild relatives are increasingly at risk, mainly due to habitat loss, degradation and fragmentation. Moreover, the increasing industrialization of agriculture is reducing populations of crop wild relatives in and around farms. Crop wild relatives are often missed by conservation programmes, falling between the efforts of agricultural and environmental conservation actions. The spread of invasive alien species (see box page 6), pollution and the growing impacts of climate change further put pressure on crop wild relatives. The wise conservation and use of crop wild relatives are essential elements for increasing food security, eliminating poverty, and maintaining the environment. For further information, see Bioversity International, 2011: Crop Wild Relatives – A manual of *in situ* conservation.

Wild plants for food and trade

Wild plants also contribute to our nutrition. Acting as a safety net in times of unexpected shortage, wild foods can play a major role in improving people's food and nutrition security. At a local level, many species contribute directly to meeting people's nutritional needs. Besides providing food to people in chronic hunger, they may overcome the dangers of the 'hidden hunger' of micronutrient deficiency. Wild foods such as wild vegetables can play a crucial role in preventing such malnutrition. In addition, they can fill cyclical food gaps like the hungry season between harvests. An example for such a wild plant used for food is the African baobab (*Adansonia digitate L.*). Its leaves, bark and fruits are used as food and for medicinal purposes in many parts of Africa. The leaves are an excellent source of protein, containing all essential amino acids (see Bioversity International, 2013).

Besides for food, many wild plants are harvested for trade, e.g. for medicinal or cosmetic purposes, such as devil's claw (*Harpagophytum procumbens*) in the Kalahari Desert in Southern Africa. This trade is internationally regulated under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). In order to ensure that the wild plant-based products are collected sustainably, the FairWild Standard has been developed (see www.fairwild.org). It allows for traceability and transparency, as well as improving product safety.

- *GIZ, 2007: Partnerships for agrobiodiversity*
- *GIZ, 2015: Adding value to agrobiodiversity*

Invasive alien species – a threat to plant genetic resources

Invasive alien species are species that have spread outside of their natural habitat and threaten biodiversity in their new area. These species are harmful to native biodiversity in a number of ways, for example as predators, parasites, carriers of disease or direct competitors for habitat and food. In many cases, invasive alien species do not have any predators in their new environment, so they can spread uncontrolled. Ecosystems that have been disrupted by outside influences and are out of their natural balance are more susceptible to the colonisation and spread of invasive species.

The introduction of invasive alien species can be either intentional, as with the introduction of new crop species, or accidental, such as when species are introduced through ballast water or in cargo containers. The main carriers are trade, transport, travel and tourism, which have all increased hugely in recent years. Invasive alien species may cause economic or environmental damage, or adversely affect human health.

- *GIZ, 2010: Unwelcome guests – invasive alien species*



Photos, l.t.r.: © GIZ, © GIZ, © Li Qingsong

Threatening aliens

One of the world's worst invasive alien species is *Prosopis juliflora*. Prosopis was originally introduced from Latin America in order to contribute to erosion and desertification control, but now threatens different areas in the Horn of Africa with environmental degradation. Ethiopia, Sudan, Djibouti, Kenya, Eritrea, and Somalia are heavily affected by the prosopis invasion. In Ethiopia's Afar Region a tremendous land mass of more than 1.2 million hectares has already been invaded at an alarmingly expanding rate per year as prosopis rapidly spreads across both pastoral and agricultural lands. Also in other areas such as Kenya's Turkana and Marsabit County, prosopis is a major driver of degradation, leading to severe losses in land and ecological functions. It challenges (agro-)pastoral livelihoods and food security in the region (see GIZ, 2014).

Plant breeding and seed distribution

It is not enough to merely conserve agricultural genetic diversity; it must also be developed further so as to improve food security, identify new utilization potential and enable agriculture to adapt to climate change. Therefore, improved crop breeding methods, breeding organizations and seed access and distribution at local level need to be promoted. So far, smallholders are rarely covered by the formal seed sector, even though this market offers considerable potential.

Open, dynamic and integrated genetic systems to cope with climate change at the local level through a combination of community-based conservation actions will improve access to genetic materials and related knowledge, and their exchange. Grass-roots breeding, participatory variety selection and participatory plant breeding will develop farmers' skills and capacity in selection in the changing context. Consolidating the farmer's roles as conserver and promoter of diversity and dynamic innovator needs to be combined with compensation or other rewards for conservation services. Activities supporting local seed systems include:

- Supporting national breeding objectives and breeding programmes with the participation of various stakeholders, including farmers, scientists, politicians and the private sector.
- Identifying and promoting superior local varieties, which can produce stable yields even under adverse conditions thanks to their high genetic diversity.
- Developing new ways to organize breeding and new models for ownership of varieties (such as open-source, see Kotschi and Wirz, 2015) with the participation of farmers' groups (participatory plant breeding, see box below).
- Supporting the propagation and distribution of seeds in smallholder areas such as through seed fairs (see box page 7, top), diversity kits (a set of small quantity of different seeds made available to farmers), community-based registers, community seed banks (see box page 7, bottom), or community-based seed production schemes.

▶ *GIZ, 2009: Biodiversity and agricultural intensification – how farmers' varieties can contribute*
▶ *GIZ, 2015: International agreements on agrobiodiversity*

Participatory plant breeding

For thousands of years, male and female farmers have been domesticating various plant species and developing a wide range of crop varieties that fit their specific needs and respective environmental conditions. Since less than 100 years ago, specialized plant breeding institutions have emerged. However, in developing countries, formal crop breeding and seed systems often fail to supply planting material of suitable quality and diversity in a timely manner and at affordable prices. Most farmers still prefer their own seed. In some regions, and for some locally important food crops, own seeds can be the only source of seed available.

Local seed systems maintain a wide diversity within and among varieties or landraces. Since farmers know best which materials meet their needs and are enthusiastic seekers of new varieties, participatory plant breeding represents a promising approach to enhancing agrobiodiversity, while also sustaining food security and alleviating poverty. In participatory plant breeding, farmers and researchers, and sometimes other stakeholders, usually work closely together to jointly redefine selection criteria and cooperate throughout the entire breeding cycle. The resulting varieties are usually greater in number, address various purposes and needs, and are more diverse, compared with the products of formal breeding programmes.

▶ *GIZ, 2005: Farmers as Breeders – Participatory Plant Breeding*

Seed fairs

Typically, seed fairs are one-day events where farmers display samples of the seeds or plant material that they use in their fields and vegetable patches. It may be the full range of cultivated species – from seed crops to tuber and root species to fruits – or the range of varieties of a single crop. Such fairs usually take place between the harvest and the new sowing season. They are also popular social occasions where people meet, exchange news and views, and eat and drink together. Here, farmers can look out for varieties they may have lost, or have always wanted to try growing. Knowledge is passed on at the same time as seeds are handed over – for example: Which site does this variety prefer?, and, What is the best use for that one?

Seed fairs can be enriched with short and easy-understandable lectures on the importance of conservation and sustainable use of agrobiodiversity, or with diversity contests, giving a prize to the farmer who displays the most diversity. Such awards underline the importance of agrobiodiversity, and also pay tribute to the achievements of those who are custodians of the cultural heritage. In addition, traditional cultural activities, for example by local dancers, singers, or musicians, will further highlight local values, culture, traditions and local knowledge.

GIZ, 2008: Markets make a come-back – Diversity displays and seed fairs

Community seed banks

Community seed banks are local institutions that conserve and maintain access to locally adapted seed and planting materials for farmers. Besides securing access for small-scale farmers to adapted seeds at the time needed, they conserve the local genetic resource for the local and the global communities. Typically, they rely on a community storage structure where the seed can be processed, selected and stored. A committee oversees activities and decides what can be stored, and how and when seed can be used. Seed banks contribute to the security of the seed supply. Keeping the seed in a secure building administered by a committee is more likely to prevent farmers from selling off or consuming the seed in times of food scarcity.

GIZ, 2008: Farmers as bankers – Community seed banks

Outlook

Agrobiodiversity is important for nourishing people and sustaining the planet. Many initiatives – local, national, regional and international – have been initiated to stop the present loss of genetic diversity. While *ex situ* conservation technologies are well developed, there is much to be done to safeguard the diversity *in situ* and on farm. Which lessons can be drawn, which principles extracted from the experiences made, how can we further improve our efforts in conserving plant genetic resources for food and agriculture?

Effective targeting towards the needs of farmers has shown to be a key factor for success. Participatory approaches should be applied, actively involving the rural population, focusing on farmer-led activities, and local institution building and empowerment, appropriate to the local conditions. It is also important to respect the vital role of women as well as the uses of traditional knowledge. In one way or the other, farmers need to benefit from their conservation activities – either through marketing of produce or by external compensation like subsidies.

Agrobiodiversity is not a mere agricultural issue – it also tackles aspects of the environment, nutrition, education, health, water and sanitation, infrastructure and markets as well as social sciences. Depending on the objective of the project, multi-disciplinary skills and a multi-sectoral approach might be needed. The application of comprehensive strategies and innovative institutional arrangements is recommended that deal with agrobiodiversity, farming system resilience, income generation and food and nutrition security in an inclusive and holistic way. Focusing conservation strategies on a single crop is in most cases not sufficient. Development cooperation has to shift attention from species and varieties towards people and their needs. A multi-level approach is needed ranging from village interventions and capacity-building to providing policy advice and mainstreaming agrobiodiversity at local, national and international levels. Multi-stakeholder approaches, focusing on collaborative learning, innovation and institutional development should be considered.

Left: Participatory Plant Breeding builds on local knowledge and farmers' innovation.

Right: Community seed banks of Masipag farmers organizations in Quezon, Philippines, maintain at least 50 rice varieties. Planted side by side, the top ten yielders will be selected, and members can obtain such seeds for multiplication (see masipag.org).

Photos, l.t.r.: © Bhuwon Sthapit/LI-BIRD; © Achim Pohl

Photos, l.t.r.: © Li Qingsong, © Christine Martins

Contact person

Dr Alberto Camacho Henriquez
naren@giz.de

Important links

- Association for Plant Breeding for the Benefit of Society: www.apbrebes.org
- Bioversity International: www.bioversityinternational.org
- Commission on Genetic Resources for Food and Agriculture: www.fao.org/nr/cgrfa/cgrfa-home/en
- Convention of Biological Diversity: www.cbd.int
- Crops for the Future: www.cropsforthefuture.org
- Sector Project Sustainable Agriculture (NAREN): www.giz.de/sustainable-agriculture

Further information

- Andersen, Regine, and Tone Winge (eds.; 2013): Realising Farmers' Rights to Crop Genetic Resources: Success Stories and Best Practices. www.farmersrights.org/resources/global_works_23.htm
- Bioversity International, 2013: Community Biodiversity Management – Promoting Resilience and the Conservation of Plant Genetic Resources. www.bioversityinternational.org/uploads/tx_news/Community_Biodiversity_Management_1603.pdf
- Bioversity International, 2015: Community Seed Banks – Origins, Evolution and Prospects. Edited by Ronnie Vernooy, Pitambar Shrestha, and Bhuwon Sthapit. Routledge. www.bioversityinternational.org/news/detail/community-seedbank-secrets-revealed-in-a-new-book
- CBD Secretariat, 2014: Plant Conservation Report 2014: A review of progress towards the Global Strategy for Plant Conservation 2011 – 2020. www.cbd.int/doc/publications/cbd-ts-81-en.pdf
- Ecumenical Advocacy Alliance, The Gaia Foundation, and African Biodiversity Network, 2013: Seeds for Life – Scaling up Agro-Biodiversity. www.gaiafoundation.org/sites/default/files/documents/seedsforlife.pdf
- FAO, 2011: Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture. www.fao.org/agriculture/crops/thematic-sitemap/theme/seeds-pgr/sow/sow2/en
- FAO, 2012: Second Global Plan of Action for Plant Genetic Resources for Food and Agriculture. www.fao.org/agriculture/crops/thematic-sitemap/theme/seeds-pgr/gpa/en
- FAO, 2015: Coping with climate change – the roles of genetic resources for food and agriculture. Rome. www.fao.org/3/a-i3866e.pdf

Published by
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Registered offices
Bonn and Eschborn, Germany

Sector Project Sustainable Agriculture (NAREN)
Friedrich-Ebert-Allee 36 + 40
53113 Bonn
T +49 (0) 228 44 60-0
F +49 (0) 228 44 60-0

Dag-Hammarskjöld-Weg 1-5
65760 Eschborn, Germany
T +49 (0) 6196 79 - 2359
F +49 (0) 6196 79 - 1115

naren@giz.de
www.giz.de/sustainable-agriculture

Author: Dr Christine Martins

Design: Ira Olaleye

As at: November 2015

On behalf of
Federal Ministry for Economic Cooperation and Development (BMZ)

Special unit
'ONE WORLD – No Hunger'

Addresses of the BMZ offices

BMZ Bonn
Dahlmannstraße 4
53113 Bonn, Germany
T +49 (0) 228 99 535 - 0
F +49 (0) 228 99 535 - 3500

BMZ Berlin
Stresemannstraße 94
10963 Berlin, Germany
T +49 (0) 30 18 535 - 0
F +49 (0) 30 18 535 - 2501

poststelle@bmz.bund.de
www.bmz.de

german cooperation
DEUTSCHE ZUSAMMENARBEIT

Published by:

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Agrobiodiversity – animal genetic resources

At a time when a growing world population needs to be fed on limited resources in a changing climate, the conservation and sustainable use of agricultural biological diversity gains utmost importance. Agrobiodiversity plays a crucial role in food security and nutrition, as well as in the provision of environmental services and livelihoods. It is critical to the sustainability, resilience and adaptability of agricultural production systems. To promote awareness and share knowledge on conservation and the sustainable use of agrobiodiversity, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ), has published this series of agrobiodiversity factsheets.

The present factsheet gives attention to those agrobiodiversity issues that are related to animals. (Note: One of the other factsheets deals with plant genetic resources). It explains the importance of genetic diversity in livestock, describes present trends in the development of animal genetic resources, and gives a brief overview about relevant key events and institutions. It explains the value of local breeds, *in situ* and *ex situ* conservation of animal genetic resources as well as the special role of small-scale livestock keepers and pastoralists in the development, use and conservation of animal genetic resources. Finally, the paper presents key elements for promoting the conservation and sustainable use of livestock genetic resources.

What is agrobiodiversity?

Agricultural biodiversity includes all components of biological diversity of relevance to food and agriculture, and all components of biological diversity that constitute the agricultural ecosystems: the variety and variability of animals, plants and micro-organisms, at the genetic, species and ecosystem levels, which are necessary to sustain key functions of the agro-ecosystem. Agrobiodiversity is the outcome of the interactions among genetic resources, the environment and the management systems and practices used by farmers and herders. It has developed over millennia, as a result of both natural selection and human interventions.

Animals for food and agriculture and their genetic diversity

Domestication of animals began over 12,000 years ago. Only about 40 of the 50,000 known mammalian and avian species were selected as useful by different human cultures and domesticated. Today's livestock diversity is the result of thousands of years of human intervention. 14 species account for most of global livestock production, and five of them (cattle, sheep, goats, pigs and chickens – the so-called 'big five') show particularly large numbers. In the past century, research and breed improvement programmes have concentrated on the 'big five' and breeding for production. Locally adapted breeds of these species and of other, 'minor', species such as dromedaries and Bactrian camels, yaks, water and dairy buffaloes, as well as donkeys were regarded as less productive and less economic, and received little attention.

In contrast to plant genetic resources for food and agriculture, animal genetic resources for food and agriculture comprise fewer species, have lower reproduction rates, and longer generation intervals. The major centres of livestock domestication are less relevant than the crop centres of origin. Unlike the many crop wild relatives, there are only very few wild relatives of livestock, such as wild banteng, gaur, kouprey, wild yak, and wild water buffalo in Asia. Many livestock wild relatives are already extinct. The risk status of these wild relatives is categorized in the IUCN Red List of Threatened Species, while the



Photos: left and middle © Christine Martins; right © GIZ/Dirk Ostermeier

What is a breed?

There is no strict scientific definition of a breed – a breed is a breed if enough people say it is. Scientists usually define a breed as 'a group of animals with definable and identifiable external characteristics that distinguish it from other groups within the same species'.

According to the FAO a breed is 'either a sub-specific group of domestic livestock with definable and identifiable external characteristics that enable it to be separated by visual appraisal from other similarly defined groups within the same species, or a group for which geographical and/or cultural separation from phenotypically separate groups has led to acceptance of its separate identity.'

risk status of domestic animal breeds is classified in the FAO Domestic Animal Diversity Information System (DAD-IS).

The erosion of animal genetic resources is much more serious than in crops, given the fact that the gene pool is much smaller. In September 2015, DAD-IS compiled data on 38 livestock species (21 mammalian and 17 avian). In total, 8,812 breeds were registered (6,242 mammalian and 2,570 avian) which consisted of 7,754 local, 513 regional transboundary and 545 international transboundary breeds. 7 % of these breeds are already extinct, and 26 % are at risk of extinction (the FAO defines this as breeds with fewer than 1000 breeding females, or 20 or fewer breeding males). However, many breeds (31 %) have an unknown status, indicating insufficient monitoring and reporting.

