Training of Trainers Sourcebook on Conservation and Management of Agrobiodiversity in the People's Republic of China

Edited by Luis Waldmueller

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Both the English and Chinese versions of this sourcebook can be obtained at www.gtz.de/de/dokumente/giz2011-en-agrobiodiv-training-of-trainers.pdf and www.gtz.de/de/dokumente/giz2011-cn-agrobiodiv-training-of-trainers.pdf.

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Training of Trainers
Sourcebook on Conservation and Management of Agrobiodiversity in the People's Republic of China

Luis Waldmueller (Editor)

Jochen Currle and Nina Seib (Co-editors)

Introduction to the users of the manual

The present manual on agrobiodiversity has been written for the specific use of trainers in this field. Its purpose is to provide

- A fast overview on all relevant issues of agrobiodiversity
- A sound background of information on important topics related to agrobiodiversity
- Easy to copy and process chapters for presentations in trainings
- Handouts to provide training participants with in-depth information on selected topics and examples

An overview is provided by two features of the manual:

1. The table of contents. The seven chapters represent seven specific issues on the topic of agrobiodiversity, all related to one another, but each are designed to be used as individual steps to approach the topic. Each of the chapters is meant to provide material for training courses of variable duration according to the available time frame of the trainer and participants.
2. Each chapter is well introduced with a short summary to provide the user with a shortcut to the contents.

In order to access the manual, the reader may use three entry points:

1. The table of contents for a systematic approach to the issue of agrobiodiversity
2. The list of boxes, which highlight specific questions in the different fields of agrobiodiversity
3. The index of keywords that provides a direct approach to relevant cross-cutting questions in the individual chapters

The "main messages" that conclude each sub chapter are ready to use feeds for trainers' presentations on the specific topic and the tables and graphs, as well, may serve to exemplify specific issues in the trainers presentation.

Handouts on most of the relevant issues provide detailed information on one specific issue. They may be used by the trainer to have these issues elaborated through individual or group work.

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Mrs. Zhang Xiuying, the MoA Project Management Office Director of the project "Sustainable Management of Agrobiodiversity in the Provinces of Hainan and Hunan" at the opening of the travelling exhibition, "When Man Meets Nature: Food Security, Biodiversity and Traditional Culture"

Dr. Christine Martins, the present GIZ Project Director of "Sustainable Management of Agrobiodiversity in the Provinces of Hainan and Hunan" during the "International Conference on Conservation and Sustainable Utilization of Agrobiodiversity", held in September 2010 in Beijing, P.R. China

Foreword

The perception of the role of biodiversity and agrobiodiversity in China is changing. This is partly due to the increasing efforts by the Chinese government to protect biodiversity and the environment as reflected in the new five-year plan. Sustainable management and protection of agrobiodiversity will in future be on the agenda of government institutions such as the Ministry of Agriculture (MoA) of the People's Republic of China as well Chinese universities and research institutions.

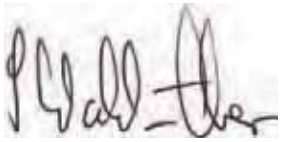
The Sino-German project "Sustainable Management of Agrobiodiversity in the Provinces of Hainan and Hunan, P.R. China", a cooperation project between the MoA and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH[1] (on behalf of the German Federal Ministry for Economic Cooperation and Development, BMZ) has developed a set of training and information materials for different target groups who are involved in implementation of agrobiodiversity measures. The project, for example, has issued a farmer training manual on agrobiodiversity, developed an agrobiodiversity exhibition and compiled a Chinese-English sourcebook on agrobiodiversity. It has also produced a brochure on agrobiodiversity in China that can be used by high school students and other interested members of the public as reference material for agrobiodiversity issues.

Capacity building is a major component of the project, which includes elaboration of this agrobiodiversity trainer sourcebook, intended for training experts who work for the Ministry of Agriculture, trainers of non-governmental organizations, university lecturers and other experts in the fields of biodiversity and agrobiodiversity. The authors of the sourcebook are local and foreign experts who contributed to the successful implementation of the project. The concept was not to use external consultants but to use persons who are familiar with the local and framework conditions that can support or hinder implementation of agrobiodiversity measures with farming communities as resources.

This trainers' sourcebook will be translated into Chinese and complements the series of publications issued by the project.

I want to thank the contributors to the sourcebook who wrote various chapters, Prof. Yang Qingwen, Prof. Xue Dayuan, Dr. Johannes Kotschi, Dr. Dieter Nill, Ms. Nicole Haeusler, Ms. Marion Buley, Ms. Birgitt Boor and Ms. Sylvia Reinhardt as well as Dr. Jochen Currle for compiling and editing and Ms. Nina Seib for editing and assisting with the layout. In addition, I want to thank our colleague Ms. Annette von Lossau who contributed with her vast experience in agrobiodiversity to the proofreading and correction of texts.

Frankfurt, August 2011



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Sustainable Management of Agrobiodiversity in the Provinces of Hainan and Hunan, P.R. China

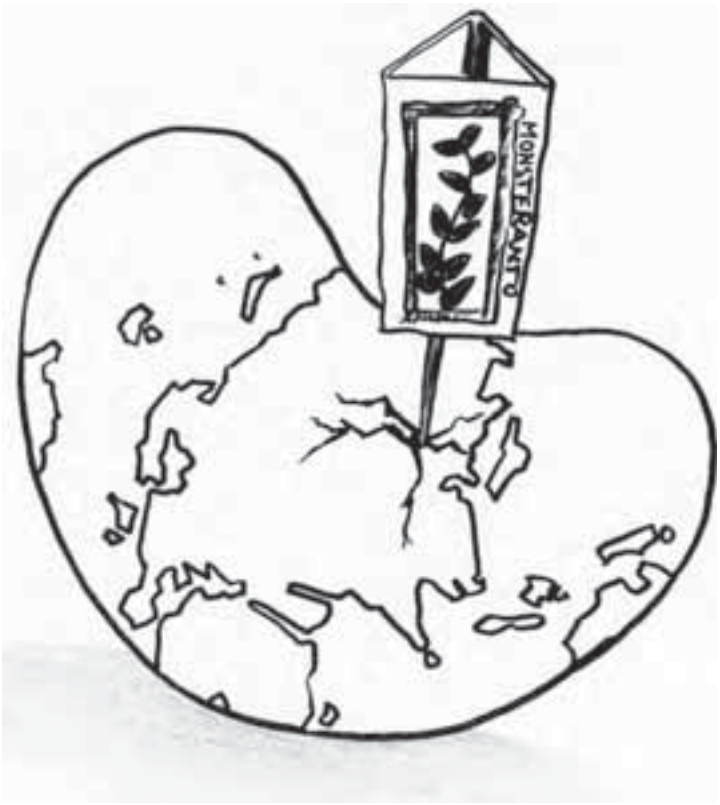
1 GIZ was formed on 1 January 2011. It brings together the long-standing expertise of DED, GTZ and InWEnt. For further information, go to www.giz.de.

Abbreviations

ABD	Agrobiodiversity
AQSIQ	General Administration of Quality Supervision, Inspection and Quarantine of the P.R. China
BfN	Bundesamt für Naturschutz (German Federal Agency for Nature Conservation)
BMZ	Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung (German Federal Ministry for Economic Cooperation and Development)
CBD	Convention on Biological Diversity
CAAS	Chinese Academy of Agricultural Sciences
CAMS	Chinese Academy of Medical Sciences
CAS	Chinese Academy of Sciences
CBIK	Centre for Biodiversity and Indigenous Knowledge
CGIAR	Consultative Group on International Agricultural Research
CIP	Centro International de la Papa (International Potato Center)
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CNAT	China National Auditor and Training Accreditation Board of the P.R. China
CNCA	Certification and Accreditation Administration of the P.R. China
COFCC	China Organic Food Certification Centre
EU	European Union
FFD	Farmer field day
FFS	Farmer field school
FAO	Food and Agriculture Organization of the United Nations
GACP	Good agricultural and collection practices
GEF	Global Environment Facility
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
GMF	Genetically modified food
GMO	Genetically modified organism
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH
GURT	Genetic use restriction technology
IEK	Indigenous ecological knowledge
ICARDA	International Centre for Agricultural Research in the Dry Areas
ICS	International Control System
IFAD	International Fund for Agricultural Development
IGC	Inter-governmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folkore
IK	Indigenous knowledge
IPCC	Intergovernmental Panel on Climate Change
IPR	Intellectual property rights

ISSC-MAP	International Standard for Sustainable Wild Collection of Medicinal and Aromatic Plants
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
IUCN	International Union for Conservation of Nature
LMMC	Like minded megadiverse countries
MoA	Ministry of Agriculture of the P.R. China
MEP	Ministry of Environmental Protection of the P.R. China
MOST	Ministry of Science and Technology of the P.R. China
NIES	Nanjing Institute of Environmental Sciences
NGO	Non-governmental organization
NPC	National People's Congress of the P.R. China
OFDC	Organic Food Development Centre
PDO	Protected Designation of Origin
PPB	Participatory Plant Breeding
PGI	Protected Geographical Indication
PVP	Participatory village planning
SFA	State Forestry Administration of the P.R. China
SEPA	State Environmental Protection Administration of the P.R. China
SMTA	Standard Material Transfer Agreement
TCM	Traditional Chinese Medicine
TEK	Traditional ecological knowledge
TIES	The International Ecotourism Society
TRAFFIC	The Wildlife Trade Monitoring Network
TRIPS	Trade-Related Aspects of Intellectual Property Rights
TSG	Traditional Specialty Guaranteed
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UPOV	Union Internationale pour la Protection des Obtentions Végétales (International Union for the Protection of New Varieties of Plants)
VC	Value chain
WIPO	World Intellectual Property Organization
WHO	World Health Organization
WTO	World Trade Organization
WWF	World Wildlife Fund

List of Key Terms



Chapter 1

Introduction to Conservation and Management of Agrobiodiversity

1 Introduction to conservation and management of agrobiodiversity

The intention of the present trainer sourcebook on agrobiodiversity is to give trainers a solid foundation of all relevant issues concerning agrobiodiversity (ABD). With this first chapter, an introduction and overview is provided for you to understand the idea of biodiversity and, more specifically, of agrobiodiversity. The chapter will provide the trainer with the conceptual understanding of agrobiodiversity and the paramount importance of the issue, especially considering the present situation in China. As well, it will give an overview of possible relevant areas of activity, which are detailed within the following chapters.

1.1 Definition and significance of biodiversity and agrobiodiversity

The concept of biodiversity was first used by Fisher and Williams (1943) in research of insect species and the abundance relationship. Over time, the concept has been extended and refers presently to "a steady ecological complex consisting of varieties of living organisms (animals, plants and microorganisms)". Biodiversity in this sense encompasses four levels of diversity (see figure 1). These levels are:

1. **Genetic diversity:** The heredity and variation diversity within species (genetic variety within one species), referring to the determined characteristics of genetic factors and the diversity of combination in living creatures.
2. **Species diversity:** The diversity of species of animals, plants and microorganisms, referring to the manifestation that the biodiversity shows on species. It contains regional species diversity and community species (biological) diversity.
3. **Ecosystems diversity:** The diversity of the ecosystem referring to diversity of habitat, biocenosis and ecological process in a certain biosphere.
4. **Landscape diversity:** The diversity of the landscape, put forward especially in recent years. It refers to landscape that consists of different types of landscape elements or ecosystems in respect to spatial structure, functional mechanism and temporal dynamics diversity or variability.

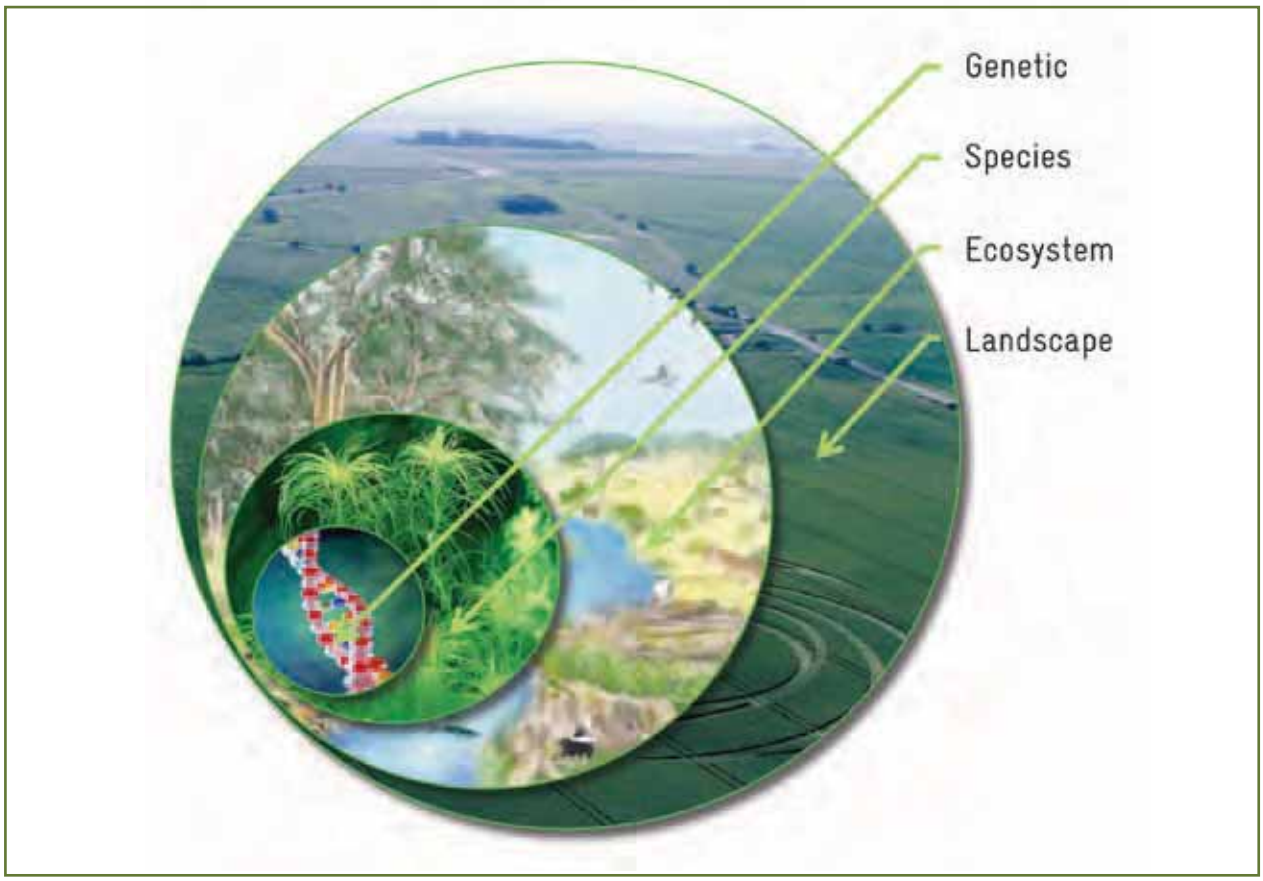


Figure 1: Relationship of the four levels of biodiversity (own source)

The relationship of the four levels of biodiversity can be analysed as: genetic diversity leads to species diversity; species diversity and polymorphic habitats constitute ecosystem diversity and aggregation and mutual effect of diverse ecosystems leads to landscape diversity. The relationship of the four levels of biodiversity is shown in figure 1.

Biodiversity consists of natural biodiversity (not influenced by man) and agricultural diversity. Natural biodiversity has existed since the appearance of life 3-4 billion years ago. With the development of mankind, agrobiodiversity gradually developed as an ecological complex formed through the interaction of people with nature. Thus natural biodiversity is the precondition and the base of the existence of agrobiodiversity. Agricultural diversity relies on natural biodiversity and also affects natural biodiversity through activities of humans. Agrobiodiversity refers to farmland diversity at the species level- which includes crops, livestock, fish, trees- and the related wild species and diversity of pollinators, symbiotic components, soil micro flora and fauna, pests, parasitic plants, carnivores and competitors for interactions. Secondly, it is also a general term for all genetic resources relating to food and agriculture. Lastly, it also can be considered as the biodiversity of areas where agricultural activities are carried out, as well as the diversity of plants and animals involved in agricultural activities.

Agrobiodiversity contains the same four levels as biodiversity: Genetic diversity of individual species, species diversity (including semi-domesticated, domesticated and wild species under management), agricultural ecosystem diversity and farmland landscape diversity.

Agrobiodiversity can be seen as the result of interaction between human cultural diversity and natural biodiversity within a regional community. Looked at with a wider perspective, agrobiodiversity related technologies, cultures, policies and awareness creation are also important parts of agrobiodiversity.

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1.2 Significance of agrobiodiversity for human development

Emergence and extinction of species over time is a spontaneous process in natural evolution and development. With the development of agriculture around 10,000 years ago, a significant change in human history and in the history of biodiversity took place. Agricultural practices changed the stable status of natural emergence and extinction of species into a relatively

Box 1: Demise through loss of biodiversity: The Mayan example

Mayan culture in the forests of Central-America prospered for a significant period of time. Breeding and cultivation of corn, the main staple crop, had reached a high yielding level. However, agricultural development research found that the narrow genetic background made that the corn did loose resilience against pests very fast at a certain point. The effect was disastrous. Yields were dropping tremendously and some

agriculturists assume that the extinction of Mayan culture was closely related to this complete loss of the staple crops potential to yield and feed the people.

dynamic and ever-increasing process, thus enlarging and expanding agrobiodiversity. Wheat began to be cultivated in China around 8,000 years ago. At the same time, indigenous people in South America started to cultivate tall and high yielding corns. People began to search for medicine when they were sick, and the effects and functions of plants grown in local medicinal plant gardens were recorded and shared. Due to the plantation of cotton and hemp crops, fabric was invented and it changed the living condition of hominids. Throughout the history of cultivation more than 7000 kinds of plants have been used by man. Thus agricultural diversity affected and affects the existence and development of man (see box 1). It is reasonable to say that the development of human history is linked to evolution and utilization of biodiversity and includes the development of agrobiodiversity as a continuous process. However, at present only just over 100 kinds of plants are cultivated to meet people's needs.

Agricultural area covers 25% to 30% of the solid surface on earth. Enlargement of farmland through deforestation and the increasing use of ameliorated wetlands have reduced the carbon sink, which is a significant reason for the increase of carbon dioxide in the atmosphere.

Even more serious, 75% of the world's nutrition needs are presently met by crops like wheat, rice, maize, potato, barley, sweet potato and cassava, etc., which are cultivated by pure line breeding methods only. The estimated total loss attributed solely to disease caused by mono-cultivation of single types and single lines of these crops is more than 25 billion US dollars every year. A high diversity of wild species closely related to these cropped cultivars has a potential gene pool with disease and insect resistance and high yielding lines.

Agricultural area covers 25% to 30% of the Earth's solid surface. Expansion of farmland through deforestation and the increasing use of ameliorated wetlands have reduced the global carbon sink, which is a significant reason for the increase of carbon dioxide in the atmosphere. Greenhouse gas emissions caused by agricultural activities in 2004 was 14% of total emissions (IPCC, 2007) and has accelerated climate warming. At the same time, the change of vegetation through agriculture also changed local weather patterns, such as rainfall, temperature and humidity. On the other hand, climate change imposes a significant influence on agrobiodiversity. Changing access to water, higher temperatures, higher frequencies of floods and bushfires will lead to a change of boundaries of agricultural climate regions and, subsequently, to a change of cultivated crops and varieties. In these changes, agrobiodiversity will play a very important role as the genetic diversity of crops and livestock will be a precious resource for the breeding of new and adapted varieties and breeds.

1.3 Present situation of agrobiodiversity in China

China has rich agrobiodiversity and it is one of the centres of origin for some of the world's main staple crops. A long agricultural history and different habitat types determined a large number of cultivation and breeding species and a rich variety in agricultural ecosystems. In China, there are 527 classes and 1993 kinds of cultivated crops. The number of collected and preserved varieties is more than 390,000 and there are nearly 10,000 plant species closely related to human production and life. Among the earliest to engage in animal husbandry of all developing countries, China has more than 200 kinds of original poultry and livestock species.

As well, a large number of rare and endangered species are living in agricultural ecosystems, such as some water birds in agricultural wetlands. Several

Box 2: The loss of wild species

In Jinghong County in Yunnan Province, 24 locations of Oryza rufipogon and Oryza meyeriana were found in 1964, but now there are only 2 locations left. In Maliutang, Guigang, Guangxi, more than 26 hectares of Oryza rufipogon were found in 1980. Today this wild relative of rice does not grow there anymore.

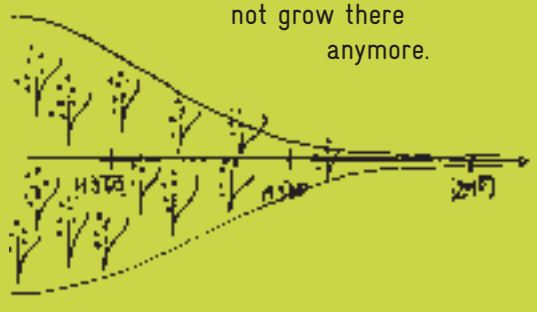

Table 1: Main threats to agrobiodiversity in China (own source)

Problem	Cause	Effect
Intensive use of farmland	Degradation of agricultural ecosystems	Acceleration of extinction of wild plants in agricultural areas and degradation of agricultural ecosystems
Destruction and over-exploitation of natural habitats	Loss of genetic resources of crop related wild plants	Range of genetic variability of cultivated plants is decreasing and with it the options to adapt cultivars to future growing conditions
Concentration on high yielding varieties for agriculture	Reduction of cultivated species varieties	Genetic background of cultivars is decreasing, and vulnerability of crops against pests and diseases rising
Serious pollution in agriculturally used areas	Damage to agricultural and natural ecosystems	Loss of beneficial insects and birds, danger of ecosystem collapse

unique kinds of solitary Chinese plants growing in grasslands and marginal agricultural lands are also important to the whole world, such as wild rice, wild soybeans and plants related to wild rice.

However, threats to rare and endangered species have become more and more serious with rapid population growth and increasingly intensive exploitation of land. Typical agricultural areas where this development can be observed are the Sanjiang Plain Wetlands in Heilongjiang Province, Dongting Lake and its surrounding area, the hilly sparse forests valued for ginseng growth in Ning'an County, Heilongjiang Province, Songfan Wetland in Northern Sichuan Province and Poyang Lake in Jiangxi Province (see box 2).

A number of factors can be seen as drivers of this increase in threats (see table 1):

1. **Intensive use of farmland:** To increase crop yield, farmland has been intensively utilized through reducing wastelands by reinforcing land consolidation, the use of chemicals to stimulate crop growth and the widespread cultivation of high yielding crops. These measures accelerate the extinction of wild plants in agricultural areas and degrade the agricultural ecosystem.
2. **Destruction and over-exploitation of habitats:** The destruction of habitats that are home to wild animal and plant varieties and their transformation into habitats catering to cultivated crops and domestic animals is causing a great loss in genetic resources. Crop varieties that originated in China always grew in areas where a broad range of their closely related wild varieties were growing close-by. However, due to over-exploitation of land, area available for wild relatives has been sharply reduced.
3. **Concentration on high yielding varieties:** This for agriculture leads to disappearance of varieties. The trend towards planting high yielding varieties is ever increasing. At present, the crops mainly cultivated in China are: around 50 varieties each of rice, soybean and wheat. However, the number of recorded and preserved local varieties and types of wheat alone add up to 20,000. Today's narrow genetic pool will decrease the adaptive abilities of current agricultural genetic resources and may increase potential damage by pests and other disasters (see box 1). In addition, a very serious problem is the disappearance of genetic source material before the onset of efforts at collection and storage in gene banks. This is a huge loss to the future diversity of agricultural species.
4. **Serious pollution in agricultural areas:** Problems related to the fast development of industry and cities and increasing population, sewage, rubbish and industrial waste are growing more serious each year. More specifically, the abundant use of pesticides and fertilizers, together with sewage irrigation and other damaging practices, aggravates the pollution of

agricultural areas all over the country. Environmental pollution leads to a reduction of beneficial insects and birds in agricultural ecosystems and also puts closely related wild plants in danger.

destructive behaviour. This has become a central factor for the loss of diversity. To protect agrobiodiversity, clear limits for agrobiodiversity use have to be drawn using effective legislation and public awareness creation. Such effective legislation can in turn lead to

Box 3: Australia as an example of effective legislation on biodiversity

Australia has always emphasized on raising public awareness regarding conservation. The Australian Government enacted Australia's National Strategy for Ecologically Sustainable Development 1992 and The National Strategy for the Conservation of Australia's Biological Diversity 1996. In different states and territories, there are also relevant regulations established to suit local contexts, such as Victoria's Flora and Fauna Guarantee Act 1988 in Victoria State. Due to these actions taken by the country or states, the public has a strong sense of conservation and protects agrobiodiversity often on its own..

1.4 Concept of agrobiodiversity management

Agrobiodiversity is not only an issue for agriculturists but for the whole national and international community. To efficiently conserve agrobiodiversity and utilize it in a sustainable way, good management is essential. Management of agrobiodiversity includes:

1. Support of the elaboration and enforcement of effective laws and regulations
2. Creation of incentives for agrobiodiversity management
3. Investigating and cataloguing of the actual biodiversity situation in agricultural areas, (relationship and endangered status of species, interactions between species and ecosystem)
4. Elaboration and implementation of specific conservation strategies and conservation measures
5. Promotion of agrobiodiversity as an issue of public interest

Although people have realised the significance of conservation of agrobiodiversity, the drive for economic profit intentionally or unintentionally causes public awareness of conservation, which is becoming more and more widely recognized by people (see box 3). However, such an effective legal system may affect farming methods and farmers' income in the short run. For example, suspended fertilizer and pesticide application, and low investment in farming structure and farming methods can reduce farmers' income in short-term, and these regulations may come up against significant farmer resistance. The task of agrobiodiversity management in this case is to design and establish measures to minimise loss to farmers while increasing their investment in protecting the land and agrobiodiversity.

Practical conservation is one of the main tasks in the management of agrobiodiversity. The two main methods of conservation can be distinguished as *ex situ* conservation and *in situ* conservation.

Ex situ conservation was the earliest method taken for species protection (see chapter 4.1.2). When people noticed that certain species were in need of protection, they transferred these endangered plants or animals to protect them, so that they could grow and reproduce outside their natural habitat. Gradually, methods such as seed warehouses and *in vitro*

culture were developed, which saved protection costs and promoted conservation efficiency. However, with this kind of protection, the species are taken away from their original environment, which halts further evolution and thus leads to a loss of species diversity. Therefore, *ex situ* conservation methods should only be used when the species are in serious danger and the ecological environment is irreversibly destroyed.

To make up for the disadvantages of *ex situ* protection, scientists proposed the *in situ* conservation concept, which allows every species to grow and reproduce in line with natural evolutionary rules. The earliest *in situ* protection method was nature reserves. However, large nature reserves could not be created for the biodiversity of agricultural ecosystems, so *in situ* protection was modified as target-species on-site protection. After 2000, the most frequently used method was to isolate the species physically, with limited fenced-in protection areas. A proposal of mainstreaming protection into agro-production (on-farm conservation) has been developed recently.

The promotion of agricultural diversity as an eminent issue of public interest aims to help the public understand the importance of agrobiodiversity and participate in the protection of agrobiodiversity. Target actors for this management task are not only farmers, but also local government officers and the public.

The promotion of agricultural diversity as an eminent issue of public interest aims to help the public understand the importance of agrobiodiversity and participate in the protection of agrobiodiversity. Target actors for this management task are not only farmers, but also local government officers and the public. All of them should understand and live up to their obligation to the conservation of agrobiodiversity. Measures to reach the aforementioned objective include public promotion and advertisement, knowledge dissemination, and training. In order to prepare the relevant staff for this task, capacity building at the managing officers' level should be promoted, a scientifically guided policy should be followed and material incentives should motivate people to work more efficiently.

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1 in March 2008 the State Environmental Protection Administration was restructured and renamed the Ministry of Environmental Protection of the P.R. China.

Main Message 1

Introduction to conservation and management of agrobiodiversity

- *The concept of biodiversity includes four aspects:*
  - *Genetic diversity*
  - *Species diversity*
  - *Ecosystems diversity*
  - *Landscape diversity*
- *Agrobiodiversity is a part of natural biodiversity influenced and developed by human activity. It can also be considered as the diversity of species involved in agricultural activities.*
- *Agrobiodiversity is closely connected with the development of human civilization. A high grade of biodiversity in general and agrobiodiversity in particular is decisive for the ability of the human race to adapt to changing environment conditions.*
- *China is one of the countries with a vast treasure of agrobiodiversity. Presently there is a growing necessity to conserve this treasure against its decline, caused by:*
  - *Intensive use of farmland*
  - *Destruction and over-exploitation of habitats*
  - *Excessive use of pesticides and use of waste water for irrigation*
  - *Industrial waste depositing in agricultural environments*
- *Agrobiodiversity management is a tool to counteract the massive loss of agrobiodiversity. Its main components are:*
  - *To support elaboration and enforcement of effective laws and regulations*
  - *To investigate and catalogue the actual biodiversity situation in agricultural areas*
  - *To elaborate and implement specific conservation strategies and conservation measures*
  - *To promote agrobiodiversity as an issue of public interest*

Chapter 2

International Legal Framework for the Protection of Biological Diversity

2 International legal framework for the protection of biological diversity

As global biodiversity is in great danger, the international community has paid close attention to the protection and sustainable utilization of biodiversity since the 1980s. Since then a number of international conventions and treaties (see figure 2) have been formulated that, in one way or the other, provide an international legal framework for the handling of topics related to biological diversity. As clearly marked in figure 2, it is the 1992 approved Convention on Biological Diversity[1], ratified by 193 countries worldwide, that plays the paramount role in this network of international agreements. Its objectives of conservation, sustainable utilization and equitable benefit sharing of biological diversity are complemented by a number of other, more specific agreements that approach the topic of biological diversity from its own perspective.

1 www.cbd.int/convention/parties/list/

- UPOV protects the rights and interests of plant breeders.
- CITES concentrates on the protection of endangered species (domesticated and wild relatives) in international trade.
- ITPGRFA focuses on protection, sustainable use and fair benefit sharing of plant genetic resources for food and agriculture.
- WIPO helps to implement the TRIPS agreement and has an advisory committee, the Intergovernmental Committee on Intellectual Property and Genetic Resources.
- TRIPS promotes the effective and adequate protection of intellectual property rights as a means to reduce distortions in international trade.

The following chapters will give more insight into this network of international agreements, their specific contents and their linkages. Chapter 2.1 will take

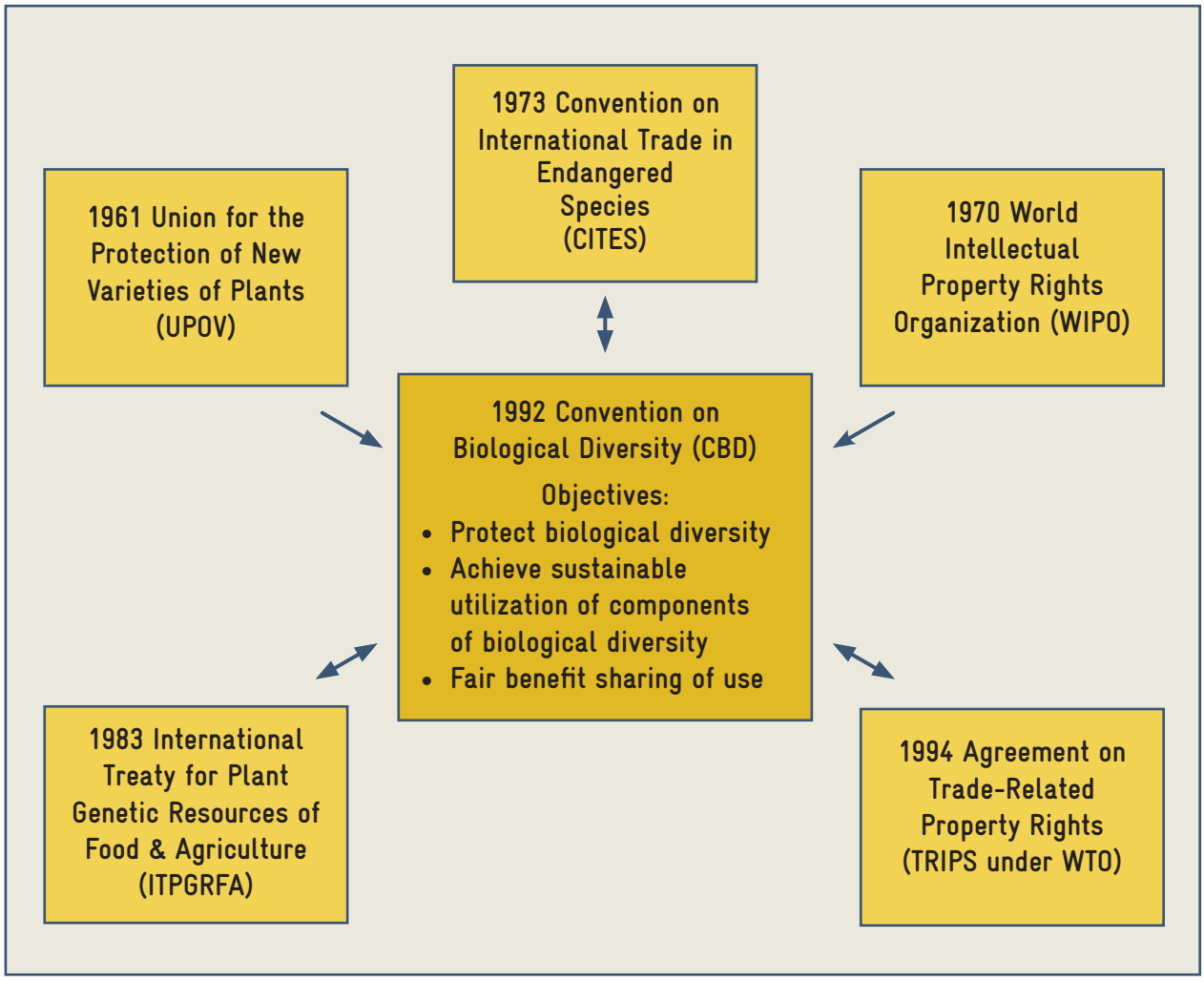


Figure 2: Network of international agreements influencing human handling of biological diversity

a closer look at the Convention on Biological Diversity (CBD); chapter 2.2 will examine the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA); and chapter 2.3 will describe the other international agreements, their contributions to the objectives of the CBD and possible frictions with these objectives.

2.1 The Convention on Biological Diversity (CBD)

The following chapter provides an insight into characteristics of the Convention on Biological Diversity. It will familiarize the reader with the basic stipulations of the convention to reach its main objectives to support global conservation and sustainable use of biodiversity and to facilitate access to genetic resources and a fair distribution of benefits. Finally there will be an overview of China's efforts to implement the provisions of the CBD within its national policy and jurisdiction. For more details see handouts 1, 2, and 3.

In 1988, the Governing Council of UNEP decided to establish an Ad Hoc Group of Experts on Biological Diversity mandated to investigate the desirability of and possibly form an umbrella convention. This instrument, called the Convention on Biological Diversity (CBD), was elaborated during a lengthy international negotiation process and came into force in 1993. By 2010, a total of 193 countries (including EU) had been approved to join this convention. China was one of the initial signatories, approving its entry into the CBD as early as 1933.

The UN CBD has set three major objectives: 1) to conserve biological diversity, 2) to achieve the sustainable use of its components and 3) to fairly and equitably share its benefits arising from the utilization of genetic resources. In order to achieve these major objectives, the following five main tasks are specified within the above mentioned articles (see handout 1):

1. Conserve and achieve sustainable use of biological diversity (Art. 6, 8, 9, 10, 11, 14)
2. Provide access to genetic resources and regulate the transfer of technology (Art. 15, 16)
3. Manage the risk of genetically modified organisms (Art. 8)
4. Control invasive alien species (Art. 8)
5. Preserve and maintain traditional knowledge (Art. 8)

2.1.1 Main characteristics of the Convention on Biological Diversity

One of the most important contributions of the CBD is the clarification of **national sovereignty** concerning biological diversity. Before the enforcement of the CBD, biodiversity was widely recognized as "the common heritage" of humankind and as such, all nations could get "free access" to genetic resources. This idea was strongly opposed by developing countries because the areas rich in biodiversity are mainly in tropical and sub-tropical regions where developing countries are located. It is specified in the preamble of the CBD that "[A] nation has the sovereignty to develop its resources according to its environmental policy". The CBD accomplished a great achievement in successfully writing the principle of national sovereignty over biodiversity (particularly genetic resources) into a legal instrument. Another great success of the CBD is symbolized by the provision of access to genetic resources and the sharing of the benefits arising from their use. This is specified in Article 1 (Objectives) as one of the three key objectives of the convention.

As a **framework convention,** the CBD's principle, content, and guidelines are of universal significance and are closely related to other international treaties and agreements. The protection of biodiversity requires good coordination with related treaties and agreements. During the progress of its implementation, the CBD entered into working relations with the Framework Convention on Climate Change, the Montreal Protocol, the Ramsar Convention, the Convention on International Trade in Endangered Species of Wild Fauna and Flora, the Convention on the Conservation of Migratory Species of Wild Animals, the Convention to Combat Desertification, the ITPGRFA, etc. The implementation of the CBD involves a number of international organizations such as the UNEP, UNDP, UNFAO, UNESCO, World Bank, GEF and other government and non-government organizations.

The UN CBD has set three major objectives: 1) to conserve biological diversity, 2) to achieve the sustainable use of its components and 3) to fairly and equitably share its benefits arising from the utilization of genetic resources.

The CBD has recognized that sufficient finances are necessary to achieve the objectives of biodiversity protection. However, developing countries rich in bio-

diversity are often short in funds, which thus delayed the implementation of the objectives of the convention. A **financial mechanism** is introduced in Article 20 of the CBD, which points out the financial difference between the developing member states and the developed member states. It requires the developed member states to provide additional funding to enable the developing countries to pay for the increased cost of implementing the CBD.

2.1.2 Conservation and sustainable use of biodiversity (handout 2)

The conservation and sustainable utilization of biodiversity are two of the three main objectives of the convention. In order to achieve these two objectives, the CBD requires each contracting party to integrate the conservation and sustainable use of biodiversity into its national economic plan and relevant programmes. The 6th conference of parties of the CBD specified objectives for the conservation of biodiversity to be reached by 2010 and described approaches and tools that can be used to achieve these objectives. These specified objectives are as follows (see handout 2):

A financial mechanism is introduced in Article 20 of the CBD, which points out the financial difference between the developing member states and the developed member states. It requires the developed member states to provide additional funding to enable the developing countries to pay for the increased cost of implementing the CBD.

- In the field of conservation of biodiversity, at least 10% of the global ecosystem will be effectively protected.
- In the field of sustainable utilization of biodiversity, the resources for the production of biological products shall be continuously managed and the management of productive areas shall be linked to maintenance of biodiversity.
- In the field of threat relief, the loss of habitats, the alteration of land use, the degradation of land and the use of water resources against sustainable development shall be reduced.
- In the field of maintenance of the products and services of biodiversity, the capability of the ecosystem to provide products and services shall be maintained.
- In the field of conservation, innovation and practices of traditional knowledge, and the diversity of indigenous and local community culture shall be maintained.
- In the field of fairly and equitably sharing the benefits arising from the use of genetic resources, all the transfer of genetic resources shall comply with the Convention on Biological Diversity, International Treaty on Plant Genetic Resources for Food and Agriculture and other applicable agreements.
- In the field of appropriate supply of resources like funding, etc., the developed countries shall be able to supply the developing countries with additional funds and relevant technology to properly fulfil their commitment.

In order to reach these goals, a number of tools have been issued by the CBD and by succeeding conferences of the CBD parties. The following are two tools briefly described - the working plan for protected areas and the ecosystems approach.

The objective of the Working Plan for Protected Areas is to help each contracting party establish- in land area before 2010 and ocean area before 2012 - a comprehensive, representative and well-managed national and regional protected area system which will achieve the three main objectives of the CBD.

The Working Plan for Protected Areas also aims at assisting the contracting parties in developing the national working plan with distinctive objectives, action arrangements, definite executors, time frames, investments and an anticipated way in which to have its results evaluated.

The **ecosystem approach** is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. Application of the ecosystem approach will help to reach a balance of the three objectives of the Convention. It is based on the application of appropriate scientific methodologies focused on levels of biological organization which encompass the essential processes, functions and interactions among organisms and their environment. It recognizes that humans, with their cultural diversity, are an integral component of ecosystems.

The relation between conservation and sustainable use of biodiversity should be balanced (see box 4) and is mirrored in the field of agriculture. Conservation of Agrobiodiversity is seen by the parties of the CBD

Box 4: Balance between conservation and sustainable use

as a pertinent issue which means in the context of the CBD:

- Conservation and sustainable use of agricultural genetic resources
- New technologies for the control of plant gene expression:

  The 3rd conference of parties of the CBD held in 1996 began to discuss Gene Utilization Restriction Technology (GURTs), a technology for the control of plant gene expression "that provides a genetic, in-built protection against unauthorized reproduction of the seed or the added-value trait."

  The contracting parties agreed that the GURT experiments should be suspended and that the governments of all countries and stakeholders should carry out further research of the impact of GURTs including the impact on ecosystems, society, economy and culture, and particularly the impact on indigenous and local areas, and also improve capacity building in developing countries.
- Sustainable production and use of biofuels:

  Biofuels and biodiversity was one of the major issues reviewed at the 9th conference of parties of the CBD held in May, 2008. The resolution adopted – though without binding provisions- recommends that a policy framework for the sustainable production and use of biofuels that contributes to the conservation and sustainable use of biodiversity be adopted.

2.1.3 Access to genetic resources and the related traditional knowledge and sharing of benefits arising from its use

The CBD establishes that a person or institution seeking access to the genetic material of a biological resource in a foreign country should seek the prior informed consent of the country in which the resource is located. More over, the person or institution must also negotiate and agree on the terms and conditions of access and use of this resource. This includes the sharing of benefits arising from the use of this resource, with relevant authorities in the provider country, in order to obtain permission to access the genetic resource and to use it.

Conversely, countries, when acting as providers of genetic resources, should try to create conditions to facilitate access to their genetic resources for environmentally sound uses and not to impose restrictions that run counter to the objectives of the Convention.

Genetic resources, whether from plant, animal or micro-organisms, are used for a variety of purposes ranging from basic research to the development of products. Users of genetic resources may include research institutes, universities and private companies operating in various sectors such as pharmaceuticals, agriculture, horticulture, cosmetics and biotechnology.

The issue of access to genetic resources and equitable sharing of benefits has been a topic of international discussion for a long time. Especially the issue of bio-piracy by international companies has been a major concern for biodiversity resource rich developing countries. International biotechnology companies may collect and acquire genetic resources from developing countries and use them to develop new transgenic species protected by patents rights. These "new crop varieties" are then sold in the developing countries without sharing benefits with the countries where the original genetic material came from.

Especially the issue of bio-piracy by international companies has been a major concern for biodiversity resource rich developing countries.

However, the 2010 Nagoya Conference on biodiversity achieved a remarkable breakthrough with the adoption of the Nagoya Protocol, which lays down ground rules on how nations should cooperate in accessing and sharing the benefits of genetic resources – including plants, fungi and pathogens. The Nagoya Protocol (coming into effect in 2020), will see govern-

ments considering ways to provide recompense for genetic material and traditional medical knowledge collected in the past that is now being used, patented and sold. This is likely to be done through a special fund for developing nations that could be used for conservation or scientific research centres.

2.1.4 China's implementation of the Convention on Biological Diversity

During the past 10 years since the CBD entered into force, China has taken an active part in the follow-up negotiations and international action for the implementation of the CBD and made contributions to the implementation of the CBD around the world. Soon after enactment of the CBD, the State Council of China appointed the Ministry of Environment Protection (the former State Environmental Protection Administration, SEPA) to coordinate the implementation of the CBD and the protection and management of biological resources at home and abroad. Having done a lot for the protection of biodiversity at home in terms of strategy and programme design, organization construction and project development, it has significantly improved the sustainable development of the national economy and society and also made notable contributions to global efforts to protect the unique biological systems, species systems and genetic resources systems of China.

Especially worth mentioning is:

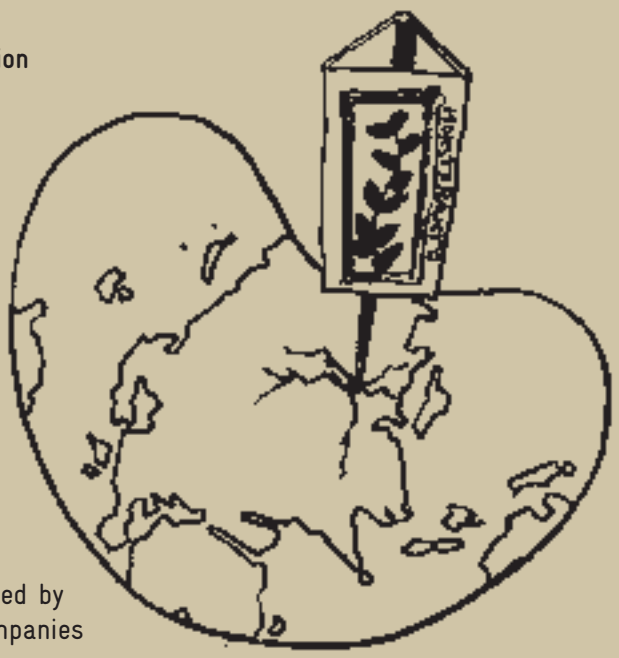
- The establishment of an efficient Chinese implementation body for the CBD
- The development of a legal and policy system for the protection of biodiversity
- The actual achievements in the physical protection of biodiversity

1. Coordinative mechanism for implementation

As the protection and sustainable utilization of biodiversity involves a lot of sectors, the establishment of an efficient coordination mechanism is necessary for the joint implementation of the treaty. The Ministry of Environmental Protection established the "State Coordination Group for Implementation of the CBD" through consultation with concerned departments, under the leadership and coordination of the former Environment Protection Committee of the State Council. Headed by the Ministry of Environmental Protection, this coordination group is composed of 24 departments (originally 13 in 1992), including all relevant administrative bodies at the ministry level. An office of the coordination group was established in the Ministry of Environmental Protection to handle daily affairs. The coordination group holds a member conference every year to make an annual working plan and to preliminarily make up a national working mechanism for the protection of biodiversity and the implementation of the CBD.

Box 5: New trends in GMO research domination

Stacked GMOs are those containing more than one gene genetically engineered into a crop plant. A controversial stacked GMO, Smarstax containing 8 such genetically engineered genes, was commercially approved in the US, Canada, Japan and South Korea during 2009. Stacked gene varieties are highly complex, posing new biosafety risks that outpace the capacity of regulatory systems. Since 2005 the global area under stacked GMOs has nearly tripled, to just under 30 million ha. Their research, development and ownership is also dominated by a handful of the world's largest biotech companies (www.biosafetyafrica.org.za).



2. Establishment of legal and policy systems for the protection of biodiversity

The legal system for the protection of biodiversity has been generally established. In order to curb the rapid decrease of biodiversity, China has enacted a number of laws and regulations, including: the Environment Protection Law, Wild Animal Protection Law, Forest Law, Grassland Law, Soil and Water Conservation Law etc. More than 20 laws and regulations on biodiversity protection have been revised. Concerning enforcement, all the departments and local government authorities are organizing numerous inspections to drastically curb violation of laws and to enforce the protection of biodiversity in China through the legal system.

In the agricultural sector, policy regarding biodiversity in China is focused on the protection of biological genetic resources and species, and it attaches importance to species much earlier than to biological genetic resources.

3. Achievements in the protection of biodiversity

By the end of 2007, 2,531 natural reserves had been established in China, with a total area of 151.88 million ha, accounting for approximately 19% of the land territory of the country. In the past 50 years, China has established a nationwide natural reserve network, relatively comprehensive in land types included, strategic in placement and well-established in functionality. 85% of land ecosystems, 40% of natural wetlands, 20% of natural forests, a vast majority of natural heritage sites, 65% of higher plant community types (especially most of the endangered and rare wildlife species listed under the key protective objectives of the state) have been effectively protected in natural reserves.

