Sourcebook on Sustainable Agrobiodiversity Management

Edited by Annette von Lossau and Qingsong Li

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in the Provinces of Hunan and Hainan

Tayuan Diplomatic Office Building 1-13-1
No. 14 Liangmahe Nanlu, Chaoyang District
Beijing 100600, P.R. China

T +86 10 8532 4618
F +86 10 8532 4096
E christine.martins@giz.de
I www.agrobiodiversity.cn

Ministry of Agriculture (MoA)

No. 11 Nong Zhan Guan Nan Li
100125 Beijing, P.R. China

T +86 10 5919 3366
I www.agri.gov.cn

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Edited by Annette von Lossau and Qingsong Li

Co-editors: Christine Martins, Sylvia Reinhardt, Nina Seib,
Luis Waldmüller, Chunyan Li, Nengrui Xu

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Preface

The United Nations declared 2010 as the International Year of Biodiversity. Worldwide, numerous activities are underway to raise awareness of the importance of biological diversity. These spotlight the unabated decline of biodiversity and explore causes and consequences. They also showcase the importance and future potential of the sustainable use of biodiversity.

Agricultural biological diversity – as part of biodiversity – plays an important role in biodiversity as a whole, especially in regards to food security in the wake of a changing climate.

Agrobiodiversity is not a new theme to the People's Republic of China, or to Germany. In both countries, a number of relevant institutions have been engaged in the field of ex situ crop variety conservation for decades.

A joint Sino-German project designed to promote the sustainable use of agrobiodiversity in the People's Republic of China was agreed upon in 2003. Initially launched in Hunan and Hainan in 2005, it was extended to the provinces of Anhui and Hubei and Chongqing municipality in 2007, with additional funding from the EU.

One of the project's priorities is to advance human capacity development and knowledge management in the field of agrobiodiversity. This has led to the production of a series of papers, supported by the German Ministry for Economic Development and Cooperation (BMZ), exploring the manifold issues encompassing agrobiodiversity and points of leverage to maintain it. Can agrobiodiversity contribute and adapt to a changing climate? How do intellectual property rights impact on agrobiodiversity? What contribution does agrobiodiversity make to food security? These are just some of the many questions addressed by the papers.

To compliment the international agrobiodiversity conference convened by the Chinese Ministry of Agriculture and the United Nations Development Programme in September 2010 in cooperation with the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH, we have compiled the papers most relevant for China in one volume, in Chinese and in English. This sourcebook is intended to assist technical and research institutions, schools and consultants by providing background information, interesting case studies and specific recommendations for action relating to agrobiodiversity.

We hope that the book encourages you take up agrobiodiversity and related issues in your work and hope that you may profit from the experience gained in the past by different institutions, including those of the German Development Cooperation. GIZ was formed on 1 January 2011. It brings together the long-standing expertise of DED, GTZ and InWEnt. For further information, go to www.giz.de.

Eschborn and Beijing

Annette von Lossau
Senior Adviser Agrobiodiversity
GIZ Germany

Dr. Christine Martins
GIZ Project Director
Sustainable Management of Agrobiodiversity in the Provinces of Hainan and Hunan, P.R. China

Foreword

The Sourcebook on Sustainable Agrobiodiversity Management, jointly compiled and published by the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH and the School of Economics and Management of Hainan University, as well as the Institute of Low-Carbon Economy Policy and Industrial Technology of Hainan University. It is an important contribution to the sustainable management of agricultural biodiversity in China. International cases are collected to assist teachers and scientific researchers in carrying out training programs and to disseminate knowledge on biodiversity. In addition, this sourcebook is a tool for enhancing the awareness of relevant institutions and individuals, e.g. government officials, scientists, private business owners, local communities, non-governmental institutions and farmers, regarding sustainable management on agricultural biodiversity. This work thus contributes to improving biodiversity management, and ensuring sustainable agricultural development in China.

In terms of field work and capacity building, Hainan University and GTZ have built a solid cooperative relationship in the area of sustainable agrobiodiversity management. In 2005, GTZ – acting on behalf of BMZ – and China's Ministry of Agriculture jointly launched the Sino-German Project of Sustainable Management of Agro-biodiversity, with Hunan and Hainan as the first pilot provinces. Mr. Li Qingsong, lecturer from the School of Economics and Management, Hainan University, participated in project design and planning, along with project monitoring and evaluation, as a technical advisor.

Hainan University undertook several surveys of the project in the province, whose findings were essential to the project's implementation. First, Prof. Yang Xiaobo conducted the resource survey in 2007. Next, Prof. Fu Guohua and Prof. Jin Shan performed surveys on the socio-economy and then on traditional knowledge respectively in 2008. A number of young faculty members and postgraduates were also involved in conducting these three surveys.

Additionally, the university and the project office jointly held the "Exhibition on China's Agricultural Biodiversity" on the campus in Haidian and Danzhou (Hainan), attracting thousands of teachers and students. Luis Waldmüller, the German Project Director at that time, gave a lecture entitled, "Agro-biodiversity and *in situ* Conservation", which broadened and enhanced teachers' and students' awareness of biodiversity. Selected teachers participated in the training programs and seminars organized by the project.

The Institute of Low-Carbon Economy Policy and Industrial Technology was founded in March 2010 at Hainan University. It will carry out research on policies for developing a low-carbon economy in Hainan and provide essential technologies. The institute aspires to become a leading think-tank and reliable source of policy analysis for the Provincial Party Committee and the Provincial People's Government, as well as an indispensable technical platform for enterprises. Commissioned by the local government, the Institute is now developing the Strategic Planning for the Development of a Low-carbon Economy in Baoting County and Sanya, which involves the sustainable management of biodiversity.

Hainan University hopes to further its cooperation with GTZ in the area of sustainable management of biodiversity, the development of a low-carbon economy as well as other fields in the future, with the aim of making a greater contribution to biodiversity conservation and the development of a low-carbon economy in Hainan and the country as a whole.

Prof. Dr. Fu Guohua
Vice President of Hainan University, P.R. China

Abbreviations

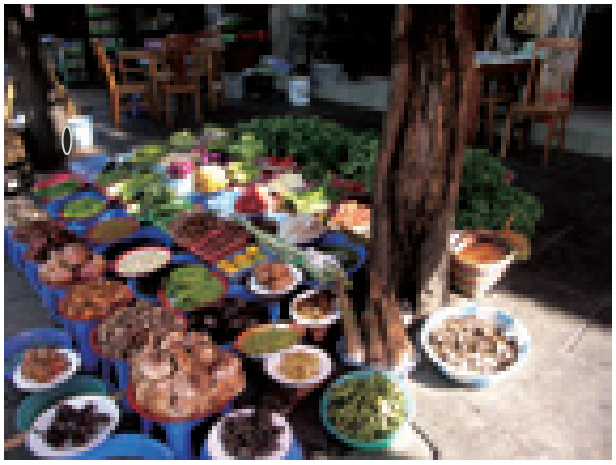
ABS	Access and Benefit Sharing
BCH	Biosafety Clearing-House mechanism
BESH	Bäuerliche Erzeugergemeinschaft Schwäbisch Hall (farmer producer cooperative in Schwäbisch Hall, Germany)
BMELV	Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz (German Federal Ministry of Food, Agriculture and Consumer Protection)
BMZ	Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung (German Federal Ministry for Economic Development and Cooperation)
Bt	*Bacillus thuringiensis*
BTFP	Biotrade Facilitation Programme
CBD	Convention on Biological Diversity
CBI	Centre for the Promotion of Imports from Developing Countries, The Netherlands
CGIAR	Consultative Group on International Agricultural Research
CIAT	International Centre for Tropical Agriculture
CIP	International Potato Center
CIPR	Commission on Intellectual Property Rights
COP	Conference of the Parties
CIMMYT	International Maize and Wheat Improvement Center
DNA	Desoxyribonucleic acid
DUS	Distinctiveness, uniformity and stability
EED	Evangelischer Entwicklungsdienst (Church Development Service – An Association of the Protestant Churches in Germany)
EFSA	European Food Safety Authority
EGE	European Group on Ethics in Science and New Technologies of the European Commission
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GFAR	Global Forum for Agricultural Research
GFU	Global Facilitation Unit for Underutilized Species
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
GM	Genetically modified
GMO	Genetically modified organism
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH
HT	Herbicide tolerance
HYV	High yielding varieties
IARC	International Agricultural Research Centre
IAS	Invasive alien species
ICARDA	International Center for Agricultural Research in the Dry Areas
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IDRC	International Development Research Centre, Canada
IPPC	International Plant Protection Convention
IPGRI	International Plant Genetic Resources Institute

IPM	Integrated pest management
IPR	Intellectual property rights
IP	Intellectual property
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
MAS	Marker assisted selection
MDGs	UN Millennium Development Goals
MoA	Ministry of Agriculture
MTA	Material Transfer Agreement
n.p.	Not published
NFR	EU Novel Foods Regulation
NGO	Non-governmental organization
OIE	World Organization for Animal Health
PDO	Protected Designation of Origin
PEA	Participatory extension approach
PGI	Protected Geographical Indication
PIC	Prior Informed Consent
PPB	Participatory Plant Breeding
PPP	Public Private Partnership
PVS	Participatory Varietal Selection
SBSTTA	Subsidiary Body on Scientific, Technical and Technological Advice of the Convention on Biological Diversity
SEAGA	Socio-economic and Gender Analysis Programme of the FAO
SEARICE	South East Asia Regional Initiatives for Community Empowerment
SPS	Sanitary and Phytosanitary Agreement of the World Trade Organization
SSSP	Small Scale Seed Production by Self-help Groups
TRIPS	Agreement on Trade-Related Aspects of Intellectual Property Rights
TSG	Traditional Speciality Guaranteed
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UPOV	Union Internationale pour la Protection des Obtentions Végétales (International Union for the Protection of New Varieties of Plants)
WHO	World Health Organization
WIPO	World Intellectual Property Organization
WSSD	World Summit on Sustainable Development
WTO	World Trade Organization

1. Basics of agrobiodiversity

1.1 Agrobiodiversity
– the key to food security

Anja Christinck, 2006



A diversified diet is likely to be particularly beneficial to the health of women and children. This picture was taken in southern Mali.
Photo: K.-U. Klinker

It is estimated that at least 852 million people worldwide suffer from hunger and malnutrition; four-fifths of them live in rural areas (FAO, 2005). Tackling hunger has for many years been one of the issues at the heart of international cooperation. The eradication of extreme poverty and hunger is also named as the first of the eight UN Millennium Development Goals (MDGs) proclaimed in 2000.

Five years after the declaration of these goals, experts from 25 nations have stated that the conservation and sustainable use of the diversity of cultivated plants and domestic animal breeds is key to the attainment of the first MDG (IPGRI, GFU, MSSRF, 2005). It is this diversity that has in the past enabled people to settle in almost all the regions of the Earth and to provide food for themselves under even the harshest of conditions. This potential is currently underutilised and could turn out to be a vast treasure trove, especially for people dependent upon agriculture in marginal rural areas.

Producing more food through the optimal use of resources

Critics admit that the higher yields of major food crops achieved through the "Green Revolution" have contributed to food security in many countries. But even where "high-tech agriculture" predominates, greater species diversity could in the long term help to develop new products, stabilise yields and optimise the utilisation of resources such as fertilisers or water for irrigation.

However, regions such as deserts or mountainous areas that are disadvantaged by their natural situation have seen very little rise in yields over recent decades. It is in these very areas that local plant species and animal breeds are often advantageous, since they are optimally adapted to the local conditions. Together with traditional knowledge and practices, they help farmers make the best use of limited resources.

The basis of food security

The World Food Summit of 1996 in Rome defined food security as follows:

"Food security [...] is achieved when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (www.fao.org/index_en.htm).

There are three core determinants of food security:

- **Availability** involves the production of a sufficient quantity of food that is available at the right time and in the right place.
- **Access** concerns the demand side, in particular the problems of people who cannot buy enough food even if it is available.
- **Utilisation** involves the correct storage, processing and combination of foods.

Very poor people often live in a situation of chronic food insecurity, while seasonal food shortages, price rises or the sudden breakdown of the supply infrastructure can lead to temporary food insecurity (BMZ, 2003; www.fantaproject.org/focus/foodsecurity.shtml).

Buckwheat not only helps to secure the nutrition of families dependent on small-scale agriculture; it also has potential for being marketed as a highly nutritious health product. Photo: W. Arnold

Buckwheat

Buckwheat is a traditional crop cultivated in parts of China and the Himalayan region. It is well adapted to mountain areas with their poor and often degraded soils. It has a short growing cycle and its cultivation can therefore help ease seasonal food shortages and failures of other crops. In addition, buckwheat grains, unlike many cereals and tuber crops, contain proteins of excellent quality. Buckwheat can therefore not only help to secure the nutrition of farming families, but also has potential for being marketed as a high-grade "health product".

However, traditionally cultivated crops and local animal breeds are often endangered by the processes of social and economic change that affect rural communities. Agricultural policies and market conditions often focus exclusively on the "modern" varieties that dominate the market. In addition, social change often leads to a shortage of family labour and the loss of traditional knowledge. Any plan to counteract this must actively promote the exchange of information about traditional plant varieties and animal breeds. It must also encourage the development of infrastructures for marketing and processing local products, and foster the conservation of animal breeding populations and the conservation of seeds.

"Hidden hunger"

"Hidden hunger" is the lack of essential micronutrients (vitamins and minerals) in the everyday diet. The effects are wide-ranging and may include delayed mental development, weakening of the immune system and loss of strength and energy. It is estimated that some two billion people are affected by lack of iron, and around 800 million are deficient in vitamin A, lack of which can in severe cases lead to blindness.

In the short term the effects of "hidden hunger" can be alleviated by giving vitamins and minerals in tablet form or by enriching basic foods with particular micronutrients. However, this requires functioning health systems or the industrial processing of food – and presupposes that the target group has access to such systems or food. In the long term, therefore, there is no substitute for a healthy and varied diet (www.micronutrient.org).

Diversity on the field and on the table – the best means of preventing "hidden hunger"

Filling one's belly is often not enough. People who live on the brink of poverty often lack a varied diet. Yet the appropriate use and combination of foods can contribute to long-term health, particularly among children.

Leafy vegetables, fruits, legumes, roots, tubers, spices, and herbs are essential for human nutrition and complement staple crops such as rice or maize. Many leguminous crops, such as cowpea and winged bean, are excellent sources of protein and micronutrients. Tropical fruits – including citrus fruits, mangoes and lychees – have a high vitamin and mineral content. The same is true of many African vegetables, such as the various squashes, or the tinangkong variety of sweet potato grown in the Philippines, the leaves of which contain significant amounts of vitamin A (Garí, 2004). The fruits and leaves of wild and semi-wild plants that grow near fields and pastures can also add variety to the menu. The children of animal herders in the arid regions of East Africa and India enjoy harvesting the berries of Ziziphus mauritania, which have a vitamin C content several times higher than that of oranges.

A school garden in the village of Salli, Trincomalee District, Sri Lanka. Photo: I. Reinhard

Sri Lanka: home gardens help combat hunger

School and home gardening programmes are an important component of the Integrated Food Security Programme in the Triconmalee district of Sri Lanka, which is supported by GTZ.

As a result of the civil war many people suffer from poverty and food insecurity. The main objectives of the programme are therefore to promote food availability, improve the nutritional status of families and create employment opportunities.

The school gardening programme focused on the production of quality vegetable seedlings and fruit tree saplings, since it appeared that the lack of planting material was the major obstacle to a further expansion of home gardening.

The combination of instruction and practical skill building was successful. Ninety percent of the students planted the saplings at home, and families passed on their knowledge to neighbours. As a result, some 1,100 tonnes of fruit and vegetables were produced in 4,000 home gardens within five years. This contributed to the better nutrition of families and also enabled them to generate additional income through selling seedlings in local markets (Wanasinghe, 2003).

Home gardens often accommodate a particularly rich diversity of crops. As home gardens are usually run by women, most of the production is directly used for cooking, benefiting all the family. The establishment and appropriate support of home gardens is therefore a promising option for improving the nutritional status of poor people both in rural and in peri-urban areas. They also serve to raise awareness of the importance of the diversity of traditional food plants.

Better access to food through new sources of income

A further cause of food insecurity is chronic or temporary shortage of money. Even if food is available in sufficient quantity and quality, not everyone has the resources to buy it. Improving the income situation of such people is an essential part of improving food security. Special, often little known plant varieties and livestock breeds offer potential for income generation. This may involve processing to food, medicines, cosmetics and craft products, or developing new markets and market niches for such products. The organic and fair trade markets provide potential for long-term initiatives in these areas.

Harmonizing food aid and agrobiodiversity

In times of acute food insecurity, people need immediate help. Food aid may be provided either as pure humanitarian aid or as part of rehabilitation programmes such as those involving "food for work".

The rediscovery of quinoa

Quinoa is a traditional crop of the Andean highlands. It is adapted to marginal soils and the harsh climate and is a source of high-quality protein and important minerals. However, production of quinoa declined because imported wheat was cheaper. Since the beginning of the 1980s the quinoa crop has been experiencing a revival, and quinoa products are now on the shelves of every organic supermarket.

In Bolivia, the national association of quinoa producers, ANAPQUI, founded in 1983, promotes cultivation of the crop. Some is exported to the USA and Europe, but innovative products such as quinoa pasta and snacks have also been developed for the domestic market. European fair trade organisations and the private enterprise "Coronilla" in Cochabamba, Bolivia, are reliable partners for these activities. This means higher and more stable prices for farmers as well as the creation of new jobs in processing and marketing (www.gepa.de/p/index.php/lan/de/sID/c724210cbdb99df64a975b31b494692d).

In addition, in countries such as India poor people regularly receive subsidies, for example in the form of vouchers or ration cards which can be used to buystaple foods at subsidised prices.

This has an impact on local food markets and the diversity of the produce available there. While the effect on prices is temporary, food aid – usually provided in the form of maize, rice or wheat – can bring about a long-term change in food habits, reducing the demand for traditional products. Over a prolonged period food aid can be counterproductive for local agriculture. It is therefore important to align food aid with longer-term development goals, such as the conservation of biological diversity.

Obstacles and opportunities

The greatest opportunity for the conservation of agrobiodiversity in the context of food security is perhaps at the same time the greatest obstacle. A decentralised approach is required, based on local knowledge, local resources and "on the ground" activities. This in turn needs local leadership and local implementation capacities.

The problems to be addressed concern primarily the following areas:

- Knowledge

Existing knowledge and experience needs to be collected and evaluated, and public awareness of the link between agrobiodiversity and food security must be promoted.

- Scope

Measurable effects can only be achieved if schemes are supra-regional in concept but at the same time take account of different local and cultural requirements.

- Institutional development

Wider implementation is hampered by the limited involvement of the rural population in national and international programmes. Another obstacle is the lack of coordination between individual sectors and disciplines, such as those involved in the conservation of biological diversity, agricultural development, food security and health. Diversity conservation must form a fundamental part of policies and programmes relating to poverty reduction, agriculture, health and nutrition. This means that it must be integrated into food security projects, emergency response measures, national poverty reduction strategies, agricultural policy programmes and guidelines, and school nutrition programmes (www.biodiv.org/doc/meetings/sbstta/sbstta-11/official/sbstta-11-03-add1-en.pdf).

It may not be possible to achieve large-scale results in the short term by means of this approach. It nevertheless offers a unique opportunity to link food security measures with other development goals such as education, the empowerment of women, or the protection of resources and the environment. The importance which agrobiodiversity had in the past for the survival of humankind would then take on a new dimension.

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1.2 Women, men and agrobiodiversity

Susanne Gura, 2006

In many cultures the division of roles is particularly strongly marked. In Hainan, China, for example, the women are responsible for drying traditional upland rice. Photo: Huang Yongfang

In the mountain areas of Nepal, women collect fodder for the animals, feed and graze them, clean the sheds and compost the dung. Children, mainly girls, take the animals for grazing. Elderly women are responsible for milking and prepare butter and ghee, a type of butterfat. The older men take decisions on the marketing of produce and the breeding of animals (Tulachan and Neupane, in: FAO, 2004).

In most traditional and modern farming systems there is a fixed division of labour, as in Nepal. Men and women may be responsible for different crops or for different tasks related to a crop. In many cases men plough the fields while women prepare the seedbeds with hoes. Weeding is often a task for women and children, while spraying or fertiliser application is mainly carried out by men. For harvesting all available hands are needed. 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. A study from Mali shows that this applies not only where very different plants, such as manioc and coffee, are concerned; labour can be divided in this way for one and the same plant. In the Bafoulabé region in the west of Mali rice was traditionally a "women's plant". It was grown along the riverbanks or in fields that were under water in the rainy season. The women worked the fields either on their own or in groups. They possessed a vast store of knowledge about the native varieties they cultivated and could distinguish between 30 varieties on the basis of growing cycle, growth type, plant height, number of stalks, yield, grain size, shape and colour, cooking characteristics, uses and the taste of

Key terms

Gender

Gender is not determined biologically; it is a central organising principle of societies and often governs the processes of production and reproduction, consumption and distribution. Gender issues focus on the relationships between men and women, the various roles of women, their access to and control over resources, the division of labour between men and women, their interests and needs. All these things affect the mutual relationships of household members, family wellbeing, planning, production and many other aspects of everyday life.

Participatory Plant Breeding

Farmers and professional breeders differ in the knowledge they possess and in the breeding techniques they use. Participatory breeding means using methods to which farmers, breeders, scientists and other interested groups contribute their knowledge. Such methods started to develop some two decades ago.

Farmers' Rights

Farmers have always saved part of their harvest as seed or grain to be planted the following year. This was and is a central element of agriculture – and the legitimate right of farmers. It is a right that came under serious threat in the mid-1980s when the first patents on plants and plant material were registered. In 2001 the right was established as part of the "Farmers' Rights" included in the International Treaty on Plant Genetic Resources for Food and Agriculture (*see 3.4 "Farmers' Rights and agrobiodiversity"*).

Women are responsible for looking after the offspring of large livestock as well as smaller animals such as small ruminants and chicken. Photo: Sylvia Reinhardt

the end product. The men knew very little about the traditional varieties of rice but were firmly in control of the cultivation of three improved varieties of rice that had been introduced into the village.

Women and children often look after the smaller livestock species while men are responsible for cattle, buffalo, yaks or camels. How roles are assigned and who takes decisions relevant to agrobiodiversity will depend on the specific situations and culture. Depending on gender roles, the man or the woman may be the agrobiodiversity conserver, or they may share the task between them.

Nutrition and health needs are most often the responsibility of women. It is therefore usually women who hold the knowledge of the plants and animals that serve these needs, whether with regard to their culinary, nutritional and curative properties or in connection with their agronomic and environmentally related characteristics. The variety of plants and animals contributing to subsistence is generally far larger than the range of products sold in the markets. When addressing agrobiodiversity conservation issues, therefore, it is primarily women who must be reached.

Maintaining biodiversity

There are many ways in which women in agriculture – and men too – can be supported in their role as conservers of agrobiodiversity. Participatory breeding, seed banks and livestock markets, tourism, home gardens, cooking, medical and religious traditions, to name but a few, are all areas with potential for successful development cooperation.

- Participatory breeding

The knowledge that farmers have enables them to outperform professional breeders. With growing experience in participatory breeding it has become evident that local varietal knowledge can be very detailed and can play a crucial part in livestock and crop breeding.

An example of this comes from Rwanda. There are in Rwanda more than 600 varieties of bean, with many differing characteristics. Since beans are regarded as "women's plants" the information about them is firmly in women's hands. In a CIAT (International Centre for Tropical Agriculture) plant-growing project scientists focused on working with women farmers. The aim was to cultivate new bean varieties adapted to the needs of the local population. Working together, the women and the scientists identified the characteristics needed to improve the beans, carried out the experiments and evaluated the results. The results amazed the scientists. The varieties selected and tested by the women farmers over four cultivation cycles demonstrated better results than those chosen by the scientists.

- Seed banks

In some places communal seed stores have existed for a long time. Most, however, have been set up in recent times in connection with conservation objectives or in response to seed shortages. The national gene bank usually cooperates with the communal

Women are the main food producers

In poor families with two adults, more than half the available income comes from the labour of women and children. Furthermore, women spend most of their earnings on meeting the basic needs of their families. Women produce 80 percent of the food in Africa, 60 percent in Asia and 40 percent in Latin America (Howard, 2003).

Women are the sole breadwinners in one-third of all households in the world. Male migration from rural areas to cities in search of paid employment has led to a predominantly female rural population in many areas. As men's participation in agriculture declines, the role of women in agricultural production becomes ever more dominant.

seed banks either to provide the communal institutions with sufficient amounts of suitable seed or to help the gene bank regenerate its collection. In order to function successfully, the operators of seed banks must understand exactly how tasks are apportioned between men and women.

- Seed fairs and livestock markets

Seed fairs are one of the most successful means of supporting agricultural biodiversity conservation around the globe. They also lend themselves to gender-specific work. They provide women with an opportunity to visit the event; they can present their own products and share their knowledge. Such events are often the start of an agrobiodiversity programme involving women who may otherwise be more difficult to reach due to social and religious restrictions. Farm animal markets offer similar opportunities but usually address male farmers.

- Home gardens

In many places gardens are tended by women, who cultivate a wide range of plants for various purposes. Home gardens are looked after with much more care than the fields that are further away. They are often fertilised with compost or manure, and watered where possible. Culinary and medicinal herbs, leafy and other vegetables, legumes, fruit and nuts – the variety available in the garden provides something for every occasion: nutritious food and medicine for the family's own use, for social and religious purposes and often also for sale. Supporting women and their home gardens is an important and practicable approach to *in situ* conservation.

- Traditional cooking and local recipes

Different uses and modes of preparation require different characteristics in the plants used. For example, potatoes used to make soup need to be mealy, while salad potatoes should be firm. Similar distinctions apply to other food plants. Nevertheless, international experts still know little about traditional cooking and local recipes, about methods of processing and storage, or about how this knowledge arises and is passed on. This was the subject of a study carried out by a female scientist at the Bunda College of Agriculture in Malawi. She discovered that around three dozen different green leaf vegetables are eaten, either fresh or dried. The dried leaves are traditionally preserved by forming them into a ball; this is covered with leaves to protect against pests and then stored by being hung up in the kitchen under the roof. It is a technique that had almost been forgotten. Home economics advisors who attend cookery classes at Bunda College are now once again passing on this traditional knowledge.

Agrotourism not only provides an opportunity to conserve biodiversity but also represents an additional source of income for women.

Photo: Sylvia Reinhardt

Tourism

Every year at the time of the November full moon thousands of tourists and pilgrims flock to the desert town of Pushkar in the Indian state of Rajasthan. They come to the camel market and to the religious ceremonies that take place in honour of Brahma. The camel market is a traditional breeders' market that over the years has become a tourist attraction.

The operators of the "potato park" near Cusco in Peru seek to attract those who come to visit the ancient Inca cities. Six communities in the Pisac valley have combined to manage the park jointly. Tourists learn about the potato through guided tours of the fields and displays in the potato museum, and in the restaurants they can enjoy regional dishes prepared in the traditional manner. As well as conserving some 400 native varieties of potato, the scheme also ensures that women's knowledge of preparing and processing the vegetables is not lost.

Heavy responsibility, limited rights

Through their daily activities, experience and knowledge local farmers, and especially women, have a major stake in protecting agricultural biodiversity. However, they are still hampered by a lack of rights relating to access to and control of the resources that they rely on to meet their needs. National policies fail to take due account of the increasing responsibility of farmers for food production and the management of natural resources. Improvement of women farmers' access to land and water resources, to education, advice, training, credit and appropriate technology is essential if agrobiodiversity conservation is to be improved. Sound and equitable agricultural policies to provide incentives for the sustainable use of genetic resources are also needed.

Women are essential to success

Individual countries must in future formulate their agricultural policies in a way that does not exclude women. This is essential if states are to produce sufficient food for their growing populations. The fact that gender aspects have so far been neglected has had serious consequences not only for biodiversity but also for gender equality.

The gender-aware design of biodiversity conservation measures involves more than just taking account of traditional seed, old native varieties and traditional knowledge. If the roles of men and women are properly considered, many negative impacts on women can be avoided. Family nutrition and health are improved if a range of nutritious plants is cultivated. Improvements in production systems can increase the income of women farmers. If more attention is paid to the knowledge and skills of women, their position in society is strengthened.

Photo: Li Qingsong

International agreements provide a framework

A range of international agreements regulates the conservation and sustainable use of agrobiodiversity. Most of these agreements, however, take little account of gender issues.

- The United Nations Convention on Biological Diversity in its preamble acknowledges the key role played by women, especially in the developing world, in the management and use of biological resources.
- The FAO International Treaty on Plant Genetic Resources for Food and Agriculture makes no specific reference to gender.
- The FAO Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture makes detailed reference to the differing roles of women and men in the conservation of agrobiodiversity. It was drawn up in 1996 at the "Plant Summit" and covers the four areas of conservation and development *in situ*; conservation *ex situ*; use of plant genetic resources including under-utilised varieties; institutional and personnel-related capacity building including raising awareness of the value of the available resources. Countries that ratify the agreement undertake to implement the global action plan at national level.
- The FAO Global Strategy for the Management of Farm Animal Genetic Resources provides a framework for assisting countries but does not go into the gender-specific issues.

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1.3 Traditional knowledge

relating to the conservation and sustainable use of biodiversity

Christine Schäfer, Alexander Schülke, 2008

Photo: Guenay Ulutuncok

Indigenous people and traditional local communities often have a profound understanding of their environment and its ecology. They know numerous ways of using wild plants and animals, for example as food, medicine and dyes. Different cultivation techniques have been developed for a large number of useful plants. This knowledge is an important foundation for the conservation and sustainable use of global biodiversity.

There are close links between cultural and biological diversity. Indigenous peoples suffer from the destruction of the environments in which they live, from being uprooted or displaced and from losing their identity; as a result there is a threat that this great wealth of traditional knowledge will be lost to these peoples themselves and humanity as a whole. At the UN Conference for Environment and Development in Rio de Janeiro in 1992 there was for the first time broad recognition of traditional knowledge. Under the Convention on Biological Diversity (CBD) contracting parties have pledged to recognise and promote traditional knowledge and to make it available for general use. Access to traditional knowledge must be based on the consent of the knowledge holders and their equitable participation in the benefits arising from the use of such knowledge. Traditional knowledge is often not confined within ethnic or geographical boundaries. In addition, biological resources and traditional knowledge are defined in the CBD as a collective asset. This contrasts with WTO usage, since the TRIPS Agreement (Trade Related

Photo: Li Qingsong

What is traditional knowledge?

This term "traditional knowledge" encompasses the knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles that are of importance for the preservation and sustainable use of biological diversity. This knowledge, which has been developed over the centuries, is a collective asset of the local communities; it is passed on from generation to generation in such forms as stories, songs, cultural values, traditional laws, local languages, rituals, medical lore and agricultural practices.

Biodiversity and the Biodiversity Convention

The term "biological diversity", or "biodiversity" for short, encompasses the diversity of life on Earth, ranging from genetic diversity and diversity of species to the diversity of ecosystems. The Convention on Biological Diversity (CBD) adopted in Rio de Janeiro in 1992 comprises three elements: the conservation of biological diversity, its sustainable use and the equitable sharing of benefits arising from such use. In the meantime, 193 Parties have joined the Convention. By signing the Convention, Germany has agreed not only to conserve biodiversity on its own territory but also to support developing countries in implementing necessary measures.

Aspects of Intellectual Property Rights) defines private and individual rights to knowledge and intellectual property. The contradiction between the CBD and TRIPS is as yet unresolved.

Traditional knowledge in the Biodiversity Convention

In the Preamble and four articles of the CBD there is reference to indigenous and local communities. The most important point is contained in Article 8(j), which calls on signatory states to respect, preserve and maintain the traditional knowledge of indigenous and local communities that contributes to the conservation and sustainableuse of biodiversity. In addition it encourages the use of such knowledge, provided that the knowledge holders have given their consent and participate in benefitsharing.

An Ad Hoc Open-ended Inter-sessional Working Group, in which all interested parties are represented, was set up at the 4th Conference of the Parties (COP) in May 1988 and meets at regular intervals to develop and implement suitable instruments for the protection of indigenous knowledge. The issue is a cross-sectoral one and thus forms part of many CBD-related activities. The 5th COP in Nairobi agreed a programme for implementation of Article 8(j), drawn up with the assistance of indigenous representatives. The most important outcome was the formulation of the "Akwé Kon Guidelines", which were adopted at the 7th COP in Kuala Lumpur (Decision VII/16F). They provide a common framework for carrying out cultural, social and ecological impact assessments, enabling projects to be assessed for the impact that they might have on sacred places or on areas and waters that have traditional importance for indigenous and traditional local communities. This is done with the full involvement of these communities. In addition the guidelines indicate how greater consideration can be given to traditional knowledge and technologies and how promotion of their use can be improved. The guidelines are, however, not legally binding.

As an issue of cross-sectoral relevance in the CBD, traditional knowledge is taken into account in the majority of working groups and programmes. There are particularly close links between the working group dealing with Access and Benefit Sharing (ABS) and that concerned with traditional knowledge. An international regime is due to come into force by 2010; involving a number of players, this will provide a framework in international law for regulating Access and Benefit Sharing (ABS) and access to genetic resources, thereby implementing Articles 15 and 8(j).

GTZ's contribution to the preservation of traditional knowledge relating to the conservation and sustainable use of biological diversity.
GTZ, on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ), helps to accelerate implementation of the Biodiversity Convention and promote further development of the Convention and its instruments and bodies at German and international level. In many bilateral cooperation projects GTZ combines the conservation and sustainable use of natural resources with the development and application of suitable instruments for the protection of indigenous knowledge. Many initiatives – from the level of regional capacity development in places such as Ecuador to further development of Article 8(j) within the international negotiation process – are based on experience gathered by the programme "Implementing the Biodiversity Convention (BIODIV-programme)".

Pilot measures of the BIODIV programme also promote implementation of the CBD. For example, the Indonesia environment programme assists and advises indigenous communities in implementing the process of free prior informed consent (FPIC) in the forestry sector. Working with the Forest Peoples Programme and the Centre pour l'Environment et le Développement (CED), BIODIV-programme supports indigenous communities in Cameroon in securing their rights in the conservation areas.

Traditional knowledge is an integral part of agrobiodiversity management. Ethnic groups very often have an abundant knowledge of the use of wild and cultivated plants.
Photo: Guenay Ulutuncok

Action required

- National and international legislation for the protection of indigenous knowledge must be developed by the Contracting Parties in collaboration with indigenous representatives;
- The collective rights of indigenous and local communities to their biodiversity and associated knowledge must be recognised;
- Contracting Parties must recognise land rights and rights of access to resource use, for they are the basis for the survival and development of traditional knowledge systems;
- Indigenous peoples and local communities must be empowered to participate on an equal basis in decision-making processes on the use of biological resources, and to protect their interests;
- Contracting Parties must inform indigenous peoples and local communities about their rights and obligations under Article 8(j) and other relevant provisions;
- The effective participation of indigenous and local communities in the political process within the framework of the CBD must be advanced.

Further information

BMZ technical paper (BMZ Spezial 33, 2001) on regulating access to genetic resources:
www.bmz.de/de/publikationen/reihen/strategiepapiere/konzept164.pdf

Relevant page of the CBD website with additional links:
www.cbd.int/programmes/socio-eco/traditional/

Work of the WIPO (World Intellectual Property Organization) on traditional knowledge:
www.wipo.int/tk/en/

1.4 Farmers as breeders
– Participatory Plant Breeding

Kirsten Probst, 2005

Participatory Plant Breeding builds on local knowledge and farmers' innovation. Photo: Bhuwon Sthapit/LI-BIRD

What is Participatory Plant Breeding?

Participatory Plant Breeding (PPB) is based on the idea that farmers as well as professional plant breeders have important knowledge and skills that could complement one another. PPB is broadly defined here as a range of approaches that involve a mix of actors (including scientists, breeders, farmers and other stakeholders) in plant breeding stages.

Other terminology has been used to describe such approaches, depending on the stage of the breeding process at which collaboration between farmers and formal breeders starts. For example, in Participatory Varietal Selection (PVS) the materials are stabilised, whereas in the narrower sense of Participatory Plant Breeding the material is still segregating. These different approaches are generally subsumed under the term Participatory Plant Breeding (or Participatory Crop Improvement).

Depending on who controls the breeding process (researchers or farmers) and the scale on which the work is undertaken (community-centred or research to extrapolate results) two broad categories are usually differentiated: "farmer-led" and "formal-led" PPB (Source: PRGA Programme).

Seeds – the first element in the food chain

For more than 5,000 years men and women farmers have been domesticating various plant species and developing a wide range of crop varieties that fit their specific needs and respective environmental conditions. Only in the last 100 years has specialized plant breeding undertaken by formal institutions emerged. Today most farmers still prefer their own seed where formal breeding and seed systems fail to supply planting material of suitable quality and diversity in a timely manner and at accessible prices. In developing countries, 60 to 90 percent of the planting material is supplied by the informal sector, i.e. farm-saved seed/propagating material. In some regions, and for some locally important food crops, this can even be the only source of seed. A typical aspect of local seed systems is that they 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.

Whose word carries most weight?

Where PPB is initiated by or under the primary leadership of formal sector institutions such as national plant breeding programmes or international research centres (formal-led PPB), it is expected to complement the formal research system and to improve its effectiveness. Formalled PPB mainly seeks to give more attention to farmer preferred quality traits and local environmental conditions, as well as to reorient general breeding directions and to reach a broader range of potential users and stakeholder groups – including women and the poor.