Why are animal genetic resources important?

Livestock contributes 40 % of the global value of agricultural output and provides approximately 26 % of human global protein consumption and 13 % of total calories. Nearly 1 billion of the rural poor hold livestock. The value of animal genetic resources for humankind are manifold as they provide different productive, cultural and ecological services. Livestock contributes to food production (meat, milk and eggs), livelihoods and economic output. It provides fibres, hides and skins, transport and agricultural draught power, fertilizer and fuel, as well as income, savings and insurance. Livestock plays ecological roles and has impacts, both positive and negative, on the functioning of the ecosystems in which it is kept – methane production, carbon sequestration, regulation of water cycling, maintenance of soil fertility, and provision of wildlife habitats.

Genetic improvement of livestock populations is dependent on the existence of genetic variation, between breeds and among animals within breeds. The degree of diversity of animal genetic resources is directly related to the capacity of livestock populations to adapt to future changes in environmental and market conditions. Livestock keepers need a broad gene pool to draw upon if they are to improve the characteristics of their animals under changing conditions. Therefore, genetic diversity is the basis for future development.

Ecosystem services and livestock breeds

Breed roles in ecosystem services relate to the ability of indigenous breeds to provide ecosystem services in harsh, remote and/or fragile environments. However, the extent to which these ecosystem services are actually delivered depends on a range of institutional factors and management practices. Actions that shift pastoralism from a sustainable to an unsustainable land use option, such as the conversion of pastoral lands to sedentary agriculture or the replacement of traditional livestock breeds with exotic stock, can cause the degradation of ecosystem services. For example, degradation of vegetative cover can undermine water-cycling, leading to both increased flooding and increased drought threatening both development and biodiversity objectives. For further information, see Hoffmann et al., 2014: Ecosystem services provided by livestock species and breeds, with special consideration to the contributions of small-scale livestock keepers and pastoralists, and FAO, 2014: The nature of ecosystem services provided by livestock species and breeds.

Present trends

Growing populations and incomes, along with urbanisation and changing food preferences, have been rapidly increasing the demand for livestock products, while globalization is boosting trade in livestock inputs and products. Humankind's ability to influence production environments and to move genetic material around the world has increased, see also the

Photos: © Christine Martins

GIZ factsheet (in the present text, GIZ factsheets, hyperlinked, are marked with ▸):

▸ *GIZ, 2006: Gene flow: Farm animals travel the world*

The livestock sector has undergone tremendous changes. Increasing polarisation has occurred across different regions. Development has differed drastically in developed and developing countries, in urban and rural areas, in high-intensity industrial and low-intensity systems, in large-scale and smallholder production systems, in sedentary and pastoralist systems, as well as in monogastric (pigs, chickens) and ruminant (cattle, sheep, goats) production systems. The world's livestock production is increasingly based on a limited number of breeds, and genetic diversity within these breeds is in decline.

There are shifts from subsistence-level livestock keeping to market-oriented production and shifts towards sedentarization and disintegration of pastoralism. Niche markets and specialty markets for high-value livestock products from local breeds have emerged. The livestock sector is entering into greater and more direct competition for scarce land, water and other natural resources. The shrinking of common-property resources due to population pressure and the expansion of cultivation and nature reserves, as well as land-grabbing, particularly affects pastoralists and small-holder livestock producers.

Feed requirements of different livestock types (ruminants and non-ruminants) and species, as well as availability and type of feed resources, determine to a large degree the scope for expansion and intensification of production. Development of intensive, near-landless systems for poultry, pig and milk production has gone much further than for beef and small ruminants. The growth in demand for livestock products in the poultry, pork and dairy sectors has been especially huge in countries with a large population and high economic growth rates (e.g. China, Brazil and, partly, India).

In highly industrialized pork and chicken production systems, hybrid breeds are used. Hybrid animals are the result of cross-breeding. These animals acquire better productivity characteristics than non-hybrids, but cannot be reproduced in a stable manner. Farmers and breeders always need to buy new chicks and piglets from the company controlling the parent and grandparent lines. Increasingly, intellectual property issues are of concern in animal genetic resource management. The majority of patent activity focuses on dominant breeds and does not involve genetic material from rarer breeds from specific countries or the use of traditional knowledge (see WIPO, 2014: Patent landscape report on animal genetic resources).

Though there is an increasing trend towards intensification and industrialization, extensive grazing still occupies vast areas of land. Many traditional livestock breeds continue to be kept by poor rural people, in more or less traditional production systems. Even where large-scale production has taken off, it often coexists with more traditional production in rural areas as well as with small-scale production of various types in urban and peri-urban zones. Given the experience of developed countries, the spread of highly intensified livestock production into the developing world has raised concerns about the fate of the locally adapted breeds, particularly in those regions such as East and Southeast Asia that have been most affected by the rapid expansion of large-scale, highly intensified pig and poultry production.

Threats to livestock genetic diversity in developing countries

- Information on the state of local livestock breeds far from complete
- Indiscriminate cross-breeding
- Weak programmes, policies and institutions for the management of livestock genetic resources
- Economic problems and market-related threats
- Factors that undermine sustainability of smallholder and pastoralist production systems
- Degradation of (or lack of access to) natural resources, disease epidemics, and climate change

Drivers of change in animal genetic resources over the last ten years:

- Changing demand for livestock products (quantity and quality)
- Economic, livelihood or lifestyle factors affecting the popularity of livestock keeping
- Changes in international trade in animal products
- Policy factors

Source: FAO, 2014: The second report on the state of the world's animal genetic resources – state of development and overview.

Even though there is a global trend of industrialized pig production using hybrid breeds, in rural areas all over the world smallholders continue to keep traditional breeds. Indigenous pig breeds are assumed to be 'low producers', although many of them have never been documented and characterized. Their advantages over hybrid pigs is in terms of ability to use a variety of feed, to forage for themselves and to cope with disease pressures.

Photos, l.t.r.: © Ute Grabowsky/photothek.net; © Christine Martins

'Livestock revolution' and 'livestock's long shadow'

Already in 1999, the changes in the livestock sector were described with the term 'livestock revolution' to highlight the accelerated growth in demand for livestock products in parts of the developing world. This was tied to human population growth, rising incomes, continuing urbanisation and changing food preferences. In contrast to the earlier Green Revolution which was supply-driven, the livestock revolution is demand-driven. The changes in the production, processing, retailing and consumption of livestock products had massive structural, financial, social and environmental implications (Sumberg and Thompson, 2013).

The 2006 study 'Livestock's Long Shadow' (FAO, 2006) shows the livestock sector's significant contributions to the most serious environmental problems, such as land degradation, climate change, air pollution, water shortage, water pollution, and loss of biodiversity. Environmental problems are associated with both production systems: low-intensity production (primarily as a result of land degradation) and high-intensity industrial production (mainly because of pollution, greenhouse gas emissions and environmental damage associated with the production of feed crops).

Global governance of animal genetic resources for food and agriculture

FAO's Commission on Genetic Resources for Food and Agriculture (CGRFA) established in 1997 the Intergovernmental Technical Working Group on Animal Genetic Resources. In its 2007 report on 'The State of the World's Animal Genetic Resources for Food and Agriculture' (SoW-AnGRFA), the working group expressed its concern about the urgent need to sustainably manage animal genetic resources. In the same year, the FAO Conference adopted the 'Global Plan of Action for Animal Genetic Resources' and the 'Interlaken Declaration'. The second SoW-AnGRFA is due to be published in November 2015.

There is no internationally agreed-upon convention or treaty for the conservation of animal genetic resources, such as there is for plants (the International Treaty on Plant Genetic Resources for Food and Agriculture, ITPGRFA). Important steps and key events concerning animal genetic resources for food and agriculture are listed in the timeline below.

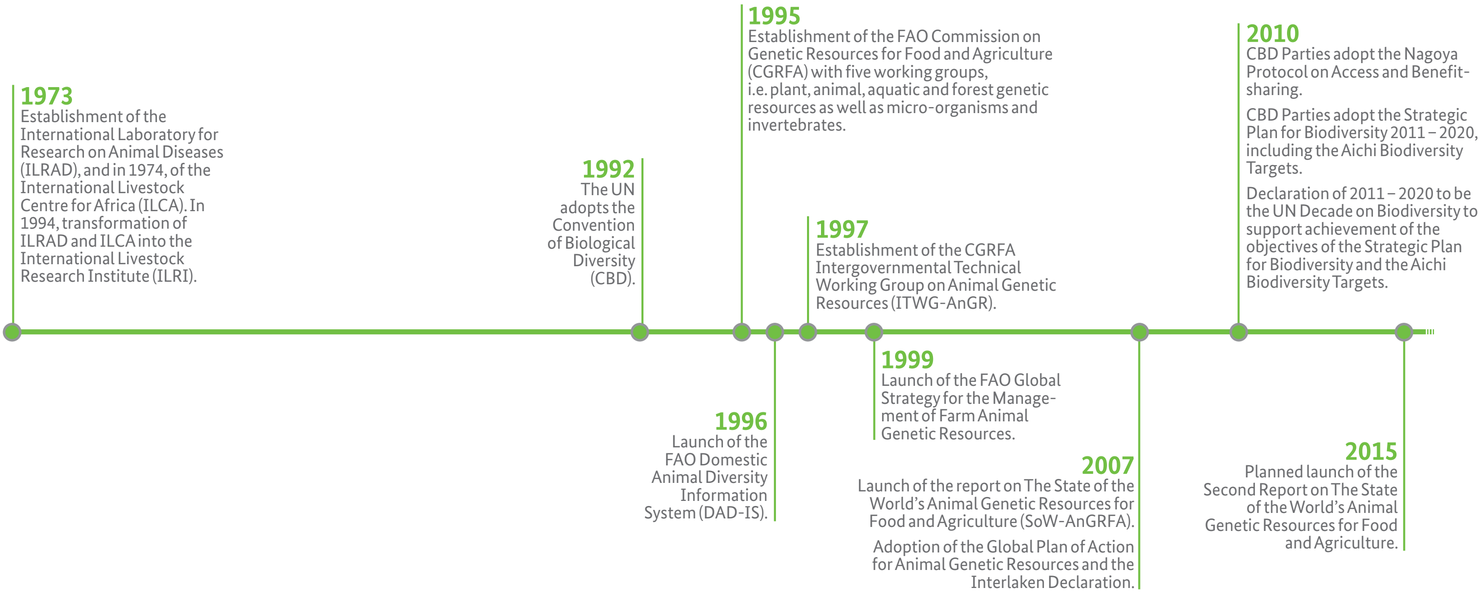
Animal genetic resources in the Aichi Targets

Aichi Target No. 13: By 2020, the genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity.

- Target element 2: The genetic diversity of farmed and domesticated animals is maintained.
- Target element 5: Strategies have been developed and implemented for minimizing genetic erosion and safeguarding genetic diversity.

All FAO member states are required to develop national strategies and action plans (NSAPs) for animal genetic resources. National, regional, and global focal points for planning and implementing these in the livestock sector have been appointed. The International Livestock Research Institute (ILRI) works as the main global research organisation for animal genetic resources. It has been developing the Domestic

Timeline of key international events in animal genetic resources



Animal Genetic Resources Information System (DAGRIS) as a web-based electronic source of information on selected indigenous farm animal genetic resources. The FAO-run Domestic Animal Diversity Information System (DAD-IS) has already been mentioned.

The value of local breeds

Many harsh production environments, such as those characterized by extreme temperatures, lack of good-quality feed resources, high elevations, rough terrain or high disease pressures, can only be utilized effectively by breeds that have particular characteristics enabling them to cope with these challenges. Traditional breeds, suited to local conditions, survive times of drought and distress better than exotic pure breeds or their cross breeds and, therefore, frequently offer poor farmers better protection against hunger. Locally adapted breeds tend to be more commonly found in marginal areas with stressful environments and high poverty rates. Globally, 51 % of all sheep, 44 % of goats, 38 % of cattle, 21 % of pigs and 27 % of chickens occur in systems where predominantly locally adapted breeds can thrive.

In fertile, favourable environments, there is a high probability of finding exotic, international transboundary breeds. The share accounted for by crossbreeds depends largely on the level of intensification. Local breeds are generally not used in intensive and large-scale systems, as their low output of marketable products makes keeping them unviable economically (Hoffmann et al., 2014).

Under climate change, the importance of well-adapted animals is likely to increase in those production systems where extensive use of external inputs is rarely possible. The genetic diversity of the world's livestock provides a range of options that are likely to be valuable in climate change adaptation, including resistance and tolerance to specific diseases, adaptation to poor-quality diets or to feeding in harsh conditions, and tolerance of climatic extremes.

Many countries face the challenge of managing their animal genetic resources across a range of very different production systems. There has so far been insufficient research on the genetic performance of local livestock breeds. Often, governments promote cross-breeding and replacement of indigenous with exotic breeds and insufficiently consider the locally available genetic resources. Different production systems require different livestock-support strategies and different types of animal genetic resources – they cannot be managed with a 'one size fits all' approach.

- *GIZ, 2005: Indigenous knowledge of animal breeding and breeds*
- *GIZ, 2006: Landraces – Allies in the fight against animal epidemics*
- *GIZ, 2008: Conserving local livestock breeds – Political strategies and legal regulations*

In situ and *ex situ* conservation

There are two possibilities for conserving animal genetic resources: *in situ* conservation, which is conservation on-farm by farmers; and *ex situ* conservation, which is conservation action away from the habitat and production systems where the resource developed – this can be either by the maintenance of live animals (*in vivo*) or by cryoconservation, the deep-freezing of genetic material in gene banks (*in vitro*). *In situ* conservation also includes steps taken to ensure the sustainable management of ecosystems used for agriculture and food production. Generally, *in situ* conservation is preferred because the genetic diversity of animals can evolve with the environment.

Cryoconservation of animal genetic resources can be used with mammals, but not with birds. There are three main methods for storing animal genetic material *in vitro* in gene banks. Semen is the most common material conserved. Its collection and use is rather low cost and it requires only moderate technical capacity. Storing embryos is an option for more special situations; it involves greater costs and technical capacity. The third option is storing somatic cells. This method is applied against the extinction of livestock breeds. The utilization is difficult and expensive. See also FAO, 2013: *In vivo* conservation of animal genetic resources, and FAO, 2012: Cryoconservation of animal genetic resources.

Gene banking can play an important role in national programmes for animal genetic resource management. However, many breeds or animal populations with specific characteristics are not well characterized and their genetic basis is not well known. There are so far only a few breeds which have been re-established from cryoconserved material. Livestock genetic resources do not have a global breed repository such as the Global Seed Vault and no global safeguard organisation such as the Global Crop Diversity Trust.

- *GIZ, 2006: Deep-frozen? Alive and kicking? Different approaches to the conservation of farm animal diversity*


Different production systems require different animal genetic resources.

Photos, l.t.r.: © Christine Martins; © Ute Grabowsky/photothek.net

Photo: © Flickr/Andrew Ashton, www.flickr.com/photos/andrew_ashton/7971738080

The Nguni cattle of South Africa are an example of ex situ in vivo conservation of a local breed: almost extinct, they were conserved on government farms, outside their natural habitat, and once their numbers had been increased by breeding, they were made available for commercial production.

Conservers of animal genetic resources

CGRFA and FAO have continuously stressed the important role of small-scale livestock keepers and pastoralists in the development, use and conservation of animal genetic resources (see FAO, 2009: Livestock keepers – Guardians of biodiversity). Breed diversity is especially high in peripheral and remote areas, notably drylands. Since their livestock is exposed to natural selection, smallholder livestock farmers and pastoralists play a crucial role in the development of adaptation and fitness traits.

The use of multi-species and multi-breed herds and flocks is one strategy that many traditional livestock farmers use to buffer against economic and climatic adversities. Different breeds and species make different contributions to livelihoods. Generally, the more complex, diverse and risk-prone peasant livelihood systems are, the more they need animal genetic resources that are flexible, resistant and diverse in order to perform the required functions.

- *GIZ, 2010: Livestock as Integral Part of the Rural Economy*

Invisible guardians – women managing livestock diversity

Feminization of agriculture as a result of outward-migration of men to urban areas turns women into important livestock keepers. They play a major role in managing animal genetic resources and thereby conserving them. Rural women tend to have an affinity and preference for indigenous rather than improved breeds because they are easier to manage and disease resistant and therefore do not increase their workload. For further information, see FAO, 2012: Invisible guardians – women managing livestock diversity and

- *GIZ, 2013: Gender and Livestock Production*
- *GIZ, 2013: Gender and Rural Development – Aspects, Approaches and Good Practices*

Smallholder livestock farmers

Despite of the global trend towards high-intensity livestock production, smallholder livestock production plays an important role in food and nutrition security as well as poverty alleviation in developing countries. According to FAO data, smallholders produce between half and three quarters of total livestock production in Africa and Asia.