As many as 390,000 crop germplasm materials have been conserved, giving China the world's second largest store of crop genetic resources. Two national permanent germplasm banks, 25 mid-term germplasm banks and 32 national germplasm resources nurseries have been established.

Over the past decade, *ex situ* conservation sites of wildlife and maintenance structures of germplasm resources have been developed. More than 230 zoos (animal exhibition zone) and 234 botanical gardens (arboretum) have been established in China. As many as 390,000 crop germplasm materials have been conserved, giving China the world's second largest store of crop genetic resources. Two national permanent germplasm banks, 25 mid-term germplasm banks and 32 national germplasm resources nurseries have been established. Resources inventorying key aspects of China's pigs, cattle, goat, horse, poultry, bees and silkworm have been published. Some farms committed to the protection of livestock and poultry genetic resources have been established. Finally, establishment of special germplasm resources banks for China's forest germplasm resources, medicinal herb germplasm resources, aquatic organism genetic resources, microorganism resources, etc. has been initiated.

Author: Xue Dayuan

Literature cited and recommendations for further reading:

Convention on Biological Diversity (CBD): www.cbd.int/convention/parties/list/

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES): www.cites.org/

Convention on the Conservation of Migratory Species of Wild Animals (CMS): www.cms.int/

Convention to Combat Desertification (UNCCD): www.unccd.int/

Environmental Protection Law, P.R. China: www.envir.gov.cn/law/envir.htm

Forest Law, P.R. China: www.law-lib.com/law/law_view.asp?id=389

Framework Convention on Climate Change (UNFCCC): http://unfccc.int/2860.php

Grassland Law, P.R. China: www.law-lib.com/law/law_view.asp?id=580

Montreal Protocol: http://unfccc.int/kyoto_protocol/items/2830.php

Ramsar Convention: www.ramsar.org/cda/en/ramsar-documents-texts/main/ramsar/1-31-38_4000_0__

Soil and Water Conservation Law, P.R. China: www.chinawater.net.cn/law/W01.htm

Wild Animal Protection Law, P.R. China: http://news.xinhuanet.com/zhengfu/2004-08/30/content_1925402.htm

Working Plan for Protected Areas under the CBD: www.cbd.int/convention/wgpa.shtml

Main Message 2

The Convention on Biological Diversity (CBD)

- *The Convention on Biological Diversity is the central agreement of the world's nations on the protection of biological diversity. Its objectives are:*
  - *To conserve biological diversity*
  - *To achieve the sustainable utilization of the components of biological diversity*
  - *To equitably share benefits arising from the use of genetic resources*
- *As tools for Conservation and Sustainable Use of Biodiversity, the CBD*
  - *Released the Working Plan for Protected Areas*
  - *Recommended the Ecosystem Approach for sustainable management of biodiversity*
- *The conservation of agrobiodiversity is defined as a central issue in the conservation of biodiversity. CBD nations agreed on*
  - *The Nagoya Protocol (coming into effect in 2020), urges governments to provide recompense for genetic material and traditional medical knowledge collected in the past that is now being used, patented and sold*
  - *Suspending field experiments of the GURTs seed technology (Gene Utilization Restriction Technology)*
  - *Recommending a policy framework for the sustainable production and use of bio fuels*
- *China as one of the first nations to ratify the CBD,*
  - *Created an administrative body to coordinate the national implementation of the CBD effectively*
  - *Released a legal framework with a large number of laws and regulations for fostering the protection of biodiversity*
  - *Implemented a nationwide strategy of in situ and ex situ conservation of endangered species*

2.2 International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) and the Standard Material Transfer Agreement (SMTA)

With an introduction to the International Treaty on Plant Genetic Resources for Food and Agriculture, chapter 2.2 focuses on regulations for the exchange and the use of genetic resources of agricultural plants. The chapter provides an outline of the provisions of the ITPGRFA and gives an insight into the Standard Material Transfer Agreement, a detailed regulation on the topic of access to genetic resources and fair distribution of the benefits derived by their economic development. For details see handout 4 as well.

2.2.1 International Treaty on Plant Genetic Resources for Food and Agriculture

In November 2001, the International Treaty on Plant Genetic Resources for Food and Agriculture (hereinafter referred to as the "International Treaty") was finally adopted. In June 2004 it entered into force. It has been signed and ratified by 127 countries. China is not a member of the Treaty at present but it is in the process of becoming one. The objective of the International Treaty is to recognize the enormous contribution of farmers to the diversity of crops that feed the world, as well as to work towards

- establishing a global system to provide farmers, plant breeders and scientists with access to plant genetic materials, and
- ensuring that recipients share benefits they derive from the use of these genetic materials with the countries where they have been originated.

The objectives of the ITPGRFA are in conformity with the CBD. The Treaty further emphasized that the achievement of its objectives depends on the close relationship between itself, the UNFAO and the CBD. For this reason a joint work plan between the secretariats of the Convention on Biological Diversity and the Food and Agriculture Organization of the United Nations and its Commission on Genetic Resources for Food and Agriculture has been elaborated.

Figure 3: Village seed fair using local genetic resources

The characteristics of the ITPGRFA are described as follows:

- **Main ideas:** The Treaty acknowledges the sovereign right of each country over its plant genetic resources for food and agriculture. The goal is to conserve and promote the sustainable utilization of plant genetic resources for food and agriculture, and to fairly and rationally share the benefits arising from such utilization. The implementation of the Treaty contributes to global food security.
- **Farmers' Rights:** The Treaty recognises the enormous contribution that farmers and their communities have made and continue to make to the conservation and development of plant genetic resources. This is the basis for Farmers' Rights, which include the protection of traditional knowledge, and the right to participate equitably in benefit sharing and in national decision-making about plant genetic resources. It gives governments the responsibility for implementing these rights.
- **Multilateral System:** The Treaty aims to establish a multilateral system for the access to genetic resources and benefit sharing arising from the use of it. The aims is to facilitate access to plant genetic resources for food and agriculture, and to share, in a fair and equitable way, the benefits arising from the utilization of these resources, on a complementary and mutually reinforcing basis.
- Each contracting party will have the **plant genetic resources in the public domain** covered by this system to enable access to them by all contracting partners.
- **The scope of materials:** 64 species (categories) have been listed in annex 1 of the Treaty. This list was established according to criteria of food security and interdependence. Soybean, peanut, and oil palm are not listed.
- **Access to plant genetic resources for food and agriculture:** Recipients of material from the multilateral system shall not claim any intellectual property or other rights that limit the facilitated access to the plant genetic resources.
- **Access and Benefit sharing:** Includes access to information, technology transfer, capacity building and sharing of monetary and other benefits of commercialization. Articles 10, 11, 12 and 13 lay out the sovereignty of states over plant genetic resources, regulate the faciltated access to these resources and describe the fair and equitable sharing of benefits deriving from the use of plant genetic resources for food and agriculture. These articles provide the basis for a Standard Material Transfer Agreement (SMTA), which aims to standardize the sharing of the benefits arising from the use of 35 species (categories) of food, crops and 29 species (categories) of legume and grass forages listed in annex 1 of the ITPGRFA (see handout 4).
- **Major mechanism:** The Standard Material Transfer Agreement (SMTA) defines the conditions for the access to and sharing of benefits arising from the use of plant genetic resources for food and agriculture. The recipient undertakes that the material shall be used or conserved only for the purposes of research, breeding and training for food and agriculture. Such purposes shall not include chemical, pharmaceutical and/or other non-food/feed industrial uses. The Recipient shall not claim any intellectual property or other rights that limit the facilitated access to the material provided under this agreement, or its genetic parts or components, in the form received from the Multilateral System. The Recipient shall pay a fixed percentage of the sales of the commercialized product into the mechanism established by the Governing Body for this purpose.

The Recipient shall not claim any intellectual property or other rights that limit the facilitated access to the material provided under this agreement, ... The Recipient shall pay a fixed percentage of the sales of the commercialized product into the mechanism established by the Governing Body for this purpose.

The ITPGRFA as an international agreement for plant genetic resources for food and agriculture does not include the genetic resources of animals. To address this, the Commission of Genetic Resources for Food and Agriculture under the FAO elaborated in 2007 *The State of the World's Animal Genetic Resources for Food and Agriculture*, a first-ever, global assessment of the status and trends of animal genetic resources. The final report was presented to the International Technical Conference on Animal Genetic Resources for Food and Agriculture, held in September 2007 in Interlaken, Switzerland. The FAO Conference, the su-

Figure 4: The distribution of banks (nurseries) for crop germplasm resources of China

preme governing body of the FAO, welcomed the report as the first comprehensive worldwide assessment of the state of animal genetic resources.

2.2.2 China's actions associated with the ITPGRFA

China is not yet a contracting party of the ITPGRFA but it has enacted many policies and regulations that are in line with the international agreement.

So far, one national crop germplasm bank for long-term preservation and one copy plasma bank, 10 germplasm banks for mid-term preservation, 32 germplasm nurseries and 86 *ex situ* habitat conservation sites have been set up. The banks are distributed in 22 provinces, municipalities and autonomous regions in China.

Until 2007, 392,000 acquisitions of germplasm resources of field crops, vegetables, and forage crops have been preserved. 380,000 samples of stored resources have been evaluated for their economic characteristics (disease resistance, stress resistance, quality). 250,000 samples of germplasm from mid-term gene banks were reproduced and a distribution network has been set up in order to lay a good foundation for the utilization of these resources (see figure 4).

In the field of international cooperation, germplasm resource exchange is still an effective means to get access to genetic resources. In the past two decades, 38,947 resources have been introduced from 116 countries and 43,864 pieces of resources have been provided to 124 countries. The benefits arising from this international cooperative research are shared in the following ways: (1) getting access to the germplasm resources from abroad, (2) getting access to information and technology, e.g. molecular labels, transgenic technology, (3) capacity building, experiment instruments and reagents, etc., (4) training researchers abroad, and (5) enlisting financial support.

At state level, access and benefit sharing is also in question between the provider and the user of the resources. The approach to benefit sharing at present abides by the following basic precedents:

- Distributing the resources on a voluntary basis to breeding units in China mostly without charge: 80% are provided free of charge or for the cost of postage only because the state has paid the resources conservation units for the cost of reproduction of germplasm. Feedback about the results of use is expected.

- Cooperatively studying and reproducing germplasm and sharing the benefits arising thereof: When a provider of resources (party A) provides germplasm for reproduction, and the user (party B) produces new varieties with the resources provided, party A, as the second breeding unit, will share 20% of the benefit and party B, as the first breeding unit, will share 80% of the benefit and provide any relevant information to party A in a timely manner.
- Party B shall not provide party A's germplasm to any third party without party A's prior consent.

The approach to benefit sharing for wild plant genetic resources in *in situ* habitat conservation sites is:

- Materials at conservation sites are used to perform more cost-effective research (included in the budget of the conservation site).
- Conservation sites involved in research projects will execute the part of the project that is arranged in the conservation site.
- Providing the technology and information about seed and high-yielding cultivation.
- Publications on wild plant resources should describe the source of the wild germplasm used, intellectual property rights, and cultivated species and allow for the sharing of a certain proportion of benefits arising from the commercialized use of them.
- The government will provide financial input and project support.

Author: Xue Dayuan

Literature cited and recommendations for further reading:

Standard Material Transfer Agreement (SMTA): www.planttreaty.org/smta_en.htm

The International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA): www.planttreaty.org/

Main Message 3

The International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA)

- *In November 2001, the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) was finally adopted. In June 2004 it entered into force. It acknowledges the sovereign right of each country over its plant genetic resources for food and agriculture and aims at:*
  - *Conserving and realizing sustainable utilization of plant genetic resources for food and agriculture*
  - *Fair and equitable sharing of the benefits arising from such utilization*
- *The Treaty recognizes the enormous contribution that farmers and their communities have made and continue to make to the conservation and development of plant genetic resources.*
- *To this end, under the auspices of the ITPGRFA, a list of 64 species was established as a basis for the multilateral system for the access to genetic resources. Each contracting party will have access to the plant genetic resources in the public domain covered by this system. No intellectual property right can be claimed by any party on the original state of the resources and a fair benefit sharing must be agreed upon for the products of any research and development with those plant genetic resources.*
- *The Standard Material Transfer Agreement (SMTA) provides a mechanism for sharing of benefits from the commercialisation of products that are plant genetic resources for food and agriculture.*
- *The State of the World's Animal Genetic Resources for Food and Agriculture was developed by the FAO in 2007. It has not yet reached the status of an internationally agreed upon convention or treaty.*
- *China's contributions to the ITPGRFA on a national level include the collection and conservation of national genetic resources in public gene banks and the establishment of a national mode of access and benefit sharing of plant genetic resources.*

Figure 5: Variety of local spices

2.3 International legal instruments applicable to the conservation of biodiversity and traditional knowledge

This chapter introduces selected international legal conventions that are connected to the topic of conserving biological diversity. The relationship between intellectual property rights and the rights of farmers and their knowledge is the focus of discussion in the UPOV convention, the TRIPS agreements of the WTO, and the activities of the World Intellectual Property Organization (WIPO).

2.3.1 International Union for the Protection of New Varieties of Plants (UPOV)

As an important agreement for protecting the rights and interests of breeders, the UPOV convention, composed of 30 articles, was adopted in Paris in 1961. By the year 2009, UPOV had been accepted by 68 member states, of which 1, 23 and 44 states respectively signed the 1961, 1978 and 1991 versions. China signed the 1978 version of the UPOV in 1999 and became the 39th member state of the UPOV.

The UPOV Convention ensures that member states acknowledge the achievements of breeders of new plant varieties by making available to them exclusive property rights for a given period of time. The Convention provides uniform and clearly defined principles for the protection of plant breeders' rights over plant varieties. To be eligible for protection, plant varieties must be novel, distinct, uniform and stable.

The International Convention for the Protection of New Varieties of Plants was adopted in December 1961, entering into force in 1968 once it had been ratified by three countries, which then formed the Union. UPOV was revised in 1972, 1978 and 1991. The latter revision entered into force in 1998. Under each revision, the protection of plant breeders' rights has been strengthened. The UPOV Convention enables each member state to grant international property rights (IPR) to the breeders who have cultivated new plant varieties in conformity with Convention requirements.

... every UPOV member may grant certain farmers' privileges but only when measures are taken to safeguard 'the legitimate interests of the breeder'. To interpret this 'legitimate interests' the EU deals with the farmers' privileges under the UPOV issued 'Restrictions on the Exercise of the Breeder's Right'.

After various revisions, the latest version of the UPOV Convention was completed in 1991. Since the 1991 Act, every UPOV member (only states can be UPOV members) may grant certain farmers' privileges but only when measures are taken to safeguard 'the legitimate interests of the breeder'. To interpret this 'legitimate interests' the EU deals with the farmers' privileges under the UPOV issued 'Restrictions on the Exercise of the Breeder's Right'. EU legislation requires that farmers other than small farmers are 'required to pay an equitable remuneration to the holder'. At present, the strength of the 'farmers' privileges' varies quite widely from country to country. France has no farmers' privileges at all with the exception of tender wheat, while the USA until the 1990s allowed farmers even to sell protected seed to other farmers.

2.3.2 Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) under the World Trade Organization (WTO)

The agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) was adopted in 1994 as one of the three basic agreements on which the WTO was built. According to the TRIPS agreement, countries belonging to the WTO are free to choose whether to include plants and animals in their patent system or not. Animal and plant varieties must be protected by an effective system. TRIPS provides minimum standards for the protection of intellectual property rights. It gives some guidance but the relevant article 27.3 reflects the lack of consensus among the negotiating parties on the form of protection. At the time of negotiations, plants were not patentable in Europe, but were in Japan and the United States. Therefore, since 2001, the Council of TRIPS is in a review and consultation process to clarify the relationship between TRIPS and the CBD and between TRIPS and protection of traditional knowledge and folk customs.

Even though the idea of including traditional knowledge into the TRIPS has gained momentum and many more supporters, an agreement on the issue has not yet been reached.

In view of the ultimate objective to promote the development of humankind, TRIPS is fairly similar to the CBD, although TRIPS is focused on the minimum standards for the protection of IPR and puts more emphasis on the interests of the inventors who successfully utilize genetic resources. The CBD focuses on the conservation of genetic resources and the access and fair and equitable sharing of benefits. It puts more emphasis on the protection of ecosystem and the interests of the provider of genetic resources. They deal with different affairs by enforcement of different laws and have different objectives and obligations. Even though the idea of including traditional knowledge into the TRIPS has gained momentum and many more supporters, an agreement on the issue has not yet been reached.

2.3.3 The World Intellectual Property Organization (WIPO) and related conventions

The other international organization dealing with intellectual property rights – WIPO – was established in 1970. In the year 2000, the WIPO created the standing Inter-governmental Committee on Intellectual Property, Traditional Knowledge and Folklore (IGC) within the organization. In creating this committee, the WIPO took the challenge of finding agreements on a number of issues related to the CBD. One was the elaboration of guidelines for access and benefit sharing (document No. GRTKF/IC/7/9 of WIPO). The other issue regarded the disclosure of the following information before the granting of patent rights:

- The genetic resources used in the development of the invented technology to be patented.
- The country of origin of the genetic resources used for the development of the invented technology to be patented.
- The traditional knowledge, invention and approaches used in the development of the invented technology to be patented.
- The country of origin for the relevant traditional knowledge, invention and approaches.
- Evidence of prior informed consent.

Until 2007, no final decisions on these issues could be made; therefore the IGC proposed that the WIPO assembly should extend its task period to continue working on this.

2.3.4 The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

CITES is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. CITES itself has no special provisions about access and benefit sharing. However, it is proposed that the license system for the endangered

species under the CBD be used as a reference for the development and implementation of the certificate for observation of the law on national access and benefit sharing. Widespread information nowadays about the endangered status of many prominent species, such as tigers and elephants, might make the need for such a convention seem obvious. But at the time when the ideas for CITES were first formed, in the 1960s, international discussion of the regulation of wildlife trade for conservation purposes was something relatively new. The trade is diverse, ranging from live animals and plants to a vast array of wildlife products derived from them, including food products, exotic leather goods, wooden musical instruments, timber, tourist souvenirs and medicines. Levels of exploitation of some animal and plant species are high and the trade in them, together with other factors such as habitat loss, is capable of heavily depleting their populations and even bringing some species close to extinction. For many years CITES has been among the conservation agreements with the largest membership, with now 175 Parties.

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Author: Xue Dayuan

Literature cited and recommendations for further reading:

Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS): www.wto.org/english/tratop_e/trips_e/trips_e.htm

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES): www.cites.org/

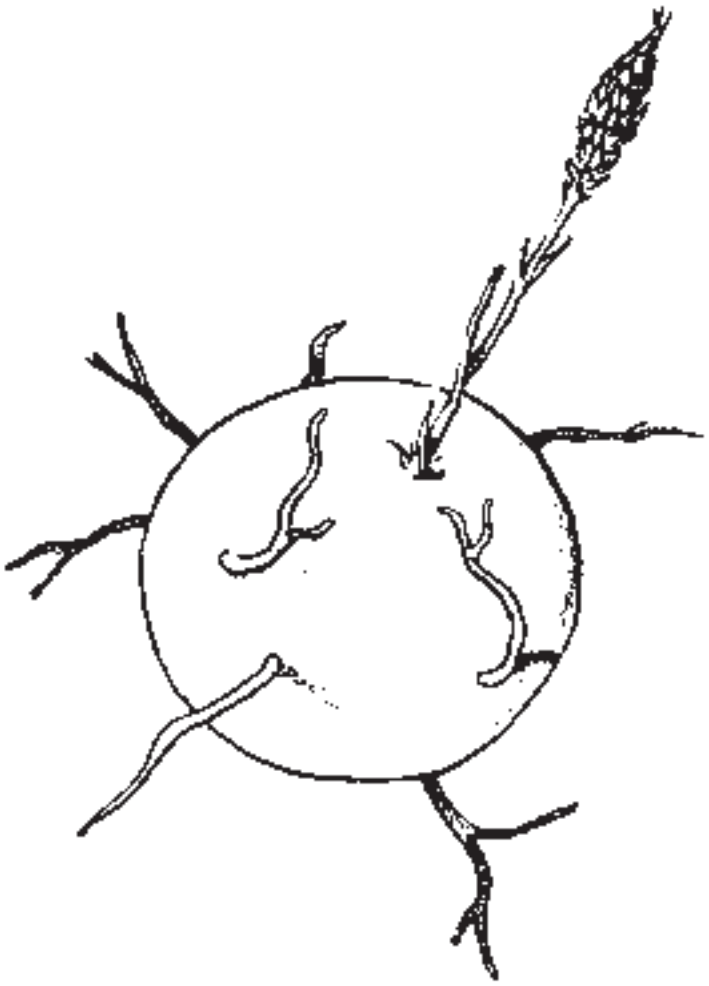
International Union for the Protection of New Varieties of Plants (UPOV): www.upov.int/index_en.html

World Intellectual Property Organization (WIPO) guidelines for access and benefit sharing: www.wipo.int/edocs/.../tk/.../wipo.../wipo_grtkf_ic_7_9.pdf

Main Message 4

International legal instruments for conservation

- *The Convention of the International Union for the Protection of New Varieties of Plants (UPOV) allows each member state to grant intellectual property rights (IPR) to breeders who have developed new plant varieties in agreement with the requirement for novel, distinct, uniform and stable features. However, in its latest state, the protection of plant breeders' rights has been strengthened, while farmers' rights were not adequately addressed.*
- *The Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) requires member states to provide protection for plant varieties either using patents or by an effective sui generis (stand alone) system, or a combination of the two. No agreement has been reached up to now on including the rights of farmers and the conservation of agrobiodiversity into TRIPS.*



Chapter 3

Strategy and Actions for Agrobiodiversity Conservation in China

3 Strategy and actions for agrobiodiversity conservation in China

Within the four sub chapters, the reader will gain an overview and get in-depth information about official strategies and activities for biodiversity conservation in China. Sub chapter 3.1 provides insight into the overarching political strategies and action plans that are the basis and background of any concrete public activity. Sub chapter 3.2 focuses on achievements and activities at a national level for the conservation and management of agricultural genetic resources. Sub chapter 3.3 looks closer into the matter of the conservation and management of wild species. Sub chapter 3.4 concentrates on newly identified potential dangers for biodiversity and agrobiodiversity. It focuses on national actions to defend against invasive alien species and to prevent negative consequences of genetic engineering with agricultural crops and microorganisms.

3.1 National strategies and action plans related to agrobiodiversity

This chapter provides an overview of general strategies and action plans with the aim to protect and sustainably manage China's national biodiversity, including agrobiodiversity. This basic framework consists of:

- the national strategy on agricultural development,
- the national strategy of biodiversity conservation,
- the national strategy of agrobiodiversity and the related action plan, and
- the national strategy and action plan on biodiversity conservation in agriculture-related sectors.

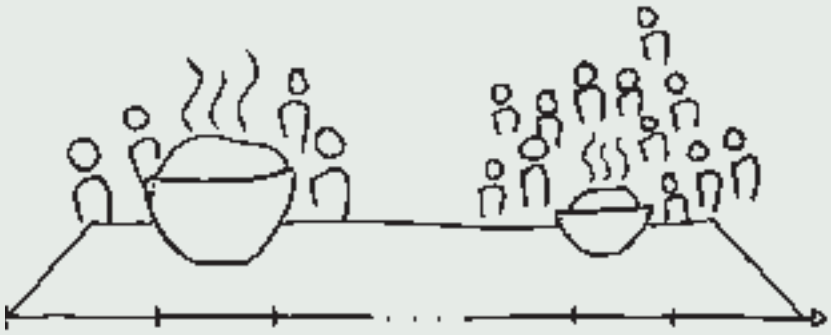
3.1.1 Strategy for sustainable development in agriculture

The National Strategy takes a look back to the steps already taken in agrarian reform and concludes that a considerable number of achievements of this reform can already be seen. Most prominently mentioned are:

- A centralized management system based on household contracted operations was introduced.
- The state has begun loosening control over farm produce prices and markets and put great efforts into commodity production.
- The agricultural structure was readjusted considerably and agriculture as a whole became far

Box 6: "Who will feed China?"

In his 1995 published, "Wake-up Call for a Small Planet," the President of the World Watch Institution, Lesley Brown, contended that with the increase of China's population and their improvement of living standards, the demand for food will rise to a great degree while the farmlands continuously shrink, irrigation water is increasingly directed to non-farming sectors



and the consumption of fertilizers reaches the point of diminishing returns. Thus by 2030, China's food production will have dropped by 20% from its current level and 369 million tons of food will have to be imported into China. This is far beyond the food supply available in the international food market, hence the question "Who will feed China?" (www.hartford-hwp.com/archives/55/017.html).

more prosperous since the single activity structure of the rural economy (food cropping) was diversified. This led to rural enterprises growing rapidly and they are now important pillars of the national economy.

- The concentrated and enhanced construction of infrastructure of agriculture remarkably improved the conditions for agricultural production.
- Education on agricultural technology was strongly developed, and the foundation of agricultural technological strength was improved. This led to a wide application of key technologies, increasing outputs and incomes.
- The construction of agriculture-supported industrial systems was enhanced to provide important material security for the continuous growth of agricultural production.
- The building of the legal regime on agriculture was reinforced with the completion of a legal framework for agriculture.

These achievements reflect the decisive role of agriculture in Chinese economy and society. However, having taken these important steps, the strategy still looks at two pivotal issues to be tackled in future. One of them is food security (see box 6) and the other is environmental degradation.

There are scholars that share the rather pessimistic view of future food security detailed in box 6. They recommend adopting a security strategy of "domestic, market based, generally self-supported, moderately import and export oriented". Others state that technological advances were, are and will also be the first source of food increase in China; the key to the food issue lies in technology and technological development depends on the technology investment policy of China. The National Strategy follows that latter line of argument and holds that an innovative strategy of sustainable agricultural development that covers technological innovation, managerial innovation, system and mechanism innovation and conceptual innovation should be implemented.

Components of technological innovations foreseen are agro-biological technology and information technology characterized by precision agriculture. High-technology approaches in agriculture support the sustainable development of modern agriculture.

This is currently hampered by an unbalanced system development, by lack of demand impetus and by lack of an intermediate system of introduction. Therefore, the focuses of high-tech development in China's agriculture are:

- the reform of the agricultural research system,
- the restructuring of high-tech investment mechanisms in agriculture,
- systemic arrangements and innovations in agriculture with relevant policy mechanisms,
- the development of market mechanisms,
- the establishment of risk security mechanisms, and
- the creation of demand orientation for high-tech tools in agriculture.

Environmental degradation and its causes are clearly identified (see box 7). Therefore, a number of guidelines for implementation of the strategy were issued, including:

- coordination between human population and resources,
- optimization of the mix of human and natural resources,
- setup of a resource-conserving production system,
- adoption of intensified management of agricultural resources,
- development of high-yield, high-quality and high-efficiency agriculture,
- establishment of a socialist market economic system in the countryside,

Box 7: Causes of environmental degradation

Due to a large population and unsustainable agricultural production, China is confronted with challenges in the environment, society and economy. A large population, limited resources, and wide gaps between regions describe the situation in China. Several high-yield crops were introduced decades ago in China through the Green Revolution, and these have brought about solutions to the food supply issue for over a billion people, but at very high costs – the destruction of the environment and loss of biodiversity.

- development of advantages in regional resources and facilitation of complementary resource exchange between regions,
- endeavour for a balanced development of regional economy, and
- acceleration of modernization in agriculture.

Being conscious about the controversial effects of the Green Revolution (see box 7), the strategy states that sustainable development in agriculture should only be based on a clear view and sound judgment of the situation in China. Eco-Agriculture is seen as the first strategy that addresses the issue of sustainable agricultural development and is but one of the options for sustainable agricultural development in China.

high growth rates are important for the country for a certain period, the effects of this growth have to be considered. Biodiversity loss, as one of these effects, has to be addressed more decidedly and the hitherto made efforts in biodiversity saving have to be consolidated.

- Management enhancement and public involvement, meaning that biodiversity actions (policies, regulations) need to have improved management, oriented towards an ecosystem approach. As well, it means that biodiversity conservation is not just a government, but a public task. Therefore all actors in society have to be involved and asked for participation.
- Sustainable use and benefit sharing, meaning that China should strengthen its efforts to take advantage of its national wealth in biodiversity, giving high priority to national bio-prospecting, defending its biodiversity treasures from being taken abroad and insisting on fair and equitable international benefit sharing as it comes to the economic use of its genetic resources.

Figure 6: Regionally characteristic fruits

3.1.2 China's National Biodiversity Strategy and Action Plan (NBSAP; handout 5)

The national strategy aims at coordinating the conservation of biodiversity with economic development. To reach this aim, it spells out a number of strategic guidelines which are then translated into short, medium and long-term goals. The guidelines are as follows:

These guidelines are translated into the overall goal: "To effectively conserve the ecosystem, species and their habitats; make sustainable use of species and

their genetic resources; share the benefits made from the use of species as well as their genetic resources and related traditional knowledge; and create a civilized society with harmonious coexistence between humans and nature, the humans using modern technology and traditional knowledge in an ecosystem approach based on the basic situation of our country and a scientific foundation." The short-term goal, to achieve in the year 2015, centres on the intention to effectively curb the trend of biodiversity loss (see handout 5). The medium-term goal, which is to be reached by 2020, is that the loss of biodiversity is basically under control. The long-term goal, finally, is that by 2030, biodiversity across the county is under effective conservation.

3.1.3 Strategy of agrobiodiversity conservation and utilization

Bio-resource conservation as a basic guarantee for modernizing agriculture and implementing a sustainable development strategy in China is the main emphasis of the strategy.

The strategy explains the chances and dangers China is facing in relation to bio-technology and lays out guidelines to prevent bio-piracy on an international level. The treasure of genetic resources is seen as a reliable resource foundation and an apparent comparative advantage of China for its independent innovation in agricultural technology. The globalization of the economy and of technology also offers an opportunity to turn this advantage into strengths in technological development and economic competition. As a result, conservation of genetic resources is perceived as an essential guarantee for the implementation of a sustainable national development strategy. The following measures are proposed:

At the international level the regulations on access to genetic resources and on benefit sharing were finalized in Nagoya, Japan in October 2010 and have to be enforced in order to prevent infringements such as species smuggling, bio-piracy etc.

1. Safeguarding genetic resources should be made a high priority in the agricultural development strategy of China.
2. To upgrade and improve decision-making related to the conservation and utilization of agricultural genetic resources.
3. To enhance management and technical support capabilities for the conservation and utilization of agricultural genetic resources in China.
4. Find new ways to guarantee plant variety rights and create useful barriers in China for the security of agricultural genetic resources.
5. To improve the laws, regulations and rules on the conservation and utilization of agricultural genetic resources in China.
6. Use international negotiation platforms to express Chinas' aspirations and request the safeguarding of genetic resource security.

3.1.4 Action plan for agrobiodiversity conservation and utilization

In order to put the strategy of agrobiodiversity conservation and utilization into practice, an action plan with a number of steps has been formulated.

1. Enhancement of survey, cataloguing and monitoring of biodiversity and related scientific research. Improve biodiversity cataloguing efforts with as many well trained experts as necessary. Based on this cataloguing, an effective monitoring system for agricultural ecosystems has to be set up and research on agrobiodiversity has to be coordinated and strengthened.
2. Establishment of agrobiodiversity conservation systems through the formulation of a well based conservation strategy, including *in situ* and *ex situ* conservation. In regards to *ex situ* conservation, the national botanic gardens and the agricultural germplasm repositories shall both be increasingly developed into a well coordinated system.
3. Strengthening the conservation of genetic resources and relevant traditional knowledge, and establishment of access and benefit sharing systems. At the international level the regulations on access to genetic resources and on benefit sharing were finalized in Nagoya, Japan in October 2010 and have to be enforced in order to prevent infringements such as species smuggling, bio-piracy and carrying species without permission, etc.
4. Documentation of traditional knowledge related to genetic resources, in order to develop traditional knowledge IPR systems and benefit sharing measures to ensure the maintenance, inheritance and development of traditional

knowledge. Useful instruments are bio-cultural community protocols (BCP), or a BCP approach. BCPs are protocols that are developed after a community undertakes a consultative process to outline their core ecological, cultural and spiritual values, and which consider customary laws relating to traditional knowledge and resources. Based on these considerations, BCPs provide clear terms and conditions to regulate access to their knowledge and resources. BCPs could prepare the ground for ABS negotiations.

5. Intensification of bio-security management capacity building. In order to curb the threat of invasive alien species to peoples' health and agricultural production (see box 8), a notification and monitoring system shall be established. While intensifying efforts in the development of GMO technology, the potential risks of this technology to the environment have to be assessed and monitored.
6. Monitoring and notification systems for pathogenic microorganisms and epidemic sources and diseases of animals have to be established for the safety of animal populations and public health.
7. Mitigation of impacts of climate change on biodiversity conservation. Climate change can have negative impacts on agrobiodiversity but a high level of agrobiodiversity may also have an adaptation effect in countering climate change impacts. In order to make these relations more transparent and understandable, research and evaluation should be carried out in order to propose management modes for biodiversity in the face of climate change.
8. Enhancement of local competence building and promotion of public participation. In order to enable a virtuous cycle of conservation and local development, the role of local communities and populations as main players in biodiversity conservation and community development shall be established. Therefore, transparent compensation mechanisms have to be workable. So do public participation mechanisms including public reporting, complaint management, petitions and public hearings.

Box 8: Invasive alien species in China

China is one of the countries that suffers the worst damages from invasive alien species. Its accession to the WTO has exposed China to increasingly severe invasive alien species. According to statistics, so far up to 400 alien species have entered into China and over 50 out of the World's 100 worst Invasive Alien Species as published by the International Union Conservation of Nature (IUCN) have been discovered in China. Invasive alien species have had serious negative effects on China's economic development and people's welfare.

3.1.5 Biodiversity conservation strategy and action plan in agriculture-related sectors

With the consent of the State Council, the "Outline of the National Plan on Species Conservation and Utilization" was released in October 2007 jointly by 17 ministries and commissions. This outline includes 10 initiatives and 55 special projects in 12 key sectors including plant, animal, and aquatic resources. With respect to these genetic resources, the outline sets forth strategic tasks as follows:

Genetic resources of plants for food and agriculture

- To continue and speed up collecting genetic resources of crops in and outside of China.
- To develop a total of 260 *in situ* conservation sites (short, medium and long-term), including 32 conservation sites for wild rice, 18 sites for wild relatives of wheat, 36 sites of wild soy-bean, 15 sites of aquatic wild vegetables, 50 sites of wild relatives of forage plants and 99 sites of wild forage, wild vegetables, wild fruit trees and others.

- To create and improve *ex situ* conservation facilities including the national long-term, duplication and medium-term gene banks of crop genetic resources.
- To conduct renewal and propagation, property identification and appraisal of crop genetic resources.
- To discover and clone genes of crop genetic resources by applying modern biological technology and to place as many marker genes as possible under the protection of China's IPRs.
- To increase the use of technical platforms for sharing experience and embark on pilot programmes for benefit sharing activities in order to supply germplasm to crop breeding, farming and research organizations, and to exploit the full potential of genetic resources.

Genetic resources of domestic animals

- To continue investigating and collecting genetic resources within and outside China so as to basically finish collecting and storing genetic resources of known domestic animals and special animals with high economic value by 2010.
- To enhance the construction of a genetic resource storage system (*in situ* and *ex situ*) for domestic animals.
- To establish an assessment system of domestic animal genetic resources and "core gene banks" of domestic animals.
- To support the establishment of screening systems for special and fine genes and innovative systems of fine germplasm exploitation and to make breakthroughs in germplasm innovation and utilization study before 2020.
- To boost the development and exploitation of domestic animal breeds, achieve intensification, and gradually plan to introduce foreign high-performance breeds of domestic animals which comply with market demand.
- To promote the construction of service/information platforms for sharing domestic animal genetic resources.

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Animal Husbandry Law, P.R. China: www.gov.cn/flfg/2005-12/29/content_141833.htm

Measures for the Administration of Crop Genetic Resources, P.R. China: http://news.xinhuanet.com/zhengfu/2003-07/18/content_982316.htm

Measures on Agricultural Wild Plant Protection, P.R. China: http://202.127.45.50/xzsp_web/bszn/t20030709_98799.htm

Regulations on New Plant Varieties Intellectual Property Protection, P.R. China: www.hbnw.gov.cn/other/zcfg/zcfg/ly11.htm

National Biodiversity Strategy and Action Plan, P.R. China: www.cbd.int/doc/world/cn/cn-nbsap-v2-zh.pdf

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Seed Law, P.R. China: http://news.xinhuanet.com/zhengfu/2004-08/30/content_1925440.htm

Tentative Measures for the Administration of Import and Export of Crop Seed and Seedling, P.R. China: www.jmsedu.net/info/jiaoyu/05/Product3/Law/16_FarmingWoods/16_FarmingWoods1632.htm

"Wake-up Call for a Small Planet": www.hartford-hwp.com/archives/55/017.html

Main Message 5

National strategies and action plans related to agrobiodiversity

- *The Chinese Strategy of Sustainable Development in Agriculture is aimed at national food security and at environmental protection. The development path to these aims lies in strengthening technological innovation and improving efficiency in agriculture. Eco-agriculture is seen as a promising approach to addressing the issue of sustainable agricultural development.*
- *The National Strategy and Action Plan for Biodiversity Conservation aims at bringing together conservation and sustainable use of biodiversity with economic development. Three fields of action are defined to contribute to this aim:*
  - *Conservation of biological diversity has to be intensified*
  - *Public involvement in diversity conservation has to be intensified*
  - *Sustainable use and benefit sharing of national genetic resources has to be strengthened*
- *The Strategy for Agrobiodiversity Conservation and Utilization emphasizes the major opportunities for bio-technology for resource-rich China and outlines six measures to be taken to defend these national treasures against bio-piracy.*
- *The Action Plan for Agrobiodiversity Conservation and Utilization defines a number of steps to put the strategy for agrobiodiversity conservation and utilization into practice. These steps include:*
  - *Documentation of existing genetic resources*
  - *Strengthening of conservation efforts for genetic resources and related traditional knowledge*
  - *Strengthening bio-safety management against invasive alien species*
- *The Outline of the National Plan on Species Conservation and Utilization defines a number of concrete activities to conserve crop, domestic animal and aquatic species. These activities include collection, documentation, conservation and sustainable utilization of the presently used species in China.*

3.2 National actions for the conservation and management of agricultural genetic resources

National actions for the conservation and management of agrobiodiversity encompass the whole range of laws and regulations relevant to the issue. This legislative framework has been developed mainly during the last two decades and is still developing further. The conservation efforts for genetic resources of agricultural plants and animals, as well, show considerable achievements today and are still being followed-up and strengthened by the development of strategy-led activities.

3.2.1 Legislation on the conservation and management of agricultural genetic resources (handout 6)

There are numerous laws and rules at state and department levels that regulate conservation and management of agricultural genetic resources. Some of the more important ones will be introduced in this chapter, including the:

- Animal Husbandry Law
- Seed Law
- Regulations on Wild Plants Conservation
- Regulations on New Plant Varieties Intellectual Property Protection
- Administrative Regulations on the Safety of Agricultural Genetically Modified Organisms
- Measures for the Administration of Crop Genetic Resources
- Measures on Agricultural Wild Plant Protection
- Tentative Measures for the Administration of Import and Export of Crop Seed and Seedling

Animal Husbandry Law

The Animal Husbandry Law of the People's Republic of China was adopted and enacted at the 19th Conference of the 10th NPC Standing Committee on the 29th of December, 2005 and taken into force as of the 1st of July, 2006. The Animal Husbandry Law was developed on the basis of the Regulations on the Administration of Breeding Livestock and Poultry, which was promulgated by the State Council in 1994. The second chapter of the Animal Husbandry Law specifies the conservation of domestic animal genetic resources with 9 related provisions. The Animal Husbandry Law strengthens the conservation and management of animal genetic resources and for the first time brings forward benefit sharing of the achievements made using genetic resources (see box 9). The law describes in detail:

- The administrative system for the conservation and management of domestic animal genetic resources,
- who is in charge of surveys, reports and conservation measures for domestic animal genetic resources,
- how newly discovered domestic animal genetic resources should be systematised and documented,
- how genetic resources of domestic animals from outside China shall be treated,
- the procedures for benefit sharing of genetic resources of domestic animals exported from China, and
- the import and export management of domestic animal genetic resources.

Box 9: Procedures for benefit sharing under the Animal Husbandry Law

The Animal Husbandry Law for the first time introduces the concept of "benefit sharing" to align China's laws with international agreements such as the CBD.

Article 16 requires that those who export from or cooperate within China with foreign organizations or individuals in studying and utilizing domestic animal genetic resources under national protection shall file applications with the relevant department of animal husbandry and veterinary services; and that no newly discovered genetic resources of domestic animals shall be exported, or be studied and utilized jointly with foreign organizations or individuals before they are identified by the National Commission on the Genetic Resources of Animals and Poultry.

Seed Law

The Seed Law of the People's Republic of China was enacted by the NPC on the 8th of July, 2000. The Law was made mainly to regulate the breeding of selected varieties and the production, trade and use of seeds, as well as to protect the rights and benefits of seed breeders and seed multipliers, traders and users. These regulations will improve seed quality, support the formal seed sector and promote the development of the seed industry and forestry. However, the Seed Law also sets forth the specific provisions of "conservation and use of genetic resources" and clearly claims State sovereignty over genetic resources. Concerning this aspect of sovereignty, the law details:

- The protection of plant genetic resources against destruction and misappropriation,
- the institutions and administrative bodies in charge of collection, compilation and storage of plant genetic resources, and
- that the state has sovereignty over genetic resources and shall enact this sovereignty through its appropriate departments.

For the implementation of the Seed Law, Measures for the Administration of Crop Genetic Resources were promulgated by the MoA on the 8th of July, 2003, specifying the authority for crop genetic resources, and the collection, preservation and information management of genetic resources (see handout 7).

Regulations on Wild Plants Conservation

Agricultural wild plants contain a large number of genes with traits of high yield, high quality, disease & pest resistance, drought resistance and cold tolerance, etc. and are very precious resources that could benefit the human race. Due to the effects of human activities like pollution, deforestation, and over-exploitation, many wild relatives and rare species of crops have been lost or reduced rapidly, which hinders sustainable agricultural development. On the 1st of January, 1997, the state issued the Regulations on Wild Plants Conservation (hereinafter, the Wild Plants Regulations) with an aim to conserve biodiversity, use wild plant resources appropriately and maintain ecological balance. The contents of the Wild Plants Regulations centre on:

The conservation of wild plant resources; presenting that "the state encourages and supports scientific research, and *in situ* and *ex situ* conservation of wild plants",

Box 10: Rules related to the Regulation of New Plant Varieties Intellectual Property Protection

Since the Regulations on New Plant Varieties Intellectual Property Protection were enacted on the 20th of March, 1997, the MoA has consecutively set down related ministerial regulations such as Rules for the Regulations on the Protection of New Varieties of Plants (Agriculture Part) (16th of June, 1999), Examination Regulations of the Commission on New Plant Varieties Re-examination of the Ministry of Agriculture (6th of February, 2001), Regulations on Handling Cases of Infringement on New Agricultural Plant Variety Rights (30th of December, 2002), and Regulations for the Agency of New Agricultural Plant Varieties (30th, December, 2002), etc. Together with the Rules for the Regulations on the Protection of New Varieties of Plants (Forestry Part) (10th of August, 1999) formulated by the SFA, Explanations of Several Issues in Trying Disputes on New Plant Varieties (5th of February, 2001) promulgated by the Supreme People's Court, and other regulative documents and relevant local regulations, the legal provisions addressing new plant variety conservation have been established as an important part of the IPR legal systems in China.

- the requirement that: "in case any infrastructure project has negative effects on the habitats of nationally protected wild plants and locally protected wild plants, the assessment thereon must be stated in the environmental effect report submitted by the project owner",
- the collection of wild plant resources, and
- the administration of import and export of wild plant resources.

Regulations on New Plant Varieties Intellectual Property Protection

In order to protect breeders' rights and drive transition of the breeding sector from planned economy to market economy, the Regulations of the People's

Republic of China on New Plant Varieties Conservation (hereinafter, the New Plant Regulations) were issued in China on the 20th of March, 1997. They aim to protect breeders' benefits, and is centred on a "certain amount of charge imposed by the breeder on the use of varieties the breeder creates as commodities for others" (see box 10).

The development of a new plant variety requires huge inputs, including skilled labour, physical resources, funds and time, and a breeder generally has to take 10-15 years or longer to develop a new variety. New plant varieties must have a comparatively stable, specific heredity and relative uniformity in biology, economy and morphology, and meet the needs for production in terms of output, quality and adaptability. The extension of new varieties is the source of huge social and economic benefits for agriculture, forestry and gardening. However, since breeders are unable to prevent others from reproducing their own varieties without making payments and to stop the sale of their varieties at a commercial scale without their consent, they cannot obtain the necessary profits to continue their breeding efforts. Regulations on New Plant Varieties Conservation aim at protecting breeders' rights and guaranteeing breeders benefits in a special protective form of IPR.

Along with vigorous legislation activities for scientific and authoritative examination of plant variety rights, the development of testing manuals for 80 new plant varieties like maize and rice was organised based on international specifications for testing new plant varieties.

The perfection of all systems and the initiation of basic preliminary work have built up the foundation for steady enlargement of the coverage of new-varieties conservation in China. With the release of the sixth batch of the list of varieties for conservation involving 21 families and genera, the coverage of conservation of new plant varieties in agriculture has extended to 62 families and genera.

Tentative Measures for the Administration of Import and Export of Crop Seed and Seedling

The Tentative Measures for the Administration of Import and Export of Crop Seeds and Seedlings (hereafter, the Measures) was issued by the MoA in March of 1997, stipulating that the supply of plant genetic resources abroad (outside the country) shall be managed according to the taxonomic lists of crop genetic resources, handled for approval by the Variety Resource Institute of CAAS, and examined and approved by the Authority on Agricultural Issues under the State Council.

As the Measures provide no additional details on the procedures for importing crop genetic resources, the same procedures shall apply to the import of crop genetic resources from outside China.

3.2.2 Conservation and management of agricultural genetic resources

Preferences: Collection and preservation of agricultural genetic resources follows certain categories that give guidelines as to the importance of the organism. According to these guidelines, the organisms that are to be collected and conserved are selected. Crop genetic resources are categorized as follows:

- Varieties which are cultivated at present, especially endangered, special and rare indigenous varieties,
- varieties which were cultivated in the past but are no longer used in agricultural production,
- wild relatives of cultivated crops,
- germplasm, e.g. mutant, breeding line, pure inbred line, intermediate distant hybridization types, and
- wild species with high value for breeding.

The evaluation indices and methods for establishing key conservation targets for **domestic animal genetic resources are:** distinct production performance (high fecundity, disease resistance, high adaptability, high feed conversion efficiency, fineness and high quality, etc.) and the threat of extinction of a breed.

According to these evaluation indices and provisions of the Animal Husbandry Law of the People's Republic of China, the MoA Gazette No. 662 dated the 2nd of June, 2006, specified 138 varieties of domestic animals (e.g. Bamei pig) as domestic animal genetic resources under national protection.

Finally, **aquatic genetic resources** shall include the following three categories according to different conservation objectives:

- Nationally protected species, locally protected species and generally accepted key endangered species. Conservation of species under this category is concentrated on rebuilding their natural populations to the greatest extent possible.
- Aquatic (fishery) resources of high economic value and key varieties in aquaculture as speci-

fied by the central and provincial governments. Conservation of population resources of species under this category shall be focused on supporting the sustainable use of fisheries.

- The original breeds and improved breeds in aquaculture which have been listed by the MoA. For species under this category, supporting industrial development is the main objective.