Development agencies often support formal-led PPB or disseminate breeding products. However, the major interest of development agencies tends to be directed towards supporting farmers' own systems of crop development, i.e. "farmer-led PPB". In a development context, farmer-led PPB is most commonly considered as a strategy that:

Photo: Jörn Breiholz

- supports *in situ* conservation of traditional crops while also improving germplasm. Many cases seek to increase the competitiveness and productivity of landraces. This can prevent farmers from abandoning such crops, and provides wider access to a choice of diversity for targeting micro-niches. Such PPB may particularly focus on "minor" crops that are not covered by private or public sector programmes, e.g. crops typically cultivated by women in home gardens, such as indigenous vegetables or varieties with specific characteristics.

- contributes to the empowerment and self-reliance of farmers.

Empowerment may be achieved through enhancing farmers' capacity in breeding and crop development; improving their access to and control over germplasm development, supply and information; as well as raising their critical awareness of policy arenas (e.g. regarding seed laws, intellectual property rights, etc.).

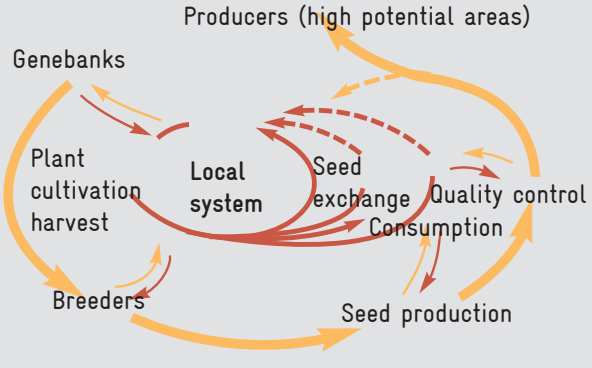
Obviously, PPB particularly farmer-led approaches can serve as a conceptual element not only in agricultural research, but also in rural development and natural resource management programmes, as well as in longer-term post-disaster adjustment initiatives (e.g. in combination with seed production).

Participatory Plant Breeding – breaking new grounds

In development cooperation, support to farmer-led PPB is still a new area, and few projects as yet refer to it as a strategic element. German technical cooperation has been working on seed sector development programmes in many African, Asian and Latin American countries for more than 30 years. These programmes have contributed to the development of an institutionally pluralistic formal seed sector, the establishment of seed companies, policy and legislation, and networking. At the same time NGOs, extension services, farmer associations and small local seed companies have contributed to strengthening local capacity. The SADC/GTZ project on the promotion of Small Scale Seed Production by Self-help Groups (SSSP) is just one example of this. The project's main activities are the development and implementation of training programmes for farmers and extension workers. PPB (i.e. Participatory Variety Selection) is promoted as one conceptual element among other measures, such as community biodiversity registers, seed fairs, seed gardens for off-season seed production, etc.

Various NGOs have spearheaded farmer-led PPB as part of their community development and biodiversity conservation programmes, such as the Foundation for the Promotion and Study of Andean Products (PROINPA) in Bolivia, the Local Initiative for Biodiversity, Research and Development (LI-BIRD) in Nepal, and the South East Asia Regional Initiative for Community Empowerment (SEARICE). The latter is involved in the Community Biodiversity Development and Conservation Programme (CBDC), a global initiative developed by 14 governmental and non-governmental organisations. Participatory plant breeding activities play a major role in the CBDC programme, with the aim of enhancing crop genetic diversity in farmers' fields by selection and breeding efforts in which farmers are the major actors, particularly in rice, maize, beans, quinoa, and root and tuber crops.

Local and formal system for the management of Plant Genetic Resources



Almekinders and de Boef, 2000

Experiences reveal that most work has been undertaken with staple food crops. Initiatives often start with Participatory Variety Selection (PVS), i.e. with stabilized materials, whereby farmers can access finished products more quickly and the learning process is easier. Though to date PPB has been applied mainly within marginal, basically subsistence-oriented production environments, an increasing number of experiences are unfolding in more favourable market-driven contexts (e.g. India, Bangladesh and the Netherlands). These take place where user preferences are not fully met by conventional breeding, where more organic products or intra-crop varietal diversity are sought, or when farmers want to gain more control over the breeding process.

Supporting contexts for PPB

The conditions and factors that tend to enhance farmers' interest in breeding, and thus the success of PPB, are as follows:

- Situations where farmers will not be served by formal (private or public) breeding and seed supply, e.g. in unfavourable or heterogeneous regions where modern varieties have little impact; in cases when poor infrastructure prevents seed or inputs from reaching farmers; and in the case of most minor/underutilized crops

- Factors that generally support innovation, e.g. situations where novel combinations of traits are desired; where a crop is economically important or where detailed folk-taxonomies and knowledge exist about a crop

- Biological factors, e.g. the existence of genetic diversity that offers variation that can be manipulated; the visibility of diversity to farmers; the fact that maintenance is easier in the case of self-pollinated crops such as rice, beans and barley.

Obstacles to PPB

In most countries, the production and distribution of seed is regulated by seed laws, phytosanitary laws and plant variety protection. While these are primarily made to regulate certified seed production and importation, they may also restrict the local promotion of unreleased varieties and non-certified seed production. The Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) prescribes the inclusion of an intellectual property rights (IPR) system in the national laws of WTO member states. As IPRs may also restrict the use of protected materials in PPB, organizations supporting local crop development activities should acquaint themselves with the respective national regulations.

Since current legal frameworks do not address jointly developed material and knowledge, PPB generally lacks a legal definition. Therefore setting up a PPB protocol which describes the different roles, mechanisms for making the process transparent and credit-sharing arrangements is recommended, as well as strategies for making the product more widely available.

Important steps

The organisation of PPB, i.e. "who does what, when and how" is an important issue in the debate on its implementation. The CGIAR System-wide Programme on Participatory Research and Gender Analysis (PRGA) has developed guidelines for PPB which discuss options and share insights from practitioners. Major steps are outlined - from an overall diagnosis and analysis of the context, to setting objectives, technology generation and the dissemination of innovations. A participatory diagnosis of the seed system can help identify constraints and the potential starting points with the aim of stimulating PPB. In many societies, women are responsible for seed management, and men and women often have different varietal preferences due to differentiated gender roles along the food chain and different priorities.

Varieties for breeding are readily available to farmer-breeders (*in situ* rice conservation). Photo: Masipag

Farmers training other farmers to do rice breeding. Photo: Masipag

Development projects can support farmer-led PPB through four broad types of interventions:

- Germplasm support to increase farmers' access to diversity (using fixed or segregating, local or external materials), combined with testing new material, and supporting seed systems (community seed banks)
- Skills support in breeding, testing or seed production (either new skills or extending local best practices)
- Support in forming links and networks to exchange material or information
- Indirect support to confront barriers to farmer-breeding (e.g. restrictive seed laws), or help promote PPB in other ways, such as market development.

Promising results

So far, the evidence of PPB's potential to support the conservation of agrobiodiversity both by delivering a greater range of varieties to fit niches, and by adding value to local germplasm through selection and crossing is encouraging. However, the relationships and trade-offs between crop improvement and the conservation of diversity are only starting to be explored. Additional well-documented case studies and inquiries are needed to assess the effects of PPB on biodiversity, food security and local livelihoods.

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www.searice.org.ph/
www.cbdcprogram.org

GTZ Publications:
www.gtz.de/en/themen/umwelt-infrastruktur/2198.htm

PRGA inventory of cases, reports, books, workshop reports: www.prgaprogram.org

Guidelines for developing PPB programmes:
www.prgaprogram.org/descargas/plant_breeding/working_documents/Guidelines%20for%20Developing%20Participatory%20Plant%20Breeding%20Programs.pdf

1.5 Farmers as bankers
– community seed banks

Conny Almekinders, 2005

In their community seed bank, the farmers' group of Kachorwa, Central Terai, Nepal, uses a traditional seed storage structure.
Photo: Pitambar Shrestha/LI-BIRD

What is the point of community seed banks and gardens?

Community seed banks are local institutions that conserve and maintain access to locally adapted seed and planting materials for farmers. Typically they rely on a community storage structure where the seed can be processed, selected and stored, in order to have sufficient quantities available even when normal supplies fail. Usually there is a community seed bank committee that oversees activities and decides what can be stored, and how and when seed can be used. In many cases, the seed stores built can provide storage conditions which are better than those on farms, and sometimes they also have an office and meeting room. 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. Thus seed banks contribute to the security of the seed supply. Seeds for the village store are procured from farmers who are recognized to be good seed producers. While the initial seed lots are often purchased by a project, a regulated process for withdrawing and depositing seed is necessary to ensure the subsequent conservation of seed stocks.

Farmers who have borrowed seed are required to return a similar quantity to the seed bank after harvest. For crops which are not propagated from seed, alternative structures must be developed for conservation and propagation at community level, e.g. by setting up conservation gardens.

We reap what we sow

For some 10,000 years, breeding and production of seed was the sole preserve of farmers. They produced the rich diversity of crop species and varieties that exist today, and maintained them in cultivation. It was only about 100 years ago, when the laws of heredity were deciphered, published and generally accepted, that scientific plant breeding began.

Gene banks were initially set up as 'working collections' for specialized breeding programmes. They are repositories holding samples of the most important crop plants from every continent *ex situ*, i.e. outside their natural context. Later, gene banks were given an additional mandate: the conservation of locally grown crop varieties. The increasingly widespread use of modern plant varieties led to the gradual replacement of traditional varieties, which meant that their genetic characteristics were also lost to farming. Thus, scientific plant breeding deprived itself of the raw material which was the very basis of its work.

Farmers have great difficulty in accessing the material in *ex situ* collections. Gene banks tend to be located a long distance away from villages. In addition, they can only respond to a restricted number of requests and distribute small volumes of seeds or planting material. So, for a farmer who may want to restock with seed of traditional local varieties, that are lost or degenerated, *ex situ* collections are not very useful. Likewise, seed programmes initiated by state or non-governmental organizations rarely distribute traditional local varieties, because their goal is usually to diffuse new breeding products.

This is why farmers are often interested in community seed banks and other community conservation schemes which give them access to important planting material.

A Philippine farmer inspects his rice seeds which he stored with the traditional method of hanging to maintain low moisture content in the seeds. Photo: Achim Pohl

Sufficient supplies to withstand the drought

In Zimbabwe's marginal rural areas, recurrent droughts make it very difficult for farmers to save seed until the next sowing season. Community seed banks have helped to remedy this problem. In cooperation with the national gene bank, two non-governmental organizations (NGOs) – the Community Technology and Development Trust (CTDT) and the Intermediate Technology Development Group (ITDG) – have launched projects on community seed banking.

In Ethiopia, community seed banks build on the farmers' cultural and religious traditions, whereby seed is donated to those who have fallen into poverty. NGOs and the Biodiversity Conservation & Research Institute (BCRI) operate community seed banks with a dual purpose: firstly, they aim to ensure that sufficient seed stocks are available in the regions for the most important crop species and local varieties, and that farmers have access to them; secondly, given the Institute's limited capacity and budget, BCRI relies on community seed banks to conserve, regenerate and distribute seeds of local varieties as a complement to the conservation work which comes under its mandate. The BCRI recognizes the importance of co-evolution of varieties maintained on-farm, and the farmers' knowledge pertaining to the growth and use of these varieties. Participating farmers who maintain local varieties rather than high yielding varieties on-farm receive compensation for the foregone yield, usually in the form of agricultural tools.

The GREEN Foundation, which works in India with women's farming groups, has been supporting the establishment of a network of 31 community seed banks in Karnataka Province. This has increased the number of women farmers involved in conserving the seed of traditional crops from 10 to over 1,500. For this innovative scheme which contributes to the conservation of biodiversity and to poverty reduction, the United Nations Development Programme (UNDP) awarded the GREEN Foundation the 2004 Equator Prize. The Equator Initiative is also supported by the German Federal Ministry for Economic Cooperation and Development (BMZ).

Gardens full of tubers

Conservation gardens in Ecuador demonstrate how conservation and evaluation goals can be combined in a communitybased approach. The National Department of Plant Genetic Resources and Biotechnology (DENAREF) in Ecuador maintains a large collection of Andean root and tuber plants. These include mashua (*Tropaeolum tuberosum*), oca (*Oxalis tuberosa*), melloco (*Ullucus tuberosus*), arracacha (*Arracacia xanthorrhiza*), jicama (*Smallanthus sonchifolia*), achira (*Canna edulis*) and miso (*Mirabilis expansa*), which are conserved *ex situ* using both tissue culture and field-planted material.

A study was conducted in 1999 in the region of Las Huaconas, home to many local Indian communities, on the crop species and varieties in use. It was found that many of the native varieties of Andean tuber crops collected by DENAREF in 1980 were no longer to be found in the communities. This circumstance motivated DENAREF to produce planting material in what they called conservation gardens. "Jardines de Conservación" are experimental plots planted on communal land. They not only proved to be ideal propagation sites but also lent themselves to collaborative evaluation of crops by farmers and researchers. Out of 30 samples of different tuber crops distributed to farmers in six different communities, 30 percent were still in production three years later.

At present, DENAREF, with support from GTZ, is coordinating the setting up of a community garden for tropical root and tuber crops in the village of Gualaquiza. Gualaquiza lies in the Amazon Basin and is home to the Shuar-Achuar Bilingual Institute (IPI-BSHA). Collections of cocoyam (*Xanthosoma spp. and Colocasia spp.*), yam (*Dioscora spp.*), sweet potato (*Ipomea batatas*) and cassava (*Manihot esculenta*) are maintained in the Institute's garden. Students will maintain, develop and study the collection as part of their training programme.

Fruitful contacts

The impetus to organize a community seed bank usually comes from outside the community, in response to the realization that it is affected by seed shortages. In many countries, the initiative is taken by NGOs, development organizations or gene banks and their programmes for the conservation of plant genetic resources. They have the possibility of bringing communities into contact with organizations which maintain *ex situ* collections, such as the BCRI in Ethiopia or DENAREF in Ecuador. Once such contacts are established, there is a chance that old local varieties or other interesting material can be reintroduced into the villages by means of community seed banks or other activities like seed fairs. It is vital that gene banks recognize the potential which lies in the linkage of *ex situ* and on-farm conservation. The reintroduction of lost species and varieties makes a critical contribution to the farmers' well-being and to the conservation of agricultural diversity.

A community seed bank in Quezon, Philippines, one of the farmers' organizations of Masipag. Such farmers' organizations maintain at least 50 rice varieties, plant them side by side, and select the top ten yielders. An organization member can get about 100g of seeds of the varieties that (s)he wants for multiplication. Through community seed banks, varieties are always available and accessible to farmers.
Photo: Achim Pohl

As interest grows, so does knowledge

For a community, the establishment of a community seed bank can be an entry point for developing village organizational structures. Among farmers, a community seed store can awaken interest in improved seed quality. In Ecuador, the community seed bank stimulated community activity on demonstration plots using old and new varieties, culminating in participatory evaluation of that material.

Because it is often the case that the returned seed may be of lower quality than that obtained from the seed bank, it can be useful to link activities surrounding the seed bank with training courses in seed production and selection, as was done in Ethiopia.

A stored seed display of the Masipag rice seed bank in the Philippines. Photo: Masipag

When a seed bank is founded and seed stocks are acquired, the use to which funds are put must be absolutely transparent. Before the seed bank becomes operational, the policy on who has access to seed, when, and under what conditions must be clearly defined. The less well-off farmers in the community, who may be most in need of the seed, may be unintentionally excluded if they cannot afford to comply with the conditions for returning seed. Training in seed production and management for seed producers opens up new sources of income, which should not remain the sole preserve of the better-off. A successful seed bank has the potential to develop into a small local seed company.

Community seed banks are a good complement to community seed fairs. Both promote the conservation of agricultural diversity. In order to assess whether a seed bank will be sustainable without project funding, an understanding of the local seed production system is required, including such key questions as: when are farmers unable to save seed, which farmers are most under threat from seed insecurity, and what quality deficiencies does the seed exhibit? Transfer of the necessary know-how may take place via training programmes on seed production and selection.

In order to make a more thorough assessment of the effect of community seed banks on the conservation and sustainable use of agrobiodiversity, however, further studies will be necessary.

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1.6 Promoting local innovation in managing agricultural biodiversity

Fetien Abay, Edson Gandarillas, Pratap Shrestha, Ann Waters-Bayer, Mariana Wongtschowski, 2010

Increasingly, development projects promote the role of farmers, smallholders, herders and other local resource users in conserving natural and agricultural biodiversity. However, they often overlook local efforts to make new uses of and enrich biological resources. Farmers' past contributions to domesticating, selecting and breeding plants and animals are acknowledged, but rarely what they are doing today. Men and women farmers continue to explore new ways to use biodiversity to spread risks, enhance food security and improve livelihoods. Especially poorer farmers innovate in biodiversity management in efforts to increase their options for coping with change and to exploit micro-environments in their agroecosystems.

Mrs. Lal Kumari Thapa with award received from LI-BIRD for her innovativeness in domesticating medicinal plants.
Photo: Shashish Maharjan

Local innovation is the process by which local people, on their own initiative, develop new and better ways of doing things. Out of this process emerge local innovations, which may be technical or socio-institutional (such as making new rules for resource use) and are tailored to the needs of the local farm families and communities. These site-appropriate ideas deserve support. Recognising them encourages farmers and scientists to cooperate in research to improve agriculture and natural resource management. Local innovations offer entry points for identifying questions of mutual interest to explore together. Taking local innovation seriously reinforces farmers' self-confidence to manage and improve the resources on which they depend.

This approach to research and development reflects the very principles of good biodiversity management: appreciating local specificity, valuing and ensuring the continued existence of multiple types of assets (be these genes or creative ideas), keeping possibilities open for adaptation and, thus, assuring resilience and sustainability.

Local innovation in domesticating plants

In many countries, one encounters local people who keep "botanical gardens". These are often local healers seeking easier access to the plants they need. Similarly, "forest farmers" manipulate mixtures of natural and cultivated species. For example, Amerindians in Amazonia sow or transplant crop species in forest openings and selectively cut and enrich the forest with desired species of timber, fruit and medicinal plants. They innovate continuously in the face of changes in environmental and social conditions and in relative value of different species.

Example: Domesticating plants in homegardens in Nepal

Jaya Bahadur Thapa and his wife Lal Kumari Thapa live in Chaur, a village in Kaski District in western Nepal. Both are traditional healers. They used to collect the medicinal plants from the forest but then began to grow them near their home to save time and ensure supply. After studying the habitat and growth habits of the wild plants, they collected seed and tried out different sowing and management practices. They have domesticated about 145 medicinal plants in their homegarden and nearby land.

The couple belongs to the Pratigya Cooperative in Chaur which, already in 1997, started working with LI-BIRD, the Nepal Agricultural Research Council and Bioversity International on *in situ* conservation of agricultural biodiversity. The Cooperative asked the couple to help identify medicinal plants and record local knowledge about them for a Community Biodiversity Registration Programme. The Thapas helped record 165 medicinal species in homegar-

dens, farm-land and the village forest, and frequently inform other farmers and visitors about the plants. They take part in the annual local Biodiversity and Agriculture Fair, where they spread awareness about the value of local medicinal plants. Their home is now a Knowledge Resource Centre for people, including schoolchildren, to learn about domesticating and using these plants.

Several farmers in Chaur now grow medicinal plants and sell them to the Thapas. People from beyond the village come to seek ayurvedic treatment from the couple. Also traders in me-dicinal plants are among their clients. To honour Lal Kumari for her contribution to domesticating and popularising threatened plant species, LI-BIRD gave her the "Innovative Women Farmers' Award for Conservation of Biodiversity" in 2007.

Mr. Jaya Bahadur Thapa (2nd from right) briefing visitors about his collection of medicinal plants. Photo: Pratap Shrestha

Local innovation in breeding

Over centuries, farmers have developed countless crop varieties and animal breeds to suit specific agroclimatic conditions and culinary purposes. To this day, farmers – especially those in marginal areas – continue to do so.

Example: Developing site-appropriate barley varieties in Ethiopia

In semiarid Tigray in northern Ethiopia, smallholders have in recent years developed locally adapted varieties of barley to suit current conditions and needs. Using single-plant and mass selection, farmers developed new naked and hulled barley varieties that are superior to cultivars recommended by formal plant breeders. These varieties are better able to tolerate stresses such as disease pressure, waterlogging and drought. They are ideal for the high-risk and low-input farming systems in northern Ethiopia. They are in high demand for local food products, such as snacks of roasted barley (*kollo*), that Tigray women are commercialising on their own initiative.

The local innovation process involves both men and women. Couples decide jointly on how many varieties to grow, seed selection and plot allocation. Seed storage is women's work. Women's important role in managing seed is reflected in local sayings such as: "*No wife, no seed, no life*".

Researchers from Mekelle University strengthened local innovation in plant breeding by engaging in participatory research with farmers and development agents. In seven districts of Tigray, farmers conduct trials that include the farmer-developed varieties. This research was the topic of a village workshop with farmer breeders, development agents, scientists and local policymakers, who discussed challenges related to seed production and variety release. The research made scientists appreciate how farmers continue to transform domesticated plants. Farmers' knowledge of genetic resources and their ongoing plant selection and breeding activities create a good germplasm base that, combined with scientists' knowledge, could lead to development of cultivars with wide potential for use in semiarid areas.

Local innovation in collective action

Individual farmers who show outstanding innovativeness in managing biodiversity generally acknowledge that their achievements grow out of past and present knowledge in the community. Most local innovation emerges from a collective process over generations and is not owned by any individual. Many rural communities have, on their own, created and continue to adjust local institutions to protect species useful for their survival. In some cases, governments have appreciated this local institutional innovation and provide support so that the initiatives can prosper.

Example:
Alternative uses and markets for Andean roots

As an alternative to growing coca, new crops like bananas, coffee, pineapple and citrus were promoted in Coroico Municipality. In the process, the genetic diversity of native roots decreased. For example, the *Arracacha*, also known as Peruvian carrot, and *Achira*, a potato-like tuber, became less important in the diet. To prevent complete loss of the traditional roots, women in San Juan de la Miel got together to promote them. For their initiative, the municipality granted them funds and land. They documented their botanical knowledge of the roots, set up varietal gardens and organised diversity fairs, where they also offered foods made from the roots. Especially tourists showed interest in these foods – and brought the women to a new business idea. To be able to take advantage of the commercial potential of the traditional roots, the women and the municipality sought experts who could help them develop and market new products. They took up contact with PROINPA, a local foundation working on genetic resources, food sovereignty and marketing.

Through the collaboration with PROINPA, the women learned more about the nutritional value and processing potential of the roots. The high digestibility of the starch (suitable for infants, the old and the sick) and their elastic and glutinous properties make the roots ideal for flakes, flour and purées. These new products led to new marketing challenges. The women's groups needed new procedures to produce with high quality, keep to industrial standards, agree on profit distribution and establish business links. Market regulations in Coroico and La Paz needed to be changed to ensure access by rural families. PROINPA accompanied the women through these changes, helping them "learn by doing". The women gained higher income from selling more varied and better-quality products, and gained higher standing in their community and families. As one woman said: "*The money we earned made our husbands consider us as an important pillar of the family*".

Policy implications

Scientists, development agents and local administrators should become more aware of local men's and women's creativity in managing genetic resources. They should look beyond traditional knowledge and recognise the dynamics of local experimentation and innovation. Local governments are well placed to promote these initiatives and to fit them into local development strategies. Only through widespread de-centralised research and development activities can adequate attention be given to crop varieties and animal breeds that are locally important to meet cultural needs and to suit sitespecific agroecological conditions.

Farmers characterising barley varieties. Photo: Fetien Abay

An enabling policy environment is crucial to strengthen endogenous innovation and stimulate participatory research and development. This is in line with the International Treaty on Plant Genetic Resources for Food and Agriculture, which supports Farmers' Rights to use, exchange and sell farm-saved seed; to take part in relevant decision-making; and to be rewarded for this invaluable contribution to the global genetic pool (*see 3.2 "International Treaty on Plant Genetic Resources for Food and Agriculture" as well as 3.4 "Farmers' Rights and agrobiodiver-sity"*).

Farmers not only save seed but also develop improved varieties for local conditions. The Treaty indeed calls for participatory plant breeding. This requires adjustment of breeding strategies and regulations for variety release. Still, however, farmer-relevant traits and locally preferred varieties may not be certified because farmer-developed varieties are not recognised in national seed-legislation systems. This recognition would increase the benefits of plant breeding for resource-poor farmers.

In addition, farmers should have the right to decide about the research agenda related to agriculture and natural resource management. This would help institutionalise a farmer-led participatory approach to developing genetic diversity.

Likewise, the Convention on Biological Diversity provides for protection of indigenous peoples' knowledge, innovations and practices; and also protection of the ecosystems needed to support local innovation in domesticating plant and animal genetic resources. These provisions – like those of the International Treaty – must be incorporated into national policies and actually implemented, including support to local innovation in conservation and sustainable use of biodiversity.

Other farmers visiting farmer breeder's experiment. Photo: Fetien Abay

Practical implications for development cooperation

Development projects related to agricultural biodiversity should deliberately seek local innovators in managing biodiversity. Finding them is not a problem, as other local farmers usually know who they are. The strengths and weaknesses of local innovations should be discussed with local farmers – men and women – to reach agreement on how to support the most promising innovations.

Local biodiversity innovators should be included as resource persons in project activities, e.g. by inviting them to workshops or organising visits by other farmers. Encouraging formation of small common-interest groups around local innovators is a good entry point for participatory research and development.

Incentives – in terms of both recognition and socio-economic benefits – can encourage farmers to innovate in biodiversity management and to share their knowledge. The possibilities are many: public awards, recognising local innovators as resource persons, helping farmers protect their rights to use genetic resources, and officially recognising the varieties and breeds developed by farmers. Often, these knowledge holders do not want individual intellectual property rights but rather public appreciation for their contributions.

It is especially important that young people learn to value local biodiversity knowledge and initiatives. Some plants almost extinct in the wild can be found only in local botanists' backyards. Schoolchildren, young farmers and extension workers should "go to school" there, so that the local botanists' knowledge about and enthusiasm for biodiversity can become infectious. Such activities can be linked to school science programmes and environment clubs.

Multistakeholder partnerships can enhance local innovation for sustainable use of biodiversity. They are essential for realising the full potential of local genetic material. Farmers involved in such partnerships can integrate scientific knowledge and new genetic material into their resource-use systems. These innovative men and women develop skills in public speaking and can then play a stronger role in community development. The interaction of support organisations with local biodiversity experts builds these people's capacities to engage in dialogue also with other stakeholders and to influence the research and development agenda.

Some organisations that deal with local innovation in managing biodiversity are:

- LI-BIRD (Local Initiatives for Biodiversity, Research and Development). www.libird.org
- PROINPA (Promoción y Investigación de Productos Andinos). www.proinpa.org
- Prolinnova (Promoting Local Innovation in ecologically oriented agriculture and natural resource management). www.prolinnova.net; here one can find more detailed information on this topic, including the longer working paper with annotated bibliography.

1.7 Home gardens
– treasure troves of diversity

Sylvia Reinhardt, 2005

Photo: Jörn Breiholz

What are home gardens?

Home gardens are agro-ecosystems located close to the area that serves as a permanent or temporary residence. Within a very small area one can find a combination of trees, shrubs, vegetables, root crops, grasses and herbs that provide food, spices, medicines and construction materials. Domestic animals are often integrated into the system too.

The produce from these gardens not only secures food and income; it will often have an important cultural significance too. For example, indigenous communities in the Amazon Basin use the red seeds of Bixa orellana as a body paint at traditional festivities, or the psychoactive Brugmansia sp., or Angels' trumpet, for shamanistic rituals.

Home gardens undergo a constant development process, since the composition and use of crops changes according to the circumstances and needs of the gardeners. Material acquired by means of barter will be tried out, or efforts will be made to domesticate wild plants. Conserving horticultural crops in cultivation (*in situ*) – as opposed to conserving them in gene banks (*ex situ*) – has the advantage that varieties are constantly continuing to develop. This means that new utility values of plants may emerge as a result of evolutionary adaptation.

Anything but wallflowers

For centuries, small farmers and indigenous communities have developed and conserved a great variety of crop plants. Adapted to their location, climate and cultivation practices, traditional horticultural crops provide a yield and an income throughout the year, even without external agricultural inputs. In developing countries, they therefore make a major contribution to the food supply and to securing the livelihood of the population.

At the same time, continuing use of crop plants, passed down from one generation to the next, makes home gardens important sites for conserving plant genetic resources and sustaining a vibrant diversity.

In most cases, women determine what plants are grown in the home garden, because in many societies they are mainly responsible for food and healthcare within the family. In terms of choice of species and varieties, the priorities they set are often different from men's, and in their small, highly productive, but often largely disregarded gardens, they cultivate the plants they need for culinary, medicinal or cultural purposes, or for the market. They experiment with species and varieties and develop them further. The women preserve knowledge about cultivation practices that are suited to the local environment, about local species and how they are prepared for use in traditional dishes or for other purposes. In many countries, therefore, women are the custodians of agricultural biological diversity.

Greater diversity – higher income

In the context of a research project funded by the German Federal Ministry for Economic Cooperation and Development (BMZ), the International Plant Genetic Resources Institute (IPGRI) conducted a study involving five countries to assess the role of home gardens in terms of conserving plant genetic resources. Another objective of the study was to examine whether promoting horticultural diversity has a positive impact on sustainable development. The results were conclusive: the greater the diversity in the home garden, the better the food and income situation of the households. At the same time, the study emphasized the key role played by rural communities in terms of conserving agrobiodiversity.

On the basis of the results of the country studies, home gardens were categorized according to agro-ecological zones and the types of vegetation present. This has provided a framework that can now be used by other countries. The findings of the IPGRI study have already been used in a number of national programmes aimed at conserving plant genetic resources.

In Vietnam, for example, where there is a long tradition of home gardens, IPGRI conducted a survey of 100 different home gardens in conjunction with national institutions. The outcome demonstrated just how productive home gardens can be. Some households derive as much as 50-60 percent of their income from the sale of garden produce. On these plots, averaging around a quarter of a hectare in size, a total of 646 plant species and varieties were identified. Key species, represented by a broad range of varieties, included banana (*Musa sp.*), jackfruit (*Artocarpus sp.*), papaya (*Carica sp.*), longan (*Dimocarpus sp.*), cassava (*Manihot sp.*), taro (*Colocasia sp.*) and sweet potato (*Ipomoea sp.*).

Since the 1970s, state-promoted structural change in the agricultural sector and resettlement measures have brought about a sharp decline in traditional agro-ecosystems in Vietnam. Many crop plant varieties have been lost as a result. The IPGRI study enhanced our understanding of the complementary nature of *in situ* and *ex situ* conservation, with the result that state development activities are now specifically aimed at promoting sustainable use of home gardens with agroforestry approaches in Vietnam.

Cuba provides us with another example: the IPGRI study proves that home gardens are well suited to protected areas, because they make a major contribution to conserving biodiversity. Cuba increasingly views home gardens as a key component of its national *in situ* conservation efforts and supports the inclusion of agroforestry-based home gardening activities in the management of protected forest areas and their buffer zones. In Cuba's national programme for protected areas ("Man and the Biosphere Reserves") and ecological reserves, products from home gardens are being promoted explicitly as a local source of income.

Photo: Jörn Breiholz

Photo: Feng Yingli

Beyond the garden fence

Whether farmers (of either gender) maintain traditional cultivation practices and broad genetic diversity depends largely on the conditions in the country concerned. Is there an infrastructure and access to markets? What sort of land rights and laws are in place? What is promoted under the national agricultural policy? These are questions that have to be addressed if home gardens are to be promoted in a sustainable way.

The socio-cultural environment, too, has considerable influence on what is grown in home gardens. If living and eating habits change, for example, this can hardly fail to have an impact on the home garden. A change in lifestyle always has a direct effect on the genetic diversity of both plants and animals used in horticulture or agriculture. Cultural losses in indigenous communities always go hand in hand with a loss of agrobiodiversity.

In order to counteract progressive genetic erosion, more attention must be devoted to home gardens in future. They should be included specifically in international and national rules and action plans. Furthermore, the significance of traditional knowledge and practices for the protection and sustainable use of biological diversity must be acknowledged. This includes ensuring that the local population and indigenous communities have long-term access to the genetic resources developed by them – despite increasing calls at international level for intellectual property rights for new varieties of plants.

Further promotion measures include:

- Better access to land (title deeds)
- Technical support for local communities, e.g. in obtaining, exchanging and further developing seeds and planting material
- Identifying new products and markets.
  This could create incentives for sustaining home gardens and their diversity.
- Promoting home gardens in zones on the fringes of protected areas, among other things to compensate for restrictions relating to protected areas
- Introducing agrobiodiversity monitoring
- Participation of farmers and indigenous communities in the process of developing policy and scientific programmes
- Promoting research projects relating to biodiversity in home gardens
- Promoting the transfer of knowledge among communities and between communities and research institutions
- Awareness-raising and sensitization of the population and policy makers

Photo: Li Qingsong

Two birds with one stone

On the one hand, home gardens are an important component of national strategies for sustaining agrobiodiversity. On the other, at local level, they contribute to securing livelihoods and incomes. Both these aspects should be reinforced in the context of development cooperation. In doing so, it is important to ensure that indigenous communities and local municipalities are actively involved in planning, executing and evaluating measures and programmes of this sort and that they are empowered to represent their interests themselves.

Home gardens can make a significant contribution to the *in situ* conservation of plant genetic resources. Efforts to promote this form of cultivation are still in their infancy, but there are already some encouraging examples. In Guatemala, for example, promoting diversity in home gardens is part of a broad-ranging municipal development strategy. In Ghana, public interest in agricultural diversity grew when new income opportunities were created through the sale of traditional foods. Home gardens are ideally suited to raising public awareness of the significance of diversity in the agricultural and horticultural context as part of cultural heritage.

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1.8 "Underutilized" species
– rich potential is being wasted

Anja Christinck, 2005

The roseleaf raspberry (*Rubus rosifolius*) can provide an additional source of income for farmers in Hunan, China. Photo: Feng Yingli

What are "underutilized" species ?

The term underutilized species – referring to animals, crop plants, wild or semi-wild plants – applies to those species which appear to have considerable potential for use yet whose potential is barely exploited, if not totally neglected, in agricultural production. For example, there are numerous plants which are particularly well adapted to specific sites and agricultural production systems. This category includes crops like yams, the 'Inca wheat' quinoa, and many species of tropical fruits and vegetables.

The reasons for the underutilization of such species vary: it may be that their useful traits are not well known; perhaps there is little processing or marketing capacity, or a lack of interest on the part of agricultural research. "Taro", the tuberous root of *Colocasia esculenta* is an example of a species overlooked by science. Although it is one of the staple foods in Africa, Asia and Latin America, there has been less research on taro than on asparagus.

Instead of "underutilized" species, the related terms "minor", "local", "neglected", or "orphan" species are also used in literature. These terms all focus on certain aspects which restrict a wider use, for example the fact that they have been "neglected" by scientific institutions, or that they are of "minor" economic importance. Other authors have suggested the terms "alternative" or "promising" species to highlight their potential.

Trend towards uniformity

Until the beginning of the 20th century, a wide range of locally-adapted crop varieties and livestock breeds were available to farmers. This diversity contributed to the security of the food supply and helped to safeguard people's livelihoods. Nowadays, the bulk of the world's food is derived from just a few species. For example, the three major cereals – wheat, rice and maize – supply more than half of the global protein and calorie intake. Relatively few modern varieties are planted on every continent, accounting for almost three-quarters of the land under cultivation, where they have supplanted the diversity that once existed. Farm animals have been affected by a similar trend. The success of Holstein-Friesian cattle seemingly knows no bounds. This highly productive breed is now dominant, making up 60 percent of European and 90 percent of North American dairy cattle. Many developing countries are becoming increasingly reliant on industrial dairy production, and are supporting cross-breeding programmes using Holstein-Friesian and other exotic high-performance breeds.
But it will take more than a handful of species to feed the world population and secure its income in the long term. It is important to retain a broad genetic base of our major crops and farm animals, so as to allow for breeding activities to adapt plants and animals to changing environmental conditions, market requirements or new pests and diseases. At the same time, increasing the number of species in agricultural systems helps to raise their all-important buffer capacity.

The 1996 Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources makes specific reference to promoting development and commercialization of under utilized crops and species. The same goals were adopted by the World Food Summit (Rome, 1996), because underutilized species make an essential contribution to food security and poverty reduction. If a proportion of the major food crops in production were replaced or supplemented with underutilized plants and breeds, this would not only increase the number of species in production but would also result in a healthier and more diverse nutritional base.

Setting a good example

A range of initiatives are already in hand to investigate potentially profitable uses of underutilized plants and animals. These activities are taking place both nationally and internationally, in some cases involving cooperation between the private and the public sectors.

Adding value to local breeds – Nguni cattle in Southern Africa

The Nguni breed of cattle is uniquely adapted to the harsh Southern African environment. Nevertheless, during the first half of the 20th century, it was crossed with exotic breeds over an extended period, causing the original Nguni cattle population to decline substantially. The local breed was deemed unproductive, but in fact the animals possessed valuable traits which had been overlooked. Not only is the Nguni breed resistant to ticks, it is also extremely tolerant of heat and drought, and relatively undemanding in terms of feed quality or veterinary care. Its hides are highly prized among the local population for their attractive markings. For all these reasons, Nguni cattle have become the stuff of numerous poems and myths.

In cooperation with the private sector, GTZ is seeking to improve processes within the production chain. It envisages supporting the organization of local smallholders and their herd management practices. Additional issues are marketing, meat quality, hide treatment at the time of slaughter, transportation conditions and secondary processing. Joint efforts will be made to seek new markets for the high quality leather and the "organic" meat produced. Both can be expected to do well in niche markets.