Smallholders make efficient use of scarce natural resources and seek to optimize the returns from (heterogeneous) family labour. Two challenges for rural smallholders are risk management and vulnerability. In response to these, smallholders have developed multiple strategies for risk management (*ex ante*, e.g. by diversification into livestock) and coping with shocks (*ex post*, e.g. by reducing variability in food consumption). Livestock offer many advantages to smallholders as they are generally more adaptable to environmental shocks than crops are; animals are mobile, which increases their survivability; they do not have a specific harvest season as most crops have; and may also be able to digest a wide variety of feedstuffs, thereby having the capacity to survive dramatic reductions in specific feed resources. Native animal breeds are adapted to local environmental risks and use available natural resources efficiently.

Pastoralists

There are world-wide about 190 million households making their living from nomadic or semi-nomadic livestock keeping. Such pastoralist communities create value in arid and semi-arid as well as remote highland regions where pastoralism is often the only sustainable form of agriculture possible – their mobile herding strategies enable them to produce food in areas too dry for cropping. Pastoralism is increasingly recognised and valued as a rational production system that is environmentally well-adapted to difficult and variable climatic conditions of arid and semi-arid regions. However, in most parts of the world, pastoralist systems are facing a crisis due to a decline in common-property resources, and unsupportive polices (e.g. driving sedentarization, restricting transboundary movements) as well as neglect by governments leading to disintegration and marginalization of pastoralist communities.

Mobile and flexible, pastoralists have created numerous breeds of cattle and camels, sheep and goats. These animal breeds have evolved over centuries within specific ecological and social systems, without herdbooks and breeders associations. Subject to strong natural selection pressure, they hold many traits that enable them to optimally use their environment, including tolerance of climatic extremes (such as hot temperatures), adaptation to poor-quality diets or to feeding in harsh conditions, and resistance to and tolerance of specific diseases. Representing the collective heritage of the communities they are associated with, these breeds cannot be conserved separately from their production systems: they will survive only as long as the knowledge systems in which they are embedded also survive.

Pastoralist production systems are important because they are a rich reservoir of adaptive genes. They counterbalance the ever-narrowing genetic base of high-performance animal breeds. See also CBD, 2010: Pastoralism, nature conservation and development – a good practice guide, and

- *GIZ, 2011: Agrobiodiversity in drylands*
- *GIZ, 2013: Pastorale Nutztierhaltung als integraler Bestandteil marginaler Standorte*

Livestock keepers' rights

'Livestock keepers' rights' is a concept developed by civil society during the 'Interlaken process' (around 2007) and is advocated for by a group of non-government organizations, livestock keepers, pastoralist associations and scientists who support community-based conservation of local breeds. The concept was originally developed in accordance to the 'Farmers' Rights' which are described in the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). Started as an effort to achieve formal recognition for livestock keepers around the world as creators and custodians of animal genetic resources, the concept has since been expanded and now includes rights to grazing, water, markets, training and capacity-building, and participation in research design and policy-making, as well as rights to the genetic resources of their animals. In contrast to 'Farmers' Rights', livestock keepers' rights also include strengthening small-scale livestock keepers and supporting them to make a living in their traditional agro-ecosystems (see LIFE, 2010: Declaration on livestock keepers' rights; and Köhler-Rollefson et al., 2010: Livestock keepers' rights: the state of discussion).

Biocultural community protocols

Pastoral communities and other indigenous peoples and local communities are often struggling to defend their rights over land and other resources they have traditionally used and over traditional knowledge they have developed over generations. Their role in the management of biological diversity, not only its livestock breeds but also its contribution to general ecosystem management, are often neither documented nor rewarded. This can be done by biocultural community protocols. This approach evolved about ten years ago, starting with civil sector organizations in South Africa and India. It implements the CBD and its Nagoya Protocol on Access and Benefit-sharing.

Biocultural community protocols provide a mechanism through which communities can assert their rights. These protocols make the linkages visible between breeds and the communities that have developed them and lay some claim to their animal genetic resources. See also IIED, 2012: Biodiversity and culture: exploring community protocols, rights and consent, www.community-protocols.org and

- *GIZ, 2011: Biocultural community protocols*

Outlook

The conservation and sustainable use of animal genetic resources for food and agriculture are important for assuring rural livelihoods, food and nutrition security, and cultural and ecosystem services – especially when considering the present trend of intensification and the narrowing of the genetic basis of livestock production. For different environments and production systems, specific livestock support strategies need to be developed. Imported high-performance breeds are often only suitable for specialised facilities and, in this case, no or little benefit arises to the poor rural population. However, in the long term, modern, intensive production will increasingly replace traditional, extensive production in places wherever this is possible.


Women make up the majority of poor livestock keepers, representing two-thirds of the estimated 600 million poor livestock keepers in the world. Women as the main keepers of locally adapted livestock breeds play a major role in managing animal genetic resources. As women are severely disadvantaged with respect to land ownership, locally adapted breeds that can access and utilize common-property resources represent an enormous asset.

Photos, l.t.r.: © Ilse Köhler-Rollefson; © Christine Martins

Photos, l.t.r.: © Ilse Köhler-Rollefson; © Li Qingsong

Contact person

Carola von Morstein
naren@giz.de

Key elements for promoting the conservation and sustainable use of livestock genetic resources include:

- Avoiding one-sided subsidies for imported breeds
- Increasing support in low-potential areas (extension, research, funds, secured access to land and water)
- Supporting local breeding and marketing organisations
- Improving breed management, pasture management and stocking rates
- Improving livestock productivity (more focus on quality instead of on quantity)
- Rising awareness on ecological services provided by smallholder livestock keepers and pastoralists.

Important links

- Commission on Genetic Resources for Food and Agriculture: www.fao.org/nr/cgrfa
- Community protocols: www.community-protocols.org
- FAO Pastoralist Knowledge Hub: www.fao.org/pastoralist-knowledge-hub/en
- International Livestock Research Institute (ILRI): www.ilri.org
- League for Pastoral Peoples: www.pastoralpeoples.org
- Sector Project Sustainable Agriculture (NAREN): www.giz.de/sustainable-agriculture

Further information

- FAO, 2007: The State of the World's Animal Genetic Resources for Food and Agriculture. www.fao.org/docrep/010/a1250e/a1250e00.htm
- FAO, 2007: Global Plan of Action for Animal Genetic Resources and the Interlaken Declaration. www.fao.org/3/a-a1404e.pdf
- FAO, 2012: Livestock sector development for poverty reduction: an economic and policy perspective – Livestock's many virtues. www.fao.org/docrep/015/i2744e/i2744e00.pdf
- Heinrich Böll Foundation and Friends of the Earth Europe, 2014: Meat Atlas – Facts and figures about the animals we eat. www.boell.de/sites/default/files/meat_atlas2014_kommentierbar.pdf
- Koehler-Rollefson, Ilse, and Hartmut Meyer, 2014: Access and Benefit-Sharing of Animal Genetic Resources – Using the Nagoya Protocol as a Framework for the Conservation and Sustainable Use of Locally Adapted Livestock Breeds. www.fao.org/ag/againfo/programmes/en/genetics/documents/ITWG_AnGR_8/side-event/01_Invitation-ABS_for_AnGR_GIZ_LPP.pdf
- The LIFE Network, 2010: Local Livestock for Empowerment. www.pastoralpeoples.org/docs/lifebrochure_web.pdf

Published by
Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

Registered offices
Bonn and Eschborn, Germany

Sector Project Sustainable Agriculture (NAREN)

Friedrich-Ebert-Allee 36+40	Dag-Hammarskjöld-Weg 1-5
53113 Bonn	65760 Eschborn, Germany
T +49 (0) 228 44 60-0	T +49 (0) 6196 79 - 2359
F +49 (0) 228 44 60-0	F +49 (0) 6196 79 - 1115

naren@giz.de
www.giz.de/sustainable-agriculture

Author
Dr Christine Martins

Design
Ira Olaleye

As at
November 2015

On behalf of
Federal Ministry for Economic Cooperation and Development (BMZ)

Special unit
'ONE WORLD – No Hunger'

Addresses of the BMZ offices

BMZ Bonn	BMZ Berlin
Dahlmannstraße 4	Stresemannstraße 94
53113 Bonn, Germany	10963 Berlin, Germany
T +49 (0) 228 99 535 - 0	T +49 (0) 30 18 535 - 0
F +49 (0) 228 99 535 - 3500	F +49 (0) 30 18 535 - 2501

poststelle@bmz.bund.de
www.bmz.de

Published by:

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

International agreements on agrobiodiversity

At a time when a growing world population needs to be fed on limited resources in a changing climate, the conservation and sustainable use of agricultural biological diversity gains utmost importance. Agrobiodiversity plays a crucial role in food security and nutrition, as well as in the provision of environmental services and livelihoods. It is critical to the sustainability, resilience and adaptability of agricultural production systems. To promote awareness and share knowledge on conservation and the sustainable use of agrobiodiversity, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ), has published this series of agrobiodiversity factsheets.

The present factsheet deals with the global governance of agrobiodiversity. It contains the relevant international legal instruments designed to reverse the current loss of agrobiodiversity and to reward those conserving agrobiodiversity and for sharing their associated traditional knowledge. Aspects covered include access and benefit-sharing, Farmers' Rights and the protection of traditional knowledge, genetic resources as a global commons, intellectual property rights, as well as human rights issues.

What is agrobiodiversity?

Agricultural biodiversity includes all components of biological diversity of relevance to food and agriculture, and all components of biological diversity that constitute the agricultural ecosystems: the variety and variability of animals, plants and micro-organisms, at the genetic, species and ecosystem levels, which are necessary to sustain key functions of the agro-ecosystem. Agrobiodiversity is the outcome of the interactions among genetic resources, the environment and the management systems and practices used by farmers and herders. It has developed over millennia, as a result of both natural selection and human interventions.

Background

As agrobiodiversity is such an important issue for the survival of humankind, the diversity of plant and animal genetic resources for food and agriculture, as well as species and ecosystem diversity, needs to be well protected and sustainably used at local, regional and international levels. Which international agreements are in place for that? There are the processes around the UN Convention on Biological Diversity (CBD) and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). Other agreements deal with intellectual property issues, such as the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) of the WTO, and the Convention of the International Union for the Protection of New Varieties of Plants (UPOV). There are many other agreements, which directly or indirectly influence agrobiodiversity and the traditional rights of farmers and herders as producers, maintainers and developers of agrobiodiversity. IIED (2014) provides an overview on international agreements on biodiversity conservation, Santilli (2012) is about the laws on agrobiodiversity, and Andersen (2008) describes the international agreements related to plant genetic resources in agriculture and how their interaction affects developing countries.

The Convention on Biological Diversity

The United Nation's Convention on Biological Diversity (CBD) is a global, legally binding treaty for the conservation and sustainable use of biodiversity, which includes agricultural biological diversity. Established in 1992 at the UN Conference on Environment and Development in Rio de Janeiro, it is one of the three 'Rio Conventions'. The CBD has three objectives:

1. the conservation of biodiversity,
2. the sustainable use of the components of biological diversity, and
3. the fair and equitable sharing of the benefits arising out of the utilization of genetic resources.

Photos, l.t.r.: © GIZ; © Li Qingsong; © Hartmut Meyer

The CBD entered into force in December 1993. In September 2015, it had 196 parties including the European Union (EU). The only countries of the world that have not accessed the CBD are the USA and the Vatican (see CBD). The USA is mainly concerned about its intellectual property interests.

Drawing on the principle of national sovereignty, the CBD recognized the rights of states to regulate access to the genetic resources in their territories. In granting the states the rights to the biological resources in their territories, the CBD also requires them to maintain these resources. The CBD acknowledges the leading role of the FAO and its Commission on Genetic Resources for Food and Agriculture (CGRFA) in agricultural biodiversity.

In order to reduce the dramatic loss of biodiversity, in 2010, the CBD Conference of Parties (COP) adopted the Strategic Plan for Biodiversity 2011 – 2020 in their tenth meeting (COP10) in Nagoya, Aichi Prefecture (Japan). The Strategic Plan comprises five strategic goals and 20 measurable targets known as the Aichi Targets. The United Nations supported the Strategic Plan by declaring 2010 as International Year of Biodiversity, and 2011 – 2020 as UN Decade on Biodiversity. FAO assists the implementation of the Strategic Plan with different tools (see FAO, 2014).

Aichi Targets relevant to agrobiodiversity

- Aichi Target No. 3: Incentives reformed
- Aichi Target No. 4: Sustainable consumption and production
- Aichi Target No. 7: Sustainable agriculture, aquaculture and forestry
- Aichi Target No. 9: Invasive alien species prevented and controlled
- Aichi Target No. 13: Genetic diversity maintained
- Aichi Target No. 16: Nagoya Protocol in force and operational.

For more details, see CBD (2013).

The CBD member states are responsible for their biological diversity including agrobiodiversity, and for implementation of the CBD. The key instruments of its implementation are National Biodiversity Strategies and Action Plans (NBSAP), which have to be integrated into broader national plans for environment and development. National Focal Points (NFP) serve for communication with the CBD; they report at regular intervals on national progress with CBD implementation. The most recent (fifth) instalment of these national reports was due on 31st March 2014. It was to focus on the implementation of the 2011 – 2020 Strategic Plan, and thus contributed to the fourth edition of the Global Biodiversity Outlook (GBO4). GBOs periodically summarize the latest data on the status and trends of biodiversity on a global level and draw conclusions relevant to the further implementation of the Convention.

The Global Biodiversity Outlook 4 (GBO4, CBD, 2014) serves as mid-term review of the implementation of the Strategic Plan for Biodiversity 2011 – 2020 and the Aichi Targets (CBD, 2010). The GBO4 shows significant progress towards meeting some components of the majority of the Aichi Biodiversity Targets. However, in most cases this progress is not sufficient to achieve the targets set for 2020. The analysis of the major primary sectors indicates that drivers linked to agriculture account for 70 % of the projected loss of terrestrial biodiversity. The GBO4 concludes that addressing trends in food systems including realising sustainable farming and food systems is crucial in achieving the Strategic Plan for Biodiversity 2011 – 2020.

CBD Protocols

Besides forming decisions, the CBD can also develop protocols as independent treaties that have to be ratified by the CBD parties to enter into force. For the time being, there are two protocols under the CBD: The Cartagena Protocol on Biosafety and the Nagoya Protocol on Access and Benefit-Sharing. A third protocol, a supplement to the Cartagena Protocol, the 'Nagoya-Kuala Lumpur Supplementary Protocol on Liability and Redress to the Cartagena Protocol on Biosafety', has not yet entered into force. All three protocols are important to agrobiodiversity.

The Cartagena Protocol on Biosafety

The 'Cartagena Protocol on Biosafety to the Convention on Biological Diversity' entered into force in 2003. In September 2015, it had 170 parties. The Cartagena Protocol is an international agreement that aims at ensuring safe handling, transport and use of genetically modified organisms. According to this protocol, the import of genetically modified plants intended for cultivation may occur only with the consent of the importing country. The protocol applies the precautionary principle – those who want to import genetically modified organisms have to prove that this will not result in harm. The Cartagena Protocol allows signatory states to restrict or ban imports even if there is no conclusive evidence that the genetically modified organism might cause damage. For further information, see the following GIZ factsheet (in the present text, GIZ factsheets, hyperlinked, are marked with ▸):

▸ *GIZ, 2009: Biosafety – Implementation of the Cartagena Protocol*

During the drafting of the Cartagena Protocol, no agreement could be reached regarding damage resulting from the transboundary movements of genetically modified organisms. For such cases, a supplementary protocol was drafted and adopted in 2010: the 'Nagoya-Kuala Lumpur Supplementary Protocol on Liability and Redress to the Cartagena Protocol on Biosafety'. By September 2015, 33 parties have ratified the protocol. It will enter into force 90 days after being ratified by at least 40 parties.

The BMZ is supporting projects which are contributing to the implementation of the Cartagena Protocol, for example a regional project which is supporting GMO-free soya production and commercialization for farmers in the Danube region of Bosnia and Herzegovina, and Serbia. This is achieved through improvement of policy framework conditions and research and extension services (see GIZ Danube Soya).

The Nagoya Protocol on Access and Benefit-Sharing

The fair and equitable sharing of the benefits arising out of the utilization of genetic resources is one of the three objectives of the CBD. From 2004 until 2010, the community of nations negotiated a set of international regulations on the access to genetic resources and the equitable sharing of benefits. After tough negotiations, the 'Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity' was adopted at the COP10 in Nagoya (Japan) in October 2010. It entered into force in 2014. In September 2015, the Nagoya Protocol had 66 parties, which now have to implement it in their national law.