The actions that have been taken in the effort to efficiently conserve and manage agricultural genetic resources can be grouped into four main areas:

1. Construction of a basic genetic resource platform
2. *In vitro* conservation
3. Microorganism conservation
4. Core collection conservation

Construction of a basic genetic resource platform

Since the 10th Five-Year Plan was implemented, under the "platform construction for natural scientific & technical resources sharing" project of the Ministry of Science & Technology (MOST), the construction of platforms for genetic resources sharing of crops, forests, animals, microorganisms and forages, etc. have been carried out. So far the following has been compiled and integrated:

- 200,000 accessions of crop genetic resources
- 101 species of animal genetic resources
- 17,000 accessions of forest genetic resources
- 40,000 strains of microorganism strain resources
- 7,000 accessions of genetic resources of common and endangered medicinal plants
- 4,000 accessions of main forages

Conservation *in vitro*

Currently, scientific workers are making great efforts in culturing plant cells, organs, embryos and protoplasts. Over the last ten years, according to incomplete statistics, the test-tube plantlets of about 200 medicinal plants were successfully produced through tissue culture in China. Two test-tube plantlet banks were set up in the 1990s by the China Academy of Sciences (CAS) for conserving genetic resources of root and tuber crops such as sweet potato and potato.

Microorganism conservation

In 1996, the CAS set up genetic resource banks for conserving wild genetic resources of plants, animals and microorganisms. There are 11 banks in operation under the committee and the culture collections of all banks under the committee involve 6,316 strains and a total 21,644 cultures collected.

Core collection conservation

In 1999, with the support of the national project "973", China took the lead in constructing core collections of 3 major world crops – rice, wheat and soybeans – of which 5% of genetic resources represent 90% of genetic variations. Currently, core collections of other crops like barley and edible beans have been established as foundations for adequate exploitation and use of fine genes of those crops.

China took the lead in constructing core collections of 3 major world crops – rice, wheat and soybeans – of which 5% of genetic resources represent 90% of genetic variations.

Progress has been made in building core collections of forest plants and ornamentals such as Japanese apricot, shaddock, Chinese chestnut, plum and tea. For the construction of core collection of tea, the trees were grouped by place of origin, classification and variety, and 126 accessions of its genetic resources out of 615 were selected as the primary core collection of tea.

3.2.3 Achievements in conserving genetic resources of agricultural plants

Conservation efforts for genetic resources of agricultural plants are comprised of *in situ* conservation and *ex situ* conservation of plants and the conservation of domestic animals' genetic resources in gene banks.

***In situ* conservation**

By the end of 2007, there were 2,531 natural reserves established with a total area of approximately 151.88 million ha. or 15.2% of the land area of China. 303 of them are national reserves with an area of 93.65 million ha. Thanks to over 50 years of conservation efforts, China has gone from having no standing natural reserves to establishing a vast network of reserves covering a percentage of China's land area in excess of the world average of 12%. A national network of natural reserves with a full range of focuses, rationally planned layouts and sound functions has been shaped. 85% of the existing natural ecosystem types, 40% of natural wetlands and 20% of natural forests are under effective conservation in these reserves. This applies as well to a vast majority of natural heritage sites and

Figure 7: Wild genetic medicinal plant resource (*Ligusticum chuanxiong* Hort.)

65% of higher plant community types. Most species of rare and endangered wildlife under national protection are protected against loss in direct relation to the conservation of genetic resources because of this. Protective efforts include natural reserves for agricultural plants, which also protected against loss.

Since Zhangjiajie National Forest Park in Hunan, the first forest park in China, was established upon approval in 1982, the national forest parks system has been expanding rapidly. By the end of 2006, there were 2,067 forest parks in operation across the country covering a total area of 15.69 million ha, of which 660 are national, operating on a total area of 11.25 million ha, and 955 are provincial parks. Up to the end of 2007, there were 116 national *in situ* conservation sites of agricultural wild plants, covering 47 species of agricultural wild plants and located across 24 provinces, municipalities and autonomous regions in China.

***Ex situ* conservation**

By the end of 2007, China owned 390,000 accessions of crop genetic resources, and thus was ranked second in the world after the USA, which held 550,000 accessions. So far, 2 long-term national banks have been completed, conserving 332,000 accessions of crop germplasm, including 35 families, 192 genera and 712 species, with duplicates being conserved *ex situ* as well. 32 national repositories of genetic resources have been set up, conserving 38,000 accessions of perennial and vegetative crops, and representing 1,026 species (including subspecies).

Of the germplasm under national conservation, all agronomic traits have been observed and recorded. Disease & pest resistance of 57%, and stress tolerance of 39% of all germplasm have been identified. Over 30,000 fine accessions have been acquired, of which some 3,000 have been offered to breeding and production organizations and resulted in remarkable benefits. Meanwhile, the national information centre of crop genetic resources has been established, storing a total of 20 million data items and 800 Mb of information on 390,000 accessions of germplasm. Conservation of forest genetic resources was initiated later but ten *in situ* conservation banks of forest genetic resources have been built up in five climate zones across the country, conserving 15,000 accessions of 76 major tree types of arbours, shrubs and flowers, and in total 55,000 accessions along with genetic materials for breeding and reproduction.

Conservation of genetic resources of wild plants has also been embarked upon throughout the national botanical garden network in China. Under the 12 botanical gardens belonging to the CAS, there are 95 special gardens, occupying some 3,000 ha, and collecting and growing some 15,000 wild plants. With respect to genetic resources conservation of medicinal plants, from 1983 to 1987, the state organized the implementation of a survey of Chinese medicine resources, which resulted in the clarification of the types and distribution of genetic resources of medicinal plants across the country. According to the survey, at

... at that point there were 11,000 medicinal plants in China, of which approximately 1,200 were common traditional medicinal materials, 4,000 were ethnic drugs and 7,000 were folk drugs.

that point there were 11,000 medicinal plants in China, of which approximately 1,200 were common traditional medicinal materials, 4,000 were ethnic drugs and 7,000 were folk drugs.

With respect to aquatic genetic resources, after the PRC was founded, several major surveys of aquatic resources in sea and inland waters were conducted to acquire a profile of the types, quantities and distribution characteristics. 32 national farms with original and fine aquatic breeds and 162 provincial farms of original and fine aquatic breeds exist across the country.

Gene bank

Since 1976, records on pig, cattle, goat and sheep, horse, fowl, bee and silkworm breeds have been published; conservation farms for some domestic animal genetic resources have been set up; sperm banks and embryo banks for cattle, sheep and goats have been established; cryopreservation (low-temperature) methods and techniques have been successfully utilized; semen and embryos of some cattle, goat and sheep have been conserved; and 1,000 accessions of silkworm eggs have been stored.

With respect to the conservation of microorganism resources, the state has set up China centres of agricultural, industrial, general, medicinal, veterinary, and marine culture collections, one after another, and undertaken the tasks of collecting, compiling, identifying, conserving and exchanging microorganism resources. Over 4,000 microorganism resources and over 100,000 strains are conserved in China.

Author: Xue Dayuan

Literature cited and recommendations for further reading:

Administrative Regulations on the Safety of Agricultural Genetically Modified Organisms: www.gov.cn/flfg/2005-08/06/content_21003.htm

Animal Husbandry Law: www.gov.cn/flfg/2005-12/29/content_141833.htm

Measures for the Administration of Crop Genetic Resources: http://news.xinhuanet.com/zhengfu/2003-07/18/content_982316.htm

Measures on Agricultural Wild Plant Protection: http://202.127.45.50/xzsp_web/bszn/t20030709_98799.htm

Regulations on Wild Plants Conservation: www.xj.xinhuanet.com/shengtai/2004-04/23/content_2026071.htm

Regulations on New Plant Varieties Intellectual Property Protection: www.hbnw.gov.cn/other/zcfg/zcfg/ly11.htm

Seed Law: http://news.xinhuanet.com/zhengfu/2004-08/30/content_1925

Tentative Measures for the Administration of Import and Export of Crop Seed and Seedling: www.jmsedu.net/info/jiaoyu/05/Product3/Law/16_FarmingWoods/16_FarmingWoods1632.htm3.3

Main Message 6

National actions for the conservation and management of agricultural genetic resources

- *The National Legislative Framework for the Conservation and Sustainable Management of Agricultural Genetic Resources is comprised of the following laws and measures:*
  - *Animal Husbandry Law*
  - *Seed Law*
  - *Regulations on Wild Plants Conservation*
  - *Regulations on New Plant Varieties Intellectual Property Protection*
  - *Administrative Regulations on the Safety of Agricultural Genetically Modified Organisms*
  - *Measures for the Administration of Crop Genetic Resources*
  - *Measures on Agricultural Wild Plant Protection*
  - *Tentative Measures for the Administration of Import and Export of Crop Seed and Seedling*

  For each different field, these regulations describe measures for conservation and management of genetic resources, provide rules for sustainable utilization (e.g. breeding/research) and fair sharing of benefits, and determine the bodies responsible for enforcement.
- *In regards to the conservation of genetic resources of agricultural plants, China has made considerable efforts in both in situ and ex situ as well as in gene bank conservation. In situ conservation activities consist of 116 national conservation sites of agricultural wild plants, covering 47 species of agricultural wild plants. Ex situ conservation efforts have reached 390,000 accessions of crop genetic resources in two national long-term and 35 medium-term repositories.*
- *The preferences and actions of the conservation and management of agricultural genetic resources are clearly laid out.*
  - *The preferences provide categories of agricultural genetic resources describing the importance of the organism to be collected and preserved.*
  - *The actions are comprised of four fields of measures, which are the basis for the construction of a basic genetic resource platform, in vitro conservation, microorganism preservation and core collection conservation.*

3.3 National actions for the conservation and management of wild species

The conservation of wild species is a paramount task in a country with high biodiversity like China. With the consent of the State Council, the Outline of the National Plan for Species Conservation and Use 2006-2020 was released jointly by 17 ministries and commissions in October 2007. This outline proposes a series of actions for enhancing the conservation and sustainable use of wild species such as wild animals, wild plants, forests, flowers and microorganisms, etc.

3.3.1 Conservation and management of wild animal resources

The measures for conservation and sustainable use of national wild animal resources deal with safeguarding endangered species in order not to lose potentially valuable genetic resources. In addition, they deal with the broadening of knowledge on the sustainable and sound use of wild animal population resources.

In regards to the first task, safeguarding of endangered or potentially endangered species, three levels of conservation are elaborated in the outline.

- The first level is a rescue project planned to last until 2020 with the objective of safeguarding all rare and endangered wild animals. Species include the Northeast China Tiger, Przewalski's Horse and many others.
- The second level includes the establishment of natural reserves for wild animals. Through the year 2020 there are approximately 100 new natural wildlife reserves planned to be constructed beyond the existing ones.
- Finally, the third level of conservation consists of the setup of zoos and wildlife breeding centres. This initiative aims at establishing 50-60 new zoos and bringing into full play the role of existing zoos in cities. In addition, 20 new wildlife breeding centres (or domestication and breeding farms) are planned to address large scale breeding and technical issues related to wild animal genetic resources.

With the above mentioned third level of conservation, China's foray into breeding and sustainable use of wild animals' genetic resources is already underway. This topic is more intensively elaborated on in the outline, which discusses and guides the development and enhancement of technological research on resource use.

3.3.2 Conservation and management of wild plant resources

As with the conservation and management of wild animals, the conservation and management of wild plant species demands a number of measures, including the intensification of reserve construction, the improvement of *ex situ* conservation, a survey on wild plant resources and the intensive exploration of the sustainable use of wild plant species. Intensification of reserve construction calls for a number of new reserves of endemic plant resources and key species. Newly established reserves should aim to conserve a number of endemic plant genera, such as *Taphrospermum*, *Roborowskia batalin*, and species including *Lithospermum tschimganicum* B. Fedtsch. and many others of the various climatic zones of China. In addition to this *in situ* form of conservation, the national gene bank and botanical garden system of wild plants is to be improved by adding 5-6 national botanical gardens for wild plant *ex situ* conservation and 50-80 local and municipal botanical gardens up to 2015. These conservation efforts will be accompanied by intensive research and documentation. This includes a combination of key-point surveys and a general census in order to understand the distribution and conservation status as well as endangerment status of wild plants.

... including the intensification of reserve construction, the improvement of *ex situ* conservation, a survey on wild plant resources and the intensive exploration of the sustainable use of wild plant species.

In the year 2015, a number of surveys of key distribution regions of wild plants will be completed. The focuses of general surveys are the reserves, modes of utilization, markets in the last few years and increases and decreases of wild resources of all economic plants. Research as well shall be intensified in the direction of sustainable use of wild plants, including the development of new technologies for wild plant domestication and cultivation, the analysis of valuable chemical constituents of wild plants, and the independent technological innovations of endemic resource development in China.

3.3.3 Conservation and management of woody plant resources

Concerning the conservation and management of woody plant resources, the outline describes ob-

jectives and measures in the areas of documentation, conservation (*in situ* and *ex situ*) and sustainable use. As for documentation, the outline proposes to, from 2006 to 2010, finish the initial surveys of forest species resources across the country, making clear the category, quantity, distribution, endangerment, conservation and use of woody plants. These efforts shall be accompanied and continued by the establishment of improved woody plant resource information systems (by 2015) containing spatial and geographic information of rare and endangered woody plants, distribution maps of woody plant species diversity and zoning of woody plant resource conservation.

Ex situ conservation of woody plants is to be intensified by strengthening national arboretum/botanical garden networks, networks of indigenous plant introduction and domestication gardens, and forest tree genetic resources in conservation forest networks. Through the year 2015, 20-30 arboretums/botanic gardens will be set up on sites representative of different geo-climatic zones to introduce and conserve indigenous, rare, and endangered woody plants. These *in vivo* conservation efforts are to be complemented, according to the outline, by an enhanced construction of forest germplasm conservation facilities.

During 2006-2010, national woody plant genetic resource banks (including conservation forests for the *in vivo* conservation of genes, seed banks, *in vitro* tissue banks, etc.) and corresponding germplasm repositories are to be built. Conservation efforts will accompany research on the development and use of woody plant genetic resources. Through 2015, systematic character identification and gene discovery of woody genetic resources preserved at germplasm banks shall be performed and modern biological propagation techniques such as tissue culture, somatic embryogenesis, etc., shall be applied to speed up industrial utilization.

3.3.4 Conservation and management of flowering plant resources

Measures outlined for the conservation and management of flowering plant resources include *in situ* and *ex situ* conservation as well as the exploration of a variety of ways to utilize them economically. These economic utilizations embrace industrial production, the creation of new varieties and the development of tourism.

For *in situ* conservation of primary habitat of wild flowers, 50-100 new wildflower reserves and conservation sites shall be established nationwide by 2020, focusing on specific regions and species. Establishment of conservation sites is to be combined, where possible, with tourism. These *in situ* conservation efforts will accompany an enhanced construction of *ex situ* conservation facilities to collect seeds or propagation materials among the populations of flowering plants of which the genetic structure of the natural population has changed greatly, and in varieties with poor adaptability and high ecological condition (environment and climate) requirements. Along with conservation, the outline includes plans to make wildflowers more amenable to domestic use and industrial production. This entails breeding specific desirable traits into already cultivated flower varieties, extending the commercial production of wildflowers and integrating them into local urban greening.

3.3.5 Conservation and management of microorganism resources

A last area of conservation and management developed in the outline is that of microorganism resources. Here the aspect of conserving a national treasure is less emphasized, whereas the systematic cataloguing, scientific utilization and the development of forms of industrial use are focused upon.

Concerning cataloguing, the outline suggests speeding up microorganism surveys in the next few years, concentrating investigations and collection on those plants with prospects of application in major sectors of the national economy and exploring the background of microorganisms in China. Specific attention shall be paid to microorganism resources within the natural ecological regions unique to China. Extensive investigation, isolation and collection in different ecological regions, systematic and taxonomic studies, exploration of genetic relationships between species, and theories on systematic evolvement will take place.

By 2015, over 100,000 strains shall be shared and up to 5,000 species of microorganisms conserved to provide high-quality microorganism genetic resources, information resources and technical safeguards to industrial and agricultural production, environmental protection, scientific research and education.

This gathering and in-depth taxonomic determination shall be accompanied by the establishment of national microorganism resource banks, sharing systems, and systematic research. By 2015, over 100,000 strains shall be shared and up to 5,000 species of microor-

ganisms conserved to provide high-quality microorganism genetic resources, information resources and technical safeguards to industrial and agricultural production, environmental protection, scientific research and education.

Scientific research and the development of new technologies shall provide a large variety of options for medical utilization such as different enzyme inhibitors, regulators of immune responses, receptor antagonists and excitants, etc. This applies as well to the harnessing of microorganisms in agriculture, bioenergy and environmental protection.

Author: Xue Dayuan

Literature cited and recommendations for further reading:

Outline of the National Plan on Species Conservation and Use 2006-2020, P.R. China: http://websearch.mep.gov.cn/info/gw/huanfa/200710/t20071031_112396.htm

Main Message 7

National actions for the conservation and management of wild species

- *The Outline of a National Plan on Wild Species Conservation and Use 2006-2020 was released in 2007 and provides detailed procedures for the conservation and sustainable use of wild species, including wild animals, wild plants, woody plants, flowering plants and microorganisms.*
- *For all five groups of species, the outline defines plans for*
  - *Cataloguing and documentation*
  - *Different approaches for conservation (in situ, ex situ, gene banks)*
  - *Research and documentation of interesting genetic traits*
  - *Utilization for breeding and production development*

3.4 National actions to protect agrobiodiversity against new potential dangers

China is one of the countries with the highest biological diversity in the world. Thanks to the long history of agriculture, China abounds in agrobiological genetic resources. For example, it is home to important crop species such as soybean and rice. In connection with new developments in biotechnology and the tremendous increase in global trade, two potential menaces to biodiversity emerge. One is a possible uncontrolled out-migration and hybridization of genetically modified plants and organisms; the other one is the already existing intrusion of invasive alien species, with the possible consequences of dislodging local species. This chapter provides an overview on the legal and administrative framework for preventing negative impacts and describes the possible activities for counteraction.

3.4.1 Legal system for agricultural GM crop biosafety administration

The legal system for agricultural GMO crop biosafety administration (see box 11) consists of the Regulations for the Administration of Agricultural GM crop Biosafety (State Council, 2001, hereinafter, the GMO Regulations) and a number of other, more specific laws and administrative measures, that complete the legal system for GMO biosafety administration. The GMO Regulations, as the core of the GMO biosafety administration, contain a full set of administrative systems. The GMO Regulations state that China will implement a safety evaluation system, marker management system, production and operation license system, and import safety examination and approval system for agricultural GMOs. The GMO Regulations follow WTO rules and the Protocol on biosafety to evaluate the safety of GMOs and their products and to administer the markers of transboundary transferred GMOs.

The GMO Regulations govern a wide range of activities including the research stage, intermediate testing, environmental release, commercial production, product marketing and labelling of GMOs, and involve the following systems:

Grading system

The state applies the grading administration and assessment system to agricultural GM crop biosafety, by which agricultural GMOs are divided into four safety levels according to the extent of threats to humans, plants, animals, microorganisms and environments. The specific grading criteria are defined by the Authority on Agricultural Issues under the State Council.

Safety assessment system

The state is responsible for the assessment system of agricultural GM crop biosafety. The criteria and technical specifications for assessing agricultural GM crop biosafety are prescribed by the Authority on Agricultural Issues under the State Council.

Production and trading license system

Production of genetically modified plant seeds, breeding livestock and poultry, and aquatic seedlings shall be subject to the production license for seeds, breeding livestock and poultry, and aquatic seedlings respectively, issued by the Authority on Agricultural Issues under the State Council. GMOs, plant seeds, breeding livestock and poultry, and aquatic seedlings are subject to the trading license stipulations specific to each product, all issued by the Authority on Agricultural Issues under the State Council.

Box 11: Current development of genetically modified plants and microorganisms

Currently, the development of transgenic disease- and pest-resistant rice and high oil content rape is in the production stage; transgenic pest-resistant cotton,

long keeping tomatoes, different coloured petunias, disease-resistant pimento and chili peppers, and vaccine engineering have been awarded certificates of production and application safety.

Labelling system

The state implements a labelling system for agricultural GMOs. The list of agricultural GMOs subject to the labelling system is formulated, adjusted and issued by the Authority on Agricultural Issues under the State Council.

Customs import/export declaration and approval system

The state adopts a customs import/export declaration and approval system for agricultural GMOs entering and exiting China, by which related organizations shall file applications with the Authority on Agricultural Issues under the State Council and will be given approval by the Authority on Agricultural Issues under the State Council if they comply with the relevant conditions.

Inspection and quarantine system of entry/exit GMO products

The State quality Inspection and Quarantine Bureau is responsible for the inspection and quarantine of GMO products entering or leaving China (including those in transit).

Reporting system

China's reporting system stipulates that, "those engaged in research on agricultural GMOs at Grade III and Grade IV shall report to the Authority on Agricultural Issues under the State Council before the research begins" and that, "in case intermediate testing of an agricultural GMO is needed after the laboratory research is closed, the testing organization shall notify the Authority on Agricultural Issues under the State Council."

Other systems

An archive system, emergency measures system and an approval system for transfer across borders are also specified for GMO administration.

In 2001, after the GMO Regulations for the Administration of Agricultural GM Crop Biosafety were enacted, the state extended the range of safety assessments and approvals to production and import.

According to the requirements of the Measures for the Administration of Imported Agricultural GM Crop Biosafety, before a GMO is approved to be imported to China as a material for processing, it must go through tests for environmental safety and food safety inspection and verification within China, pass the safety assessment by the State Agricultural GM Crop Biosafety Committee and be awarded a safety certificate by the Ministry of Agriculture (MoA).

Since the Regulations for the Administration of Agricultural GM crop biosafety and related rules were promulgated, the administrative capability of law enforcement has been enhanced. Through the implementation of administrative systems like safety assessments and labelling, biosafety has been guaranteed, biotech development has been promoted, national benefits have been protected and wide recognition by the world community has been won.

3.4.2 Administration system for invasive alien species

Another already existing threat to agriculture, human health and biodiversity is the uncontrolled intrusion of species (plants, animals, microorganisms) from abroad that interfere with and possibly damage native species and ecosystems. As the prevention, control and elimination of invasive alien species involves a number

of sectors, a collaboration team has been formed, led by the MoA and including organizations in several sectors such as environmental protection, quality inspection, forestry, ocean, science & technology, commerce and customs. All sectors perform their respective duties of examining and dealing with invasive alien species according to relevant laws and regulations.

Another already existing threat to agriculture, human health and biodiversity is the uncontrolled intrusion of species (plants, animals, microorganisms) from abroad that interfere with and possibly damage native species and ecosystems.

The agricultural sector is responsible for the administrative examination and approval of genetic resources such as crop seeds, grass seeds, aquatic seedlings, breeding livestock and poultry, etc., as well as aquatic wildlife, agricultural wild plants, veterinary microorganisms and edible fungal strains.

All responsible administrative bodies developed a number of activities and measures (lists of invasive alien species, emergency action plans) including the completion of Network of Pest Status Report and Notification (see box 12).

Box 12: Activities of the Network of Pest Status Report and Notification

Starting from 2000, more than 20,000 fruit fly monitoring points were designated in 31 provinces, autonomous regions and municipalities, and a nationwide network for quarantining fruit flies monitoring was built up and collected much data during the following 4 years. In addition, the monitoring of alien pests such as the Colorado potato beetle and banana-root nematode was carried out. The number of varieties and batches of pests captured rose steadily year by year.

The state strengthened pest detection and identification competencies, undertook studies on effective pest control techniques and equipment, developed (and revised) a series of technical standards of handling and enhanced pest control capability. For the sector of plant quarantine, there are 166 set standards introduced by the inspection and quarantine department.

Some basic systems were formed in practice for the agricultural and woody plants quarantine in China, and basic systems for port quarantine were developed and play an important role in preventing alien pests.

3.4.3 Action plan for the biosafety administration of GMOs and invasive alien species

In order to implement the above mentioned preferences for biosafety administration, the government issued an action plan with seven goals and very detailed activities (see handout 8). The issued goals are as follows:

- Identification of the status of invasive alien species across the country
- Establishment of a high-efficiency biosafety coordination mechanism and information exchange mechanism
- Development of complete biosafety laws and regulations
- Establishment of early warning and quick response systems against invasive alien species
- Create relatively complete technical systems and platforms with conditions for the assessment, testing and monitoring of GMO biosafety
- Noticeably increase biosafety awareness of the public
- Effectively fulfil obligations under relevant international conventions

Author: Xue Dayuan

Literature cited and recommendations for further reading:

Regulations for the Administration of Agricultural GM Crop Biosafety 2001, P.R. China: www.gov.cn/flfg/2005-08/06/content_21003.htm

Main Message 8

National actions to protect agrobiodiversity against new potential dangers

- *Two risks in relation to agrobiodiversity are the possible uncontrolled out-migration and hybridization of genetically modified plants and organisms (GMOs) and the already existing intrusion of invasive alien species.*
- *In relation to GMOs, a number of laws provide a framework that determines responsible administrative bodies and describes different security systems as follows:*
  - *Grading system*
  - *Safety assessment system*
  - *Production and trading license system*
  - *Labelling system*
  - *Customs import/export declaration and approval system*
  - *Inspection and quarantine system of inward/outward GMO products*
  - *Reporting system*
- *The risk of uncontrolled intrusion of species (plants, animals, microorganisms) from abroad conflicts with and can possibly damage native species and ecosystems. Prevention, control and elimination of invasive alien species are assigned to a number of administrative departments under the guidance of the Ministry of Agriculture.*

Chapter 4

Conservation of Agrobiodiversity – Current Approaches

4 Conservation of agrobiodiversity – current approaches

Nature is systematically used for human nutrition through agricultural cultivation and the collection of wild plants. Both ways of human appropriation of nature present serious threats to global biodiversity. Therefore, the next two chapters will introduce and discuss present approaches to mitigate, control and stop the loss of biodiversity caused by human use. Chapter 4.1 will focus on the practiced approaches for the conservation of agricultural cultivars and chapter 4.2 will discuss standards and regulations that aim to make wild plant collection sustainable and thus prevent the loss of natural genetic resources.

4.1 Conservation strategies for agricultural cultivars (handout 9)

This chapter provides an overview of the multiple dimensions of agrobiodiversity, the scientific understanding of it and the current threats to diversity. Two conservation approaches – *ex situ* and *in situ* – are introduced and their specific effectiveness is discussed before describing pervasive concepts and strategies.

4.1.1 The dimensions of agrobiodiversity

Genetic diversity on our globe: what does it mean? The total number of species on earth is estimated at between 13 and 14 million and only 1.75 million have been described (and what is unknown is difficult to protect). There is not only diversity between species (inter-species diversity) but also an enormous diversity within species (see figure 1). Intra-species diversity is of enormous importance in agriculture as most crops have been cultivated and selected over thousands of years and this process of evolution has resulted in a high genetic diversity within species. The complex patterns of variation and distribution that they exhibit provide the very substance of biodiversity.

The total number of species on earth is estimated at between 13 and 14 million and only 1.75 million have been described.

The origin of plant genetic resources

Nikolai Vavilov was a pioneering Russian scientist of the early twentieth century who postulated the existence of eight major 'centres of origin' of cultivated plants. Vavilov recognized these centres as exhibiting tremendous diversity of a complexity of crops. While Vavilov never used the term 'centre of diversity', we now recognize that Vavilov's centres were indeed centres of diversity, which in many but not all cases corresponded to centres of origin for groups of crops.

In 1971, Jack Harlan published the first major critique of Vavilov, putting forth the view that there were both centres and 'non-centres' of domestication, some being so large or diffuse as to render the term meaningless. Shortly thereafter, he observed in addition that "...it is becoming increasingly apparent that some [crops] do not have discernible centres either of diversity or of origin and that many have originated in areas outside of the centres of origin postulated by Vavilov. Our studies have shown that most crops indigenous to Africa did not arise in a centre of origin in any conventional sense of a centre, and that the same situation is likely to have occurred in Southeast Asia and Oceania and in South America" (Harlan, 1975).

Intra-species diversity is of enormous importance in agriculture as most crops have been cultivated and selected over thousands of years and this process of evolution has resulted in a high genetic diversity within species.

However, following Vavilov's thinking, the CBD specifies that the country of origin of domesticated and cultivated species is the country where the genetic resource developed its distinctive properties under given natural and cultural conditions. Given the prominence of the Vavilov centres of origin, it may have appeared to negotiators of the CBD that identification of a country of origin of wheat, for example, would be as straightforward as ascertaining the country of origin of a rare orchid found in the Brazilian rainforest. This is not the case, however. In effect, Vavilov postulated geographic regions of origin (or domestication) for groups of crops; the CBD speaks of (national) countries of origin for specific 'distinctive properties' of a particular crop, a far more precise criterion. It is well known that crops were domesticated over vast expanses of land and over a long period of time, and that crops travelled as part of this process.

Pinpointing the location where a specific property arose may often be difficult, if not impossible. Moreover, most properties come in gradients: there are different shades of red apples, different sizes of bananas, different degrees of disease resistance, different levels of antioxidants in fruit, etc. Also, varieties incorporate a myriad of properties, each of which may have arisen

Box 13: The present menace to agrobiodiversity

Everywhere in the world, farming communities have adapted local crops and plants to their needs. But it has been in the tropical and sub-tropical belts of the planet where the most wild plant biodiversity is concentrated and thus where farmers have had access to a wider variety of materials to meet their needs. This treasure, enhanced by farmers' ingenuity, has been under severe and increasing threat for several decades now. Throughout the modernization of agriculture and the Green Revolution, favoured crop varieties were promoted for one staple crop after the other; hundreds of farmers' varieties of those crops were either relegated to marginal areas or just lost. In the past, 7,000 plants were cultivated. Today, 120 plant species are important for food and agriculture and only 30 crops provide 95% of all human dietary energy or protein. In other words: Our nutrition depends on just a few plants.

at a different location and point in time. For some crops, the existence of secondary centres of diversity (such as Sub-Saharan Africa for maize and India for sorghum and millets) is recognized. All these factors reduce the practical value of using the Vavilov centres as the sole tool in determining 'origin' as used in the CBD.

The Vavilov legacy has also influenced the negotiations of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). In these negotiations, delegates established a multilateral system for some 64 species (categories) and a number of forage plants, obviating the need (as in the CBD) to identify a precise country of origin for these materials.

4.1.2 Conservation approaches

The fact that agrobiodiversity was decreasing with enormous speed (see box 13) demanded a response by the institutional sector and the international community. This response got underway in the 1960s and 1970s. Scientists collected remaining farmer varieties of major food crops and put them into gene banks. By doing this, the local cultivars and wild relatives could be saved for a long period while remaining available to breeders. This approach is called *ex situ* conservation, meaning literally "off-site". It is the process of protecting an endangered species of plant or animal by removing part of the population from a threatened habitat and placing it in a new location, which may be a wild area or within the care of humans (zoos, botanical gardens and seed banks). Apart from *ex situ* conservation, *in situ* conservation considers conservation "on-site". It can be defined as "the conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties".

Hence, it is the process of protecting an endangered plant or animal species in its natural habitat, either by protecting or cleaning up the habitat itself, or by defending the species from predators. Wildlife conservation is mostly based on *in situ* conservation. Applying this approach to the conservation of agricultural cultivars results in "on-farm" conservation, sometimes in specially designed conservation areas, but usually managed by farmers on their farms. On-farm conservation embraces entire agroecosystems, including immediately useful species (such as cultivated crops, forages and agro-forestry species), as well as their wild and weedy relatives that may be growing in nearby areas.

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Box 14: Alternative procedures for *ex situ* conservation

So-called 'recalcitrant' plants such as the coconut, avocado, mango, potatoes and tea have seeds that do not stand up to a process of dehydration. The *ex situ* conservation of these crops and vegetative propagated plants relies therefore largely on field banks. Recently, *in vitro* conservation techniques have also been used for

the conservation of recalcitrant crops. Wild crop relatives and large species (such as trees) are often conserved in botanical gardens.

4.1.3 *Ex situ* conservation in gene banks – present conservation efforts

Present conservation of plant genetic resources is worldwide emphasizing the *ex situ* conservation in gene banks. Gene banks are compartmentalised cold storages in which seeds are theoretically kept in controlled conditions of temperature and humidity. The banks work on the principle that dehydrated seeds are capable of remaining viable for long periods of time in cold conditions. Seeds may be kept in long-term storage (from 0 to -18°C), medium-term storage (0 to 10°C), or short-term storage (more than 10°C). Orthodox seeds (those that can be dehydrated) account for most of crops, including all major cereals (see box 14).

For *ex situ* conservation in gene banks a number of seeds have to be collected, because even under the most stringent long-term conservation conditions, seeds eventually loose viability and die. Accessions have to be regenerated regularly by planting them in order to obtain new seed. However, the process of regeneration also results in a loss of genetic diversity, especially if it is done in conditions different from those of the site of origin of the accession. This is because the new environment may result in a different kind of selective pressure.

Gene banks may hold different types of collections. Active and working collections allow easy access to breeders: they are raw materials used for the development of new varieties. However, the ability of any gene bank to conserve agrobiodiversity for current and future generations depends on how it manages its base collections. Base collections can only be maintained under long- to medium-term storage conditions. But even the best-conserved accession will be of limited use unless basic information on it is available. Information on accessions is classified under three categories:

- Passport: this includes basic data such as the sampling date and site.

Table 2: Global distribution of gene banks and their accessions (FAO, 1998)

Region	number of accessions	% of total accessions	No of gene banks	% of national gene banks
Africa	353,523	6	124	10
Asia	1,861,942	34	360	27
Latin-America	642,405	12	227	17
North-America	762,061	14	101	8
Europe	1,934,574	35	496	38
Total national	5,554,505	100	1308	100
CGIAR Centres	593,191		12	

- Characterisation: this includes data on taxonomic, environment-independent properties that describe the variety.
- Evaluation: this includes data on agronomic properties of the accession, which are normally closely related to the environment.

The global distribution of *ex situ* conservation in gene banks as documented by the FAO (1998) is summarized in table 2 below.

A main problem of gene banks is regeneration. In order to stay alive, seeds stored in gene banks have to be grown and harvested – regenerated – once in a while. The frequency of this regeneration depends on the crop. The report of the FAO states that if a gene bank had to regenerate its collection once every 10 years, 10% needs to be regenerated annually. However, the FAO report finds the reality quite different: "some 95% of the countries report a far higher level of need". Of the 95 countries providing information about regeneration activities, at least 71 (altogether holding nearly three million accessions) "experience some difficulties in regenerating their collections". The FAO

Figure 8: Germination tests of local seeds in a gene bank

concludes that almost half (48%) of all stored seeds worldwide now need to be regenerated. But its report also warns that some of these "may already have lost their viability or genetic integrity, or they may be from populations where re-collecting may prove more cost-effective than regeneration". However, for many of the accessions, re-collecting may prove impossible, because of extinction in the field. In addition, many countries do not have the funds, facilities or staff necessary to conduct their needed regeneration activities. Although countries in the South are most affected by this backlog, both the CGIAR gene banks and some countries in the North (such as the USA and Japan) are also affected. Part of the problem comes from the fact that when the gene bank system was set up, nobody really took into account the needs and costs of the long-term maintenance of the accessions. The global picture, according to the FAO Plan of Action, is "a steady deterioration of many facilities and their ability to perform even basic conservation functions".

Accessions have to be regenerated regularly by planting them in order to obtain new seed. However, the process of regeneration also results in a loss of genetic diversity, especially if it is done in conditions different from those of the site of origin of the accession.

Duplication of unique accessions and their storage in other gene banks is crucial to ensure their security in the face of unexpected losses (because of fire, earthquakes, war, etc.). Also in this area, the results of the FAO surveys are alarming: only half of the countries provided information on their duplication effort (probably meaning that they do not have a structural approach to duplication). Of the other half that did respond, only 11 countries indicated that their collections (430,000 accessions) were fully duplicated somewhere, 51 countries reported partial duplication, and 10 countries reported no duplication at all. In summary, the state of *ex situ* conservation of agricultural crops can be seen to be critical (see box 15).

One severe shortcoming of the present *ex situ* conservation is its bias towards northern agriculture and international agricultural trade (40% of the accessions are cereals, 4% are tubers and roots). Many locally-valuable crops have only just started to be collected, and regional base collections are being kept by national gene banks. The information on the type of accession (whether wild relatives, local varieties or breeding lines) is only available for one third of global accessions.

Globally, 48% of accessions are advanced cultivars or breeding lines, 36% are old cultivars or farmers' varieties and only 15% are wild or weedy plants or crop relatives. Grossly lacking are crops that do not enter international trade and are 'only' important at national or local levels. Also, species providing wild foods and other products important to local livelihood systems are notably absent. As far as the type of material is concerned, almost half of the stored seeds worldwide consist of breeders' germplasm, while only just over one third are the original farmer varieties.

4.1.4 *In situ* conservation

As a consequence of the experiences with *ex situ* conservation, it can be said that *ex situ* gene banks are of limited capacity, of limited security, and they are a very costly method of conservation. This brings environmental economists to ask: How much agrobiodiversity shall be conserved to secure our future? Do we not have to conserve all we have, because the future needs for human survival are unknown? On the other hand it seems to be unrealistic to conserve all of them irrespective of any valuation. But as a basic principle it is evident that a maximum of genetic resources has to be conserved at the lowest possible public cost (see box 16). Hence a conservation concept is required that goes far beyond *ex situ* conservation, being the predominant approach for plant genetic resources. Storage of seeds in refrigerated banks or botanical gardens is essential. But this method exceeds the capacity of public funding, is of limited scope and of limited security. Therefore, gene banks can only be complementary to a more comprehensive conservation approach. Such a more comprehensive approach relies primarily on these *in situ* concepts that are managed by farmers and farming communities doing conservation and breeding on their farms and in their villages (see 4.1.2). Farmers who have done so over thousands of years have been ignored or neglected by the for-

Box 15: The Svalbard Global Seed Vault – an outstanding example of *ex situ* conservation

The Svalbard Global Seed Vault will be the ultimate safety net for the world's most important natural resources. The vault is being dug into a mountainside near the village of Longyearbyen, Svalbard, a group of islands nearly a thousand kilometres north of mainland Norway. Construction was to be completed in September 2007.

Permafrost and thick rock will ensure that even without electricity, the samples will remain frozen. The vault's construction will be funded and managed by the Norwegian government as a service to the world community. The Global Crop Diversity Trust considers the vault an essential component of a rational and secure global system for conserving the genetic diversity of all crops.

The Structure: In order to maintain the temperature at a constant -10°C to -20°C, the cold Arctic air will be drawn into the vault during the winter, automatically and without human intervention. The surrounding rock will maintain the temperature requirements during the extremely cold season and during warmer periods, refrigeration equipment will engage. However, in the event of an equipment failure, temperatures in the vault would not rise above approximately -3.5°C, and would in fact take months to warm even to that level, which would be perfectly adequate for seed conservation for some years.

The Seed Vault will have a capacity of three million seed samples. Samples eligible for conservation at Svalbard must already be housed in two conventional long-term gene banks elsewhere, in keeping with current international standards.

Seed would be stored under what is known as "black box" arrangements, meaning that seed packages and boxes sent for storage would not be opened. The responsibility for testing material or for subsequent regeneration and multiplication will remain with the gene banks sending their seeds to Svalbard.

Cited from: www.croptrust.org

Box 16: The benefits of *in situ* conservation

1. Enhancing the processes of evolution and adaptation:

   The conservation of agrobiodiversity at all levels within local environments helps ensure that the ongoing processes of evolution and adaptation of crops to their environments are maintained within farming systems. This benefit is central to *in situ* conservation, as it is based on conserving not only existing germplasm but also the conditions that allow for the development of new germplasm. This idea of dynamic conservation extends to all aspects of the farming system, including the wild and weedy plant species that may interact with their cultivated relatives.

2. Conserving diversity at all levels:

   In its maintenance of farming systems, on-farm conservation applies the principle of conservation to all four levels of biodiversity: landscape, ecosystem, species and genetic (intra-specific) diversity. In conserving the structure of the landscape and agroecosystem, with its different niches and the interactions among them, the evolutionary processes and environmental pressures that affect genetic diversity are maintained. When species – plants, animals and microbes – within the agroecosystem, and genetic diversity within species are maintained, the diverse interactions of crop populations are preserved.

3. Integrating farmers into the National Plant Genetic Resources Conservation System:

   Farmers are likely to know the nature and extent of local crop resources better than anyone through their daily interactions with the diversity in their fields. Given their expertise, incorporation of farmers into the national PGR system can help create productive partnerships for all involved. This integration can happen in several ways, including:

   - Seeing farmers as partners in the maintenance of selected germplasm,
   - establishing a national dialogue on biodiversity conservation, sustainable use and equitable benefit sharing between farmers, gene banks and other partners,
   - assisting the exchange of information with and among farmers from different sites and projects,
   - farmers visiting gene banks or seeing demonstrations by gene banks, and
   - developing systems to make gene bank material more easily accessible to farmers.

4. Conserving ecosystem services:

   On-farm conservation may be an important way to maintain local crop management systems for agroecosystem sustainability by ensuring soil formation processes, reducing chemical pollution and other waste emissions from farms, and restricting the spread of plant diseases.

5. Improving the livelihoods of resource-poor farmers:

   In situ conservation programmes also have significant potential to improve the livelihoods of farmers at the local level. On-farm conservation programmes can be combined with local infrastructure development or the increased access of farmers to useful germplasm held in national gene banks. Farmers will benefit from the continued agricultural diversity and ecosystem health that on-farm conservation supports. Local crop resources can be the basis for initiatives to increase crop production or secure new marketing opportunities. By building development efforts on local resources and through the empowerment of farming communities, they can lead to sustainable livelihood improvement.

mal seed sector during the past 40 years and, since recently, are slowly being rehabilitated. Latest concepts of *in situ* conservation follow the idea that conservation and use of genetic resources are closely linked. True to the slogan "use it or lose it", plant species or animal breeds should be used whenever possible, should contribute to securing rural livelihoods and to rural culture. As long as farmers themselves find it in their own best interest to grow genetically diverse crops, both farmers and society as a whole will benefit at no extra cost to anyone.

Latest concepts of *in situ* conservation follow the idea that conservation and use of genetic resources are closely linked. True to the slogan "use it or lose it", plant species or animal breeds should be used whenever possible.

As a consequence, economic or social benefits have to be found for seemingly useless crops or farming systems and value has to be discovered in them. Some examples of adding economic value are: wild plants may be used for medicinal purposes, wheat landraces grown under organic agriculture may get a higher price, farming communities as a whole may profit from agrotourism if they maintain their diversity, etc. However, it will not be possible to find a market for everything that should be protected. Therefore, a remainder will have to be protected without 'using' it – a service that has to be paid for by the public.

Factors determining *in situ* conservation

There are many reasons why farmers conserve and raise a certain plant or a specific animal (see box 16). For instance, the value of a local rice variety in the lifestyle or identity of a particular social group may encourage its maintenance. Landraces may have specific valued traits that cannot be obtained from exotic sources. Landraces may be valued because of their place in local traditions – for major events such as religious festivals, and for everyday occurrences such as meals or medicinal practices requiring specific crop varieties. Generally it can be said that the cultural and crop diversity of a rural society are closely correlated, particularly due to remoteness if they are high in mountain areas.

Figure 9: Women play an important role in *in situ* conservation

Land tenure

A farmer's landholdings and how they are distributed in size and quality may influence his or her decisions about crop variety and the allocation varieties among different areas. By determining population sizes and the propensity for gene flow, these in turn affect the allele frequencies on which measurement of crop genetic diversity is based. In Ethiopia, a change in the land tenure system from communal to private ownership resulted in farmers' adoption of more sustainable land management practices, including terracing and afforestation. Although these practices may not directly affect crop genetic diversity, they may have implications for land tenure and the crop and seed management practices through which farmers shape on-farm agrobiodiversity. Researchers found land access to be a significant determinant of farmers' seed sources in a maize-cultivating Mexican community. Sharecroppers and farmers with small landholdings consumed all or most of their maize crop each year and so had to obtain seed elsewhere each planting season. Consequently, farmers planting mostly their own seed cultivated on average twice as many varieties as those obtaining all of their seed from others.

Farmers' age

Indigenous Knowledge (IK), including knowledge of crop diversity, is often held by the older members of a community. The link between indigenous knowledge and agricultural practices can be a precarious one, as knowledge can be lost if elders do not pass it down to younger generations. Although IK is often positively associated with age, young people may also have unique IK regarding crops and associated wild plants.

Gender

In Burkina Faso for instance, men take responsibility for the main family field in which all household members work. In addition, men and women may have their own smaller plots, in which crops are grown for market sale. Women cultivate their own plots after the family fields have been tilled, where they grow okra, peanut, voandzea, sesame and hibiscus. The cash generated by the sale of these crops is used by the women for household needs.

Wealth

The link between wealth and IK is variable. Depending on the ecosystem and local socioeconomic context, wealth can be either positively or negatively correlated with agricultural diversity. The wealthy may be able to afford to maintain landraces and associated knowledge for purely aesthetic reasons, such as the maintenance of tradition. At the same time, the poor may have special knowledge of the crop diversity adapted to marginal and low-input agroecosystems.

4.1.5 Conservation strategies (handout 9)

Both approaches, *in situ* as well as *ex situ* conservation, have their advantages and disadvantages. With *ex situ* conservation, it is relatively easy to identify the genetic diversity conserved; diversity is directly controllable if the techniques of *ex situ* conservation are well applied. Also, in a gene bank or in a botanical garden there is good access to the material. On the other hand, there are clear disadvantages. *Ex situ* conservation relies on a crop-by-crop, fragmentary approach, which ignores the interactions of the different elements in the agroecosystem, as well as the role of farmers' knowledge. It cuts the genetic materials developed by farmers off from their evolutionary process and thus forms a static approach to conservation. As far as the use of the material is concerned, it is mainly directed to official plant breeders, with farmers merely being on the receiving end of the 'improved' varieties. In a sense, it is a 'band-aid' approach to conservation that does not provide solutions for the causes of genetic erosion (Grain, 1996).

On-farm conservation is not necessarily less costly, but the costs are mainly borne by farmers, whereas the benefits are private and public.

There are many advantages to *in situ* conservation. It addresses the genetic material and the processes (cropping, use etc.) associated with it, offers continued availability of the genetic variation that can be maintained and developed in farmers' fields, can address a large number of species at a single site, larger amounts of germplasm can be conserved economically on-site than off-site and – last but not least – continued evolution and adaptation to the environment is possible. Problems, on the other hand, are that scientists may have difficulties identifying and accessing suitable genetic material and there is less control over germplasm conservation. Genetic erosion can still occur due to unforeseen circumstances like natural disasters or war and social and economic change may enhance but also hinder on-farm biodiversity.

Ex situ conservation is necessary but should be complemented by *in situ* conservation. Therefore, integrated strategies are desirable relying primarily on *in situ* concepts, e.g. farmers and farming communities,

who are conserving and breeding seeds on their farms and in their villages. On-farm conservation is not necessarily less costly, but the costs are mainly borne by farmers, whereas the benefits are private and public. In order to make on-farm conservation a success, genetic resources must remain largely in the public domain, with well-balanced benefit sharing concepts among the stakeholders that use and conserve agrogenetic resources. Gene banks could and should be a supplementary part of these integrated strategies.