El Salvador's balsam trees – conservation through use

The balsam trees of *Myroxylon balsamum var. Pereirae* only grow in the western part of El Salvador. Long ago, the Mayan people knew of the tree's resin, which can be used for medicinal purposes, for cosmetics, and as an aromatic ingredient. During the colonial era, balsam was shipped to Spain via the port of Calao in Peru, which is why the name "Peru balsam" is still in widespread use today. With the emergence of synthetic substitutes, balsam production has become less and less profitable over the years and balsam forests have increasingly been destroyed. In collaboration with local partners and the Centre for the Promotion of Imports from Developing Countries (CBI) in the Netherlands, GTZ is now working to strengthen El Salvador's balsam sector.

A sector strategy will be formulated and the production process of the natural product will be better documented. Other planned support measures include the establishment of a central quality control system and the development of a marketing concept. Furthermore, the project will explore how far an integrated 'balsam tourism project' is likely to help to improve the economic and social situation of the people living in the balsam production region, who are the guardians of this unique tropical forest.

Creation of a global hub

In order to promote international exchange on species with high potential and to strengthen existing initiatives and networks, a dedicated global hub – the Global Facilitation Unit for Underutilized Species, GFU – was created in 2002. The project, which was initiated by the Global Forum for Agricultural Research (GFAR), is being financed by the German Federal Ministry for Economic Cooperation and Development (BMZ) and is based at the International Plant Genetic Resources Institute IPGRI in Rome. Its main function apart from providing information is to offer a forum for discussion, of support concepts for the sustainable use of underutilized species, for instance. Initially the GFU will confine itself to the sphere of plant species.

What underutilized species can offer

Greater food security: Local crops and animal breeds can increase food security, particularly if they are adapted to specific marginal agricultural conditions. Diversification is a means of risk reduction.

Healthy nutrition: Many underutilized crops have important nutritional qualities, such as a high fat content, high quality proteins (essential amino acids), a high level of minerals (such as iron), vitamins, or other valuable nutrients which have not yet been described satisfactorily. They are therefore a significant complement to the "major" cereals and serve to prevent or combat the hidden hunger – a diet deficient in vitamins, minerals and trace elements – which is prevalent in developing countries.

Income generation: Underutilized species are capable of supplying both foodstuffs and industrial raw materials, which will offer new opportunities for income generation if their market potential is successfully recognized and developed.

Poverty reduction: Many underutilized plant species and breeds require few, if any, external inputs for production. This is an incalculable advantage, especially for poor sections of the population. For example, local cattle breeds can thrive without fodder supplements and preventative veterinary treatments. While they may be less productive, their performance remains consistent when conditions are less than ideal. Local crops produce lower but stable yields even on marginal land and without additional inputs of mineral fertilizers and pesticides. If the land in question does not belong to the farmers, it may still be possible to use wild or semi-cultivated species (such as medicinal herbs, dyes, etc.).

Sustainable use of natural resources: Locally adapted crops and animal breeds offer potential for the sustainable use of more challenging sites, such as semi-arid or mountain regions. A well-known example is that local cattle breeds are often less destructive to the vegetation cover on slope land than (heavier) high performance breeds. Local crop species and varieties fit easily into traditional sustainable farming systems geared towards maintaining or restoring soil fertility, like mixed cropping and agroforestry.

Indigenous knowledge and cultural identity: Many smallholders possess very specific knowledge of cultivation and processing techniques for underutilized species and their diverse uses. It is not unusual for certain plant or animal species to be of great spiritual importance for the people and their cultural identity.

What are the limitations on use?

Lack of market infrastructure: Many underutilized crops and animal products are used almost exclusively for the farmers' own subsistence, even where the potential exists to market them more extensively. This is due to the lack of infrastructure for marketing products of suitable quality and in appropriate quantities to potential customers.

Lack of technologies: Traditionally, underutilized plant and animal products have been processed manually on farms, often using labour-intensive and time-consuming methods. To expand the scale of production, efficient technologies must be developed for manufacturing, storage and processing, to ensure that quality standards can be met.

Photo: Li Qingsong

Lack of knowledge and erosion of cultural diversity: Often, neither scientists nor consumers are aware of the nutritional value, medicinal properties or other special characteristics of these products. Indeed, fundamentally negative attitudes may prevail towards local traditions. In extreme cases, indigenous culinary traditions and local specialities may be dismissed as "old-fashioned" or "paupers" food.

Lack of political support: The food security programmes in many developing countries are based on agricultural policies which favour the 'green revolution crops' and focus exclusively on maize, wheat or rice, and export crops. In animal production, the emphasis has long been on promoting the use of high-performance breeds, even though they only produce high yields in ideal production conditions. Incentives, subsidies and loan programmes for this type of agricultural production distort the market, to the detriment of traditional crop varieties and animal breeds. Complicated authorization procedures can also be an obstacle to accessing new international markets. One example is the Novel Foods Regulation of the European Union, which requires extensive safety-testing of novel foodstuffs on public health grounds before they can be introduced to the European market.

In addition to the reasons mentioned, there are certainly other causes of underutilization which are not so easily remedied, at least not in the short term; for example, low yields, unpalatable flavours or poor keeping qualities.

New strategies to promote use

Before strategies can be developed to promote use of a species, careful analysis is needed of its potential and the factors constraining its use. Essentially, two different approaches are possible:

- The commodity chain approach aims to develop the market potential of a particular species or product by strengthening weak points in the value chain.
- The livelihood approach is an effort to exploit the full livelihood potential. It seeks to find better uses for the species in relation to the producers' life situation, e.g. for their nutrition, for their health, to strengthen their cultural identity, and to conserve natural resources.

Both approaches can combine various strategic steps to promote their product: optimizing production and storage methods, improving quality standards, processing and marketing, strengthening organizational structures, lobbying, awarenessraising and public relations work.

Essentially, promoting the use of underutilized species is most successful when it does not concentrate on one product in isolation but forms part of a regional development concept. Of course, the technologies and social structures deployed within the project must be sustainable. In the case of export products, it often makes sense to team up with fair trade and organic initiatives.

In the long term, the promotion of underutilized species must be mainstreamed into regional and national development strategies, and research and advisory work must take up the cause of species with high potential. The main point is not to carry out isolated projects, but to make a lasting impact by reversing the loss of agricultural diversity.

Win-win solutions are possible

In recent years, a growing interest in exotic foods has been noticed among consumers in the northern hemisphere. Products made from underutilized species could satisfy this desire for variety, encouraging greater agricultural diversity and benefiting producers in the South – as long as those who have developed the previously neglected species into lucrative ones are not forced out of the market later by more powerful producers.

The promotion of high-potential species will only result in higher agrobiodiversity if their increasing commercial use does not simply displace other crops or breeds from production. Hence it is necessary to monitor and document the precise impacts of export-oriented promotion on agrobiodiversity, on opportunities for income generation, and on social structures.

Photo: Guenay Ulutuncok

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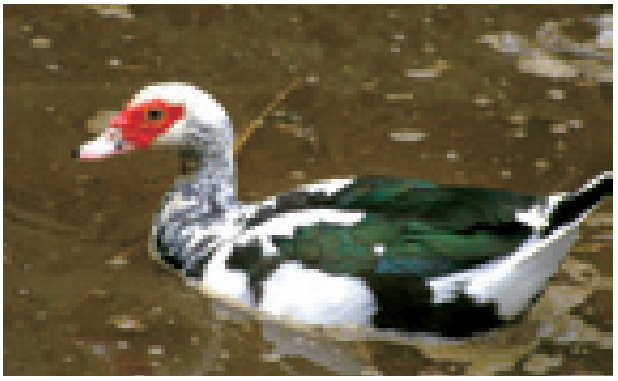
1.9 Landraces

– allies in the fight against animal epidemics

Ilse Köhler-Rollefson, 2006



Current measures against Avian Influenza severely threaten domestic poultry diversity – the photo shows a Pomeranian Duck, a breed threatened by extinction. Photo: Feldmann/GEH

Avian Influenza is the latest animal disease that has frightened many people as we watched it spread across Asia and Europe. Apparently, not even the pre-emptive culling of chickens, geese, ducks and turkeys – whether infected or not – can halt its spread, even though that is the exact objective of culling. In the past decades the carousel of animal diseases has spun ever faster. According to the United Nations Food and Agriculture Organization (FAO), every year on average one new animal disease has emerged. Three quarters of these were zoonoses.

Globalisation accelerates the spread of disease

Several factors are thought to be responsible for the increase in pandemics. The increase in intensive livestock farming requires increased drug use. This in turn leads to increased drug resistance among disease-causing organisms and a reduced immunity status of livestock populations. Globalisation and the expansion of world trade have resulted in more frequent movements of livestock and livestock products around the globe, and have facilitated the spread of infections. Some regard the Sanitary and Phytosanitary (SPS) Agreement of the World Trade Organization (WTO) as a further cause. To facilitate trade, it restricts the use of sanitary and phytosanitary measures considered excessive. Some countries regard this as a way of forcing them to accept low-quality imports of animal products.

Key terms

Immunity is a human's or animal's insusceptibility to a certain disease. It can be congenital or acquired through vaccination.

Resistance is the ability of a host to resist infection or control the lifecycle of a parasite.

Tolerance means that an infected animal displays few measurable symptoms of a particular disease.

An infection or disease is endemic if it occurs in a particular location or population with predictable regularity.

A disease is called an epidemic if it infects many animals at the same time and spreads rapidly.

An epidemic becomes a pandemic if it spreads all over the world or over several continents.

Measures designed specifically to prevent the spread of an infectious agent are termed biosecurity measures.

Zoonoses are animal diseases which can also be transmitted to humans; they include rabies and anthrax.

In vitro conservation describes the preservation of genetic material, for example in a seed bank.

In vivo conservation, in the context of the conservation of animal genetic resources, describes the keeping and breeding of animals, for example on a farm.

Cryoconservation is the deep-freezing of sperm or embryos.

At the international level, the World Organisation for Animal Health (OIE) is a standard-setting body. It has established a list of diseases that spread rapidly, have significant mortality and/or morbidity and have zoonotic properties. Member countries are obliged to notify the OIE in the event of an outbreak of these diseases. The OIE then limits the trade in animals and animal products from the affected country.

The OIE regulations are also the basis for the relevant EU Directives. Since 1991, the EU has prohibited vaccinations against Foot and Mouth Disease (FMD), Classical Swine Fever (CSF) and Avian Influenza, because it was not possible to distinguish between vaccinated and infected animals. Despite massive farmer protests the EU continues to follow this policy. In China, however, poultry is now being vaccinated in response to Avian Influenza.

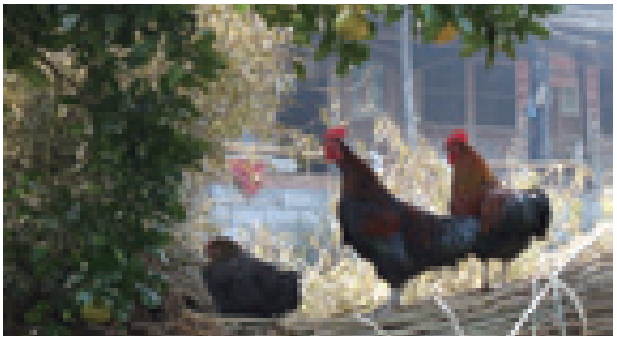


Photo: GTZ

Damage runs into the billions

Livestock epidemics cause enormous damage. For example, the impact of the current outbreak of Avian Influenza in Asia has been estimated at US$ 1015 billion in the affected countries. By April 2005, more than 140 million birds had died or had been preemptively destroyed.

During the Avian Influenza outbreak in the Netherlands in 2003, more than 20 million birds were culled in order to prevent the spread of the disease. Vaccination was prohibited. Exemptions were not even made for purebred show birds and hobby flocks. Thus more than 175,000 hobby animals and waterfowl were culled.

Disease control – the end of the road for rare and threatened breeds

The EU's disease control policy has significant impacts on rare breeds. During the FMD outbreak in the UK, breeding populations of sheep such as South Country Cheviot and Herdwick were reduced by a third, and specially adapted breeds including Lonk and Rough Fell were reduced by a quarter. The largest flock of high-performance British Milk Sheep, consisting of 400 ewes, was also culled.

In developing countries it has not been possible to monitor the effect of the stamping-out policies on animal genetic resources, but the impact is likely to have been devastating.

In Germany, regulations to combat CSF require that pig stables must be built inside a gated enclosure to guarantee that no contact can take place with possible disease carriers. Outdoor keeping of pigs has been placed under so many restrictions that many keepers of rare pig breeds have given up.

In the wake of these experiences, rare breeds associations and smallholder/farmer associations have strongly lobbied their governments and the EU to change the stamping-out policy and to make special provisions to save threatened breeds and hobby animals.

Both the OIE and the EU Commission have recognised that there are ethical, ecological and economic problems with fighting outbreaks of epidemics by means of mass culling. They have acknowledged that vaccinations are a more appropriate approach. In guidelines for decision-making for the control of FMD, the FAO has also emphasised the importance of genetic conservation as an insurance against change, and recommended a combination of in vivo and in vitro conservation programmes.

Accordingly, the new EC Council Directive (2003/85/EC of 29 September 2003) on FMD gives priority to emergency vaccinations over killing. This legislation also contains special provisions for zoos,

The need to integrate wildlife into disease surveillance

Many pandemics can be cayrried and transmitted by wild animals as well. Even when all infected domestic animal stocks both commercial and hobby flocks or herds have been stamped out, free-ranging and captive wildlife can provide important reservoirs for reinfection of livestock. With respect to Avian Influenza, it is known that wild birds play a role in spreading the disease; however, the exact mechanism is not yet known. In the UK it is suspected that deer populations may carry FMD. Hence it is necessary that the disease status of wildlife populations is also monitored. However, this is difficult and there is great need for further research.

wild animal parks and other institutions that conserve threatened breeds and species. If a breeding herd has been identified as essential for the survival of an officially registered threatened breed in advance, then the appropriate body in the country can order special measures such as prophylactic vaccination instead of killing. Nevertheless, these special measures, together with basic strategies for combating the epidemic, need to be embedded in a specific contingency plan. While countries are in the process of discussing these contingency plans with stakeholders, they are under no obligation to make them public.

The Directive also places a responsibility on Member States to establish lists of holdings where animals are kept for purposes related to the conservation of animals that are indispensable for the survival of that breed. A good example of the implementation of the Directive is furnished by the British contingency plan.

Thanks to outspoken non-governmental organisations (NGOs), special provisions are now being made in Europe to save valuable animal genetic resources in case of disease outbreaks. But in developing countries there have been no such moves. The global strategy for the progressive control of highly pathogenic Avian Influenza, which entails a seemingly comprehensive plan of action, does not make any reference to animal genetic resources, even though indigenous poultry breeds and their smallholder owners are the ones that will be most affected. There is thus a need for organisational strengthening of livestock keepers in developing countries, so that they can press for special regulations for their indigenous breeds, following the example of Europe.

Breeding instead of vaccinating

Breeding for disease resistance is an emerging trend in disease control. It is motivated by the increasing resistance of pathogens. In addition, consumers increasingly favour naturally grown food that contains no additives.

Diseases that can successfully be managed by breeding include tick infestations, helminth infections, and Marek's Disease – a viral disease causing paralysis in poultry. Experts emphasise that genetic options for disease management need to be integrated into whole-system solutions, and that the communities which depend on livestock need to be actively involved. Currently there are many open questions with respect to breeding for disease resistance. One is the issue of whether this may compromise productivity. Resistance to infections is always relative rather than absolute, and it is also not possible to achieve resistance to all pathogens. However, an increased level of natural resistance can certainly reduce morbidity and economic losses caused by infectious diseases. The solution may lie in combining vaccination programmes with breeding for natural resistance.

Cryoconservation is, however, not sufficient for the conservation of animal genetic resources, as freezing prevents the adaptation of the genetic material to changing disease scenarios and new diseases.

Epidemics undermine consumer confidence

Epidemics affect consumer behaviour worldwide, at least temporarily. Following the Avian Influenza outbreak, fast-food chains in Southeast Asia reported a switch from chicken products to fish burgers. In Vietnam, lack of supplies led to the disappearance of chicken from upmarket restaurants, and from the homes of those on higher incomes. In Europe, the BSE outbreak caused consumers to avoid purchasing conventionally raised beef. The series of disease outbreaks precipitated policies supporting sustainable and organic livestock production and contributed to raising consumer interest in organic products.

Combining disease eradication with the conservation of genetic resources

In order to ensure that disease control does not eliminate valuable animal genetic resources and does not reduce genetic resistance in the global livestock population, targeted policies for the protection of rare and indigenous breeds need to be designed and integrated into disease control strategies.

Photo: Guenay Ulutuncok

International level

- The FAO and OIE must give consideration to animal genetic resources and the socio-economic status of livestock keepers in their global pandemic action and contingency plans.
- Discriminatory use of mass culling policies.
- Reconsideration of agricultural policies and practices in order to take account of biological, environmental and financial factors. NGOs such as Rare Breeds International suggest that "attention has been focused too narrowly on maximising production and profit, and that insufficient attention has been paid to food security, animal health and genetic conservation". They recommend a critical evaluation of the impact of intensive farming methods, and an assessment of the benefits of extensive systems and local production for local needs.
- More effective regulation of long-distance movement of livestock and the feeding of animal products such as meat-and-bone meal.

National level

- Inclusion of indigenous animal genetic resources in national contingency plans, as well as the national pandemic preparedness plans and global pandemic exercises that have been suggested by the FAO, OIE and WHO.
- Establishment of inventories of rare and threatened breeds in developing countries and registering of the relevant communities or breeders' associations.
- Keepers of rare and indigenous breeds in developing countries need to be supported organisationally so that in the event of a pandemic, their holdings can be given special consideration and be exempted from culling.

Regional level

- Increased research to develop vaccines that allow a distinction between vaccinated and infected animals.

Photo: GTZ

- Awareness-raising and capacity-building of NGOs in developing countries, so that they can play a similar role to that of European NGOs.
- Firmer focus on local production of livestock products with full traceability. Locally adapted breeds, marketed and processed through local networks of abattoirs and markets, reduce the possibilities for major epidemics and provide the basis for a vigorous local economy.

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1.10 Unwelcome guests – invasive alien species (IAS)

Dieter Nill, 2010

The globalisation of flora and fauna has changed biodiversity more significantly than any other phenomenon apart from species extinction. Human activity has introduced animals and plants to regions previously inaccessible to them. In some cases this has been an intentional process, while in others species have been introduced accidentally and frequently unnoticed at first.

Alien species can be found amongst animals, plants and micro-organisms. Alien or exotic animal species are known as "neozoa", and plants as "neophytes". Not all succeed in becoming established or spreading to any great extent. Only a few give cause for concern in terms of the environment, the economy or human health, or have the potential to harm biological diversity. Such species are termed "invasive". The distinction between "alien" and "invasive" species is not always clear-cut and ultimately depends on the damage they cause.

The "tens rule" suggests that of all the introduced species, about 10 percent escape to the wild. Of these, about 10 percent become established in their new environment. And a tenth of these in turn become invasive and pose an ecological, economic or health hazard. Although this rule has been challenged and modified several times, it nonetheless shows that compara-tively few species become invasive. However, it is extremely difficult to predict whether or not a new species will become a pest due to the complex interactions of ecological systems.

The prevalence of wild-growing water hyacinth (*Eichhornia sp.*) can block the passage of boats and disrupt shipping. Photo: Li Qingsong

Causes of the spread of invasive alien species

The underlying cause of the spread of invasive species is the increased mobility of society. The rise of global tourism and trade has meant that not only people and goods, but also plants, animals and micro-organisms are transported over large distances, and across geographical and climatological barriers to areas where they do not naturally occur.

Seeds can be carried unintentionally to other regions, in the mud adhering to vehicle wheels, in imported timbers or packaging materials. Travellers bring pathogens home with them or inadvertently transport insects or micro-organisms harbouring in their baggage or clothing. Carelessness is the major culprit of such inadvertent transfer of organisms, coupled with a lack of awareness of the potential impact.

Familiar examples of the inadvertent introduction of alien species are the brown rats which are decimating kiwi populations in New Zealand, the zebra mussel which attached itself to ships and has succeeded in colonising all of central Europe, and the water hyacinth which has clogged the surface of many waterways and made fishing and shipping impossible.

In contrast the intentional introduction of alien species is usually driven by economic considerations, such as the need to improve yields in agriculture, forestry, horticulture or fisheries, or the pursuit of

leisure activities. Some ornamentals and crop plants escape gardens and agricultural areas and become established elsewhere. When new crop plants are introduced it is often impossible to predict whether they will become invasive. Numerous alien species of game animal have been deliberately introduced such as the common pheasant to central Europe and the rabbit to Australia. Most of these species need human care and protection to survive, but some have the potential to become entrenched in their new environment, building up stable populations and prevailing over their indigenous competitors.

Species of plants which need no more than the wind to pollinate and disperse their seeds spread extremely quickly. A fast growth habit, undemanding nature and short generation time favour the process, as does a tolerance to wet or dry conditions, heat or cold or high levels of soil salinity. When they encounter no natural enemies – such as certain insects – invading plant species are able to proliferate more quickly in their new environment than in their native habitat.

Habitats which have been disrupted by outside influences are susceptible to the colonisation and spread of invasive species. Although some species are quite capable of invading intact and resilient ecosystems, they are much more likely to infiltrate "disturbed" habitats. For instance, they spread throughout farmland, grazing land, housing estates and roadsides. Human activity is constantly creating new ecological niches which are quickly populated by alien species.

Major changes in species composition and the local emergence of new species have also been linked to climate change. Any change in local climate, regardless of whether it becomes warmer or cooler, wetter or dryer, causes stress and decreases the ability of local species to compete. This situation encourages the infiltration of species which are better adapted to the new conditions. For instance, ornamentals that have been growing innocuously in certain areas for many years can suddenly become invasive when climatic changes cause the environmental conditions to become more favourable.

Ecological and economic impact

The economic impact of invasive species is substantial. In Europe alone the damage is estimated to run to at least EUR 10 billion per year – triggered by more than 11,000 alien plants, animals and micro-organisms. As only 10 percent of these species have so far been assessed in terms of economic impact, the actual damage is likely to be much greater.

In the marine realm the intake and discharge of ballast water to maintain the stability of shipping vessels has added a new dimension to the spread of alien species. It is estimated that the global merchant fleet carries about 10 billion tonnes of ballast water each year, transporting about 7,000 waterborne organisms around the world every day. The North American comb jellyfish was accidentally introduced to the Black Sea in this way, almost eradicating stocks of anchovy and sprats, and inflicting catastrophic and permanent damage on the local fishing industry. The Chinese mitten crab spread to numerous areas in the same way; the damage it has caused to riparian zones, fishing equipment and industrial infrastructure in Germany alone is estimated at EUR 80 million.

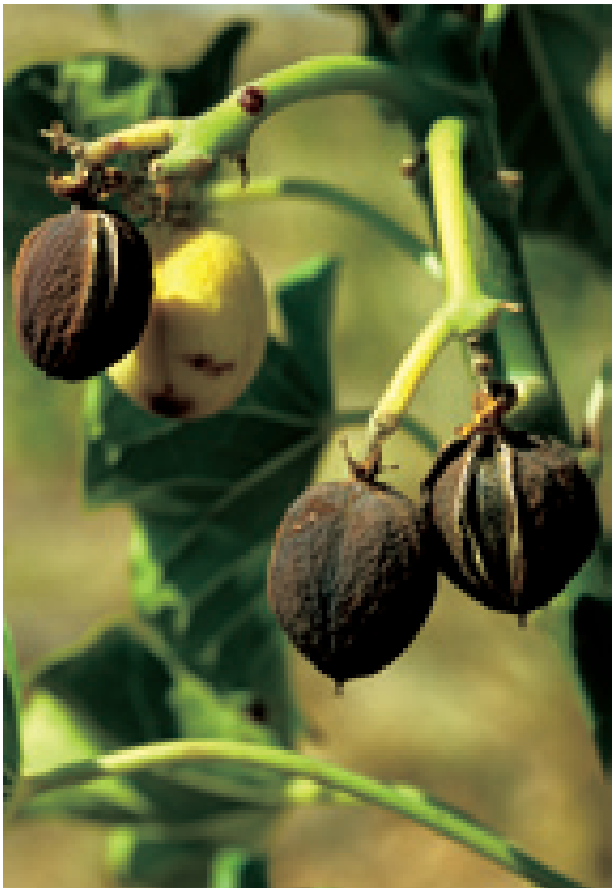
Along with the comb jellyfish and the mitten crab, the list of 100 of the World's Worst Invasive Alien Species includes the Asian tiger mosquito which, aided by climate change, is spreading across Europe, particularly Italy. This unwelcome bloodsucker can transmit pathogens such as the West Nile virus, and trigger dengue and chikungunya fever.

Lantana camara, a native of tropical America, has made rapid inroads into wide areas of Asia in recent years, becoming a dreaded weed which attacks both natural and agricultural ecosystems. In the forest it forms dense, bushy undergrowth that inhibits the growth of the natural vegetation, thus decreasing biodiversity. It also threatens fields, pastures and gardens as it poses a risk to coffee, palm oil, coconut and cotton plantations. It has overrun entire sandalwood plantations in India. Lantana is not only hazardous to other plants, but also animals. It contains toxic substances which lead to digestive disorders and reduced milk yield in grazing animals. *Lantana camara* is rarely afflicted by disease, needs little water and tolerates extreme heat.

Black wattle *Acacia mearnsii* is very popular throughout many regions of the world. It is native to Australia, but for economic reasons it became established in Asia, Africa and South America long ago. It is a fast-growing tree with the ability to fix nitrogen in the soil. Its bark is a commercial source of tannin which is used for tanning leather, and its wood can be processed into charcoal or simply used as firewood. However, black wattle also suppresses indigenous

vegetation and rapidly spreads across grazing land and riparian zones, extracting large amounts of water from the soil. After bushfires the black wattle is usually the first species to germinate, crowding out the later growth of natural vegetation. The current trend of extracting energy from plant matter increases the risk of colonisation by potentially invasive alien species. For instance, *Jatropha curcas* is widely cultivated as an energy crop: although not yet listed as an invasive species, its undemanding nature and tolerance to drought make it highly suspect. For this reason Australia, following the precautionary principle, has already banned the cultivation of *Jatropha*. Recent studies indicate that a very large number of tropical and subtropical species which are suitable for bioenergy production have invasive potential.

A current topic of heated debate is whether the genes of transgenic plants can spread and stimulate the development of invasive species. The hybridisation of genetically modified crops with wild plants of related species could – theoretically – produce species with competitive advantages such as drought or herbicide resistance which are difficult to control. This development however is still considered hypothetical.



The oil crop Jatropha is used for producing biodiesel and is a potential invasive species. Photo: © GTZ / Jörg Böthling

International aid efforts can also contribute to the spread of invasive species. *Parthenium hysterophorus* weed (see box) was unwittingly introduced to Africa in shipments of grain sent to Ethiopia as emergency relief.

Containing invasive species

There are two ways to contain invasive species: prevention and limitation of spread. Prevention is much more cost-effective and includes public education, risk assessment and early warning systems for new species, legal regulations and controls, quarantine and treatment of fresh imports, and even trade restrictions and bans. Furthermore, stable, rich ecosystems are less vulnerable to invasive species than species-poor systems. The same holds true for cultivated landscapes where a rich (agro)biodiversity can help to prevent, or at least restrict, the rampant spread of invasive species.

Once an invasive species has become established, measures must be taken to completely eradicate it, contain it in certain areas or reduce its population to an acceptable level. In most cases total elimination is not possible: this is usually limited to small areas, being very costly in terms of money and man-power. The cost of a 3-year campaign to permanently eradicate Japanese knotweed (*Fallopia japonica*) in Great Britain, for example, is estimated to exceed EUR 2 billion. By contrast, selective measures to check the further spread, minimise potential damage in extremely valuable habitats, or to control species which have recently appeared are often worthwhile and appropriate.

The earlier control measures are implemented, the more effective they are likely to be. For this reason it is important to carefully monitor potentially invasive species and to prevent their spread without delay. As it is difficult to make predictions and assess the risk they pose, alien species should not be introduced at all if there is any element of doubt (precautionary principle).

Photo: Forest & Kim Starr

Case study: *Parthenium hysterophorus*

Parthenium hysterophorus is an invasive weed native to the Gulf of Mexico area. Having spread over large areas of Asia, Africa and Australia during the past 50 years, it is steadily developing into a worldwide problem. Its leaves and blooms contain parthenin, a toxin that suppresses the germination and growth of crop plants such as barley, wheat and pea, leading to yield losses of up to 30 percent. Parthenium weed decreases pasture productivity by inhibiting forage plants. Cattle grazing on land with Parthenium exhibit lower growth rates.

National and international regulatory framework

The problematic nature of invasive species was first addressed comprehensively by the 1992 Convention on Biological Diversity (CBD). Article 8h of the CBD requires that each contracting party should, as far as possible and appropriate, prevent the introduction of, control or eradicate alien species which threaten ecosystems, habitats or species. The Conven-tion's Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) has produced a set of recommendations for invasive species, which advocates:

- preventing the entry of new species,
- putting early detection and urgent measures in place to address species that are not yet established,
- mitigating the impact of established species, and
- introducing programmes to raise public awareness of the problem.

At the 9th session of the Conference of the Parties to the CBD in Bonn in May 2008, the parties evaluated their national endeavours to contain the spread of invasive alien species. Most nations have made international commitments to limit the threat they pose, but only about half have adopted corresponding legislation. Even fewer are taking appropriate action.

Numerous international regimes and regional bodies are also addressing the topic of "invasive species". About 40 binding agreements have been established, as well as a range of nonbinding recommendations and technical guidelines. Of most relevance to plants is the International Plant Protection Convention (IPPC) that serves to control the infiltration and spread of organisms that are harmful to plants and plant products. It refers to all organisms which damage plants, either directly or indirectly. So far 19 standards for plant protection measures have been adopted, and these have also been accepted by the World Trade Organization in its Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement).

Implications for technical cooperation

Development cooperation can influence the spread of invasive alien species through the areas of precaution, monitoring, control and capacity development. Projects in the fields of environmental policy, resource conservation and management, trade, private sector promotion, health and food aid would all lend themselves to this purpose. Specific tasks could also include the support of partners in the following areas:

- Formulating a normative framework for the import and export of goods which could, intentionally or unintentionally, promote the spread of invasive species;
- Reinforcing mechanisms to control the importation of potentially invasive species (customs inspections, purity testing of seeds and food imports, quarantine measures, etc.);
- Promoting national and international information systems for invasive species;

- Producing and refining risk assessments prior to the importation of alien species for agricultural and forestry purposes, and introducing procedures to monitor the spread and impact of new alien species;

- Introducing measures to reduce populations of invasive species, particularly in protected areas and other ecologically vulnerable areas, as well as cultivated land;

- Introducing measures to conserve biological diversity in natural ecosystems, and land cultivated for agriculture and forestry;

- Raising awareness of the hazards posed by invasive species.

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Global Invasive Species Database (GISD): The GISD was developed by the Invasive Species Specialist Group (ISSG) of the Species Survival Commission of the IUCN-World Conservation Union and is updated on an ongoing basis. GISD also compiles the list of 100 of the World's Worst Invasive Alien Species. www.issg.org/database

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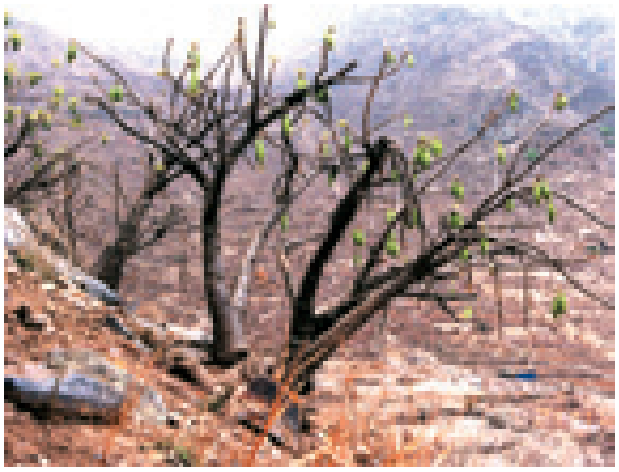
1.11 Agrobiodiversity and climate change
– a complex relationship

Johannes Kotschi, 2006



Ficus carica, which grows wild, is well adapted to conditions in the Peruvian highlands. In view of the increasing aridisation of the country, it has great potential for use. Photo: CIP

Planet Earth is rich. It has many millions of species – plants, animals and micro-organisms. But biological diversity is being eroded, and species are becoming extinct at an alarming rate. The loss of biological diversity jeopardises the whole of mankind. This is especially true of the decline in agrobiodiversity, which is the resource base for our food.

Climate change – a threat to food security

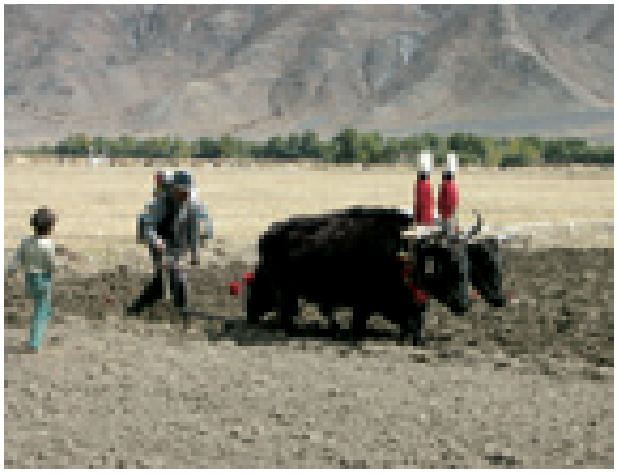
The implications of climate change for agriculture have opened a new window in the discussion of agrobiodiversity. Environmental change is one of many factors reducing the diversity of crops and livestock. Five climate change-related factors can be identified: the rise in temperatures, changes in precipitation patterns, the rise of sea levels, higher incidence of extreme weather events and the increase of greenhouse gases – especially carbon dioxide – in the atmosphere.

The rise in temperature – commonly known as global warming – is probably the most obvious phenomenon of climate change. In the past 150 years the global mean annual temperature has increased by 0.6°C as atmospheric carbon dioxide concentrations have risen by 32 percent. This is likely to double in the next 40 to 100 years. Scientific estimates suggest that mean annual temperatures will rise by a further 1 - 5.8°C, although this will vary from region to region. It is expected that the increases will be highest in the tropics and subtropics, and the anticipated consequences there will be large-scale extinction of species, lower agricultural yields and a major change in cropping systems. Indirect temperature effects will also be significant, including the increased evaporation of water from the soil, the accelerated decomposition of organic matter, and the increased incidence of pests and diseases affecting both animals and plants.

Pastoralists' innovative responses to drought

Southern Ethiopia suffered a severe lack of rainfall between 1997 and 2000 and as a result experienced a major drought. Most of the livestock – the source of livelihood for most of the people of this region – died and the vegetation withered. Many people in the Horn of Africa lived for months on the verge of starvation.

In 2000 the Oxfam partner, Action for Development, purchased 120 camels, which are more drought-resistant than cattle because they only need water every ten days or so. As beasts of burden they can also be used for transporting water. Adde Lokko Aao describes what this means for the women: "The camels bring enough water for a number of households at a time. We women no longer have to carry water on our backs". The women used to walk for 6 - 10 hours to bring back as much water as they could carry. Now that the camels do this work, the women can spend their time on other tasks. They can now care for their families and return to a variety of income-earning activities. Moreover, the camels can also be used for ploughing if enough rain falls for seed to be planted. Looking after the camels is a man's task. "Our men have started getting involved in the work of fetching water, which is normally the responsibility of women. We are pleased to witness that our camels have shared our burden," says the mother of six children (Oxfam, 2002).



Yaks are particularly well adapted to the climatic conditions at high altitudes. Photo: Sylvia Reinhardt

The global water supply will also be seriously affected by climate change. In the last century, for example, subtropical regions most likely received around 3 percent less precipitation and suffered more frequently from drought than in the preceding centuries. By contrast, the northern hemisphere experienced 5 - 10 percent higher rainfall.

At the same time, increasing seasonal and regional rainfall irregularity has been observed, and scientific research suggests that this trend will become more pronounced. In many tropical areas there is already increased cultivation of drought-tolerant plant varieties. Similar trends can be observed in animal husbandry. For instance, camels are replacing cattle and goats in very drought-prone areas of Ethiopia.

Carbon dioxide is not the only greenhouse gas to give cause for concern. Chlorofluorocarbons (CFCs), for instance, have severely reduced the atmosphere's protective ozone layer, increasing the amount of ultraviolet radiation which reaches the earth. Scientists believe that the destruction of the ozone layer is reducing crop yields, and have, for example, studied this effect in the particularly sensitive soybean. Additional expected consequences are increased rates of pests and diseases in plants and animals and a rise in cases of sunburn in animals.

In summary, dramatic implications are expected for agriculture and food supply, although with large regional differences. It is predicted that the 40 poorest countries, located predominantly in tropical Africa and Latin America, may lose 10 - 20 percent of their grain-growing capacity due to drought by 2080. It is also argued that many rain-fed crops in some areas are already near their maximum temperature tolerance, and their yield may fall sharply with a further temperature rise. By contrast, yield increases are expected in temperate regions; a country like China could experience a 25 percent rise in production. Tragically, these changes are likely to hit the world's poorest people hardest.

Combating such changes requires a two-pronged strategy of mitigation and adaptation. On the one hand all possible efforts must be made to reduce greenhouse gas emissions and to slow climate change. On the other, fast and appropriate action is needed to enhance capacity to adapt to irreversible changes already inherent in the system but not yet fully visible.

Agrobiodiversity – an indispensable part of the solution

In the light of this recognition, the subject of agrobiodiversity and its insidious decline acquires new significance. 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.