The teff case

In 2005, an access and benefit-sharing agreement was made on teff genetic resources between Ethiopia and the Dutch company Health and Performance Food International (HPFI). Teff (*Eragrostis tef*) is a food grain endemic to the Ethiopian highlands, where it has been cultivated for several thousand years. Rich in nutritional value, it is an important staple crop for Ethiopians, and since it is gluten-free, it is interesting as health food and sports and energy food for markets in other parts of the world.

Provisions of the agreement included various payments to Ethiopia including 5 % of net profits, involvement of Ethiopian researchers, and sharing of results with Ethiopian scientists. The Teff Agreement was seen as one of the most advanced of its time. It was seen as a pilot case for the implementation of the CBD in terms of access to and benefit-sharing from the use of genetic resources. But the high expectations were never met: the only benefits Ethiopia received were a payment of EUR 4000 that had been paid upfront towards the beginning of the implementation of the agreement and a small, early-interrupted research project.

Ethiopia provided access to the teff genetic resources under the agreement, but HBFI failed in large part to comply with its obligations. In 2007, HPFI obtained a patent from the European Patent Office on the processing of teff flour and related products in the Netherlands, which, in practice, covered all ripe grain and all genetic resources of teff in addition to relevant products. With this patent, HPFI has assumed the right to commercially exploit teff exclusively throughout the world for the next twenty years. Though HPFI was declared bankrupt in 2009, it established other companies and transferred values to these companies. These companies, in turn, continued to produce and sell teff flour and teff products, and expand their activities to other countries and continents.

In the end, Ethiopia received almost nothing, but lost its right to utilize and reap benefits from its own teff genetic resources in the countries where the patent is valid. For more information, see Andersen and Winge, 2012: The Access and Benefit-Sharing Agreement on Teff Genetic Resources: Facts and Lessons, and GIZ, 2014: The teff case – Ethiopia (poster).

Discussion during the meeting of the Parties to the Cartagena and the Nagoya Protocols during COP12 in Pyeongchang, Republic of Korea, October 2014.

Photo: © IISD/Earth Negotiations Bulletin

Photos, l.t.r.: © GIZ; © Sylvia Reinhardt; © IISD/Earth Negotiations Bulletin

The Nagoya Protocol on Access and Benefit-Sharing is an international legal framework, which aims at sharing the benefits arising from the utilization of genetic resources and associated traditional knowledge in a fair and equitable way, thereby contributing to the conservation and sustainable use of biodiversity. It creates greater legal certainty and transparency for both providers and users of genetic resources, by establishing more predictable conditions for access to genetic resources and helping to ensure benefit-sharing with the provider of genetic resources.

Access and benefit-sharing (ABS) is based on free, prior and informed consent granted by the providers of genetic resources. Mutually-agreed terms regulate rights and requirements between two or more parties. Benefit-sharing can be both monetary and non-monetary (e.g. transfer of financial resources, technologies and knowledge, especially of the private sector). The Protocol puts pressure on companies in the pharmaceutical, cosmetic and food industry regarding their usage of genetic resources and helps prevent illegal appropriation of genetic resources and related traditional knowledge ('bio-piracy').

BMZ, in collaboration with other donors, is supporting the ABS Capacity Development Initiative which supports the development and implementation of national ABS regulations and the development of capacities to negotiate ABS in various international fora and at national levels. For more detailed information on the international ABS regime, see Santilli (2012, Chapter 6), ABS Initiative and

- *GIZ, 2009: Genetic Resources – Access and Equitable Benefit-Sharing*
- *GIZ, 2012: Access and Benefit-Sharing (ABS)*
- *GIZ, 2015: Agrobiodiversity access and benefit-sharing*

The International Seed Treaty

The International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), commonly known as the International Seed Treaty, regulates the multilateral exchange of a defined list of genetic resources of important food and fodder crops, and recognizes Farmers' Rights. Adopted in 2001, by September 2015, it had 136 contracting parties including the EU. Among those countries not joining are the USA, China, South Africa, and New Zealand. The ITPGRFA is an international agreement based on the FAO's constitution.

The principal objectives of the ITPGRFA are the conservation and sustainable use of plant genetic resources for food and agriculture and the fair and equitable sharing of benefits derived from their use, in harmony with the CBD, for sustainable agriculture and food security. The ITPGRFA requires its member countries to conserve their plant genetic resources for food and agriculture in accordance with the CBD, to ensure their sustainable use, to safeguard their free exchange, and recognize farmers as custodians and managers of genetic diversity (this is known as 'Farmers' Rights'). States hold sovereign rights over their own plant genetic resources, but agree to facilitate access to these resources for the purpose of 'utilization and conservation for research, breeding and training for food and agriculture'.

Farmers' Rights and the ITPGRFA

Farmers' Rights include the right to protection of farmers' traditional knowledge of plant genetic resources, the right to participate in sharing of the proceeds arising from their use, the right to participate in decisions on issues relating to conservation and sustainable use of these resources, and their right to keep seeds and planting materials grown on their farms, to plant them, to share them with others and to develop them.

The ITPGRFA is the first legally binding international agreement to recognise Farmers' Rights. Responsibility for implementation lies with national governments; they have to consider Farmers' Rights in their national legislation (see Farmers' Rights Project).

For further information on Farmers' Rights and agrobiodiversity, see Santilli (2012, Chapter 8) and Andersen and Winge (2013): Realising Farmers' Rights to Crop Genetic Resources: Success Stories and Best Practices, and

- *GIZ, 2006: Farmers' Rights and agrobiodiversity*

The core of the ITPGRFA is the multilateral system for facilitated access to 35 specified food crops and 29 forage crops. The system also includes the collections in the gene banks of the International Agricultural Research Centres of the Consultative Group on International Agricultural Research (CGIAR) and other international and national institutions with agreements with the ITPGRFA.

The multilateral system enables providers and users of genetic resources to exchange genetic material between the parties, equitably sharing benefits arising from commercial use, on the basis of standard contracts (Standard Material Transfer Agreement, SMTA). The SMTA describes the rights and obligations of all parties involved, as well as provisions regulating monetary and non-monetary sharing of benefits resulting from the use and marketing of plant genetic resources.

Crop genetic resources as a global commons

Bioversity International (2013) studied methods for supporting the collective pooling and management of shared plant genetic resources for food and agriculture. This included support through laws regulating access to genetic resources and the sharing of benefits arising from their use, with focus on the ITPGRFA. The report analyses a range of relevant background factors, including the impact of climate change on countries' interdependence on plant genetic resources, and germplasm flows in and out of international gene banks. It shows where challenges remain in terms of the multilateral system's performance as a central feature in a global system of collective action to conserve and sustainably use plant genetic diversity, and equitably share benefits derived from that use. The report presents ways to increase the scope, utility and sustainability of the global crop commons and offers options for policy initiatives to further strengthen the support which the multilateral system provides to the global crop commons.

The aspect of crop genetic resources as a global commons is also covered by Santilli (2012) in her comprehensive analysis of the impact of the legal system on agrobiodiversity and on small-scale farmers who conserve and manage agrobiodiversity, by Kloppenburg (2014) as well as by Kotschi and Wirz (2015).

The International Seed Treaty has resulted in an improved multilateral exchange of genetic materials and has strengthened joint efforts to preserve seeds and planting materials in gene banks (*ex situ* conservation). The conservation of plant genetic resources by farmers in the field (*in situ* conservation) and their sustainable use are key provisions of the treaty. However, as the multilateral system was not functioning at the level hoped for, in 2013, the 'Ad Hoc Open-ended Working Group to Enhance the Functioning of the Multilateral System' was established and discussions on its improvement are ongoing. The working group is giving attention to landraces, farmers' varieties, crop wild relatives, informal seed systems, nutrition issues, and wider consideration of farmers' needs.

- *GIZ, 2009: The International Treaty on Plant Genetic Resources – status of implementation*

Treaties on intellectual property rights

In recent years, the seed sector saw an increase of granting intellectual property rights to newly developed plant varieties. At the same time, the sector experienced a concentration of seed companies into few multinational companies. Intellectual property refers to various sets of exclusive rights that are granted to applicants as a reward or incentive for intellectual endeavour. They include patents, copyrights, trademarks/trade names, utility models, plant variety protection laws, geographical indications, and *sui generis* traditional knowledge laws.

Intellectual property rights make access to genetic resources and their free use more difficult or even prevent it for breeders and farmers. The informal seed system in which farmers freely cultivate, exchange and further develop seeds is being increasingly blocked by the commercial seed sector. The broad debate concerning the role of intellectual property rights in agriculture is deadlocked, and positions have become polarised. At one end of the scale is the call for strong property rights as a driving force for innovation and the possibility of refinancing of investment. At the other end is a rejection of strong property rights, to enhance food security based on small-farm agriculture that at the same time preserves biological diversity (see GIZ, 2010, and GIZ, 2015a).

Intellectual property rights must be designed in such a way that ethical principles are taken into consideration, the rights of farmers are respected, fair growth in developing countries is supported, and the implementation of the CBD, as well as research and cultivation of new varieties, are not hindered.

Today, the most relevant intellectual property protection systems affecting agrobiodiversity are the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) under the WTO regime, and the convention of the International Union for the Protection of New Varieties of Plants (Union Internationale pour la Protection des Obtentions Végétales, UPOV). While the USA uses patents to protect newly developed genetic resources (the first plant, a climbing rose, was patented in 1931), Europe applies plant variety protection in line with the UPOV convention.

- *GIZ, 2010: The role of intellectual property rights in agriculture*
- *GIZ, 2011: Intellectual Property Rights in Agriculture. Plant variety protection and its effects on food security and biological diversity*

Photo, l.t.r.: © GIZ; © GIZ/Bärbel Högner; © Hartmut Meyer

TRIPS

As part of negotiations that led to the creation of the WTO, the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) was adopted in 1994. The TRIPS agreement requires WTO signatory states to provide intellectual property protection for plant varieties, but allows governments quite a lot of choice in how they put this requirement into effect. WTO members may extend patent protection to cover plant varieties or may choose, as European countries have, to keep conventional plant breeding out of the patent system. In the latter case, though, TRIPS requires a specific ('*sui generis*', Latin for stand alone, in a class of its own) intellectual property regime for plant varieties. UPOV is one such intellectual property regime.

Alternative *sui generis* approaches have been developed by several countries so far, including India, Malaysia and Thailand (most promising is the plant variety protection law in India). Similarly, Zimbabwe's, Zambia's and Uganda's plant variety protection laws also deviate in some elements from the UPOV Convention and would possibly not comply with it. Since these countries have not, to date, been faced with any complaints of non-compliance under the dispute settlement provisions of TRIPS, a study of these extant alternatives could be a pragmatic way to identify elements of a TRIPS-compatible *sui generis* system. For designing *sui generis* plant variety protection sytems in developing countries, see Correa, (2015).

UPOV plant variety protection

The UPOV Convention is a multilateral treaty signed in Paris in 1961. It entered into force in 1968 and was revised in 1972, 1978 and 1991. In September 2015, UPOV had 73 members. Both the ITPGRFA and the UPOV Convention aim at supporting plant breeding activities and encouraging the development of new varieties of plants. The ITPGRFA, which entered into force in 2004, does so by providing a system for facilitated access to plant genetic resources, while the UPOV Convention does so by establishing a system for plant variety protection.

The UPOV Convention and human rights

GIZ (2015b) has commissioned an integrated assessment of potential impacts of UPOV 91 on the right to food and other human rights as well as on Farmers' Rights. The rights of plant breeders and Farmers' Rights as defined in the ITPGRFA are both within the national jurisdiction of each country. Generally, farmers have an implicit right concerning their genetic resources, including seed and planting material, unless it is challenged by other law, e.g. plant variety protection law. UPOV-based plant protection laws protect the rights of plant breeders; however, they hinder the farmers' customary practices of exchanging and selling seed from their own harvest – important elements of farmer-managed breeding and seed systems. This involves risks for the realisation of the right to food and Farmers' Rights, which can be more or less pronounced in each country. Depending on other measures taken by a state, e.g. ensuring that vulnerable groups have access to seed, the plant variety protection law can be in harmony with the right to food or not.

The study also analysed whether the UPOV regulations are suitable for the agricultural conditions in developing countries. The concept of 'intellectual property' in the seed sector emerged historically from countries with an effective formal seed sector. In developing countries, the most important source of seed is farmer-managed seed systems which rely on traditional knowledge and the farmers' practices of freely saving, using and exchanging seed (see also GIZ, 2015a). At least 40 – 50% of all agricultural land in developing countries is estimated to be 'marginal'. Here, agricultural intensification is not economic and low-input systems prevail. Under such conditions, farmers depend especially on a functioning informal seed system and a rich genetic diversity and varieties that are well adapted and continue to develop to the local environment. The UPOV criterion of 'uniformity' could become a challenge for protecting varieties relevant to stress-prone environments and low-input farming systems, thus hindering rather than promoting breeding progress for these conditions.

Developing countries that have not yet joined UPOV should consider opting for alternative *sui generis* systems of plant variety protection that allow for more flexibility in meeting the obligations of different treaties, for balancing the interests of diverse actors, and for protecting and promoting Farmers' Rights, compared with the UPOV system.

The UPOV Convention facilitates the international protection of new varieties of plants that meet certain minimum standards (novel, distinct, uniform and stable features). UPOV allows each member state, within their domestic laws, to grant intellectual property rights to breeders who have developed new plant varieties.

UPOV contains certain exemptions: the farmers' privilege (the right of farmers to save and re-use harvested seeds of a protected variety), and the breeders' exemption (allowing other plant breeders to use protected material, without a licence, to breed new varieties). However, in its latest version from 1991 (UPOV 91), the protection of plant breeders' rights has been strengthened, while farmers' privilege and the breeders' exemption were not adequately addressed. UPOV 91 partially restricts the use of farm-saved seeds and propagation materials of protected varieties and, thus, prohibits their exchange and sale by farmers. Concerns have therefore been raised that UPOV 91-type plant variety protection laws overly restrict the traditions of seed management and sharing among farmers, thereby reducing the effectiveness and integrity of the informal seed system and, thus, negatively affecting farmers' livelihoods and national food security in developing countries (see QUNO, 2011, and The Berne Declaration, 2014).

Implementation of international agreements on agrobiodiversity

GIZ analysed the level of implementation of international agreements on agrobiodiversity by case studies in five countries (India, China, Ethiopia, Brazil, and Peru). In all five countries, the conservation of agrobiodiversity is mainly in the hands of small farmers and indigenous communities. All countries have undertaken significant efforts to translate international obligations to conserve biodiversity into national laws and policies. The focus has been on conserving natural biodiversity and plant genetic resources, but less importance has been attached to the conservation of agrobiodiversity, and even less to that of animal genetic resources. More intensive measures are needed to reduce the loss of agricultural genetic resources. The practical implementation of legal provisions is constrained by a lack of awareness, a shortage of resources, and limited capacity. Coordination among ministries, the private sector and civil society need to be improved. Concepts are required to create value for diversity, craft incentives for conserving it, for sharing benefits, and ensuring the rights of farmers. Despite these shortcomings, certain countries have acquired significant experience and have developed innovative approaches that can inspire future initiatives.

GIZ, 2011: Implementing international agreements to conserve agrobiodiversity: Lessons from five countries

Germany's commitment to biodiversity

As a signatory to the biodiversity-related international agreements, Germany is committed to implementing them at home as well as to supporting its partners in doing so through development cooperation. Germany is supporting the implementation of the CBD and the ITPGRFA through different national and supra-regional projects. Every two years, the German Government publishes a list of projects and programmes related to biodiversity, that are implemented within the framework of German international cooperation. In 2014, there were 269 ongoing projects and pledges for new projects made in 2013 with main focus and principle objective to support at least one of the three objectives of the CBD (see BMZ and BMUB, 2014).

Outlook

Genetic resources provide the building blocks that allow classical plant breeders and biotechnologists to develop new commercial varieties and other biological products. Neither genetic resources nor the biotechnologies that apply to them have a clear market value by themselves; this only exists for the commercial products obtained through them. Since the 1960s, a number of international bodies and agreements (TRIPS/WTO, UPOV) have passed regulations for intellectual property rights that allow the right-holders to obtain part of the profits from the commercial products they have developed. Since the 1990s, other international agreements (CBD with the Nagoya Protocol, ITPGRFA) have granted equivalent but collective rights on the providers of the genetic resources.

This situation calls for a symmetrical and balanced system of incentives to promote, on the one hand, the developments and application of new biotechnologies and to ensure, on the other hand, the continued conservation, development and availability of genetic resources to which these technologies apply. It is now up to national governments to implement these provi-

Photo: © GIZ

Photos, l.t.r.: © Li Qingsong, © Bioversity International/S. Landersz

Contact person

Friederike Kraemer
naren@giz.de

sions, including the development, as appropriate, of national legislation that takes fully into account the two 'pillars' of the system, thereby allowing for harmony and synergy in the implementation of the various binding international agreements. The aim should be to ensure long-term food security, protect livelihoods and provide incentives to maintaining biological and genetic diversity.