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Main Message 9

Conservation strategies for agricultural cultivars

- *Our globe hosts between 13 and 14 million living species. About 7,000 of them have served human consumption and agricultural purposes in the past, presently 120 plant species are relevant to feeding the human race.*
- *Centres of origin for wild species can be proven. This is more difficult for domesticated species, as the process of domestication usually took vast periods of time and stretched over vast geographic areas. However, as these regions of domestication usually abound with wild and semi-wild varieties of one domesticated species, they are called regions of diversity.*
- *The main approaches to conservation are in situ (on-site) and ex situ (off-site) conservation.*
- *Ex situ conservation entails removing a species from its original habitat and placing it in a new location, which may be a wild area or under the care of humans (zoos, botanical gardens and seed banks). Seed or gene banks, that conserve reproductive parts of plant species under steady conditions (temperature, humidity) allow for conserving large numbers of species and are a rich resource for breeders. Worldwide more than 1300 seed-banks host more than 6 million accessions. Problems of conservation in seed-banks are:*
  - *High costs for collection, documentation and care*
  - *The need to regenerate some stored seeds after several years*
  - *No adaptation of the stored varieties to environmental changes*
  - *Bias towards easy to store species (preference of seeds compared to tubers)*
- *In situ conservation can be defined as the conservation of ecosystems and natural habitats in the case of domesticated or cultivated species, the surroundings where they have developed their distinctive properties. Hence in situ conservation of agriculturally used species can be defined as on-farm conservation.*
- *Both forms of conservation do have specific advantages and disadvantages. Conservation strategies have to integrate both approaches, and combine and supplement in situ conservation programmes with ex situ conservation in gene banks.*

4.2 Conservation strategies for collected wild plants

Biodiversity is also endangered by the indiscriminate collection of wild plants. This chapter gives an overview of the dimensions and consequences of wild plant collection and presents three regulatory approaches to keep it sustainable. These approaches for regulation are:

- The EU Regulation on Organic Farming
- The Medicinal Plants Act of Bulgaria
- The International Standard for Sustainable Collection of Wild Medicinal and Aromatic Plants

4.2.1 The dimensions of wild plant collection

Since ancient times, mankind has been collecting wild plants for different purposes. Berries, nuts and herbs are the main product groups, which are consumed. Herbs are used for cooking, in cosmetics as well as in traditional and modern medicine. There are 50,000 - 70,000 medicinal and aromatic plants used worldwide. Only around 3,000 species are traded and only approximately 900 species are commercially cultivated. According to estimations, 15,000 medicinal plant species are more or less threatened.

Until today, wild collected plants have a big significance in trade for medicinal and cosmetic use. Eighty percent of all medicinal plant species are procured from wild collection. Reasons, among others, are that some species are only demanded in small quantities and others have a long reproduction period, often reaching several years. Domestication and cultivation are too expensive in these cases.

Small farmers and poor people in rural areas generate additional income by collecting wild plants. Some of them depend on this income. Although most berries, nuts and some herbs can be cultivated, the market also demands wild collected plants. Due to good market opportunities, more and more plant species, especially medicinal and aromatic plants, are becoming in danger of going extinct. Besides the threat regarding the species themselves, this situation is also threatening important resources for the pharmaceutical industry.

In order to make collection sustainable, several initiatives have arisen. There exist a number of public and private standards for certifying wild collection, and in some countries governments regulate wild collection. In organic agriculture (see chapter 5) standards play an important role in assuring product quality and Good Agricultural and Collection Practices (GACP) have been developed as guidelines by NGOs and governmental institutions. In the following, the Regulation on Organic Farming of the European Union, the FairWild Standard and the Medicinal Plants Act of Bulgaria are given as examples.

4.2.2 Collection of wild plants according to the EU Regulation on Organic Farming

The EU Regulation on Organic Farming does not only refer to cultivated plants but also to plants from wild collection. Their market relevance is high for the above mentioned product groups and the demand for sustainable procurement is steadily increasing. For these reasons and as wild collected plants are supposed to be free of pesticide residues, they were included into the Regulation. Wild collection is defined as shown in box 17.

Box 17: Definition of organic wild plant collection

The collection of wild plants and parts growing in natural areas, forests and agricultural areas is considered an organic production provided that: those areas have not, for a period of at least three years before the collection, received treatment with products other than those authorised for use in organic production under article 16 of EU Regulation 834/2007; the collection does not affect the stability of the natural habitat or the maintenance of the species in the collection area (Article 12.2(a)+(b), EU Regulation 834/2007).

The regulation defines mainly what is not allowed and that the stability of the natural habitat and regeneration of respective species should not be affected. However, the regulation does not provide any tools on how to assess sustainability. Therefore, an evaluation

Figure 10: Wild plant used as a medicinal herb

of collection activities and their impact on sustainability of the species and its habitat is difficult. A farmer may have a list of 100 different herbs to collect. The difficulty is to get the relevant data about every species and how the collection affects their population and their habitat. For instance, the collection of wild berries, being an important feed for birds in winter, may endanger bird populations. It is also important which part of the plant is collected. The gathering of roots/rhizomes may have a much more negative effect on the population's viability than the collection of fruits and seeds or of herbal parts after maturity and seed setting.

Therefore, a regulation like the EU one requires practical guidelines for inspectors and certifiers that help to implement it more efficiently in practice. Main items are:

- As a first step, a resource assessment must be made in order to determine how much of a certain species can be collected in a well-defined collection area. It is a pre-condition for verifying sustainability. In some countries, such assessments are done by government institutions, in others, no information exists at all. Therefore, main questions to be asked are, who does the assessment of natural resources, how reliable is the research, and who pays for it? Further information needed includes a description of the habitat, the parts of the plant to be collected, collection techniques and legal requirements. Before any activity is started the correct botanical name must be clear, as inconsistent naming is sometimes a problem with collecting companies.
- The next step is to define how much can be collected. Threatened species or species on the red list are not allowed to be collected. If a licence for collection is necessary, the collectors have to provide that permit to the certifier. In some cases, authorities allow certain quantities of the product to be collected in a certain area. Quite often, however, there are no "official" data available. Certification bodies might rely in that case on data of the collection company. But how reliable are these data? Also, different certification bodies might assess the situation differently. In addition, it is very important that the certifiers check whether other collectors are active in the same collection area.
- A third aspect concerns inspection and the organization of collections. Quite often there is an exporting company that organizes one or more groups of collectors. The company has to take care of all the documentation. They

have to list all the collectors within their areas of collection. Additionally they have to list all products collected with quantities and date. For inspection purposes, the company has to present the following information:

1. Geographic (map) definition of the collection areas
2. Average quantities of collection per collection area
3. A list of collection points (where the collectors sell the raw material to the company)
4. A list of collectors
5. The flow of products
6. A system of traceability (lot or batch numbering system)
7. A collection permit, if demanded
8. Evidence of non-use of prohibited inputs/sprays in the collection areas for at least the last three years

The inspector checks all the documentation and spot-checks areas of collection. He has to inspect whether the collection takes place in the indicated areas, that the collection techniques are appropriate and that no more than the defined quantities are collected. In case there is a product with a risk of over-collection, the client has to prove that he respects sustainable quantities of collection. For that proof, the client can rely on experts or authorities. There might be research projects and relevant botanical information at universities. If the collector has a number of potential critical products, this task can get very time and money consuming. A very big problem is that collectors who sell to other companies might be active in the same collection area. This might happen when no collection permits are required from the authorities. When the certification body defines sustainable quantities to be collected, this needs to be considered. In China, for example, the control body BCS certifies a number of wild collected products like herbs, berries (raspberries, strawberries, goji berries), mushrooms, aniseed, lemongrass, chestnuts and so on.

In China, for example, the control body BCS certifies a number of wild collected products like herbs, berries (raspberries, strawberries, goji berries), mushrooms, aniseed, lemongrass, chestnuts and so on.

In summary, the certification of wild collection according to organic regulations is unsatisfactory because data are lacking about the population size of species and about their habitat. In addition, there are no standardized criteria for inspection and, there is a lack of information as to whether there are other collectors or companies in the same area.

4.2.3 The Medicinal Plants Act of Bulgaria – an example

Bulgaria is an important supplier of medicinal plants for the pharmaceutical industry of Western Europe. In the past, it was the state that organized the wild collection and the trade of plants. State companies bought and sold the products. Therefore the collection of plants was well controlled. Nowadays, private trading firms are collecting for this profitable market. Due to this, some herbs are actually close to extinction.

As medicinal plants are of great economic importance for Bulgaria, the government decided to protect the natural resources by means of the Medicinal Plants Act (see box 18). It came into force in the year 2000 and was amended in 2002. The aim is to ensure the sustainable exploitation of medicinal plants. Overall goals are to maintain biodiversity of medicinal plants and their resources and to conserve ecosystems and habitats. Preventive and current measures are to be undertaken on a long-term and short-term projection basis.

The Medicinal Plants Act applies to a list of around 700 herbs. It applies to collection and the first stages of processing and storage. In addition, it contains provisions for a National Strategy on Medicinal Plants that regulates the management, conservation and sustainable exploitation activities. Owners of natural habitats of medicinal plants – be it land, forest or water bodies – are obliged to take measures for the conservation of medicinal plants. In case of threatened species, a special regime applies which consists of temporary prohibition of the collection, the establishment of annual quotas and the adoption and implementation of measures for the restoration of populations and habitats.

Medicinal plants are considered a natural resource, which is not free of cost. Fees apply for their exploitation, which are used for the implementation of conservation measures, for example:

- Planning of conservation and exploitation regimes at national and municipal levels

Box 18: Bulgaria's National Strategy on Medicinal Plants

As a consequence of the Medicinal Plants Act, the Ministry of Environment and Water has created a National Strategy on Medicinal Plants. It consists of:

1. A description and analysis of:
   - The conservation status of medicinal plants in state territory in regards to their range, genetic base, resources, features of their habitats, conservation of ecosystems and habitats, level of exploitation and restoration
   - Factors influencing ecosystems, populations, the genetic base and medicinal plant resources
   - Resources of medicinal plants along with information about their present or future value
2. A prognosis about:
   - Factors influencing ecosystems, populations, the genetic base and medicinal plant resources
   - The exploitation of medicinal plants
3. Strategic decisions with regard to:
   - Possible approaches to achieving sustainable development of medicinal plants
   - Objectives and indicators to be achieved with regard to resources and biodiversity, tasks and activities ranked in stages and by priority, the means of achieving the objectives set, including those having an unfavourable impact on the natural environment of medicinal plants
   - Financial and other resources for achieving the objectives

- Activities for the maintenance and restoration of medicinal plants and their natural habitats
- Scientific research and monitoring of medicinal plants
- Elaboration and up-to-date maps, registers and information systems on medicinal plants
- Artificial propagation and processing of medicinal plants
- Training, training materials and conferences on medicinal plants
- Other activities related to management and control, as provided by law

Collectors need a permit for the exploitation of medicinal plants. The following activities require permission for:

The collection of wild and artificially propagated medicinal plants,

the purchase of herbs with the intention of primary or further processing, and

the collection of genetic material from wild medicinal plants for the purpose of artificial propagation, for conservation out of the natural environment of medicinal plants or for re-introduction into other areas.

Permits issued by the authorities specify the type of exploitation, the quantity of plants or genetic material allowed, the type of morphologic organs collected, the area or the habitat and the method of exploitation. The government collects fees per kilogram. The collection permit has to accompany the product to the manufacturer or exporter in Bulgaria. Manufacturers are obliged to perform book-keeping and they have to provide evidence that permits exist for all raw materials.

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Persons who are processing herbs are obliged to inform the Regional Inspectorate of Environment and Water before they establish stations for the primary processing of herbs and herb storage facilities. In addition, they have to keep records on quantities collected, stored, sold, etc. Supervising authorities have to be given access for control purposes. Once a year (in winter), the authorities require a report about herbs bought, processed and sold in the previous year. Controls regarding the implementation of this law are installed at the national and municipal level. Persons or companies violating any provisions of this law face financial penalties.

The government of Bulgaria has undertaken a resource assessment of endangered medicinal plants in all collection areas of the country. This information base is updated every few years and at regular intervals. Every year in spring, quotas and collection areas for each species are determined in order to guarantee sustainability.

The data elaborated within the National Strategy on Medicinal Plants is crucial for good management and the control of natural resources. Certifiers for standards regarding wild collection can rely on these data for their inspections. Bulgaria is a good example for applying 'best practices' in sustainable wild collection.

4.2.4 The International Standard for Sustainable Collection of Wild Medicinal and Aromatic Plants (ISSC-MAP) and the FairWild Standard

The International Standard for Sustainable Wild Collection of Medicinal and Aromatic Plants (ISSC-MAP) was developed jointly by Worldwide Fund for Nature (WWF), the Wildlife Trade Monitoring Network (TRAFFIC), the International Union for Conservation of Nature (IUCN) and the German Federal Agency for Nature Conservation (BfN). In addition, private companies, governments, NGOs and scientific institutions were involved.

The ISSC-MAP standard development can be traced back to the year 2004, when the founding members revised and updated the WHO/IUCN/WWF Guidelines on the Conservation of Medicinal Plants. As a consequence, in the following years, two separate working groups developed and implemented different standards:

- The ISSC-MAP is primarily an ecological sustainability standard with some economic and social aspects.
- The FairWild Standard is primarily a social standard with supporting elements of ecological and economical sustainability.

Both initiatives supported the merger into one organization in late 2008, with the aim to unify the two standards into one system. A certification system that covers all aspects of sustainability: ecology, economy and social aspects- will therefore be available in the near future. The ISSC-MAP principles and criteria will be integrated into the FairWild Standard as the ecological sustainability chapter. The ISSC-MAP criteria can be applied by governments for resource management and, in combination with the FairWild Standard, by certification bodies for certifying all aspects of sustainability. Besides, the FairWild Foundation and its partners will promote the criteria to political decision makers and international actors as a best practice for wild plants management. The ISSC-MAP follows six principles:

1. All wild plant resources have to be maintained
2. Negative environmental impacts have to be prevented
3. All relevant laws, regulations and agreements have to be followed
4. Customary rights and benefit sharing have to be respected
5. Responsible management must be practiced
6. Responsible business practices are required

A responsible management practice (principle 5) means that the company should have a management plan which includes plant and habitat conservation strategies. The latter includes that natural resources are monitored, and that the impact of collection practices and of purchases from collectors are analysed. Most collecting companies do not have such a management plan, especially where a natural resources assessment does not exist, or it is not done in a reliable way, and there is no one paying for it.

The good business practices (principle 6) include a market analysis, in which the required qualities and quantities of a product are identified. They result in instructions for the collectors who shall be registered and well trained by the collecting company. The standard also includes instructions regarding safety at work and compensation.

The FairWild Standard has as a pre-condition that sustainable harvesting practices are fulfilled (organic standard or ISSC-MAP). The principles of the FairWild Standard consist of provisions for a fair re-

lationship between collectors and the collecting station. This includes a fair contractual relationship, no discrimination, no child labour, respecting customary rights and fair trade benefits for collectors. Fair labour conditions for workers in the collection company shall be respected. That includes fundamental principles and rights in the work place and good and healthy working conditions.

One of the current ISSC-MAP implementation projects is located in China, in the provinces of Sichuan, Shaanxi and Gansu (Upper Yangtse Ecoregion). A target species for the first project phase is Southern (*Schisandra sphenanthera*), a medicinal plant.

There are also some obligations of FairWild companies to their suppliers and buyers, which consist of a fair and quality conscious trading behaviour. Buyers (importers or traders) have to respect fair trade practices and fair prices with a fair trade premium.

Some ISSC-MAP pre-audits have already been realized. Currently, checklists with a rating system are being developed for inspectors of certification bodies. In the future, FairWild envisages a non-exclusive accreditation system for interested certifiers.

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Authors: Marion Buley and Birgitt Boor

Literature cited and recommendations for further reading:

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SIPPO (2005): Manual for Sustainable Wild Collection. www.sippo.ch/internet/osec/en/home/import/publications/food.html#ContentSlot23184

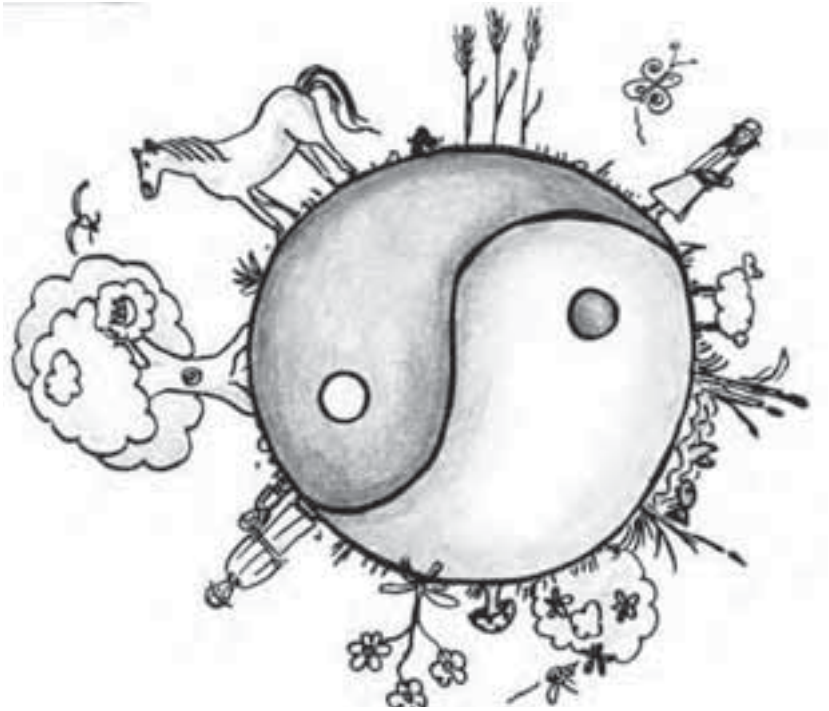
Wildlife Trade Monitoring Network (TRAFFIC): www.traffic.org/

Worldwide Fund for Nature (WWF): www.wwf.org/

Main Message 10

Conservation strategies for collected wild plants

- *There are 50,000 - 70,000 medicinal and aromatic plants used worldwide, with most of them (80%) being collected by people from their surrounding environments. Only around 3,000 species are traded. According to estimations, 15,000 medicinal plant species are more or less threatened to extinction.*
- *One of the initiatives to mitigate this development is the EU Regulation on Organic Farming. This regulation defines mainly what is not allowed and that stability of the natural habitat and regeneration of respective species should not be affected. In order to make it a practical instrument for controlling sustainable collection, a number of concrete, situation specific rules have to be defined within the framework.*
- *An example regulation is the Medicinal Plants Act of Bulgaria, which*
  - *Lists 700 medicinal plants and defines them as national resources*
  - *Maps the potential for sustainable collection of these plants*
  - *Regulates the amount of collection by stipulating collection permissions according to quota*
  - *Demands fees for collected plants and uses this money for conservation projects and programmes*
- *On the international level, the ISSC-MAP and the FairWild Standard have been developed and agreed upon by relevant organizations (WHO/IUCN/WWF). These standards demand compliance with 6 basic principles for conserving collected species. Companies and countries can apply for certification if they provide proof that they collect, process and trade their products according to these principles.*



Chapter 5

Current Approaches for Sustainable Utilization of Agrobiodiversity

5 Current approaches for sustainable utilization of agrobiodiversity

Agrobiodiversity can be safeguarded and increased by a number of different human activities. This chapter introduces and describes four complex approaches that help to overcome the tendency of present agriculture to reduce and minimize biodiversity, yet still prove to be economically viable. These approaches are:

- Organic agriculture
- Agro-ecotourism
- Alternative plant breeding and seed production
- Value addition to underutilized crops and animals

5.1 Organic agriculture (handout 10)

This chapter provides an overview on organic agriculture, explaining the background and basic principles, its impact on biological diversity, production technology, the necessary quality control for organic production and organic products, and its development and present-day contribution to food provision and economy.

5.1.1 Definition and principles of organic agriculture

The basic idea of organic agriculture is to cultivate land or raise animals in harmony with nature. Natural resources such as soil, water, plants or animals shall be used respectfully from the production stages through handling and processing. "Respectful" means they shall not be destroyed or degraded but rather sustained as a renewable resource. Agriculture "in harmony with nature" is practiced by enhancing basic laws of nature. For instance, natural processes are enhanced, nutrient and energy flows are kept as cyclic as possible, and plant and animal husbandry are closely linked. The agricultural enterprise – the farm – with its people, land, plants and animals, is conceived as a manifold whole, as a living organism (like a human being, for instance).

The art of organic farming is in making the best use of ecological principles and processes, and always seeing the 'farm' as a whole living organism ... Therefore it can be said that organic agriculture follows a systems approach, whereas conventional agriculture looks at single crops or animals only.

The art of organic farming is in making the best use of ecological principles and processes, and always seeing the farm as a whole living organism, and learning from nature (e.g. forests). Therefore it can be said that organic agriculture follows a systems approach, whereas conventional agriculture looks at single crops or animals only. The following definition can be given:

"Organic agriculture is a holistic production system, may it be cropping or animal husbandry, which promotes and enhances the health of nature, produces safe and nutritious food, and respects social justice" (see box 19).

Following this definition, a number of principles can be formulated that, if respected, will help farmers and processors to achieve high standards of production, making their farms organic and economically viable at the same time:

- To encourage and enhance nutrient cycles within the farming system
- To maintain and increase long-term fertility in soils
- To maintain biological diversity on the farm
- To create a harmonious balance between crop production and animal husbandry
- To minimize all forms of pollution

Handout 10 helps to understand these principles and provides a clear idea of the paradigm of organic agriculture.

5.1.2 Organic agriculture technology

In order to make organic agriculture productive, three issues are pivotal. The organic farmer has to:

- Keep the soil fertile
- Nourish his cultivars adequately
- Control pests, weeds and diseases

Soil fertility

The soil is the most important production factor. For the organic farmer, feeding the crop means feeding the soil. Fertile soil is the most important resource of every farm – only fertile soil can yield healthy crops. Soils are diverse, complex and full of life. The soil itself can be viewed as a living organism, because it is a habitat for plants, animals and micro-organisms which are all interlinked.

Box 19: Impact of organic and conventional agriculture on biological diversity

Organic agriculture

Organic farmers are both custodians and users of biodiversity at all levels.

- At the gene level, traditional and adapted seeds and breeds are preferred for their greater resistance to diseases and their resilience to climatic stress.
- At the species level, diverse combinations of plants and animals optimize nutrient and energy cycling for agricultural production.
- At the ecosystem level, the maintenance of natural areas within and around organic fields and absence of chemical inputs create suitable habitats for wildlife.

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The frequent use of underutilized species (often as rotation crops to build up soil fertility) reduces loss of agrobiodiversity, creating a healthier gene pool – the basis for future adaptation.

The provision of structures providing food and shelter, and the lack of pesticide use attracts new or re-colonizing species to the organic area (both permanent and migratory), including wild flora and fauna (e.g. birds) and organisms beneficial to the organic system such as pollinators and pest predators.

The use of GMOs within organic systems is not permitted during any stage of organic food production, processing or handling. As the potential impact of GMOs to both the environment and health is not entirely understood, organic agriculture is taking the precautionary approach and aims to encourage natural biodiversity. The organic label therefore provides an assurance that GMOs have not been used intentionally in the production and processing of the organic products.

Conventional agriculture

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The so-called conventional way of modern agriculture is based on the intensive use of chemical fertilizers and pesticides ("Green Revolution"). It must be acknowledged that with this technology, crop yields increased tremendously, especially in the temperate zones, but also in tropical areas. As a result of Green Revolution technology, regions suffering severe famine became self sufficient in food.

However, the success of industrial agriculture was unevenly spread: while the technology brought considerable yield increase in fertile river plains or irrigated land, it failed on marginal soils which constitute the majority of globally used agricultural land. One reason for this failure is the low efficiency of fertilizer application on tropical soils. Unlike soils in temperate regions, many tropical soils do not retain chemical fertilizers well. The nutrients get easily washed out from the soil or evaporate as gas. A majority of the applied fertilizers may therefore get lost.

In addition, it has become evident that high input farming has many unwanted side effects, both on natural resources (soil, water, biodiversity) and on human health:

- Soil: Vast areas of once fertile lands became degraded due to soil erosion, salinisation or a general loss of soil fertility.
- Water: Freshwater resources have been polluted or overexploited through intense use of agro-chemicals and excessive irrigation.
- Biodiversity: Many wild and cultivated plant and animal species have become extinct and landscapes have become dull.
- Human health: Residues of harmful pesticides in food or drinking water endanger both farmers' and consumers' health. Further health risks derive from antibiotics in meat.
- It is based on an excessive use of external inputs and consumes a lot of energy from non-renewable resources.

Keeping the soil fertile means the organic farmer has to support and stabilize this living organism with its micro-organisms, earthworms, and plants (cultivated and not-cultivated).

Key measures to enhance soil fertility are:

- To improve the soil structure for easy penetration of plant roots, good aeration, sufficient infiltration of water and active soil life. This can be achieved through application of organic matter such as manure, compost, mulch, green manure plants, etc.
- Reduce soil cultivation in order to reduce mineralization of organic matter.
- Avoid soil erosion through effective erosion control measures (continuous plant cover, contour planting, integration of shrubs and trees into the field, etc.).
- Water conservation (improve the infiltration of rain water, increase water holding capacity and reduce evaporation, e.g. through mulching).

Plant nutrition

The approach to plant nutrition in organic agriculture is fundamentally different from the practices of conventional agriculture. While conventional agriculture aims at providing direct nutrition to the plants by using mostly easily soluble mineral fertilizers, organic farming feeds the plants indirectly by feeding the soil organisms with organic matter. Thus organic fertilization provides a more balanced nutrient ratio, which keeps the plants healthy.

Basic standards for plant nutrition in organic agriculture give the following rules:

- Chemical fertilizers shall be used only as a supplement to organic nutrient sources.
- Chemical fertilizers shall be used only in their natural composition.
- No chemical fertilizers containing nitrogen can be used – Chilean nitrate and all synthetic nitrogenous fertilizers, including urea, are prohibited.
- Only restricted use of mineral potassium, magnesium fertilizers, trace elements, manures and fertilizers with a relatively high heavy metal content and/or other unwanted substances (e.g. basic slag, rock phosphate and sewage sludge) is permitted.

Two basic production principles provide a balanced offer of nutrients for the organically-produced cultivars.

Practice of mixed cropping and diverse crop-rotations

In many traditional agricultural systems, a diversity of crops in time or space can be found. Different plant species have different root systems – some plants generally grow deep reaching tap roots, while others have rather flat root systems. This principle is exploited in organic agriculture. But, to many farmers, the benefits of mixed cropping and crop rotations are not known and these techniques are applied rarely. The way the plant roots occupy the soil can be influenced by the farmer to a certain extent (e.g. through a specific association of species, and through cultural practices such as tilling, ridging and mounding). To be able to decide which plants are best grown in association with each other and which sequence of crops is the most appropriate, it is necessary to know how different crops occupy the soil with their roots.

The importance of nutrient cycles

In nature, nutrient recycling results from the close link of above ground and underground life. Plants

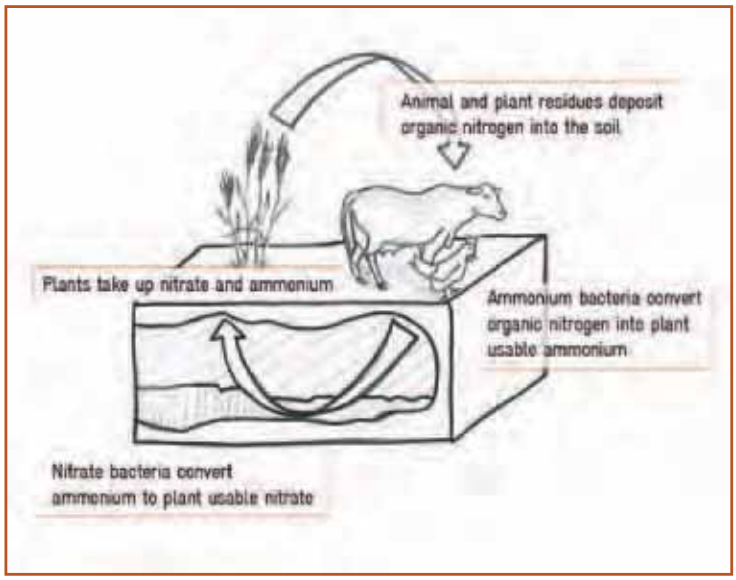

Figure 11: The nitrogen cycle

generally build biomass in the soil and above ground. Roots are rapidly and constantly decomposed and are an important source of food for the soil organisms. Through their work and the nutrient release that follows their death, the soil organisms are recycled into food for new plant growth. When the plants die, the recycled plant matter is again recycled by feeding the soil organisms, thus closing the cycle and slowly improving soil fertility. In contrast to nature, in agriculture, the farmer fertilises the fields to harvest more products. If a farmer does not want to depend on ex-

ternal inputs to a great extent, he must achieve a more efficient use of nutrients, e.g. practice better nutrient management in the farm. This results in the idea that nutrients should be made available from within the farm itself. This idea leads to the concept of closed nutrient cycles.

Pest management

Pest and disease management consists of a range of activities that support each other. Most management practices are long-term activities that aim at preventing pests and diseases from affecting a crop. Crop management focuses on keeping existing pest populations and diseases low. The general approach in organic agriculture to deal with the causes of a problem rather than treating the symptoms also applies for pests and diseases. Therefore, management is of a much higher priority than control. It consists of the following practices:

The general approach in organic agriculture to deal with the causes of a problem rather than treating the symptoms also applies for pests and diseases. Therefore, management is of a much higher priority than control.

1. Plant health

A healthy plant is less vulnerable to pests and diseases. Therefore, a major aim for the organic farmer is to create conditions which keep a plant healthy. The interaction between living organisms and their environment is crucial for a plant's health. In favourable conditions, the plant's own protection mechanisms to fight infections are sufficient. This is why a well-managed ecosystem can be a successful way of reducing the pest or the disease pressure. Certain crop varieties have more effective mechanisms to protect themselves than others and therefore have a lower infection risk.

2. Preventive methods

Knowledge about plant health and pest and disease ecology helps the farmer to choose effective preventive crop protection measures. As many factors influence the development of pests and disease, it is crucial to intervene at the most sensitive points. This can be accomplished through the right timing of management practices, a suitable combination of different methods, or the choice of a selective method.

3. Curative methods

If all preventive crop protection practices fail to sufficiently prevent economic losses to the farmer, it may be necessary to take curative action. Curative action means controlling the pest or disease once it has already infested the crop. Several options exist in organic agriculture:

- Biological control with natural predators or antagonistic microbes
- Natural pesticides based on herbal preparations or other natural products
- Mechanical control with traps or hand picking

4. Promotion of natural enemies

There are many different kinds of organisms in a field and not all of them are "pests"; in fact, many insects can have a beneficial function in the agroecosystem. Natural enemies to pests are the "friends of the farmer" because they help farmers to control pests or diseases in crops. Natural enemies of pests and diseases do not damage plants and they are harmless to people. They can be divided into four groups: predators (eating pest organisms), parasitoids (parasitizing pest organisms), pathogens (causing a disease in pest organisms) and nematodes.

5. Natural pesticides

If preventive measures are not sufficient and the damage by a pest or a disease reaches a level of considerable economic loss, then direct control measures with natural pesticides may become appropriate. Contrary to conventional farming practices, where it has become a widely-held view that pesticides are the best and fastest means to reduce pest damage, organic farmers know that preventive methods are superior and that natural pesticides should be applied only if prevention is not sufficient. The preparation and use of botanicals requires some know-how, but not much material and infrastructure. It is a common practice under many traditional agricultural systems. Some commonly used botanicals are neem, Pyrethrum, rotenone, quassia, ginger, chilli pepper, Mexican marigold and garlic.

Taking all the discussed methods together, we are talking about alternative pest and disease management (APM), a technology that has become feasible and quite successful for almost all crops. Currently there is much experience and know-how in this field.

5.1.3 Economic viability of organic agriculture

Can organic agriculture generate adequate yields? Research provides little evidence with respect to the performance of organic agriculture in comparison to conventional agriculture. However, the boom in farmer initiatives worldwide that seek to work with

ecologically-oriented agricultural techniques is an indication of widespread conviction that this is a promising approach. These initiatives of smallholder farmers have been very successful. For example, in the North Indian mid-hills of the Himalayas, many villages have converted to ecological agriculture. After years of input-intensive farming under the banner of the "Green Revolution", the degraded soils were rehabilitated and, within a relatively short period of time, the villagers managed to achieve good yields that were, in part, higher than would have been the case had they continued with conventional methods of production. Under very fertile conditions, organic agriculture cannot bring the same physical yields as can conventional agriculture. On degraded or marginal soils, however, such success stories are numerous and demonstrate that organic agriculture can compete successfully with conventional agriculture.

Is organic agriculture economically competitive?

An economic comparison with conventional agriculture has to consider differences in costs and in revenues. There are almost no costs for mineral fertilizers and pesticides in organic agriculture, whereas these contribute to a high share of all costs in conventional agriculture and, with rising energy costs, this share is increasing rapidly. Contrary to this, organic agriculture has higher costs with respect to labour, e.g. mechanical weed control, inspection and certification (see below).

On the revenue side, there may be higher yields in marginal areas for organic agriculture, and in many cases a higher price is paid for organic produce. Prices for organic products - also called premium prices - range from 5 to 100% on top of the "normal" price. Taking all aspects into consideration, organic agriculture is in many cases clearly economically superior to conventional production, mainly due to reduced costs of production.

Organic agriculture reduces economic risks

The income of many farmers depends directly on the sale of the harvest of one or two crops. If prices for these commodities drop, these farmers inevitably face tremendous problems. Even with stable prices, large losses can occur when yields suddenly drop, e.g. due to pest or disease incidence which could not be sufficiently controlled. Diverse farms with a range of crops will suffer less from price fluctuations or yield reductions than single crops. Crop diversity therefore is not only helpful for establishing a balanced ecosystem and avoiding the spread of pests and diseases, but it also helps farmers avoid high economic risk.

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5.1.4 Quality control

Why is quality control needed? More and more consumers are getting interested in organic products because they are worrying about their health or are concerned about the environment. Some of them are ready to pay a somewhat higher price for agricultural products. But, the consumer wants to be sure that the product he buys is really organically produced.

China organic product certification seal

China organic product certification seal

Figure 12: Chinese organic certification seals

On the other side, more and more farmers switch over to organic agriculture for various reasons. At least some of them expect to get a better price for their products because they have a higher workload, lower yields, better quality and additional costs for quality control. And, the organic farmer also needs to be protected from unfair competition of other farmers who use the term "organic" in a fraudulent way. In order to show the buyers in the markets or shops that a product is organic, usually labels or certification marks are used. Like brand names, these labels are registered and protected and can be used only by authorized producers and processors.

The basic principles of quality control

The quality control system in organic agriculture is based on three components:

1. Standards that define the "rules" of organic agriculture
2. Regular inspection (control) to ensure that production and processing of products do comply with the organic agriculture standards

3. Certification confirms that a product is produced and processed according to specific organic standards. In addition, inspectors and certifiers are supervised and accredited by the government

This rather complex system has proven to be quite effective worldwide. The following paragraphs provide a brief overview of the quality control system.

Organic standards

If a product is labelled "organic" this product is produced according to certain requirements, which are called "standards". Organic standards do not define a quality status which can be measured in the final product. They define the way of production and the way of processing.

In 2005, the China National Organic Product Standard came into force. The Chinese national standard was elaborated by the OFDC, the Organic Food Development Centre. OFDC is an organization within the Nanjing Institute of Environmental Sciences (NIES) thus belonging to the Ministry of Environmental Protection (MEP).

Inspection

If an organic farmer wants his products to be certified, he has to undergo an inspection at least once a year. The inspector evaluates the performance of the farm activities with the help of the farmer's statements and records and by viewing the fields, animals and farm buildings. He or she checks whether the statements and records are correct and plausible. In case of doubt, the inspector can take samples for laboratory testing or later conduct unannounced inspections. However, laboratory testing is only one tool for inspection in cases where application of – or contamination with – prohibited substances are suspected. Chemical analyses just reveal whether a certain sample contains a specific substance at a certain moment. There is only limited scope to detect residues of chemical fertilizers and pesticides after some time, and in addition, chemical analyses are expensive. Therefore, laboratory inspection cannot replace the inspection of the whole farming process.

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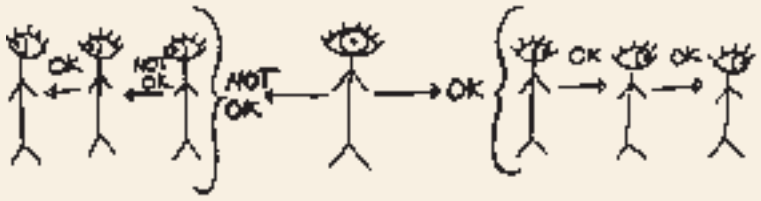
Certification

Certification can be defined as a procedure in which a certification body assesses a farm or company and assures in writing that it meets requirements of the organic standards (see box 20). The inspector writes a report to the certification body. The certification body compares the results of the inspection with the requirements of the organic standards. A certifica-

Box 20: Smallholder group certification

Where large numbers of smallholders are to be inspected and certified, the involved costs for inspection of each farm would be very high. Therefore, groups of farmers with similar production systems are being organized and an internal control system established. This means the farmer group itself organizes quality control and inspection internally. The internal control system (ICS) operates like a small internal control body with internal standards, a written commitment from the participating farmers, internal inspectors inspecting the farms at least once a year and an internal system of sanctions against defaulting farmers. The external certifier inspects the functioning of the ICS and re-inspects at random a certain percentage of the farms. The contracted party is the farmer group, project or cooperation which also is the owner of the certificate.



tion committee decides whether certification may be granted or not.

Following the rapid growth in organic production and export, there has been a dramatic increase in the number of certification bodies in China. At the end of 2006, 30 certification organizations were registered. There are two organizations that certify the biggest share of products for the domestic market: a) the Organic Food Development Center (OFDC) under the MEP and b) the China Organic Food Certification Centre (COFCC) under the MoA.

Certification of export of organic products is done by internationally accredited companies like OCIA (United States), Ecocert (France), BCS (Germany), IMO (Switzerland), Soil Association (Great Britain), and JONA (Japan).

Accreditation

In order to make sure that the certification programme is competent to carry out inspection and certification, a third level of quality control is needed. Authorized bodies regularly evaluate certification programmes and check their proper functioning according to certain criteria. In the case that the certification body complies with the criteria, they accredit the certification programme.

According to the China National Organic Product Standard, all certification bodies have to be registered with the the Certification and Accreditation Administration (CNCA). Inspectors working for the certification bodies have to be registered with the China National Auditor and Training Accreditation Board (CNAT). The supervision of the certification bodies and the administration of organic certification at the local level are the responsibility of the General Administration of Quality Supervision, Inspection and Quarantine of China.

5.1.5 Organic agriculture today

Concepts of an "organic", alternative way of farming were already developing in 1924, mainly in Europe and before the invention of synthetic agrochemicals. Some innovative pioneers tried to improve traditional farming systems with methods characteristic of organic farming. At that time, new approaches were focusing on soil fertility based on humus and were aiming for an ecological balance within the farm.

For almost 60 years, only a very small minority of farmers practiced organic agriculture. Only in the 1990s did organic agriculture experience a strong rise. A number of environmental disasters and food scandals supported growing consumer awareness and an increasingly supportive policy in some countries. At the same time, a range of innovative organic technologies (especially in biological pest management) and more efficient distribution systems were developed.

Despite these successes, organic agriculture still makes up a very small portion of the world's agriculture, rarely constituting more than a few percent of a country's farming sector. Governmental support for

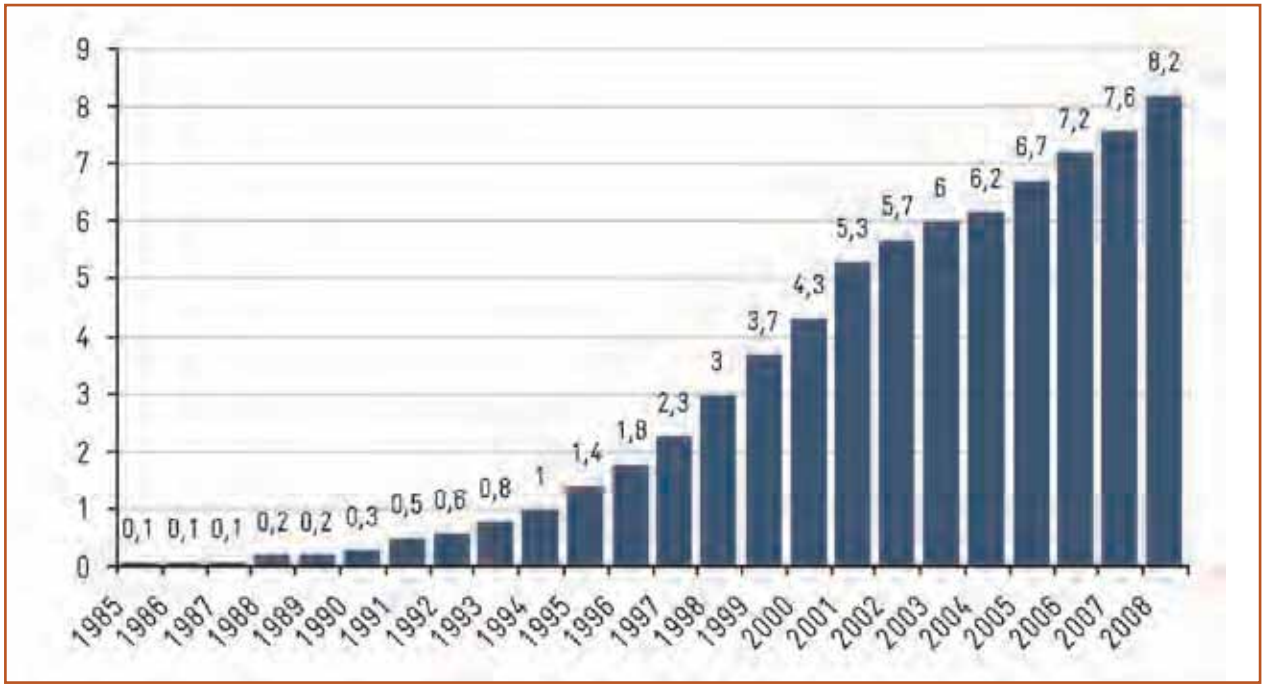


Figure 13: Development of organic agriculture in Europe (Willer and Kilcher, 2010)

research, extension or marketing in organic farming is still very low in most countries. Nevertheless, organic farming at present exhibits promising growth rates all over the world.

Today, organic agriculture is currently practiced in more than 120 countries. As of 2005, it was estimated that worldwide about 31 million ha are managed to be organically certified. The share of land area under organic management (by percent) per country is highest in some European countries, where it involves a considerable share of the total agricultural land (see figure 14). The success of organic agriculture in these countries is mainly due to the increased consumer awareness of health and environmental issues, the mainstreaming of marketing (e.g. supermarkets) and favourable national policies.

Organic trade is growing rapidly. According to estimates, the world retail market for organic food and beverages reached an estimated 33 billion US dollars in 2005. It is estimated that annual sales growth rates are above 10% per year.

Export markets are difficult to access, but there are good market opportunities for China for exporting organic products to Europe or North America in products such as tea, soybean, sunflower, oilseed, various spices, etc. The biggest markets for organic products worldwide are Europe (50% of the global market) and the USA (45% of the global market). In China, local markets for organic products are evolving too, but are still very small. Production is concentrated in eleven provinces: the five north-eastern provinces (Inner Mongolia, Heilongjiang, Jilin, Liaoning and Hebei) and the six eastern and southern provinces (Jiangxi, Fujian, Jiangsu, Hubei, Shandong and Yunnan).

Consumer awareness in China is rising because of a high incidence of health risks in recent years, but demand remains subdued partly because of the low spending power of most Asian consumers. Premium prices in China are exceptionally high.

Author: Johannes Kotschi

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www.biofach-china.com

China Greenfood Development Center:
www.greenfood.org.cn

China Organic Food Trade Net:
www.chinaorganicfood.cn

China Organic Grain Net:
www.zgzl.com

General Administration of Quality Supervision, Inspection and Quarantine of China:
www.aqsiq.org.cn

Global Organic Product Trade:
www.yjsp.com.cn

Main Message 11

Organic agriculture

- *The idea of organic farming is to make the best use of ecological principles and processes and to see always the farm as a whole – as a living organism. It follows a number of basic principles:*
  - *To encourage and enhance nutrient cycles within the farming system*
  - *To maintain and increase long-term fertility in soils*
  - *To maintain biological diversity on the farm*
  - *To create a harmonious balance between crop production and animal husbandry*
  - *To minimize all forms of pollution*
- *The centrepiece of organic farming is fertile and living soil. Thus plant nutrition is not an issue of using artificial fertilizers but keeping the soil prepared to feed the plants. The same applies for fighting pests and diseases: Paramount to organic agriculture is preventing them through balanced rotations, tolerant varieties, and the creation of optimal environment conditions for the crops and strengthening plants through healthy soil conditions.*
- *Organic agriculture can compete with conventional agriculture as far as economic viability is concerned. There are, for example, lowered costs for the purchase of fertilizers and pesticides in organic agriculture, but there are higher costs for labour, certification and marketing. There are slightly lower yields, but given a market for organic products, also premium prices.*
- *Quality control is an indispensable feature of organic farming. Implemented through inspection and certification of organic standards, this provides a justification for premium prices for organic products and gives security to the consumers, that their food is produced healthily and in and environmentally friendly way. With the group certification approach, an economic inspection and certification procedure is being developed that provides small farmers with a cost saving form of certification.*

5.2 Agro-ecotourism

In this chapter, the contribution of agro-ecotourism to pro-poor economic development and to safeguarding agrobiodiversity is discussed. It also provides step by step instruction on how to proceed when intending to develop agro-ecotourism.

5.2.1 Concept of agro-ecotourism

The term agro-ecotourism is a combination of 'ecotourism' and 'agrotourism'. One of the most accepted definitions of ecotourism is the one formulated by The International Ecotourism Society (TIES, Washington/USA): "Responsible Travel to natural areas that conserves the environment and improves the well-being of local people". This means that travellers must think and act responsibly in all aspects in order to minimise their impact on the environment, biodiversity and the local community.

In contrast, naturetourism is simply defined as "a form of travel to natural areas where the experience and appreciation of nature and natural phenomena is the prime motivation for visiting these places" (Strasdas, 2002).

Agrotourism is a direct extension of ecotourism which encourages visitors to experience agricultural life first-hand (see box 21). While ecotourism is nature-based and agrotourism is farm-based, agro-ecotourism is a combination of both. The rural landscape, usually a combination of wild and agroecosystems, can be an important resource for tourism development and agro-ecotourism can be an effective tool to maintain and enhance agrobiodiversity. This type of tourism is gathering strong support from small communities.

Even though agro-ecotourism may seem like a perfect tool for a balanced, nature and culture conservation approach in which biodiversity plays a prominent role (see box 22), is not an easy one because it requires a strong commitment from the community members and the local government, business skills, and an eagerness to serve others (service-orientated thinking).To achieve significant local community involvement in the rural tourism economy, intensive and professional training over a period of years is often a critical motivating factor. Even though the timing is good for agro-ecotourism, thanks to a growing interest of the consumers worldwide, it is important for all stakeholders (government, private sector, and community) to take a long-term perspective.

While ecotourism is nature-based and agrotourism is farm-based, agro-ecotourism is a combination of both.

This long process may cause a community to go through several emotional phases with euphoria in the beginning and periods of apathy before graduating

Box 21: Activities linked to the development of agro-ecotourism

Possible activities linked to the development of agro-ecotourism can be (non-exclusive list):

- Accommodation (traditional housing)
- Board (providing local foods, horticultural crops, etc.)
- Sale of local products, including food (packed tea, honey, dry fruits, fruit jams, and minor crops such as coriander, etc.) and non-food handicrafts made of natural materials (bamboo, rattan, painted pottery, carpets, hand-sewn clothes, traditional figurines, embroideries, etc.)
- Development of new professions (local tour guide, manager of travel circuits or accommodations)
- Renting of animals (horses, donkeys, etc.) for recreational tours
- Enhancement of the knowledge of local communities and their visitors about the protection of natural resources
- Promotion of the sustainable use of biodiversity, including the realisation of benefits from local genetic resources and the commodity chain development of neglected species of medicinal and aromatic plants, grains and cereals
- Fishing

Box 22: Benefits and opportunities from agro-ecotourism

Benefits and opportunities from agro-ecotourism for rural communities and bio-diversity can include the:

- Rapid creation of lasting jobs throughout the economy, with a strong and direct impact on agriculture, construction and other local activities
- Provision of a springboard for the unemployed to enter the labour market through training and career development
- Encouragement of small and medium enterprises based at the local community level
- Stimulation of local food production (based on local varieties, neglected crops), crafts, community pride, heritage and nature conservation
- Renting of animals (horses, donkeys, etc.) for recreational tours
- Help to sustain local services and facilities and enhance the quality of life
- Direct links between small-scale agriculture with urban consumers
- Encouragement of the rural residents to protect their natural environment that provides them with economic benefits

Box 23: Challenges for the implementation of agro-ecotourism

Challenges and barriers to a successful implementation of an agro-ecotourism project include:

- Limited knowledge of the tourism industry
- Limited exposure to and understanding of markets
- Lack of business experience
- Lack of a strong business and marketing strategy
- Lack of funding for marketing and promotions
- Insufficient market access
- No service-orientated thinking by the providers – passive attitude by locals
- Lack of sufficient training and education
- Limited infrastructure
- Environmental pollution by tourists
- Obstacles to access to agro-ecotourism sites

to a balanced perspective. Although tourism development has helped many communities economically, many have not benefited from it. Tourism may cause a number of severe socioeconomic and cultural problems, and it is important to inform the community about these potential problems.