Plants and animals which have until now had no economic value but which can cope with the changing climatic situation will become more important. One question immediately arises: how much agrobiodiversity should we conserve for our future? Can our present cost/benefit calculations, based on tight budgets, provide the right answer, or must we conserve all we have because the future needs for human survival are unknown? In scientific circles, the idea of conserving every species is regarded as utopian. Nevertheless, attempts should be made to maximise agrobiodiversity while keeping costs as low as possible. This requires an approach that goes far beyond the conservation strategies most widely used today. The *ex situ* conservation of seeds, involving storage in refrigerated banks or botanical gardens, is essential but does not go nearly far enough. What is needed are broader and better integrated conservation schemes 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. Farmers have been doing this for thousands of years. Gene banks can complement their work but cannot replace it.

In India there are many varieties of millet that have high yields even in very difficult climatic conditions. Photo: Detlev Franz

In situ schemes enable the use and conservation of genetic resources to be closely linked. True to the slogan "use it or lose it", plant species or animal breeds should be used whenever and wherever possible; they should contribute to securing rural livelihoods and form a part of rural culture. The inherent value of seemingly uneconomic crops or farming systems needs to be recognised and harnessed. Thus wild plants may be used for medicinal purposes, organically grown wheat landraces may fetch a higher price, or regions that maintain their diversity may profit from agro-tourism, and so on. Of course it will not be possible to find a market for everything that should be conserved. But plants and animals deserve to be protected not only on account of their immediate "usefulness"; there are also social and cultural justifications for conservation, and it is therefore right that the public should pay for the service provided by farming communities.

Agricultural diversity furthers adaptation to climate change

However, climate change requires not only that genetic resources should be conserved, but also that they should adapt to climate change. 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. Adaptation is a dynamic process brought about through an organism's interaction with its environment. It is not a matter of, for example, deep-freezing a drought-resistant strain of millet for many decades in a gene bank, but rather of continuing to grow and breed the seeds in the fields where they are exposed to a wide range of agricultural and ecological conditions. The resistance of plants to environmental stress (e.g. drought tolerance) is a multigenetic characteristic. It is difficult to achieve through genetic engineering and best developed through classical breeding under *in situ* conditions.

The social dimension of these adaptive processes is no less important. The poor sectors of the population, in particular, must be enabled to adapt to changing environmental conditions; traditional knowledge and social organisation must be strengthened and developed. Women play an important part in this process. In farming communities throughout the world, they are and always have been the seed keepers and the preservers of genetic resources. Such a strategy as outlined above addresses regional and local agro-ecological variations and offers site-specific solutions. This contrasts with the large seed companies, which operate on the principle of mass production and aim to distribute a standardised variety or a whole cropping system technology as widely as possible.

Minor millets save the poor from starvation

Sankappa is a small farmer owning three hectares of dry land in Vittalpura village of Bellary district in Northern Karnataka, India. This village is situated on the semi-arid Deccan Plateau and receives annual rainfall of 500 mm over a three-month period, which allows just one crop between July and October. Like his forefathers and other farmers of the village, Sankappa grows foxtail millet (*Setaria italica*). The amount of rainfall in this part of the country has dropped continuously over the last four years. It was below 300 mm in 2003. "All other crops failed due to extreme drought, and my family and livestock were saved from starvation only by the harvest of foxtail millet," says Sankappa. The varieties grown and conserved by the farmers of Vittalpura have excellent drought resistance (Bala Ravi, 2004).

Agrobiodiversity is an integral part of rural development

Despite the fundamental importance of agrobiodiversity for future food security, the subject has received little attention in the international debate on adaptation to climate change. Adaptation to climate change in agriculture – if discussed at all within the various international development initiatives – is driven by the increased frequency of drought and flooding, and focuses mainly on improved water management.

Agrobiodiversity – although a fundamental resource for adaptation – is almost forgotten.

The conservation and sustainable management of agrobiodiversity is one of our greatest environmental challenges. An agrobiodiversity strategy needs to take account of the following:

- Stronger coordination is needed between the key global programmes such as the United Nations Framework Convention on Climate Change (UNFCCC), the Convention on Biological Diversity (CBD) and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA).

- Agrobiodiversity conservation should form a basic component of the adaptation strategies and plans for adapting to climate change called for by UNFCCC.

- Programmes for the management of agricultural genetic resources require their strategies to be reoriented. Formal institutional systems based on gene banks (*ex situ* conservation) must be broadened to an integrated management system that includes farmers and their agricultural systems (*in situ* conservation).

- *In situ* conservation of agricultural biodiversity must be made an integral part of agricultural development and be supplemented by *ex situ* conservation.

Individual states and the international community of nations must take the lead in implementing such a comprehensive approach. National laws and intergovernmental agreements will have to provide the necessary legal frame so that genetic resources remain largely a public domain with well-balanced benefit sharing concepts among the various stakeholders. Civil society organisations as well as the corporate sector are more than ever required to fill this frame with development reality on the ground. Climate change-induced environmental stress may in fact exceed the adaptive capacity of animals and plants to cope with it. Nevertheless, the *in situ* approach offers a genuine chance to shape a future worth living.

Protecting biological diversity by means of gene banks enables Chinese agrobiodiversity to be conserved and later used.
Photo: Guenay Ulutuncok

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1.12 Biodiversity and agricultural intensification – how farmers' varieties can contribute

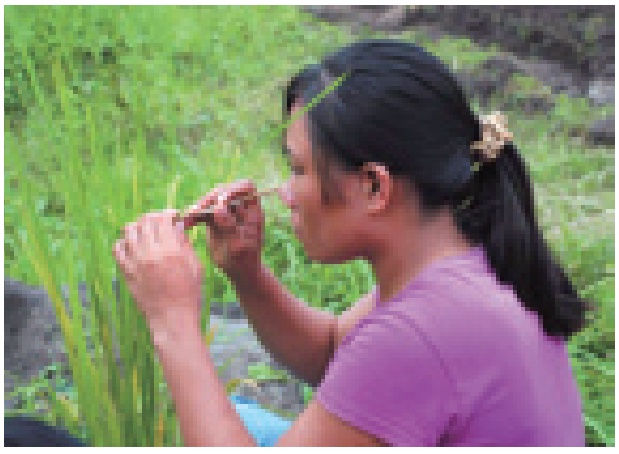
Johannes Kotschi, 2009

Plant breeding has existed since crop domestication. For more than 10,000 years farmers have been selecting plants to develop varieties that produce higher yields, are less susceptible to diseases, and that show a certain degree of uniformity in germination and ripening, which makes harvesting easier. Through this selection of crop plants and by cultivating them under various, in some cases harsh environmental conditions, over the millennia a rich diversity of agricultural crop species has developed. In India, for instance, until a few decades ago up to 30,000 rice cultivars were grown.

During the past 150 years this trend has reversed. The biological diversity of crop plants has since been dwindling. Fewer and fewer species are being used for agriculture, and no more than three of them (rice, maize and wheat) supply 60 percent of the world's food. Not only are fewer and fewer plant species used for agriculture, but genetic diversity within species is also declining. Plant breeding and commercial seed production have contributed substantially to the reduction of genetic diversity within individual species. The number of varieties of any given crop is constantly decreasing and the varieties are becoming increasingly uniform, while certain characteristics are being lost during the process. In view of the necessity of adapting to climate change and of ensuring global food security, this "genetic erosion" threatens the existence of the global population. In order to meet these and future challenges, some of which are still unknown, humanity needs whatever genetic diversity still exists. At the same time, conservation of biological diversity must be reconciled with agricultural intensification. Plant breeding plays a key role in this endeavour.

Intensification in agriculture – achievements so far

In the 50 years from 1950 to 2000, global grain production almost tripled. This increase was mainly made possible through progress in plant breeding, intensive nitrogen fertilisation and effective herbicides for weed control. This productivity increase, however, was mainly achieved on fertile soils, under optimal growing conditions, and only a small percentage of farmers benefited. According to more recent estimates, 95 percent of all farms are still peasant smallholdings.



On-farm breeding of local rice varieties in the Philippines: many farms are going back to producing and using their own seed.
Photo: Masipag

Only small areas of land are cultivated, and these mostly involve no external inputs such as fertiliser and pesticides, because the classic intensification strategies are not suitable for such farms. In the 1980s, around 60 percent of all agricultural land was still being farmed in this manner. Even though this figure is probably smaller today, traditional agriculture still contributes substantially to world food production and is fundamental to food security.

In order to feed the increasing world population, further agricultural intensification is required. The world population is expected to grow to approximately 9 billion people by 2050. The potential to expand agricultural land to feed this population, however, is very limited. In order for intensification to be sustainable, agriculture must start using nutrients and energy more efficiently, it must sustain ecosystems and their functions while conserving biodiversity, and it has to be climate-friendly.

Harmonising intensification and sustainability can most easily be achieved in the resource poor areas farmed by peasants that have been neglected by past intensification strategies. One possibility for increas-

ing the yield potential of traditionally farmed lands is plant breeding, another is increasing on-farm species diversity. These are key steps to improving food security. But crops and their varieties that are expected to produce higher yields on poorer sites must have traits different to the high yielding varieties used on agriculturally favourable sites. This is a challenge that plant breeders must address.

Local farmers' varieties – a source for intensification

The search for alternatives started 50 years ago and led to today's method of evolutionary plant breeding. In order to generate new varieties, breeders systematically utilise farmers' local varieties that are genetically diverse and have adapted ecologically. This involves bringing together seed from different origins and recombining them through crossbreeding. The resulting mixtures, also known as "composite cross populations", can also be crossed with high yielding varieties. From these crosses, the best progenies are selected and again propagated as bulk. In this manner, the populations are subjected to natural and artificial selection processes, ultimately resulting in a modern local variety with good performance characteristics. For example, it has been shown that composite cross populations of barley in Syria are superior to the leading high yielding varieties, because they adapt very well to various ecological conditions. Furthermore, scientists conclude that natural selection favours genotypes that also produce high yields under fluctuating environmental conditions.

Another important characteristic of crossbred populations, if they are suitably assembled, is their better disease resistance. With genetically diverse populations, disease-induced yield losses can be limited. These populations adapt well to mutating pathogens. The coevolution of plants and diseases in genetically diverse populations is an effective, self-regulating mechanism that maintains the disease resistance of the plant. As a general rule, this characteristic is not found in genetically uniform crop plants.

Evolutionary breeding with composite crossbred populations is a very promising method for agricultural intensification, particularly under ecologically disadvantageous conditions, and for adapting crops to climate change-induced environmental changes.

Definitions

DUS criteria	distinctiveness, uniformity, stability
Maintenance breeding	selection of individual plants for maintaining the purity of a variety, which are then propagated as bulk
Genotype	the entirety of genes of an organism located in the nucleus (on the chromosomes)
Uniformity	a variety is uniform if it is sufficiently homogeneous in the expression of the traits responsible for distinctiveness
Coevolution	the process of mutual adaptation of two closely interacting species that exert strong selection pressure on each other (e.g. a plant with a parasitic fungus)
Population	the reproducing community of individuals of a species that are different in terms of their genetic constitution

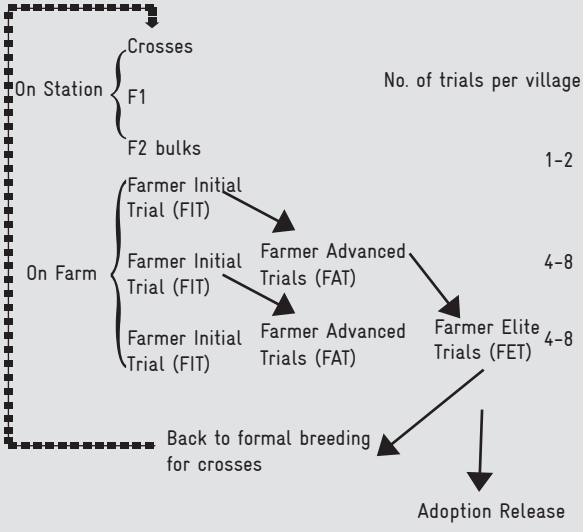
Breeding with farmers – faster and more efficient

Another innovation is called participatory plant breeding (*see 1.4 "Farmers as breeders"*). In contrast to classical approaches, breeding is not done by breeders alone, nor does it take place only in experimental fields or in laboratories. Farmers are involved throughout the entire breeding process and most of the breeding takes place in their fields. This challenges the ecological adaptability of the populations, as in the farmers' fields the crops are exposed to a wide range of different environmental conditions and individual production methods. In contrast, research stations of commercial breeders are usually located on better soils and the environmental and growing conditions are more uniform than those on farms.

An example is the participatory barley breeding programme in Syria (see box next page). Breeders and farmers make crosses and selections over several generations, according to the evolutionary breeding method. The populations thus obtained are then tested over a period of three years in field experiments. Once this stage has been completed, either the material is released as a variety or the whole process is repeated.

Breeding barley in Syria: farmers and scientists working together to produce high-yield and robust native varieties. Photo: ICARDA

Example: Participatory barley breeding in Syria



Ceccarelli, 2006

Participatory evolutionary plant breeding has emerged over the past 10 years. It is mainly supported and promoted by international agricultural research centres (e.g. ICARDA and ICRISAT) and by a number of NGOs (e.g. Misereor and Oxfam). The process is now being practised in many countries with outstanding results. Using this method to breed varieties with higher drought tolerance and better adaptation to low rainfall environments has been particularly successful.

Outstanding successes include barley in the Middle East, rice in South Asia and sorghum in West Africa. The method has been extended to other crops such as vegetables and maize.

There are three strong arguments in favour of the participatory approach:

- The effectiveness of breeding can be improved as the farmers' experiences, as well as their agricultural knowledge and skills, are fed into the entire breeding process.
- Varieties bred by this method have high acceptance and accelerated adoption rates because the farmers, as users of the new seed, are able to input their own needs and preferences.
- The breeding time can be reduced by several years because, in contrast to classical breeding methods, a lower DUS (distinctiveness, uniformity and stability) level is sought and variety screening trials can also be omitted. This saving of time is an important aspect during our period of rapid climate change, with the resultant need for fast adaptation of agriculture.

Synergies of both innovations

Evolutionary and participatory breeding are intertwined. Together they represent an important complement to classical plant breeding. The innovations have already accomplished much in various areas:

Scientifically, this method has broadened the understanding of appropriate breeding technologies. It has enriched the discussion about the interaction between plants and the environment, and it has shown that breeding primarily for yield is no guarantee that farmers will accept and adopt a variety. So far, however, very few breeding companies are making use of this finding.

In socioeconomic terms, this method empowers farmers to regain control of their seed systems, and to safeguard their interests after decades of marginalisation due to global trade liberalisation.

From an ecological standpoint, it will become easier to exploit unfavourable sites and to tap the potential benefits of plants that have been little used in the past. The new method thus contributes substantially to improving global food production. Furthermore, it will enable us to sustain the diversity of agro-genetic resources and to develop it further for a more rapid adaptation to environmental change.

Scaling up – constraints to overcome

In terms of adoption ("scaling up"), evolutionary and participatory plant breeding is still in the early stages. For this new approach to become an institutionalised part of seed production, some bottlenecks still need to be overcome. Scientists, professionals and political decision makers must realise its value, as well as the need for the new approach. Only then will national agricultural research centres be moved to take it up, and public funding be raised.

National seed laws need to be amended. Today, in almost all countries, only registered varieties can be distributed and traded. The registration criteria and procedures exclude local farmers' varieties, as they do not meet the high DUS standard and novelty requirements. Therefore legal amendments have to be made that exempt local varieties and populations and allow registration at a much lower DUS level and at less cost. Such a change, however, is firmly opposed by the commercial seed sector.

Scaling up will only be possible with the systematic involvement of seed companies at local or regional level. Seed supply is an entrepreneurial task for the private sector, and maintenance breeding could possibly be undertaken in cooperation with the national agricultural research sector. Can seed production, seed provision in rural areas and maintenance breeding of publicly owned local varieties be undertaken in the context of such partnerships? Joint ventures between private and public sectors need to be explored, and new business models need to be developed. The potential is there, as the farmers' need for good quality seed is enormous.

Plant breeding and seed production cannot be considered in isolation. Both are components of rural development. They will only have a significant impact on food security and biodiversity conservation if agricultural smallholders gain access to resources (land, water, other agricultural inputs) and markets, and if they can rely on improved transport infrastructure and reasonable commodity prices. In this context the key requirements for plant breeding and seed production are:

- The topic of seed supply breeding, production and marketing must be put back on the agenda of rural development.
- The amendment of seed laws must be given priority in the advisory services provided to governments.
- The importance of plant genetic resources in adapting agriculture to climate change needs to be understood and incorporated in national development plans, programmes and projects. The same goes for agricultural research and rural development.
- The private and public sectors must collaborate in the provision of suitable seed.

The ongoing paradigm change in agriculture towards sustainable intensification must embrace the role of agrobiodiversity in general, and the need for innovation in plant breeding in particular. Evolutionary, participatory plant breeding could make a significant contribution to agriculture in the future.

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1.13 Genetic engineering in agriculture:
how does it impact on biodiversity?

Johannes Kotschi, 2008

Soybean has been cultivated in southern Latin America since the 1980s. The use of genetically engineered seeds and rising soybean prices have reinforced the trend for soybean monoculture in the region. A soybean field in Canindeyú, eastern Paraguay with erosion curves. Photo: E. Dimpl

The majority of the world's plant genetic resources are located in tropical and sub-tropical regions and therefore in today's developing and emergent countries. It is primarily small farmers who preserve and take care of these resources and the related agricultural diversity. As genetically modified crops have also been cultivated in these regions for some 12 years now, the question of their influence on agrobiodiversity arises. Is the impact of genetically modified crops on biodiversity beneficial, detrimental or neutral? We shall use the examples below to discuss this.

An estimated 40 percent of the global acreage of transgenic, i.e. genetically modified (GM), crops is to be found in developing and emergent countries, and, in fact, almost exclusively in just six countries: Argentina, Brazil, China, India, Paraguay and South Africa. Four crops account for 95 percent of all transgenic varieties planted: soybean, maize, cotton and canola (see Table 1). They are grown for industrial purposes or as animal feed. Until now, only two genetically-induced traits have gained commercial importance: herbicide tolerance (HT) in crops and pest resistance through insertion of a gene from the bacterium *Bacillus thuringiensis* (Bt).

Table 1: Estimated global distribution of transgenic crops

a) By crop	Million hectares	percent
Soybean	60.0	58.8
Maize	20.1	19.7
Cotton	12.1	1.9
Canola	5.0	4.9
Other	4.8	4.7
Total global acreage	102.0	100.0
b) By selected developing and emergent country	**Million hectares**	**percent**
Argentina (soybean, maize, cotton)	18.0	17.6
Brazil (soybean, cotton)	11.5	11.3
China (cotton)	3.5	3.4
India (cotton)	3.8	3.7
Paraguay (soybean)	2.0	2.0
South Africa (maize, soybean, cotton)	1.4	1.4
Other	0.7	0.7
Total developing and emergent countries	40.9	40.1

James, 2006

Genetically modified crops – enrichment or contamination?

The example of transgenic maize in Mexico (see box next page) illustrates how transgenic plants, when released from the greenhouse, may cross-pollinate with other varieties and with wild relatives. This pollination is irreversible and difficult to limit regionally. British scientists found pollen of transgenic creeping bent (*Agrostis stolonifera*) up to 21 kilometers away from where it had been cultivated. Greater distances were assumed, but not quantified. This makes the coexistence of transgenic crops with non-transgenic crops virtually impossible.

Another question remains controversial: is the introgression of transgenes a threat to genetic diversity, or an enrichment? The Director of the international maize research institute CIMMYT (2002), referring to the Mexican case, sees this as no different from landraces of maize cross-pollinating, a process that increases and enriches genetic diversity. On the other hand, in 2007 the UN's Food and Agriculture Organisation (FAO) advised all international agricultural

Local varieties of maize crobs – does the cross-pollination of transgenic varieties pose a threat to diversity?
Photo: Elin Volder Rutle/The Development Fund

The case of transgenic maize in Mexico

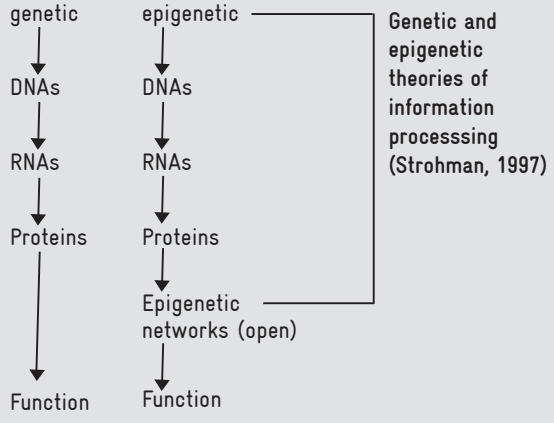
Around 10,000 years ago, maize was discovered and domesticated in the Oaxaca region of what is now Mexico. Over the millennia, the indigenous peoples of Central America have bred a vast number of landraces and created a unique genetic diversity of maize. To this day, such diversity is maintained largely by smallholders who keep cultivating their varieties year after year. Today, Mexico probably has the richest maize gene pool in the world.

With the commercial use of transgenic maize varieties in North America, the government of Mexico issued a moratorium on GM maize in 1998. It banned cultivation of transgenic varieties, but did not take further action to control maize imports. Transgenic maize thus entered the country in various ways. Large North American food imports containing high proportions of GM maize made up the major share. In 2001, scientists found evidence that GM varieties had introgressed into the genome of landraces of maize in southern Mexico.

research centres to do everything possible to avoid unintentional transgenic introgression into their *ex situ* gene bank collections. There is evidently no consensus at present on how to deal with this problem.

Molecular biology provides new insights

Molecular biology provides new insights into the subject. Scientists have pointed out that the regulation of living organisms is much more complex than commonly assumed, that the development of traits goes beyond individual genes, and that traits are not static but dynamic, in other words can change over time. They are therefore speaking of a paradigm shift – from genetics to epigenetics. The doctrine of "one gene – one trait" is considered obsolete. According to more recent scientific findings, cell regulation and trait development are controlled by a network in which DNA is involved but does not play an exclusive role. It is a network in which feedback to DNA is possible (see diagram) and in which acquired traits can be stored and passed on.



The risk of disturbing this network of cell regulation by introducing foreign DNA is an area in which there has been little research to date. However, various unexpected phenomena and unintentional changes have been observed. For example, genetically modified soybeans were found to have up to 20 percent higher lignin content than normal. This higher lignin content has a negative influence on heat tolerance, which in turn results in lower yields of transgenic soybean under heat stress. Thus, on the basis of current knowledge, it cannot be ruled out that disturbances in the organism as a whole may be created, sometimes with a substantial time lag. If this holds true, genetically engineered crops contain unknown risks

and the unintentional introgression of transgenes must be considered a contamination for plant genetic resources.

Herbicide tolerance is seen to have an effect on biodiversity

Transgenic soybean varieties have been grown in Argentina since the mid-1990s. The introduction of these varieties has enormously accelerated a trend that already existed: the large-scale expansion of monoculture cultivation of soybeans. The plants are resistant to the herbicide glyphosate, allow fully-mechanized production and require less agricultural skill than conventional varieties. Within ten years (1994 - 2004) the acreage under soybean has increased from 6 to 14 million hectares, and the share of transgenic soybean in the fields from zero to 99 percent. The Argentine government aims to increase the acreage by another four million hectares by 2010.

In terms of the national economy, this drastic change to land use and farming systems in Argentina (s. Table 2) would initially appear to be positive, but it has had a negative impact on food production and the diversity of cropping systems. Rice and potato cultivation have suffered a reduction of 40 percent and 38 percent respectively. Even higher losses have been observed with vegetables, and a similar trend has been observed with products such as milk, eggs and meat. The mixed farming systems practised by smallholders are gradually disappearing and are being replaced by large monocropped fields. Above all, smallholders and indigenous peoples such as the Guaraní (*see 2.7 "Utilising biodiversity through marketing – the case of fine flavour cocoa from Ecuador"*) are becoming impoverished and their traditional knowledge is being lost.

Table 2: Land newly planted with soybeans – land use changes in Argentina (1996 - 2004)

Land use before soybean production	Additional soybean area in percent
Major crops:	
wheat, sorghum, maize, sunflower	25
Other crops:	
rice, cotton, oats and beans etc.	7
pasture and forage production	27
forest and savannah	41

Benbrook, 2005

Does Bt-technology have a positive effect on biodiversity?

Bt-technology is used to produce transgenic plants – cotton, for example – that has the Bt-toxin in its DNA. Most insects that eat the Bt-toxin die, making chemical pesticides unnecessary. Experience with Bt-cotton in the early years was very promising. Many studies showed that pesticide use was substantially reduced, alleviating damage to insect fauna, decreasing costs of production, and improving net incomes.

Meanwhile this positive picture has changed. For instance, in a study of 481 farms in 5 provinces of China, researchers from Cornell University in the USA found that the majority of farmers had to treat their cotton fields 15-20 times more often than in the early years of growing Bt-cotton to kill secondary pests, in particular mirids (*Miridae*). Mirids are relatively resistant to Bt-toxins (Wang et al., 2006) and researchers believe they were kept in check before the switch to Bt-varieties by regular use of pesticides. Farmers now spend the same amount on pesticides as neighbouring non-Bt-growers, in addition to having to pay about 2-3 times more for Bt-seed. A similar finding is reported from the Makhatini Flats, the leading cotton growing area in South Africa, and a comprehensive evaluation of growing Bt-cotton in developing countries calls into question whether it is economically advantageous (Smale et al., 2006). Furthermore, the effect of Bt-toxins on beneficial insects and soil microorganisms is not yet clear. To sum up therefore: based on current knowledge, the impact of Bt-technology on biodiversity is at best neutral.

Concentration in the seed supply sector – a threat to genetic diversity

Within the past 25 years there has been unparalleled concentration in the seed sector that is responsible for commercial breeding and propagation. In 2006, over half of the global seed market was supplied by only ten seed corporations. As far as transgenic crops are concerned, the market is cornered by just one company (Monsanto), which provides seed directly or indirectly for approximately 90 percent of the total area under transgenic crops. Biotechnology has not caused the monopolization of the seed sector, but it has accelerated and reinforced the process. One main reason for this is that the breeding costs for GE crops are extremely high and the necessary investment can only be borne by larger companies. Con-

Demonstration against GMOs in Stuttgart, Germany.
Photo: www.gentechnik-freie-landwirtschaft.de

versely, to cover these costs a standardized variety or a whole cropping technology has to be distributed as widely as possible. This development creates dependency among farmers and leads to genetic uniformity of cropping systems as reported from the United States, for instance, where farmers say that it has now become virtually impossible to find high quality, conventional varieties of corn, soy and cotton seed.

Another consequence is the increasing control of genetic resources by a few companies through patents, licences and the like. In the past, genetic material for breeding purposes was in the public domain. Today, it has increasingly become private property, accessible only with the permission of patent holders. This gives them have a strong influence on breeding programmes and strategies and on maintenance of varieties. Today, the concentration in the seed sector is probably the greatest threat to the diversity of agricultural crops.

Conclusions and the way forward

Genetic engineering has accelerated the industrialization of agriculture and thus amplified the negative impact of farming on biodiversity. In addition, it holds new, unknown risks. The introgression of genetically modified plants into non-transgenic varieties and races poses a potential threat that is currently impossible to predict.

Agricultural genetic engineering is usually justified with the argument that it can achieve a quantum leap in intensification of agriculture and accelerate breeding of varieties. So far, no evidence of this has been seen. Most of the progress in plant breeding (yield potential, drought resistance and salt tolerance) has been achieved by conventional methods.

In both economic and ecological terms, agricultural genetic engineering does not fare better than other innovative technologies that promote agricultural intensification. Particularly smallholder cotton production provides good examples of this. Integrated pest management (IPM) (Russel and Kranthi, 2006) and organic agriculture (Eyhorn et al., 2007) are economically competitive and environmentally friendlier than Bt-technology as they work with reduced or no synthetic pesticide input, and they maintain biodiversity.

Marker assisted selection (MAS) is another innovation that merits attention. Gene-markers are used to identify desired traits more easily. This method can be used as early as the seedling stage of a plant and it also allows wild relatives to be included more easily. It has upgraded and accelerated classic breeding and has become standard practice with every major seed breeding company.

Biodiversity is a strategic resource for the future and therefore indispensable common property. Intensification of agricultural productivity must not proceed at the expense of biodiversity, but instead must harmonize with it. The fact that this is possible is demonstrated by innovations such as marker assisted selection, integrated pest management and organic agriculture – methods that are more in line with the aims of sustainable intensification of agriculture.

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1.14 A question of coexistence

– genetically engineered crop plants in farmers' fields

Dieter Nill, 2010

Aerial photograph showing a test field for determining minimum spatial separation. Up to what distance can cross-pollination occur in conventional or organic maize crops? Field trials have been carried out in several EU countries and there is now a great deal of information available on maize, rape and other crops.
Photo: www.biosicherheit.de / H. Pienz

Cultivation of genetically modified (GM) crops is increasing steadily all over the world. More than half of the countries in which these crops are grown are developing countries. Maize, soya and cotton are the main GM crops grown here (*see 1.13 "Genetic engineering in agriculture: how does it impact on biodiversity?"*). Many consumers, farmers and conservationists are sceptical of GM plants and the products derived from them. In many European countries, there are calls for GM-free zones. While consumers are primarily worried about health issues, the concerns of farmers and conservationists centre on the consequences for the existing, unmodified crop cultivars and their relatives in the wild – consequences that are not yet fully understood. They also fear economic damage and increasing commercial dependence on GM seed producers. Wind and insects disperse the pollen of genetically modified cotton, maize and soya plants. The transgenic genetic material is thus intermixed with unmodified material.

Legal provisions on coexistence aim to prevent this intermixing as far as possible. This is also true for admixtures of GM products in organic or other non-GM produce. Significant organisational and financial efforts are required to prevent inadvertent admixture, from field to supermarket shelf. In the event of damage occurring, an insurance system would need to be established in law, but as yet no country has an adequate system in place.

The clear separation of GM and non-GM products is a challenge that even the industrialised countries are sometimes unable to meet. This challenge is likely to be a good deal greater for developing countries. As complete separation appears to be unrealistic, many countries have already established threshold values. Strict separation of GM and non-GM products during production, harvesting, storage, transport and processing in conjunction with the necessary monitoring systems can limit the admixture of genetically modified products to non-modified products to a GM content of 0.5-0.9 percent. This is in keeping with the threshold values adopted in many countries. The additional costs of staying within these limits is estimated to be in the region of 10 percent of the producer price.

Statutory requirements

Threshold values for admixtures

Legal and technical provisions governing the production, processing and marketing of GM products are currently still under development in many countries. In the European Union, for example, a regulation on genetically modified foods and feedstuffs provides that food products must be labelled as "genetically modified" if the admixture of genetically modified

Coexistence

In farming, the term "coexistence" refers to the parallel operation of production systems with and without genetically modified plants, neither of the two adversely affecting the other. Coexistence comprises the entire chain from cultivation to storage, transport, processing and sale.

Cartagena Protocol on Biosafety

The Biosafety Protocol regulates the safe transfer, handling and use of genetically modified organisms and establishes the standards for ecological risk assessments. The detailed design of the relevant rules, including coexistence, is a matter for the signatory countries.

Combine harvesters are generally very hard to clean. The dispersal risk is largely dependent on the design of the machines.
Photo: www.oekolandbau.de / © BLE/Thomas Stephan

components is greater than 0.9 percent. The establishment of specific rules based on overall guidelines is a matter for the individual Member States. Fifteen Member States have so far adopted specific coexistence legislation and another three have produced relevant bills. In Germany, coexistence is governed by the Genetic Engineering Act and by a corresponding federal ordinance adopted in 2008.

Minimum distances and buffer zones

In order to avoid the admixture of GM and non-GM crops, most countries prescribe minimum distances to be kept between fields. These vary by crop. For example, for maize, different countries have prescribed distances between GM and non-GM fields of 25 to 400m, and 75 to 400m between GM and organic maize. For potatoes, the prescribed distances to non-GM potatoes range from 10 to 40m while distances between 20 and 60m must be kept to organic potatoes. Greater distances apply to seed production in some instances.

In addition to the minimum distances, buffer zones may be prescribed. These are a number of rows of non-GM crops which must surround the genetically modified plants in order to reduce outward pollen movement. In such cases the crop grown in the buffer zone is considered to be a genetically modified product.

Transportation and storage

As admixture can take place not only during production but also before and after the crop is grown, some countries have adopted additional legal provisions. For example, there may be a requirement to store seed of genetically modified cultivars separately from non-GM seed in closed, labelled containers. Similarly, storage of GM products in the field may have to be strictly separate with transport to the field in closed or covered vehicles. All equipment and vehicles used in the transportation, sowing, cultivation, harvesting, and processing of GM products may have to be carefully cleaned before they are used for any other product.

Liability and monitoring

Generally, where damage is caused by GM crops the producer is held liable. In some countries hauliers and processors are also held liable if damage is caused in the course of handling genetically modified products in their sphere of responsibility. Some countries have established special damage compensation funds which are financed from contributions paid by producers of GM products. In individual cases, provisions have been made for compensatory payments to be made by the state, but only if no one can be held liable.

Most countries maintain a register of producers of GM products and some countries also keep a register

of the individual fields on which the crops are grown. Government authorities such as agriculture ministries or phytosanitary services check the information provided by way of random spot checks of fields and crop sampling.

Most EU countries have not adopted regional bans on the growing of genetically modified crops. However, some countries have prohibited or limited the production of such crops in nature reserves. The declaration of "GM-free zones" in the EU is as yet merely political in character; it is voluntary and carries no legal obligation. Important producer countries of agricultural products such as China, Thailand, Brazil and Argentina have established GM-free zones in order to be able to continue to supply sensitive markets. Other countries such as Algeria, Benin, Peru and Ecuador have introduced moratoria which will be in force until such time as suitable national coexistence strategies have been established.

Patent law

Depending on the details of national patent law there may be a further risk to the farmer: if transgenes are found in a crop the farmer can be forced to pay licence fees to the patent holder no matter how contamination has taken place. A well known example is the case of the Canadian farmer Percy Schmeiser. In the late 1990s he was sued by Monsanto for patent infringement and sentenced to pay retrospective licence fees for his oilseed rape harvest. However, he maintained that he had not sown genetically modified oilseed rape. The transgenes originated in neighbouring fields which had contaminated his own crop.

Experience with coexistence so far

A study in Spain found the following: after six years of GM maize production it can be said that coexistence works and that contamination levels are between 0.5 and 0.9 percent. At the time the study was conducted in 2003, a total area of 460,000 hectares was cropped with maize of which 7 percent was planted under GM maize, 0.1 percent under organic maize, and the remainder under non-organic, non-GM maize. The production of GM-maize was concentrated in areas with high levels of pest infestation while in areas without disease pressure non-GM cultivars were preferred. Due to this large-scale separation of GM and non-GM maize little contamination occurred. Only two cases of contamination of organic

A direct seeding machine in operation. Residual seed can be completely removed from seeding machines relatively easily.
Photo: www.oekolandbau.de / © BLE/Dominic Menzler

maize came to light. No major difficulties are expected for the fu-ture, as even with a tenfold increase of the area under organic maize there would be few contact points. In the few areas where in the future GM maize will be grown side-by-side with organic or non-organic maize, buffer zones and minimum distances are considered sufficient to remain within the threshold values for contamination.

Other experience, however, highlights the difficulties which can arise in the field when attempting to separate GM and non-GM crops. Transgenes have already been discovered in important old landraces of maize in remote areas of Mexico which, as genetic hotspots, are indispensable for maize breeding worldwide. Similarly, in China genetic material from genetically modified rice cultivars has already been found in traditional rice cultivars due to outcrossing.

Contamination can quickly inflict major ecological and economic damage, as evidenced by the GM maize variety "Starlink". In 2000, "Starlink" maize was planted on a mere 0.4 percent of the maize cropping area in the United States yet in the same year 10 percent of all maize samples tested had been contaminated with "Starlink" through outcrossing and admixture. The genetic modification was found in 80 cultivars of yellow maize. In 2001 modified "Starlink" genes were found in a 55,000 tonne shipload of maize. Ultimately 300 products had to be withdrawn and taken off the market. The damage caused to the US economy was estimated to be in the region of 1,000 million US dollars in 2001 alone.

Similarly in the US, Monsanto conducted a trial with a non-approved genetically modified cotton cultivar in 2008. The test site was only 0.4 ha in size. From this site 0.25 t was harvested an d accidentally mixed

with the 60 t harvest from an adjacent field of non-GM cotton. The yield from both fields was taken to a 20,000 t storage facility of a processing plant, thus contaminating an amount of cotton 80,000 times the weight of the original GM product. Government authorities ordered the processor to withhold the contaminated cotton mix.

The situation in many developing countries is exemplified by that of Burkina Faso, where organic cotton production has been practised successfully for a number of years now. In 2003, the national research institute INERA began cultivation trials with genetically modified cotton. At the time there was no national biosafety legislation and the national Biosafety Committee, which would have been the competent authority, was not consulted. This *fait accompli* created uncertainties for producers and buyers, especially of organic cotton, as there was no information on the degree of contamination caused or the effectiveness of technical measures regarding seeds, cultivation and processing in terms of the separation of GM and organic cotton. Similarly, little information was available on the legal provisions in the event of damage. There are legitimate concerns as to whether coexistence rules can be economically applied and monitored by state authorities in a small-scale farming sector as is prevalent in countries like Burkina Faso. Producers, buyers and international financiers are now seeking to study the extent of contamination and analyse possible technical measures to limit it. They will also bear the cost of this study. While this contravenes the polluter-pays principle, no other way to do this can be found since the biosafety law adopted in Burkina Faso in 2006 lacks clear provisions on these matters. The law mentions neither the precautionary principle nor the polluter-pays principle. Nor does it contain any provisions on coexistence and liability.