In particular, assistance is needed for the formulation of national seed laws – for example in drafting a *sui generis* plant variety protection law according to the country's respective conditions, needs and interests. Other important fields where support is needed are capacity-building, awareness-raising, and mainstreaming of international agreements on agrobiodiversity, in such a way that all levels of society as well as all relevant sectors are involved.

Important links

- ABS Capacity Development Initiative: www.abs-initiative.info
- Cartagena Protocol on Biosafety: bch.cbd.int/protocol
- Convention on Biological Diversity: www.cbd.int
- Farmers' Rights: www.farmersrights.org
- Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES): www.ipbes.net/
- ITPGRFA: www.planttreaty.org
- Nagoya Protocol on Access and Benefit-Sharing: www.cbd.int/abs
- Sector Project Implementing the Biodiversity Convention: www.giz.de/biodiversity
- Sector Project Sustainable Agriculture (NAREN): www.giz.de/sustainable-agriculture

Further information

- CBD, 2010: Strategic Plan for Biodiversity 2011 – 2020, including Aichi Biodiversity Targets. www.cbd.int/sp and www.cbd.int/doc/strategic-plan/2011-2020/Aichi-Targets-EN.pdf
- FAO, 2014: FAO's tools and guidance to assist implementation of the Convention on Biological Diversity and the Strategic Plan for Biodiversity 2011-2020. www.fao.org/fileadmin/templates/biodiversity_paia/FAO_Instruments_Strategic_Plan_Aichi_Targets.pdf
- FAO and Bioversity International, 2011: Plant Genetic Resources and Food Security – Stakeholder perspectives on the International Treaty on Plant Genetic Resources for Food and Agriculture. www.bioversityinternational.org/uploads/tx_news/Plant_genetic_resources_and_food_security_1532.pdf
- GIZ, 2010: Triggering the Synergies between Intellectual Property Rights and Biodiversity. www.giz.de/fachexpertise/downloads/gtz2010-en-iprs-and-biodiversity-reader.pdf
- GIZ, 2015a: Farmers' Seed Systems – The challenge of linking formal and informal seed systems. www.giz.de/expertise/downloads/giz2015-en-dokum-expert-talks-farmers-seed-syst.pdf
- GIZ, 2015b: The UPOV Convention, Farmers' Rights and Human Rights: An integrated assessment of potentially conflicting legal frameworks. www.giz.de/fachexpertise/downloads/giz2015-en-upov-convention.pdf
- UNEP, 2015: Sourcebook of opportunities for enhancing cooperation among the Biodiversity-related Conventions at national and regional levels. wcmc.io/Sourcebook

Published by
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Registered offices
Bonn and Eschborn, Germany

Sector Project Sustainable Agriculture (NAREN)
Friedrich-Ebert-Allee 36 + 40
53113 Bonn
T +49 (0) 228 44 60-0
F +49 (0) 228 44 60-0

Dag-Hammarskjöld-Weg 1-5
65760 Eschborn, Germany
T +49 (0) 6196 79 - 2359
F +49 (0) 6196 79 - 1115

naren@giz.de
www.giz.de/sustainable-agriculture

Author: Dr Christine Martins

Design: Ira Olaleye

As at: November 2015

On behalf of
Federal Ministry for Economic Cooperation and Development (BMZ)

Special unit
'ONE WORLD – No Hunger'

Addresses of the BMZ offices

BMZ Bonn
Dahlmannstraße 4
53113 Bonn, Germany
T +49 (0) 228 99 535 - 0
F +49 (0) 228 99 535 - 3500

BMZ Berlin
Stresemannstraße 94
10963 Berlin, Germany
T +49 (0) 30 18 535 - 0
F +49 (0) 30 18 535 - 2501

poststelle@bmz.bund.de
www.bmz.de

german
cooperation
DEUTSCHE ZUSAMMENARBEIT

Published by:
giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Incentives for agrobiodiversity conservation

At a time when a growing world population needs to be fed on limited resources in a changing climate, the conservation and sustainable use of agricultural biological diversity gains utmost importance. Agrobiodiversity plays a crucial role in food security and nutrition, as well as in the provision of environmental services and livelihoods. It is critical to the sustainability, resilience and adaptability of agricultural production systems. To promote awareness and share knowledge on conservation and the sustainable use of agrobiodiversity, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ), has published this series of agrobiodiversity factsheets.

The present factsheet deals with measures to motivate and compensate farmers and herders for the conservation and sustainable management of agrobiodiversity. Issues covered include: the question of who the providers of and beneficiaries from agrobiodiversity conservation are; the public good characteristic of agrobiodiversity due to the manifold services it provides; the question of how to value these services; the need for provision of incentives and payments for agrobiodiversity conservation services; as well the question of how could such incentives be sustainably financed.

What is agrobiodiversity?

Agricultural biodiversity includes all components of biological diversity of relevance to food and agriculture, and all components of biological diversity that constitute the agricultural ecosystems: the variety and variability of animals, plants and micro-organisms, at the genetic, species and ecosystem levels, which are necessary to sustain key functions of the agro-ecosystem. Agrobiodiversity is the outcome of the interactions among genetic resources, the environment and the management systems and practices used by farmers and herders. It has developed over millennia, as a result of both natural selection and human interventions.

Who conserves agrobiodiversity, and who benefits?

Agrobiodiversity is a key public good that delivers necessary services for human wellbeing. While the benefits of agricultural biodiversity are increasingly recognized, their total economic value is not fully accounted for – neither by individuals nor by society. Benefits comprise private benefits to the farmer and herder in terms of food, fodder, fibre, and other products, as well as public benefits to wider society, such as those related to agro-ecosystem resilience and the maintenance of evolutionary processes and future options. Agrobiodiversity provides a mixture of private and public benefits. Markets only capture a part of these benefits, thus underestimating their true worth.

The majority of the genetic diversity used worldwide in agriculture is in the hands of numerous small farmers and herders who, with their breeding activities, keep adapting local crops and livestock to the local conditions. They decide which crops and crop varieties they will grow and which species and breeds of animal they will rear. In recent decades, industrialisation, global competition, climate change and structural changes in agriculture have led to a displacement of traditional crop plants and livestock by commercially more viable high-yielding varieties and breeds. However, a high level of agrobiodiversity often still exists in poorer rural communities in marginal areas in developing countries, where people depend on plants and animals that still produce a more reliable yield even under unfavourable climatic conditions.

Much of the on-farm conservation of agrobiodiversity is being done by poor farmers, men and women, around the world, at their personal cost and based on their local creativity and energies. While the costs of conservation are covered at farm level, the benefits can extend far beyond. An example for such

Photos, l.t.r.: © Li Qingsong; © Luis Waldmueller; © Sylvia Reinhardt

Photos, l.t.r.: © Ding Jinwu; © Christine Martins; © Luis Waldmueller

Guardians of diversity

Smallholder farmers, especially those on marginal lands, are often much more interested in minimizing risk than in maximizing productivity. They need to feed themselves and their families. Maintaining a variety of different crops can reduce the risk of complete loss in the event of harvest failure. A particular species, variety or breed may also be socially and culturally valuable, used as part of a traditional cuisine or ceremony such as a wedding. Often, women play a key role in the conservation of agrobiodiversity. Farmers are also exploring new ways of using biodiversity in a sustainable way with a view to spreading risks, enhancing food security and improving their livelihoods. Poorer farmers in particular are innovating in biodiversity management in order to increase their options to cope with variable environmental conditions and to exploit micro-environments ('niches') in their agro-ecosystems. For more information, see the GIZ factsheet (in the present text, GIZ factsheets, hyperlinked, are marked with ▸).

▸ *GIZ, 2015: Understanding agrobiodiversity*

Ecosystem services provided by agrobiodiversity

- **Provisioning services:** products obtained from ecosystems such as food, fibre, fuel, draught power, manure, genetic resources, biochemicals, cosmetics, pharmaceuticals, and clean water
- **Regulating services:** benefits obtained from the regulation of ecosystem processes such as pollination, erosion prevention and maintenance of soil fertility, carbon storage and sequestration, water regulation and purification, air quality regulation, microbial decomposition of wastes or pollutants, natural pest and disease control, as well as resilience to shocks and climate variability
- **Cultural services:** non-material benefits people obtain from ecosystems such as recreational and aesthetic values, cultural heritage, educational values, inspiration, spiritual and religious values, as well as the maintenance and further development of local knowledge and innovations
- **Supporting services:** services necessary for the production of all other ecosystem services such as habitat provision, photosynthesis, water and nutrient cycling.

benefits are ecosystem services – resources and processes that are supplied by ecosystems to the benefit of humans and all forms of life (see box this page); they are the result of concrete activities by farmers. Those who do the conservation work and contribute to functioning ecosystems, do not get sufficiently compensated for the benefits they create.

How to value agrobiodiversity?

Many of the services provided through the conservation and sustainable use of agrobiodiversity are at present not economically valued. How to value (and whom to let pay for) regulating ecosystem services of agrobiodiversity, such as pollination and erosion regulation, or cultural ecosystem services, such as recreational and aesthetic values, and inspiration? And how to assure that agrobiodiversity is conserved when there are insufficient direct immediate benefits for farmers? Despite their many and significant links, ecosystems as well as agricultural and food systems are typically evaluated in isolation from one another. However, ecosystems are the ecological home in which crop and livestock systems thrive and produce food for humans, and, in turn, agricultural practices, food production, distribution and consumption impose several unquantified effects on ecosystem health. So far there is no comprehensive economic evaluation of the 'eco-agri-food systems' complex. The economic value of agrobiodiversity ecosystem services needs to be investigated and evaluated, to cover fields such as pollination, soil fertility and plant protection. A helpful analogy would be the TEEB ('The Economics of Ecosystems and Biodiversity') approach; see GIZ, 2012, and

▸ *GIZ, 2012: The economics of ecosystems and biodiversity (TEEB)*

A 'TEEB for Agriculture and Food' study presently reviews the inter-dependencies between agriculture and food systems and natural ecosystems, in order to assess the social, environmental, economic and health-related benefits and costs of these systems, so that governments and businesses can use the information and recommendations to improve decision-making (TEEB, 2014; TEEB 2015). However, besides economically valuing the ecosystem services provided by agrobiodiversity, the costs of policy inaction (in terms of not conserving agrobiodiversity) also need to be considered. Money that we spend today on agrobiodiversity conservation might well save money which we otherwise had to spend in future.

Incentives for diversity

Unlike for 'wild' biodiversity, agrobiodiversity conservation requires continued active human intervention. If the old varieties and breeds are to be prevented from disappearing, incentives are needed which make them more attractive to farmers. Value chain approaches making use of agrobiodiversity alone are insufficient for agrobiodiversity conservation. They only cover a few plant varieties or livestock breeds which have a potential for (niche) marketing. Many threatened agrobiodiversity resources have a low or no market value; and even where successfully conserved they may displace other threatened genetic resources. This happened with quinoa under the current quinoa boom: high market prices for a few (mostly white) quinoa varieties favoured by export markets led to a reduction of quinoa diversity in the Andean highlands (see GIZ, 2013).

Recognition of the value of farmers' work in maintaining agricultural biodiversity and the provision of positive incentives that adequately compensate them for doing so is urgently needed. The Convention on Biological Diversity (CBD) gives high attention to incentives for biodiversity; it runs a programme of work on incentive measures (see CBD, 2011). The FAO covers this aspect with its programme 'Incentives for Ecosystem Services in Agriculture' (IES). One of the 20 targets of the Strategic Plan for Biodiversity 2011 – 2020 is on incentives (Aichi Target No. 3). It demands that by 2020, incentives harmful to biodiversity are eliminated, phased out or reformed, and that positive incentives for the conservation and sustainable use of biodiversity are developed and applied.

Incentives for agrobiodiversity conservation can be positive – promoting activities encouraging conservation – or negative – promoting activities harmful to conservation, such as low prices for local varieties, subsidies for modern varieties, or one-sided promotion of monocultures and high-input agriculture. There are direct and indirect incentives. Direct incentives motivate or discourage the farmers directly in monetary form (e.g. direct payment, loan, landrace or local breed subsidy, or increased market price) or in kind (e.g. awards/recognition for 'custodianship', training, extension advice, school materials and school meal programmes, infrastructure, seed access and seed fairs, or land use rights). Indirect incentives lead to changes in an actor's agro-ecological and socio-economic environment, which in turn has an impact on the sustainable use and conservation of agrobiodiversity.

GIZ, 2006: Incentive Measures for the Conservation of Agrobiodiversity

In the European Union, incentives for the continuous on-farm use of agrobiodiversity have become an integral part of EU support for regional and rural development in recent years. The measures aimed at achieving the objectives of the ITPGRFA and the CBD pass through the EU Common Agricultural Policy and become part of the Rural Development Plans. At global level, the Benefit Sharing Fund (BSF) of the ITPGRFA serves as incentive for agrobiodiversity conservation. It aims at directly assisting farmers in developing countries in the management of crop genetic resources for sustainable food security and improved livelihoods. Under the third project cycle of the fund approved in March 2015, over USD 10 million were allocated in 22 projects around the world.

Agro-ecotourism stimulating agrobiodiversity conservation

Agro-ecotourism is a form of tourism that combines ecotourism and agrotourism, focussing on nature conservation, agriculture and culture. It can contribute to the *in situ* conservation of typical regional diversity of crop varieties and livestock breeds. The more unusual the variety or breed, the more suitable it is for promotional purposes. By providing income and employment, agro-ecotourism can serve as an incentive for the conservation of agrobiodiversity and traditional cultural practices (including food culture), stimulate community pride and awareness of heritage, nature and agrobiodiversity, and revive the appreciation of traditional crops and local farm animals. Examples for German development cooperation in support of tourism as an incentive for conservation and sustainable use of agrobiodiversity are the projects 'Conservation of Agrobiodiversity in Rural Albania' (CABRA) and 'Competitiveness of the Private Sector in Rural Areas' in Kosovo (COSiRA)'.

GIZ, 2007: Maintaining and promoting agricultural diversity through tourism



Photos, l.t.r.: © Christine Martins; © GIZ; © Ding Jinwu

Photos: © Bioversity International, Alfredo Camacho; l.t.r.: c1.staticflickr.com/9/8189/8413236815_c1951e1b41_o.jpg; c1.staticflickr.com/9/8464/8414334430_a7577c12e9_o.jpg; c1.staticflickr.com/9/8045/8414337860_ac6560624c_o.jpg



Payments for agrobiodiversity conservation services

If we want to secure socially desirable levels of conservation for the greater public good and protect the crops and breeds that are at the most risk of extinction, a kind of 'payment for ecosystem services' (PES) should be applied for agrobiodiversity conservation. PES has been successfully applied in paying for environmental services achieved through conservation of wild biodiversity, but also for activities related to agrobiodiversity conservation, such as soil and water conservation measures, windbreaks, riverbank protection, the creation of pastures for bees, the less intensive use of arable land or pastures, and the maintenance of cultural features in the landscape.

Effective payment schemes for agrobiodiversity conservation have to consider what payments should be made for, which species/varieties/breeds to conserve (the so-called 'Noah's Ark Problem'), minimizing costs of agrobiodiversity conservation while maximizing benefits, and reducing transaction costs. Other questions include who should be paid, how much should be paid, and how should payments be made. For exploring such aspects, Bioversity International is running a programme on payments for agrobiodiversity conservation services (PACS). PACS is an agriculture-related PES scheme designed to tackle the public good characteristics of agrobiodiversity. Payments are monetary, in-kind, or other types of rewards that effectively increase the private benefits for farmers in utilizing certain crop varieties or livestock breeds on-farm.

Safe minimum standards need to be defined for the conservation activities under the scheme. For a livestock breed these are: more than 1000 breeding females or 20 breeding males (FAO criteria for 'not at risk'). However, such numbers do not exist for plant genetic resources – here, conservation activities should consider how much land to be cultivated, by how many farmers, their geographical distribution, the amount of seeds available in local systems, existing seed distribution networks, the degree of local knowledge maintained, socio-cultural traditions and market integration. Farmers as service providers are to be selected according to the expected outcome in terms of ecological effectiveness (reaching the conservation goal), economic efficiency (least-cost conservation), and social equity (pro-poor outcomes, fairness). For minimizing conservation costs, competitive tender approaches proved successful (see box this page).

PACS schemes appear to have potential as an environmentally effective and cost-efficient mechanism through which to provide conservation incentives. Interventions should be targeted to areas of high agrobiodiversity and high poverty in order to maximize impact. Prioritization of particular plant and animal genetic resources will ensure that the most diversity can be conserved for a given budget. Limited conservation budgets can achieve maximum impact by identifying least-cost providers. Payments or rewards may be made in different ways (see Drucker, 2011, and Narloch et al., 2011).

In order not to undermine existing conservation efforts, informal local institutions for the self-governance of natural resources have to be considered. The incentive scheme should involve a socially accepted allocation of rewards in order to support and strengthen collective action in natural resource management and agrobiodiversity conservation.