Table 3: Agro-ecotourism readiness assessment checklist (Comen, 2006:30; adapted by Haeusler)

Low readiness	Moderate readiness	High readiness
No tourism product in place	Discovery stage of tourism life cycle with limited tourism products in place	Tourism products in place
Commodities (cash crops) rather than speciality products	Limited speciality products available	Speciality products available from a wide variety of community sources
Limited educational opportunities	Educational opportunities in community	Organized education and support in place
Low community involvement in decisions	Moderate community involvement in decision-making process	Active community cooperation
Limited or no support mechanisms in place (such as support by local government, private tourism sector or non-governmental organizations)	Support mechanisms through other partners and stakeholders	Support mechanisms effectively working in the community; understanding of the challenges Agro-ecotourism can present
(Total) lack of infrastructure, such as hospitals, roads, telecommunication, train and flight services	Infrastructure partly exists	Infrastructure exists and functions well

5.2.2 Strategy for implementation of agro-ecotourism

In order to minimize the danger of failure, it is advisable to choose a strategic approach to decide, plan and initiate agro-ecotourism. In order to do so, a couple of issues have to be taken into consideration. Necessary questions are:

- Are we ready to start?
- What are our specific local skills to be developed into a tourism product?
- What are the characteristics of agro-ecotourists?
- How can we do effective marketing?
- How can we manage specific service packages?
- What are the fields of cooperation?

Ready to start?

Not all communities are ready for tourism development. Many criteria must be met to achieve readiness for the successful integration of a tourism product. Table 3 is a guide that practitioners can use to determine the potential for success or to develop a road map by identifying key variables that may need to be introduced.

Product development – for instance the use of agrobiodiversity

After making the final decision to implement agro-ecotourism in a region, the next step is to identify and develop the product.

It is often difficult for rural people who have not been tourists themselves to understand why someone from outside the community would want to experience rural life. Everyday activities, views, smells, and tastes are not what locals would consider interesting. Tourists, however, seek experiences that differ from their normal routine or daily life. What is exotic to a tourist may be very ordinary to the host community. Through the process of developing a product, community members learn to identify especially skilled people in their community, discover great views of the area (viewing points), historical legends/history and buildings, great trees or unusual flora. From this initial identification, the agro-ecotourism product can be developed.

Box 24: Agro-ecotourism in Crete (Greece)

Students stay on an organic farm on the northern coast of Crete operated by the agronomists of the Mediterranean Association for Soil Health. Classes are limited to eight students and are taught by local leaders, farmers and experts in related subjects. In rural Crete a high proportion of self sufficiency is still pertinent. Rural people grow, collect and process the food, wine and even tea and salt on their tables. Students study with farmers, pick wild herbs, listen to traditional music, and just breathe the mountain air.

A successful agro-ecotourism product simply tells the story of the entire rural community or region through authentic experiences. The examples of daily village life can be woven directly into the tourist experience through guided activity and interpretation. The ordinary activity can become an extraordinary experience for the rural tourist. This service provided by rural communities may represent an important economic activity and may add value to nature and, last but not least, support biodiversity conservation.

To develop a place-based thematic package, the historical element of the region linked to the agricultural tradition of the region must be integrated and can be easily developed by engaging the elders of a community in an active participation process.

An educational component to each package is a *must* because the main market segments for agro-ecotourism are well-educated tourists ranging in age from thirty to sixty (see box 24). Even meal times can become an educational experience, by learning how food is prepared, its ingredients, and how and where these ingredients are grown.

Walking and cycling trails can be created to cater to different types of tourists, including links to villages and heritage sites.

Profile of agro-ecotourists

The type of tourists who are attracted to certain tourism products is important to consider when developing a professional agro-ecotourism experience. The market for agro-ecotourism tends to attract international tourists who have travelled extensively and

Table 4: Characteristics of agro-ecotourists (own sources)

Experienced agro-ecotourist	General tourist interested in agro-ecotourism
Strong environmental commitment	Moderate to strong environmental commitment
Seeks physical challenge (adventurer)	Seeks physical comfort
High interest in nature and culture	Moderate interest in nature and culture
Prefers new experiences to revisiting familiar places	Likes new experiences but might also revisit a tourist destination
Comfort not a requirement	Comfortable surroundings; good services expected
Emphasis on personal experiences	Emphasis on Interpretation
Medium to high educational level	Medium to high educational level
Experienced traveller	Partly experienced traveller

are eager to venture to destinations that have not been popularized and which allow them to enjoy authentic and sometimes rustic conditions (see table 4).

These tourists are also interested in farm-based travel experience, typically seeking peaceful surroundings where they can enjoy hearty meals fresh from the farm, see the farm life, and learn a little about agriculture. This type might be interested in a farm stay as well.

Nevertheless, it has to be taken into consideration that tourists from across the world have different ideas about how to spend their holidays. The same applies to agro-ecotourists. Product developers need to be aware that *the* agro-eco tourist does not exist. The classifications below might help to understand better the range of profiles of agro-ecotourists.

Elements of successful 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 seals make it easier. 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 organizations, NGOs and nature conservation groups facilitate implementation

The more diverse the facilities of the region, the larger the stream of visitors.

Partnerships – working together

The process of improving quality in line with identified standards requires a close working relationship among everyone involved in tourism, and well-designed training and assistance programmes which meet their needs:

- From the very beginning, the community should work closely together with local trade bodies for the different sectors of tourism (hotel, tour operators, transport services, restaurants, museums, etc.).
- If necessary, it is recommended to establish a local tourism association and local network groups which can work on quality, including sustainability issues.
- Design training programmes to encourage participation with well-targeted short courses.
- Access to training in customer service, technical skills, local knowledge, sustainability, and overall business management has to be provided.

The contribution to the conservation of agricultural diversity 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 for local farm animals and crops. For farmers in remote regions, additional benefit accrues from the intensive communication both with visitors and with other farms involved.

As well as having an impact on incomes, agrotourism can help to strengthen the identity of the native population, heightening cultural awareness and appreciation for local farm animals and crops.

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Main Message 12

Agro-ecotourism

- *Agro-ecotourism is a combination of nature based ecotourism and farm-based agro tourism and an effective mechanism to pay for biodiversity conservation.*
- *It provides good economic opportunities for rural areas (employment, simulation of small and medium enterprises, local food production, sustainable local services and facilities) but also requires good preparation, the acquisition of new skills, and a long-term outlook. A strategy to develop agro-ecotourism must find answers to the following questions:*
  - *Do we have the necessary basic conditions to venture into this field of business?*
  - *What are our specific local skills which can be developed into a tourism product?*
  - *What are the characteristics of agro-ecotourists and are we able to serve their needs?*
  - *How can we do effective marketing?*
  - *How can we manage specific service packages?*
  - *What are our fields of cooperation?*

5.3 Plant breeding and seed production for agricultural intensification and biodiversity conservation

Plant breeding has an enormous impact on agrobiodiversity. After long periods of enriching the diversity of cultivars that are used by man, the agrobiodiversity has been increasingly narrowing in the last 150 years. To counteract this menacing development, two promising breeding methods have been developed within recent decades:

1. Evolutionary plant breeding and
2. Breeding with farmers

Within this chapter these approaches are introduced and discussed.

5.3.1 Development and consequences of plant breeding

Plant breeding has existed since the advent of crop domestication. For more than 10,000 years farmers have selected plants for higher yields and health; uniformity in germination and ripening became important traits allowing better harvesting. Plants were exposed and adapted to various environments. Gradually, a rich, man-made diversity of agricultural crops developed. Thousands of plant species were utilized and each crop exhibited major diversity.

During the past 150 years, agricultural development has reversed this trend – biological diversity in agriculture is dwindling. Today, only some 150 species are cultivated, and no more than three of them (rice, maize and wheat) supply almost 60% of global food. Not only are fewer and fewer plant species used for food and agriculture, but plant breeding and commercial seed production have contributed to the reduction of genetic diversity within individual species. The number of varieties of a crop is constantly decreasing and varieties are becoming increasingly uniform. This is worrying, because plant genes represent potential traits. Their loss – also called genetic erosion – is receiving increasing attention as it coincides with two global challenges: to ensure global food security and to adapt to climate-induced environmental changes. It is becoming increasingly clear that plant genetic resources are crucial for both. Reconciling agricultural intensification with the conservation of agro-genetic resources is becoming a key concern. Plant breeding and seed production are key to that endeavour.

Today, only some 150 species are cultivated, and no more than three of them (rice, maize and wheat) supply almost 60% of global food.

This is worrying, because plant genes represent potential traits. Their loss – also called genetic erosion – is receiving increasing attention.

... also called genetic erosion ...

5.3.2 Evolutionary plant breeding – a new method that increases genetic diversity

The search for alternatives started 50 years ago and led to the method of evolutionary plant breeding. This method can be described as follows:

- In order to generate new varieties, breeders systematically utilize genetically diverse and ecologically adapted local varieties. Landraces of different evolutionary origin are assembled and recombined by cross-pollination; such mixtures are named "composite cross populations".
- Over several generations, the progenies (genetic off-springs) are propagated as bulk, and the bulk is subjected to natural and artificial selection under various ecological conditions, which ultimately results in a "modern local variety".

Mainly with barley and also with wheat, composite cross varieties can become superior in comparison to "leading" high yielding varieties, because they perform well under various ecological conditions. Obviously, yield stability and a high yield over a range of environments require genetic diversity.

The co-evolution of plants and diseases in genetically diverse populations is a well functioning, self-regulating mechanism that maintains the plant's disease resistance.

Better disease resistance of composite cross populations is another important result. Not only can disease-induced yield reductions be limited by increasing genetic diversity, but genetically diverse populations also adapt well to changing disease patterns. The co-evolution of plants and diseases in genetically diverse populations is a well functioning, self-regulating mechanism that maintains the plant's disease resistance – a characteristic which generally is not found in genetically homogeneous crops.

In summary, evolutionary breeding with composite cross populations is a very promising method for the intensification of land-use systems and for future

adaptation of crops to environmental change. This applies in particular to marginal environmental conditions and may become increasingly relevant to farming in general.

5.3.3 Breeding with farmers – a new organizational approach (handout 11)

Another innovation is called Participatory Plant Breeding (PPB). In contrast to classical approaches, PPB is not done by breeders alone and hardly takes place on experimental fields or, as practiced nowadays, in laboratories. Throughout the whole process of breeding – the generation of variability, selection and testing of cultivars' phases – farmers are fully included in decision making.

Secondly, most of the process takes place on farmers' fields, not in research stations. In doing so, the bias of genotype-environmental interactions from research stations can be avoided. Whereas research stations have better soils, and possibly irrigation facilities, etc., farmers' fields represent the full range of environmental (and management) conditions for cropping.

Participatory Plant Breeding emerged within the past ten years, mainly promoted by the research centres under the Consultative Group on International Agricultural Research (CGIAR) and by a number of NGOs. The process is now practiced worldwide in developing countries, with outstanding results in three regions: barley in the Middle East, rice in South Asia and sorghum in West Africa. In all three programmes, the improvement of drought-tolerant cereals in low rainfall environments has been a main objective. Now the method extends to other crops such as vegetables and maize.

Participatory Plant Breeding emerged within the past 10 years.

Considering the impact of the method, there are at least three strong arguments in favour of it:

- The effectiveness of breeding can be improved as farmers' experience, agronomic knowledge and preferences are included in the entire breeding process. All this gives varieties bred by this method high acceptance and accelerated adoption rates, lending a demand-driven approach to breeding.
- Research efficiency can be improved and farmers' selections can be as high-yielding as breeders' selections.
- Time for breeding can be reduced. Normally it takes about 15 years to release a variety. As under PPB site-testing on-farm is included in the breeding process, the release of superior bulks requires only half the time, and if pure lines are necessary, 3 - 4 years can still be saved. This is an important aspect in times of rapidly changing climate and the need for fast adaptation.

5.3.4 Alternative breeding approaches that complement classical breeding

The method of evolutionary breeding and the organizational approach of participatory breeding interlock. Together they can provide an important complement to classical plant breeding. They have several advantages:

- Scientifically, they have broadened the understanding of appropriate breeding technologies. Complementing formal breeding, evolutionary breeding offers a methodology that focuses on crop-environment interaction and makes use of it. Secondly, it has stimulated discussion on genotype-environment interaction and new methods have been developed that allow breeding under local conditions with various environments.

- Socially they help to empower farmers to regain control of their seed systems, and to safeguard their interests after decades of marginalization due to trade liberalisation. Secondly, small scale farmers in marginal areas are now receiving benefits from agricultural research and development, as well as recognition that greater efforts must be made to develop technologies that are better suited to improving their livelihood.

Socially they help to empower farmers to regain control of their seed systems, and to safeguard their interests after decades of marginalisation due to trade liberalisation.

- Economically it provides an answer as to how the potential of marginal areas and the large range of minor crops can be exploited and made more productive. This is one key aspect of increasing global food production.
- Ecologically the new approaches provide an answer to sustaining the diversity of agro-genetic resources and further developing it in accordance with environmental change within a shorter period of time. The challenge of global warming is to adapt to difficult environments as fast as possible.

An interesting example for the understanding of the described approaches is the Bingenheim Initiative in Germany, a farmer initiative with the objectives to stay independent from the seed industry and to achieve a higher food quality in their crops (see handout 11).

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Main Message 13

Plant breeding and seed production for agricultural intensification and biodiversity conservation

- *Plant breeding spawned a rich diversity of cultivated plants over thousands of years. Strong selection on uniform criteria all over the world, however, reversed this trend in the last 150 years and led to a decreasing diversity in agricultural cultivars.*
- *Evolutionary plant breeding to create new local races is an alternative to the mainstream breeding procedure. With this practice landraces of different evolutionary origin are assembled and recombined by cross-pollination. Progenies of this cross pollination are propagated as bulk, and the bulk is subjected to natural and artificial selection under various ecological conditions. This ultimately results in a "modern local variety", which can compete with high yielding varieties in many situations.*
- *Breeding with farmers and in their fields is an organizational approach, which is often combined with evolutionary plant breeding. This provides several advantages:*
  - *Socially it helps to empower farmers to regain control of their seed systems.*
  - *Economically it provides an answer as to how marginal areas and minor crops can be made more productive.*
  - *Ecologically the new approaches answer the need to sustain the diversity of agro-genetic resources.*

5.4 Value addition of underutilized crops or animals

Underutilized plant and animal species as part of the existing agrobiodiversity have an important potential to generate income for the rural poor, to create employment (economic benefits), to improve food security and nutritional diversity (social benefits) and to stabilise agroecosystems and conserve biodiversity (environmental benefits). In order to conserve agrobiodiversity, one possibility is to add value to underutilized species and derived products, thereby generating income for producers, which in turn makes cultivation and conservation of these species more interesting – protection by use. Among the value adding possibilities, the value chain approach and the attribution of geographical designations are presented in the following chapter, introducing first the concepts and then providing advice for a strategic procedure to implement them (see handout 12).

5.4.1 Characteristics of value chains

A value chain comprises all activities, stakeholders and involved processes from the primary production of a product (producers), the subsequent processing steps (processors), the marketing to wholesalers and retailers (traders, middlemen) and finally, the consumption of the product (consumers). At each step, the product gains additional value, which on the one hand has to be high enough to satisfy the participants in the value chain and on the other hand low enough to keep the product competitive in the market. An example of a potato value chain (VC) from South America is given in figure 14.

The analysis of the value chain allows insights with regard to concerned actors, the processes and division of labour, the involved quantities of products and the distribution of costs, benefits and power. The distribution of power and benefits within a VC is called the governance structure. Value chains with fair governance are more likely to maintain a keen interest from all VC stakeholders.

In addition to economic viability, which is essential for all types of VCs, it is important for a pro-poor and agrobiodiversity-oriented VC to know (see figure 15):

- Is the VC favouring pro-poor growth? (i) are poor households participating in the value chain and (ii) do these households have a fair share of the benefits? The rural poor manage an important part of agrobiodiversity. If agrobiodiversity conservation is a major objective of the VC, then rural poor households have to be important players.
- What is the gene-pool that can be protected? Some value chains only protect one species or few varieties within a species, while others conserve a larger gene-pool.

Specific inputs	Agricultural production	Processing	Marketing	Consumption
Functions				
- seeds - fertilizer - Plant protection	- Seed propagation - Production of potatoes - Storage	- Cleaning - Sorting - Packing	- Buying up, collection - Transport - Sale to the end consumer	- Self-consumption - Fresh consumption
Actors				
- Researcher - Extensionists - Farm suppliers and services - Banks	- Small farmers - Production communities	- Rural farms and farming communities	- Producers - Buyers - Retailors	- Rural and urban consumers

Figure 14: Example of a potato value chain (own sources)

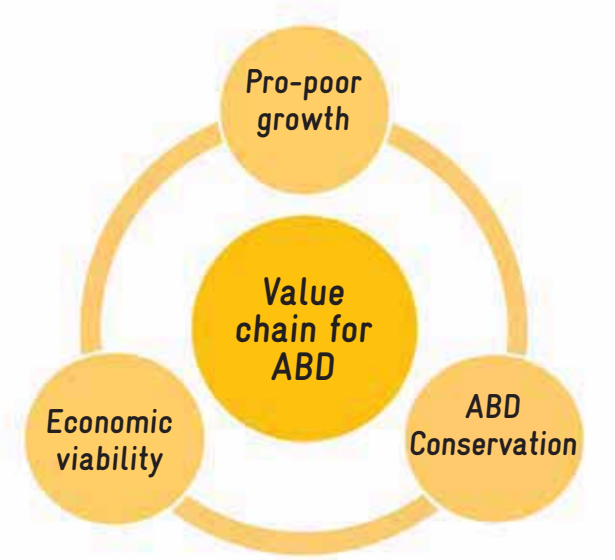

Figure 15: Criteria for ABD-relevant value chains (own sources)

5.4.2. Strategic steps for value chain promotion

Working with the concept of value chains for the promotion of agrobiodiversity and pro-poor growing implies a strategic and methodological approach. Basically there are three steps that have to be followed in order to do this successfully:

1. Screening of underutilized species
2. Socioeconomic and process analysis of the concerned value chain
3. Identification of upgrading options

Screening of underutilized species and agrobiodiversity products for promotion

If there is no demand for a product, there will be no selling and therefore no value chain. Therefore, underutilized species and products with a market potential have to be identified. In order to assess the market potential, the following aspects are important:

- Do the species or products' have unique distinguishable properties with respect to appearance, taste and smell (aromatic plants, special vegetables or fruits)?
- Can a special story or history that is attached to the product be used for marketing purposes? This can also be a secondary benefit of the product. Take the example of Ethiopian highland forest coffee: the name already inspires consumers' fantasies of drinking a really special coffee coming from a unique destination (highland forests).
- What kind of knowledge exists? Often marketable products already exist traditionally in local/ regional markets and the indigenous knowledge for production and processing is available.
- What does the potential market look like? Who are competitors or which are the competing products?

If species or products seem to have market potential, it is necessary to analyse (i) their potential for poverty alleviation and (ii) for agrobiodiversity conservation.

- Pro-poor relevance: Can poor farmers participate in the production and processing? What is the required investment for participants? What is the potential number of poor households that can participate and do all gender, social groups have access? Is the indigenous knowledge available and how complicated are involved processes? What is the potential for income and employment generation? Experience shows that VCs with high investment requirements, complex production and processing know-how, and high risk, generally do not favour poor households.
- Relevance for agrobiodiversity: Some ABD VCs promote only one species or variety, whereas others demand inputs of a larger genetic range. For example, the promotion of the value chain of the precious Moroccan argan oil requires only fruits from one tree species – the Argan tree. Promotion of the VC produces income advantages for numerous poor households but protects a rather limited genetic diversity. In the Andean region, the production of jalca potato chips requires 30 differently coloured local potato varieties and thereby protects a larger genetic diversity.

In the Andean region, the production of jalca potato chips requires 30 differently coloured local potato varieties and thereby protects a larger genetic diversity.

Therefore, the choice of the right products determines market success, the impact on poverty alleviation and the degree of biodiversity conservation. In order to maximise the use of available know-how and increase ownership, the choice is best done with the participation of concerned stakeholders and available resource persons.

Analysis of the value chain

Once identified, an analysis of the value chain is undertaken to visualise the core processes of the system with the functions and participating actors, to

analyse involved product quantities, expenditures and benefits of concerned actors, to determine bottlenecks and points of entry for support measures. The analysis serves at the same time to create awareness among stakeholders about the overall value chain.

The analysis of a value chain comprises different analytical steps, which can be flexibly applied depending on the specific questions and available resources. The scope of the analysis therefore needs to be determined first.

In most cases, initial basic research will identify the different main process steps in the value chain, the functions and the participating actors as was shown in figure 15. In a further step, the main processes may further be broken down into more detailed steps (e.g. seed potato production comprises numerous specific sub-steps from production to storage).

A financial analysis gives an idea of the distribution of costs and benefits at the various stages along the value chain (see table 5).

Table 5: Distribution of costs, revenue and income among actors of a value chain for yam commercialisation (prices in US Dollar/kg) (KIT and IIRR, 2008:42)

1	2	3	4	5	6	7
Chain actor	Variable costs	Revenue	Gross Income	Added value	Gross margin	Value Share
		Selling price	Revenue – Costs	Revenue – Previous actors revenue	Gross income x 100 / revenue	Added value x 100 / Retail price
Farmer	0.50	1.00	0.50	1.00	50%	50%
Travelling Trader	1.25	1.50	0,25	0.50	17%	25%
Wholesaler	1.54	1.70	0.16	0.20	9%	10%
Retailer	1.74	2.00	0.26	0.30	13%	15%
Total				2.00		100%

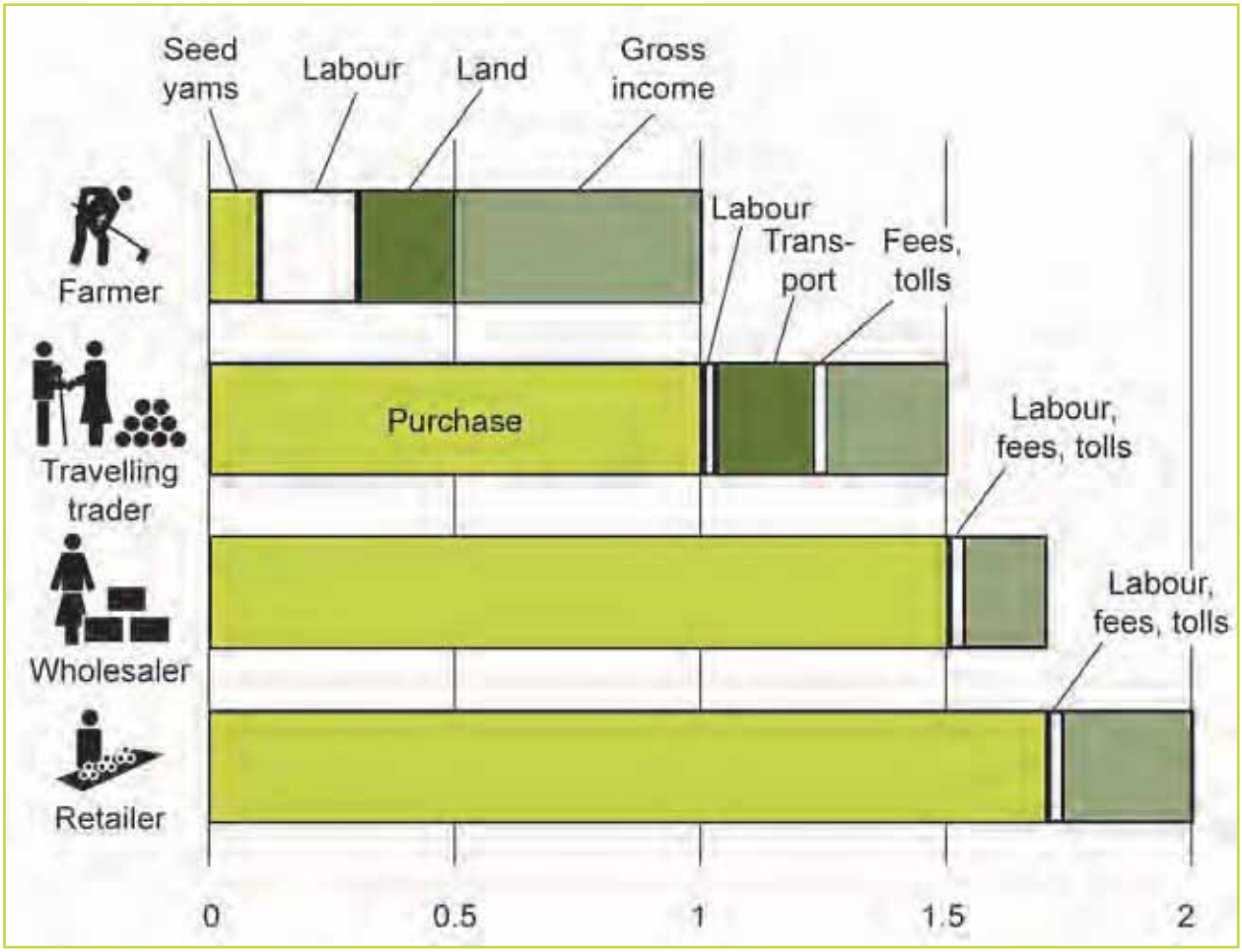

Figure 16: Distribution of costs and revenues along the value chain (KIT and IIRR, 2008)

The farmer in the example in table 6 receives $1 at the farm gate for his yam from the trader, which leaves him with a gross income of $0.5. The last actor in the chain – the retailer – gets $2 for the yam and makes a gross income of $0.26 per kg. A look at the distribution of the gross margins along the chain (column 6) shows that the farmer has the highest gross margin (50% of the revenue are gross income), followed by the travelling trader and the retailer. The wholesaler has the lowest gross margin per kg (9%), which is normal, because he deals with large quantities. The same information can also be displayed in graphical form as bar chart (see figure 16) or as a flow diagram.

The Value Chain analysis should give information about costs and margins along the value chain, capacities of involved actors and strengths and weaknesses in order to allow the definition of an upgrading strategy in the next step.

Identification of upgrading options

Up-grading options can be related to the improvement of processes of the VC, to the improvement of the products and to the optimal choice of functions in the VC:

Process upgrading looks at the efficiency with which processes are carried out. Is it possible to increase the speed, reduce the costs or enhance the quality of processes (e.g. by reducing losses during processing, storage, and transport, and by meeting compliance to standards etc.)? Strategies for upgrading may involve technical improvements but very often they also involve the strengthening of concerned participants, organizational set-ups, communication or marketing.

Product up-grading identifies possibilities to improve the product. This may concern the internal product quality (e.g. concentrations of ingredients, taste or smell) or external characteristics (appearance, packaging etc.).

The functional upgrading looks at the activities that a specific actor carries out in the value chain and whether he or she is well positioned. For some actors it may make sense to add additional value, for example, by starting some pre-processing of the primary

product or by developing direct marketing channels. For others, it may be advantageous to concentrate on certain core activities, while sourcing out other activities.

5.4.3 Adding value to agrobiodiversity products through geographical designations

Another strategy of value addition is the registration of products under geographic designations (see figure 17). Local animal breeds and plant species are

Figure 17: European geographic designations

used worldwide to produce specialty products by employing indigenous knowledge. Examples of such products are Champagne or Roquefort from France or smoked ham from Parma in Italy (Prosciutto di Parma). Such products combine a unique tradition and quality with high esteem for local craftsmanship and know-how. In order to protect the ownership of such special products from specific regions, countries have introduced so-called geographic designations. Designations guarantee a defined standard of the product and make it easily recognisable for the consumer. Products registered under such geographic designations benefit from a price premium for extra quality, cultural uniqueness and authenticity.

In Europe alone, there are currently 554 products of 15 different countries that are registered under three different designations:

- The Protected Designation of Origin (PDO)
- The Protected Geographical Indication (PGI)
- The Traditional Speciality Guaranteed (TSG)

The PGI and PDO cover products and food, which are produced in a defined region; the regional influence, in combination with the natural conditions and human influence, determine the characteristics of the product. While the PGI allows processing of the product outside the defined region of origin, production and processing have to take place in this region if products are registered under the PDO. TSG registration in turn requires the production either from a traditional raw material, by a traditional process or according to a traditional recipe.

While geographical designations also exist in other countries, it is interesting that the three described European designations also allow producers from other countries to register their products in the European Union.

Geographic designations are generally created by groups of producers and processors, which are conscious about having a special high quality product without getting sufficient access to markets or decent price premiums for quality. As an association they de-

Box 25: Tam Xoan Rice as geographical designation

A very recent designation is Tam Xoan rice from Vietnam. The Nam province in the valley of the Red River is a genetic hot spot for rice. Several dozen of the much valued aromatic rice varieties originate from the area. The local variety Tam Xoan of Hai Hau district is mostly appreciated by the urban population of the region's cities. It yields a 50% higher price as compared to other rice varieties, which makes it very appealing to the local farmers. For this reason, other farmers, not belonging to the area, also started marketing their rice as Tam Xoan rice, which started to put pressure on the price. In 2003, 25 farmers applied for the registration of a geographical designation for Tam Xoan rice. One year later, the designation was approved and another 420 farmers joined the initial group. In the mean-time, the farmers' association has signed supply contracts with several supermarkets.

fine the conditions for producing the product and the quality standards to which the product has to respond, and the obligations and rights of the members are laid down in the statutes. Then the association can apply at the patent office for a geographical designation for their product. The designation protects against other products of lesser quality pretending to come from the same region and being of similar quality. The association holding the designation also controls the quality of the product and the compliance of all regulations. Additionally, the members are reviewed once a year by an external accredited and independent institution. It is important for a successful geographical designation that a strong corporate feeling is created among the members in order to accept and defend the special obligations and character of their product.

Examples of geographic indications show that poor farmers can gain from the cultivation of local species and varieties and make a higher margin of their products. However, not all geographic designations contribute to the same degree of conservation of agrobiodiversity, and might actually have contrary effects. In the case of the Tam Xoan rice (see box 25), a study revealed that the rice diversity in Hai Hau district has decreased because Tam Xoan rice has become so lucrative that other rice varieties were abandoned.

Success or failure of achieving positive impacts for poor rural households and agribiodiversity depends on a number of strengths and weaknesses, which were identified as lessons learnt from previous experiences. Some important ones are given in table 6:

Table 6: Success factors for value addition (own sources)

Success factors for value addition	Constraints
Clear economic benefits from the activity for all stakeholders as compared to economic alternatives	Competitive substitute products available
Specific attributes of product (health, taste, appearance, background story) favoured by consumers	Other economic alternatives available (high opportunity cost)
Traditional knowledge available and gives comparative advantage of existing actors in comparison to newcomers	Seasonal duplication with other activities with high labour demand
Low resource requirements allow poor households to participate	Complex production or processing methods
Tradition of self-organization and benefit sharing	High initial input requirements
Already existing networks of producers/processors and traders	Weak, unstructured business sector
End-products, which ask for a low level of standardisation	Social barriers between actors (e.g. ethnic, caste, gender or social discrimination)
Available access to fair credit	Restrictive business environment (market distortions, very high production and processing standards, corruption)
Enabling environment (e.g. efficient administration for exports, functioning research institutions, good market access to reduce transaction cost)	
No one size fits all but case by case study of possibilities and opportunities	

Protection by use is a viable concept to conserve agrobiodiversity and create income for poor households. Different options exist regarding how to develop new products like the two preceding examples and link them to the markets. It is, however, only a solution for some endangered farm animals or plants with special characteristics and can therefore only supplement other conservation and protection approaches.

Protection by use is a viable concept to conserve agrobiodiversity and create income for poor households.

Author: Dieter Nill

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Main Message 14

Value addition of underutilized crops or animals

- *The value chain concept comprises all activities, stakeholders and involved processes from the primary production of a product (producers), the subsequent processing steps (processors), the marketing to wholesalers and retailers (traders, middlemen) and finally, to the consumption of the product (consumers). At each step, the product gains additional value.*
- *Working with this concept to bring forward agrobiodiversity and pro-poor growth, guides the view on hitherto underutilized species and analyses them according to three questions:*
  - *What are underutilized species with a possible market potential?*
  - *What are the processes of production, processing and selling, which are the key-actors in the value chain?*
  - *What options exist to upgrade the value-chain process and add value to a product?*
- *One outstanding option to add value to underutilized products is to brand them with geographical designations. Designations guarantee a defined standard of the product and make it easily recognisable for the consumer. Products registered under such geographic designations benefit from a price premium for extra quality, cultural uniqueness and authenticity. Examples of geographic indications show that poor farmers can gain from the cultivation of local species and varieties and make a higher margin of their products.*

Chapter 6

Traditional knowledge of conservation and sustainable utilization of agrobiodiversity

6 Traditional knowledge of conservation and sustainable utilization of agrobiodiversity

Indigenous people and traditional local communities mainly live in areas of high biological diversity. They often have a profound understanding and a comprehensive knowledge of their surrounding environments which is extremely important for both the conservation and the sustainable use of biodiversity and agrobiodiversity. Nowadays, this fact is well understood throughout the world and the protection and promotion of traditional knowledge, innovations and practices are seen as being of key importance both in the daily lives of these people and for the maintenance and sustainable use of global biodiversity. In the two sections of this chapter, three topics are presented:

1. What is meant by traditional knowledge and how it is related to biodiversity?
2. Which are the areas of biodiversity-related traditional knowledge?
3. What are the ingredients of a strategy to prevent traditional knowledge from being lost?

6.1 Traditional knowledge and biodiversity

This chapter will examine the linkages of cultural and biological diversity and the role and potential of traditional knowledge and practices for maintaining agricultural biological diversity. Practical examples will illustrate the theoretical considerations.

6.1.1 What is traditional knowledge?

The term "traditional knowledge"[1] refers to the knowledge, innovations and practices of indigenous and local communities around the world. Traditional knowledge has developed over centuries, is generally passed on from generation to generation by word of mouth, and is adapted to the local culture and environment.

Traditional knowledge takes the form of stories, songs, folklore, proverbs, cultural values, religious beliefs, spirituality, rituals, community laws, language, and agricultural practices. Traditional knowledge is mainly of a practical nature, particularly in such fields as agriculture, fisheries, health care, horticulture, and forestry. Traditional knowledge is unique to every culture or society and it generally belongs to the whole community and is thus viewed as collectively owned (CBD Secretariat, n.d.; GTZ, 2004a).

Traditional knowledge is unique to every culture or society and it generally belongs to the whole community and is thus viewed as collectively owned.

Traditional knowledge also includes strategies of protection for the utilization of plant resources as well as management systems. The development of these so-called traditional knowledge systems covering all aspects of life including management of the natural environment has been a matter of survival for the peoples who generated these systems. Such knowledge systems are cumulative, representing generations of experiences, careful observations, and trial-and-error experiments.

The term "traditional" used in describing this knowledge does not imply that this knowledge is old or non-technical in nature, but "tradition based". Traditional knowledge systems are dynamic, which means new knowledge is continuously added. They do innovate from within and also will internalize, use, and adapt external knowledge to suit the local situation.

This knowledge is used to sustain the community and its culture and to maintain the genetic resources necessary for the continued survival of the community. In this way, traditional knowledge on agrobiodiversity includes, for example, inventories of local animal breeds or plant and crop species. It may cover information on useful medicinal plants or about indicator plants, such as plants that show the soil salinity or that are known to flower at the beginning of the rains. Thus, it includes practices and technologies, such as seed treatment, storage methods, and tools used for planting and harvesting.

Traditional knowledge is not easily scientifically recallable. It differs from Western scientific knowledge in several ways: Scientific knowledge is compartmentally approached, communicated in a written form, and taught through lectures and theories with value free explanations. In contrast, traditional knowledge has a holistic approach, is mainly orally communicated, and taught through observations and experiences. It is explained through spiritual and social values. To understand these differences is important for under-

1 Traditional knowledge is often described as local knowledge or indigenous knowledge and a variety of definitions and further terms are in use. Some refer to the connection between traditional knowledge and techniques and the natural environment, e.g. "traditional ecological knowledge" (TEK), "indigenous ecological knowledge" (IEK), "indigenous technological knowledge" (ITK), "local community knowledge", "traditional knowledge systems" or "indigenous knowledge systems".

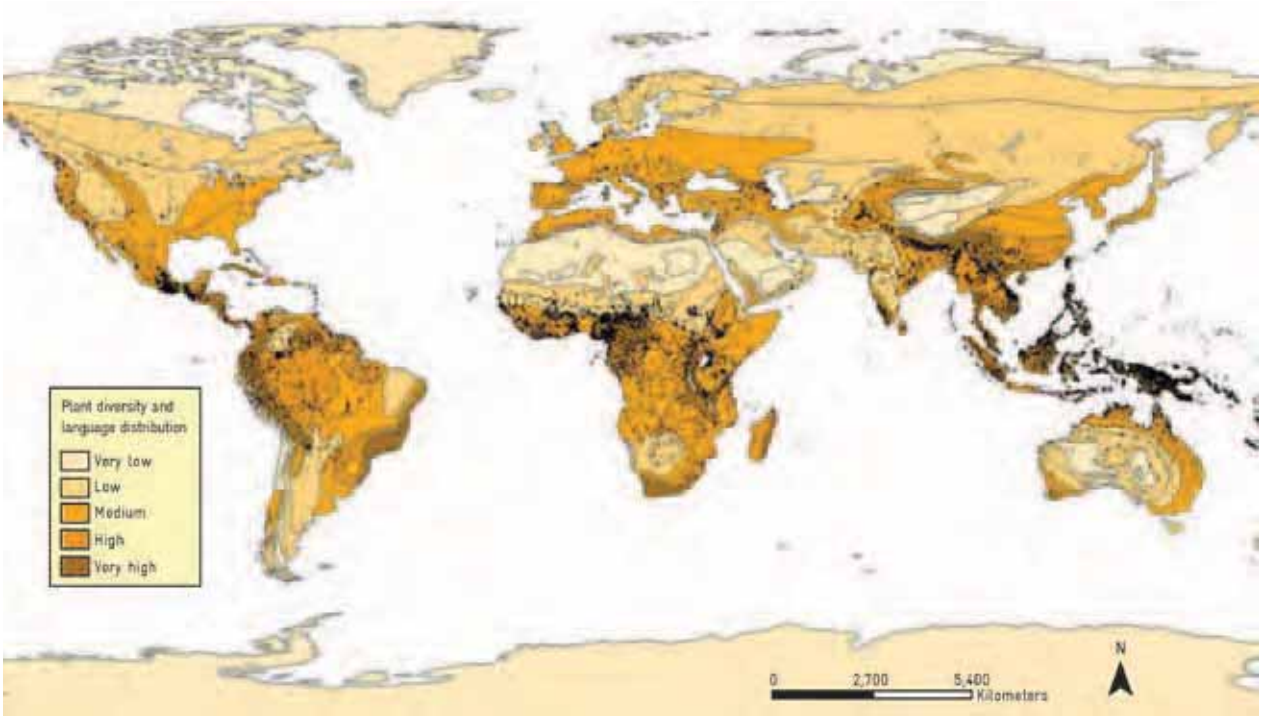

Figure 18: Correlations between linguistic and cultural diversity and biodiversity (UNESCO, Terralingua and WWF, 2003)

standing the value and the role of traditional knowledge.

6.1.2 Hot spots of cultural and biological diversity

Indigenous peoples or ethnic minorities[2] became perceived differently since it became clear that areas of highest biological diversity on the planet (so-called "hot spots") are inhabited by indigenous peoples. Accordingly, there is an inextricable link between biological and cultural[3] diversity. For example, tropical rainforests are known to be the world's richest areas in biodiversity. They cover just 7% of the planet's land surface and yet are home to at least 50% of the world's species. These ecosystems are perhaps as well the most culturally diverse regions, harbouring at least 1,400 distinct indigenous peoples (WWF, 1999; European Commission, 1994).

The "hot spots" of remaining agrobiodiversity are confined to traditional farming systems and remote areas with harsh environments.

On the map above (figure 18), correlations between linguistic and cultural diversity and biodiversity can be observed by comparing the patterns of geographical distribution of the world's biodiversity and those of linguistic and cultural diversity. Areas of high biodiversity tend to host a high number of different languages (UNESCO, Terralingua and WWF, 2003).

Agrobiodiversity and culture are also closely linked and the "hot spots" of remaining agrobiodiversity are confined to traditional farming systems and remote areas with harsh environments, for example mountainous areas (ICARDA in Secretariat of the Convention on Biological Diversity, 2008).

One reason often assumed for the linkages between high biological diversity and the presence of ethnic minorities and local communities is that the

2 Indigenous peoples, ethnic minorities, ethnic groups, indigenous groups or tribal societies are all social groupings which are distinguished from the dominant society as a rule by a different social and cultural identity. According to the standard international definition, indigenous peoples living in particular geographical regions have the following distinctive features: Presence of common law, social and political institutions, often a predominantly subsistence-oriented production system, a strong bond with their ancestral land and the natural resources it contains. The fact that these lands and territories are inextricably linked to their culture and identities which are distinct from the greater society, often makes them vulnerable to being marginalised in development.

3 Culture is manifested in language, self-identification and identification by others as members of a distinct cultural group (GTZ, 2004b). In China ethnic groups are officially titled as minority nationalities. China does not formally recognize that its citizens include indigenous peoples in the sense the term is used in international arenas (IFAD, 2006). Therefore, we use the term "ethnic minority" in this sourcebook.

Figure 19: Agricultural calendar of the Hani, Yunnan (Mei Lan, a local Hani artist. CBIK, 2005)

forms of land use they practice are primarily directed to meet their own needs. As a result, their interventions in the natural ecosystem are generally slight or moderate. Another reason cited is that in the regions where ethnic minorities live, ecosystems limited by high biomass turnover and coinciding nutrient deficiency place constraints on land usage practices.

Such ethnic communities, living in close contact with the environment, normally consider themselves as part of nature and not separate from it. It has been frequently documented that these communities have elaborated complex classification systems for the natural world, reflecting a deep understanding of local flora, fauna, ecological relations and ecosystem dynamics, in many cases more sophisticated than those of Western science. One example is the traditional agricultural calendar of the Hani in Southern Yunnan (see figure 19). In this calendar the environment, monthly agricultural and cultural activities of the Hani are linked and festivals are carried out in honour of certain plants and animals.

Such ethnic communities, living in close contact with the environment, normally consider themselves as part of nature.

Furthermore, through awareness of their being part of, and dependent on, local ecosystems, these peoples recognize the need to regulate resource use and maintain an ecological balance, and thus develop sustainable resource management and utilization strategies. Respect for the environment arises from this direct dependence on and active use of natural resources. Traditional symbolic values help to enable societies to avoid overexploitation and to live within the limits imposed

These communities have elaborated complex classification systems for the natural world, reflecting a deep understanding of local flora, fauna, ecological relations and ecosystem dynamics, in many cases more sophisticated than those of Western science.

by the availability of resources and technology (WWF, 2000).

Nevertheless, despite the fact that ethnic minority groups have been living in certain ecosystems such as mountain regions for thousands of years, and lived as hunter-gatherers, pastoralists and agriculturalists, they are often viewed by outsiders as objects to be managed rather than citizens of the mountain ecosystems. The local languages, traditional knowledge and religious practices linked to the worship of sacred spaces and to the maintenance of biodiversity have already been extinguished in many places as a result of the history of government policies, market penetration, out-migration, external education and assimilation (Xu et al., 2006).

6.1.3 Values of traditional knowledge

Ethnic minorities and local communities often know numerous ways to use wild plants and animals. They have developed many valuable medicines and other useful products. Thus, traditional knowledge has contributed to their food security and healthcare. For centuries they depended on their traditional knowledge to sustain their daily lives. Today there is growing appreciation of the value of traditional knowledge on an international level. In several cases, scientists have acknowledged that damages were done in the recent past due to disregarding traditional knowledge: scientists in the USA, for example, developed in the 1940s an anti-malarial drug from a traditional Chinese remedy based on extracts of a hydrangea plant (*Dichroa febrifuga*). The drug induced such strong sickness that patients refused to take it. But the researchers were unaware that, when used as a malaria treatment in China, the remedy was administered with other ingredients such as ginger and liquorice root, both powerful anti-emetics. A less reductionist approach that had taken such information on board might have saved millions of lives in the intervening period (Dickson, 2003). Other cases illustrate the recognition and use of the values of traditional knowledge:

Commercial values

For centuries, Western civilizations have been searching for new material based on the knowledge of indigenous people, including their genetic resources, medical remedies, folkloristic designs, etc. Modern pharmaceutical and cosmetics industries have manufactured valuable products as drugs and creams on the basis of traditional knowledge (GTZ, 2004a; Hansen and Van Fleet, 2003). In most cases, traditional knowledge holders have been exploited without being asked for their consent and without sharing in the benefits of such exploitation, despite being the original "owners" of the knowledge. This behaviour, claimed by the indigenous people as unfair and disrespectful, is mostly in compliance with existing intellectual property right laws, which see indigenous knowledge as lying in the public domain (Von Lewinski, 2004; see chapter 2).

In most cases, traditional knowledge holders have been exploited without being asked for their consent and without sharing in the benefits of such exploitation, despite being the original "owners" of the knowledge.

In some cases, pharmaceutical enterprises can make high profits from products based on traditional knowledge. However, due to high costs, these products are not always successful, so their potential should not be overestimated. Access to traditional knowledge in pharmaceutical research is of particular relevance because it increases the probability of success of the search for new active plant genetic substances (Kuppe, 2001).

... mostly in compliance with existing intellectual property right laws, which see indigenous knowledge as lying in the public domain.

Over the last few decades, much valuable traditional knowledge has been identified and used for the development of successful drugs. Examples include Snakeroot (*Rauwolfia serpentine*) in India for use against hypertension, and quinine (*Cinchona* spp.) in South America for use against malaria. Another case involves Vincristin and Vinblastine, a medicine used to treat cancer made from the active components of the Rosy Periwinkle (*Catharanthus roseus*). The plant originates in Madagascar, but now exists all over the tropics. With the sale of the medicine, according to Greenpeace, the American pharmaceutical group Eli Lilly earns around 100 million US Dollars per year. It is estimated that almost one quarter of the worldwide pharmaceutical sales volume of 130 billion US Dollars per year derives from the use of the biological resources of tropical countries. Raw materials from tropical countries are valued at some 30 billion US Dollars, and contribute to nearly a quarter of the sales volume of pharmaceutical enterprises. However, the countries of origin receive only a fraction of this amount.

Currently, in China and in Southwest China in particular, there is active international research by eth-

nobotanists and phytochemists into using traditional knowledge for the identification of potentially useful medicinal plant species. This commercial value facilitates the preservation of traditional knowledge and encourages local conservation of the necessary biological resources and the environments. A challenge now is to ensure that potential benefits also remain within local communities, rather than being exploited by outsiders (Xu et al., 2006). There are examples of outsiders attempting to control ethnic tourism and commercializing local medicinal plant knowledge in Southwest China.

A challenge now is to ensure that potential benefits also remain within local communities, rather than being exploited by outsiders.

Values of traditional knowledge on seeds and landraces

It is not only medicinal herbs that have attracted industrial companies. In the agricultural sector, ethnic minorities and local communities have often achieved a high and effective level of agrobiodiversity. Therefore, the seed industry often draws on traditional agrarian knowledge.