Key challenges for development cooperation

The partner countries of German development cooperation pursue a variety of strategies on genetically modified crop plants and their coexistence with non-GM crops. Some countries designate cropping zones for both systems in order to serve specific markets. In other countries, the spread of genetically modified crop plants is due to individual proponents in the absence of prior development of political rules. Other countries again postpone the approval of genetically modified crops until such time as suitable strategies for parallel production have been developed.

Plots of traditional maize at varying distances from a field of transgenic maize. Photo: www.biosicherheit.de / Norbert Lehmann

Individual countries have different capacities for coexistence. In countries or regions with large-scale production of crops for export the separation of GM-zones and GM-free zones can quite easily be assured. However, separation is more difficult in countries or regions with small-scale family farms, high agrobiodiversity and weak monitoring systems. In such instances the introduction of coexistence rules may even be unsuitable on ecological, micro-economic and macro-economic grounds.

In the majority of countries information is lacking on the degree of the existing admixture of local seed with GM elements, on required distances between fields, and on sources of contamination between the field and the final processed product. Studies on background contamination levels prior to GM tests are often neglected, leading to a situation where contamination discovered at a later stage can not clearly be assigned to a source.

Tasks of German development cooperation may include the following:

- Support for partner governments in the development of strategies and legal provisions suited to their countries.
- Compilation of the required scientific and technical information and baseline studies.
- Provision to decision-makers and the public of objective information and lessons learned worldwide.

2. Adding economic value to agrobiodiversity

2.1 Partnerships for agrobiodiversity

Dieter Nill, 2007

Photo: Jörn Breiholz

Products from rare useful plants and animals whose preservation is at risk – so-called agrobiodiversity products – provide numerous opportunities for private industry. Marketing these products or otherwise 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. At the same time, successful marketing gives the producers and breeders of such rare plant varieties and animal breeds an incentive to continue conserving them. This secures a rich gene pool which future generations will be able to draw on to continue developing and adapting agriculturally useful plants and animals to changing environmental conditions.

Development partnerships with industry

Very many different forms of cooperation are possible between private companies and development initiatives, institutions or programmes which support the sustainable use and marketing of agrobiodiversity. GTZ provides various kinds of support for private companies operating in developing and newly industrialising countries. Companies interested in using and protecting agrobiodiversity in these countries are no exception. These development partnerships with private industry, or Public Private Partnerships (PPP), enable the public and private partners involved to combine their individual strengths. PPP projects are jointly planned, financed and implemented. The companies benefit from GTZ's contacts, experience and global network of experts, and at the same time their active involvement contributes towards achieving development policy objectives.

More than EUR 140 million have flowed into these projects so far. The public-sector contribution amounted on average to about 40 percent (www.gtz.de/de/dokumente/gtz2010-en-developpp-brochure.pdf).

Advantages for the companies

A firm that has made or wishes to make the conservation of agrobiodiversity one of its company objectives can benefit from doing so:

- Agrobiodiversity products are innovative and new. Selling them opens up new markets, provides access to new groups of buyers and creates profit.
- For companies dependent on agrobiodiversity, conservation of the latter secures their resource base and future raw materials supply.
- A commitment to conserving (agro)biodiversity creates a positive social and ecological image.
- By committing itself to conserving agrobiodiversity a company can achieve its sustainability goals while also securing itself a marketing advantage.
- A positive image makes it easier to find well-trained employees.
- Investments in the protection of agrobiodiversity receive public support, as in the context of PPP projects, for example.

Private companies and their potential for using agrobiodiversity

Fundamentally, any company can contribute something to the conservation of agrobiodiversity, such as using predominantly regional and seasonal produce in

Photo: GTZ

In Traditional Chinese Medicine (TCM), the Ganoderma mushroom has been used for over 4000 years and is one of the most important medicinal plants. Photo: Jörn Breiholz

their works canteens or serving only fair trade coffee. And rather than having plane trees or robinias planted on the green spaces belonging to the company, old endangered fruit trees, such as the service tree (*Sorbus domestica L.*) or old species of cherry, could also be planted. This kind of activity gives companies above all a means of improving their image both internally and externally.

The companies that manufacture or trade in agrobiodiversity products have direct benefits from the use of agricultural diversity. There are various possibilities for this:

Development of new products

Little used agricultural species are often largely unknown. They offer the possibility of developing new products for various spheres – a unique opportunity for companies to create marketable produce for existing or new groups of consumers.

Integration of agrobiodiversity products into existing ranges

Companies that market foods, spices, oils, flavourings or starch, for example, have the opportunity to integrate biodiversity products directly into their product range. Large retail chains that have included fair trade and organic products in their range provide a role model for this. New products such as these improve the range of products on offer for existing customers and attract new ones.

As the number of markets for various agrobiodiversity products increases, so too does their importance for the conservation of agricultural biological diversity.

Awareness-raising and information for consumers

Retail companies can charge higher prices for biodiversity products if they raise their customers' awareness and inform them about the background of the products and their specific objectives. In doing this, they send a signal to consumers that they are environmentally aware and concerned about quality.

Responsible use

Companies that process large quantities of plant or animal raw materials from endangered varieties and breeds can cause farmers to switch to sustainable production methods by means of appropriate supply contracts. In the case of semi-wild species, sustainable use can ensure that stocks are not wiped out through overuse. This is also a way of helping to conserve diversity. Dealing responsibly with agricultural diversity can also be useful in marketing, creating a positive image in the general public sphere and among customers.

Benefit sharing

Private companies can contribute actively to the welfare of farmers by sharing benefits fairly by paying them a higher price for certain qualities, for example. Dealing with producers and suppliers in this way demonstrates an active commitment to agricultural diversity.

Fair and equitable benefit sharing

The Convention on Biological Diversity and the International Treaty on Plant Genetic Resources for Food and Agriculture stipulate that the country

of origin is to receive an appropriate share of the benefits arising from the economic use of genetic resources. This share can be monetary or non-monetary. Access to seeds or support for conserving seed and plant resources also counts as sharing benefits. On the basis of these rules, seed companies that obtain new varieties from genetic material, for example, are obliged to give the country of origin a share of the turnover from a product derived from genetic resources. Exactly how these approaches can be implemented is still a matter of trial and debate. Private industry can set a good example here and make clear its interest in the conservation of genetic resources. At the same time it can use its commitment to do so as a competitive advantage.

Examples of successful marketing of agrobiodiversity products

Agrobiodiversity products have become a taken-forgranted part of the range of international foods, especially in the organic sector; the range of products offered by the manufacturers of natural cosmetics and natural medicines would also be much the poorer without the diversity produced by small farmers around the world. There are now many examples of agrobiodiversity products being marketed successfully, including those that are worthwhile for both producers and marketers and that conserve diversity at the same time.

India: Small local companies established in conservation area

On account of their great diversity of native plants the Biligiri Rangan Hills in the Indian state of Karnataka were declared a nature reserve in 1974. About 4,500 people live in 25 villages in this area. They belong to the Soliga ethnic group. They generate about half their income through the commercial use of plants that grow in the conservation area. These include the Indian gooseberry (*Phyllanthus emblica*), the soap nut (*Sapindus spp.*) and shikekai (*Acacia sinuata*). The latter contain saponins, which are a component of natural shampoos. These plants are endangered by overuse, as is the diversity of the other plants.

The local non-governmental organisation VGKK (Vivekananda Girijana Kalyana Kendra), in cooperation with the Biodiversity Conservation Network (BCN), the University of Massachusetts and the Tata Energy Institute, formed two local organisations and set up two companies to process various forest products. One company processes medicinal plants, the other foodstuffs and honey.

The produce – vegetables in a sweet-sour brine, jams, honey and pumpkins – are sold in company-owned shops in Mysore and Bangalore, the two largest cities in the region. The companies also sell their products in the villages themselves. This has created jobs and increased the people's incomes.

South Africa: Devil's claw from agricultural production

Devil's claw (*Harpagophytum procumbens*) is a plant that grows only in southern Africa. Its root nodule contains active substances that help to ease rheumatic pain. It has been used by the local population for a long time. The growing demand worldwide for natural medicines in the last few years has not stopped at devil's claw, posing a threat to those that occur in the wild: the plants have been dug out whole from the soil, damaging the parent tuber and thereby reducing their natural ability to regenerate. It was obvious that measures aimed at the sustainable use of the plant were needed. These included improving the production, harvest, gathering and marketing of the plant. However, little was known about the ecology of devil's claw.

GTZ initiated a cooperative venture between a medium-sized German manufacturer of natural medicines, with 250 employees and an annual turnover of EUR 55 million, a 5,000-hectare commercial cattle farm in South Africa, and three villages, in which a total of 300 people earn their living collecting devil's claw. The Universities of Durban in South Africa and Münster in Germany looked into specific research issues. The goal of the company was to ensure a reliable supply of good quality raw material and the genetic improvement of devil's claw. The interest of the three villages and the farm was to preserve existing jobs, create new ones and earn extra income. The sustainable use of devil's claw was the common goal of all those involved, through improvements in production, harvesting, wild gathering and marketing.

GTZ financed a number of measures, such as training events for the farm workers in which they learnt how to handle the devil's claw nodule properly and with care.

Staff from Durban University received special training in the area of tissue culture and cloning, and the laboratories' capacity for analysis was improved. The villagers received instructions regarding the agricultural production of devil's claw and how to preserve the wild plants, while special collecting areas were also marked out. GTZ contributed a total of EUR 110,000 to this cooperative venture.

The cattle farm Avontuur provided experimental fields for growing the plant and permitted research to be done on the devil's claw plants that grow wild on the farm's land. A central collecting point for devil's claw was set up and managed by the farm. Münster University provided research equipment and scientific know-how for the tests on the farm. The German company contributed analytical instruments and software, know-how about the ecology and the processing of devil's claw, as well as expertise with regard to data analysis. The company also secured certification for the product and committed itself to purchasing a fixed amount at a price guaranteed by contract. The overall financial contribution of Münster University and of the company was EUR 125,000.

Within two years suitable procedures were developed for the agricultural production of devil's claw and the villagers were trained as professional producers. Now, not only do they produce the raw product, they also dry it, which brings an additional increase to their income. The quality of devil's claw produced on the farm has also improved, thanks to the training given to the technical staff. So far, only a small part of the population has benefited from the above measures. Efforts are currently being undertaken to increase the number of beneficiaries.

Further improvements needed

The systematic and organised development and promotion of new biodiversity products has so far been limited to a few initiatives. There is generally little transparency surrounding the market for biodiversity products, patent rights for such products and benefit sharing along the value chain.

Many agricultural biodiversity products are used traditionally, meaning that they have to be "discovered" and adapted to urban consumer habits in terms of their appearance, quality, taste and packaging if they are to be launched on new markets.

Further information

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2.2 Markets make a come-back
– diversity displays and seed fairs

Conny Almekinders, 2005

The seed fair in Wuzhishan, Hainan Province, China, in October 2009 attracted many people of the Li ethnic group. Photo: GTZ

The more farmers – the more varieties

In the Andean region, "*ferias*" – fairs – were annual events at which farmers sold their products and stocked up on seed and planting material for the next season. The farmers who gathered at these fairs came with products from many different agroecological zones of the wild Andean landscape. Not all crops can be grown and processed at all altitudes so a crop like maize, for example, would be traded for local freeze-dried potatoes.

In old Zimbabwe, communities were expected to donate seed to the royal granary. This practice was known as the "zhunde ramambo", and every community had its own ritual for displaying and storing the king's seed. Special events held every year between harvest time and the new sowing season are an age-old custom of traditional agriculture. With the modernization of society and the emergence and consolidation of a formal seed sector, these old structures have disintegrated and traditional ceremonies like the "zhunde ramambo" have tended to die out.

Now efforts are in hand to revive the traditional fairs. These will facilitate the exchange of seeds once more and begin a process of raising awareness of the richness of agricultural diversity. The same is true of the livestock sector. Livestock markets are another age-old tradition which is of major cultural importance to particular farming regions.

What are seed fairs for?

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. Fairs usually take place between the harvest and the new sowing season, when farmers routinely have plentiful supplies of seed and other planting material. The fairs are also popular social occasions where people meet, exchange news and views, and eat and drink together.

They are also occasions for farmers to 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: which site does this variety prefer, and what is the best use for that one? There is a special interest in old varieties which were believed to have been lost in the region. Frequently there are also diversity contests: the farmer who displays the most diversity is awarded a prize. Sometimes the prizes are a real economic incentive to the farmers to introduce more diversity into their fields or their vegetable gardens. The organizing committee nominates the judges and sets out the criteria for the judging of the material. The prizes awarded to the diversity contest winners underline the importance of agrobiodiversity, and also pay tribute to the achievements of those who are custodians of the cultural heritage.

Working successfully on every continent

In regions all around the world, seed fairs are among the most popular and successful activities for promoting agrobiodiversity. Once introduced, the fairs usually attract more and more exhibitors each year. The most renowned are the seed fairs in the Andes region, in Nepal and in sub-Saharan Africa. In Nepal and the Andean countries, both regions where farmers have domesticated a range of crops over several millennia, seed fairs play an important role in supporting on-farm conservation programmes.

During a seed fair in Chaoba village of Baoting county, Hainan, China, old varieties, e.g. of traditional upland rice, were displayed and exchanged among local farmers. Photo: Luis Waldmüller

Reports of the sheer extent of the diversity on display at these fairs can be quite astonishing. At seed fairs in Zimbabwe, over 250 varieties of 25 different crops have been counted. The 32 participants in a seed fair in a rural community in Peru displayed over 800 seed samples of 17 different arable crops, plus a variety of apples, aromatic and medicinal plants.

In Zimbabwe, the seed fairs are organized as complements to agricultural shows, which usually focus on modern agricultural technology, favouring uniform varieties. At agricultural shows, only registered varieties may be entered. So farmers much prefer the seed fairs where they need pay nothing to display their seeds and offer them for sale. Visitors also enjoy the fairs because they can easily make contact with exhibitors, negotiate payment or barter, and even arrange to visit the exhibitor later on his or her farm.

In Cuba, seed fairs are events where farmers are invited to onfarm or on-station demonstration plots where conservation work is in progress. In this way they can evaluate lots of varieties and then make up their minds from which ones they want to have samples. In 2002 in Mali, German Agro Action organized local seed fairs to help farmers who had lost all their millet seed after a two-year drought to make contact with potential suppliers. The seed transactions were facilitated with a voucher system. Thus farmers who had lost their seed in the crisis could replenish their seed stock, knowing that it would be adapted to the specific local conditions.

Initiative is called for

Organizing a seed fair is relatively straightforward and no special conditions or supporting context are required, but it takes considerable time and effort. If the fair will only be held once a year, it can easily be integrated with a project's other tasks, e.g. combined with such activities as an agricultural show, but the effort is only worthwhile if plans are made to run the fair regularly in future. The most important prerequisite is a "project champion" – someone with initiative who is willing to organize the first seed fair, including the logistics, the prizes and the judges. Furthermore a committee or a community group must take joint responsibility for the planning and implementation. This committee may need support in the early years to make the seed fair a sustainable activity.

Experience from Ecuador

The National Department of Plant Genetic Resources and Biotechnology (DENAREF) in Ecuador views seed markets as a kind of barometer which indicates how much genetic diversity is being used by farmers in a certain region. In the province of Chimborazo, DENAREF used the 'Ferias de Conservacion de Semillas' from 1999 to 2002 to ascertain how much diversity exists at village level among Andean tuber crops. Registration forms were issued, and a panel of judges was convened to evaluate the information and select the winners of the diversity contest. The number of participating farmers and communities grew over the next few years and a flourishing exchange of planting material developed. Researchers used the seed fairs as an indication of where diversity was particularly rich and where its custodians were especially active. Then they could visit and interview these farmers in greater depth.

	1st Seed fair 1999	2nd Seed fair 2000	3nd Seed fair 2001	4th Seed fair 2002
Number of participants	115	281	307	529
Number of communities	23	22	29	70
Number of communities in Las Huaconas area*	7	8	9	6
Ratio of women to men	54% men 46% women	56% men 44% women	60% men 40% women	35% men 65% women

*Communities not directly involved in the project.

Only if the farmers realize that the fair is not just an ordinary market for buying and selling will it have a positive impact on the use and conservation of agricultural diversity. It is therefore important never to lose sight of the original goal of stimulating awareness of the diversity of crop plants. The awarding of prizes must be done with absolute integrity and the judging criteria must be comprehensible and transparent. Any suspect practices are liable to do long-term harm to the fair.

Prelude to other activities

For a village, a seed fair can be a prelude to other activities which enhance the functioning of the local seed supply system. For example, this may include the establishment of a community seed bank or the setting out of demonstration plots. Another potential effect of the seed fair may be to encourage communities to develop more comprehensive and better integrated conservation programmes. DENAREF in Ecuador has built up some positive experience in involving communities and their administrations in the organization of seed fairs. The communities have a budget and may well be interested in including a seed fair as part of their plans.

In Zimbabwe an NGO supported by GTZ organized a seed fair for the first time in 1994 after a community had expressed its seed security problems. Finally, the seed fairs evolved into a Participatory Extension Approach (PEA) and spiralled off into field days where farmers jointly evaluated variety trials and made exposure visits to other communities.

Gender

A seed fair offers particularly good opportunities for involving women. In many cultures, women are responsible for seed selection and storage. As a consequence, they are often more knowledgeable than the men about seed – and how the different varieties perform in the field, the kitchen and the market. With a seed fair as a starting point, women may then be drawn in to other activities, such as participatory selection of varieties or work relating to seed banks.

Inventories and monitoring

Seed fairs offer farmers a good opportunity to collaborate with researchers and development agencies that may be working in their locality to take inventories of the diversity of crops and varieties used in the area. In Zimbabwe following the droughts in the early 1990s, the fairs revealed that a large number of seed varieties – even very old varieties – were still to be found. Via the seed fairs, it is possible to find the farmers with the greatest diversity. In collaboration with them, it is then possible to collect information on the varieties and their management, and to plan more in-depth studies. This may be the starting point for developing an integrated conservation programme. Inventories and information on the species

Like many other seed fairs, the seed fair in Longmudong, Hunan Province, China, was organized by the Sino-German project "Sustainable Management of Agrobiodiversity in the Provinces of Hainan and Hunan". Photo: GTZ

in use are of interest to researchers and farmers alike. In India and Nepal, for example, they resulted in the setting up of "Community Biodiversity Registers".

Agricultural diversity contributes to food security, particularly in marginal locations with unstable environmental conditions. This is probably the key reason why farmers are constantly seeking out new and old varieties, and demonstrate great willingness to try out interesting novelties. For instance, DENAREF's monitoring revealed that the number of Andean tuber crop varieties grown by farmers – including mashua (*Tropaeolum tuberosum*), oca (*Oxalis tuberosa*), melloco (*Ullucus tuberosus*) and potatoes (*Solanum tuberosum*) – had increased after old native varieties were brought into circulation through seed fairs. Which proves yet again that making use of diversity is the best way to conserve it.

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2.3 Maintaining and promoting agricultural diversity through tourism

Dieter Nill, 2007

Photo: Li Qingsong

Tourists seek experiences of nature; they want to try foreign foods and regional specialities. This interest in what is down-to-earth and distinctive represents an opportunity to preserve old plant varieties and animal breeds and unique agricultural landscapes that farmers in different parts of the world have created over centuries – whether they be rice terraces in South-East Asia or vineyards in central and southern Europe. The varieties and breeds that have been bred over generations and the landscapes on which they have left their mark are the cultural inheritance of future generations. At the same time they form a resource base of great value for our future food security.

Diversity is a form of touristic capital that, correctly used, benefits both the entire tourism sector and related aspects of the economy – such as manufacturers of local food specialities or producers of craftwork.

Agrotourism for the conservation of agricultural diversity

Many people have become involved in the conservation of now rare farm animals and crop plants. Research and breeding institutes, charities, parks and botanical gardens work privately or on behalf of the state to secure agricultural diversity for the future. Not all these institutions are funded entirely by external sources; some must raise some or all of their funds themselves, and income from tourism is one of the means by which they do so.

However, the most important breeders and keepers of now rare farm animals and crop plants are still the farmers themselves. In developing countries, in particular, farmers make use of a large number of local plants and animals because they are well adapted to local conditions or because the farmers have no access to alternative seed or other animals. Some farmers, even in developing countries, make a point of keeping endangered animal breeds and plants varieties in order to preserve them for the local culture or to earn extra income through tourism. For example, providers of rural holiday accommodation may add the opportunity to encounter rare plants and animals to the attractions of the traditional farmhouse stay. The table on the following page summarises the important functions of this value chain and the different individuals and organisations involved.

Within the setting of the agricultural enterprise visitors can encounter the plants and animals "live"; they can buy bread, cold meats, jam or fruit juices produced from them, or craft products such as jumpers made from the wool of rare sheep or tablecloths of handwoven linen. In addition to the farmhouse guests, local businesses such as bakers, butchers, restaurants and souvenir sellers are also important buyers. They purchase the raw or already pre-processed products from the farmers and sell them on to the tourists as specialities.

In order to market the local attractions successfully, the involvement of other bodies may be necessary – marketing agencies for the development of tourism products and advertising strategies; tourism associations for the distribution of information, to serve as a contact point and to make arrangements with guests; and local and regional planners to ensure that the infrastructure is adapted to tourist needs.

There are many ways in which agricultural diversity can be profitably combined with tourism, as examples from all over the world illustrate.

Figure: Possible functions and participants of the value chain between agricultural diversity and tourism

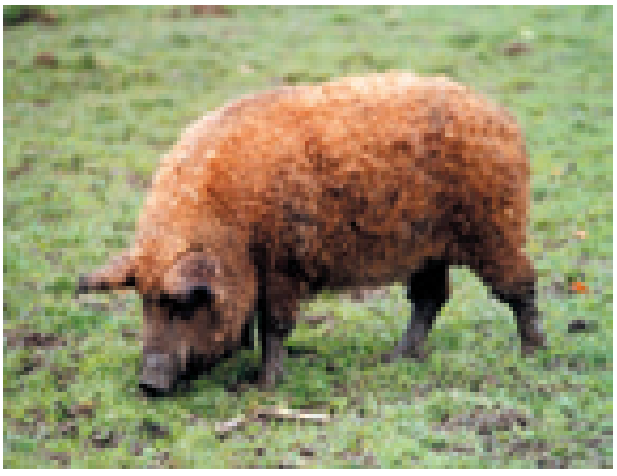
Production	Processing	Marketing	Consumption
Functions			
• Cultivation of rare crops • Breeding of endangered farm animal breeds	• Processing raw materials into products (food, craft products) • Describing the special characteristics of plant varieties and animal breeds • Developing quality labels, brands and certification systems • Developing tourism infrastructure	• Compiling product packages and programmes • Drawing up marketing plans • Organising or taking part in trade fairs • Developing internet platforms • Selling local products (souvenirs, food)	• Viewing animals and plants • Consuming food products made from them • Buying souvenirs etc. • Leisure activities (riding, carriage rides, dyeing, spinning etc.)
Participants			
• Farmers • Scientists • Breeding associations • Sector organisations • Environmental organisations	• Farmers • Local/regional representative bodies • Occupational bodies/ breeding associations • Scientists • Specialists • The food-processing trade • Craft workers • Restaurants	• Holiday companies • Tourism advisers • Marketing agencies • Tourism and farming organisations • Tourist guides • Sales stalls, shops selling souvenirs and local food • Restaurants	• Day trippers • Holidaymakers • Social groups (weddings, company outings) • Educational tourists (schools, occupational groups) • Specialist visitors

Serbia: Wallachian sheep and woolly pig as tourist attractions

In the mountainous region surrounding the Stara Planina Nature Park in Serbia the predominant form of farming for centuries involved the alternating use of the high-altitude summer pastures and the winter meadows in the valley. This local usage pattern fostered a varied mountain flora and fauna and contributed to the development of animal breeds adapted to this system – Bardoka and Wallachian sheep, the Balkan goat, the Bosnian mountain pony and the Mangalitza or woolly pig. In the last hundred years the extensive farming of the mountain meadows has declined. In consequence some areas have become overgrazed as a result of more intensive farming methods; in other places the meadows have gone wild and there has been a sharp decline in the number of species.

Since 2002 the organisation Natura Balkanika in Dimitrovgrad has been attempting to help the region's farmers reintroduce native pigs, horses, sheep, goats and chickens. The old local breeds are of great interest from an economic point of view because they are easy to keep and well adapted to the barren terrain. Meat and wool are of high quality and readily saleable. Natura Balkanika is supported by the national authorities, the Deutsche Gesellschaft für Technische Zusammenarbeit (German Technical Cooperation, GTZ), the Evangelischer Entwicklungsdienst (Church Development Service of the Protestant Churches in Germany, EED) and the Regional Environmental Center for Central and Eastern Europe (REC).

Natura Balkanika advises farmers on agricultural issues and also promotes measure s for strengthening tourism in the region. A farm with a wide range of tourist facilities set up in 2004 forms the region's central attraction. It offers bed & breakfast accommodation combined with the opportunity to encounter traditional local farm animals and to taste their products such as smoked meat and cheese. Astride mountain ponies tourists can explore the natural beauty spots of the area and visit traditional farms whose owners have been specially trained in matters of tourism. As they visit these small rural enterprises tourists can discover local craft techniques and enjoy foods typical of the region.



Rare farm animals, such as Wallachian sheep (left) an Mangalitza woolly pigs (right), are adapted ideally to local conditions and can also be strong tourist attractions. Photos: GTZ

A special attraction is the annual "Regional Fair of Balkan Agrobiodiversity and Rural Heritage". With its well-known livestock show and a range of local specialities on offer it draws visitors not only from the local area but from all over the country.

The modest but varied tourist attractions enable the farming families to bring in additional income. As a result of the various farm initiatives the region around Dimitrovgrad is now one of the most important centres for the conservation of Serbian animal breeds.

Ecuador: Ullucu tubers, jicama roots and community tourism

Two hours north of Quito are the villages of the Cotacachi, an ancient volcanic area. The local cooperative umbrella organisation has launched a tourism initiative there that enables visitors to hike selected routes through the distinctive landscape or to explore it by mountain bike or on horseback. Excursions are led by 25 licensed guides – young people of the villages who have been specially trained as tourist guides. Accommodation for tourists is provided by twelve host families who have erected simple lodges hosting up to four people.

During their stay in the individual villages guests can learn how the local people live. They can, for example, visit the local gardens and fields where many unusual food crops are grown alongside herbs and plants for ceremonial uses. Ullucu tubers, jicama roots, tree tomatoes, quinoa, annona and dozens of other plants arouse visitors' curiosity and can be tasted at shared meals taken with the host families. Via a partnership with the National Agricultural Research Institute the villagers receive additional old varieties that had disappeared from the area. These are now being planted and used – not only for the tourists.

Germany: Ark Farms – a model for the conservation of rare breeds

Ark Farms (Arche-Höfe) are a group of more than 80 farms located all over Germany that combine the provision of farm holidays with the breeding and use of rare, local animal breeds. Interested visitors can join farm tours that provide a fascinating insight into the history of these breeds, their current situation and their prospects for the future. Each Ark Farm has its own special character with a range of animals on view. At the same time the "Arche-Hof" designation is a quality label held by the Society for the Conservation of Old and Endangered Domestic Animal Breeds (GEH). The GEH set up the project, monitors adherence to defined quality criteria, provides support services to members and documents animal stocks. The Ark Farms are visited by individuals, school groups, societies and specialist groups.

Great Britain: Farm Parks as a refuge for rare breeds

The Cotswold Farm Park in Great Britain was set up in 1970 as a private initiative. It focuses on the breeding of rare breeds of British cattle. The farm, originally planned purely as a breeding centre, utilises the interest of tourists in history, culture and aesthet-

ics to generate additional income. Visitors pay an entrance fee and in return are able to view small groups of each animal breed in an attractive pastoral setting. The Farm Park has never received any external financial support; it is funded solely by the visitors, who number about 100,000 each year. Their entrance fees are used to maintain more than 300 sheep, 100 cattle, 30 pigs, 50 goats and 15 donkeys of rare breeds. Other Farm Parks have now been established; they attract a great deal of media interest and are popular destinations for tour organisers, school outings and specialist groups. The farms thus play an important role in raising awareness and disseminating information about rare animal breeds and the importance of agricultural diversity.

Elements of successful touristic marketing of agricultural diversity

Agricultural diversity in itself does not draw any visitors. It becomes a business proposition only when combined with other tourist attractions. For example, riding, hiking, wine-tasting and traditional festivals will attract the required numbers of people. The more diverse the facilities of the region, the larger the stream of visitors. It is also advantageous if options are bundled together to form attractive packages for different groups of visitors, according to their particular interests.

Quality labels make marketing easier, as the Ark Farms show. Such seals confirm the quality of the services and products on offer – an essential requirement if species diversity is to be successfully sold as an attraction.

It is also important that the whole atmosphere of tourist facilities should reflect the distinctive features of local culture as authentically as possible. The products, too, must be genuine. Visitors love opportunities to try, feel and taste new things.

Cooperation and networking between agricultural enterprises, the restaurant trade, food processors, dealers, local authority bodies and travel organisers is useful, making it easier to create and market integrated packages. Strategic partnerships with environmental organisations, NGOs and nature conservation groups facilitate implementation.

The contribution of tourism to the conservation of agriculturaldiversity and culture

The conservation of traditional farm animals and crop plants ought to bring with it improvements in income that provide breeders with an incentive to continue their work. In developing countries the additional gain from tourist activities depends on fair agreements between groups and individuals involved in the value chain. Through equitable profit-sharing the low incomes of rural dwellers can receive a significant boost even from relatively low levels of tourism.

The close encounters that take place between visitors and hosts provide an opportunity for in-depth communication; at the same time the risk of negative consequences such as alcoholism, prostitution or begging must not be ignored.

As well as having an impact on incomes, agrotourism can help to strengthen the identity of the native population, heightening cultural awareness and appreciation of local farm animals and crop plants. For farmers in remote regions additional benefit accrues from the intensive communication both with visitors and with other farms involved.

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2.4 Value chains

and the conservation of biodiversity

Dieter Nill, 2007

In Dafang, Anhui Province, China, wild kiwis are processed into liquor which improves farmers' income. Photo: Christine Martins

It is crucial to conserve the diversity of useful plant varieties and animal breeds still in existence worldwide: this diversity forms the basis not only for the survival of small farmers in Africa, Asia and Latin America but also of the entire world's nutrition. Yet despite gene banks and plant nurseries, conservation is not guaranteed in the long term. This can best be achieved if farmers continue to use old varieties and breeds, even if they are not as productive or efficient as the modern ones, the reason being that they have other advantages, such as secure yields even in unfavourable conditions.

One way of improving farmers' incomes and thereby preserving biological diversity is to seek new opportunities – or indeed any at all – for selling products made from old plant varieties and breeds ("underutilised species"). It is also a means of reducing poverty and hunger. The term "biodiversity products" refers to products originating from local useful plants and animals that are very well adapted to local conditions, reflect traditional knowledge in terms of their development or processing, and are part of the local culture. Their particular characteristics and cultural connection make them suitable mainly for niche markets.

Value chains are helpful for planning

The individual stages from production, processing and marketing through to consumption are described as a value chain.

A value chain analyses activities, products and services during the individual stages of the process and does the same with regard to those involved, their relationships and power relations, as well as the exchange of information and knowledge that takes place between them. The value chain approach enables one to look beyond individual sectors and national boundaries at all the stages in the process and all those involved. If support measures are oriented early on towards the marketability of products, sales opportunities later on can be improved.

The marketing potential of a biodiversity product depends both on its characteristics and origin as well as on the type of value chain. To achieve a realistic assessment of the role played by the marketing of biodiversity products in the conservation of endangered varieties of useful plants and animals, it is necessary to know the characteristics both of the products and of the value chain.

The most important elements in a value chain and their impact on diversity

The most important elements of a value chain are:

- the original product,
- the number of producers and suppliers of the original product,
- the market power of the buyers (individual consumers or large buyers),
- the length of the value chain itself and
- the number of parallel value chains for an original product.

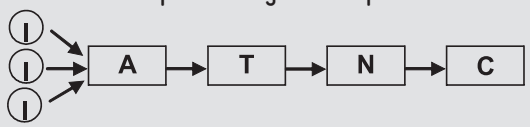
The original product

The starting point of a value chain may be an individual species or variety of plant or an animal breed, such as argan trees or grasscutters, or else it may consist of diverse varieties of a single species. The latter is the case with coffee and potatoes, for example. If the value chain develops only a limited amount of diversity – a single species in our example of the argan tree – then marketing the product will conserve only a comparatively small gene pool (see Diagram 1). In

the case of Andean potatoes and Ethiopian coffee, for example, a very large amount of genetic diversity is conserved, as can be seen in Diagram 2.

Diagram 1: Value chain with little genetic input

Diagram 2: Value chain with numerous varieties or species as genetic input

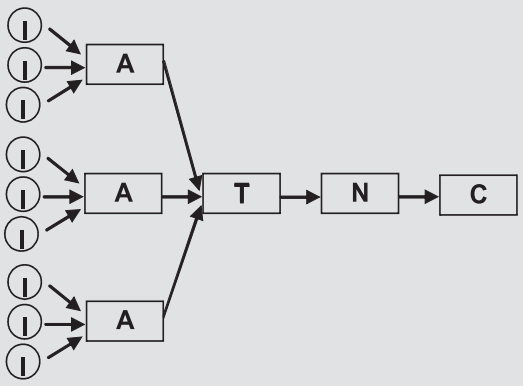


I genetic input
A agricultural production
T transformation
N trade
C consumption

Number of producers

Value chains supplied by many small producers (see Diagram 3) tend to be more helpful for the conservation of agrobiological diversity than those that are served by a few large farms. This is because subsistence farmers and small farmers use considerably more species and varieties than larger farms. The large number of small suppliers also indicates that a production sector is accessible to small producers as well as larger ones. When supplies come from larger farms this can be a sign that standardised qualities are necessary which can hardly be guaranteed by small farms, or that a bigger initial investment in equipment or know-how is necessary, which limits small farmers' access.

Diagram 3: Value chains with many small, non-specialised suppliers frequently use a large amount of genetic diversity



Market power of the buyers

Value chains that are determined one-sidedly by large buyers are frequently associated with disadvantages for the producers, who are forced to bow to the buyers' dictates. Coffee is an example of this. There are a few large coffee roasting companies on the buying side and numerous small coffee farmers on the producer side. Certain quality requirements and established standards on the part of the buyers can lead to a loss of diversity. However, if there are people in the companies on the buyer side who are open to new things, this is a constellation that provides an opportunity to integrate niche products in larger quantities into the mainstream market, such as premium or fair trade products in supermarkets.

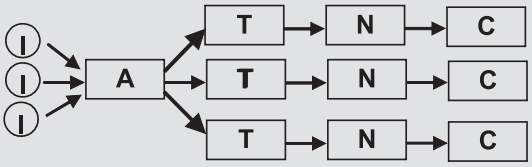
Length

The longer a value chain becomes, the more points there are at which support measures can be introduced. The number of actors increases, as does the complexity of the circumstances. This occurs in particular when a value chain extends over a large area across country borders. At the same time, long value chains open up new markets, customer groups and foreign know-how in production and processing. This can be at the expense of agrobiodiversity, if it is accompanied simultaneously by a large measure of standardisation of the end product. By contrast, short value chains, in which the original product goes directly from producer to consumer, are conducive to diversity.

Number of parallel value chains for an original product

Several parallel processing and/or marketing channels for one and the same product (see Diagram 4) make it easier to find a suitable marketing channel for biodiversity products – or to initiate another one – than if only one value chain exists. The various marketing channels facilitate both the purchase of different primary products as well as access to different groups of consumers. The use of argan oil as a cooking oil and in the manufacture of cosmetics is one example of this. The marketing of biodiversity can also occur outside the classical sectors of agriculture and nutrition, for example via tourism, as the establishment of a potato park in Peru demonstrates.

Diagram 4: Value chain with several processing and marketing channels



This is how a value chain influences diversity

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

Which characteristics of biodiversity products make market access easier?

As is the case with many products, there are particular features of biodiversity products that make it easier to market them. The product's own history can make marketing easier, as can a striking name. For example, "wild" or "forest" coffee from the Ethiopian Highlands can be well utilized in advertising, as the names spark the consumers' imagination. Since this coffee also depends on the shade provided by the forests, every forest coffee drinker is simultaneously protecting the few remaining tropical mountain forests of Ethiopia with their natural coffee growth. This additional benefit of forest coffee can likewise be used for marketing purposes, as it opens up access to more groups of consumers.

Other biodiversity products possess special constituents that make them unique. This is often the case with vegetables, medicinal plants, spices and aromatic plants. It is also good for marketing if a plant grows in just one particular region, as the advertising can then be geared towards selling it as a product with a protected geographical origin. This is the case with the argan tree, for instance. It grows only in Morocco, so argan oil can only be obtained from this country.

The proportion of a biodiversity product contained in an item for sale also influences its marketability. In a medicine, for example, the amount of the biodiversity product may be so small that it is no longer noticeable to the consumer. In the case of forest coffee, 100 percent of the end product consists of the biodiversity product, which makes it easier to see the connection between biological diversity and the pack of coffee in the supermarket.

Which supporting measures are especially suitable for developing the market for biodiversity products?

The analysis (GTZ and GFU, 2006) of support measures implemented for the four biodiversity products forest coffee, Andean potatoes, grasscutters and argan oil showed that in every case it was important to organise the producers into production or marketing structures; this made it easier to tackle product development, to conduct an exchange of information and to train the farmers. Training included technical, organisational and business management courses, and in some cases basic education as well, such as literacy programmes.

All the programmes or projects developed an intensive strategy of innovation which stimulated cooperation with universities, encouraged the farmers to experiment with and develop practical solutions, and promoted an exchange of information among producers, researchers and experts.