GIZ, 2011: Payment for Environmental Services (PES) to conserve agricultural biodiversity

Conservation tenders

Under the PACS programme, Bioversity International tested a competitive tender scheme using auction-based mechanisms for conservation of nine threatened quinoa varieties in Bolivia and Peru. Farmer organisations were invited to participate in a single round, sealed-bid reverse auction, offering their services to plant different quinoa varieties for conservation reasons, comparing the cost-effectiveness of the offers for selection.

Experiences showed that payments may be not only in cash to individuals, but also in-kind at community level (e.g. school renovation). Relative to fixed price programs, the transaction costs of running conservation tenders can be relatively high, since the conservation agency has to coordinate the whole selection process with all –possibly dispersed – land users. Cost reduction can be achieved by dealing with groups of land users or motivating self-compliance through the contract terms stipulating that no payments are made unless the whole contract is delivered in its entirety. This also creates a strong incentive for participating farmers to ensure that all group members deliver (Bioversity International, 2013).

Financing the conservation of agricultural diversity

The Little Biodiversity Finance Book (GCP, 2012) provides an overview of how biodiversity finance is generated at present by public funds (international, national) as well as by market and private sources and how it might look in future. Most international and national financing instruments are tailored to conserve biodiversity in general and not agrobiodiversity in particular. However, many of the international finance instruments supporting biodiversity can also be used for agrobiodiversity, such as the Global Environmental Facility (GEF) and the Green Climate Fund (GCF; see box below).

Global Environmental Facility (GEF)

National governments and civil society organisations can obtain funds from the Global Environmental Facility (GEF) to cover additional costs associated with transforming a project with national benefits into one with global environmental benefits. There are several GEF Operational Programs under which agrobiodiversity measures can be co-funded. Operational Program 13 was especially launched to conserve and ensure the sustainable use of agricultural genetic resources.

Green Climate Fund (GCF)

The Green Climate Fund (GCF) was established in 2010 under the UN Framework Convention on Climate Change (UNFCCC) to serve as the central global investment vehicle for climate finance. It started operations in mid-2014. It was established to help developing countries reduce greenhouse gas emissions and adapt to climate change. Funds can be applied for agrobiodiversity conservation schemes as long as the climate relevance of funded activities is described – co-benefits to biodiversity conservation, sustainable agriculture, etc. are considered an advantage for GCF funding.

Various countries – both industrialised and developing – provide national funds for the conservation of genetic resources; others have set up special national eco-funds, which are financed from national and international sources and are used in particular for smaller-scale measures, e.g. the National Gene Fund in India (PPVRA, 2011). Generally, these funds focus on natural biodiversity, but many of them also offer the possibility of promoting agrobiodiversity conservation.

Also, development projects offer potential for implementing activities to conserve threatened crop varieties and livestock breeds and related indigenous knowledge. For instance, value chains for products from plants and domestic animals that are currently rarely used can be promoted.

Comprehensive financing instruments which target international, national and regional levels are needed to conserve agrobiodiversity for our future. For sustainably financing interventions to conserve agrobiodiversity, a combination of market, public and private sources of finance should be identified, incorporating a mixture of incentive instruments – value chain development combined with payment schemes built on governmental funds and private sector funding. See also Bioversity International (2013) and

▸ *GIZ, 2008: Financing the conservation of agricultural diversity*

Outlook

The costs of maintaining agricultural biological diversity for local, national and global benefit is currently borne by the smallholder farmer and herders. Given the existence of 'public good' values, positive incentives are required to ensure socially desirable levels of agrobiodiversity conservation and use. Agrobiodiversity-related payments for ecosystem services – in cash and in kind, to individuals as well as communities – can provide such incentives in a cost-efficient and pro-poor way. Support has to be cleverly planned, involving a mix of different incentive mechanisms, adjusted to the specific context.

Governments, non-governmental organisations, multilateral agencies, private companies, academic institutions, and independent experts need to cooperate to promote conservation finance solutions through exchanging information and expertise and developing studies and tools.



Photos: © Christine Martins

Photos, l.t.r.: © Sylvia Reinhardt; © GIZ/Florian Kopp

Contact person

Friederike Kraemer
naren@giz.de

Important links

- Bioversity International, Payments for Agrobiodiversity Conservation Services (PACS): www.bioversityinternational.org/pacs/
- Convention on Biological Diversity (CBD), Programme of work on incentive measures: www.cbd.int/incentives/background.shtml
- FAO Programme Incentives for Ecosystem Services in Agriculture (IES): www.fao.org/nr/aboutnr/incentives-for-ecosystem-services/en
- Sector Project Sustainable Agriculture (NAREN): www.giz.de/sustainable-agriculture
- Sector Project ValuES: www.aboutvalues.net

Further information

- Bioversity International, 2013: No free lunches: PES and the funding of agricultural biodiversity conservation – Insights from a competitive tender for quinoa-related conservation services in Bolivia and Peru. www.fao.org/fileadmin/user_upload/pes-project/docs/FAO_RPE-PES_Bioversity_BoliviaPeru.pdf
- CBD, 2011: Incentive measures for the conservation and sustainable use of biological diversity – Case studies and lessons learned. www.cbd.int/doc/publications/cbd-ts-56-en.pdf
- FAO, 2011: Payment for ecosystem services and food security. www.fao.org/docrep/014/i2100e/i2100e00.htm
- GCP, 2012: The Little Biodiversity Finance Book – A guide to proactive investment in natural capital. Global Canopy Programme. globalcanopy.org/materials/little-biodiversity-finance-book
- GIZ, 2011: Bezahlung von Ökosystemleistungen für den Erhalt der landwirtschaftlichen genetischen Vielfalt – Konzepte, Erfahrungen und Relevanz für die Entwicklungszusammenarbeit. www.giz.de/fachexpertise/downloads/giz2011-de-agrobiodiv-bezahlung-von-oekosystemleistungen.pdf
- IPBES, 2016: Pollinators, Pollination and Food Production. Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services (in preparation).

Published by
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Registered offices
Bonn and Eschborn, Germany

Sector Project Sustainable Agriculture (NAREN)
Friedrich-Ebert-Allee 36+40
53113 Bonn
T +49 (0) 228 44 60-0
F +49 (0) 228 44 60-0

Dag-Hammarskjöld-Weg 1-5
65760 Eschborn, Germany
T +49 (0) 6196 79 - 2359
F +49 (0) 6196 79 - 1115

naren@giz.de
www.giz.de/sustainable-agriculture

Author: Dr Christine Martins

Design: Ira Olaleye

As at: November 2015

GIZ is responsible for the content of this publication.

On behalf of: Federal Ministry for Economic Cooperation and Development (BMZ)

Special unit: 'ONE WORLD – No Hunger'

Addresses of the BMZ offices

BMZ Bonn
Dahlmannstraße 4
53113 Bonn, Germany
T +49 (0) 228 99 535 - 0
F +49 (0) 228 99 535 - 3500

BMZ Berlin
Stresemannstraße 94
10963 Berlin, Germany
T +49 (0) 30 18 535 - 0
F +49 (0) 30 18 535 - 2501

poststelle@bmz.bund.de
www.bmz.de

german cooperation
DEUTSCHE ZUSAMMENARBEIT

Published by:

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Adding value to agrobiodiversity

At a time when a growing world population needs to be fed on limited resources in a changing climate, the conservation and sustainable use of agricultural biological diversity gains utmost importance. Agrobiodiversity plays a crucial role in food security and nutrition, as well as in the provision of environmental services and livelihoods. It is critical to the sustainability, resilience and adaptability of agricultural production systems. To promote awareness and share knowledge on conservation and the sustainable use of agrobiodiversity, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ), has published this series of agrobiodiversity factsheets.

The present factsheet introduces the topic of market incentives for the conservation and sustainable use of agrobiodiversity. Adding value to agrobiodiversity products through the development of value chains and niche markets, partnerships with the private sector, and certification – for example, according to geographical designation – can motivate farmers to continue cultivating traditional crop varieties or keep rare local livestock breeds and conserve agrobiodiversity by using it.

What is agrobiodiversity?

Agricultural biodiversity includes all components of biological diversity of relevance to food and agriculture, and all components of biological diversity that constitute the agricultural ecosystems: the variety and variability of animals, plants and micro-organisms, at the genetic, species and ecosystem levels, which are necessary to sustain key functions of the agro-ecosystem. Agrobiodiversity is the outcome of the interactions among genetic resources, the environment and the management systems and practices used by farmers and herders. It has developed over millennia, as a result of both natural selection and human interventions.

Market incentives for agrobiodiversity conservation

Throughout the world and over centuries, small-scale farmers and livestock keepers have developed crops and animal breeds that are well suited to their local conditions. These crops and breeds are hardy and disease-resistant. They can survive in hostile environments and continue producing reliable yields where modern, often imported crop varieties and breeds fail without significant external inputs. They enable people to earn a living in otherwise inhospitable areas. These crop varieties and breeds are in danger of disappearing, pushed away by modern plant varieties, livestock breeds and production techniques. Valuable genetics for future breeding efforts are being lost. Incentives for farmers are needed so that they maintain important agrobiodiversity on farm. For further information on incentives for agrobiodiversity conservation, see box next page, Thies (2000): Incentive measures appropriate to enhance conservation and sustainable use of agrobiodiversity, and the GIZ factsheet (in the present text, GIZ factsheets, hyperlinked, are marked with ▶):

▶ *GIZ, 2015: Incentives for agrobiodiversity conservation*

Market incentives are one way to support farmers in their efforts of conservation and sustainable use of agrobiodiversity. To add value to so-far underutilized crops and livestock breeds and derived products will generate income for producers. This income, in turn, makes cultivation and conservation of these species more interesting (protection through use). There are many examples of how the diversity of crops and animal breeds could be promoted through market initiatives:

GIZ, 2007: Promoting the diversity of useful plants and animal breeds through marketing:

▶ *The example of potato diversity in the Andes*
▶ *Example: Fine flavour cocoa from Ecuador*
▶ *The example of argan trees in Morocco*
▶ *The example of the Schwäbisch-Hällisches Landschwein pig*



Photos, l.t.r.: © Christine Martins; © Heinz-Josef Heile; © Ouyang Lina

Incentive measures for conservation and sustainable use of (agro-)biodiversity

- Market incentives: access to markets and differentiation of products in markets
- Social incentives: enhancement of human capital (skills, knowledge and abilities) and social capital (a supportive and cohesive environment that fosters the adoption of sustainable practices throughout a value chain)
- Financial incentives: facilitation of access to finance or financial compensation for sustainable practices
- Physical incentives: enhancement of production facilities, access to equipment and transport
- Property rights: access and rights to own, use or manage biodiversity resources that are defined by public measures
- Fiscal incentives: budgetary measures such as taxes and subsidies.

(Source: UNCTAD, 2014)

Value chains promoting agrobiodiversity

Products from rare and useful plants and animals whose existence is at risk – so-called agrobiodiversity products – can provide numerous opportunities for value chain development. Successful marketing gives the producers and breeders of such rare plant varieties and animal breeds an incentive to continue conserving them. In order to provide economic returns on agrobiodiversity conservation, suitable agrobiodiversity crops and animal products with economic potential should be identified. Possible steps for strengthening value chains of agrobiodiversity products are listed in the box below.

The most important elements of an agrobiodiversity-supporting value chain are

- **The original product:** The degree to which a value chain contributes to conserving agrobiodiversity depends on the diversity of the original product.
- **The number of producers and suppliers of the original product:** The presence of many small producers in the value chain favours the conservation of agrobiodiversity.
- **The market power of the buyers (individual consumers or large buyers):** If a value chain is dominated by a few large buyers, this may have either a positive or a negative effect on the conservation of diversity, depending on their behaviour.
- **The length of the value chain itself:** Short value chains are more suitable for the conservation of agrobiodiversity than long ones.
- **The number of parallel value chains for an original product:** Several parallel value chains for an original product offer a better opportunity for opening up new markets for agrobiodiversity products than is the case with only one value chain.

What is a value chain?

A value chain comprises all activities, stakeholders and processes involved from the primary production of a product (producers), the subsequent processing steps (processors), the marketing to wholesalers and retailers (traders, middlemen) and, finally, the consumption of the product (consumers). At each step, the product gains additional value, which on the one hand has to be high enough to satisfy the participants in the value chain and on the other hand low enough to keep the product competitive in the market. The analysis of the value chain allows insights with regard to concerned actors, the processes and division of labour, the involved quantities of products and the distribution of costs, benefits and power.

Understanding the markets, the products and the production systems is part of promoting sustainable agrobiodiversity products. It is useful to differentiate market segments: the market in industrialized and the market in developing countries; the market of the well-to-do and the market of the less-well-off. Product interest of the consumers and their behaviour in these market segments varies, offering different opportunities and requiring different approaches if marketing opportunities are to be utilized and translated into incentives for sustainable use and conservation of agrobiodiversity.

Agrobiodiversity products can attract potential buyers who are interested in cultural diversity and values, novelty, health food, and environment. Producers should focus on the unique qualities of agrobiodiversity products for which consumers

Possible steps for strengthening value chains of agrobiodiversity products

- Field survey for identification of possible marketable agrobiodiversity products, considering such specifications as: taste, colour, appearance, measurements, weights, level of standardisation, packaging requirements and distribution channels
- Market survey on the demand for high-value speciality products
- Training in value chain analysis and marketing for local farmers (male and female); support of producer networks
- Identification of private businesses interested in marketing agrobiodiversity products
- Introduction of small scale (primary) processing facilities for farmers, e.g. drying facility for fruits and vegetables
- Development of a local brand, or establishment of a national eco-label
- Quality assurance
- Special events like festivals or 'agrobiodiversity-selling days' for product promotion

might be willing to pay more. For unique local products of a low quantity, the primary focus in order to maximise marketability could be the production methods (which can include organically grown products), nutritional value, regional provenance and associated product stories. However, the premium price that the market demands for high product-standards, processing and packaging requires a constant supply, and needs relatively large volumes of uniform quality.

It is important to make use of all the stakeholders involved – producers, governments, international, regional and national trade bodies, the private sector and, most important, consumers. Consumers are the most crucial stakeholder as they determine what sells and what does not, and the price that is paid for the goods. Recent consumer trends such as the increased demand for vegetarian and vegan food or the slow-food movement (see slowfood.com) also offer options for agrobiodiversity products. Further information on value chain promotion and (agro-)biodiversity can be found in Will (2008) and

▶ *GIZ, 2007: Value chains and the conservation of biodiversity*

Value chain development training in China

In a Chinese-German cooperation project on sustainable management of agrobiodiversity in mountain regions in Southern China, farmers have been supported in promoting marketable traditional varieties. They received training on the value chain concept, how to perform a thorough value chain analysis, and marketing strategies and tools, as well as pricing and negotiation skills. Focus was on developing basic business and marketing skills, improving product quality, forming farmer cooperatives to improve their position in negotiations, and generally maximising profit in all areas of production. Farmers analysed the value chains of selected local crop varieties, developed action plans for placing them on the market and identified areas in which external support was needed (Feng, 2011).

Impacts of value addition to agrobiodiversity products – cocoa from Ecuador

The impacts of value addition to agrobiodiversity products occur on the social, the economic and the environmental level, as shown in the case of cocoa production in Ecuador. In Ecuador, the local premium cocoa was endangered by being replaced through higher-yielding consumer cocoa varieties. In order to promote premium cocoa, local cocoa producer cooperatives were strengthened and all actors of the cocoa value chain were interlinked as part of the National Cocoa Export Promotion Programme. The quality of the local premium cocoa variety 'Nacional' was improved, the producers certified and contacts between premium chocolate producers and cooperatives were established. Within three years, 19,500 ha of 'Nacional Cocoa' were certified under Fairtrade and Rainforest Alliance standards. 4,000 farmers received access to the international bio- and fair-trade certified market with an export volume of 1,880 t of cocoa. The farmers receive 30 % higher prices for their cocoa, which triggers further positive changes in their livelihoods such as better health, education, housing, and reduced temporary migration. The production of cocoa in traditional intercropping systems with shade trees protects the natural forest ecosystem with its large diversity. Logging has much decreased in the area.

Niche markets

Finding niche markets for agrobiodiversity products is one possible way of ensuring the survival of locally adapted crop varieties and animal breeds. It enables farmers to earn more with their current production system. A niche market is a market segment that addresses a need for a product or service not being met by mainstream suppliers. It has a narrowly defined group of potential customers. It usually develops when a potential demand for a product or service is not being met by any supply, or when a new demand arises because of changes in society, technology or the environment. Despite the fact that niche markets are by their nature very limited in volume as compared with the mainstream market, they may be very profitable due to specialization and focusing on small and easily identified market segments.

Value chain development training in China: Analysing the value chains of agrobiodiversity products to identify options for action.

Photos: © Nina Seib

Exploring niche markets for adding value to livestock diversity

- Use existing resources, identify a suitable entry point, start small
- Do the research (on production system, potential product and market/potential customers)
- Identify special characteristics of the breed (create new products, refine existing traditional products, or find new markets for existing products)
- Find a viable business model, focus on quality, build capacity
- Do not put all your eggs in one basket, but address a range of products and markets.