China is a major centre of genetic diversity for many important domesticated crop species, such as rice and soy bean, which are largely represented in the country by uniquely adapted landraces and wild types and genetically diverse forms. The genetic diversity of China's landraces has been used worldwide to develop new crop varieties and to address acute constraints affecting yield. Some of this crop diversity is found in the small fields of remote living farmers who, aided by nature, have played a central role in the maintenance and use of these resources.

China's farming has its foundation in traditional crops and landraces that farmers have adapted to meet changing needs over centuries on the basis of selection and use. Farmers are instrumental in conserving germplasm, since they often retain seed stocks for security. In addition to household storage, farmers in remote regions have well-established systems to ensure the security of the seed supply, and they often operate in networks; for example, seed fairs for seed exchange. Farmers exchange crop types representing a wide range of adaptation to diverse environments. In this way, planting material can be chosen to suit a particular set of agro-climatic conditions.

Farmers are instrumental in conserving germplasm, since they often retain seed stocks for security. In addition to household storage, farmers in remote regions have well-established systems to ensure the security of the seed supply, and they often operate in networks

Figure 20: Seed fair with local landraces

Figure 21: Women of the Li, an ethnic minority, during a traditional festival

This practice is nowadays rarely used as many traditional crops are displaced by introduced high yield cultivars. In some communities, for example in Guangxi and Northwest Yunnan, these traditional networks have been re-established without the support of international projects.

Values of traditional knowledge for *in situ* conservation

In situ conservation is defined as the safeguarding of traditional cultivars (or landraces) in surroundings to which they have adapted, or in the farming systems where they have acquired their unique characteristics. These traditional landraces and suitable crops will become more and more important in view of climate change (see next page). There is the need to maintain these landraces growing under natural conditions in a dynamic state and to support the preservation of related local knowledge. This can be best achieved through *in situ* conservation strategies that actively involve the local communities and local knowledge holders and create an equal partnership with farmers in all aspects of the project activities, including planning and implementation. It also includes a willingness to learn from farmers who hold traditional knowledge as well as close partnerships and collaboration between scientists and farmers to achieve a synthesis between modern and traditional knowledge.

Traditional knowledge and practices are significant for the *in situ* conservation of agrobiodiversity. Farmers' daily activities of growing, collecting, preparing and consuming food are an integral part of many cultures. Farming systems vary greatly but the knowledge to sustain them plays a central role in all. This traditional knowledge has provided local communities with the skills to sustainably manage their farming systems, thus ensuring food security, providing nutrition and health care and creating livelihoods (Secretariat to the CBD, 2008). Thus, traditional knowledge associated with agrobiodiversity plays an important role in maintaining the security of the ecosystem and in the development of sustainable models of agriculture adapted to the respective environment.

Thus, traditional knowledge associated with agrobiodiversity plays an important role in maintaining the security of the ecosystem and in the development of sustainable models of agriculture adapted to the respective environment.

Women as custodians of agrobiodiversity

In many countries, home gardens play a significant role for *in situ* conservation because they contain a great combination of trees, shrubs, vegetables, root crops,

grasses and herbs that provide food, spices, medicines and construction materials. In home gardens of Vietnam, which are on average a quarter of a hectare, a total of 646 plant species and varieties were identified. Domestic animals are often integrated into home gardens too. These systems not only secure food and income, but often have important cultural significance too. Home gardens are constantly changing, since the composition and use of crops changes according to the circumstances and needs of the owners. In most cases, women decide what plants are grown in the home garden, because in many societies they are mainly responsible for food and healthcare within the family. They select, experiment with, and further develop species and varieties. The women own the knowledge of cultivation practices that are suited to the local environment, local species, preparation of food, and selection of medicinal plants. Often they also have a great awareness of the nutritional properties of plants and crops. In many countries, women are the custodians of agricultural biological diversity (GTZ, 2004c).

In many countries, women are the custodians of agricultural biological diversity. Often they also have a great awareness of the nutritional properties of plants and crops.

Significance of traditional knowledge to the adaptation of climate change

Traditional knowledge systems in mitigation and adaptation have for a long time been neglected in climate change policy formulation and implementation and have only recently been taken up in climate change discourse.

Ethnic minority groups who live in marginal areas and whose livelihoods are highly dependent on natural resources are among the groups most vulnerable to climate change. Many ethnic groups have been pushed to the least fertile and most fragile lands as a consequence of historical, social, political and economic exclusion. On the other hand, people living in marginal areas have long been exposed to many kinds of environmental changes and have developed strategies for coping with these occurrences. They have valuable knowledge about adapting to climate change, but the extent of future hazards may exceed their adaptive capacity, especially given their current conditions of marginalization. These peoples may therefore have valuable traditional knowledge to offer the rest of the world in relation to adaptation and mitigation measures for climate change.

Many ethnic groups may therefore have valuable traditional knowledge to offer the rest of the world in relation to adaptation and mitigation measures for climate change.

Another important factor which influences socioeconomic vulnerability is the maintenance of a diversified land-use system which is qualified for adaptation to climate variability and change. Diversified livelihood systems allow local communities to draw on various sources of food and income, and in doing so, spreads out the risks of vulnerability to climate change. Biodiversity loss as a result of potential adverse impacts of climate change will affect local communities in many different ways, such as depriving them of important food sources and reducing their ability to cope with pests and diseases with the help of medicinal plants (IUCN, 2008).

Diverse crops and varieties reduce the risk of crop failure. The International Potato Centre (CIP) in Peru has identified about 3,800 traditional Andean cultivated potato varieties. This high number of potatoes varieties was developed by the farmers over centuries and allowed them to adapt their crops to different environmental factors including soil quality, temperature, inclination, orientation and exposure. Such communities already employing diversified livelihood systems are less vulnerable than others to climate change and will have higher chances of successfully coping with future climate change (IUCN, 2008).

6.1.4 The loss of traditional knowledge

On the one hand, traditional knowledge and techniques are lost naturally as techniques and tools are modified or fall out of use. But nowadays the rate of loss and the speed of extinction of traditional knowledge systems is very high due to modernization processes, rapid population growth and the ongoing destruction of traditional communities' habitats which can be caused by unresolved land rights issues and the expansion of settlements, industry and transport infrastructure. There is a risk that this great wealth of traditional knowledge will be lost, not only to them but also to humanity as a whole.

Some ethnic minority communities now get most of their education formally in schools. Textbooks, however, do not teach them about the medicinal plants found in their local environment, which earlier generations have been using effectively for a long time to treat illness. Much of this knowledge is not being

transmitted in the course of daily life either. Many younger people do not learn the names, characteristics, and uses of traditionally used plants. Traditional ecological knowledge cannot simply be put into databases, knowledge centres or research publications. Instead, the possibility to use and develop it through traditional livelihood practices and management systems is necessary (UNESCO, Terralingua and WWF, 2003).

Traditional ecological knowledge cannot simply be put into databases, knowledge centres or research publications. Instead, the possibility to use and develop it through traditional livelihood practices and management systems is necessary.

Associated with the losses in traditional knowledge and traditional techniques are the losses in biodiversity and cultural diversity. For example, policies promoting generic rice and wheat varieties devalue locally adapted species. Also, more and more traditional knowledge is being lost due to the societal preference for fast food and other readily available commercial foods. Traditional dishes made by utilizing local biodiversity seem to have become less important. Knowledge is also lost as a result of the disruption of traditional oral communication. Often many community members work outside and do not spend as much time in their community anymore. As a result, they do not learn traditional methods anymore and it is hard for older generations to transmit their knowledge. As there is a growing global awareness of the value of traditional knowledge and the interaction and interdependence of biological and cultural diversity, governments, research organizations, and development organizations try to find ways to support traditional knowledge (Grenier, 1998; GTZ, 2004).

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Main Message 15

Traditional knowledge and biodiversity

- *Traditional knowledge refers to the knowledge, innovations and practices of indigenous and local communities around the world. Traditional knowledge has developed over centuries, is generally passed on from generation to generation by word of mouth, and is adapted to the local culture and environment.*
- *Most indigenous peoples, groups, or ethnic minorities are living with and by a large treasure of traditional knowledge that helped them to exist over centuries in remote areas, using and influencing their natural environment in a sustainable and attentive way. Many of the world's most naturally diverse areas are inhabited by indigenous peoples.*
- *Traditional knowledge involves knowledge on the use of medicinal plants, and over generations it created locally adapted varieties of cultivars and domesticated animals. These treasures are of great value to humanity and it is important to prevent them from being misappropriated for economic exploitation only.*
- *Local communities of indigenous peoples and particularly women can play a significant role in the implementation of in situ conservation strategies and the development of sustainable models of agriculture adapted to the respective environment. Their well guarded rich agrobiodiversity makes them ready to adapt more easily to the challenges of the climate catastrophe.*
- *Modernization processes, rapid population growth and the ongoing destruction of traditional communities' habitats presently cause an unprecedentedly high rate of extinction of traditional knowledge systems. There is a threat that this great wealth of traditional knowledge will be lost, not only to them but also to humanity as a whole.*

6.2 Areas of traditional knowledge of conservation and sustainable utilization of agrobiodiversity

This chapter provides a short overview on the present situation of traditional knowledge in China. With the help of short case studies from China's ethnic minorities it then gives a comprehensive picture of the character of biodiversity-related traditional knowledge. There are examples of knowledge and use of local varieties, of traditional technologies for agriculture and of traditional land-use systems. Lastly, a strategy drafted to conserve and keep traditional knowledge alive is outlined.

6.2.1 The situation of traditional knowledge of ethnic minorities in China

In China, 55 minority nationalities are officially recognized (plus the majority, Han Chinese). More than half of these ethnic groups are present in Southwest China. Ethnic minorities still generally live in periphery regions. Often, the ethnic minority culture is undervalued in comparison to 'modern' and 'scientific' culture associated with the Han majority (IFAD, 2006; Xu et al., 2006).

There are no colonized indigenous people in China, but so far, ethnic communities have been living primarily in national minority areas. The local ethnic groups have maintained their own traditional culture, production methods and life style. They are most often the native people in those areas, also called "indigenous and local communities" recognized worldwide. Therefore, we can systematically study the concept of traditional knowledge of local people and communities, including the heritage, conservation, access and benefit sharing of their traditional knowledge.

In the past, conservation policies in China have generally excluded people as a factor crucial for preservation of ecosystems. Traditional resource use or land-use practices were seen as a threat to biodiversity. In the past two decades, there has been a trend toward the revival of traditional knowledge and religious practices. The culture of ethnic minorities, including their traditional rituals, dances and sacred places, is seen as increasingly marketable. This movement is driven by China's successful economic reform, and also due to the growing domestic tourism market (Xu et al., 2006). On the other hand, China's economic growth and expansion to a free market economy is also putting great pressure on the environment and cultural diversity. In many cases ethnic minority groups are still isolated from decision-making on conservation or land-use and do not receive benefits from the new commercial interest in their culture.

China pays great attention to existing traditional medicinal knowledge. Besides the Traditional Chinese Medicine (TCM) system, the medicinal systems of the Tibetans, Dai, Uyghurs and Mongolians are officially recognized. In 2001, China granted more than 3,000 patents on innovative developments within the field of Traditional Chinese Medicine. The Chinese State Intellectual Property Office has a team of patent examiners specializing in Traditional Chinese Medicine.

So far in China, no national policies or legislation exist for the protection of traditional knowledge or the fair sharing of benefits arising out of the commercial use of traditional knowledge.

According to the 3rd Chinese national report to the Secretariat of the Convention on Biological Diversity, China investigates the traditional knowledge, innovation and practice of several areas. For example, in Yunnan, an investigation on the traditional knowledge of local experts on wild animals and plants and forest management was carried out and a database of local experts was established. So far in China, no national policies or legislation exist for the protection of traditional knowledge or the fair sharing of benefits arising out of the commercial use of traditional knowledge.

At the international level, China has signed the Convention on Biological Diversity (CBD) and the UNESCO Convention for the Safeguarding of Intangible Cultural Heritage and has the obligation to implement these conventions and agreements. Furthermore, China has joined a group of seventeen countries of the world that are rich in biological diversity and associated traditional knowledge. This group is known as the like minded megadiverse countries (LMMC) and provides a platform for consultation and cooperation so that their interests and priorities related to the preservation and sustainable use of biological diversity can be promoted. The LMMC group holds more than 70% of all global biodiversity, and 45% of the world's population, and is now well recognized as an important negotiating block in the United Nations (UN) and other international forums.

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As well, there is a high number of national and international non-governmental organizations (NGOs) and research institutes working on minority issues and supporting communities in enhancing the culture of ethnic minorities and traditional knowledge on biodiversity. The majority of these project activities are ongoing in the culturally diverse Southwest China and many of the following case studies are examples of their excellent research.

6.2.2 Cases of traditional knowledge related to local crop variety resources

Traditional knowledge of locally adapted crop varieties is created and accumulated by local communities and people through many years of production activities and life experiences, during which they have domesticated different livestock varieties.

Case 1: Cultivation and use of traditional rice varieties by the Dai people (handout 13)

The Dai people's name for rice is "Hao". There are two types of rice planted and consumed by them: their main staple food is an indica type glutinous rice and they also eat common rice. This case is based on Mandong and Mandan Villages of Mengla Township and Manli Village of Mengbang Township, Mengla County, Xishuangbanna Prefecture, Yunnan Province. The traditional knowledge associated with rice variety resources and rice plantation has a number of interesting characteristics which are summarized below and explained in more detail in handout 13:

The knowledge and use of rice varieties is dynamic and innovative. Records of more than five decades indicate that there has been subsequent use of a number of different varieties since the 1950s. This includes the introduction and boom of new traditional varieties and the end of cultivation of others altogether.

- There is an active process to match best suited rice varieties to a classified system of paddy fields, which provides the best yields from each specific field.
- Rice varieties are improved through selection during transplantation and in-breeding new strains from neighbouring villages. This breeding work is mainly done by women farmers.
- Rice varieties do follow the same patterns of food preparation and consumption. Each of the varieties with its specific characteristics has its specific use in the kitchen.
- Specific varieties are used for religious purposes.

Case 2: The edible plants of Mongolians on the Erdos Plateau (handout 14)

The Mongolian people have been nomads since time immemorial. They live on their animals but have also accumulated abundant traditional knowledge of wild edible plant resources which provide them with necessary inputs to enrich their diet such as vitamins, minerals, and salt. This case is based on the situation of Mongolian communities on the Erdos Plateau. Unlike the Dao, who have also collected an abundance of knowledge in the areas of cultivation and breeding, the focus of Mongolian knowledge is rather on identifying useful plants and how to prepare and consume them. They distinguish 14 kinds of plants that are consumable for different purposes. Wild plants are appreciated for their leaves and as whole plants (leek, chicory) and their fruits (nuts, berries), and the range of uses is broad. Plants or parts of plants are eaten as food to complement and enrich a meat-based diet, provide the base for wine, and are used in a variety of applications for seasoning and cooking with meat. *Artemisia frigida* and *Sabina vulgaris* are two plants that are used to fumigate milk and process the utensils used in the milk fumigating process. As milk is considered a sacred product, the cleaning and sterilization of the tools that happens during fumigation is as well considered a religious rite. The various and differential traditional knowledge of edible wild plants of the Mongolians on the Erdos Plateau completely reflects the ecological conditions and diversity in this region.

Besides the Traditional Chinese Medicine (TCM) system, the medicinal systems of the Tibetans, Dai, Uyghurs and Mongolians are officially recognized. In 2001, China granted more than 3,000 patents ... within the field of Traditional Chinese Medicine.

At present, there are a number of research projects that try to commercialise the knowledge of the herdsmen by reproducing their recipes for processing on a bigger and mechanical scale. "Sami Vinegar", which has entered the market and is being researched and developed, "Sami Brand" wild sand rice, "Sand Onion", Mongolia leek vegetable or canned food and the series of oleaster beverages are examples of the fruits of these efforts.

6.2.3 Cases of traditional technologies for agriculture

As an effective means to protect biodiversity and realize sustainable utilization of biological resources,

traditional technologies for agriculture are also helpful to improving food quality and ensuring food safety. This kind of traditional knowledge generally refers to the applied technology created by ethnic groups and communities in agricultural and living practices over long periods of time. These technologies include traditional ecological agriculture and the processing of biological resources. Examples are:

- Stereoscopic plantation to make full use of space and sunlight
- Mixed plantations of various plants or varieties to prevent diseases and insect pests
- The technological innovation of integrated utilization of paddy fields for fish farming, and farmyard manure for marsh gas development
- The traditional technique and innovation of food processing by biological fermentation and brewing
- Textile technology and the folk technique of tie-dyeing cloth with natural plant pigment
- Slash and burn cultivation

These examples mentioned constitute the main features of adaptation to nature and adapted use of its products. The case studies below will provide vivid examples of how these features are implemented by traditional communities.

Case 1: Raising ducks and fish in paddy fields, a traditional practice of the Hani (handout 15)

Raising fish in terraced fields is similar to that in paddy fields in many ways. However, in Hani ethnic group areas, it is typical that women play a leading role in fish production. Raising fish in terraced fields is unique in the Hani ethnic group area in the Ailao Mountains, where streams which originate deep in the mountains flow all the year round and supply water for the villagers. Every household in the village has a pond to raise fish. There are 20 varieties of fish raised in the terraced fields of the Hani.

The women have the power to decide the place to raise fish and the varieties and the number of fish to be raised while the men do not usually take care of this matter. The Hani women generally like to raise carp and Shi fish. Nowadays, the women in Hani society enjoy a high position economically, domestically and socially because they control fish farming as operators and managers of the fish farming in terraced fields.

Case 2: The utilization of water resources by the Hani (handout 16)

The traditional knowledge of water resources utilization and water culture of the Hani can be summarized as follows:

- Efficient utilization of water resources
- Philosophy of water resources conservation
- Rational programme and management ideas for terraced field irrigation areas

In their villages, the Hani usually set up hydraulic stone rollers, pestles, grinders, etc., which are driven by hydroelectricity, saving themselves much fatigue and hard work. As well, they invented a sophisticated method of manure distribution with the help of downstream and irrigation water, thus saving labour and preventing physical toil.

As well, the Hani attach great importance to the protection of water resources, particularly the cultivation and protection of forested areas for water conservation. They have and obey an old rule to forbid logging forest areas key to water conservation. The forests behind their villages are even considered hallowed sacred places. These sacred forests are mostly composed of trees with good water catchment propensity.

The terraced fields of the Hani have complete irrigation systems with all technical features comparable to modern agricultural irrigation and water conservation technology (catchment, channelling, prevention of sedimentation, distribution), a sophisticated management organization (water manager of each village, irrigation toll) and strict regulations for the construction, use and maintenance of the system. That's why the terraced fields of the Hani people which were developed hundreds of years ago still work and will continue to work in the future.

6.2.4 Cases of traditional land use systems and traditional culture

This kind of traditional knowledge involves the traditional system for land utilization, cultivation methods and religious custom. It embodies conservation and sustainable utilization of biodiversity mixed with religious belief such as the worship of sacred mountains, forests and geomancy, as well as conventions such as folk law and village rules, family systems, and the habit of protecting and utilizing biological resources in the ethnic custom. These cultures and customs may result in the conservation and sustainable utilization of some biological resources.

Case 1: The sacred forest of the Hani (handout 17)

Forest area is the core of the natural ecosystem of the Ailao Mountains and an important part of the terraced field ecosystem of the Hani. The terraced field ecosystem of the Hani is composed of forest, villages, terraced fields and river valleys which are distributed in a pyramid shape. On the top of the pyramid, the cold mountain ridge hosts conserved primitive forest, on the warm hillside are the villages or houses, on the lower half of the mountain ranging from the border of the village to the valley and at the foot of the hill are the terraced fields, and below the terraced fields are the rivers. So forest is on the top of the pyramid-shaped ecosystem and its water conservation property plays an important role in the control of the whole ecosystem. But forest is much more for the Hani people than an important part of their ecosystem, providing them with an abundance of water, building material, fire wood, wild meat and edible plants. Forest is at the same time a spiritual counterpart of man, a religious object expressed through the idea of the untouchable sacred forest in the village's vicinity, and in the tradition of planting trees in the forest along with the birth of every newborn child. There is a deeply rooted relationship between trees and people that determines the Hani vision of the world.

The do's and don'ts of the relationship between Man and Nature derive from the religious belief characterized by the worship of the universe and respect of nature as generally agreed upon by the Hani. This belief has been developed into a concept engraved in their sub-consciousness and a code of behaviour everyone will consciously comply with, which has successfully protected the complete vegetation and ecosystems in their living area. The ritualised expression and reinforcement of this belief is expressed in yearly religious rituals to honour the village god and the sacred village tree, and it is expressed in very practical regulations for the use of the forest, which are strictly enforced by village appointed wardens.

6.2.5 How to conserve and transmit biodiversity-related traditional knowledge

Without doubt, there are many reasons why the protection of traditional knowledge is important and therefore leads to many discussions on the global level. One main reason is to respect the rights of ethnic minorities and local communities and to safeguard the knowledge because it is a cultural heritage. Further reasons are that ethnic minorities and local communities improve their livelihoods with their knowledge about natural resources of the surrounding environment. Indigenous activities are not simply less harmful, but can positively support the conservation of biodiversity. Thus, valuable knowledge of plants and

animals can benefit local and national economies. The last point leads to further reasons for the protection of traditional knowledge, which are to prevent bio-piracy and comply with international treaties (see chapter 2).

Ethnic minority groups themselves often have a great interest in preserving and developing their traditional knowledge and culture and in continuing to share it among community members. Nevertheless, many communities see their knowledge disappearing. In particular, lifestyle changes have stopped or impacted the transmitting of knowledge from the elders to the younger generation. For these groups, preserving their traditional knowledge and culture may also contribute to their cultural and political goals of self-identity, self-reliance and self-government by creating a strong, ongoing appreciation within the community of its history and its roots. For many ethnic minority groups, these reasons are the most important ones for preserving and protecting their knowledge.

With the threats to local traditional cultures, it is essential not only to document traditional knowledge and practices through books and films but also, most importantly, to enhance the capacity of ethnic minority groups and local communities to strengthen their evolving cultural traditions and improve their livelihoods and awareness of the value of their own culture – this might in return support conserving the local biodiversity.

Preserving and transmitting traditional knowledge is challenged by many factors:

- Some ethnic minority groups or local communities are not aware of what particular traditional knowledge they possess.
- Many ethnic minority groups or local communities do not know how to identify and protect it.
- There are few national and international laws that help ethnic minority groups preserve and protect their knowledge in a way that reflects their traditions and customs.

There are many cases where communities are actively working to preserve their traditional knowledge. They are collecting and recording oral traditions and knowledge and they are developing ways to make the knowledge more relevant to young people. However, finding long-term sustainable approaches to preserve and transmit the knowledge is a difficult task for every country. Too often, traditional knowledge issues are examined from the perspective of researchers and policy makers. Often missing is the community perspective that focuses on community control and management.

Research and development activities on traditional knowledge in ethnic minority and local communities should always ensure that the communities receive full disclosure regarding the reasons and the specific procedures for the activity, the potential risks involved

as well as the full implications of the activities before they take place (also required by the CBD). This so-called Prior Informed Consent is necessary to respectfully inquire of the community whether they are interested in sharing the resource or information, and it is a means of creating transparency.

Steps relevant to preserving traditional knowledge on agrobiodiversity on a local level may include the following:

Step 1: Community organizing and planning and processing of initial information on traditional knowledge

Empowering local communities to preserve their traditional knowledge begins with community organizing and planning. In the first stage, the community needs to understand what is meant by traditional knowledge and techniques; the villagers need to clarify what value they see in traditional knowledge and which aspects of their environmental knowledge and practices still have value for them; organizational structures of the community which gather traditional knowledge need to be identified and the roles of community members need to be determined (e.g. Who holds the knowledge?).

Here, tools can be used such as participatory meetings (open meetings involving everyone from the community in the discussion and decision-making, with special consideration of gender relations), information meetings to develop awareness of the traditional knowledge issue or workshops with small group discussions.

Step 2: Gathering and assessing information on agrobiodiversity related traditional knowledge

This includes the identification of the traditional knowledge in detail, its values for the community and the identification of ways to preserve traditional knowledge for future generations.

For the specific identification of traditional knowledge on agrobiodiversity, a resource assessment on traditional used, cultivated, and wild plant species is necessary. The inventory serves to identify plants that play a role in traditional culture. The community members or traditional knowledge holders should actively participate in the survey and assessment. Specific knowledge on plant names, categorization, locations, uses, preparation, harvesting, etc. should be collected through semi-structured or open interviews and then be categorised and analysed. The confidentiality of the collected data should be ensured by all participants and it should be agreed upon which knowledge is considered secret and should not be shared

with outsiders. In addition, data on traditional farming practices, traditional seed storages, traditional organizations within the community, etc. can be collected. A simple database can be established that is owned by the community, with all collected data on plants and related knowledge and techniques. But a databank doesn't necessarily preserve knowledge actively. Additional ways should be identified to record and preserve traditional knowledge, and to educate younger generations and others (for example through using videos or performances).

Step 3: Implementing action plans on how to preserve agrobiodiversity related traditional knowledge

An action plan developed in cooperation with the community should lead to a strategic plan that brings together all previous research and decision-making and finds solutions on how to preserve, use and transmit agrobiodiversity related traditional knowledge.

Activities of a community based action plan can include: establishing a community biodiversity databank, establishing a community gene bank with local varieties, arranging seed fairs with other communities, linking local and scientific knowledge for further development, for example through participatory plant breeding. Establishing community owned measures such as agrotourism or ecotourism can make traditional knowledge and culture an asset of more central importance and thus provide income possibilities, as can finding ways to add value through marketing specific traditional plant or plant products or crops. Thus at a national level, information and recommendations from lessons learned and good practices should be exchanged with decision makers in order to impact national legislation and regulations on biodiversity, agrobiodiversity and traditional knowledge. The development and implementation of conservation policies are important and traditional knowledge plays an active role in maintaining the environment. In cooperation with ethnic minority groups and local communities, rules must be developed and implemented at national levels to protect traditional knowledge.

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Main Message 16

Areas of traditional knowledge of sustainable use of agrobiodiversity

- *Traditional knowledge in China can be mainly attributed to the 55 so called "ethnic minorities". Official policy on nature conservation has recently become more favourable to them, and has stopped regarding human interference with nature as indiscriminately dangerous. Furthermore their medicinal knowledge is highly respected and researched. However, there are no formal regulations as how to make them true stakeholders in the process of conservation, use and economic valuation of their traditional knowledge.*
- *Traditional knowledge systems encompass traditional, locally adapted land utilization systems with their social and cultural rules and rites, agricultural technologies and local varieties of crops and animals.*
- *To fight the growing threat of loss of traditional knowledge, strategies may be developed that are designed according to the following steps:*
  - *Community organizing and planning and processing of initial information on traditional knowledge*
  - *Gathering and assessing information on agrobiodiversity related traditional knowledge*
  - *Implementing action plans on how to preserve agrobiodiversity related traditional knowledge*

Chapter 7

Assessment and Planning of Agrobiodiversity Management at Village Level

7 Assessment and planning of agrobiodiversity management at village level

Agrobiodiversity management is a complex process with numerous activities and decisions to be made at a variety of levels. However, throughout the management process, the progress and situation should always be assessed. An assessment plan is the first step to doing this. As both steps – assessment and planning – carefully conducted are paramount to the successful implementation of any local biodiversity management, this chapter will describe the procedures involved in both. Chapter 7.1 provides basic considerations on the shortcomings of present agrobiodiversity management practices and develops ideas for possible reorientation. Chapter 7.2 elaborates on the assessment step and chapter 7.3 focuses on the planning of actions and measures for effective ABD management.

7.1 Present management of agrobiodiversity – shortcomings and ideas for reorientation

This chapter will characterise present management of agrobiodiversity and its most relevant problems. It will then provide some ideas to achieve a higher degree of sustainability in local conservation and better utilization of agrobiodiversity.

7.1.1 The gap between present agrobiodiversity management and sustainable agrobiodiversity management

Deterioration of the environment and the loss of biodiversity have given mankind many warnings and lessons. Due to the continuous increase of land used for agricultural production, agrobiodiversity is disappearing rapidly and the negative consequences are considerable. There are basically two ideas to counteract this negative direction. One is to preserve-protect specific areas by banning all human use. The other is to conserve nature while at the same time allowing utilization.

Due to the present scale of ecological destruction and alteration and increasing population pressures, the absolute protection idea (preserve) is not realistic at a large scale. Already, both large and small nature reserves have been created and animals or plants can reproduce within these fenced areas. Yet these efforts have shown the problem of creating islands of protection without linkages to the surrounding environment. As well, the alternative approach – agrobiodiversity management by protection and utilization – does have its limitations. The main shortcomings are shown in table 7.

Methods of conservation and management are overly simplistic

The most frequently applied management methods include the establishment of nature reserves and fence-isolated areas. Many conservation efforts have chosen these measures because the enclosure of land looks simple and easy to handle. Moreover, it is easy to create visible achievements. However, it is rarely considered how much of an area could be taken out of production in this way and how the relative isolation affects the development of species. Another problem is high maintenance costs and fiscal sustainability. Once payments stop, the protection effect is lost. Often farmers and villagers are not actively involved in setting up those areas.

Relationships between species are overlooked and efficient management is deficient

The quantity of targeted species has long been the final evaluation standard in agrobiodiversity conservation and management. The whole ecosystem – interactions and mutual influences of all sorts of plants, animals and microbes that grow together with the targeted species within the ecological environment – were generally not further examined and evaluated. Therefore, when diseases, pests or other species invaded the area, there was little way to stop or address such issues with practical efficient management measures.

Influence of traditional knowledge on agrobiodiversity has been neglected

Until now, traditional knowledge has had a profound influence on biodiversity conservation. The influence of modern culture has made Western values of individual accomplishment and material wealth considerable challenges towards the traditional thought of "harmony between mankind and nature". Even modern biodiversity management approaches have sometimes neglected traditional knowledge as an important contributor to agrobiodiversity management.

Farmers and the public's guidance are not stressed

People frequently damage agrobiodiversity unconsciously in their efforts to increase their own gains. Environmental deterioration is caused by farmers' living and production modes to some degree, and also

Table 7: The present shortcomings in agrobiodiversity conservation (own source)

Shortcomings	Effects
Simple methods of fencing in are preferred	– Isolation of the fenced in ecosystem – Poor financial sustainability
Single variety protection approach rather than ecosystem approach	– Stabilizing effects of the ecosystem cannot be harnessed, when protected plants are attacked by pests and diseases
Traditional knowledge has not been understood and regarded sufficiently	– The neglect of traditional approaches leads to a reduction of methods in a complex system of conservation and utilization
Farmers and the public are not involved enough and convinced by the idea of conservation	– Destruction of biodiversity cannot be stopped if the stakeholders are not convinced that conservation is a good and necessary idea
Legal framework is insufficient	– Gaps in the legal framework and weak enforcement of existing rules are not helpful to stopping malfeasance against agrobiodiversity conservation regulations

by the living and consumption patterns of modern society in general. The present management methods do not emphasize the promotion of the value of biodiversity to the farmer or public as maintainers. Harsh control and simple preaching cannot convey the need for conservation properly.

Shortcomings of laws and regulations

Individual awareness and conscious behaviour should be based on a clear framework of rules. A sound legal system can not only regulate peoples' behaviour, but also provide a legal framework of sanctions. Although there are several laws and regulations about biological resources conservation in China, their pertinence and enforcement is not specific enough. This leads to the fact that damaging agrobiodiversity is not sanctioned adequately and efficiently.

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7.1.2 How to achieve the goal of sustainable agrobiodiversity management

To overcome the described flaws of present management of agrobiodiversity and make progress towards the goal of sustainable development, it is advisable to consider a couple of issues:

Combination of agricultural production and biodiversity

As mentioned above, there are two main tools for biodiversity conservation and management: *ex situ* protection and *in situ* protection. *Ex situ* protection means to collect and protect resources. It is usually performed by different levels of scientific research institutes. As a consequence, this kind of conservation has little to do with farmers' agricultural activities. *In situ* conservation in "fenced in" areas is often carried out by national institutions or by international organizations. The drawbacks of this method are as quite obvious: a certain area will be fenced in, and after a certain time the funds for keeping up the regime will be depleted. These measures restrain and alter peoples' productive activities and leave farmers having trouble seeing the value of protection. Managing biodiversity (*in situ* conservation by farmers), in contrast to fencing it in, seeks to combine production with agrobiodiversity conservation. This approach tries to efficiently utilize agrobiodiversity, correct the contra-

diction between protection and production, and raise the farmers' knowledge about and enthusiasm for protecting agrobiodiversity.

Proper guidance to farmers

Farmers utilize agricultural diversity – they are the direct beneficiaries of agricultural diversity and the direct victims of damages to diversity. Proper guidance that links the knowledge of agrobiodiversity with knowledge on production and development should be set up to make farmers understand and accept protection ideas. This guidance should include public promotion, training, extension and control.

Managing biodiversity (*in situ* conservation by farmers), in contrast to fencing it in, seeks to combine production with agrobiodiversity conservation.

Incentive mechanisms for agrobiodiversity management

Agrobiodiversity management is the responsibility of a wide range of people, including farmers, agricultural scientists, development personnel and also political leaders. However, for many of them, the conservation of agrobiodiversity runs contradictory to their desire for a better and economically secure life. Farmers in areas with an abundance of biodiversity face enormous pressures in meeting their basic living needs, and local governments are still focused on solving livelihoods problems. The key factor in the success of sustainable development is the ability to address this perceived contradiction between basic needs provision and sustaining biodiversity over the long-term. The establishment of national and local incentive mechanisms that suit each situation, therefore, is another ingredient for the sustainable development of agrobiodiversity management.

The establishment of national and local incentive mechanisms that suit each situation, therefore, is another ingredient for the sustainable development of agrobiodiversity management.

The formulation of related laws and regulations

Through a clear legislative system which is duly enforced by the national administration, damaging behaviours could be sanctioned adequately.

Author: Yang Qingwen

7.2 Assessment of relevant components of agrobiodiversity at village level

When entering a region or a village with the intent to improve or to start proper management of biodiversity, most often a clear and comprehensive picture of the status and relevant factors of agrobiodiversity is missing or incomplete. Usually data has to be gathered and organized in order to understand the relevant components, the relations and dynamics of an area, and its associated agricultural and cultural situation. As agrobiodiversity is a rather complex concept, the understanding of it requires looking into a number of aspects, starting with the very biodiversity of the agricultural ecosystems. Other necessary perspectives include the socioeconomic situation related to agricultural diversity and the traditional knowledge within the social system.

7.2.1 Baseline survey of agrobiodiversity

Understanding agrobiodiversity requires an understanding of the state and dynamics of animals and plants within the given local environment (village, watershed, or landscape area).

A dynamic tool for assessing many aspects of biodiversity at a local level is the participatory assessment, typically a first step of participatory village planning. This participatory assessment is usually carried out by research teams working in close collaboration with the villagers. It usually is an exercise with a range of different participatory appraisal methods and takes between one and three days. Usually it provides a fair overview of the situation and sufficient insight for further steps. Moreover, it helps to increase mutual understanding between villagers and technicians, building the basis for future cooperation in biodiversity management. Handout 19 provides an overview of the methods used and results produced by such a procedure. If this instrument of participatory assessment does not provide sufficient information, more intensive research may be needed, including researching data on domesticated and wild animals and approaches for gaining detailed insight into the ecological environment with domesticated and wild plant societies.

7.2.2 Investigation of socioeconomic issues

The level of local socioeconomic development has an important influence on agrobiodiversity as it par-

Figure 22: Agrobiodiversity baseline survey in a village

tially determines human utilization of natural resources. Semi-structured interviews with a list of topics to be covered during a conversation with farmers are a useful tool to gain the necessary insights. There are a number of aspects that can help to assess and evaluate the situation broadly and thus decide on further steps from a sound basis of knowledge.

General information on the situation includes questions on:

- The size and structure of the local population. Investigation should be carried out by gender and age groups. The main method is the utilization of administrative statistics.
- The degree of public awareness refers to the agrobiodiversity conservation knowledge by the population within the area. An investigation on this could be done by media analysis or by a questionnaire.

The capacity of the local administration is determined by:

- The personnel in local agrobiodiversity conservation organizations and institutions. Investigations are mainly carried out by interviewing relevant staff.
- Do policies and regulations for the conservation of agrobiodiversity made by the local government and relevant departments exist? Main investigations at the local and village level should cover the local rules with respect to agricultural production and analyse if they will influence the conservation of agrobiodiversity. Main methods for investigation are document enquiries and interviews.

The economic situation can be characterized by:

- The quantity and source of collective economy of the administrative village within the area. It is carried out by interviewing village cadres.
- Roads, drinking water, waste disposal, irrigation, power supply and communication facilities controlled in the managing area. Investigation on this subject is mainly carried out by interviewing village cadres together with field surveys.

The socioeconomic situation of farm households can be described using data on:

- The land that is utilized for agricultural production within the agrobiodiversity management area. Agricultural land includes farmland, garden plots, forestland, forage and fishing area. The investigation can be done by interviewing village farmers.
- Farmland area per person and average output value per mu.
- The quantity, source and structure of the net income within the area, which is mainly found by investigating households.
- Formal and informal education such as primary school, middle school, high school, illiteracy elimination and other training. Investigations in this field are mainly carried out by interviewing village cadres and by distributing questionnaires. It is important in this respect to also observe women's education levels.

A number of these aspects can as well be assessed during the above mentioned participatory village assessment (see handout 18). Furthermore, the socioeconomic assessment can include inquiries into the existence of traditional knowledge within a given society. In this respect, it is important to design the focus accordingly.

7.2.3 Traditional knowledge investigation related to agrobiodiversity management

Over the past millennia, man has experienced a long agricultural civilisation. Such an experience has made people respectful of and intimate with nature (see box 26 and 27). Native ethnic groups in each area have established very close relationships with their local environment and its animals and plants. Diverse indigenous knowledge systems and traditional religions have been formed through interactions and long-term experiences of humans with the local environment. These knowledge systems and traditional cultures contain rich cognition, knowledge and practice of the utilization and conservation of animals, plants and ecosystems as a whole. Therefore, they have become the social base and technical safeguard for the harmonisation between the native ethnic groups and their local environment and local biodiversity. In spite of tremendous changes in society and agricultural techniques, rural people still use traditional knowledge and techniques to manage and operate and it could and should be the basis of agrobiodiversity management. We should not only value it, but also use it as a reference for conservation work in the future.

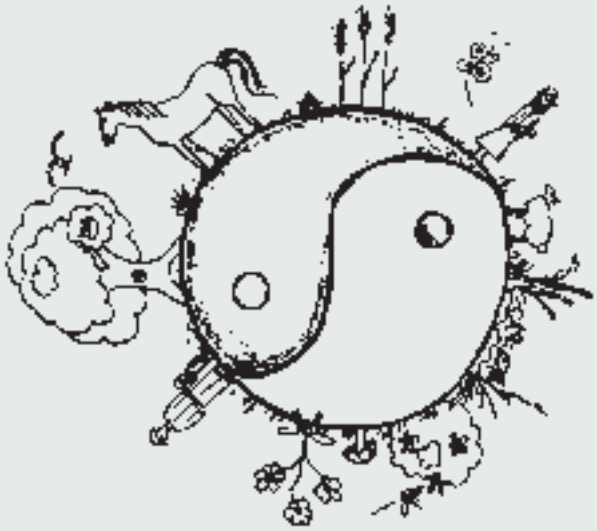
In order to truly comprehend it, Western, urban and technically trained people have to change their perspectives and carefully observe and listen to rural people. Usually, traditional knowledge is manifested

Box 26: The holy nature of the Hani

The Hani consider swamps and natural lakes to be "holy land" for "gods" that should be under absolute protection. The Naxi see oak trees as trees of life and the cypress tree takes a top position in Naxi culture and is not allowed to be hurt. Some tribes also regard snakes, tigers, leopards and other animals as a life force, the hunting of which is not allowed.

Box 27: The Dao idea of man and nature

Having played an important role in traditional Chinese culture and instructed by the thought of "harmony between nature and human being", Daoism emphasises the harmony between people and all species in the universe. Daoism insists that there is no difference in ranks, everything has equal rights and every life should be treated with respect. Daoism teaches of a natural balance. It considers everything in the universe to be formed by Qi (energy). Daoism also considers the variety of species as an index for the standard of wealth, thus valuing the protection of biodiversity and a natural balance.



through sets of norms and internalised rules that guide attitudes and behaviour of rural people. It is advisable to be attentive in the following areas:

Mode of production

In different areas, depending on the local natural conditions, local modes of production have been developed (see box 28). This formation of different modes of production is not an accident – it is formed through a long-term practice of interdependence between agrobiodiversity and environmental resources. Looking at these complex production systems, always tightly related with religious rituals, traditional customs, folk arts, food culture and social life aspects, these modes of production can be considered as management of agrobiodiversity using traditional knowledge.

Internalised social rules and norms

Social rules and norms usually are not within the conscious room of thoughts and ideas of the individual, but guide the person's behaviour. This is true as well for rural people who obey some behavioural rules spontaneously. These rules have a similar and even much stronger effect like the local laws affecting human behaviour on a more conscious level. They instruct villagers' daily actions and, in many cases, promote the conservation of agrobiodiversity.

At present, traditional resource managing modes based on folk cultural beliefs, folk values and regulations of villages are challenged in every respect. Collection of native local knowledge of biodiversity conservation, and management and recovery of the positive influence of folk cultures towards biodiversity are therefore two of the most important tools for biodiversity conservation in rural areas.

Author: Yang Qingwen

Box 28: Multiple use production modes of the people in the Tang river basin

In the Ming and Qing Dynasties, people that lived around Tang river basin used to practice a sustainable utilization of all kinds of biological resources. They created an integrated form of farming, forestry, animal husbandry and fishing. In Sanyang Wetland, where a dense water network existed, they planted water chestnut between rivers. This was not only helpful to increasing the farmers' income; it also helped with beautifying the environment and cleaning the water. In the Tang river basin, people also had the good habit of digging the river mud. They dug out the river mud each year and applied it to the root of crops, which cleaned the channel and fertilised the crops.

Main Message 17

Assessment of relevant components of agrobiodiversity at village level

- *Management of agrobiodiversity at village level starts with an assessment of:*
  - *The situation of agrobiodiversity*
  - *The socioeconomic context*
  - *Rural societies' traditional knowledge*
- *Participatory assessment tools provide necessary data for all aspects of biodiversity management and help to involve the local population in a joint learning process with the aim of protecting biodiversity.*

7.3 Strategies and action plan for sustainable agrobiodiversity management at village level

7.3.1 Ecosystem approach in agrobiodiversity conservation

Conservation of agrobiodiversity includes conservation of the agricultural ecosystem. In general, the agricultural ecosystem contains a number of subsystems that can be neighbouring and overlapping areas. These subsystems are the:

- Subsystem of farmland and plantations
- Subsystem of animal husbandry and grassland
- Subsystem of wetland, agricultural and other residual wild habitat
- Subsystem of nature reserves and surrounding farming areas

In order to provide a complete picture, there is of course the village subsystem with coexistent animals (birds, mosquitoes, flies, mice, etc), domesticated animals (chicken, pigs, dogs, cats, etc) and coexistent plants that form the whole of the rural ecosystem and agricultural food chain.

Biodiversity friendly farming practices aim to increase the diversity of crops. Thus, they encourage the expansion of varieties grown, and the preservation of older, locally bred indigenous varieties and breeds, adapted to the local environment.

Most rural landscapes and ecosystems are shaped by farmers' activities and the farming community. In rural mountain areas for example, cultivated rice terraces form part of the village landscape. Fruit trees intercropped with local and wild vegetables are near the homestead, and small village forest areas contain a variety of local and naturalized forest trees with herbs and wild medicinal plants. Hedges in and around village areas provide shelter for many small animals and mountain birds. A variety of flowering plants, crops and fruit trees attract bees and other small pollinators to ensure proper setting and development of fruits.

Farmers can support and promote rich biological diversity in their village through adoption of biodiversity friendly farming practices. They integrate crops, fruit and forest trees, wild plants (mushrooms, medicinal herbs etc.), livestock and small wildlife habitats (such as hedges, small stands of trees for birds and other small animals) as part of the farming system. Combined with a high diversity of crops and farm animals is a reduced reliance on agrochemicals to control changes in soil and environmental conditions.

Figure 23: Local agricultural ecosystem

Biodiversity friendly farming practices may include the following measures:

- Creation of small niches or biotopes for wildlife (hedges, shrubs, stands of trees)
- Protection of existing habitats such as swampy areas, stream beds, rocky areas and village forest
- Creation of breeding places for beneficial insects
- Intercropping (mixture of different crops) and agro-forestry
- Incorporation of crop residues into the soil
- Controlled application of mineral fertilizer, promotion of application of organic fertilizers (compost) to increase soil organic matter and humus content
- Environment friendly application and use of pesticides and herbicides
- Biological pest control

Biodiversity friendly farming practices aim to increase the diversity of crops. Thus, they encourage the expansion of varieties grown, and the preservation of older, locally bred indigenous varieties and breeds, adapted to the local environment.

An ecosystem approach to biodiversity conservation regards the totality of the mentioned systems and their interaction with local human culture. It assesses and evaluates traditional knowledge, biodiversity friendly farming practices and innovations, and encourages their use and extension in all possible and adapted ways of promotion.

7.3.2 Increasing farmers' awareness of biodiversity and agrobiodiversity

Biodiversity issues relate to everyone's daily life, but of course farmers have the most direct and close relationship with natural biodiversity. As well, it is their behaviour that imposes a tremendous influence on agrobiodiversity conservation and utilization. Therefore, it is important to strengthen farmers' awareness of biodiversity while providing them with hands-on practical knowledge to develop and improve their professional practices. In order to do this effectively, the following issues should be observed:

An ecosystem approach to biodiversity conservation regards the totality of the mentioned systems and their interaction with local human culture.

- Education and awareness has to be based on the farmer's living and communication patterns.
- Rural multiplicators, like teachers, local politicians and local economic leaders, have to be included in any awareness-creating campaigns.
- Local social events and organizations could be used to combine group festivities with agrobiodiversity knowledge and thus increase farmers' enthusiasm.
- Specifically target rural women. Their words and behaviour largely influence children. With women having a positive attitude towards biodiversity conservation, consciousness will be deeply planted and widely spread in new generations. Furthermore, in most cultures, women play a significant role in agriculture, especially in managing the home gardens.

7.3.3 Rural development and agrobiodiversity management planning

In the past, rural development measures always caused damage to biodiversity. Large farming areas and pastures were developed with the sacrifices of vegetation and function of wetlands, swamps and waterside areas. Large quantity of fertiliser and herbicide were used to increase yields, but other species were also endangered or even eliminated. Construction of roads and houses replaced large amounts of farming area and changed the landforms and ecology to a degree. Species habitats were destroyed, the number of species varieties dropped sharply and some species were even on the edge of extinction. Driven by profit, local people hunted or killed the animals or over-collected plants to increase their income.

Figure 24: Training of farmer field school women group members

Table 8: Possible measures supporting *in situ* conservation at village level (own source)

Potential in-village activities	Project involvement	Other support
1. Establish farmer groups – farmer field schools (FFS) in project villages	National/Provincial level provides training, county implements	
2. Assist to establish an ABD demonstration plot for the farmer group	Small inputs by project, advice through township staff	
3. Train farmer groups (FFS) in crop husbandry improvement and ABD related measures	Township and county staff	MoA county subject matter specialists
4. Establish ABD crop registers managed by FFS	National and county staff	
5. Assist to define village regulations on ABD management	National and county staff	
6. Train farmers in seed production and storage techniques	National/provincial level organizes training, county/township level conducts training	MoA county subject matter specialists
7. Organize seed exchange	National/provincial office organizes training and inputs, county staff organizes exchange	MoA seed department
8. Assist to establish conservation areas	National level provides compensation fund and materials, farmers provide materials and labour	
9. Assist in establishment of small nurseries (fruit tree, timber)	National/provincial level organizes training and few materials, county implements	Horticultural experts and foresters
10. Support village in small scale development measures	Project provides fund, farmers provide material, input and labour	Expertise from other departments
11. Link village to development measures provided by other government departments and organizations	Organize link and contacts	Other departments and organizations
12. Link farmer groups to markets	National/provincial level develops concept and contacts, county and township level follow up	Private industries
13. Train and assist farmers in small scale processing of farm produce	National/provincial level develop concept and contacts, county and township level follow up	Consultants and private industry
14. Link potential minority villages to development of agro-/ecotourism	National level develops concept, Provincial and county level provide contacts	Tourism department and national park authorities

In order to avoid similar situations, agrobiodiversity management and rural development must be paid the same attention and planning has to be carried out together with the local community. Participatory village planning is a good planning tool, described in detail in handout 18. Careful assessment as the basis of careful and feasible planning leads to an integration of conservation measures into village development efforts.