In all four cases the producers were supported in the process of improving the quality and efficiency of their production. The certification and development of labels made the products more marketable. Networks between producers, traders and processors were built up in order to open up new (niche) markets. In addition, norms were created for the production process and for the products themselves,

analytical capacity was built up for the purpose of monitoring these norms, legal hurdles were dismantled and property rights clarified.

What contribution can support measures for biodiversity products make towards reducing poverty and improving nutrition?

Measures aimed at improving the marketing of biodiversity products also offer an opportunity to improve the incomes and living conditions of what are usually poor small farming households. However, this does not happen automatically; it is dependent on various characteristics of the value chains:

- **The division of power (governance) within the value chain**

This may be concentrated so heavily around a few actors that they are able to dictate prices and procedures to the other actors. In this way, the profits accrue not to the households of the poor producers but rather at the level of processing or trading of the product.

- **Opportunities for access to the value chain**

The manufacture of new products usually requires startup investment in equipment, buildings or education. Poor households can only join in if these initial costs are not too high or if they can be financed through loans or subsidies. Poor people frequently have only a low level of education, and this limits the use of complicated production or processing procedures.

- **The proportion of women among the beneficiaries**

Many poor households are headed by women. Since the division of labour in developing countries is very gender-specific, the participation of women in value chains depends on the kind of activities and products involved. Some activities are culturally inadmissible for women, and in other cases women have been later replaced by men, who took over the activity once it became clear that there was economic benefit to be had from it, as was partly the case, for example, with the highly profitable activity of grasscutter husbandry in West Africa.

Important parties involved in the sphere of marketing biodiversity products

The opening up of markets for biodiversity products is supported by various initiatives and institutions. The Biotrade Facilitation Programme (BTFP) of UNCTAD (United Nations Conference on Trade and Development) promotes contacts between suppliers of biodiversity products in developing countries and buyers in the European Union (EU) via a business to business (B2B) programme. The programme cooperates with the Centre for the Promotion of Imports from Developing Countries (CBI), which also helps to forge contacts in addition to offering market information, help with product development and training measures. BTFP also supports the regional Amazon and Andean BioTrade Programmes as well as several national programmes.

Further support for (biodiversity) products from developing countries occurs through national programmes run by the industrialised countries. The Swiss Import Promotion Programme (SIPPO) provides assistance for initiatives in more than a dozen countries. The Danish Import Promotion Programme (DIPP) provides market information, and on its website there are numerous links to support programmes in other countries (www.dipp.eu/en/linksen.aspx). In Germany the PPP office at GTZ supports partnerships between private companies and initiatives in developing countries in order, among other things, to improve the marketing of biodiversity products.

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SIPPO: www.sippo.ch
UNCTAD: www.unctad.org/Templates/Page.asp?intItemID=4138&lang=1

2.5 Creating value from products with protected designations to conserve agricultural diversity

Dieter Nill, 2007

All over the world local animal breeds and plant varieties combined with the traditional knowledge of small-scale farming and craft enterprises provide the basis for a range of local products that are sold beyond the region as specialities. Black Forest ham, champagne, Nuremberg gingerbread – the list could be continued; in Europe alone 564 products from 15 countries have so far been registered. In addition these traditional products often have their own history which, alongside the product's quality and the appeal of traditional methods of manufacture, provides an additional purchase incentive for the consumer.

Geographical indications and agricultural diversity

In 2006, in order to promote regional and product-specific diversification and provide better protection for distinctive cultural features, the European Union introduced regulations designed to protect "geographical indications" or "designations of origin" of foodstuffs and other agricultural products. In contrast to other international provisions such as those contained in the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) the EU regulations make no distinction between wines and spirits and other foodstuffs. In both cases the aim is to protect traditional knowledge and to strengthen ownership rights in relation to local products linked to this knowledge.

The European Union distinguishes different protected designations:

1. Protected Geographical Indication (PGI), for example "Quality meat from Schwäbisch Hall (PGI)"
see 2.6 "Utilising biodiversity through marketing – the case of the Schwäbisch Hällisches pig"

2. Protected Designation of Origin (PDO), for example "Meat from Lüneburg Heidschnucke sheep (PDO)"

These trademarks can be awarded for agricultural products or foodstuffs that are produced in a specific place or region and that possess a specific quality or other characteristics attributable to that geographical origin or to natural or human influences associated with it. In the case of the protected geographical indication, processing can take place outside the area of origin. The protected designation of origin is more tightly defined: both production and processing must take place in the region of origin.

3. Traditional Speciality Guaranteed (TSG)

This is awarded to products and foodstuffs that are produced from traditional raw materials or by atraditional production process or evince a traditional composition. "Traditional" means that the special, traditional knowledge involved must have been transmitted over at least a generation. An example of this is Serrano ham.

Protected seals of origin may be used by firms, producer groups or individuals provided that the conditions of the seal are adhered to. Protection can be applied to geographical terms and to specific forms of product or packaging that are associated with a specific region, such as the Bocksbeutel bottle shape used for wine from the Franken region of Germany. An interesting feature of the EU regulations is that it is not only European manufacturers who can register their products; producers from non-EU countries are also entitled to do so. This enables developing countries in particular, to have their goods protected by a designation in the EU, although none have as yet taken advantage of this.

Chart: Functions and participants in the value chain for products with protected designation of origin

Inputs	Production	Processing	Marketing	Consumption
Functions				
• Typical cultural landscape with characteristic climate • Local animal species, types and species of plants • Traditional production related knowledge	• Formation of an organisation/ association • Description of the special product attributes and development of guiding principles • Registration of origin • Production of raw materials • Quality control • Promotion of cohesion among producers • Research support	• Cheese production • Prematuration • Final maturation • Packaging • Product quality control • Accompanying research	• Advertising • Sale to intermediate dealers • Dispatch to dealers and end-customers • Sale to end-customers • Forming and cultivating strategic partnerships • Political lobbying	• Fresh consumption • Consumption of prepared products
Participants				
• Small-scale producers • Processing businesses	• Inter-professional committee • Milk producers • Cheese dairies	• Master cheese makers • Cellarers • Control institutions	• Gastronomy sector • Retailers • Speciality food stores	• End-customers of retailers and market chains • Restaurant customers • Tourists

France: Comté cheese from the Jura

There is evidence that cheese with a long storage life has been produced in the Jura area of France since the 12th century. In 1951, Comté was the first producer organisation in France to have the local speciality cheese certified with a seal of origin (Appellation d'Origine Controlée, AOC).

In order to register a geographic seal of origin, a detailed description of the product and its manufacture and of the relevant geographical boundaries must be provided. An appropriate umbrella organisation needs to act as owner of the seal and safeguard the quality that it certifies. In the case of Comté, this umbrella organisation – the Interprofessional Committee – includes representatives of the milk producers, the dairies and the cheese dealers. In drawing up the conditions of the seal of origin, the rights and duties of the different trades involved were defined and the way in which tasks, costs and takings were to be allocated was laid down. The certificate of origin is a key element of value chain governance, dictating the internal rules and the code of conduct for members. It guarantees the consumer a precisely defined quality and the image associated with the product.

The milk of the Montbéliard cattle is particularly well suited for making cheese. The cows of this ancient breed have lower milk yields but better longevity and fertility. Photo: CIGC

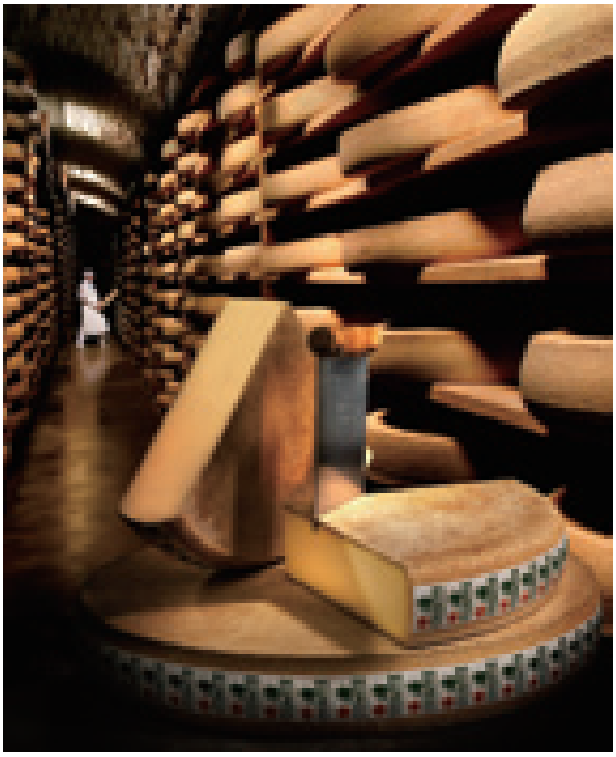

Photo: CIGC

In purchasing the product the consumer contributes to the conservation of regional culinary, cultural and ecological diversity.

The milk for the Comté cheese comes exclusively from Montbéliard cows. This breed has been kept in the region for a long time; it is adapted to the local mountain climate and yields milk that is high in protein but low in fat. The animals of the 3,500 Comté enterprises are fed only on local fresh feed and hay. The use of silage as cattle feed is prohibited. At least a hectare of pasture is available for each cow; there is virtually no use of fertiliser. This preserves the species' diversity of the meadows. The farmers are organised into village cooperatives; each cooperative operates its own cheese factory where a master cheesemaker is permanently employed. The master cheesemaker is responsible for the quality of the cheese. The production process is tightly regulated, and before the cheese is sold it undergoes strict quality control. Independent controllers guarantee consistent quality standards. The entire production process is continually adapted to take account of the latest developments in science and production technology.

Advertising plays an important role in the marketing process. As with all branded products, detailed market surveys are carried out; they form the basis of the company's marketing and external communication strategies. A considerable proportion of takings is channelled into advertising.

The Comté products are sold by middlemen and retailers, delicatessens and restaurants. The consumers acquire products of guaranteed origin and quality and are prepared to pay a premium for this.

Mexico: Mezcal – agave spirit with a long tradition

Mexico is an origin and diversity centre of agave; half of the approximately 450 species of agave grow here. Even in early times the agave was cooked in order to extract the sugar, which the Aztecs called "mexcalli". Since distillation techniques were introduced in the 17th century, fermented agave mash has been distilled to make mezcal. Depending on the agave species used and local distilling techniques, different types of spirit are produced: tequila, bacanora or tobalá. Mezcal is the generic term for all spirits made from agave mash, irrespective of the agave species used.

The desire to protect these local drinks led Mexico to introduce a seal of origin (*Appellation d'Origine, AO*) for the three spirits tequila, mezcal and bacanora. The mezcal seal of origin permits more than a dozen different agave species to be processed for the manufacture of the product. Geographically, it covers a large area including five provinces and two cities. Not all the parts of the area are geographically connected; this makes quality control more difficult and renders it expensive. Since the boundaries of the area have been arbitrarily defined on the basis of political and administrative considerations, some districts that are home to traditional mezcal producers have been excluded from the AO. Producers in these districts where mezcal has been produced for centuries are now faced with the problem of being unable – for purely legal reasons – to use the term. The Mezcal AO Committee was not set up until ten years after the seal had been established. However, the regulations for the production of agave spirit drawn up by the committee did little to focus on quality. For example, they permit the addition of up to 20 percent of other sugars. Producers of pure mezcal without other sugars therefore find it more difficult to obtain a higher price for their better quality spirit. As a result of these underlying system faults, it has not yet proved possible to create a significant awareness of

quality among consumers or an identification with the seal of origin among producers. Nevertheless, certification has enabled mezcal to become better anchored in the market and this has strengthened the economic interest of producers in conserving many agave species.

Vietnam: Tam Xoan rice – sought-after throughout the country

In the Nam province of northern Vietnam a seal of origin for rice has been registered.

The province of Nam is an important rice-producing area on the Red River. The valley of the Red River is also a genetic centre for rice; more than a dozen of the sought-after fragrant rice varieties occur there. The Tam Xoan variety, which comes from the Hai Hau district, is particularly popular with the urban dwellers of the region. On account of this popularity, and to the annoyance of producers, rice from other districts is incorrectly sold as Tam Xoan rice. With support from a rural development centre the farmers have established their own value chain. As a first step the producers agreed on an action plan for the creation of a geographical seal. In 2003, the first year, 25 small farmers undertook production and five families assumed responsibility for processing and marketing the rice. By the second year, 442 enterprises had joined the association; they grew Tam Xoan rice on 54 hectares of land. In 2004, the registration of geographical origin was granted; this enabled regulations governing production, administration, marketing and profit distribution to be formally laid down and approved. From the outset, the certified Tam Xoan rice commanded a price that was half as high again as the price of non-certified Tam Xoan rice and the farmers were able to conclude a number of contracts with supermarkets.

Certification proved to be economically very worth while for all concerned. However, a study of the distribution of the local rice varieties in the area has shown that there is less genetic diversity in the Hai Hau district than in neighbouring districts. This is attributable to the preference for growing the more profitable Tam Xoan rice, which results in the suppression of other native varieties.

Advantages and opportunities of geographic certification

The suitability of geographic seals of origin for conserving genetic diversity in agriculture depends on the way in which they operate. The manufacture of Comté cheese serves to conserve the ancient and proven breed of Montbéliard cattle and their specific characteristics. The seal of origin for Mexican mezcal contributes to the conservation of agricultural diversity: its comprehensive character permits the use of more than a dozen different agave species. This gives producers an interest in conserving these species. In the case of the Vietnamese rice variety Tam Xoan, the economic success of the seal of origin and its focus on a single variety led, on the other hand, to the suppression of other varieties.

Seals of origin are an aid to the consumer in making a purchase: the products are more easily identifiable and the seals provide additional information about quality and origin. In purchasing the product the consumer acquires not only quality but a piece of local culture, authenticity and reputation.

Geographic seals do not automatically protect agrobiodiversity

The following aspects help decide whether a seal of origin represents a viable option for the conservation of agricultural diversity:

- Are there already interesting products that are produced from local animal breeds or plant varieties? What specific characteristics do these products possess that could make them attractive to consumers – characteristics such as quality, positive image, contribution to the sustainable development of the region? What distinguishes these products from comparable ones of no specific origin?
- Do the social, ecological and economic conditions for sustainable production and marketing exist or could they be developed?
- In which geographic areas are the animals, plants and local products produced? Are these areas of origin very large or small, diffuse or clearly defined? Are there other common social, cultural or natural features that could further strengthen a producers' association?

- Are there possible partners for any processing that might be necessary and for the regional, national or international marketing of the products?

The following considerations should also be borne in mind in the development of geographical seals:

- The geographical boundaries should correspond to the actual area of origin and not to artificial administrative boundaries;

- High quality standards help to differentiate the certified products from the rest of the market segment;

- The management committee must work to ensure that members identify closely with the seal. This can be achieved through high quality, objective monitoring, transparency and credibility on the part of the committee, and equitable sharing of rights and duties among those involved (governance);

- A geographic seal of origin should if possible cover the marketing of a number of animal breeds or plant varieties; however, the uniqueness of the products must be maintained.

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2.6 Utilising biodiversity through marketing
– the case of the Schwäbisch Hällisches pig

Dieter Nill, 2007

Our ancestors domesticated wild animals over many generations, breeding a wide variety of farm animals that were extremely well adapted both to their local environment and to the various uses to which they were put. This is how local livestock breeds came into being with their specific traits. These landraces shaped farming culture over the centuries and left their imprint on the landscape that was their home. Industrial animal husbandry was encouraged by the intensification of agriculture, increasing use of growth promoters, antibiotics and feed concentrates. This was accompanied by the broad-scale use of a few animal breeds that were especially suited to this approach. With regard to pigs, for example, tried-and-proven old landraces were displaced by fast-growing "highperformance breeds" with low fat content or even died out completely. This meant that their special genetic characteristics were lost for future breeding. A study carried out in the year 2000 by the Food and Agriculture Organization of the United Nations (FAO) found that about one quarter of the 649 known pig breeds around the world have become extinct. About a third of the 333 pig breeds that had existed in Europe have become extinct, while many others are endangered.

Back from the brink of extinction: In the mid-1980s, reconstruction of the breed began with the last 7 pure-bred sows and one boar.
Photo: BESH

The Schwäbisch-Hällisches Landschwein – an old pig breed rich in tradition

The Schwäbisch-Hällisches Landschwein pig breed emerged around 1820 as a result of crossing Chinese saddleback pigs with local breeds. The European domestic pig breeds of the time were all descended from domesticated wild pigs (*Sus scrofa scrofa*). Chinese Meishan pigs (*Sus scrofa vittatus*) from the Jinhua province found their way from China to Europe in the 18th century via the East India Company. At first they spread only in England, but with the lifting of Napoleon's continental blockade in 1816, they quickly made their home on the continent as well. Upon the decree of King Wilhelm I of Württemberg, some of these pigs were brought to the royal domains in the area around Stuttgart and deliberately crossed with the local pigs. The new livestock breed developed especially well in the area around the town of Schwäbisch Hall, which eventually gave its name to the breed. The first breeders' association was established in 1925.

Its characteristics like its high fertility and exceptionally good mothering ability made the Schwäbisch-Hällisches Landschwein pig popular among the Hohenlohe farmers. Schwäbisch-Hällisches Landschwein pigs are also vigorous, robust, long-lived and tolerant of stress. The animals possess a natural layer of fat, and their flesh is firmer and somewhat darker than that of other breeds. These characteristics make it popular today among gourmet chefs. On account of their long bodies, the animals have longer intestines, enabling them to digest green fodder more effectively. This makes them especially suitable as grazing animals. In the 1950s, 90 percent of the pigs that came onto the market in northern Württemberg were Schwäbisch-Hällisches Landschwein, and in the district of Schwäbisch Hall itself the figure was nearer 100 percent.

The introduction of fast-growing lean pigs, which were suitable for intensive farming, along with the industrial standards that were specially established for them displaced the Schwäbisch-Hällisches Landschwein pigs during the 1960s at a breathtaking pace. By 1969 pedigree breeding had been halted, and by the beginning of the 1980s the breed was considered to be extinct.

At the last minute, however, seven breeding sows and one boar were saved for breeding as pure-bred Schwäbisch-Hällisches Landschwein pigs from the remaining small stocks. The gradual re-construction of the breed began with these eight animals – in opposition to the established breeders of "modern" breeds and to scientists and agricultural extension services, who resisted the move. In 1986 a small number of farmers who were convinced of the advantages of the breed founded the new Schwäbisch-Hällisches Landschwein Pig-Breeders' Association (Zuchtvereinigung Schwäbisch-Hällisches Schwein). In order to ensure quality marketing of the meat the BESH farmers' cooperative (Bäuerliche Erzeugergemeinschaft Schwäbisch-Hall) was established in 1988. After regularly achieving success at agricultural shows like the International Green Week in Berlin, where it was possible to demonstrate the especially high quality of the animals' meat, the Schwäbisch-Hällisches Landschwein landrace gained increasing recognition once again.

The value chain of the Schwäbisch-Hällisches Landschwein pig

Cooperation with existing breeders' organisations proved to be problematic, so that in 1986 an independent breeders' organisation was set up with 17 members at first (cf. table next page). This laid down the formal framework for systematic breeding work. The organisation has now grown to over 120 members. In 2006 the pedigree breeding stocks comprised 280 female and 26 male nucleus animals for breeding and about 3,500 animals for fattening. As such, the stocks are still judged to be "moderately endangered", but still form a solid basis for building up the breed further and ensure that there is an ongoing steady supply of fattening animals for the Schwäbisch-Hällisches Landschwein Quality Pork marketing programme (TGRDEU). The breeding farms are simultaneously either fattening farms or suppliers of young pigs for pure fattening farms.

Protected brand

The marketing programme forms the economic basis for the preservation of the breed. In July 1988 the eight founder members of the BESH farmers' cooperative set down their aims, activities and principles in a constitution. This states that animals are to be kept according to principles appropriate to the species and the environment – no medicines, antibiotics or growth promoters. The constitution also prohibits the use of genetically modified feeds. The producers receive a guaranteed price that is 25 percent higher than the normal market trading price, making Schwäbisch-Hällisches Landschwein pig farming a lucrative activity. The farmers bring their fattening pigs to the slaughterhouse themselves.

The cooperative invested about EUR 6.4 million to renovate the originally communally-run slaughter-

Today more than 300 members of the producer association keep the breed.
Photo: BESH

house and bring it up to standard. This infrastructure facility guarantees the producers direct access to the market and ensures that all the production and processing requirements are fulfilled.

During slaughter, a slaughter protocol is completed containing details about the owner, the quality of the meat, its weight and the results of the meat inspection. The animal halves are branded with the BESH "trademark": "Schwäbisch Hällisches Qualitätsschweinefleisch g.g.A." (Schwäbisch-Hällisches Landschwein Quality Pork PGI). PGI stands for "protected geographical indication". This is a specific kind of brand protection for agricultural food and produce valid throughout the EU (*see 2.5 "Creating value from products with protected designations to conserve agricultural diversity"*). In Germany the applicant for this type of protection (through the German Patent and Trade Mark Office, Munich) can only be an association, as is the BESH cooperative. Now, the Schwäbisch-Hällisches Landschwein pig enjoys the same brand protection as Italian Parma ham or Greek feta cheese.

Currently about 4000 pigs, 250 cattle, 150 sheep and about 1000 suckling pigs are slaughtered every week in the producers' slaughterhouse. The animals are supplied by the 950 BESH member farms, which now produce not only pork meat but also beef (under the brand name of Boeuf de Hohenlohe), lamb and goose.

Quality management is of great importance to BESH. The slaughterhouse and every producer facility are monitored at least once a year and are subject to an audit. These inspections are carried out by an independent, EU-accredited institute.

Professional marketing strategy

From the very beginning BESH has considered a professional marketing strategy to be of great importance. Newspaper, magazine, radio and television reports about the cooperative and the Schwäbisch-Hällisches Landschwein pig help to make the activities of the cooperative better known, as well as helping to promote transparency and trust between the producers, buyers and end customers. 70 percent of the meat produced goes to specialist butchers shops, 30 percent goes straight to the restaurant trade and to delicatessen shops. The butchers commit themselves to supplying BESH meat exclusively; this goes for beef and other types of meat as well as for pork.

Chart: Functions and participants in the value chain of the Schwäbisch-Hällisches pig

Functions				
Production	**Processing**	**Marketing**	**Processing**	**Consumption**
Pig breeding: Organising and implementing breeding (breeders' association) **Pig fattening:** • Organising the producers' association • Introducing & checking guidelines • Certifying as a brand product (PGI) • Implementing fattening and monitoring quality • Relevant research • Transport to slaughterhouse using own vehicles	• Slaughter in producer-run slaughterhouse • Completion of slaughter protocol • Branding the seal of origin • Auditing and independent quality controls	• Customer deliveries • Direct sales at farmers' markets, market halls, restaurant trade • Sales to butchers • Introduction of marketing standards • Sales to a middleman	• Processing into fresh meat products • Production of industrial premium products • Preparation of meals for direct consumption	• Consumption in households as meat or meat products • Consumption in the form of a meal
Participants				
• 180 organised breeders • 950 pig producers • Auditors • Researchers	• Producers • Slaughterhouse workers • Quality inspectors • Environmental organisations as partners	• Producer community • Marketing experts • Certifiers • Butchers • Restaurants	• Specialist meat shops • Food industry • Delicatessen shops • Restaurants • Hospitals	• Households • Restaurant trade • Gourmets

The slaughterhouse and cutting facility operated by the producer association. Photo: BESH

The 280 specialist butchers and 150 restaurants receive direct deliveries every day from more than 20 BESH refrigerated vehicles. The customers appreciate the demonstrably high quality of the meat, as well as the fact that they are able to purchase it directly from the farmer via the cooperative.

Special care is also taken with the processing of the meat to ensure the prime quality of the final products, regardless of whether they are cold cuts and tinned meats or restaurant meals prepared especially for those with sophisticated tastes. In some cases, old processing methods are used, such as hot boning, where the meat is not cooled first, but rather is cut up when it is still warm from the slaughter and thus stays especially tasty.

The excellent quality of the meat supplied by the cooperative created the basis for a business cooperation with Unilever. The prime meat products supplied under the corporation's brand name "Du darfst" are manufactured exclusively from meat produced by BESH. In addition to the use of Schwäbisch-Hällisches Landschwein pigs, other landrace pigs are also supplied for this range, likewise produced according to the strict BESH guidelines. The sole exception to this is that the transport time to the slaughterhouse is permitted to be two hours rather than one, since the Unilever facility is located 60 kilometres away.

In addition to the marketing channels mentioned so far, BESH also has some sales outlets of its own. In Stuttgart and near Heilbronn farmers' markets have been set up at which BESH markets its products directly to consumers. Another sales outlet is operated in the market hall in Stuttgart.

Both on the production side as well as in the area of slaughter and marketing BESH works with strategic partners who provide advice and support. For example, the cooperation with Unilever is supported by the European Natural Heritage Foundation (Euronature). The Society for the Conservation of Old and Endangered Livestock Breeds (Gesellschaft zur Erhaltung alter und gefährdeter Haustierrassen e.V., GEH) was a part of the set-up from the start when the breeders' association was first established. Trials are conducted together with Stuttgart-Hohenheim University in order to further improve livestock management and production processes and shape them in accordance with aspects of animal welfare.

Impacts of the preservation of the pig

The targeted use and marketing of the special characteristics of the Schwäbisch-Hällisches Landschwein pig has enabled this old breed to be preserved as a cultural asset and the carrier of valuable genetic traits. At the same time it has also been possible to create a niche market with added value for the producers.

In a rural, structurally weak region, BESH has created a business enterprise with an annual turnover of EUR 72 million and a workforce of 250 in processing and sales. Through the marketing provided by the cooperative, the nearly one thousand production and breeding facilities have access to a quality sales channel that safeguards their survival and offers them opportunities for the future. The range of tasks undertaken by agricultural facilities in the region has thus been cut back and new structures built up. Since the cooperative also organises a specialist advisory service for the producers and sees to marketing and sales, farmers who had already halted agricultural production have been able to start keeping pigs again, in addition to their non-agricultural work. The buyers in the butchers and restaurant trades have been able to offer a higher quality product range with the high quality meat and to open up new sources of custom.

The producers stress that their working conditions and job satisfaction have also improved through their commitment to animal-friendly and environmentally-friendly production. Pastures that had been given over to scrub have been put to use again as grazing land for pigs.

Both the countryside and the natural animal and plant world have recovered a measure of diversity through this mode of preserving the countryside and have thus become more attractive to tourists.

Useful elements for development cooperation

This successful example is located in a highly developed industrialised country and cannot be applied straightforwardly to developing countries. Nonetheless, a few elements are of use to development cooperation.

As with other value chains, a direct relationship between producers and customers was helpful for the selling process. It made it possible to market an appreciation for the product's origins, mode of production and cultural specificity and thus to build up the necessary trust on the part of the customers. Within the value chain a large number of small, well-organised producers work together with a large number of buyers. This means that the power of decision making and knowledge of the product is not concentrated solely on the buyers' side. All those involved in the value chain have a transparent share in the profits. The cooperation with strategic partners from the sphere of environmental protection and research helped when it came to establishing and improving production. The use of traditional knowledge as well as the ability to innovate played an important role both in the production of the animals and at the processing stage.

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2.7 Utilising biodiversity through marketing
– the case of fine flavour cocoa from Ecuador

Josef Haider, 2007

Once used as a currency among the Aztecs, cocoa beans continue to be a key export of Ecuador. Photo: Bianca Untied

"Food of the gods" was the epithet given to the cacao tree in 1753 by the Swedish botanist and cocoa lover Carl von Linné. And it is still known as such today, for that is the meaning of its scientific name Theobroma cacao. The cacao tree comes originally from the tropical regions of South America; its home is in the Amazon rainforest, where it flourishes in the shade of the gigantic trees of the virgin forest. The first reports of cultivation of the cacao tree come from the Olmecs, who settled along stretches of the Caribbean coast in what is now southern Mexico around 3,000 years ago. Cocoa was particularly popular among the Mayas and later among the Aztecs, who even used cocoa beans as a form of money. The Spanish conquerors of the Aztec empire brought the fruits back to the Old World, and cocoa began its triumphal march that was to sweep the world.

Varieties and origins

The fruits of the cacao tree grow directly from the trunk and contain the cocoa beans themselves. It is the substances contained in these beans the various flavourings and also the high fat content (around half the bean consists of cocoa butter) that made cocoa a sought-after product among consumers and traders even in early times.

On the basis of taste and quality cocoa can be divided into two types: "fine flavour beans" and "ordinary" cocoa, also known as "bulk beans". Varieties such as "Criollo" and the traditional Ecuadorian variety "Cacao Nacional" (also know as "Arriba") belong to the fine flavour type. They are distinguished by their special flavour and low content of bitter constituents. Fine flavour cocoa is used for refining; this has given it the name "flavour cocoa". These varieties are very delicate and have low yields; they are therefore being replaced increasingly frequently by high-yield bulk beans. Only 5 percent of global cocoa production is fine flavour cocoa, and around two-thirds of that comes from Ecuador.

The most important cacao-growing countries today are in West Africa. Around 70 percent of global production takes place in Africa; only 14 percent comes from Latin America, where the most important producing countries are Brazil and Ecuador.

The traditional value chain – from small farmers to the chocolate factory

In Ecuador the majority of the cocoa is grown by small family businesses. The cacao trees are mostly hybrids of traditional fine flavour cacao varieties chiefly "Nacional"and bulk bean varieties, which are gradually displacing the fine flavour genotype.

Pests and susceptibility to disease often lead to serious harvest failures, but the small farmers are unable to afford either expensive pesticides or artificial fertilisers that would boost yields. One solution, alongside the use of assorted varieties, would be to grow cacao in a mixed culture, for example with bananas, papaya or coco palms. This would imitate the natural ecosystem in which cacao is at home. This method of cultivation not only reduces susceptibility to pests and diseases, but also increases the yield of the fields and thus improves the income of the farming families.

Harvesting is carried out entirely by hand, as is the further processing. The cacao pods are split open; the beans are removed, fermented and then dried in the sun. In the course of fermentation and drying important flavour-forming processes take place in the beans. Because of inadequate infrastructure and limited technical knowledge among the farmers, the raw cocoa often suffers considerable loss of quality at this stage. Once the preparation process has been completed the crop is sold.

A board used to grade the beans.
Photo: Bianca Untied

Marketing the raw cocoa

Dealers usually buy the raw cocoa either direct from the farmers or at collecting points; the farmers are typically paid according to the quantity and not the quality of the crop they sell. This means that there is no incentive to improve quality. Via middlemen the raw cocoa then arrives at the export port of Guayaquil – around three-quarters of Ecuadorian raw cocoa is exported to Europe and the USA.

After oil and coffee, cocoa is among the most-traded raw materials on the world market. It is sold primarily on the commodity futures markets in London and New York, where the world market price is also determined. This price fluctuates strongly and is presently falling; in recent years the price – principally on account of the mass product coming from Africa – has averaged around 1,500 USD per ton.

Processing and distribution

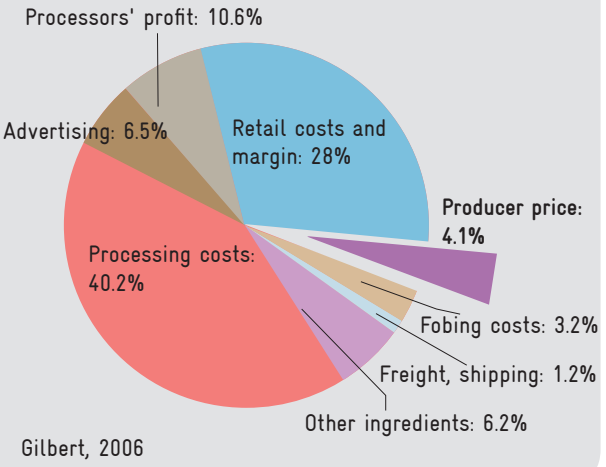
The raw cocoa is processed further at special processing centres most of them in the Netherlands, the United States and Germany or by the large chocolate manufacturers. Cleaning, roasting and grinding the cocoa beans are the main operations. Grinding produces what is known as the cocoa mass, some of which is used directly in the production of chocolate. Further separation of the cocoa mass yields cocoa butter and cocoa powder. Most of the cocoa powder goes to the confectionery industry, while the cocoa butter is used in chocolate production and also in the pharmaceutical and cosmetics industries.

Most cocoa is consumed in the form of chocolate in the industrialised countries. But for some years demand has been stagnant, except for particularly high quality chocolate and fairly traded or environmentally friendly brands sold mostly by specialist shops and over the Internet. Chocolate for mass consumption, by contrast, is usually sold through normal wholesale and retail channels.

The winners are the processors

The proceeds received by the producers for the sale of their raw cocoa are low and often scarcely cover the costs of production. The value added at producer level is therefore very small. There has as yet been no precise analysis of the value chain for Ecuadorian cocoa, but research into the cost structure of milk chocolate in England carried out by Gilbert (s. chart) indicates that in the production of milk chocolate the proportion of costs attributable to the raw cocoa material is less than 5 percent (*see 2.4 "Value chains and the conservation of biodiversity"*).

Chart: Cost structure for milk chocolate in England



Gilbert, 2006

According to this study, the chief costs and also the main profit lie in the areas of processing and distribution, both of which take place in Europe and the USA. The considerable profit made by the processors is particularly striking and reflects the power position in this part of the value chain. The cost structure described also makes it seem likely that a chocolate manufacturer will be particularly interested in processing high-quality raw cocoa, since significantly higher prices can be obtained for high-quality chocolate than for mass goods and the raw material costs are almost insignificant.

Measures for promoting production and marketing

Cocoa production in Ecuador has declined significantly in recent decades. Only very recently has more consideration been given to the opportunities and possibilities associated with cacao cultivation. On account of cocoa's importance in the nation's history it

A fruit pod contains 25 to 60 seeds – the cocoa beans. Photo: GTZ

has been declared the country's "symbolic product". In addition, as part of a concerted campaign involving organisations such as UNCTAD, GTZ and the Inter-American Development Bank, a number of initiatives designed to revitalise cocoa production and marketing have been set up. Part of the reason for this is that cocoa is still one of the country's most important export products. The planned analysis of the value chain will play a useful role in this and will help identify weak points and enable plans for specific improvements to be drawn up. As part of the process GTZ is providing advice to the cocoa producers' cooperatives and communication and coordination between those involved at different stages of the value chain is being improved.

The aim of the project is to increase the cocoa farmers' income by improving access to the market, conserving natural resources and maintaining biological diversity. GTZ's measures aim to strengthen the value chain, linking it to the national export promotion programme and the national agricultural strategy. GTZ is helping to draw up a national strategy for the cocoa sector and for the tapping of new markets. In addition GTZ supports advice and training in the field of cocoa production and marketing; it has mobilised the resources of other stakeholders to help towards attainment of the goals that have been set. Measures that directly benefit the farmers include the strengthening of cocoa producers' organisations, promotion of product quality and support of certification procedures for environmental and social standards. GTZ is also involved in creating direct links between producers' organisations and the market its staff initiate contact between these organisations and the manufacturers of special types of chocolate.

Close cooperation with the private sector is a significant element of plans to promote the cultivation of Ecuadorian fine flavour cocoa. A number of public-private partnerships with Ecuadorian and European firms play an important part in this, as does the involvement of organisations and bodies from the private sector (such as the National Cacao Exporters Association) in almost all promotional activities (*see 2.1 "Partnerships for agrobiodiversity"*). Emphasis is placed on the formation of alliances between the different parties involved in the chain and between the supporting organisations. GTZ is planning the necessary measures, working with other donors – such as the Inter-American Development Bank and official development organisations in Switzerland, the United States and Canada – and with private-sector and governmental bodies in Ecuador.

New products and higher incomes

Cocoa quality has been improved, the export volume has risen. That is the outcome of eleven PPP measures. Kraft Foods is now buying Ecuadorian fine flavour cocoa produced in accordance with the strict standards of the Rainforest Alliance. The French company KAOKA has undertaken to purchase organic and Fairtrade cocoa. The cocoa processors Felchlin and PRONATEC (Switzerland), and ICAM (Italy) have entered into six new, long-term marketing agreements with small producers' organisations in Ecuador. As a result of direct marketing links between small farmers in Ecuador and chocolate processors and the support provided by GTZ, ten new cocoa products are now available on the international market.

With GTZ support 9,500 hectares of cacao have so far been certified to organic standards and 10,000 hectares have been certified in accordance with Rainforest Alliance standards. The number of producers working to Fairtrade standards has risen from zero in 2003 to more than 1,600 last year. A further 600 producers are currently in the process of being certified to Fairtrade standards.

Around 10,300 cocoa producers profit from the activities supported by GTZ; they will be able to improve their incomes significantly in the medium term. Between 2003 and 2006 some 4,500 producer fami-

The raw cocoa is bought up at collecting points before embarking upon its long journey as one of the most-traded commodities on the world. Photo: Bianca Untied

lies acquired direct access to the market because they were cultivating high-quality, organic or Fairtrade-certified cocoa. In the same period the volume of exports from these producers rose by 250 percent to 1,880 tonnes of raw cocoa. The prices received by the farmers were 30 percent higher than previously; the incomes of the producer families rose by between 120 and 1,025 USD per year.

Conserving agrobiodiversity and the rainforest

The involvement of small producers in the lucrative international markets has also had a positive impact on agricultural and natural biodiversity in Ecuador. As a result of the "Nacional" cacao variety's specific requirements in terms of site and growing conditions, it is grown in only very localised areas. Since this variety has in addition been supplanted on a large scale by other types, the very fact of its conservation contributes to the maintenance of biodiversity. Products made from this cacao variety can therefore be termed biodiversity products. In addition, the cultivation of cacao in intercropping systems using agroforestry methods in which some of the large trees of the virgin rainforest can be left standing enables a wide range of animal and plant species to be conserved. This diversity is even greater if the land is managed to organic standards.