(Source: FAO, 2010)

Development partnerships with the private sector

Agrobiodiversity products provide numerous opportunities for private sector involvement. Marketing these products and promoting agricultural biological diversity enables companies to gain access to new groups of customers, make more profit and build up an image of being ecologically and socially responsible. Sustainability and the protection of agrobiodiversity is a huge business opportunity. A growing middle-class in developing and transition countries are becoming more aware of environmental issues and are increasingly looking for 'healthy' ecologic products. Companies should consider these issues in their business models, decisions, sourcing and production methods.

Different forms of cooperation are possible between private companies and development initiatives that support the sustainable production, processing and marketing of agrobiodiversity products. Development partnerships with the private sector, also called public-private partnerships (PPP), enable the public and the private partners involved to combine their individual strengths. PPP projects are jointly planned, financed and implemented. For further information, see the Global Partnership on Business and Biodiversity of the Convention of Biodiversity (CBD) and

- *GIZ, 2007: Partnerships for agrobiodiversity*
- *GIZ, 2007: Promoting the diversity of crop plants and animal breeds through marketing. Example: Fine flavour cocoa from Ecuador*

BioTrade Initiative

Since its launch by the United Nations Conference on Trade and Development (UNCTAD) in 1996, the BioTrade Initiative has been promoting sustainable bio-trade in support of the objectives of the CBD. The Initiative has developed a number of regional and country programmes. Since 2003, the BioTrade Initiative also hosts the BioTrade Facilitation Programme (BTFP) which promotes contacts between suppliers of biodiversity products in developing countries and buyers in industrialized countries, focussing on enhancing sustainable bio-resource management, product development, value adding processing and marketing (see BioTrade Initiative and BTFP).

Standards and certification schemes

With certification it is possible to achieve a 'recognizable' product, distinct from others, which can point to its additional value (more healthy, better taste, produced/processed in a particular way, by particular people, in a particular region). High quality standards help to differentiate the certified products from the rest of the market segment. Certification, special labels and brand names can make use of the 'distinctiveness' of agrobiodiversity products and help conserve agricultural diversity. Support programmes might promote certification of origin, the production of organic products, and aim to add value to products by other standards such as Fairtrade or FairWild (see boxes next page). However, certification of agrobiodiversity products requires careful planning and organization.

Organic products

Many small-scale farmers in Africa and elsewhere are producing 'organically' because they just cannot access or afford the use of external inputs. This is also the reason why many farmers prefer to plant local varieties and use local animal breeds: these tend to be better adapted to low input levels. Often, they are also better able to tolerate local pests, diseases and other stresses, which makes it possible to produce without external inputs. Local varieties and animal breeds are usually highly valued by local people for their excellent taste and nutritious value. This makes these products excellent organically produced health food items. Certification as organic product is a means to obtain higher prices; however, there are different certification standards, the certification process is complex, is often expensive, requires time, and product standards have to be guaranteed, especially for export markets.

Fairtrade

Fairtrade is an alternative approach to conventional trade. It is based on a partnership between producers and consumers. When farmers can sell on Fairtrade terms, it provides them with a better deal and improved terms of trade. Fairtrade standards are designed to support the sustainable development of small producer organizations in developing countries. Fairtrade standards distinguish between core requirements, which producers must meet to be certified, and development requirements that encourage producers to continuously improve and to invest in the development of their organizations. The concept is developed to encourage sustainable, social, economic and environmental development of producers and their organizations (see Fairtrade).

FairWild

The FairWild Standard was developed to help ensure that wild medicinal plant products are produced sustainably and ethically. It originated from the International Standard for Sustainable Wild Collection of Medicinal and Aromatic Plants (ISSC-MAP). The FairWild Standard applies to wild plant collection operations wishing to demonstrate their commitment to sustainable collection, social responsibility and fair trade principles. It allows for traceability and transparency, as well as improved product safety. The FairWild certification is based on a completed species resource assessment, species management plan, established sustainable collecting practices (including collectors' trainings), transparent cost calculation along the supply chain, traceability of goods and finances and documented fair trading practices. On-site annual audit by a third party certification system is compulsory for the certification.

- *GIZ, 2012: Collection of Wild Plants in the Caucasus – FairWild as Alternative Management and Trade Model*

Geographical indications of origin

Geographical indications of origin provide the consumer with information about quality characteristics of a product that are closely associated with its place of origin, thereby distinguishing it from products of different provenance. Geographical site conditions such as soil quality, vegetation and climate, as well as traditional knowledge on how local plants and animals can be used and processed, provide products with unique selling points. In purchasing the product, the consumer acquires not only quality but a piece of local culture, authenticity and reputation.

In an ideal situation, the protection afforded by geographical indications of origin contributes to the attainment of economic, environmental and social objectives. In contrast to private-sector certification schemes, product differentiation by means of geographical indication is intended to benefit a region rather than individual businesses and to promote the economic capacity, special environmental features and cultural identity of that region. A geographic seal of origin should, if possible, cover the marketing of a number of plant varieties or animal breeds; however, the uniqueness of the products must be maintained.

Many countries have their own certification systems and labels to protect geographical indications of origin, such as the 'appellation d'origine contrôlée' (AOC) used in France, and the 'denominazione di origine controllata' (DOC) used in Italy. The EU employs three different protected status schemes to encourage diverse agricultural production, protect product names from misuse and imitation, and help consumers by giving them information concerning the specific character of the products (see box below). Non-EU members can also register their products.

The approach of employing geographical indications of origin has been utilised successfully in development cooperation, for example in marketing the products of the argan tree in Morocco. For further information, see Larson (2007), CTA (2013), and

- *GIZ, 2007: Creating value from products with protected designations to conserve agricultural diversity*
- *GIZ, 2011: Intellectual Property Rights and Rural Development: Protection of Geographical Indications of Origin of Agricultural Products*

Geographical indications and traditional specialities in the EU

- **Protected Designation of Origin (PDO):** covers agricultural products which are produced, processed and prepared in a given geographical area using recognised know-how. In September 2015, there were 594 product names registered as PDO, for example Prosciutto di Parma, Gorgonzola, Parmigiano-Reggiano, Camenbert, Roquefort and Champagne.
- **Protected Geographical Indication (PGI):** covers agricultural products closely linked to the geographical area. At least one of the stages of production, processing or preparation must take place within a defined geographical area. In September 2015, there were 647 product names registered as PGI, including Gouda Holland and Esrom cheese as well as Darjeeling tea.
- **Traditional Speciality Guaranteed (TSG):** indicates that the product is of traditional composition or produced by a traditional process. In September 2015, 50 product names had been awarded TSG status, including Mozzarella and Pizza Napoletana.

Note: All registered products are listed in the Commission's online database DOOR.

Photos: © GIZ

Contact person

Dr Alberto Camacho Henriquez
naren@giz.de

Outlook

Adding economic value to products derived from agrobiodiversity can serve as an incentive for smallholder farmers and livestock keepers to continue growing traditional crops and raising rare local livestock breeds which are threatened with extinction, pushed aside by modern plant varieties and exotic breeds. This can lead to the conservation and sustainable use of agrobiodiversity as well as improved livelihoods. The genetic resources are used and, thus, do not get lost (slogan 'use it or lose it').

The success of adding value to agrobiodiversity products can attract public investments in the development and conservation of the entire stock of neglected and underutilized local species, thereby safeguarding the related agrobiodiversity ecosystem services. There are different opportunities available to add value to agrobiodiversity products – the challenge is to make use of them.

Important links

- BioTrade Initiative: www.biotrade.org
- Global Partnership on Business and Biodiversity: www.cbd.int/business/gp.shtml
- Global Platform on Business and Biodiversity: www.cbd.int/business
- Sector Project Sustainable Agriculture (NAREN): www.giz.de/sustainable-agriculture

Further information

- FAO, 2010: Adding value to livestock diversity. www.fao.org/docrep/012/i1283e/i1283e.pdf
- Feng, Yingli, 2011: Adding value to 'agrobiodiversity products'. In: Seib, Nina (ed.), 2011: Best Practices – Sino-German Project on Sustainable Management of Agrobiodiversity. GIZ, Beijing. www.giz.de/fachexpertise/downloads/giz2011-en-agrobiodiv-best-practices.pdf
- GIZ, 2014: Biotrade training manual. www.giz.de/expertise/downloads/giz2014-en-Biotrade_Training_Manual.pdf
- Nill, Dieter, 2011: Value Addition of Underutilized Crops or Animals. In: Waldmueller, Luis (ed.): Training of Trainers Sourcebook on Conservation and Management of Agrobiodiversity in the People's Republic of China. GIZ, Beijing. star-www.giz.de/dokumente/bib-2011/giz2011-0382en-agrobiodiv-training-trainer.pdf
- UNCTAD, 2014: The Business of BioTrade: Using biological resources sustainably and responsibly. www.biotrade.org/ResourcesPublications/UNCTAD_DITC_BCC_2009_4.pdf
- Will, Margret, 2008: Promoting Value Chains of Neglected and Underutilized Species for Pro-Poor Growth and Biodiversity Conservation. Guidelines and Good Practices. Global Facilitation Unit for Underutilized Species. www.underutilized-species.org/Documents/PUBLICATIONS/promoting_vc.pdf

Published by	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH Registered offices Bonn and Eschborn, Germany Sector Project Sustainable Agriculture (NAREN) Friedrich-Ebert-Allee 36+40 53113 Bonn T +49 (0) 228 44 60-0 F +49 (0) 228 44 60-0 naren@giz.de www.giz.de/sustainable-agriculture	 Dag-Hammarskjöld-Weg 1-5 65760 Eschborn, Germany T +49 (0)6196 79 - 2359 F +49 (0)6196 79 - 1115
Author	Dr Christine Martins	
Design	Ira Olaleye	
As at	November 2015	

On behalf of	Federal Ministry for Economic Cooperation and Development (BMZ)	
Special unit	'ONE WORLD – No Hunger'	
Addresses of the BMZ offices	BMZ Bonn Dahlmannstraße 4 53113 Bonn, Germany T +49 (0)228 99 535 - 0 F +49 (0)228 99 535 - 3500 poststelle@bmz.bund.de www.bmz.de	BMZ Berlin Stresemannstraße 94 10963 Berlin, Germany T +49 (0)30 18 535 - 0 F +49 (0)30 18 535 - 2501

GIZ is responsible for the content of this publication.

german cooperation
DEUTSCHE ZUSAMMENARBEIT

Published by:
giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Agrobiodiversity for survival

At a time when a growing world population needs to be fed on limited resources in a changing climate, the conservation and sustainable use of agricultural biological diversity gains utmost importance. Agrobiodiversity plays a crucial role in food security and nutrition, as well as in the provision of environmental services and livelihoods. It is critical to the sustainability, resilience and adaptability of agricultural production systems. To promote awareness and share knowledge on conservation and the sustainable use of agrobiodiversity, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ), has published this series of agrobiodiversity factsheets.

What is agrobiodiversity?

Agricultural biodiversity includes all components of biological diversity of relevance to food and agriculture, and all components of biological diversity that constitute the agricultural ecosystems: the variety and variability of animals, plants and micro-organisms, at the genetic, species and ecosystem levels, which are necessary to sustain key functions of the agro-ecosystem. Agrobiodiversity is the outcome of the interactions among genetic resources, the environment and the management systems and practices used by farmers and herders. It has developed over millennia, as a result of both natural selection and human interventions.

The present factsheet shows how agrobiodiversity provides food and nutrition from marginal land, and how it can buffer against short-term and long-lasting climate variations, as well as its contributions to human health. It discusses the complex relations between agrobiodiversity, disasters and emergency aid. The present loss of agrobiodiversity urgently needs to be halted.

Features of agrobiodiversity for survival

Agrobiodiversity plays an important role for survival, for individual households but also for humankind – at present and in future. The broad diversity of cultivated varieties, breeds and species not only contributes to food security, but also safeguards the productivity and adaptability of crops and livestock breeds. Stable ecosystems are the very basis of human survival, far beyond their defined geographical boundaries – for instance as the most important 'producers' of clean water, fertile soil and oxygen.

Agrobiodiversity enables us to make use of environments which are inhospitable to human beings, and reduces the risks posed by pest and disease infestation, as well as changes in environmental conditions, such as floods and periods of drought. Medicinal plants can provide ingredients for basic health care. Agrobiodiversity can help to better cope with HIV/AIDS. However, disasters and emergency aid can affect agrobiodiversity – all this will be explained in the text below.

Utilization of marginal land

Over the centuries, smallholder farmers and livestock keepers all over the world have succeeded in breeding plant varieties and animal breeds which are well adapted to their respective local environments, which can survive under harsh conditions, in remote locations, without or few external inputs. Their special characteristics allow us to make use of areas where other forms of agriculture would not be possible. At the same time, the productivity and adaptability of crops and breeds is maintained.

Local crop varieties can still be productive in areas with short vegetation period, salty soils, cold temperatures, or irregular and low rainfall patterns. During droughts and scarce food


Photos, l.t.r.: © Christine Martins: © GIZ/Dirk Ostermeier supply, traditional plant varieties are often vitally important for rural people. In arid as well as high mountainous areas, adapted livestock are the only sustainable option for food and income production as well as an important means of transport. Modern, high-yielding varieties and breeds are often less productive in uncertain, harsh and low-input environments, and will do even less so when the weather conditions get more erratic and extreme.

Ruminants such as cattle, sheep and goats, and also yaks in the Himalaya, as well as lamas, vicunas and alpacas in the Andes, make use of areas where, due to low rainfall or high altitude, plant production is not possible. The digestive system of ruminants allows the utilization of food (fibrous plant material, roughage, cellulose) which monogastric animals such as swine and poultry cannot digest. Ruminants also have the advantage that they roam around to find their food and can be moved to different areas, such as high altitudes in summer and valley bottoms in winter, or from low-rainfall areas to areas with better grazing. Mixed flocks of different livestock breeds and species allow an optimum use of different natural resources.

Especially in drylands, agrobiodiversity plays an important role. Many dryland inhabitants are poor and depend on local plants and animals for their survival, food and income. The world's 190 million pastoralists have adapted especially well to dryland conditions. The breeds they have developed and their mobile herding strategies enable them to produce food in areas too dry for cropping. However, land-use patterns as well as social and economic conditions are changing rapidly, promoting the intensification and expansion of cropping and livestock keeping and the expansion of areas for nature conservation. Overuse of resources and inappropriate land use lead to competition for resources (grassland, water), degraded soils, desertification and the loss of biodiversity.

Food crops from drylands

Numerous food crops of global importance originate from drylands. The list includes maize, beans, tomato and potatoes from Mexico, Peru, Bolivia and Chile; and wheat, rice, barley, millet, sorghum, lentils, chickpeas, and many fruit trees such as olives, dates, figs, pistachios, almonds and plums from North Africa, Central and West Asia and the Mediterranean. The gene banks at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and the International Center for Agricultural Research in the Dry Areas (ICARDA) have more than 119,000 and 131,000 accessions, respectively, from about 144 countries – cereals, food and feed legumes and forages, including cultivated varieties, landraces and wild relative species. Such gene bank holdings can be vital when diseases, conflicts and other disasters destroy the natural resource base.

Stable dryland ecosystems and agrobiodiversity are essential for dryland communities to overcome their poverty or maintain subsistence. A major challenge is how to facilitate agricultural growth without endangering the resource base. Communities are expert, but need support and conducive conditions to continue their sustainable use and conservation of dryland agrobiodiversity while getting out of poverty. For more information, see the GIZ factsheet (in the present text, GIZ factsheets, hyperlinked, are marked with ▸):

▸ *GIZ, 2011: Agrobiodiversity in drylands*

Agrobiodiversity and climate change

Agrobiodiversity and climate change are closely interrelated; they influence each other in many ways. Climate change – the rise in temperature, changes in rainfall patterns, higher incidence of extreme weather events and the increase of greenhouse gases in the atmosphere – is one of many factors reducing the diversity of crops and livestock and affecting the livelihood of the rural poor.

On the other hand, agrobiodiversity is the key for coping with climate change, at present and, even more importantly, in future (FAO, 2015a; FAO, 2015b).

The rise in temperature – commonly known as global warming – is probably the most obvious phenomenon of climate change. Temperature increase is expected to be highest in the tropics and subtropics, and the anticipated consequences there will be large-scale extinction of varieties, breeds and species, lower agricultural yields and a major change in these cropping systems. Indirect temperature effects will also be significant, including increased evaporation of water from the soil, accelerated decomposition of organic matter, and increased incidence of pests and diseases affecting both animals and plants.

Rainfall in the tropics and subtropics is expected to be reduced, but seasonal and regional rainfall irregularity and intensity will increase. Drought-tolerant plant varieties will become more important and, in extreme dry areas, camels will increasingly replace cattle. The increase of greenhouse gases will destruct the ozone layer which is expected to reduce crop yields, increase rates of pests and diseases in plants and animals and increase the incidence and severity of sunburn in animals.