7.3.4 Implementation of agrobiodiversity management with farmers groups, farmers associations and local communities

The joint assessment and planning process described above results in an implementation procedure, designed as a community and participatory process. There are a number of possible activities for the combination of agrobiodiversity conservation and rural development, as outlined in table 8, and further elaborated in the paragraphs below.

Establishment of farmer groups (farmer field schools in project villages)

The establishment of farmer groups involves organizing a group of farmers who are trained and actively involved in the sustainable management of ABD. This farmer group is the lead group in the village for ABD conservation and is associated with a farmer field school (FFS). The farmer field school is an ideal concept for the establishment of village groups who meet at regular intervals (twice per month) and discuss their issues on ABD. The group meets only for 2-3 hours per session. This requires little input and time for the group meetings. The group meeting is attended by technical agriculture field staff that may provide inputs or even invite other experts to give inputs to the group. Usually farmer field schools establish demonstration plots on one of the farmers' fields. These plots may serve as demonstration site to show the group and other farmers how management of ABD can take place on a village level and how crops with high value can be grown. The demonstration site is normally close to the village area so that all farmers can visit the site. The farmer field schools usually have to get some initial training on group building and on management of groups before running the technically supported groups on their own.

Agrobiodiversity management and rural development must be paid the same attention and planning has to be carried out together with the local community.

The steps in the establishment of an FFS are as follows:

- Identify target participants according to the following criteria: land holding, gender representation, interest, space for cultivation, one member per family, etc.
- General meeting at community level for each FFS area with the local elites to share the objective of the project and gain support from community people.
- Household visit: after having identified a certain number of interested people, extension officers visit the listed participants at their house to explore family acceptance and observe the feasibility of project interventions.

The FFS group members then prepare a plan on the content of the learning sessions and field activities for their improved farming based on the existing situation and their needs. Before the actual start of the FFS, a learning contract specifying rules and regulations of the learning process should be signed by both parties (FFS group members and Agricultural Bureau staff). In this contract, the responsibilities of the participants and the project staff are clearly defined. This creates a sense of ownership by the participants from the very beginning of the activities.

The farmer field school is an ideal concept for the establishment of village groups who meet at regular intervals and discuss their issues on ABD.

The field school should be located in a suitable location (usually in a farmer's home or community space) and close to the study plot and other members' houses so that all participants can conveniently attend the regular sessions. In general, 20 members form a group and meet once or twice a month (up to three hours) to share the learning of the field implementation and discuss new topics. In general, it is advisable to have some initial material provided (training material like paper, drawing pen, scale, seed, or saplings for study plot support, etc.), which functions as "starting capital" for the FFS and is administered by the FFS. FFS group members should add an almost equivalent sum in kind to run the FFS: for example, land, compost, labour, and fencing. A register is maintained where all members' names, expenses for the study plot, observations, and recommendations are kept. The recording is done by the lead farmer or a literate member of the FFS.

Each field school has an organizational structure with a group leader, secretary, etc. The FFS sessions are pursued for eight to nine months and are typically comprised of technical and social issues. The sessions timing and content amongst different FFS are not uniform but depend on the cropping pattern of the locality and the preferences of the participants, as mentioned earlier.

Technical topics could include: ABD and biodiversity conservation, seed improvement and storage, hand pollination of vegetables, organic pesticide and fertilizer preparation, winter vegetable production technology, study plot establishment, fruit tree management, insect management of major fruits, vegetable seed collection and preservation, and compost preparation.

Social topics could include: environmental protection and promotion of a clean environment, gender awareness, and sanitation.

A typical FFS learning event includes the review of last meeting's activities, group dynamics, a learning session with action plan preparation, discussion of farmers' recent problems (planning of support session), impact points (delivering emergency messages relevant to that month) and review of the whole session.

Study plot

The study plot is an integral part of the FFS. It is a piece of land (about 0.5 - 1 mu) situated right beside or near the FFS meeting place. Each FFS establishes one study plot. The Lead Farmer or any other farmer provides the land for learning. Members themselves select the crop to be grown according to their learning interest. The participants compare the crop cultivated following the improved methods discussed (raised bed, use of compost, use of natural or non-toxic pesticides, etc.) with the status of the plants in the adjacent plot which are cultivated in the traditional way (farmers' practice).

The participants should keep notes about the baseline information of the farmers' practice in the FFS register to avoid any manipulation and to compare with the results of the improved practice. This helps FFS members enhance their self-confidence and decision-making capacity and gives the community the opportunity to observe the impact of different cultivation methods and possibly to adopt them in their own fields.

Farmers field day

Farmers field day (FFD) is an effective extension process by the extension or technical office staff for

Figure 25: Training of farmer field school members in their study plot

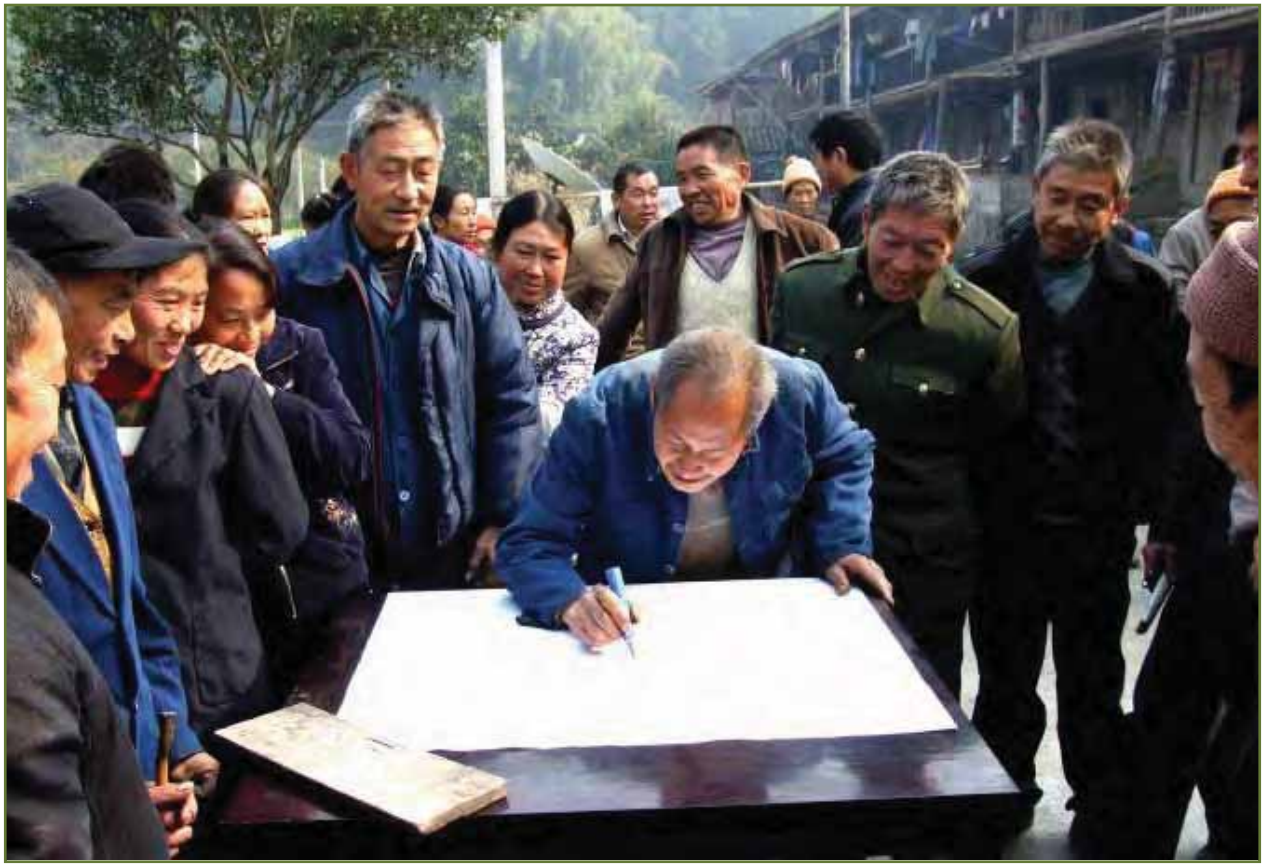


Figure 26: Discussion of establishment of a small local conservation area

sharing and dissemination of group achievements with local elites, community members and others. At the end of the FFS season, each FFS group organizes a Farmer's field day, together with their facilitators, at a prominent place in the community (school ground, fallow high land, a larger farm, etc.), where the group presents its learning, its new experience and its successful cultivation practices. Stalls are set up in which the topics discussed during the past FFS season are presented in drawings, models (for example on how to set up a homestead including biodiversity aspects: "ideal homestead plantation"), and demonstration material. Group members explain their learning and experience to visitors. The field day also includes a social event like village fair with music and short plays to inform the audience about the group's work and achievements.

An additional effect besides the sharing of information with fellow villagers is that the group members gain recognition and develop some pride for what they have done. For female participants, it is a remarkable opportunity to expose and get recognition by the society.

Training of farmers and farmer field schools in seed production and storage techniques

An important aspect for proper seed modification and breeding is the availability of good quality seeds. This refers to both the production techniques of good quality seeds and also the storage techniques of the seeds. The current practice of seed production and storage are first evaluated. This evaluation results in recommendations for respective trainings on how to improve seed production and storage, which may be provided to the FFS groups.

Organization of seed exchange

In many villages, old and traditional ABD crops that were held in esteem by the farmers and used for traditional ceremonies were lost over the years. In order to give farmers the opportunity to gain access to the old varieties again, an exchange of seeds between farmers, farmer field schools and also between different villages in the same county can be supported. The seed exchange can be organized twice per year before the planting season. The exchange can take place at regular fairs or markets for farmers, where special areas are reserved for farmers' traditional seeds. Initially, the seed exchange may take place in form of a meeting between farmer groups, but later on the seed

exchange should be more institutionalized through provision of traditional ABD seeds at local markets.

Assist in the establishment of conservation areas

Conservation areas refer to areas with high value ABD crops that are endangered and also to areas of wild relatives of crops. These areas can often be found in marginal places with steep slopes, along the roadside, and in the vicinity of small streams. Farmers and farmer field groups can be supported in clearly delineating such areas as reserved areas which have to be protected. Protection can take place using different methods or steps. First, the area is clearly marked as reservation area and an area of high biodiversity through signs, and is protected by locally established demarcation lines. Permanent fences should only be erected if the species in question is on the red list of highly endangered species. Generally, conservation and protection should be promoted through increasing the awareness and the pride of the villagers in wild plants and the abundance of species in their surroundings as a treasure.

Establishment of small nurseries (fruit trees, timber)

It may be important that some members of farmer field school groups get knowledge on how to establish and manage small tree nurseries. This is important for future activities and also can create income for farmer groups. However, the establishment of nurseries is dependent on requirements by the farmers and local necessity.

Support villages in small scale development measures

Small scale development measures are measures to support the villages according to the needs elaborated during participatory village planning (PVP). The problem analysis during the PVP exercise can indicate the most urgent problems of the village and their requirements. These problems cannot be neglected during the implementation of ABD measures, but should be taken into consideration and linked to them. Small funds should be available for those improvement measures and measures supported should be linked to ABD conservation. For example, if the building of an access road is being supported, the road can also be designed to increase market access and lead to better marketability of ABD crops. It is also required that the villages contribute to the small development measures, either in kind through labour, or even make cash contributions whenever required.

Figure 27: Local processing

Link villages to development measures provided by other departments

Here, development measures refer to ongoing national programmes. Villages can be linked and put in contact with other departments of the government. For example, if an ongoing road building programme is nearby the village, this could be extended. Links can also be established between rural energy stations and other government departments and ongoing projects.

Link farmer groups to markets

The ABD farmer field school groups who have potential ABD crops for further marketing can be linked to those markets. This means farmers, groups of farmers, or NGOs will have to carry out studies to find these markets and to evaluate the potential of ABD crops for local, regional, and maybe in the long-run national or international markets.

Train and assist farmers in small scale processing and production

Farm products with value added can usually obtain higher prices on the market than plain raw products. Initial forms of processing that could add some value to raw products and that are feasibly done by the producers themselves (grading, cleaning, etc.) could be supported, especially for crops that are important components of agrobiodiversity. Value chains that provide the possibility for value addition have to be identified for this, and farmers have to be linked to potential entrepreneurs, processors or traders. Regular meetings between farmers, consumers and processors can give farmers the opportunity to get to know the quality criteria for their products.

Link villages that have the potential to the development of agrotourism

Some villages may be close to tourism centres and agrotourism could be established (see chapter 5). Interested tourists can come and see the villages, potential ABD crops, and traditional life styles. A careful approach, however, has to be taken to maintain the traditional attitude of villagers which is in itself an attraction for tourists. Agrotourism is not mass tourism. It is individual tourism with interested people who want to know more about traditional agricultural farming systems, traditional use of crops and farmers' way of working and living.

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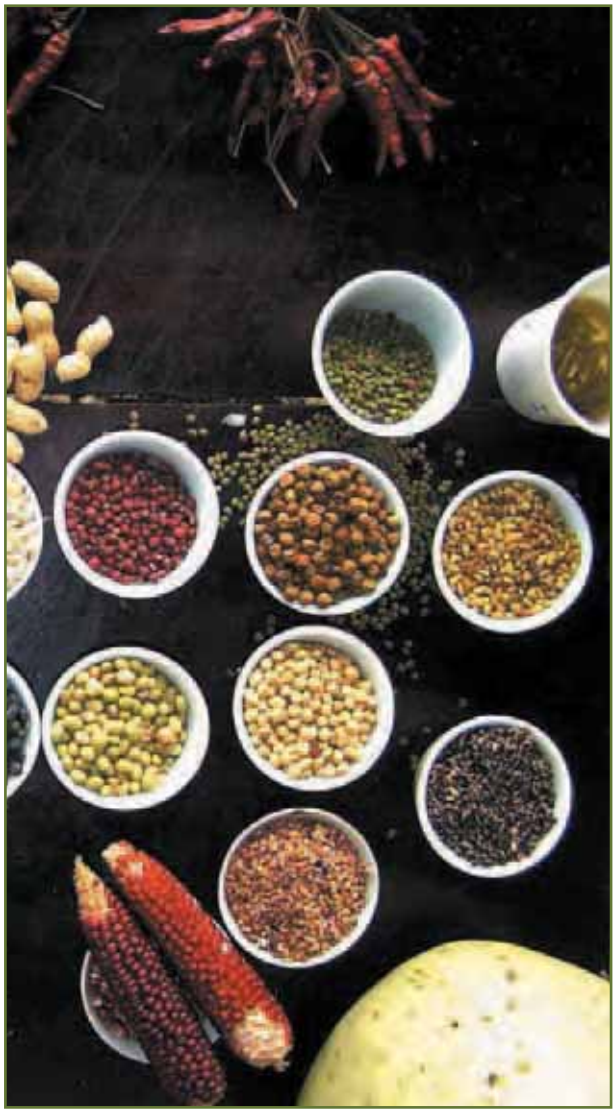

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Main Message 18

Strategies and action plan for sustainable agrobiodiversity management at village level

- *Management of agrobiodiversity has to take a systems perspective to be effective. Only if the complex dependencies of the landscape, local ecosystem and human cultural system are taken into consideration, can management measures be sustainable.*
- *Traditional knowledge systems encompass traditional, locally adapted land utilization systems with their social and cultural rules and rites, agricultural technologies and local varieties of crops and animals.*
- *Farming practices can both harm and foster biodiversity. For concrete decisions on farming measures, it is important to understand their impact on the surrounding ecosystem.*
- *In order to bring forward biodiversity supporting farming practices, it is important to strengthen farmers' awareness of biodiversity and provide them in the mean time with practical knowledge to improve their professional practices.*
- *Biodiversity management at village level includes:*
  - *Joint learning of and with farmers in farmers study groups*
  - *Joint elaboration of an agreement on rules and regulations with as many rural stakeholders as necessary*
  - *Appreciation of existing and introduction of new, biodiversity enhancing techniques*
  - *Linkage to local and regional markets*
  - *Measures for environmentally friendly and ecosystem protecting rural development*

Handout 1

Main thematic fields of Convention on Biological Diversity provisions

Protect and achieve sustainable utilization of biological diversity

It is specified in Article 6 of the Convention on Biological Diversity (CDB) that a national strategy and plan shall be made and the protection and sustainable utilization of biological diversity shall be included in the relevant department and inter-department plans, schemes and policies. In order to carry out protective action on the basis of scientific research and analysis, it is required by the CBD that all the contracting parties of the treaty shall investigate and verify the components of biological diversity and determine the top protective project to be implemented.

- It is specified in Article 8 of the CBD that a natural reserve system shall be established to protect the natural environment and wildlife.
- Article 9 specifies that *ex situ* protection shall be carried out as a complementary step.
- In Article 10 of the CBD states that sustainable utilization of the components of biological diversity shall be achieved.
- All the contracting parties are required to encourage protection and utilization of biological diversity by means of social and economic strength in Article 11 of the CBD.
- In Article 14 of the convention, all the state members are required to assess the impact of any conceived project on the environment and on biological diversity, so as to minimize the adverse impact of the project and threat posed to biodiversity.

During the 10 years after the commencement date of the CBD, the protection of ecological systems including forest, wetland, the sea, grassland, desert and endangered rare species was taken as a top priority and a number of projects for protection and sustainable utilization of biodiversity were carried out in developing countries based on the CBD's financial mechanism (Global Environment Fund, GEF).

Access to genetic resources, sharing of benefits and transfer of technology

The access to genetic resources and sharing of benefits between nations constitute a central part of the CBD.

- It is specified in clause 1, Article 15 of the CBD that a nation has sovereignty over its natural resources and the government has the authority to decide on the access to natural resources based on the law of the country providing the natural resources.
- As per clause 5, Article 15 of the CBD, the access to natural resources shall be approved by the contracting parties providing such natural resources.
- In clause 6, every contracting party is required, where applicable, to have the countries providing genetic resources involved in the development and research of genetic resources it has supplied.
- In clause 7, the contracting parties of the CBD are further required to fairly share the results and commercial interests arising from the research and development of such resources based on agreement between both parties pursuant to laws, administrative regulations and policies.
- The CBD also emphasized the transfer of the relevant technology while encouraging access to genetic resources (see Article 16, Access to Genetic Resources and Transfer of Technology).

That is to say, developed countries should transfer their technology, including biological technology and particularly technology on research and development of genetic resources, to developing countries on preferential terms and share the benefits with the countries which provide the genetic materials. The restrictions imposed by property rights on the access to and transfer of technology are also dwelled on in Article 16 of the convention, which requires every member nation to facilitate the access to and joint research as well as development of technology by the enforcement of law, government regulations and policies.

Security of genetically modified organisms

It is specified in Clause g, Article 8 of the CBD that measures shall be taken to regulate, manage or control the risk that may be caused by the application and release of living modified organisms arising from the use of biological technology.

At the second Conference of the Parties held in 1995, a resolution was approved to formulate a protocol to regulate appropriate procedures to safely operate, handle and apply the living modified organisms and their related products produced by using modern biological technology. After hard negotiation and preparation for four years, the document of the Cartagena Protocol on Biosafety was finalized and came into effect on 11th of September, 2003.

This protocol specifies that the cross-border transfer of transgenic organisms and their related products shall be approved by the importing countries, the risk of environmental release of transgenic organisms shall be assessed and its potential risk shall be managed, the cross-border transfer of transgenic organisms shall be labelled on the shipment of such materials, and the exporter shall compensate for and remedy the losses caused by the hazard of transgenic organisms on the environment.

Management of invasive alien species

It is specified in Clause h, Article 8 of the CBD that invasive alien species threatening ecosystems, habitats or species shall be prevented from introduction, controlled or eliminated.

In order to enforce this clause, the secretary division of the CBD has held several expert meetings to find a solution to the prevention of the cross-border transfer of invasive species and formulated the Guideline for Prevention and Relief of the Impact on Introducing Alien Species that Threaten Ecosystems, Habitats or Species. This guideline stresses that the control of domestic and international introduction of invasive species shall be taken as a top priority to prevent the invasion of alien species and requires every country to fully recognize the risk of invasive species and try to minimize such kind of risk through joint efforts of all governments.

Protection of traditional knowledge

It is specified in Clause j, Article 8 of the CBD that the contracting parties shall, subject to its national legislation, respect, conserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles related to the conservation and sustainable use of biological diversity, promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices and encourage the equitable sharing of the benefits arising from the utilization of such knowledge, innovations and practices.

In recent years, the CBD has held a number of international negotiations for the protection of traditional knowledge and the sharing of the benefits arising from the use of it.

Handout 2

Objectives for the conservation of biodiversity in 2010

Conservation of biodiversity

In the field of conservation of biodiversity, at least 10% of the global ecosystem will be effectively protected, particularly in the areas critical for biodiversity, the population of certain categories of species shall be restored and maintained and the decline of their size shall be reduced to relieve threatened species for the conservation of biodiversity. As for the maintenance of genetic diversity, the conservation of the genetic diversity of crops, livestock and fowl, forest, fish and wild fauna, as well as other valuable species shall be strengthened to conserve traditional knowledge about genetic resources.

Sustainable utilization of biodiversity

In the field of sustainable utilization of biodiversity, the resources for the production of biological products shall be continuously managed and the management of productive areas shall be linked to the maintenance of biodiversity. The unsustainable utilization of biological resources and the impact of consumption on biodiversity shall be reduced and the international trade in endangered rare species shall be banned.

Threat relief

In the field of threat relief, the loss of habitats, alteration of land use, degradation of land, and the use of water resources against sustainable development shall be reduced, the loss and degradation of natural habitats shall be inhibited, the potential invasion of major invasive alien species shall be controlled, a management plan for alien species threatening ecosystem, habitats or species shall be formulated, the capability of biodiversity to adapt itself to climate change shall be maintained and improved, and pollution and its impact on biodiversity shall be reduced.

Maintenance of the products and services of biodiversity

In the field of maintenance of the products and services of biodiversity, the capability of ecosystem to provide products and services shall be maintained and the capability of biological resources to support the sustainable livelihood of human beings and guarantee local food safety and health shall be maintained.

Conservation, innovation and practice of traditional knowledge

In the field of conservation, innovation and practice of traditional knowledge, the diversity of indigenous and local community culture shall be maintained, the innovation and practice of traditional knowledge shall be protected and the rights of the indigenous and local community in regards to its traditional knowledge, innovation and practice, including the rights of sharing benefits, shall be protected.

Fair and equitable sharing of benefits arising from the use of genetic resources

In the field of fair and equitable sharing of benefits arising from the use of genetic resources, all transfer of genetic resources shall comply with the Convention on Biological Diversity, International Treaty on Plant Genetic Resources for Food and Agriculture, and other applicable agreements.

Appropriate supply of resources

In the field of appropriate supply of resources, developed countries shall supply developing countries with additional funding and relevant technology to properly fulfil their commitment.

Handout 3

Mechanisms of the Bonn Guidelines on Access to Genetic Resources and Fair and Equitable Sharing of the Benefits Arising out of their Utilization

The Bonn Guidelines specify the procedures to get access to genetic resources and share benefits arising from their utilization, including a "Prior Informed Consent" system and "Agreed Provisions and Conditions".

Prior Informed Consent

The Prior Informed Consent procedure requires that the access to genetic resources should be preceded by informing the provider country of the resources in advance to getting its consent, including the information to be provided to the competent authorities about the time to get access to the genetic resources and the purpose for their use, entering into the procedure of Prior Informed Consent, the mechanism for consultation with the stakeholders, etc.

Agreed Provisions and Conditions

The Agreed Provisions and Conditions is an agreement reached between the providers and recipients of genetic resources, including the type, quantity, and distribution range of genetic resources, the possible limitations of the use of genetic materials, the sovereign right of the country of origin, requirements for capacity building, regulations on transfer to a third party, respect for the rights of indigenous communities, handling of confidential information, sharing of benefits (type of benefits, valid time of benefits, benefit allocation and benefit sharing mechanisms, etc.).

Handout 4

ITPGRFA Annex 1: List of the crops included in the Multilateral System

Food crops		
Name	**Genus name**	**Remark**
Breadfruit	*Artocarpus altilis*	Exclusive
Asparagus	*Asparagus* ssp.	
Oat	*Avena sativa*	
Beet	*Beta vulgaris*	
Brassica complex	*Brassica ssp.*	The genera included are: *Brassica, Armoracia, Barbarea, Camelina, Crambe, Diplotaxis, Eruca, Isatis, Lepidium, Raphanobrassica, Raphanus, Rorippa and Sinapis.* Including oil seeds and vegetables such as cabbage, rapeseed plant, mustard, cress, rocket salad, radish and turnip, excluding *Lepidium meyenii.*
Pigeon Pea	*Cajanus cajan*	
Chickpea	*Cicer arietinum*	
Citrus	*Citrus* ssp.	*Poncyrus* and *Fortunella* are included
Coconut	*Cocos nucifera*	
Major aroids	*Colocasia, Xanthosoma*	Including Taro, Cocoyam, Dasheen and Tannia
Carrot	*Daucus carrota*	
Yams	*Dioscorea* ssp.	
Finger millet	*Eleusine coracana*	
Strawberry	*Fragaria* ssp.	
Sunflower	*Helianthus annus*	
Barley	*Hordeum vulgare*	
Sweet Potato	*Ipomoea batata*	
Grass pea	*Lathrus sativus*	
Lentil	*Lens culinarus*	
Apple	*Malus* ssp.	
Cassava	*Manihot esculenta*	Only *Manihot esculenta*
Banana/Plantain	*Musa* ssp.	Excluding *Musa textilis*
Rice	*Oryza sativa*	
Pearl millet	*Pennisetum glaucum*	
Beans	*Phaseolus vulgaris*	Excluding *Phaseolus polyanthus*
Pea	*Pisum sativum*	
Rye	*Secale cereale*	
Potato	*Solanum nigrum*	Including some *tuberose*, excluding *Solanum phureja*
Eggplant	*Solanum nigrum*	Including some *melangena*
Sorghum	*Sorghum vulgare*	

Triticale	*Triticosecale*	
Wheat	*Triticum aestivum* etc.	Including *Agropyron, Elymus* and *Secale*
Faba bean/Vetch	*Vicia* ssp.	
Cowpea	*Vigna unguiculata*	
Maize	*Zea mais*	Excluding *Zea perennis, Zea diploperennis* and *Zea luxurians*

Forage crops

Genus name	Species name
Leguminous forage	
Astragalus	*Astragalus chinensis, cicer* and *arenarius*
Canavalia	*Canavalia ensiformis* (Jack-bean)
Coronilla	*Coronilla varia*
Hedysarium	*Hedysarium coronarium*
Lathyrus	*Lathyrus cicera, ciliolatus, hirsutus, ochrus, odoratus* and *sativus*
Lespedeza	*Lespedeza cuneata, striata* and *stipulacea*
Lotus	*Lotus corniculatus, subbiflorus* and *uliginosus*
Lupinus	*Lupinus albus, angustifolius* and *luteus*
Medicago	*Medicago arborea, falcata, sativa, scutellata, rigidula* and *truncatula*
Melilotus	*Melilotus albus* and *officinalis*
Onobrychis	*Onobrychis viciifolia*
Ornithopus	*Ornithopus sativus*
Prosopis	*Prosopis affinis, alba, chilensis, nigra* and *pallida*
Pueraria	*Pueraria phaseoloides*
Trifolium	*Trifolium alexandrinum, alpestre, ambiguum, angustifolium, arvense, agrocicerum, hybridum, incarnatum, pratense, repens, resupinatum, rueppellianum, semipilosum, subterraneum* and *vesiculosum*
Gramineous forage grass	
Andropogon	*Andropogon gayanus*
Agropyron	*Agropyron cristatum* and *desertorum*
Agrostis	*Agrostis stolonifera* and *tenuis*
Alopecurus	*Alopecurus pratensis*
Arrhenatherum	*Arrhenatherum elatius*
Dactylis	*Dactylis glomerata*
Festuca	*Festuca arundinacea, gigantea, heterophylla, ovina, pratensis* and *rubra*
Lolium	*Lolium hybridum, multiflorum, perenne, rigidum* and *temulentum*
Phalaris	*Phalaris aquatica* and *arundinacea*
Phleum	*Phleum pratense*
Poa	*Poa alpine, annua* and *pratensis*
Tripsacum	*Tripsacum laxum*
Other forage grass	
Atriplex	*Atriplex halimus* and *nummularia*
Salsola	*Salsola vermiculata*

Handout 5

Strategic goals of the National Biodiversity Strategy and Action Plan (NBSAP)

Overall goal

The ecosystem, species and their habitats are effectively conserved. Species and their genetic resources are being made sustainable use of. The benefits from the use of species as well as their genetic resources and related traditional knowledge are shared. A civilized society with harmonious coexistence between humans and nature is created. Modern technology and traditional knowledge are used in an ecosystem based approach based on the basic situation of our country and scientific foundation.

Short-term goal

By 2015, the declining trend of biodiversity is to be effectively curbed in China. To achieve the goal, specific objectives set out below shall be achieved by 2015.

1. Large-scale national background check and cataloguing of biodiversity and related traditional knowledge based on the key species survey in China are carried out. On that basis, the directories and databases of various categories of ecosystems, species, genetic resources and traditional knowledge prioritized for conservation are prepared and further completed. Primary biodiversity monitoring and alarm network systems and standard database systems are established, and data- and information sharing of biodiversity conservation and management are established.
2. A new plan for natural reserve development is completed under the guidance of main functional areas layout across the country focused on quality evaluation and rectification of the completed national natural reserves. Current conservation results and the setup of a number of new natural reserves for complementary needs are considered. At the same time, reserve systems in a large geographic range are built up in combination with the construction of eco-functional areas and *ex situ* conservation facilities. The management quality of natural reserves is improved to a large extent and the area under effective protection is enlarged to 10% of all land.
3. The policy and regulation systems for biodiversity are improved. A trial period and partial implementation of the policy on ecological compensation is improved. The system of biodiversity impact evaluation on construction projects is initially completed, Natural Reserve Law is promulgated and executed, and the regulations and systems on access to genetic resources and benefit sharing as well as on management of invasive alien species and biological security are established.
4. Biodiversity conservation is incarnated in major plans of the State and sectoral plans, and mainstreamed gradually. Biodiversity conservation is included in the Twelfth Five-Year Plan for National Economic and Social Development of the State, and in the local Twelfth Five-Year Plans for National Economic and Social Development of 50% of all provinces.
5. The management system of biodiversity conservation is further clarified, and the system of inter-ministerial joint meeting for bio-resource conservation and the coordination

mechanisms for CBD performance are enhanced. The administrative organizations in governments in association with biodiversity conservation are further completed and the administrative departments are set up at 90% national natural reserves. The management quality is largely improved.

6. The capability of bio-prospecting is notably strengthened and the identification, screening and utilization of gene properties and functions of a large number of species and genetic resources are accomplished on condition of effective conservation. The activities of bio-resource exploitation are regulated and conform to the sustainability standard. The research and development skills are greatly improved and the innovation abilities are enhanced. The the number of products is increased, patent applications rise steadily and fair sharing of benefits from genetic resources and traditional knowledge is shown for the first time.
7. Conservation awareness of all people is demonstrably strengthened, and stronger partnership between stakeholders of biodiversity conservation is established. The investments of enterprises, NGOs, individuals and foreign partners in biodiversity conservation are increased markedly to be equivalent to 10% of governmental investments. The public participation mechanism is initially set up and the opinions of stakeholders and the public are incarnated in the decisions on biodiversity conservation and management.

Medium-term goal

By 2020, the loss of biodiversity is basically under control. Therefore, specific objectives set out below shall be achieved over the period of 2016 to 2020.

1. The large-scale check and cataloguing of biodiversity resources and related traditional knowledge across the country are basically completed to have a clear picture of species, genetic resources and the background of related traditional knowledge. The compilation and update of China Plant Red Data Paper and China Animal Red Data Paper is accomplished. The biodiversity monitoring and alarm network system is basically erected and running effectively to realize documentation and information sharing of biodiversity conservation and management.
2. The evaluation, improvement and addressing of gaps in the national natural reserves network is continued, conservation is further supported and management quality is improved. Through gap filling, reserve network systems with diversified characteristics are shaped in respective geographically preferred areas. The renovation of natural reserve management systems across the country is completed and the administrative authorities of the natural reserves are strengthened to work more efficiently and in higher quality.
3. Policies, regulations and policy systems on biodiversity are further strengthened and improved. The policy on ecological compensation is brought into effect in numerous fields. The system of biodiversity impact evaluation on construction projects is basically established and successfully implemented. The regulations and systems on access to genetic resources and benefit sharing and on management of invasive alien species and biological security are finalized and put into practice.
4. Biodiversity conservation is mainstreamed in major plans of the State and in sectoral plans. Biodiversity conservation section is included in the Thirteenth Five-Year Plan for

National Economic and Social Development of the State, and in the local Thirteenth Five-Year Plans for National Economic and Social Development of 75% provinces, and integrated with the programmes and plans of many municipal and county governments.

5. Activities of bio-resource exploitation are further regulated and most of them conform to the sustainability standard. A series of technical development of various species are completed, techniques of gene identification and isolation are gradually improved, and more genes are discovered for application in farming and medicine & health etc. Research and development and innovation in capabilities continue to grow to supply more bio-resource products to the public.
6. The partnership between stakeholders of biodiversity conservation is more perfect, and the investments of enterprises, NGOs, individuals and foreign partners in biodiversity conservation reach 20% of governmental investments. The public participation mechanism is basically established and the opinions of stakeholders are adequately incarnated in the decisions on biodiversity conservation and management.

Long-term goal

By 2030, the biodiversity across the county is basically under effective conservation, and the objectives set out below are achieved.

1. The management of natural reserves is largely improved and populations of a vast majority of rare and endangered species are able to grow constantly.
2. *Ex situ* facilities and capabilities are considerably enhanced, the populations of rare and endangered species artificially propagated are increased and their wild populations are recovered by returning them to their wild state.
3. The property evaluation and function identification of genetic resources at the molecular level is accomplished. Major breakthroughs are made in the development of biological technology on the condition of ensured biological security.
4. All conservation policies and regulations have obvious effects, sectoral coordination mechanisms are running well, the partnerships between all stakeholders are shaped, the public consciously participate in species conservation and a context of harmonious coexistence between humans and nature is formed in the community.

Handout 6

Relevant laws/regulations on the conservation and management of agricultural genetic resources

Main State laws enacted by the Standing Committee of the National People's Congress (NPC) of the P.R. China

- Fisheries Law (1986)
- Law on the Protection of Wildlife (1989)
- Law on the Entry and Exit Animal and Plant Quarantine (1991)
- Seed Law (2000)
- Animal Husbandry Law (2005)

Main regulations enacted by the State Council of the P.R. China

- Regulations on Breeding and Conservation of Fishery Resources (1979)
- Regulations on Conservation and Management of Wild Chinese Medicinal Material Resources (1987)
- Regulation on Plant Quarantine (1992)
- Regulations on the Protection of Traditional Chinese Medicines (1993)
- Regulations on Nature Reserves (1994)
- Regulations on Administration of Breeding Livestock and Poultry (1994)
- Regulations on Wild Plants Conservation (1997)
- Regulations on the Protection of New Plant Varieties (1998)

Rules, regulations and administrative measures enacted by each competent department under the State Council of the P.R. China

- List of the Rare and Endangered Plants Protected in China (totally 354 varieties in the 1st batch; Environmental Protection Committee under the State Council, 1984)
- Regulations for the Implementation of Terrestrial Wildlife Protection (Ministry of Forestry MoF, 1992)
- Regulations for the Implementation of Aquatic Wildlife Protection (Ministry of Agriculture MoA, 1993)
- Tentative Measures for the Administration of Import and Export of Crop Seed and Seedling (MoA, 1997)
- Measures for the Examination and Approval of Original and Fine Breeding of Aquatics (MoA, 1998)
- Rules for the Regulations on the Protection of New Varieties of Plants (Forest Part; State Forestry Administration SFA, 1999)
- List of National-Level Protected Resources of Livestock and Poultry (78 varieties; MoA 2000)
- Measures for the Administration of Seedling of Aquatic Product (MoA, 2001)
- Measures for the Conservation of Agricultural Wild Plants (MoA, 2002)
- List of Improved Tree Species (SFA, 2002)
- Regulations on Handling Cases of Infringement of New Agricultural Plant Variety Rights (MoA, 2003)
- Regulations on the Administration of Fishery Licensing (MoA, 2002)
- Measures for the Administration of Inspection and Quarantine of Inward Aquatic Animals (General Administration of Quality Supervision, Inspection & Quarantine AQSIQ, 2003)
- Measures for the Administration of Genetic Resources of Crops (MoA, 2003)

Handout 7

Measures for the administration of crop genetic resources

For the implementation of the Seed Law, Measures for the Administration of Crop Genetic Resources (hereinafter, the Measures) were promulgated by the MoA on the 8th of July, 2003, specifying the authority for crop genetic resources, and the collection, preservation and information management of genetic resources.

Authorities for crop genetic resources

The Measures require that, "the MoA shall organize the National Commission on Crop Genetic Resources to work over and propose national strategies and guiding policies on the development of crop genetic resources, and coordinate the management of crop genetic resources across the country. The office of the said committee shall be stationed at the MoA Planting Management Department to take charge of daily activities of the said committee". They also emphasize that, "the work on crop genetic resources is a public welfare undertaking, and the relevant departments of the State and local governments shall take measures to safeguard the stability and fund sources of the work on crop genetic resources".

Collection of crop genetic resources

The Measures state that the State shall organize a census, a key investigation and collection activities of crop genetic resources. Under circumstances such as project construction and climate change, which may cause extinction of crop genetic resources, rescue and collection shall be organized without delay. Collecting or cutting wild species, wild relatives, endangered and rare species under the list of nationally protected wild fauna and flora and crop genetic resources within conservation areas, sites and germplasm repositories, is prohibited. The collection or cutting for scientific research or other special reasons shall be subject to ratification formalities.

They also prescribe that, without authorization, no foreigner shall collect crop genetic resources within China, and those who take them out of China shall go through examination and approval formalities for supplying crop genetic resources abroad in line with relevant regulations. They also clearly require that organizations and individuals holding genetic resources not yet registered or stored by the State are obligated to submit them to the state germplasm repository for storage.

Identification, registration and conservation of crop genetic resources

The Measures demand that, "taxonomic classification and main agronomic traits of all crop genetic resources shall be identified. The identification of crop genetic resources shall be subject to a unified national standard system. The registration of crop genetic resources shall be subject to a unified coding system, and no organization or individual shall change the unified national codes and names. [...] The conservation of crop genetic resources is subject to the system of integrated *in situ* and *ex situ* efforts. The *in situ* conservation includes the build-up of conservation areas and sites of crop genetic resources; the *ex situ* conservation includes the setup of all sorts of germplasm banks, and repositories".

Propagation and use of crop genetic resources

The Measures require that the State shall encourage organizations and individuals to engage themselves in research and innovation in crop genetic resources. The national long-term repositories shall periodically check their genetic resources in stock, and shall restore them through reproduction when the genetic resources in stock become less active or lower in quantity to the extent of affecting the security of genetic resources. The national medium-term repositories shall periodically reproduce to update the genetic resources in stock to keep their liveliness and quantity.

The MoA shall periodically publicize a list of crop genetic resources available and select and recommend fine genetic resources. Organizations and individuals who demand crop genetic resources on the list for scientific research and for breeding purposes can file applications with the national medium-term germplasm banks (repositories). In addition, "no application for new variety protection or other intellectual property rights of genetic resources acquired from the State shall be filed directly".

State sovereignty over crop genetic resources

The Measures stress that, "the State enjoys sovereignty over crop genetic resources, and supply of genetic resources abroad by any organization or individual shall be subject to review by the Authority on Agricultural Issues of the province, autonomous region or municipality in which they are located, and to the examination and approval by the MoA. Supply of crop genetic resources abroad is subject to category management system and the MoA makes periodic revisions to the directory of category management".

The Measures encourage organizations and individuals to introduce crop genetic resources from the outside. Organizations and individuals who import genetic resources shall go through quarantine formalities in line with the provisions of laws and regulations related to plant quarantine. The State implements the unified registration system and the introduced genetic resources are all coded and given translated names by the National Commission on Crop Genetic Resources. No organization or individual shall change the codes and translations of introduced resources given by the State.

Information management of crop genetic resources

The Measures demand that the Office of the National Commission on Crop Genetic Resources shall enhance the information management of crop genetic resources, including dynamic information such as the collection, identification, conservation, use and international exchange of genetic resources, perform information service for related departments and protect national information security of genetic resources. "Organizations responsible for collecting, identifying, conserving and registering crop genetic resources are obliged to provide relevant information to the Office of the State Committee of Crop Genetic Resources to guarantee the sharing of information about genetic resources.

Handout 8

Action Plan for the Biosafety Administration of Genetically Modified Organisms and Invasive Alien Species

Goal 1: Identification of the status of invasive alien species across the country

Action 1.1

- To carry out a national survey of invasive alien species
- To continue the national investigation of invasive alien species every five years, focusing on dangerous and harmful ones in areas rich in biodiversity and on newly introduced ones

Goal 2: Establishment of a high efficiency biosafety coordination mechanism and information exchange mechanism

Action 2.1

- To strengthen the building of ministerial coordination mechanism and competence
- To set up biosafety authorities in sectors such as environmental protection, agriculture, forestry, science and technology, and quality inspection, enhance competence building of all dedicated organizations, and implement an inter-ministerial joint conference system to facilitate communication and alignment between all parties involved

Action 2.2

- To construct the biosafety database system and information sharing platform
- To promote the exchange and sharing of information on biosafety between all parties involved, build a national biosafety database system and an information sharing platform to deliver rich, accurate and timely data resources for the administration of biosafety by the State

Goal 3: Development of complete biosafety laws and regulations

Action 3.1

- To complete laws and regulations on the control of invasive alien species
- To formulate regulations for the control of invasive alien species, to specify clearly risk assessment, alarm, introduction, elimination, control, biological recovery, and compensation liability concerning alien species
- To revise the list of dangerous biology in the Law on the Entry and Exit Animal and Plant Quarantine, adding invasive alien species threatening the environment and biodiversity or potential ones with possible threats

Action 3.2

- To complete laws on genetically modified organisms (GMO) biosafety
- To amend conditions for the administration of agricultural GMO crop biosafety and improve ministerial coordination mechanisms, adding open information, environmental

effect monitoring, compensation liability for damages and public participation, and the like information

- To formulate laws on GMO biosafety in due time

Goal 4: Setup of early alarm and quick response systems against invasive alien species

Action 4.1

- To set down and implement the system of environmental risk assessment of alien species
- To develop techniques for evaluating environmental risks from alien species, set up a system for assessing environmental risks of alien species and make environmental risk assessments for all introduced alien species. No alien species introduction shall be allowed until it is made sure that the said species will not bring harm to the environment, people's health and economic growth

Action 4.2

- To erect and perfect quarantine facilities
- To build and improve quarantine facilities of the port quarantine system, and set up a number of introduced species quarantine nurseries and bases, isolation experiment stations and quarantine centres

Action 4.3

- To develop techniques and standards for the detection of invasive alien species
- To improve the techniques and methods for detecting existing potential and dangerous invasive species and work on rapid molecular detection techniques

Action 4.4

- To develop techniques and standards for the monitoring of invasive alien species
- To formulate technical specifications and operating instructions for the monitoring of invasive alien species, and specify the list of key objects to be monitored
- To conduct long-term monitoring of introduced invasive alien species with limited distribution, invasive species occurring in a large area and spreading, and dangerous alien zoonosis pathogens and their media, etc. based on the list

Action 4.5

- To construct environmental monitoring system of invasive alien species
- To build a national monitoring and alarm centre against invasive alien species, and regional branches and branches in different sectors to create a monitoring and alarm system against invasive alien species

Action 4.6

- To develop sustainable control techniques against invasive alien species
- To broaden and innovate in techniques and methods of biological control, ecological regulation and ecological restoration, set up the technical system for sustainable control over invasive alien species, and create pilot areas for ecological restoration technology of impaired ecosystems and for invasive alien species management

Action 4.7

- To reinforce control and elimination of key invasive alien species
- To apply sustainable control technology against invasive alien species, extend practical techniques for controlling and eliminating invasive alien species, and strengthen the control and elimination of key invasive alien species

Goal 5: Build-up of relatively complete technical systems and platforms with conditions for the assessment, testing and monitoring of GMO biosafety

Action 5.1

- To develop assessment technology for GMO biosafety
- To work on techniques and models for assessing the safety of main exogenous genes and GMOs, with a focus on techniques of environmental risk analysis of GMOs like transgenic rice, wheat, maize, cotton, pigs, cattle, sheep and goats, and of safety assessment of food and feed
- To develop techniques for objective traits identification, for the assessment of genetic stability and unexpected effects of GMOs, for environmental safety assessment such as existence competition capability, gene flow and its ecological effects, impacts on target organisms and non-target organisms, and impacts on ecosystems; develop techniques for food and feed safety assessment such as toxicity, sensitivity and key ingredients

Action 5.2

- To develop GMO testing techniques
- To work on techniques of GMO sampling based on nucleic acid, protein and metabolite, and rapid, precise and high-throughput testing techniques
- To prepare relevant standards, standard substances, testing instruments, equipment and products
- To conduct research on measurement and calibration techniques such as measured value validity and uncertainty
- To explore whole process traceability techniques

Action 5.3

- To develop GMO environmental monitoring and control techniques
- To study techniques and standards for safety monitoring and risk management of environmental release, application in production and GMOs imports/exports
- To work on new techniques for monitoring and protecting the effects of GMO application on rare and endangered species, agroforest ecology and the natural environment
- To develop risk alarms, effective control and safe handling techniques combining molecular ecology, toxicology and digital simulation, etc.

Action 5.4

- To construct platforms with conditions for GMO biosafety assessment, testing and monitoring.

- To build four to five national GMO biosafety reference laboratories in different sectors to conduct research and develop new technology, methodology and products for GMO biosafety assessment, testing and monitoring, provide technical supports to the formulation of national and international standards and technical arbitration, etc., and facilitate technological advancement and enabling resource sharing
- To improve and establish between 18 and 20 centres of GMO biosafety assessment, testing and monitoring to carry out safety assessment, testing and monitoring, and deliver key techniques and data for the GMO biosafety administration and industrialization in China

Goal 6: Noticeable increase of biosafety awareness of the public

Action 6.1

- To develop biosafety training materials
- To prepare readable training materials on biosafety for different target groups such as decision-makers in governments, management staff, technical workers, management in enterprises and the public

Action 6.2

- To strengthen biosafety training of practitioners in all industries like trade and tourism, etc.
- To enhance biosafety training of practitioners in customs, tourism, quarantine and other sectors to equip them with basics about biosafety, skills of invasive alien species identification and GMO testing, and knowledge on biosafety control, etc.

Action 6.3

- To conduct public communication on biosafety
- To make use of multiple means such as broadcasting, television, lectures, exhibitions, summer camps, intellectual contests, festivals and anniversaries, etc.
- To communicate information about biosafety extensively, populate knowledge on biosafety control and enhance the public's awareness of biosafety

Goal 7: Effective fulfilment of obligations under relevant international conventions

Action 7.1

- To take initiatives to get involved in the affairs of related international conventions
- To actively participate in the negotiations on biosafety issues under the CBD and the Cartagena Protocol on Biosafety, and of the FAO and WHO to further the setup and improvement of international and regional cooperation mechanisms, and to protect national safety and benefits

Action 7.2

- To take initiatives to carry out bilateral and private sector cooperation and exchanges in biosafety To vigorously engage in dialogues, exchanges and cooperation with relevant national governments and NGOs to promote consensus, reduce difference, enhance friendships and facilitate bilateral economic and political exchanges and cooperation

Handout 9

Seed conservation – an example from India

Genetic resources in agriculture – be they a local rice variety or a local chicken race – comprise a large range of plants and animals that have been selected and bred often over thousands of years. This selection and breeding resulted in a wealth of genetic diversity. With the modernization of agriculture this wealth is getting lost. High yielding varieties (HYV) or high performing animal breeds increasingly replace local varieties and local animal races, often with low intra-specific genetic diversity. More and more, local varieties are disappearing and valuable germplasm is getting lost.