The improved incomes of the producer families are also a factor contributing to the conservation of agricultural and natural biodiversity. For only when families can earn an adequate income from the cultivation of cacao do they continue the tradition of growing cacao in a way that maintains species diversity and dispense with other types of cultivation, such as oil palms in monoculture. Adequate incomes from cocoa production also help to prevent the felling of intact rainforest. This is all the more important because cacao is often grown in the buffer zones of protected rainforest areas, the conservation of which is of incalculable value for global species protection.

Poverty reduction and species conservation go hand in hand

The Ecuadorian "Cacao Nacional" is a high-quality biodiversity product that is sought-after on the market. Promoting the environmentally sound and socially equitable cultivation of this variety in particular by linking the producer families to lucrative niche markets, such as the markets for particularly high-quality chocolate specialities, organic cocoa products, products of specified origin or Fairtrade products makes an important contribution towards improving the incomes of small family farming businesses in the cropping regions of Ecuador. In addition, the genetically valuable cacao variety itself is being conserved, and at the same time an important contribution to the maintenance of natural biodiversity in Ecuador is being made. Promotion of the marketing of the Ecuadorian "Cacao Nacional" provides a good example of the way in which poverty reduction and the sustainable conservation of natural resources – especially the maintenance of agricultural and natural species diversity – can be brought into harmony with each other.

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2.8 Utilising biodiversity – who benefits?

The case of Stevia, the sweetener of the Guaraní people

Udo Kienle, Manuel Ruiz, Pedro Willi, 2008

The University of Hohenheim, too, is researching into Stevia; this photo was taken at the horticultural experiment station.
Photo: University of Hohenheim

Background

Providing access to genetic resources and ensuring their sustainable use is a key objective of the Convention on Biological Diversity (CBD) adopted in 1992 so, too, is sharing, in a fair and equitable way, the benefits arising from the utilisation of these resources. The aim is to create incentives for the sustainable and profitable utilisation of biological diversity to the benefit of developing countries. For these countries are home to some 80 percent of species diversity worldwide. Nonetheless, despite such governance mechanisms and intensive debate at international level, there are hardly any examples as yet of successful and sustainable implementation of equitable benefit sharing in relation to an animal breed or plant variety of global commercial interest. Utilising Stevia, the sweet herb of Paraguay, is of very great commercial interest. Benefit sharing as envisaged by the CBD has not yet emerged.

This article explores the setting and presents experience gathered in relation to benefit sharing. This experience may provide a basis for ways to handle other genetic resources of commercial importance.

"Ka'a he'ê" – "sweet herb" – is the name given by the indigenous Guaraní people in eastern Paraguay to the perennial shrub whose leaves they have used for centuries to sweeten their mate tea. They were also aware of the healing properties of the sweet herb and made use of these – although modern medicine continues to doubt the pharmacological effect of Stevia.

Until about one hundred years ago, Ka'a he'ê or *Stevia rebaudiana Bertoni*, as the plant is called in scientific nomenclature, only grew in the wild. The Swiss botanist Moises Bertoni, who "discovered" the plant towards the end of the 19th century, classed it in the sunflower family (*Asteraceae*) and gave it its scientific name, and thus made the plant known outside Paraguay. In 1908, Stevia was domesticated for the first time. Its commercial use only began in the late 1960s and early 1970s. The aqueous extract of the leaves was used to sweeten beverages, cakes, ice cream and other foodstuffs. Japan, China, Brazil, Switzerland and the United States were the first countries to use Stevia as a sweetener on a larger scale.

Stevioside is the principal component of Stevia. It makes the leaves of the plant 20 - 30 times sweeter than sugar. In chemical terms, this is a glycoside, i.e. sugar molecules bound to alcohol. The plant contains further, related constituents that also have a sweetening effect. Depending upon the specific plant material and the area in which it is cultivated, one kilogram of dried Stevia leaves contains 40 - 200 grams of sweet-tasting glycosides.

Cultivation and marketing

In Paraguay, its country of origin, Stevia is cultivated mainly by smallholders, most of whom are mestizos. The plant is undemanding in terms of fertilisers, water and plant protection, and thus ideal for poorer farmers. Cultivating Stevia is, however, very labour-intensive. Smallholders generally crop slightly less than one hectare of Stevia, but this generates more

income for them than, say, cultivating cotton. The sweetleaf or sugarleaf, as Stevia is sometimes called, delivers excellent yields: 1,700 to 2,000 kilograms of dried leaves per hectare. Per kilogram sold, a farmer receives 0.4 to 0.6 US dollars, which translates into 1,000 to 1,200 dollars per hectare.

In 2006, some 800 hectares of Stevia were cultivated in Paraguay for commercial use. Until 2005, the entire crop was exported to neighbouring country Brazil. In the meantime, dried Stevia leaves are also sold to other countries such as the US, Japan, Germany, Argentina, Mexico, France and even to China, which, with an estimated area of 4600 hectares, is itself the largest producer of Stevia worldwide.

Stevia leaves are processed to sweeteners in Brazil, China, Japan, Malaysia, Korea, Canada, Ukraine and the US, but also in the European Union. Despite growing production and rising consumption of Stevia products, its share in global sweetener consumption is only around one percent. This means that, to be precise, only 800 of the 80,000 tonnes of synthetic sweetener are Stevia-derived.

On the world market's doorstep

It is quite possible that the sweet herb of Paraguay is not only suited as a substitute for sugar. Researchers are now exploring the possible use of Stevia in medicine and pharmacology. Individual studies now suggest that the plant contains active medicinal substances. Broad-scale studies of these substances' effects are yet to be carried out.

Stevia's commercial prospects on the global food market are more tangible. In some South American and Asian countries, notably Japan and China, Stevia-derived products have been marketed for some time now as sweeteners. In the US, too, they have been available on the market for more than ten years as dietary supplements. However, the products still lack regulatory approval as foods in that country. A number of US food corporations are in the starting blocks, waiting for the US Food and Drug Administration (FDA) to approve Stevia-derived sweeteners as safe. The Blue California company, for instance, has already announced plans to embark upon large-scale extraction of the sweetener in 2008 (www.foodnavigator-usa.com/news/ng.asp?n=81404-blue-california-Stevia-sweetener). The PureCircle company has established a partnership with Ghanzou Julong

An Ayurvedic food supplement from India – although their medicinal effect has not yet been proved, Stevia products are a runaway success on markets worldwide. Photo: GTZ

High Tech Food Industries, a large-scale producer in China, thus gaining access to large acreage for the cultivation of 5,000 tonnes of Stevia leaves in China; further production sites are to follow in other Asian countries and in Africa (www.earthtimes.org/articles/press/Stevia-agriculture-into-usa,1407959.html).

In the European Union, there is still a ban on the use of Stevia products. Neither steviosides, nor the plant or parts of it, have approval for use as foods or food additives in the EU. An application for approval under the Novel Foods Regulation made in 1997 was rejected by the European Commission by Decision 2000/196/EC because of health concerns. The World Health Organization (WHO) is still evaluating whether the consumption of Stevia can be hazardous to human health or not. These safety assessments concentrate on the question of whether Stevia can have a cancerogenic effect, and on whether it may reduce fertility in men. Neither of the two questions have yet been resolved conclusively, although there are many indications that these concerns are unfounded. In June 2004, the Joint WHO/FAO Expert Committee on Food Additives (JECFA) set a preliminary ADI value of 0 - 2 milligrams per kilogram body weight for steviosides. Ongoing studies to assess safety in terms of human health are expected to conclude by mid-2008. It is expected that the European Food Safety Authority (EFSA) will have to reconsider steviosides, as two new applications for approval (*Stevia rebaudiana as a novel food and steviol glycoside as a food additive*) were made in July and September 2007.

Experts do not expect an approval of Stevia products in the EU before 2011, and even that is considered optimistic by some. Debate on the proposal for an amendment to the Novel Foods Regulation (Regulation 258/97/EC) published by the European Commission on 14 January 2008 has only just started and will probably continue until 2010. It remains to be seen whether the amended Novel Foods Regulation does in fact lead to the hoped-for simplification in approval of traditional foods from third countries. (www.ec.europa.eu/food/food/biotechnology/novelfood/COM872_novel_food_proposal_en.pdf).

Be this as it may, broad-scale utilisation of Stevia is only a question of time. It is important to resolve, before that happens, how the Guaraní, the original "owners" of the plant, are to gain a share in the anticipated benefits.

International agreements and benefit sharing

The Biodiversity Convention is the international agreement regulating access to biological diversity and the associated indigenous knowledge as well as the sharing of the benefits arising from use of that diversity and knowledge (Access and Benefit Sharing – ABS). The CBD prescribes that every state has sovereign rights to its genetic resources. Whosoever wishes to utilise these resources needs the consent of the government in question and must conclude a contract with it that regulates fair and equitable benefit sharing. Moreover, by signing the CBD, its member states have committed to protecting and promoting, within the framework of their national legislation, the rights of indigenous and local communities embodying traditional lifestyles with regard to their biological resources and knowledge systems, and to accord these communities an equitable share in the benefits arising from the commercial use of such resources.

This puts a hold on "biopiracy". In order, however, to actually be able to pursue biopiracy as an offence, comprehensive national-level legislation needs to be enacted which must also cover the fields of illegal use and patenting.

The FAO International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) (*see 3.2 "International Treaty on Plant Genetic Resources for Food and Agriculture"*) serves specifically to conserve agrobiodiversity and protect the traditional rights of farmers and indigenous communities as the custodians of this diversity. The International Treaty entered into force in mid-2004. It stipulates the specific rights of farmers – "Farmers' Rights". Further key elements of the Treaty are the protection of traditional knowledge, the right to equitable benefit sharing, and the right to participate in national decisions relating to the use and conservation of these resources (*see 3.4 "Farmers' Rights and agrobiodiversity"*).

Of agreements and benefits

The Biodiversity Convention constitutes the framework for the handling of genetic resources. An important rule is that, as a matter of principle, the original holder or breeder of this resource has a say in access and equitable benefit sharing. The CBD does not, however, make provision for any monitoring or coercive mechanism which might allow the imposition of sanctions in the event of non-compliance.

In practice, the international patent system, and specifically the protection of plant varieties, has a much stronger bearing on the way genetic resources are handled than the CBD, and effectively decides their fate. In contrast to the CBD, these systems envisage that the first holder of rights to genetic resources is not the state of origin of the organism or the peoples or communities who have domesticated and selected the organism. The rights rest with the inventor or breeder who has registered his/her additional input as a patent or protected variety. Neither patent law nor the law governing the protection of plant varieties make provision for an equitable sharing of benefits with states of origin or the holders of traditional knowledge; nor do they yet require any proof of having gained access in accordance with the provisions of the CBD as a precondition for the granting of a patent or protection.

No national regime in place yet

The Guaraní's sweet herb and its worldwide commercial use are a case for both the CBD and the International Treaty. Paraguay has ratified both agreements, but has not yet transposed their provisions into national law. As a result Stevia continues to be subject to national law in the fields of plant variety protection, patent protection and indigenous communities. This leads to a situation in which the Guaraní

continue to be excluded from co-determining how Stevia is used and having a share in the profits. This situation is not ameliorated by the current national strategy and action plan for biodiversity conservation in Paraguay. In order to allow the Guaraní an equitable share in the benefits arising from the use of Stevia, the Paraguayan Government would therefore need to implement as quickly as possible the international agreements relating to biodiversity and create the corresponding national-level laws.

The national agricultural institute of Paraguay gained variety protection for a newly bred variety of Stevia in 2005, and for another in November 2007. Paraguayan farmers need pay no licence fees for these varieties. Whether this is relevant in the event of a worldwide breakthrough of Stevia is questionable.

Conserving Stevia and safeguarding indigenous interests

To ensure that the Guaraní gain their justified share in the benefits arising from the use of Stevia, the following activities are needed:

- inventorising the present ecological and commercial (production, trade, consumption, demand, supply chains, markets etc.) situation of Stevia
- clarifying the geographical origin of Stevia and the associated traditional knowledge
- reviewing patents on Stevia and, where appropriate, lodging complaints by the Paraguayan state
- formulating and implementing national policies that clearly regulate access to Stevia and the way in which the indigenous population has a share in the benefits arising therefrom
- contacting states which cultivate Stevia and engaging in negotiations and implementing agreements concerning equitable benefit sharing
- completing national-level implementation of the provisions of the Biodiversity Convention and the International Treaty, and adjusting national patent and variety protection law to the provisions of these agreements
- pursuing participation of Paraguay in international ABS negotiations with reference to the issues surrounding Stevia
- raising awareness among all groups with a stake in Stevia: the Guaraní are the custodians of the plant and must receive compensation if others make a profit from it
- promoting fair and equitable business practices.

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3. Governance of agrobiodiversity

3.1 Incentive measures
for the conservation of agrobiodiversity

Conny Almekinders, 2006

Improved access to local and national markets can be an incentive to the sustainable use of biological diversity, as it has a direct effect on the family's income. Photo: Sylvia Reinhardt

Today it is quite normal for spaghetti and macaroni to be made from home-grown durum wheat in some regions of central Ethiopia. Even just a few years ago, the raw material for producing the pasta still had to be imported. The story behind this is first the decline then the successful saving of an important indigenous cereal crop.

Central Ethiopia is the home of many varieties of barley and durum wheat. However, during the last two decades of the previous century they were increasingly displaced by higher-yielding varieties of common wheat. These, though, are nowhere near as well adapted to the soil and climate conditions as their predecessors and, besides, are considerably more susceptible to plant diseases. Food security for local families was under threat. By the time the farmers realised this, it was almost too late. The old varieties had disappeared, and there was virtually no seed stock to be found.

Old varieties rediscovered

Communal seed banks offered a way out of the crisis. As well as receiving the old varieties of durum wheat that had been collected decades earlier and kept in central storage, the farmers were reacquainted with the knowledge that had been lost. It had become apparent that only farmers over the age of 50 were still familiar with the old varieties and knew how to cultivate them. The seed banks are managed by elderly men and women in the respective villages, and these people are also responsible for selecting and propagating the seed stock in collaboration with scientists.

The marketing of durum wheat is also handled centrally via the seed banks. As a result, the farmers are able to obtain respectable prices. This fact and the secure supply of seed at the local level, along with having the broad range of cultivars available again, are strong incentives for the farmers to preserve the old varieties and to develop them further on a voluntary basis.

Diversity must provide benefits

When it comes to preserving diversity out in the fields and in the livestock pens, farmers have a key role to play. It is they who decide which species and breeds of animal they will rear and which crops and varieties they will grow. The precondition for their choice is that they will obtain a benefit, for example

What are incentive measures?

The terms "incentive" and "incentive measure" were brought into the debate in connection with the Convention on Biological Diversity (CBD, 1992). Article 11 of the Convention encourages all signatory states to adopt economically and socially sound measures that act as incentives for the conservation and sustainable use of components of biological diversity.

At the Third Meeting of the Conference of the Parties (COP 3) in 1996, a document (COP 3, 24) was produced that contained a definition of incentive measures. It states that such measures are specific in-ducements designed and implemented to influence government bodies, business, non-governmental organisations or local people to conserve biological diversity or to use its components in a sustainable manner. The intention behind this is to change the behaviour of individuals and institutions in such a way that this objective is actually achieved.

Small-scale producers in Bolivia enter the market with an assorted selection of native potato varieties, benefiting directly from their local diversity. Photo: Conny Almekinders

more grain, greater food security or better wool. This has been the case for millennia. In recent decades, though, the industrialisation of agriculture has speeded up dramatically. This accelerating tendency is reinforced by increasing global competition and structural changes in agriculture itself. The result is a trend that leads to concentration on an ever smaller number of commercially viable high yielding varieties and breeds that displace traditional crop plants and agricultural animals to an ever greater extent. If the old varieties and breeds are to be prevented from disappearing, incentives are needed which make them attractive to farmers again.

This is because, for an individual farmer, "biological diversity" and "agrobiological diversity" are abstract terms in which he or she at first glance sees no tangible value. In fact, though, the diversity of cultivated plants and domesticated animal breeds is fundamental to food security. It is precisely the poorest people, living in marginal areas, who depend for their survival on plants and animals that still produce a yield even under the least favourable climatic conditions, for example extreme aridity. For individuals working on the land, however, this is not easy to appreciate without further explanation if they themselves enjoy no direct benefit. Incentives therefore have a major role to play when it comes to motivating farmers to engage in the conservation of agrobiological diversity. At the same time, though, consumers, politicians, scientists, agri-

Type of incentive	**Positive incentives** These encourage activities at an economic, statutory or institutional level that are conducive to agrobiodiversity.	**Negative incentives** These lead to unsustainable behaviour at the expense of agrobiodiversity.
Direct incentives These strengthen the actors directly, enabling them to utilise and conserve agrobiodiversity. Conversely they are directly discouraged by negative incentives and negative influences of counterproductive incentives.	**Economic** • Direct payments for sowing local varieties • Subsidised market prices • Access to loans when growing local varieties • Promotion of the growing and sale of (for example) indigenous vegetables (semi-wild varieties) through state subsidies or support from development cooperation projects **Non-economic** • (Public) recognition for the conservation of diversity • Greater availability of and easier access to seeds for local varieties (through participatory plant breeding, seed markets) • Training (e.g. in integrated plant protection) and education	**Economic** • Lower market prices for small quantities, for less uniformity or lower quality • Subsidies for modern varieties **Non-economic** • Restricted access to local varieties preserved in gene banks • If the marketing of local/non-registered varieties is illegal • If local varieties are not accepted by – buyers – processors because of their heterogeneity or because there are too few
Indirect incentives These lead to changes in an actor's agro-ecological and socio-economic environment, which in turn has an impact on the use and conservation of biodiversity.	• Legislation which allows farmers to sell seeds of local varieties • Establishment of production chains for diversity products in the food sector: – processing – labelling – joint marketing	• If the extension services promote monocultures and high-input agriculture • Promotion of export crops/cash crops to the detriment of food plants • If access to loans is tied to the use of modern varieties

cultural extension officers and seed producers have to play their part too if the outcome is to be successful.

The table on the previous page shows which measures – positive or negative – motivate or demotivate farmers in this connection.

The success of incentive systems stands and falls with their acceptance by farmers. It therefore follows that the incentives must be tailored to farmers' wishes and interests. Whatever the case, advantages are achieved through:

- new knowledge, for example knowledge of new processing techniques or the development of new products
- improved access to markets
- increases in yield
- cost reduction
- prices.

This is illustrated by the experience gathered to date by the British Overseas Development Institute (ODI) with the project co-financed by GTZ, "Options for Supporting On-farm Conservation in Eastern and Southern Africa" (www.sustainable-biodiversity.org/) (www.africanfarmdiversity.net).

Photo: Jörn Breiholz

Attractive competition – seed and livestock markets

Access to information, capacity development and social recognition are factors that should not be underestimated as incentives for farmers to conserve the diversity of species. One example of a suitable means of bringing these factors into play is seed and livestock markets, at which diversity competitions take place at the same time. A side-effect of such markets is that they attract the attention of both farmers and visitors to the beauty and importance of the diversity of plants and animals in agriculture.

A more significant aspect, however, is that at these public events farmers receive recognition and praise for their work, both of which are non-economic incentives that substantially contribute to the success of the markets and the successful conservation of agrobiodiversity. In addition, the farmers with the greatest diversity are often also in line for cash prizes, thus giving them a direct economic incentive that makes their work worthwhile.

Furthermore, seed and livestock markets stimulate the exchange of information and products not only among farmers but also between farmers and scientists.

The surrounding economy also needs incentives

The service sector itself also needs incentives to enable it to provide effective support to farmers in the exploitation of agro-biological diversity. For example, it is barely worthwhile for a seed company to produce and market seeds from local varieties of bambara nut originating from West Africa. A subsidy from the agriculture or environment ministry could change that. In so doing, the ministry could also simultaneously fulfil its obligation under the Convention on Biological Diversity. Moreover, if the outcome of such a step is greater food security on the ground, then the incentive measure will have paid off.

Similarly, in the processing sector too, appropriate incentives can pave the way for the conservation of agrobiodiversity. As a rule, smallholders harvest only small quantities of grain, and to make things yet more difficult, even these are highly heterogeneous. It is therefore difficult for them to find a mill to process the grain. State-guaranteed fixed prices for this grain or subsidies could encourage a mill to purchase machines which can be used to process such small, non-uniform batches of grain.

Rising demand and, in turn, rising sales are likewise incentives to conserve diversity. But first of all, it is often necessary to run public awareness-raising campaigns among people with purchasing power, advertising the local product and its advantages. This is what happened in Peru, for example. There, sales

of quinoa were successfully expanded following an information campaign spreading the word about its nutritional value.

Successful incentive systems can be planned

Experience gained in recent years has shown that promotional measures targeted at conserving agricultural biodiversity are always successful whenever certain basic rules are observed. These rules include:

- **Integrated project approach**

In this connection, project activities designed to promote the utilisation and conservation of diversity are placed in a broader context.

The range of incentive measures is directed both towards the organisational development of farmers, traders and the seed industry and to the provision of technical support to them.

- **Effective working relationships with the farmers**

Sufficient time and resources must be available in order to find out the interests of the farmers, because it is they who are the key players in the conservation and use of biodiversity.

- **Group work**

This is greatly valued by farmers; farmers' meetings, the determination of group objectives and institution building all improve results.

- **Short funding paths and a clear role model**

The successful projects spent a great deal of time and resources on coming to an understanding with the relevant interest groups: they obtained political backing, made sure that they had support from the service sector, and consulted with the world of trade and commerce.

In parallel, there are a series of other factors that promote the sustainable use and conservation of biodiversity on farmers' fields and pastures and in their sheds and stables:

– popularity of the project among the farmers

– market-related, reliable incentive measures

– constantly accessible funding (if required) – which means via marketing agreements with industry or through membership dues instead of via financiers

– economic integration, which in the long term is the responsibility of a reliable local institution.

Eliminating negative incentives

To achieve success, though, it is also important that negative incentives should be eliminated, for example the promotion of breeding programmes for exotic breeds which crowd out indigenous breeds. No additional money is needed for this, but instead normally only political will and the ability to assert oneself over the stakeholders concerned.

In the public service sector, non-economic incentives can have a great impact on breeders, researchers and extension officers. They create the conditions under which services are oriented more towards the needs of the farmers and the requirements of agrobiodiversity. A sensible, professionally designed incentive system that is geared to success in the field and does not depend on the number of reports and scientific articles generated may be an effective example. In order to gain the support of political decisionmakers and representatives of donor organisations, a joint village visit helps achieve the desired outcome. An exchange of experience with farmers and the drawing of attention to the beauty and importance of agricultural biodiversity have proven to be highly fruitful.

Photo: Feng Yingli

3.2 International Treaty on Plant Genetic Resources for Food and Agriculture

A. Seiler, 2005

Photo: Guenay Ulutuncok

Plant genetic resources for food and agriculture are the basis for the world supply of food and for all breeding efforts. Free movement of germplasm is an essential prerequisite for the adaptation of crops to changing environmental conditions and market requirements. As most crop plants today are spread throughout the world, there is tremendous global interdependence with regard to these resources. Every country is dependent on secure access to suitable breeding material. Most of this material these days is no longer found under *in situ* conditions in southern nations, but is stored in gene banks (*ex situ*). Up to 95 percent of the known cultivated species used in agriculture are stored in gene banks worldwide. According to the Report on the State of the World's Plant Genetic Resources (FAO, 1996), stored collections of e.g. wheat account for 95 percent of cultivated varieties and 60 percent of wild varieties, with equivalent figures for maize of 95 percent and 15 percent and for potatoes of 95 percent and 40 percent respectively.

After seven years of negotiations, the International Treaty on Plant Genetic Resources for Food and Agriculture ("IT") was adopted in Rome in November 2001. The broad goal of the treaty is to create a legally binding framework for the protection and sustainable use of all plant genetic resources for food and agriculture. The multilateral approach taken in the IT to facilitating access to propagating material for the most important food crops and forages, including early cultivated varieties and wild crop relatives, is intended to ensure that transborder exchange is maintained.

From International Undertaking to International Treaty (IT)

The IT replaces the International Undertaking, a commitment to the conservation and use of plant genetic resources for food and agriculture which had existed since 1983 in non-binding form under the FAO umbrella, and whose provisions had to be revised after the adoption of the Convention on Biological Diversity (CBD). The IT now regulates a number of problem areas which have been controversial in recent years, including some omitted from the CBD drafting process as potential risks to its adoption. This specifically relates to Farmers' Rights and the use of the extensive *ex situ* collections of plant genetic resources of national and international institutions and research centres. The centrepiece of the IT is the creation of a multilateral system intended to facilitate access to a range of crop plant genera and species. In addition, the IT sets out to regulate the fair and equitable sharing of benefits arising out of the use of the plant genetic material made available. The treaty will enter into binding force in international law 90 days after ratification by 40 states, probably in 2004/2005. Only then will a Governing Body of representatives from all member states begin to implement the treaty in concrete terms.

IT – summary
Farmers' Rights and contributions

For years, Farmers' Rights have been the focus of international dispute about plant genetic resources for food and agriculture. The recognition of Farmers' Rights at the international level acknowledges

Photo: Jörn Breiholz

the contribution of farmers since the start of arable farming in creating and preserving the vast biological variety in agriculture. Farmers' Rights (Art. 9) are intended to ensure that farmers have access to good seed. Art. 9 explicitly notes that it is not intended to limit the rights of farmers to save, use, exchange and sell farm-saved seed or propagating material. Farmers' Rights are intended to provide a counterweight to the intellectual property rights which industry and the industrialised nations are now demanding for breeding products and other developments in green genetic engineering. The IT establishes Farmers' Rights for the first time in the context of a legally binding, international commitment. They are, however, only vaguely described, and the responsibility for their realisation rests with national governments.

Box 1: Farmers' Rights (Art. 9) in the IT relate to:

- the protection of traditional knowledge relevant to plant genetic resources for food and agriculture;
- the right to equitably participate in sharing benefits arising from the utilisation of plant genetic resources for food and agriculture; and
- the right to participate in making decisions, at the national level, on matters related to the conservation and sustainable use of plant genetic resources for food and agriculture.

Facilitated access to plant genetic resources: the multilateral system

The core of the IT is a so-called multilateral system, which is to be created in order to facilitate access to plant genetic resources for food and agriculture. While the general provisions of the IT create a legally binding framework for lasting conservation of all plant genetic resources for food and agriculture, the provisions governing facilitated access and fair distribution of benefits are limited to the plant genera and species listed in the annex to the treaty. To date, this list comprises 35 food crops and 29 forages. These were selected on the basis of their importance for food security, and together cover 80 percent of the calorie intake of the world's population. No agreement could be reached on other important species, e.g. soya, by the end of the negotiations. However, these could still be added to the list later. There is great international interdependence with respect to the crops included in the multilateral system. Most of them are spread worldwide today, and breeding is dependent on the availability of these resources.

Facilitated access to the collections of the multilateral system shall be provided solely for research, breeding or training purposes serving food security in the broader sense of the term. Such access will not be provided for the purpose of chemical, pharmaceutical or other (industrial) uses.

Fair and equitable benefit sharing

Besides recognising the importance of the multilateral system and the benefits arising solely out of its creation, the IT provides the following mechanisms for fair benefit sharing: exchange of information, access to and transfer of technology, capacity building, and the sharing of monetary benefits arising from commercialisation. These benefits should flow primarily to the farmers in developing countries for their contributions in developing and conserving plant genetic resources.

Box 2: Provisions on benefit sharing (Art. 13)

- **Exchange of information:** The information made available under the multilateral system includes catalogues and inventories, nonconfidential information on technologies, the results of technical and socioeconomic research, and research into characterising and evaluating plant material.
- **Access to and transfer of technology:** The parties to the treaty undertake to provide or facilitate access to technologies for the conservation, characterisation, evaluation and use of plant genetic resources for food and agriculture which are under the multilateral system. This includes access to improved varieties and genetic material developed through the use of plant material obtained from the multilateral system. Technology transfer to developing countries will accordingly be promoted, although applicable intellectual property rights shall be recognised and effectively protected.
- **Capacity building:** Creation of institutional and personnel capacity for the conservation and sustainable use of plant genetic resources will be promoted through education and research programmes in developing countries.
- **Sharing of monetary and other benefits of commercialisation:** If improved varieties from plant material of the multilateral system are developed and commercialised in a way that limits further use for research and breeding, the treaty provides for mandatory payments. This applies primarily to the award of intellectual property rights, unless corresponding exceptions are made in the relevant national framework. In all other cases, commercial users are "encouraged" to make voluntary payments.

Everything is in flux – provisions for a standard material transfer agreement are still lacking

On ratification of the IT the parties to the treaty agree to facilitate access among themselves to the plant collections included in the multilateral system. Access to the genetic resources in the multilateral system must be expeditious and at minimal cost. The details of the conditions for access still have to be set out in detail, in a so-called standard material transfer agreement (MTA). It is planned to create a form of linked obligation, so that everybody receiving material is tied to the provisions of the MTA. The obligations arising under the transfer agreement must only be complied with by direct parties to the MTA. The Contracting Parties are not obliged to track what happens subsequently to the material transferred.

Photo: Guenay Ulutuncok

The major collections held by the International Agricultural Research Centres

The multilateral system covers all plant genetic resources that are (a) listed in the annex to the treaty, (b) under the management and control of the Contracting Parties, and (c) in the public domain. A central role in this is played by the plant collections maintained *ex situ* by the International Agricultural Research Centres (IARCs) and other international institutions.

The seed banks and plant collections of the Consultative Group for International Agricultural Research (CGIAR) contain the most important collections of germplasm for international plant breeding. To keep these freely accessible to interested parties, they were placed under the supervision of the FAO in the 90s. Access has since been granted on the basis of a specific material transfer agreement which requires the recipient of materials not to claim ownership over the material, nor to seek intellectual property rights over these resources.

The IT recognises the outstanding importance of the *ex situ* collections held by the IARCs and calls on the

centres to formulate agreements on access modalities with the Governing Body. This will be done by a differentiated system of material transfer agreements (cf. box 3).

Box 3: Access to the IARC collections (Art. 15)

- Plant genetic resources listed in the IT annex and held by the IARCs shall be made available in accordance with the provisions of the multilateral system.
- Plant genetic resources for food and agriculture held in IARC collections other than those listed in the IT annex and collected before entry into force of the IT shall be made available in accordance with existing arrangements. These will be brought into closer correspondence with the IT provisions in due course by the Governing Body.
- Plant genetic resources other than those listed in the IT annex and collected after the coming into force of the IT shall be accessible under conditions agreed between the recipient IARC and the country of origin of the resources or the country which has acquired the resources in accordance with the Convention on Biological Diversity or some other applicable law.

Need for action in the context of international development cooperation

In the course of the impending formulation of the material transfer agreement and implementation of the IT it will be important to prevent provisions being undermined at the cost of the developing countries. This applies particularly to the interpretation of provisions which have so far been only vaguely expressed in the treaty. Resolution of the following questions is particularly urgent for the interests of the developing countries: When can IPR be awarded over improved varieties and genetic material? What genetic distance is required between the genetic material which is the subject of the IPR application and the initial material taken from the system? What payment modalities are required if commercialisation of newly developed products is associated with restrictions on third party research and breeding?

A key task of technical cooperation in the coming years will be to assist partner countries in the following areas:

- concretising and implementing Farmers' Rights;
- institutional and personnel capacity building, by promoting training programmes, strengthening facilities for conservation and sustainable use of plant genetic resources, and carrying out research projects in partner countries;
- developing policies and legislation for implementing the IT at national level. For this, interfaces must be formulated with other treaties, and specifically the Convention on Biological Diversity and WTO-TRIPS Agreement.

In addition, it should be considered to what extent the principles of the IT can be transferred to other areas of biological diversity, e.g. farm animal genetic resources. These are also very important for global food security.

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3.3 The role of intellectual property rights in agriculture

Hartmut Meyer, Susanne Schellhardt, 2010

In 2002, the UK company Plant Bioscience patented a procedure through the European Patent Office for the identification of broccoli plants that have an increased glucosinolate content. That patent, however, encompassed not only the use of special marker genes to breed broccoli, but also the vegetable plants and the broccoli seed obtained by means of this process. The seed and biotech firms Limagrain and Syngenta have filed oppositions to the patent. Interestingly, Syngenta supports the wide-ranging patenting of breeding processes, and its purpose in bringing the case to court is presumably not to have it revoked, but in fact confirmed. Farmers' groups and development organisations, in contrast, stand in opposition to such undermining of patent law.

Decsions with respect to intellectual property rights at an international level are negotiated by the World Intellectual Property Organisation (WIPO), such as at this high level confererence of representatives of the least developed countries (LDCs) in 2008.
Photo: Mercedes Martínez/WIPO

Similarly far-reaching patents have been applied for in the field of animal breeding. In April 2009, farmers' groups and development organisations protested against the "pig patents" applied for by the Monsanto company. This involves a gene test that can be used to identify pigs that grow and put on flesh particularly quickly. Monsanto further applied that the animals selected by means of this method be patented. Following public protests and a critical assessment by the patent office, Monsanto withdrew these wide-ranging claims and the patent was approved. In the same month, several objections were lodged, referring to the still unclear effects of the patent upon the free availability of the animals and the non-patentability of "essentially biological processes".

In 2009 and 2010, Monsanto applied for patents on pig and fish fattening products arising from processes in which feed is used that contains a certain proportion of omega-3 fatty acids derived from genetically modified soya, oil thistle, sunflower, rape or maize.

Eighty years of intellectual property rights in agriculture

Since genetic engineering became a part of breeding activities some 25 years ago patents on plants and animals or their constituent parts, such as genes or gene sequences, have acquired an increasingly important role. This development has attracted criticism, especially from civil society groups worldwide. Intellectual property (IP) rights have existed in agriculture for almost 80 years. In 1930 the USA enacted the first statute in this area, which then made it possible to patent plants that were propagated vegetatively through bulbs or cuttings. A different path was taken in Europe. The UPOV Convention of 1961 (Union internationale pour la protection des obtentions végétales – International Union for the Protection of New Varieties of Plants) guaranteed plant breeders protection of their intellectual property rights, whilst at the same time permitting other breeders to use the material free of charge for their own breeding purposes (plant breeders' privilege). Farmers were not prohibited from propagating protected varieties; this "farmers" privilege" was recorded in writing, with certain restrictions, in the 1991 version of UPOV. These privileges clearly differentiate between plant variety protection and patent law. However pressure is mounting from the biotechnology industry to align the level of protection in the field of plant breeding with patent law.

The present intellectual property regulations heighten the political and economic imbalance between industrial and traditional breeding, as they only protect the interests of individuals, not those of collective innovation and knowledge systems. For traditional farmers and herders, the plants, animals and microorganisms they use are community assets which they have

National seed legislation adapted to rural agriculture is needed to preserve local farmers' breeding systems. This photo shows a female farmer sitting in front of a seed bank in India's Kolli Hills.
Photo: J. Cherfas/Bioversity International

a collective responsibility to propagate, safeguard and pass on to future generations. The IP rules now in force can not protect their rights and needs.

Moreover, numerous studies have shown that strong industrial IP systems do not serve primarily to promote innovation, as asserted by IP theory, but increasingly to protect investment and fence off markets. This is one of the conclusions reached by the report on the assessment of the impacts of transgenic seed technology in developing countries prepared by the German Bundestag's Office of Technology Assessment and submitted in April 2009. As long ago as 2002, the Commission on Intellectual Property Rights (CIPR) set up by the British Government concluded that there was no evidence that strong intellectual property rights encourage autonomous agricultural research and development for the developing countries.

This conclusion also applies explicitly to plant variety rights. Breeders of agricultural crop species were using such rights to protect their intellectual property rights long before patents were possible in this sector. According to the CIPR, the actual beneficiaries of IP rights are the seed industry and commercial farmers. Developing a commercial seed sector will not improve conditions for subsistence farmers. If IP protection systems are to foster innovation in the developing world, they need to be adapted to the specific circumstances on the ground. The trend towards high uniform standards mainly serves the trade interests of industrialised nations. This is the conclusion of a World Bank report published in 2006. In 2008 the European Commission's European Group on Ethics in Science and New Technologies (EGE) stated in its opinion on intellectual property rights in agriculture that the current system could "pave the way for market predominance where a few companies control much of agricultural production. This would impact on innovation and the growth of local economies in developing countries".

Protection of intellectual property rights for developing countries

With the establishment of the World Trade Organization (WTO) in 1995 the patenting of living organisms became relevant for the developing countries. Each country that joins the WTO automatically becomes a signatory to the TRIPS (Trade-Related Aspects of Intellectual Property Rights) Agreement, which establishes patent protection in all sectors, including agriculture, as the standard means of protection for IP rights. Living organisms can as a matter of principle be patented, but under Article 27.3b member countries are permitted to exclude certain kinds of invention, such as essentially biological processes for plant and animal breeding, as well as the plants and animals themselves, such as the European Patent Agreement, for instance, prescribes. However, WTO mem-bers are required to provide effective IP rights protection for plant varieties, which can be established outside the scope of patent law (sui generis system). For years now many developing countries – the African Group (a UN Regional Group) in particular – have been demanding a ban on the patenting of organisms. Since 2000 the rules set out in Article 27.3 have been under review by the TRIPS Council.

Since 2006, in support of the implementation of the Convention on Biological Diversity (CBD) provisions on Access and Benefit Sharing (ABS) in relation to the use of genetic resources, several WTO members have been calling for a more stringent disclosure obligation when patents are applied for under Art. 29. Some 110 developing and industrialised nations now endorse their demands. The USA, Australia, New Zealand and Japan on the other hand consider there to be no need to supplement the TRIPS Agreement.