However, agricultural genetic resources are not only a victim of climate change; they are of fundamental importance for adaptation to this change and are crucial to coping with the problems it poses. The *ex situ* conservation of seeds, involving storage in gene banks or botanical gardens, is essential but not sufficient. Broader and better integrated conservation schemes are needed that rely primarily on *in situ* concepts – the conservation and breeding of genetic resources by farmers and farming communities on their farms and in their villages.

Coffee adapting to climate change

Coffee is one of the world's most important export crops. Coffee requires very specific growing conditions. It is particularly sensitive to changes in seasonal temperatures and rainfall. Research findings and reports from producers in Kenya, Mexico, Peru and Nicaragua show production losses because of prolonged drought, changes in the forms of the seasonal climate, and increased crop diseases and pests. Modelling calculations indicate that by 2020 coffee yields in Mexico will decline by one-third, due large areas becoming unprofitable for coffee cultivation.

Because of the warming, the areas suitable for coffee production will shrink and shift to other locations. Production will have to move to higher altitudes – if suitable land is available. In Uganda, for example, such areas are not available and the coffee production area will decline significantly; coffee farmers will have to switch to other crops. The shift in cultivation to higher altitudes is likely to result in clearing the mountain forest, threatening wild coffee varieties and other species. At lower altitudes, the replacement of coffee plantations with other crops will affect the environmental services of these areas, such as regulation of water resources, local climate, soil cover and fire protection which, in turn, could reduce food security.

30 million coffee farmers around the world are likely to suffer declines in coffee yield because of the changing climate. The expected changes in coffee cultivation will have consequences for the entire coffee value chain – from producers, through processors and marketers, to consumers. Coffee supplies will change radically, as will investment in old and new cultivation areas. This will in turn influence service providers, the regional distribution of employment, foreign exchange earnings, and national budgets. Consumers are likely to feel the effects in the form of higher prices.

Serious impacts of the changed climate are expected in Ethiopia. Ethiopia has a unique genetic diversity of cultivated, semi-wild and wild Arabica varieties with different types of disease resistance, environmental adaptations and quality characteristics. This natural diversity is the basis for breeding coffee varieties that are adapted to the changed climate. Climate change is expected to reduce this diversity considerably.

GIZ, 2011: Agrobiodiversity and adapting to climate change: The example of coffee

Plants, animals and ecosystems have the capacity to adjust to changes in factors such as heat, drought or salinity, and this enables us to cope with the consequences of changing environments. This capacity is an outcome of genetic diversity. The resistance of plants to environmental stress (e.g. drought tolerance) is a multi-genetic characteristic. It is best developed through classical breeding under *in situ* conditions. Such adaption processes, which address regional and local agro-ecological variations and offer site-specific solutions, contrast with commercial seed companies, which aim at mass-production of standardised varieties or a technology for one production system which suits large areas.

GIZ, 2006: Agrobiodiversity and climate change – A complex relationship

Agrobiodiversity and human health

Through its influences in and around agricultural production systems, agrobiodiversity contributes essentially to food security and health. It is the source of the components of production and the genetic diversity within these systems that ensures continuing improvements in food production, allows adaptation to current needs and ensures adaptability to future ones. It is also essential for agricultural production systems, underpinning ecosystem services such as pollination, pest control, nutrient cycling, erosion control and water supply. Pollinators play a significant role in the production of approximately one third of global food supply. Pollination is essential to food security generally and to the production of many of the most nutritious foods in particular (see the IPBES study on pollinators, pollination and food production, forthcoming).

Ethiopia is the centre of origin of coffee. Left: Coffee is an important part of Ethiopian culture. Right: On the way to Yayu Coffee Forest Biosphere Reserve, Illubabor Zone, Oromia Regional State, Ethiopia, one of the last remaining montane rainforest fragments with wild Coffea arabica populations in the world, designated as UNESCO biosphere reserve in 2010 in order to conserve and sustainably use the wild Arabica coffee populations.

How can agrobiodiversity help in the fight against climate change?

One of the main challenges that farmers have in the context of climate change is its unpredictability. Farmers can no longer rely on the timing of seasons and the availability of rainfall through the year. Using agrobiodiversity in the fight against climate change is about responding to variety with variety. Diversity can help farmers mitigate, adapt and ensure food and nutrition security, by providing them with more options to manage climatic risks, and strengthen the resilience of their farms and the surrounding ecosystems and landscapes. Examples for such options are:

- **At the genetic level:** Different crop varieties can be used to deal with climate-induced stress and unpredictability. Planting different varieties, including drought-tolerant varieties with different flowering times, can reduce the risk of a farmer losing all of a crop in sudden climatic events. Some local varieties are hardier and better able to cope with poor soil or little water. Farmers can use these varieties to profit from areas they would otherwise struggle to cultivate.
- **At the species level:** Different crops and livestock respond differently to environmental stresses such as heat, drought, frost and salinisation. Having different species on farm prevents farmers from losing everything – some species will deal with unpredictable shocks better than others. In general, mixed crop and crop-livestock systems provide opportunities for synergy and strengthen the resilience of a farm. Nitrogen-fixing legumes and trees not only keep soils fertile, but can act as windbreaks to mitigate strong winds and soil erosion from heavy rains. Livestock can be fed with biomass from crop parts that humans do not eat and, in return, provide fertilizer for crops in the form of manure, reducing the need for chemical inputs.
- **At the ecosystem and landscape level:** Diverse sources of food and smarter seasonal planting help communities cope with 'hungry' seasons. A landscape with many different land uses helps communities and their ecosystems deal with shocks. Forests store carbon, but also reduce soil erosion, runoff and landslides during storms. Managing water, land and soil at a larger scale with practices such as terracing or storage reservoirs can help buffer the impacts of climate stress.

Source: Bioversity International (2015)

The loss of diversity from agro-ecosystems increases the vulnerability and reduces the sustainability of many production systems and has negative effects on human health.

Medicinal plants

Even today, the majority of the world's population depends on traditional medicine and, thus, on the use of plants and plant extracts. This is especially true for the population in developing countries, because natural remedies are not only cheaper than modern medicines but are often the only medicine available in remote rural areas. Medicinal plants are collected from the wild or planted in fields and home gardens, in most cases by women. Medicinal plants are easily integrated into fields with traditional crops such as maize, beans and vegetables. The different harvest times enable the farmers to distribute their income more equally over the entire year. The gathering of wild medicinal herbs frequently provides socially and economically disadvantaged groups such as smallholders and landless shepherds with their only form of cash income. Small-scale traders and industries also benefit from being able to buy dried medicinal plants and process them into teas, ointments and tinctures for not only the local but also the international markets.

▶ *GIZ, 2008: Medicinal Plants – Biodiversity for health care*

The use of chemical inputs, particularly pesticides, can have severe negative consequences for wildlife, human health and for agrobiodiversity. Increasing sustainable production and meeting the challenges associated with climate change will require the increased use of agricultural biodiversity (CBD and WHO, 2015).

Agrobiodiversity and HIV/AIDS

About 70 % of all people living with HIV/AIDS live in sub-Saharan Africa, despite accounting for just 10 % of the world's population. The epidemic has tremendous effects on the continent, in economic, social and environmental aspects – the workforce is dying, agricultural production is declining, knowledge is being lost, poverty and hunger among the rural population is increasing. Agrobiodiversity is affected by HIV/AIDS and, at the same time, it affects the situation of those infected with HIV/AIDS.

Many studies have shown that HIV/AIDS accelerates the loss of indigenous knowledge and, thus, also the loss of agrobiodiversity. As the traditional way of passing on knowledge while working together is interrupted, traditional knowledge is often not passed from HIV/AIDS-infected parents to their children. Emergency sales of livestock for payment of drugs, food and funerals diminish the genetic base of farm animals.

Species diversity provides rural households affected by HIV/AIDS with the opportunity to both respond to the distinctive labour situation and ensure that all members of the family receive – as far as possible – adequate and balanced nutrition. Traditional, neglected or little-used plants are particularly suited to this purpose. They are adapted to the soil and climate, and often require less work than modern varieties; furthermore, women know how to use them, which is especially important when the husband has died.

Macronutrient and micronutrient deficiency in the diet of HIV-infected people increase the risk of infections and lead to higher mortality. Sufficient and well-balanced nutrition can maintain body weight and physical capabilities and strengthen the body's defences. The timespan between infection with HIV and the onset of AIDS can be extended. A good diet helps to prevent the illnesses and complications that often occur with HIV infection, for example, fungal diseases, herpes, lung infections, tuberculosis, diarrhoea, oral infections, nausea and vomiting. Malnutrition weakens the physical barriers and the immune defences of the mucous membranes, allowing better entry possibilities for the virus. A healthy and balanced diet is an important prerequisite for the optimal function of the immune system and is essential for successful antiretroviral treatment.

With a varied and carefully chosen mixture of plants and some animals, small farmers can make the best possible use of their land, minimise the risks posed by drought or plant diseases and improve the nutrition of their families. Good, healthy nutrition enables those affected to lead a longer, healthier and more productive life. The existing agrobiodiversity and the associated indigenous knowledge provide an opportunity for improving the living conditions of the rural population affected by HIV/AIDS. However, both genetic diversity and indigenous knowledge are subject to creeping erosion, which is being accelerated by the disease.

- *GIZ, 2006: Agrobiodiversity – an option for cushioning the consequences of HIV/AIDS*
- *GIZ, 2009: Nutrition security is key in the fight against HIV and AIDS*

Agrobiodiversity, disasters and emergency aid

Disasters affect agricultural production systems severely through the losses in plant and animal genetic diversity that accompany them. There are many consequences of either war or natural disaster, such as earthquakes, cyclones or tornadoes, floods and drought. Such crises affect agrobiodiversity differently, depending on the point at which disaster interrupts the agricultural production cycle and the duration of the interruption.

HIV/AIDS, sharecropping and agrobiodiversity

Gebreselassie et al. (2008) analysed the impact of HIV/AIDS on labour allocation, crop choice and agrobiodiversity in south-western Ethiopia. They found that HIV/AIDS caused households to increase sharecropping of their land and led to more crop species grown in the home garden. However, the impact of HIV/AIDS on labour allocation and crop diversity depended on the stage of the disease and on which family member is (or members are) affected. The observed increase in agrobiodiversity in the home garden indicates a potential that can be strengthened for improving nutrition in the context of HIV/AIDS, for example, through integrating nutrition education.

In addition, the extent of the disaster and whether all farms in a stricken region have suffered equal damage influence the consequences on agrobiodiversity. Genetic resource losses are particularly dramatic when population groups stay for prolonged periods of time in refugee camps outside of their home region's agro-climatic area.

Can seed aid do harm?

Seed interventions are the major agricultural response during emergency and recovery phases of humanitarian aid. They are implemented by diverse agencies, and widely promoted. However, seed aid suffers from a lack of critical attention, perpetuating widespread myths among practitioners, policymakers, and the larger humanitarian community. Sperling and McGuire (2010) have challenged prevalent myths about seed aid, among others, that seed aid could do no harm.

Experience on the ground contradicts this harmless image. Seed aid can pose real risks to farmers, for instance through providing the wrong crop or variety for the area, or providing it too late for farmers to sow. New diseases or pests can inadvertently be introduced. The practice of seed aid is littered with examples of this, where agencies provided long-maturing varieties when fast-maturing varieties were needed, introduced serious new weeds, introduced seeds unadapted to the stress area, or distributed seeds so unacceptable that farmers used the subsequent crop as fodder.

The promise of seed aid also poses risks to farmers, since this expectation of seed carries significant opportunity costs, such as farmers allocating precious labour to field preparation, or not seeking seeds elsewhere. If what they ultimately get from seed aid is late, or mal-adapted, they are worse off than if they had not received aid. Also, there is evidence that providing seed aid as a routine response over multiple seasons undermines the functioning of small-scale commercial seed enterprises and local markets.

Photos: © Christine Martins

Contact person

Carola von Morstein
naren@giz.de

There are direct effects of disasters and their indirect consequences. Depending upon the type of crisis, direct losses during disasters can considerably destroy seed stocks in the field or in stores as well as reduce farm animal populations. Impoverishment following disasters leads to the consumption of seed and farm animals as food when no alternative is available. In addition, relief measures sometimes displace local varieties and breeds. This happens when foreign genetic resources are introduced, or when seed and farm animals are distributed that are not as well adapted to local agro-climatic conditions as local genotypes are.

If food and seed aid are not coordinated, farmers may use grain received as food aid for sowing. This involves considerable risk, because the varietal characteristics and the degree of adaptation to local conditions are usually unknown. Furthermore, local varieties of crops such as millet or maize may be contaminated by cross-pollination. One way of avoiding such problems is to distribute foreign food aid in the form of processed products, for example as flour rather than as whole grain. In addition, food provided as emergency aid might influence local food habits, which might influence agrobiodiversity.

▶ *GIZ, 2006: A basis for a better future: Agrobiodiversity and emergency response*

Outlook

Genetic resources for food and agriculture are important for survival. Only a comprehensive and integrated approach can halt the present loss, and conserve and sustainably make use of agrobiodiversity. In order to ensure its conservation, all stakeholders need an increased understanding of the different aspects of agrobiodiversity. National and international law should better protect agrobiodiversity, supported by civil society, science and education as well as by the private sector. Local, national and international level interventions are needed, smartly interlinked and supporting each other.

Important links

- Sector Project Sustainable Agriculture (NAREN): www.giz.de/sustainable-agriculture
- United Nations Convention to Combat Desertification (UNCCD): www.unccd.int
- United Nations Framework Convention on Climate Change (UNFCCC): unfccc.int/2860.php

Further information

- Bioversity International, 2015: What can agricultural biodiversity do in the fight against climate change? www.bioversityinternational.org/e-library/publications/detail/what-can-agricultural-biodiversity-do-in-the-fight-against-climate-change
- BMZ and BMUB, 2014: Committed to Biodiversity – Germany's International Cooperation in Support of the Convention on Biological Diversity for Sustainable Development. www.bmz.de/en/publications/type_of_publication/information_flyer/information_brochures/Materialie238_Biodiversity.pdf
- CBD and WHO, 2015: Connecting global priorities: Biodiversity and human health. www.cbd.int/health/SOK-biodiversity-en.pdf
- FAO, 2015a: Coping with climate change – the roles of genetic resources for food and agriculture. www.fao.org/3/a-i3866e.pdf
- FAO, 2015b: Voluntary guidelines to support the integration of genetic diversity into national climate change adaptation planning. www.fao.org/3/a-i4940e.pdf

Published by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Registered offices
Bonn and Eschborn, Germany

Sector Project Sustainable Agriculture (NAREN)
Friedrich-Ebert-Allee 36+40
53113 Bonn
T +49 (0) 228 44 60-0
F +49 (0) 228 44 60-0

Dag-Hammarskjöld-Weg 1-5
65760 Eschborn, Germany
T +49 (0)6196 79 - 2359
F +49 (0)6196 79 - 1115

naren@giz.de
www.giz.de/sustainable-agriculture

Author Dr Christine Martins

Design Ira Olaleye

As at November 2015

On behalf of Federal Ministry for Economic Cooperation and Development (BMZ)

Special unit 'ONE WORLD – No Hunger'

Addresses of the BMZ offices

BMZ Bonn
Dahlmannstraße 4
53113 Bonn, Germany
T +49 (0)228 99 535 - 0
F +49 (0)228 99 535 - 3500

BMZ Berlin
Stresemannstraße 94
10963 Berlin, Germany
T +49 (0)30 18 535 - 0
F +49 (0)30 18 535 - 2501

poststelle@bmz.bund.de
www.bmz.de

GIZ is responsible for the content of this publication.

Published by
Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

Registered offices
Bonn and Eschborn, Germany

Sector Project Sustainable Agriculture (NAREN)
Friedrich-Ebert-Allee 36 + 40
53113 Bonn
Germany
Tel. +49 (0)228 4460-0
Fax + 49 (0)228 4460-1766

Dag-Hammarskjöld-Weg 1-5
65760 Eschborn
Germany
Tel. +49 (0) 6196 79-0
Fax +49 (0) 6196 79-1115

naren@giz.de
www.giz.de/sustainable-agriculture

Design and layout
Ira Olaleye, Eschborn, Germany

Photo credits
© GIZ/Florian Kopp

As at
November 2015

GIZ is responsible for the content of this publication.

On behalf of
Federal Ministry for Economic Cooperation and Development (BMZ)
Special unit 'ONE WORLD – No Hunger'

Addresses of the BMZ offices

BMZ Bonn
Dahlmannstraße 4
53113 Bonn
Germany
Tel. +49 (0) 228 99 535-0
Fax +49 (0) 228 99 535-3500

BMZ Berlin
Stresemannstraße 94
10963 Berlin
Germany
Tel. +49 (0) 30 18 535-0
Fax +49 (0) 30 18 535-2501

poststelle@bmz.bund.de
www.bmz.de