Intellectual property rights, the CBD and the International Treaty

The review of the TRIPS Agreement mirrors the disputes that persist between the international regimes established by the WTO, CBD and the International

Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). Whilst the World Trade Organization's TRIPS Agreement asserts private trade-related intellectual property rights, the CBD and the International Treaty recognise the sovereignty of the signatory states over their biological diversity and establish rules of access to genetic resources and equitable benefit sharing (*see 3.2 "International Treaty on Plant Genetic Resources for Food and Agriculture"*). The International Treaty governs the multilateral exchange of genetic resources for the most important food and fodder plants and deals in detail with Farmers' Rights (*see 3.4 "Farmers' Rights and agrobiodiversity"*). Farmers' Rights play a pivotal role in the debate on property rights and entitlements to genetic resources for agriculture. The Treaty's aim is to protect the traditional knowledge of farmers, and to secure equitable benefit sharing from the use of genetic resources and the right to participate in decisions at national level. Further, the Treaty does not limit the customary rights of farmers to reuse, exchange or sell farm-saved seeds – but nor does it safeguard these rights by establishing international standards. Safeguarding the "farmers' privilege" in law was left up to industrial plant breeding lobbyists. National-level implementation of the 1991 UPOV Agreement is to establish binding rules, but these must always observe the interests of IP rights holders.

Both international regimes, the CBD and the International Treaty, demand equitable Access and Benefit Sharing (ABS) in relation to the use of genetic resources. A corresponding agreement was negotiated as part of the International Treaty and is already being implemented; an international protocol on equitable benefit sharing under the CBD is to be finally negotiated in 2010.

Although the Convention on Biological Diversity and the International Treaty recognise the achievements of indigenous populations and farmers in terms of the creation and conservation of biological diversity, corresponding rights to use "their" genetic resources and traditional knowledge must be established at a national level – which has not yet occurred in most cases. Moreover no concepts have been developed which legally define and protect traditional collective rights to genetic resources (in agriculture). The first step in this direction was taken in 2007 with the adoption of the UN Declaration on the Rights of Indigenous Peoples, which stipulated that their material and intellectual right to genetic resources and traditional knowledge is a human right.

Members of the international farmers' movement Via Campesina protest at the World Food Summit in Rome in 2002. A large mumber of civil society groups worldwide oppose strong intellectual property rights in the field of breeding.

Photo: Aksel Naerstad/Development Fund

Effects on biodiversity and food security

The inadequate enshrinement in law of Farmers' Rights and community rights has an adverse effect on the conservation of biological diversity in agriculture and on global food security. The patenting of genetic resources as demanded by the biotechnology industry limits the freedom of both the conventional seed industry and farmers' breeding systems to use modern varieties to safeguard food supply. The industrialisation of agriculture and the introduction of intellectual property rights led to a dramatic decline of species diversity in the industrialised world.

A similar development is to be feared in developing countries. In view of the lack of food security in many regions, and in the face of climate change, this would have serious consequences – especially since agricultural biodiversity offers as yet unexploited possibilities for the future security of the world food supply (*see 1.11 "Agrobiodiversity and climate change – a complex relationship"*).

The right to food: requirements upon intellectual property regulation

The state's obligation to respect, protect and guarantee the right to food must also be complied with in respect to intellectual property rights in agriculture, because farmers' access to seed is an essential condition for the implementation of the right to food. The UN Special Rapporteur on the Right to Food, Olivier de Schutter, outlines such obligations in his report published in 2009. The obligation to respect

requires that nations do not adopt legislation or other measures which create obstacles for farmers to use informal seed systems. The obligation to protect includes appropriate state regulation of seed companies and plant breeders, to prevent their compromising farmers' traditional use of seed. States must also actively promote farmers' access to seeds and other resources, partly by supporting farmers' seed systems, in order to guarantee the right to food.

According to de Schutter, states should not be pressurised into joining the UPOV Convention. For instance, many free trade agreements between European states, the USA or Japan and developing countries stipulate the adoption of UPOV 1991, without taking the specific needs of the particular developing country into account. At farmer level, many state programmes offer their support, such as credits, in a single "package" which at the same time prescribes the purchase of protected modern varieties, thus contributing to the erosion of agrobiodiversity. De Schutter recommends carrying out impact assessments, with the aim of ensuring that the system of intellectual property rights selected is compatible with the right to food. Such assessments can identify potential impacts on the right to food of envisaged laws and measures (i.e. governing IP rights). They would ensure, prior to TRIPS implementation, that the IP rights system selected serves development goals and does not impede smallholders' access to productive resources.

Summary and implications for development cooperation

Development cooperation advocates an equitable balance between the legitimate interests of both sides: those of property rights holders on the one hand and those of traditional users (farmers) on the other. It advises governments on the use of existing flexibilities of the TRIPS Agreement in the fields of biological diversity, agrobiodiversity, the handling of industrial property protection for plant varieties and access to medicines.

There is as yet no universal consensus on how development cooperation (DC) is to strike a balance between the interests of the private sector – in this case the seed sector – and the equally valid interests

The 4th meeting of the Conference of the Parties to the Convention on Biological Diversity launched negotiations on the international ABS regime (2004). Photo: Hartmut Meyer

of small farmers. In order to combat poverty and hunger and at the same time foster the preservation of biological diversity, DC needs to position itself clearly in this respect. This issue paper is intended to promote discussion between the various stakeholder groups and foster consensus.

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3.4 Farmers' Rights
and agrobiodiversity

Regine Andersen, 2008

Access to seeds is Farmers' Right. Photo: Guenay Ulutuncok

For thousands of years farmers all over the world have sown and harvested, saved seed and planting material for the following year and exchanged seeds and plants with their neighbours. In so doing they have created an almost unimaginable abundance of plants, and with their knowledge and skill they have paved the way for the food plants that we use today. In industrialised countries plant breeding and propagation has long been fully commercialised, but in developing countries it remains part of the day-to-day work of many farmers. Yet no one rewards these farmers for their contribution to the conservation of food plant diversity and thus to the global food security.

This was the background against which, following many years of discussion, the members of the Food and Agriculture Organization of the United Nations (FAO) adopted the International Treaty on Plant Genetic Resources for Food and Agriculture. Among other things, this treaty establishes what have come to be known as Farmers' Rights. The aim is to ensure that it is worthwhile for farmers to continue safeguarding and enhancing agricultural plant diversity. The Treaty came into force on 29 July 2004.

International commitment to Farmers' Rights

The International Treaty on Plant Genetic Resources for Food and Agriculture is the first international agreement to deal exclusively with the management of plant genetic resources in agriculture. The Treaty takes account of varying conditions in different FAO member countries by not laying down a catalogue of measures to be applied indiscriminately across the board. It is left to national governments to decide for themselves what measures are appropriate to their particular needs and purposes. This is not, however, a licence to act as they please: Article 9 of the Treaty obliges governments to assume responsibility for the upholding of these rights. The Preamble to the Treaty underlines the responsibility of national governments and emphasises that the implementation of Farmers' Rights requires support at both national and international level.

Articles 13.3 and 18.5 stipulate that "benefits arising from the use of plant genetic resources for food and agriculture (...) should flow (...) to farmers (...) who conserve and sustainably utilise plant genetic resources for food and agriculture." The implementation programmes for the International Treaty should also benefit this target group.

Farmers' Rights – a working definition

The International Treaty does not offer a definition of Farmers' Rights but simply describes the measures that need to be taken to protect and promote them. The document is, however, based on a common understanding of these rights acquired in the many years of negotiations that led up to the formulation of the Treaty:

The traditional rights which farmers as guardians and stewards of agrobiodiversity have had since agriculture began are termed Farmers' Rights. They include the right of farmers to self-determination when they store seed and planting material, plant it and share it with others, develop it and conserve varieties. Farmers also have the right to be rewarded for their contribution to the global pool of plant genetic resources and to the development of commercial plant varieties, either by the seed industry which uses their resources or – where the conservation of genetic resources for the general good is concerned – by the state or by the international community of states. They also have the right to be involved in any decision-making processes that have a direct bearing on Farmers' Rights.

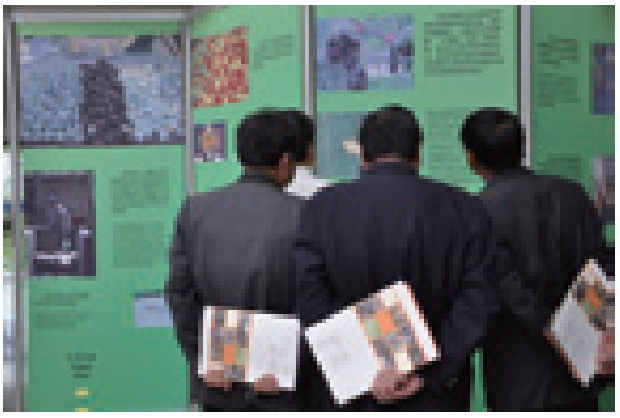


Photo: Ouyang Lina

Farmers' Rights are collective rights

Farmers' Rights are the rights of millions of farmers throughout the world, particularly in developing countries whose agriculture is based on the cultivation of traditional varieties or varieties that farmers themselves preserve and improve. In many developing countries these farmers are by far the largest sector of the population.

In 1986 the subject was aired for the first time by delegations from developing countries at FAO negotiations. This was an attempt to provide a counterbalance to the rights of commercial plant breeders whose new varieties were based on varieties developed by farmers. It was regarded as unfair that only the commercial breeders should benefit financially from this. This issue led to discussions both in developing countries and among the NGOs of North and South as to how the farmers' intellectual property rights could be secured. As the FAO negotiations progressed it became clear that, because the exchange of plant genetic material had been taking place over many generations, it would be difficult to identify the holders of such rights in any legally robust way. In addition, exclusive rights could lead to other farmers being denied access to these fundamentally important resources – a situation which would be counterproductive for Farmers' Rights. Experts in many fields have therefore broadly agreed that Farmers' Rights should be defined not as individual rights but as collective rights for the sectors of the population involved in the conservation and improvement of agricultural plant diversity.

The key points

Although there is no binding catalogue of measures for the implementation of Farmers' Rights, some key points have emerged as important for practical implementation:

- In order that they may continue to fulfil their role as stewards and renewers of plant genetic diversity in agriculture, farmers are dependent on their traditional right to store seed and planting material, to reuse it, to develop it as they deem right, to exchange it with other farmers and to sell it. Seed legislation (variety conservation and certification) must therefore permit these activities.

- The protection of traditional knowledge is a particular concern. The most important task here is to ensure that indigenous varieties remain publicly accessible and are not protected by plant breeders' rights. Plant registers can be used to document all known varieties; this is important for the legal protection of plant varieties since such protection can only be granted for new varieties.

Farmers' Rights in Article 9 of the International Treaty on Plant Genetic Resources for Food and Agriculture

9.2 The Contracting Parties agree that the responsibility for realising Farmers' Rights, as they relate to plant genetic resources for food and agriculture, rests with national governments. In accordance with their needs and priorities, each Contracting Party should, as appropriate, and subject to its national legislation, take measures to protect and promote Farmers' Rights, including:

a) protection of traditional knowledge relevant to plant genetic resources for food and agriculture;

b) the right to equitably participate in sharing benefits arising from the utilisation of plant genetic resources for food and agriculture; and

c) the right to participate in making decisions, at the national level, on matters related to the conservation and sustainable use of plant genetic resources for food and agriculture.

Photo: Feng Yingli

- Farmers must be rewarded for the contribution they make to the global gene pool. This is not only a question of money. They need to be supported in conserving and developing these vital resources which form the basis of their own existence and that of the world's population. This means that they need access to seed suitable for improving traditional varieties and support in conserving seed and planting material and in the sustainable utilisation of these resources, for example through the setting up of local gene banks. Cooperation with professional breeders is also important, in order to improve the productivity and quality of local varieties. Improved opportunities for processing and marketing traditional food plants are other measures that help farmers improve their livelihoods.

- In order to safeguard these rights, it is important that farmers participate in decision-making processes. Different political systems provide different possibilities for this.

Farmers' Rights in the fight against poverty

The reduction of poverty is a primary goal of the United Nations and of development cooperation. More than a billion people live in extreme poverty, three-quarters of them in the rural areas of developing countries. Most of them depend for their survival on traditional agriculture without machinery and without artificial fertilisers or pesticides. The right of farmers to retain access to genetic resources is therefore at the heart of the fight against poverty. Climate, soil quality and the availability of water are important for food security, but most important of all are plant varieties that can adapt to the given conditions and that are affordable for small scale farmers.

Salvator Ndabirorere, advisor at the Burundi Ministry for Land Management, the Environment and Tourism, brought home the importance of Farmers' Rights in the struggle against poverty in these words: "Burundi is a poor country. More than 90 percent of the population is rural and their livelihoods are based on farming. Under these conditions, it can be stated that declaring the rights of farmers would secure all Burundis."

Farmers' Rights in practice

Implementation of Farmers' Rights on the basis of the International Treaty is now under way. Some examples illustrate the process:

- In a number of countries, such as Ethiopia and India, laws on Farmers' Rights have already been adopted or – as in Bangladesh, Bolivia and Zambia – are currently passing through the legislative process.

- In many developing countries projects are helping to strengthen farmers' seed systems. Such projects typically involve training in plant breeding for farmers, the setting up of local seed banks, support for seed propagation and marketing and/or participatory plant breeding in collaboration with commercial breeders. An example of such activi-

Creative solutions required for monitoring

A Governing Body has been set up to monitor the implementation of the International Treaty on Plant Genetic Resources for Food and Agriculture. All the Treaty's member countries are represented in it and it meets biennially. Because the individual provisions relating to the implementation of Farmers' Rights are optional, accordance with Article 9 is not measurable; therefore the usual methods of monitoring cannot be used. This means that creative solutions are required. With the support of the Norwegian Ministry of Agriculture and Food, the Royal Norwegian Ministry of Foreign Affairs and GTZ, the Norwegian Fridtjof Nansen Institute has set up an international project that aims to support the development of appropriate monitoring methods by the Governing Body.
More details at: www.farmersrights.org

ties is the Philippine organisation South-east Asia Regional Initiatives for Community Empowerment (SEARICE) (more information at: www.searice.org.ph).

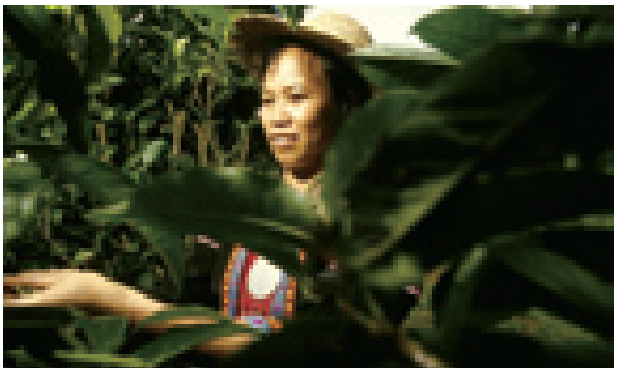
- Civil society organisations are the principal agents in the implementation of Farmers' Rights in developing countries. Without their involvement it is likely that little would be achieved. Some of these organisations have been very successful – for example the M. S. Swaminathan Research Foundation in India (www.mssrf.org), the Community Technology Development Trust (CTDT) in Zimbabwe (www.ctdt.co.zw) and Local Initiatives for Biodiversity Research and Development (LI-BIRD) in Nepal (www.libird.org).

A programme for development cooperation work

Farmers' Rights are a strategic instrument in the battle against poverty. Experts say that development cooperation is the most promising way of ensuring that farmers actually get to benefit from what is due to them.

There are many ways in which development agencies and organisations can support the implementation of Farmers' Rights, including these:

- Programmes for the on-farm conservation of plant genetic resources;
- Setting up local seed banks and registers of varieties;
- Programmes to improve farmers' knowledge of breeding, particularly with regard to broadening the plant genetic base;
- Programmes to improve the marketing of products from genetically diverse systems of cultivation;
- Information and training on the subject of Farmers' Rights at different levels, but particularly for political decision-makers at national and local level, farmers' organisations and farmers;



Farmers' Rights include the protection of traditional knowledge and are therefore particularly important for indigenous people and minorities. Photo: Guenay Ulutuncok

- Support of organisations involved in the protection and promotion of Farmers' Rights in developing countries;
- Including the subject of Farmers' Rights in discussions with recipient countries. Particular issues which need to be covered are seed legislation and the involvement of farmers in decisions affecting the management of plant genetic resources and Farmers' Rights;
- Ensuring that smallholders' organisations from the developing world can participate in relevant international institutions, such as the Sessions of the Governing Body of the International Treaty.

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3.5 Genetic resources – access and equitable benefit sharing

Andreas Drews, Suhel al-Janabi, 2008

For thousands of years plants and animals have been transported from country to country and from continent to continent to be used outside their region of origin, for example as cultivated plants, for improving seed and domesticated animal breeds, and as medicinal plants. The modern methods associated with biochemistry, molecular biology and above all gene technology have yielded rapid growth in the demand for genetic information for the various fields of application. It is often the countries of the South, with their enormous biodiversity, that supply this genetic information. The potential for use of the vast majority of plants, animals and microorganisms remains essentially unexplored. At the same time, their habitats are in danger and many species are threatened with extinction. The traditional knowledge of indigenous people and local communities about the possible uses of the biological diversity that surrounds them is an important resource, particularly in the search for new remedies.

As an incentive to the countries of the world to preserve their biodiversity, the Convention on Biological Diversity (CBD) proposes an international Access and Benefit Sharing (ABS) regime for genetic resources. The aim is to ensure that countries of origin receive a fair share of the benefits and technologies that result from the biotechnological exploitation of genetic resources and of the associated traditional knowledge, in return for preserving these resources, where possible in their natural habitats. Such benefits include the transfer of biotechnology and expertise that developing countries so urgently need, and their participation in research into genetic resources.

Access to genetic resources within the CBD

The principles of the international framework for access to genetic resources and for benefit sharing is outlined in Article 15 of the CBD. Access shall only be granted

- subject to prior informed consent (PIC),
- on mutually agreed terms (MAT),
- in connection with sustainable uses, and
- subject to fair and equitable sharing of the bene.ts that arise from the use of genetic resources.

The Bonn Guidelines on ABS, which were adopted in March 2002 by the 6th Conference of the Parties in Den Haag, are intended to support the Contracting Parties and other relevant actors:

Photo: GTZ

What are genetic resources?

Genetic resources are materials of animal, plant, microbial or other origin that contain functional units of heredity and have an actual or potential value. They include animals and plants and parts thereof, seed, seedlings, fungi, bacteria and other single-celled organisms, cell cultures, spermatozoa, ova, chromosomes and DNA (desoxyribonucleic acid).

Photo: GTZ

- in shaping national policies and the statutory and regulatory frameworks on ABS, and/or

- in negotiating bioprospecting projects in accordance with the principles of the CBD. In practice, however, as a voluntary instrument, the Bonn Guidelines have proven inadequate to ensure that the benefits of the use of genetic resources are equitably shared between the countries of origin and the users of the resources. Consequently, in the Plan of Implementation of the World Summit on Sustainable Development (WSSD), adopted in Johannesburg in September 2002, it was agreed to negotiate an international regime to promote and safeguard the fair and equitable sharing of benefits arising out of the use of genetic resources. Negotiations on this regime should be concluded by 2010.

The contribution of GTZ

On behalf of the Federal Ministry for Economic Cooperation and Development (BMZ), at German and international level GTZ is working to ensure that the protection and conservation of biodiversity is better integrated in other policy areas and in national development strategies and plans. In many of its bilateral cooperation programmes GTZ creates a connection between the protection and sustainable use of natural resources and poverty reduction measures. Many approaches are based on experiences gained by the programme. Implementing the Biodiversity Convention, which range from community level resource protection to national legislation against biopiracy. The implementation of the CBD's ABS provisions is today being promoted by bilateral development cooperation, through pilot measures run by the BIODIV programme, and by the ABS Capacity Development Initiative for Africa. For instance, the environment programme in the Philippines is supporting the environment agencies in raising public awareness of the implementation of national ABS legislation. The programme is based on experiences made with pilot measures under the BIODIV programme. The NGO SEARICE (South East Asia Regional Initiative for Community Empowerment) has worked with indigenous and local communities to combat illegal bioprospecting (biopiracy) and draw up fair bioprospecting agreements. In the semiautonomous province of Palawan, the Palawan NGO Network (PNNI) continued to implement measures to implement national access laws locally under a programme coordinated by SEARICE.

One major task for the environment programme in Namibia is to identify sources of income that are based on biological resources and can be used by those who live in and close to protected areas. To this end, existing value chains are analysed and stabilised, while active support is given to the development and enforcement of a national legal framework for ABS. Since 2005 the Directorate General for International Cooperation (DGIS) of the Dutch Ministry

Biodiversity and the Biodiversity Convention

The term "biological diversity", or "biodiversity" for short, encompasses the diversity of life on Earth, ranging from genetic diversity and diversity of species to the diversity of ecosystems. The Convention on Biological Diversity (CBD) adopted in Rio de Janeiro in 1992 comprises three elements: the conservation of biological diversity, its sustainable use and the equitable sharing of benefits arising from such use. In the meantime, 193 Parties have joined the Convention. By signing the Convention, Germany has agreed not only to conserve biodiversity on its own territory but also to support developing countries in implementing necessary measures.

of Foreign Affairs has supported the efforts of the BIODIV programme to promote ABS competence in Africa. An initial regional pilot workshop in Addis Ababa in October 2005 led to the establishment of the Dutch-German ABS Capacity Development Initiative for Africa. Clear evidence of success, such as an improved preparation of the African group for the ongoing negotiations on the international ABS regime, has led Africa and other regions to call for more support and has heightened the interest of other donors in working with the initiative.

The international exchange of information, particularly the South-South exchange, is supported through nancial assistance and technical conceptual advice on planning events and relevant publications.

Action required

- Finalise the negotiations on an international ABS regime by 2010;
- Transpose the international ABS laws into national legislation and policies, in keeping with the Bonn Guidelines;
- Support the implementation of the CBD's Action Plan on Capacity-Building within the framework of development cooperation;
- Develop and implement rules at international and national level that govern the protection and use of traditional knowledge of genetic resources;
- On the part of industrialised nations, ensure that within the international regime, the details of which are yet to be defined, genetic resources are only used provided their origin is certified and the benefits are equitably shared by the user companies;
- At international level, align the provisions of relevant intellectual property agreements with those principles and provisions of the CBD that relate to ABS.

Further Information

BMZ, 2001: Access to genetic resources and Benefit Sharing. Special 33. www.bmz.de/en/what_we_do/issues/Environment/biodiversitaet/arbeitsfelder/gewinne/index.html

German Development Institute, 2003: Access and Benefit Sharing (ABS): An instrument for poverty alleviation – proposals for an international ABS regime. www.cbd.int/doc/?mtg=ABSWG-02&tab=1

ABS homepage of the CBD Secretariat: www.cbd.int/abs/

Information from the EU on implementing the Bonn Guidelines on access to genetic resources: www.abs.eea.europa.eu/

Portal of the ABS Capacity Development Initiative for Africa: www.abs-africa.info

Photo: Guenay Ulutuncok

3.6 Biosafety
– the implementation of the Cartagena Protocol

Hartmut Meyer, Alexandra Müller, 2008

The use of genetic engineering methods in agriculture is associated with highly disparate expectations. While research and industry have for 20 years been holding out the prospect of reducing hunger and poverty through the cultivation of genetically modified crops, advanced breeding methods that do not involve genetic engineering are now yielding more attractive alternatives. Many breeding successes were reported in 2007, including beans for dry and impoverished soils in Colombia, rice for land at risk of flooding in Bangladesh and wheat for dry soils in India.

The genetically modified plants that are now being grown – soya, maize, rape and cotton with resistance to herbicides and some insect species – are accredited by research and industry as well as by regulatory authorities as involving negligible risks for people and the environment. Critics point to inadequacies in some of the study methods used and draw more negative conclusions from the results.

The term biosafety is used to cover the entire range of instruments intended to avoid or reduce the risks to biological diversity and human health that arise from the release and use of genetically modified organisms (GMOs). It covers the analysis of these risks as well as measures to control, manage and monitor them.

The introduction of GMOs can have far-reaching and undesirable ecological consequences, particularly in developing countries: the dissemination of artificial genes in the natural gene pool is an example.

This is a particular problem in centres of origin and diversity of food crops, since their wide variety of species and genes has important potential for long-term food security. Another negative impact is the possible effects of GMOs on other, non-target organisms such as wild animals and beneficial insects.
The use of GMOs may also have negative socioeconomic and sociocultural consequences on account of the increased capital expenditure involved. Genetically modified seed commands higher prices; the use of insect-resistant plants requires special knowledge in order to avoid the development of insect lines that are resistant to the plants. GMO use can therefore be economically risky, particularly for small farmers in poor agricultural settings. Village social structures may also be adversely affected. There is a risk that

Photo: Guenay Ulutuncok

Biotechnology and genetic engineering

Biotechnology is the term used to designate all technical applications that use biological systems, living organisms or products thereof to produce or change products or procedures for a specific purpose. Biotechnology thus embraces "classic" procedures such as brewing beer and producing yoghurt (fermentation) as well as microbiological procedures (e.g. synthesis of natural substances) and genetic engineering which aims to make specific changes to the DNA of an organism.

The term "modern biotechnology" as defined in the text of the Cartagena Protocol refers to the application of genetic techniques that overcome natural reproductive or recombination barriers and that are not techniques used in traditional breeding and selection. GMOs, or "living modified organisms" as they are termed in the protocol, are defined as "any living organism that possesses a novel combination of genetic material obtained through the use of modern biotechnology".

Photo: GTZ

women will be particularly disadvantaged by the use of modern technologies and the commercial acquisition of seed; in many cultures both activities are seen as male domains. Depending on the national legislation in place and agreements with the patent owners, the purchase of genetically modified seed can create new dependence as a result of built-in patents. Another risk is the replacement of export products such as cocoa butter or vanilla by products that can be produced industrially through the use of GMOs.

The Cartagena Protocol on Biosafety

In January 2000, under the Convention on Biological Diversity (CBD), the Cartagena Protocol on Biosafety was adopted.The protocol entered into force in September 2003 after the 50th ratification; it has so far been ratified by 143 states. It strengthens in particular the position of states that as yet have no biosafety legislation, since any importation of GMOs for use in agriculture requires the prior consent of the importing country. An important element of the protocol is the anchoring of the precautionary principle, permitting Member States to impose import restrictions and prohibitions even if there is no conclusive evidence of possible dangers.

Transboundary movements of GMOs are regulated by the Biosafety Clearing House (BCH), an Internet-based information system. Since the protocol focuses on transboundary traffic, it does not regulate every aspect of genetic engineering and, for example, contains no statement on the national development of GMOs. Since it forms part of the CBD, the Protocol covers only GMOs that are capable of reproduction. All genetically modified organisms that are approved at national level as food or feed and which are registered with the BCH may be exported to other Member States without prior consent unless the importing state has stipulated otherwise in its own regulations. The import of GMO products that are not capable of reproduction, such as soya flour, is not covered.

The German Biosafety Capacity Building Initiative

The need for consultancy for the implementation of the Cartagena Protocol is extremely high in developing countries, and the capacities required do not yet exist.Within the scope of the German Biosafety Capacity Building Initiative of the Federal Ministry for Economic Cooperation and Development (BMZ), partners are receiving support to implement this protocol at national level and to assess independently the risks of genetic engineering.

GTZ's contribution to implementation of the Cartagena Protocol

GTZ, on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ), works at German and international level to accelerate implementation of the Cartagena Protocol and promote its further development. This is effected in particular through the programme "Implementing the Biodiversity Convention", which is responsible for implementation of the German capacity building initiative.

The Cartagena Protocol was also discussed during the tenth meeting of the parties (COP 10) to the Convention on Biological Diversity in Nagoya, Japan, 2010. Photo: Ricardo Icaza

GTZ carried out wide-ranging advisory work during the negotiation process which surrounded the Protocol; this is now being continued in the implementation phase. In addition, GTZ is conducting a regional project with the African Union for the development of biosafety capacities and a number of single measures for developing capacities in selected partner countries such as China.

Action required

- Support to developing countries for implementing the international resolutions and regulations on biosafety at national level in legislation and policy-making, e.g. in setting up biosafety authorities;
- Support to developing countries in the further negotiations on the Cartagena Protocol;
- Intensified capacity building and raising of biosafety awareness in developing countries, for instance through educational and public relations work;
- Development of mechanisms enabling civil society to participate in political decision-making processes;
- Promotion of networking between government and civil society stakeholders at national and regional level.

Further information

Biosafety Clearing House Mechanism:
www.bch.cbd.int/

The Biosafety Protocol:
www.bch.cbd.int/protocol/

Third World Network Biosafety Information Centre:
www.biosafety-info.net/

International Centre for Genetic Engineering and Biotechnology: www.icgeb.trieste.it/

3.7 The EU Novel Foods Regulation

– its impact on trade in biodiversity products from developing countries

Kirsten Probst, Irmgard Höschele-Zeledon, 2005

Photo: Guenay Ulutuncok

What is "Novel Food"?

The NFR regulates the placing of "novel foods" in EU member states to protect public health by ensuring food safety. It calls for anyone wishing to place a food product on the EU market to first evaluate whether the food is "novel" and then to present evidence that it is safe. **Novel foods are foods and food ingredients that have not been used for human consumption to a significant degree within the Community before 15 May 1997.** What constitutes "a significant degree" is not specified and is subject to interpretation. Applicants may seek advice on these matters from commission officers or member states.

The regulation (258/97) principally addresses food safety concerns in the context of foods derived from, or containing, genetically modified organisms (GMOs), with "new molecular structure" or those derived from novel production processes. The categories established in the regulation do not expressly recognize or accommodate traditional foods from outside the EU, and yet according to article 1.2.[e] "food and food ingredients consisting of or isolated from plants and food ingredients isolated from animals" may be novel foods, except for those "obtained by traditional propagating or breeding practices, and having a history of safe use". Thus, the regulation appears to exclude traditional foodstuffs, but the wording is unclear (How does one prove a history of safe use?) and contradicts current interpretations and practice under the NFR.

The challenge

Most of the world's food is derived from just a few crops. Rice, wheat and maize supply roughly three-quarters of the world's food energy. In total more than 95 percent of all food energy and protein comes from just 30 species. This obscures the rich diversity of edible plant species, particularly in the tropical latitudes of developing countries. These foods have been consumed for millennia, but mostly in their native range. In recent years the prospects for commercializing "neglected" and "underutilized" species beyond national or regional borders have improved. Demands for more diverse and nutritious diets, grown in accordance with verified social and ecological standards, are on the increase, particularly in developed countries. Therefore, official development assistance agencies support the efforts of developing countries to promote trade and investment in biological resources, with the aim of contributing to sustainable development and biodiversity conservation. Several organizations, such as BMZ/GTZ (through Public Private Partnerships and other programs), SIPPO (Swiss Import Promotion Program), CBI (Center for the Promotion of Imports from Developing Countries, Netherlands) and the UNCTAD Biotrade Initiative, seek to link cash-poor but diversity-rich communities with emerging international markets for exotic foods.

Unfortunately, potential traders in foods that are exotic in developed countries but nevertheless traditional in their region of origin, face considerable challenges in accessing the European market legally. The EU Novel Foods Regulation (NFR) (Regulation No. 258/97) adopted in 1997, in efforts to harmonize consumer protection within the EU and to confront food safety concerns, is an obstacle to marketing such exotic foods.

If a food product or ingredient is identified as novel, it must go through a safety assessment procedure to gain access to the EU market. This places a high burden of proof on those bringing traditional food products from the South to the EU market, the costs of which are usually beyond the possibilities of smallscale producers and exporters in developing

Photo: Guenay Ulutuncok

countries. Europeans are fortunate to have introduced products like potatoes and coffee long before 1997; today both would almost certainly be rejected by the NFR.

Discouraging experiences

Those who followed the rules have experienced a lengthy and expensive process with an uncertain outcome. Even investigating whether an exotic traditional food product is "novel" or not to the European Community may involve considerable time and effort. When an application is accepted, the average time taken to reach a final decision has been 18-24 months.

Some exotic traditional plant products have been denied access to the EU market for lack of what country authorities regard as sufficient food safety evidence despite their long history of safe use in other parts of the world. One is ***Stevia rebaudiana***, a shrub first cultivated in Brazil and Paraguay. The plant has been known for centuries by the native Guaraní Indians for the sweet taste of its leaves. Today Stevioside, a white crystalline powder, is extracted from Stevia leaves, and both Stevioside and Stevia are widely used as a natural, non-calorific sweetener, particularly in Brazil, China, Japan and South Korea. In 1998 a request was made for Stevia plants and dried leaves to be marketed in the EU as a novel food under the NFR. The EC Scientific Committee on Food concluded in June 1999 that the information submitted on the plant products was insufficient with regard to specification and standardization of the commercial product and contained no scientific safety studies. The fact that Stevia has long been used in the abovementioned countries was not taken into account.

Another case concerns **nangai** nuts, harvested from *Canarium indicum*, a commonly cultivated tree native to the Pacific. The nuts are already exported as gourmet products to Australia, Japan and Hawaii. Access to the EU market was denied because the information submitted for safety assessment was considered incomplete.

Maca (*Lepidium meyenii*), a root crop from Peru, where it was enjoyed centuries ago by the Incas, appeared as a "non-authorized novel food" in the weekly "Rapid Alert System for Food and Feed". This instrument assists authorities in rejecting incriminated foods at the EU's external borders or removing such foods from the market.

By November 2003, only one exotic plant product had been authorized as a novel food; the juice of the **noni fruit** (*Morinda citrifolia*), which is marketed by a large US-based company that was able to supply the extensive food safety evidence needed.

The authorization is limited to noni juice; any other noni product (e.g. jam, spray-dried juice, dried whole fruit) would require a separate application. Moreover, authorization is specific to the applicant. A competitor cannot market noni juice, unless evidence has been presented of substantial equivalence.

Not surprisingly, potential importers are increasingly reluctant to invest in the supply chain for such foods.

Changing the current situation

The upcoming amendment of the Novel Foods Regulation (Regulation No. 258/97) provides an opportunity for change. In July 2002 the European Commission's Health and Consumer Protection Directorate General (SANCO D4) published a Discussion Paper that presents some of the major issues that have emerged in relation to the implementation of the NFR. The review is limited to non-GM novel foods, as since April 2004 the authorization and traceability of GM food and feed is covered by a separate regulation. With the new GM food and feed regulation, issues have become somewhat disentangled and the prospects have improved that the long-awaited amendment of the NFR can be realized in 2005.

A joint initiative by the Global Facilitation Unit for Underutilized Species (GFU), the International Plant Genetic Resources Institute (IPGRI), and the Deutsche Gesellschaft für technische Zusammenarbeit (GTZ) is raising awareness and campaigning for an amendment of the regulation so that exotic traditional foods can access the EU market more easily. The issue was brought to the attention of the German Ministry for Economic Cooperation and Development (BMZ) and the German Ministry of Food, Agriculture and Consumer Protection (BMELV) highlighting the inconsistency between development policies and consumer protection within the EU. The group developed a proposal containing suggestions of how the interests of developing countries could be better taken into account:

- Exotic traditional foods should be recognized as a separate novel food category so that different requirements can be set for them.

- There is a need to develop simplified safety assessments for traditional exotic foods. The NFR

Photo: Guenay Ulutuncok

should admit evidence from ethnobotanical and anthropological literature as well as from anecdotes and folklore. Toxicity, allergenicity or clinical studies should only be required where reasonable doubts as to food safety are justified. Taxonomic position and relatedness of novel food sources to widely used species (within and beyond the EU) should provide important hints for appropriate safety assessments.

- Exotic traditional foods should remain in the public domain and no private entity should be granted privileged access to the EU market for authorized products, as happened in the case of noni fruit juice.

- It would be desirable if both the commercial companies and the non-profit or public sector institutions with no intent of placing the product on the market themselves could make an application in order to open up the EU market to assist beneficiaries such as poor farmers.

- Wherever possible a generic admission should be granted for a range of products from the same species (e.g. for pasteurized juice, frozen pulp, jam, ice-cream and related products from one fruit).

These recommendations are currently being scrutinized from a legal point of view by BMELV, the competent national authority for the implementation of the regulation in Germany, and will be fed into the EU-working group on Novel Food currently reviewing the regulation.

Roles for the research and development community

Legitimate food safety concerns regarding exotic traditional foods will not disappear. Even an amended NFR will require documentation on nutrition, composition and other aspects that is currently not available for most traditional and under-researched foods. Research and development activities that promote exotic foods must increasingly accommodate food safety concerns and consider this need in project design, product development and trade promotion. Awareness raising is still needed among those fostering the development of biodiversity products for niche markets.

There is a need to develop dossiers for exotic traditional foods, which compile the available knowledge and identify gaps. Issues that need to be addressed include history of use (origins, domestication, cultivation), composition and compositional changes due to post-harvest conditions and processing, evidence for the presence of functional nutrients, evidence for the presence or absence of anti-nutritional or toxic factors, and nutritional assessments (food intake levels considered safe) for both human and animal use.

Developed and developing countries should discuss together the risks of marketing new exotic foods, assess different approaches of dealing with "novel" foods, and harmonize their regulations.

Further information

Hermann, M., 2004: The amendment of the EU Novel Food Regulation: Opportunity to recognize the special status of exotic traditional foods. Discussion paper. IPGRI. www.underutilized-species.org/Documents/PUBLICATIONS/nfr_discussion_paper_june_2004.pdf

EC SANCO D4, 2002: Discussion paper: Implementation of Regulation (EC) No 258/97 of the European Parliament and of the Council of 27 January 1997 concerning novel foods and novel food ingredients. European Commission. http://ec.europa.eu/food/food/biotechnology/novelfood/discussion_en.pdf

Article "An unintended barrier to EU markets":
www.new-ag.info/focus/focusItem.php?a=1289

EC Novel Foods Webpage:
www.ec.europa.eu/food/food/biotechnology/novelfood/index_en.htm

Global Facilitation Unit for Underutilized Species:
www.underutilized-species.org/eu.asp

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