With the case study of Navdanya in India we shall take a look at possibilities to maintain local varieties, for crops such as grains, vegetables, pulses and oil-seeds. The case study demonstrates how farming communities can be supported in conserving their genetic resource base. Navdanya is an Indian non-governmental organization. It pursues biodiversity conservation, organic agriculture and human rights to food. The NGO was founded in 1987 and registered as a legal trust in 1991.

Navdanya is not only an organization; it is also a movement. The movement is based on rural campaigns for farmers. Individuals can become members of Navdanya. Most members are farmers under Navdanya's Biodiversity Conservation and Organic Agriculture Programme. Members have to stop using synthetic fertilizers and chemical pesticides, to use their own seed instead of buying it on the market, and to avoid hybrid varieties. In turn, they receive from Navdanya seed to start their own seed bank, and they receive training in seed conservation and organic agriculture.

Objectives of Navdanya

Navdanya sees its "role in seed conservation as a catalyst, creating an ever widening circle of awareness at many levels, from the micro to the macro, stepping in to facilitate local groups and communities to take up seed conservation activities, and then stepping out, when the local capacities have been built up".

The Biodiversity Conservation and Organic Agriculture Programme – hereafter named shortly "the programme" – has two objectives. It aims to "empower local communities in India to protect and conserve their biodiversity and defend their community rights to seeds and knowledge", and to improve food security for farmers. Special attention is to be given to women and children.

Strategy of Navdanya

In order to achieve these objectives, the programme follows a strategy, which is based on three pillars:

1. The retrieval, collection and identification of local seeds
2. The support of farming communities in biodiversity conservation and organic agriculture
3. The creation of a national network of biodiversity conservation initiatives

Retrieval, collection and identification of local seeds

Firstly, the programme aims to retrieve, collect and identify lost or "forgotten" seeds in all parts of the country as comprehensively as possible. A limited number of regions are to be covered over a number of years, until most of the still existing germplasm has been collected (in the past in Uttaranchal, Kerala and Tamil Nadu; at present in Uttaranchal, Orissa, and West-Bengal). Then, the programme should shift to other regions. In doing so, it is hoped that almost all still existing indigenous varieties and strains in the country have been found and identified. The focus is on agricultural crops but vegetation in general (trees, shrubs etc.) shall be included.

Support of farming communities

The second pillar, support to farming communities, is manifold. Navdanya has selected small intervention areas and works in clusters of 5 to 20 villages. It starts with campaigns on awareness creation and continues later on with those who are willing to convert to organic agriculture. These groups are given seed, and they are trained and advised in seed conservation and organic agriculture.

Creation of a national network

Thirdly, Navdanya envisages building up a national network. A growing number of initiatives spread all over the country shall enable a scaling up of biodiversity conservation. Each initiative should be as autonomous as possible, but at the same time be part of the national Navdanya movement, which understands itself as a political pressure group.

Important principles of the strategy

Based on the three pillars described above, the programme's strategy follows the following principles:

- To concentrate on tribal and marginal areas in India
- To link biodiversity conservation with organic agriculture
- To address women in particular
- To seek cooperation based on idealism and personal commitment
- To support biodiversity conservation initiatives as a catalyst and temporary partner
- To conduct lobbying and advocacy

Tribal and marginal areas

Tribal and marginal areas are advantageous in several aspects: Remaining biodiversity is comparatively higher than in the high potential areas. The Himalaya mid hills in Uttaranchal, for instance, have not been exposed as long and as intensively to the Green Revolution as the plains of Punjab. Secondly, marginal and medium soil fertility allows more easy conversion to organic agriculture. Often, the economic improvement due to less costly inputs is visible already after one to two years of time and even the physical yields are either equal or even in terms of yield with crops under the conventional regime after a conversion period of only a few years.

Organic agriculture

Biodiversity conservation can certainly be done under conventional agricultural regimes. But to make it fully convincible requires the linkage to organic agriculture. Biodiversity and organic agriculture belong to each other. Biodiversity maintenance is a basic principle of organic agriculture and a necessity for practicing it successfully; the latter advises against the use of hybrid seeds due to their narrow genetic potential and it prohibits the use of genetically modified varieties. In turn, organic agriculture guarantees to maintain biodiversity.

Focus on women

The focus on women takes into consideration the fact that women throughout the world have always been the seed keepers in rural societies. It is the women who take care of reproduction in agriculture as well as in all aspects of rural life.

Cooperation based on idealism and commitment

Navdanya is a small NGO with a huge objective. Under the theme of biodiversity conservation it aims to do rural development and thus create initiatives on small islands of communities in the country (which are hopefully expanding and are affecting more and more people). Such initiatives are to create and manage community seed banks and to develop sustainable agriculture through participatory research, training and advisory work. Needless to say, the catalyst function of Navdanya, the limited resources for biodiversity conservation and the highly political nature of the work can only be addressed through an alliance of people who share Navdanya's convictions and engage themselves for the sake of idealism and social commitment.

Biodiversity conservation activities

Biodiversity conservation activities comprise of

- The collection of seeds
- Their identification and description
- The documentation of agrobiodiversity
- The multiplication and maintenance of seeds
- The distribution of seeds

Saving seeds of endangered varieties and strains is the predominant activity and core of the programme. It involves the retrieval and the collection of forgotten seeds, their identification and documentation, their multiplication and maintenance, and, last but not least, the distribution of seeds.

Navdanya has been quite successful in retrieving and collecting forgotten seeds and it can be assumed, that the biggest part of the still existing varieties of agricultural crops (grains, pulses, vegetables) have been collected in West-Bengal, whereas in Uttaranchal and Orissa not all have been covered as of yet.

The identification and description of seeds is done with great care. In West-Bengal, 35 characteristics based on the ITPGRFA norms are taken, which would allow a registration at the National Board of Plant Genetic Resources. Navdanya in Northern India takes 17 characteristics. The description so far is mainly based on morphological characteristics.

The documentation of seeds relies mainly on Community Biodiversity Registers. As a rule, they can be found in all villages, where Navdanya is working. Documentation is a precondition to secure community intellectual property rights (IPR) to defend them against intellectual property rights claims of corporate companies. The latter increasingly raise IPR claims in their effort to promote genetically modified varieties. The question is, however, which level of documentation is necessary and advisable. Do community registers suffice, or should official registration be envisaged? Different opinions and practices exist among Navdanya staff and among Navdanyas cooperation partners.

Another aspect seems worth mentioning. With increasing extension of Navdanya's seed collection efforts, the workload for identification and description is steadily growing and the existing staff has difficulties coping with the continuously newly found varieties and there will be a shortage of skilled professionals soon.

With respect to multiplication and maintenance Navdanya pursues a double strategy. On one hand it promotes *in situ* seed banks managed mainly by individual (female) farmers. The "Navdanya Seed Keepers" exist in all villages, a few in some, many in others and each takes care of a few varieties. On the other hand, Navdanya runs or supports "on-station" seed banks, farms with hundreds of varieties and/or populations to be stored and multiplied. In general, both ways deliver good results. Both do multiplication and maintenance with great care. But there are differences: on-station, there is a stricter regime concerning maintenance selection. Secondly, seeds with no immediate economic interest of the farmers can be multiplied here. It is estimated that this applies to 60 to 80% of all varieties.

Therefore, on-station seed banks are indispensable as a complement to on-farm seed conservation. The double strategy reduces the risk of losses to a minimum. At the same time, however, they require continuous external support and their economic sustainability is uncertain. In other words: With the establishment of seed farms, Navdanya has taken an (admittedly necessary) public service, which will always be dependent on public or private subsidies.

Seed distribution is an important complement to Navdanya's advisory work with farmers and is highly appreciated by them. The seed quality is generally good. Some farmers, however, argued that Navdanya does not know the best suitable seed. This may be an indicator that Navdanya has not sufficient knowledge on the performance of the seeds it has collected.

Seed conservation as a way for empowerment

Keep seeds in your hands, sisters. [...] Seed preservation, conservation and germination are primarily women's work in agrarian societies for thousands of years. It is highly intricate knowledge transmitted from mother to daughter, from sister to sister, from mother-in-law to daughter-in-law, from grandmas to granddaughters or from one village to another.

Unless one is familiar with the delicate wisdom of seed conservation and propagation, it is hard to even guess why some seeds should be dried under bright sun, and others under shade. Among the germination techniques, some seeds are left overnight in atmospheric moisture. Once such sharing started among peasant women they decided to recollect the science in a more systematic manner and ask us to document their seed practices, now disappeared due to availability of HYV seeds from the markets.

Women feel strongly that the loss of seeds from the household also means the loss of women's power. Dependence of the farmers on the market for seeds means the displacement of women from the control of a crucial technology at the heart of agriculture. Once women lose that control they are disempowered and dispossessed. Women generally do not possess land. Possession of seed, therefore, is crucial for them to assert their positive and powerful role in agrarian culture. Loss of seed made women redundant and powerless (cited from Navdanya leaflet).

Farmers who become Navdanya members and want to start seed conservation on-farm and covert to organic agriculture are supplied with local seeds free of cost. After one season, they are obliged to return double the amount of seeds to Navdanya. Seed multiplication is done by other Navdanya farmers and represents a valuable source of income for them.

Navdanya follows the principle of giving seed for free. It does not want to be compared with a corporate seed company. Selling seed might also have legal implications, as most of the seeds are not registered as varieties. On the other hand, the seed supply is free of cost to thousands of farmers, a measurable expenditure. Such costs could possibly be avoided. During interviews, farmers confirmed that a fee would be acceptable, as Navdanya is trustworthy and has a good reputation.

Lobbying and advocacy

Lobbying and advocacy, as a vital element of the strategy of Navdanya, is comprised of

- Agricultural advisory services are combined with local political campaigns.
- At a local level, legal cases are supported by Navdanya.
- International lobbying against GMOs and for community property rights is done.
- International level law suits against patents on genetic resources are pursued.
- Navdanya is member of a network of Indian NGOs that follow the same objectives.

The village information campaigns (awareness creation and information on the fallacious character of "modern agriculture", on the use of HYV combined with pesticides and mineral fertilizer, and on the economic interests of corporate companies) through exhibitions and marches with banners and posters performed by students and active farmers give an excellent access to farming communities and create a conducive atmosphere for advice. Evidently, they have been an eye opener for thousands of farmers. Many of those whom we interviewed during our visit mentioned this as a primary benefit. The seed distribution is the second step to building confidence and self-reliance, and technical advice is the third.

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Handout 10

Basic principles of organic agriculture

Cycling of nutrients

Trees and other plants take up nutrients from the soil and incorporate them in their biomass (leaves, branches etc.). The nutrients go back to the soil when leaves fall or plants die. Part of the biomass is eaten by various animals (including insects), and their excrements return the nutrients to the soil. In the soil, a huge number of soil organisms are involved in the decomposition of organic material, which makes nutrients available to plant roots again.

Organic nutrient management is based on plant and animal residues which can be decomposed. Nutrient cycles are closed with the help of composting, mulching, green manuring, crop rotation, etc. Farm animals can play an important role in the nutrient cycle. Their dung is of high value and its use allows recycling nutrients provided with the fodder. If carefully managed, losses of nutrients due to leaching, soil erosion and gasification can be reduced to a minimum. This helps to save costs and to avoid environmental pollution. However, nutrients exported from the farm with sold produce need to be replaced in some way.

Soil management

Soil and its fertility together constitute the centre of the agricultural ecosystem. A more or less permanent soil cover prevents soil erosion and it helps to build up soil fertility. The continuous supply of organic material feeds a huge number of soil organisms and helps to increase or at least maintain soil humus. As a result, the soil becomes soft and capable of taking up and storing large quantities of water. A key sentence in organic agriculture is "Feed the soil not the plant". In other words: A fertile soil is the best guarantee for good and sustainable yields.

Enhancing and maintaining diversity

Nature hosts a high diversity of plant varieties of different size, root systems and requirements; they are all living together in an "ecosystem" (as we call it today). Animals are also part of the system. If one organism drops out, it is immediately replaced by another one, which fills the gap. Thus space, light, water and nutrients are optimized. As a result, the ecosystem is also very stable. Organic farms aim to regard this diversity at various levels of farming. They try to grow many different crops, including trees, either as mixed cropping or in rotation. The diversity not only allows optimum use of the resources but also serves as an economic security, for instance in case of a pest or disease attack or low market prices for certain crops.

Animals are an integral part of the farm system

Whenever possible and appropriate, crop husbandry is to be combined with animal husbandry. Animals can use plant and harvest residues in grazing areas that are unsuitable for cropping and in doing so they supply additional income and manure for crop husbandry. The provision of organic manures for crops can become the most important aspect of animal husbandry.

Avoid all forms of pollution through an active pest and disease management

Pests and diseases do occur in nature, but they rarely cause extensive damage. Due to diversity, it is difficult for them to spread. Plants usually can recover from an infestation on their own and many pests are controlled by other organisms such as insects or birds. Organic farmers try to keep pests and diseases at a level which does not cause economic damage. The main focus is on supporting the health and resistance of the crop. Beneficial insects are promoted by offering them a habitat and food. If pests reach critical levels, natural enemies and herbal preparations are used. Synthetic pesticides are not allowed in organic agriculture.

As a result of the cyclic nutrient management and the pest management approach of organic agriculture, main sources of pollution are excluded right from the beginning. For instance, overdoses of nitrogen do occur very rarely, as soil nitrogen is entirely accumulated by micro-organisms (soil bacteria and fungi).

Handout 11

An example of breeding for a broader biodiversity – the case of Bingenheim in Germany

The Bingenheim Initiative started in 1985 as a network of mainly vegetable growers with the objective to supply seed among themselves. Their objectives were manifold. Some wanted to take responsibility for the conservation of endangered seeds, others to maintain independence from the seed industry, a third group aimed to achieve a higher food quality of crops, and all of them wanted to comply with the standards of organic agriculture.

Organizational structure

Today the initiative comprises of three organizations:

- An informal network of farmers, doing mainly seed multiplication
- A registered association (NGO) that supports breeding: "Kultursaat e.V."
- A shareholder company that produces the seeds: "Bingenheimer Saatgut AG"

Farmer network

The farmer network is an informal association. It has around 120 members – mainly vegetable growers, mostly from Germany, some from neighbouring countries (Switzerland, France, Austria, Italy, Spain and the Netherlands). They multiply seed, and some do breeding as well. The farmers meet twice a year to exchange experiences on seed multiplication and develop future strategies. The network is the central foundation for the project.

The purpose of the group is to produce seed for biodynamic agriculture and its members mainly do maintenance breeding. The farmer network has a fairly loose and informal organizational structure and no legal status.

Registered association

The second entity, called "Kultursaat e.V." is a registered association – public and non-profit oriented. It was founded in 1994 to coordinate and combine already existing breeding initiatives of individuals and to support them financially and professionally (e.g. through training). In addition, the idea was to bring together people from various backgrounds that are motivated to support the maintenance and further development of agricultural crops, and who see in them a cultural heritage. Today, the association has around 400 members – not only breeders but also an interested public. In an annual general assembly, the members make decisions on strategic questions.

The association supports breeders financially and logistically; breeders apply for funding via project proposals to the association and the board of the association decides over the distribution of funds. The association coordinates breeding activities, and raises funds for breeding. Today 21 breeders at 18 locations do breeding on behalf of the association. Breeding is done on organic farms. Each breeder has two "godfathers", members from the association and breeders themselves, who accompany and supervise the breeding work. This comprises a visit and inspection of the breeding

fields each year and discussion about the progress of work. In doing so, the association takes care of each single breeding activity.

The materials may be the work of an individual breeder within the initiative, but they are considered the result of a collective effort. Accordingly, promising materials developed by single breeders are handed over to the association. In its capacity as the legal owner, the NGO formally presents the materials for variety registration and takes care of the costs and responsibilities involved. This situation is ideal, considering the fact that the breeders consider private ownership of varieties as inappropriate. Therefore, the association is the owner of new varieties and the varieties are considered collective property.

The annual budget of the association is small. It comes from membership fees and mainly from donations. Kultursaat has registered approximately 30 varieties of different vegetables. Kultursaat, as the owner, is responsible for maintaining the varieties and giving licences to third parties for seed multiplication, for use and for commercialisation. So far, only Bingenheimer Saatgut AG has licences for varieties registered to the name of Kultursaat.

Seed enterprise

The "Bingenheimer Saatgut AG" is basically a seed enterprise. Its purpose is to organize and coordinate seed processing and distribution in a professional manner. It contracts organic farmers (from within the farmer network) for the multiplication of seeds of vegetables, herbs and flowers. The company itself does seed processing and marketing of the seeds.

The new company has the following objectives

- To distribute organically produced varieties
- To conserve and promote genetic diversity in agriculture and in horticulture
- To maintain and enhance seed production as a cultural task of the society
- To develop an economy that allows participation of all stakeholders in production and use of seeds

The shares of the company are held by the members of Kultursaat (3%), the farmer network (20%), the Bingenheim Community (20%), a foundation (49%) and other single donors. Shares can only be sold after approval of the company.

Three types of seeds are produced

- Initially, the company produced only seeds of free varieties, e.g. varieties that were not protected by plant breeders' rights and were, therefore, freely available to the public.
- Later on, it produced also seed under licence from a number of varieties from other independent seed companies (mainly vegetables).
- Today, the company also produces seeds of varieties that have been developed by members of Kultursaat and that are registered under its name.

Breeding strategy

Breeding for organic agriculture differs significantly from conventional breeding. Mandate and role of plant breeding are perceived differently. Organic agriculture can be described as the management of agroecosystems with the objective of sustainable supply to the regional market with safe and healthy food and non-food products, while maintaining a largely closed system. Central are the agro-ecological sustainability at plant and farm level, the socioeconomic sustainability, and the interaction between these. Diversity within and between varieties and crops and management thereof play an important role in the sustainability of agroecosystems. Whereas in conventional agriculture the genetic basis of crop production has narrowed considerably, organic agriculture aims at maintaining genetically diverse production.

This objective fits the perception that breeding has to play a role in maintaining the availability of diversity and in keeping this diversity in 'good condition'. This is in contrast with conventional breeding where the continuous introduction and replacement of varieties seems a necessity for breeding companies and farmers to survive.

In the organic sector, farmers and vegetable growers are not only considered end-users of breeding products: they also form the environment in which breeding is integrated. The organization of breeding activities on-farm does not necessarily imply direct participation of farmers in the breeding activities.

An important element in organic agriculture is the recognition of the specific character of the farm and the region. In breeding terminology this can be translated as the objective of aiming at specific adaptation to farm and environment.

Breeding methodology and technology

In general, plant breeders distinguish four phases in the development of varieties:

1. The recombination of genetic variation
2. Selection
3. Variety maintenance
4. Production of foundation seed

The differences in breeding for organic agriculture are most relevant in 1) and 2). Conventionally, breeding is applied at plant or population level, cell and meristem level, and DNA level. In bio-dynamic agriculture the technologies at DNA and cell levels are not acceptable. If, like now, the majority of the organic breeding activities are taking place in the bio-dynamic domain, these technologies are likely to remain irrelevant for breeding in the organic sector. Another discussion is the acceptability of hybrid varieties. On this point the opinions among bio-dynamic practitioners vary. It is possible that in the future hybrids will not be acceptable anymore in the bio-dynamic sector. At present, hybrids are widely used in the organic sector, including the bio-dynamic sector.

The breeders of Kultursaat develop lines and populations according to the guidelines of bio-dynamic agriculture. As parental material they use free varieties and other commercially available varieties. They also evaluate a range of materials from gene bank collections, but so far these have hardly been used in their crossing work.

Rejection of various gene technologies has important repercussions for the flow of genes between organic and conventional breeding. At present, organic breeding can tap from the conventional sector. If in future, varieties developed with gene technology will dominate in the conventional sector, then the materials from this sector will be largely unusable as source material for organic bio-dynamic breeding.

Main features of breeding

Breeding generates diversity

For crossing, breeders use conventional varieties as sources of new genes, including hybrid varieties. The segregation of hybrid varieties in following generations is also used to develop new lines through selection. This forms a genetic link between the breeding programmes of the conventional and the organic sector.

Variation in selection

Crossing and segregation can be considered as the means to generate genetic variation (recombination) at plant level. Selection can be seen as the way to generate a diverse portfolio of varieties. This means that selection should not only be seen as an activity that reduces available variation. The Bingenheim group selects in different environments and by different selectors.

Exploitation of variation in environment and time

Variations in climate, mineral supply, and planetary constellation represent forms of variation in environmental conditions. They are the result of variation in time and place. Variation in environmental conditions leads to different materials being selected.

Variation in selectors

Involving more selectors leads to more variation in selection preferences. This means that variation can be better evaluated and exploited, which may result in more variation being selected. One way to have more selectors is by involving farmers and vegetable growers. In a number of cases in the Bingenheim Initiative, the role of the breeder and producer are combined in the same person. When the breeder is also producer, it is assumed that the breeder selects 'with the eyes' (preferences) of a producer.

Exploiting location-specific adaptation

The selection under different conditions and by a larger number of people contributes to a larger portfolio of varieties with region-specific adaptation. In breeding this is also referred to as 'exploitation of location-specific adaptation'. In addition to identifying the best variety for different conditions, this strategy contributes to a broad genetic base in agricultural crop production. It has, however, disadvantages, too. For example, varieties that were selected on the sandy soils usually perform less well on clay soils, and vice versa. This also explains that varieties developed for specific conditions are often low producing in the variety trials when presented for registration.

Results and conclusions

General observations

Bingenheim and other similar initiatives have created an alternative seed sector in Europe that provides mainly vegetable seeds and increasingly also grains for the organic market.

Breeding methodology

Decentralised breeding offers opportunities to exploit region-specific adaptation, and close interaction with producers and with end-users. Breeding is based on the use of licence free varieties and varieties from the conventional sector. This may become a problem if genetically modified (GM) seeds gain increasing importance in the conventional seed sector, as non-GM parent material may become scarce in future.

Seed production and marketing

The initiative addresses clients that appreciate diversity of crops. This concerns the organic sector in general and organic small scale vegetable growers and farmers in particular. The prices are based on normal market prices.

Financial aspects

Financial resources from gifts and foundations create "external" benefits that do not pay directly and that help farmers tolerate reduced revenues from seed sales. Therefore, the initiative does not depend entirely on market mechanisms.

Social aspects

Breeding is carried out by a network of breeders, and all parts of society are included in the financing of breeding. Broad participation and full transparency make breeding a socially widely supported activity.

Legal aspects

The Bingenheim Initiative practices collective ownership of varieties. Property rights of the varieties lie with Kultursaat e.V. This emphasises their perception that the availability of the varieties is a public task.

Handout 12

Impact of value addition to underutilized crops and animals – three examples from abroad

Impacts of value addition to agrobiodiversity products occur on the social, the economic and the environmental level, which will be shown in the following examples.

Ecuador

In Ecuador, the local premium cocoa was endangered by being replaced through higher yielding consumer cocoa varieties. The premium cocoa production was therefore promoted by strengthening local cocoa producer cooperatives and interlinking all actors of the cocoa value chain as part of the National Cocoa Export Promotion Programme. The quality of the local premium cocoa variety "Nacional" was improved, the producers certified and the contacts between cooperatives and premium chocolate producers were established. Within three years, 19,500 ha of "Nacional Cocoa" were certified under Fairtrade and Rainforest Alliance standards. 4,000 farmers received access to the international bio- and fair trade certified market with an export volume of 1,880 t of cocoa. The farmers receive 30% higher prices for their cocoa, which increased their income between 120 and 1,025 US Dollars per year.

The production of cocoa in traditional intercropping systems with shade trees also protects the natural forest ecosystem with its large diversity. Logging has much decreased in the area. Sufficient income in poor households triggers further positive changes in livelihoods like for example better health, education, housing and reduced temporary migration.

Morocco

Another example, the Argan tree is a species occurring only in Morocco on the slopes of the Atlas Mountains. Clearing for agriculture, timber and construction reduced the Argan tree to an area of 8,000 km². Since the 1970s, research institutes started to analyse the high quality oil from the tree, which is used traditionally. During the 1990s, several organizations started to promote the production of hand-pressed Argan oil as an ecologically friendly production system, which serves poor rural households. Currently, about 70 women's cooperatives are organized in three federations, which were brought in contact with international traders. The produced volumes of oil were multiplied up to six times. 90% of the oil is exported, especially to European retailers. But the prices for certified hand-pressed oil have also gone up in the local market and provide all in all higher incomes to Argan fruit and oil producing families. Especially women take an important part of their income from oil production and gathering of fruits. As Argan trees have an appreciable economic value, they are meanwhile replanted and existing stands are better conserved. The federations have gained political influence in the formulation of product norms and standards for Argan products.

Germany

In the beginning of the 19th century, the pig Schwabisch-Hallisch Landrace was cross-bred in Southern Germany from local pig races and Chinese saddleback pigs from Jinhua City, Zhejiang Province. The Schwabisch-Hallisch Landrace is a very prolific, disease resistant and stress tolerant pig. During the 50s, the race represented 90% of the pigs in some districts of Southern Germany. However, by 1980, the race was supposed to be extinct. Rebreeding started from seven females and one male pig that could still be found in scattered farms by a breeders association that was created in 1986. Later on, a producer association was created and its membership has reached 950 farmers today. The producer association's regulations stipulate that the animals have to be produced without medicine or growth promoters according to environmental and animal-friendly principles.

In 2006, the breeder association had increased from an initial 17 to 120 members having some 300 pure-breds for breeding purposes and 3,500 animals for piglet production. Producers gain 25% higher prices for the pigs. The producer association, which has grown to 950 members, has bought a communal slaughterhouse, where 5,000 pigs are butchered and processed every week. The products are sold to 280 registered butchers (70% of meat produced) and 150 restaurants and delicatessen shops. The production from the Schwabisch-Hallisch Landrace is registered as a Protected Geographical Indication (PGI).

Apart from the improved income for about 1,000 breeders and producers, another 250 jobs were created in processing and marketing operations with an annual turnover of 72 million Euro. Producers are also satisfied by improved working conditions that favour environmentally and animal friendly production. The rearing of the pigs on the pastures of the area has re-established the former cultural landscape, reduced scrub encroachment and increased the touristic attractiveness of the landscape.

Handout 13

Cultivation and use of traditional rice varieties by the Dai people

The rice planted by Dai people

The Dai call rice "Hao", and mainly consume an indica type rice composed of glutinous rice and some common rice. This case is based on Mandong and Mandan Villages of Mengla Township, and Manli Village of Mengbang Township, Mengla County, Xishuangbanna, Yunnan Province.

Traditional knowledge associated with rice variety resources and rice planting

Traditional rice varieties

The traditional rice varieties in Manli Village in the 1950s and 1960s included Haoxiangli, Haolainun, and Haobulong, and during the period from the 1950s to 1980s, dry land rice was planted in Manli Village. The glutinous rice varieties grown on dry land were mainly Haokanlong, Haoguolei, Haohuo, and Haobo. Mandong Village, governed by Mengla Township of Mengla County, generally grows glutinous rice. The traditional rice varieties there are mainly Haohuo and Haoshan, which mean "female parent rice" and "male parent rice" respectively in the Dai language. It is obvious that these two varieties were grown for a long time historically, though they are not planted there anymore. The old varieties are preserved to some extent in highly-elevation Mandan Village, an affiliate to Mengla Township, where the land is mostly covered by hills at an altitude of 850 m a.s.l.

Classification of paddy fields

The classification of paddy fields is a traditional approach in the area. The Dai in Mandan Village classified the paddy fields into three grades:

1. The first class fields are those adjacent to the paddy fields of the village. This kind of field is most fertile because they are accessible to pigs, cattle and chicken, whose droppings are flushed into the paddy fields by rain.
2. The second class fields are those which are frequented by cattle who feed on grass in the fields, and who use them as a sleeping place.
3. The third class fields are marshes.

In early days, differently performing rice varieties were planted in different fields. The farmers would systematically plant the rice which proved to be less productive in the third class fields, transplant those which grew well in the second class fields into the third class fields, and those which did not grow well in the first class fields into the third class fields. They grew crops by the natural fertility of land instead of using farmyard manure. Thus their traditional farming method involved systematically planting rice in different types of land according to what they deemed suitable for the growth of each variety.

Traditional method for spreading seeds and selecting seedlings

The rice seed is soaked for about three days before being spread into the fields. The spreading of seeds is followed by the selection of seedlings. The selection of seeds is not carried out with the aim of selecting plump rice seeds, but rather of removing wizened and weak ones. Because the seedlings are grown densely, differences in their quality become clearly apparent. The selection of seedlings begins about 28 days after the spreading of seeds. Every ten well-developed seedlings are selected and bound into one sheaf before being planted into the field and after 12 to 15 days when they have grown taller they are moved to paddy fields. To prevent 'yellow dwarf' after planting, the farmers spread minced

Abutilon crispum or *Lindera obtusiloba* into the fields and erect the stump of a Gezhonghan tree into the field. If the soil of the paddy field is acidic, they spread lime or furnace ashes on the field.

Knowledge of water conservation and irrigation

Dai people attach great importance to water conservancy and irrigation. They developed a complete management system and relevant law and regulations on water conservancy ranging from canal and dam building to water management and utilization. During the period of the Dai chieftain system, a multilevel management mechanism was established. An officer called "Leshilang" was in charge of the water conservancy in the whole area. Appropriate officers were appointed to directly manage water conservancy. Each canal was managed by a manager and his assistant and in each village a manager of water conservancy was appointed. Dedicated to their duties, the managers at all levels would organize villagers to build canals and dams, examine the dams and canals, set up distributive pipes, distribute water according to determined irrigation times, regularly and irregularly patrol canals and dams, deal with disputes arising from the use of water, etc.

Rice used for religious activities

To perform religious rituals and celebrate festivals, the Dai would make "Haoluosuo" or rice cake using glutinous rice minced and mixed with the flowers from Shizi of Yunnan province and wrapped in palm leaves before being steamed. Glutinous rice is an important sacrifice to be offered to "Peila" and the rice god. When offering sacrifice to the rice god, the glutinous rice would be dyed black. People would go to temples to offer sacrifice to their god with glutinous rice every morning. When the festival "Gedai" comes, they make "Haoluosuo", bean jelly, and "Baba", using glutinous rice and palm leaves to offer as sacrifice to god.

Rice used as food

The well-known aromatic bamboo rice or bamboo stem rice of the Dai is made by putting the glutinous rice in bamboo and baking it on the fire until it is well-done and giving off a fragrant smell. The Dai used to eat glutinous rice for three meals every day. Every morning they would steam rice soaked overnight and take the steamed rice wrapped in palm leaves to the field to eat. Because they were too busy to go home to cook meals, the rice they brought with them in the morning could support them all day. They would also cook bamboo rice at the field. However, it is troublesome to cook glutinous rice when more labour is needed during the period of seedling transplantation. In this case, they would look to the convenience of eating common rice. Therefore, the Dai also plant a small amount of common rice in addition to the large scale planting of glutinous rice. They do not usually eat rice cooked the day before, since they think only rice freshly cooked can maintain its original look and taste. Cooked rice will be quickly cooled by a fan to prevent it from getting loose. The Dai usually pinch the rice to soften it before eating. As glutinous rice is not easily digestible, they eat it with acidic food to improve digestion.

Other features of rice

The water left after steaming rice and washing rice can be used to wash hair for its hair-tonic function. Haogan can also be used as a medicine. It can be used to make porridge with horse and deer's heart and blood and ginseng to cure anaemia. The glutinous rice can also be used to make fine wine.

Rice seed selection and reservation

It mainly is the job of women to select and reserve rice seeds. They will survey well-developed rice varieties and ask the owner to offer the seeds of it after harvest. It's one of the responsibilities of women to exchange seeds and introduce fine seeds from other villages.

Handout 14

The edible plants of Mongolians on the Erdos Plateau

The Mongolians have been nomads since time immemorial and they rely on animals to survive. They also accumulated abundant traditional knowledge of wild edible plant resources to get access to the substances necessary for their physical constitution such as vitamins and mineral salts or enrich their diet. This case is based on the situation of the Mongolians on the Erdos Plateau.

The traditional knowledge of wild edible plants of these people includes that of food plants, wild vegetables, wild fruits, wine making plants, flavouring plants, fumigated milk food utensils and plant catalytic dairy products, etc.

Traditional utilization of wild food plants

The wild food plants of the Mongolians on the Erdos Plateau include 14 main food plants including *Achnatherum splendens, Prunus mongolica, Caragana intermedia* and others. The food plants used by these people are mainly fruits and seeds which are classified into eleven categories.

The Mongolians use *Achnatherum splendens* and *Agriophillum arenarium* as a complement to their main food. The food made of *Achnatherum splendens* is a match for rice which has a tonic effect to restore energy. Mongolian *Prunus mongolica* is the food substitute of the herdsmen in the Arbas Mountains of the Western Erdos. Its seeds are fried for food because it is not toxic after being fried and the herdsmen also exchange the seeds of *Prunus mongolica* for food.

Traditional utilization of wild vegetables

The edible wild vegetables of the herdsmen include the Mongolian leek, Arbas leek, Huolan leek, chicory, *Mulgedium tataricum, Pugionium dolabratum, Pugonium calcaratum* Kom., *Ulmus pumila* L., *Chenopodium acuminatum, Chenopodiaceae, Lepidium apetalum,* dandelion and morningstar lily. The wild vegetables in the herdsmen's diets are generally made up of eleven varieties of plant leaves, seven varieties of stems and roots and two varieties of fruits.

Traditional utilization of wild fruits

The wild fruits eaten by these Mongolians are *Hedge prinsepia* nut, *Nitraria, Nitraria sibirica* Pall., *Nitraria roborowskii* Kom., *Nitraria roborowskii, Zizyphus jujube,* sea buckthorn, and others. The Mongolian name of *Nitraria roborowskii* is "Haad-in-mod" which means "the tree of the King". According to the introduction of the local herdsmen, the nut of *Hedge prinsepia* was the fruit attributed to the emperor historically. Only the emperor could eat it. The tasty sour sweet flavor of *Hedge prinsepia* nut is similar to that of the favorite milk wine of Mongolian nomads. Therefore, its original Mongolian name denoted its value and nutrition and reflected the culture of Mongolian to name a plant according to its features.

The three plants of *Nitraria, Nitraria roborowskii* Kom. and *Nitraria sibirica* Pall. were called "Do-bong" in the Mongolian language, which means "small Aobao". This name reminds us of the vivid image of *Nitraria* bush. The Mongolians call the fruit of *Nitraria* plants "Ham-rag", which is slightly

different from "Har-mag", the Mongolian name of *Nitraria* in modern plant taxonomy. The herdsmen sometimes eat it as a substitute for *Nitraria roborowskii* Kom. In Uxin Banner of the Erdos Plateau grow large areas of *Iris ensata* Thunb., the fresh and tender wild fruit eaten by the local herdsman for both hunger and thirst. The herdsmen in hilly areas eat the young and tender fruits of *Ulmus pumila* L. which are added to wheat foods to give an appealing colour and improve nutrients.

Traditional utilization of wine-making plants

The fruit of *Nitraria* is the material for the wine making by the Mongolians. They make sweet red wine from fermented *Nitraria* plant with a unique ethnic brewing process of "fermenting fruit with dairy". If you add 10 grams of wine and 1 gram of sugar or crystal sugar to fruit wine, a wine is created which they consider as good as grape wine in terms of colour and taste.

Traditional utilization of wild seasoning plants

The wild seasoning plants eaten by the Mongolians are mainly leaves of plants including *Sabina vulgaris*, thyme, Mongolian leek, Arbas leek, and Helan leek. The stem plants include *Sabina vulgaris* and thyme. The inflorescence includes alkali leek and narrow-leaved leek. The fruit seasoning plants include *Nitraria, Nitraria roborowskii* Kom. and oleaster.

People in the area use *Sabina vulgaris* as firewood to bake mutton. In this way, the functions of both firewood and seasoning are brought into play at the same time. The mutton baked by *Sabina vulgaris* is tasty with an appealing colour, crisp, fresh, tender and spicy and can stimulate your appetite. The Mongolians on the Erdos will choose among thyme, Mongolian leek, alkali leek, narrow-leaved leek and Helan leek to be stewed with "Shou-ba" meat as a seasoning. Particularly, the mutton stewed with thyme seasoning is very popular for its tenderness and wonderful taste.

In the autumn, the herdsmen will collect the leaves of Mongolian leek, Helan leek and Arbas leek and dry them after cleaning them of soil, bind them in bunches and reserve them as seasoning. They also grind the florescence of alkali leek and narrow-leaved leek to make seasoning. *Sabina vulgaris*, thyme and Mongolian leek are the seasoning plants of the Mongolian herdsmen in hilly or desert areas, whereas the herdsmen in mountains use thyme, Arbas leek and Helan leek to make seasoning.

Traditional utilization of plants for fumigating dairy utensils and plant catalytic dairy

Artemisia frigida and *Sabina vulgaris* play an important role in the milk food culture of the Mongolians in this area because they traditionally use the stems and leaves of the two kinds of plant to fumigate and sterilize dairy utensils. According to tradition, milk is sacred and allows not to be contaminated. It is the cultural characteristics of these people to fumigate milk utensils with the plants which give off scent after burning. They put the clean leaves and switches of *Artemisia frigida* in fresh milk to speed up the separation of fat elements and thicken them after separation.

Conclusion

The traditional knowledge of the Mongolians about wild edible plants on the Erdos Plateau can be summarized as follows:

1. Their traditional knowledge of wild edible plant on the Erdos has the element of innovation.
2. Their traditional knowledge of wild edible plants on the Erdos also bears appreciable regional characteristics.
3. There are mountains, desert, and hills with grassland vegetation, desert vegetation and halophytic vegetation on the Erdos Plateau. The varied traditional knowledge of edible wild plants completely reflects the ecological conditions and diversity of this region.

At present, "Sami Vinegar", "Sami Brand" wild sand rice, "Sand Onion", and others are developed by the commercial mechanical research institution of the Ministry of Commerce. The objective is to create modern organic food developed on the basis of traditional knowledge mastered by common people. Research projects such as "The Research of Technology on Tissue Culture of Mongolian Leek" represent the extension and improvement of the traditional knowledge of protection, management and development of plant resources among the common people. The commercialized development of the traditional knowledge of edible wild plant resources of the Mongolians on the Erdos Plateau and the application for geographically labelled products may be the best practice to respond to adverse development trends in modern society.

Handout 15

Raising ducks and fish in paddy fields, a traditional practice of the Hani people

In the areas of the Hani ethnic group, it is typical that women play a leading role in fish raising. The Hani are engaged in farm work in terraced fields suitable to use as fish ponds. Therefore, in Quanfu Village, Ailao Mountains, where the climate is quite suitable for the breeding of fish, every household has a pond to raise and breed fish.

Breeding methodology

Fish fry caught in rivers and lakes are moved into paddy fields during the season of seedling nursery. This season is critical for the breeding of fish and the fields are easy to mange because they are close to the villages. After moving the seedlings from the nurseries into the terraced fields, the breeding fish are caught and returned to the ponds and the hatched fish fry are released into the terraced fields planted with seedlings to grow with the crops. The water inlet and outlet of each paddy field are covered by bamboo sieves to prevent fish from swimming to neighbouring fields but to also keep the water flowing through all the terraced fields.

Free from pollution, the fish here grow tender and tasty and even their scales are soft and edible because the water in the paddy fields comes from the mountains and the growth of crops in terraced fields do not usually depend on chemical fertilizers and pesticides. The fish raised in the terraced fields do not need any feed because they live on plenty of plankton and rice pollen brought by the flowing water in the fields. This kind of fish is also called "Pollen fish" by local Hani as it lives on pollen. Surveys revealed that the Hani learned to catch fish fry in rivers and lakes and raise them in their ponds long ago.

Women's role in Hani society

The women have power to decide the place to raise fish and the varieties and the number of fish to be raised while the men do not usually take care of this matter. Hani women generally like to raise carp and Shi fish, since they hold that carp and Shi fish are strong, grow fast and are tasty. They have a good market among urban residents. It is well-known that the Hani raise fish to eat, sell, entertain guests, and use them as sacrifice to worship their ancestors. In fact, the utilization of fish as food, dishes for entertainment of guests and sacrifice for worship of ancestors has long been determined by women. They have the power to decide how to utilize the fish and spend the money earned from fish farming. Women usually sell fish to earn money for household living costs, such as electricity fees, salt and oil purchase, etc. Nowadays, the women in Hani society enjoy a high position economically, domestically and socially because they control fish farming in terraced fields as operators and managers.

Handout 16

The utilization of water resources by the Hani people

The terraced fields of the Hani people are amazingly impressive. Water is not only a daily necessity to all people, but to the Hani it is a life force important to all aspects of their society. Traditional knowledge and its associated culture invented and maintained by the Hani people in the long history of production practices act as a sound base for sustainable utilization of water resources. The traditional knowledge of water resource utilization and water culture of the Hani can be summarized as follows: the efficient utilization of water resources, the philosophy of water resources conservation, rational programme and management ideals for terraced field irrigation areas.

Efficient utilization of water resources

Residing on the hillside of the Ailao Mountain, the Hani generally depend on surface and spring water which are formed by rainfall retained by forest for their water supply.

In order to realize the efficient utilization of water resources, the Hani use hydroelectricity generated by water from the mountain to facilitate their life and work activities and save labour. The streams around Hani villages flow rapidly and therefore contain considerable hydraulic power even though they are small. The Hani usually set up in their villages hydraulic stone rollers, pestles, grinders, etc. which are driven by hydroelectricity which greatly relieves them of fatigue and hard work.

Besides that, the Hani invented the "Chongfei" (manure flushing) method to save labour by using water from the mountains. There are two kinds of manure flushing:

One is to flush the septic pit in the village. There is a special pit in each Hani village to collect farmyard manure and trash and, during the season of seedling plantation, this manure will be flushed by the water channelled from mountains to flow along the ditches into the terraced fields at lower elevations. If only one household needs the manure to fertilize its fields, it will notify the other households to close their water inlets in their fields.

The other way to fertilize terraced fields is flushing the manure in the mountains. The raining season of each year is the time when the rice crops begin to ear and the rotten leaves piled up on the mountains for a year flushed by rain are flowing down with droppings of animals into the ditches on the hillside which coincide with the need of terraced fields for fertilizer. Therefore, the villagers, men and women, old and young, all come out to help channel the fertilizer coming from the mountains into the fields. This activity was called "Chongfei" (manure flushing) or "Gangou" (collecting manure in valleys) in ancient time and is still popular today.

The awareness of water resources conservation

As the terraced field is considered the god of grain that keeps the Hani people alive, water resources are the blood of the god and the forest is the marrow that produces the blood. The Hani attach great importance to the protection of water resources, particularly the cultivation and protection of water conservation forests.

The Hani usually reside somewhere above the hillside (from 1,400 m a.s.l. to 2,000 m a.s.l.) between deciduous broad leaved forests and evergreen broad leaved moss forests. The forest found above 2,000 m a.s.l. is considered water conservation forest. The Hani have an old rule forbidding logging

in the water conservation forest. The forests behind their villages are even hallowed as their god. Nearly every Hani village has its sacred forest. For example, in Yuanyang County, according to unconsolidated statistics, there are 431 sacred forests. The Hani will hold rituals to worship the sacred forest every year and the sacred forest is not allowed to be entered without approval in order to prevent any damage to it.

Owing to the awareness and measures taken by the Hani to protect forests, the natural surroundings of the Hani boasts a high density of forest coverage which has formed a great bank of water catchment to ensure the water supply for the terraced fields. The sacred forest is mostly composed of the trees of good water catchment function, such as *Camptotheca, Axillary choerospondias, Schima wallichii* Choisy, Chinese birch, Duoyishu, alder, banyan, etc.

Rational programme and management of irrigation areas

The terraced fields of the Hani people have complete irrigation systems. For example, in the terraced field irrigation areas in Yuanyang County, the Hani build canals along the paralleled contour at the hillside above 1,900 m a.s.l. to collect water flowing down from the mountains and the branch canals vertical to the contour at different levels to form a relatively complete canal system. As the water channelled to the villages needs to be distributed, the Hani invented carved stone (or wood) pieces to appropriately distribute water for the irrigation of terraced fields. This invention involves the old experience of "the interrelation of water potential and flow velocity". One of the important features in the terraced field area is the sand collection field which is the same as the current detritus pit in function. All the terraced fields are equipped with sand collection fields to catch sand because the sand carried by water from the mountains may be harmful to the terraced fields.

Each village has appointed a water manager who is paid by the village with money and grain to manage irrigation. Particularly during dry seasons when the water level in the canal dramatically drops, the rotating irrigation system set up by the Hani can prevent fights and conflicts over water.

The management of water conducted by the Hani reflects the value of water resources and their awareness of their right over water utilization. The Hani have long regarded water as a resource and attach much importance to the terraced field irrigation system. During the period of chieftain governance, the villagers had to pay a proportion of their harvest for the water channelled from the canal built by chieftains. The Hani have established the system of building canals every year since time immemorial and everyone has the duty to repair the canal whenever he or she detects any damage. Furthermore, villagers of every village would come out in groups to dredge ditches and canals or clean weeds and repair the irrigation system. It is due to this kind of canal maintenance system that the terraced field irrigation area of the Hani people has been conserved for tens and hundreds of years.

In conclusion, the programme and maintenance of the Hani terraced fields and the management of water utilization involves the technology and ideas of modern agricultural water conservation. That's why the terraced fields of the Hani which were developed long ago still work and will continue to work in the future.

Handout 17

The sacred forest of the Hani people

The position and function of forest in the terraced field ecosystem of the Hani

Forest is the core of the ecosystem of Ailao Mountain and an important part of the terraced field ecosystem of the Hani. The terraced field ecosystem of the Hani is composed of forest, villages, terraced fields and river valleys which are distributed in a pyramid shape. On the top of the pyramid on the cold mountain ridge is the conserved primitive forest, at the warm hillside are the villages or houses, on the lower half of the mountain ranging from the border of the village to the valley at the foot of the hill are the terraced fields and below the terraced fields are the rivers. This kind of distribution is best described by the ballad of the Hani that goes, "Wanna eat meat? Go to the top of the mountain. Wanna till land? Stay at the foot of the hill. Wanna have a baby? Find a woman on the hillside".

Since forest lies on the top of the pyramid-shaped ecosystem, its water conservation property plays an important role in the control of the whole ecosystem. "The higher the mountain is, the more abundant water resources will be." The vertically distributed climate of the Ailao Mountain is largely attributable to this kind of landscape, and the saying goes, "You can see four seasons on one day in the mountain, walking for a distance of ten miles". The unique landscape and climate have provided advantageous conditions for the development of terraced fields.

In addition, forest also provides the Hani with abundant resources of meat and vegetables. Hunting used to be one of sources of meat for the Hani. The collection of edible wild plants, especially wild vegetables, is still an important source of food for the Hani. The forest also contains abundant timber, firewood, forages and medicinal herb resources. The Hani have accumulated quite a lot of traditional knowledge about medicine and developed its own medical treatment skills.

The culture of sacred forest of the Hani

The forest plays an important role in the daily life and traditional culture of the Hani. They are very particular about the site of their villages: there must be ample forest above the site where they choose to build houses. Older Hani people often tell the young people that the "tree is the soul of water, water is the soul of the field, and the field is the soul of the people".

They classified forest on the top of mountains as water conservation forest, forest behind the village as sacred forest (which can be divided into mountain god forest and village god forest), forest below the village as the forest "to suppress the demon", forest by the road outside the village as the forest "to separate Man from ghosts" and forest around the village as landscape forest in which cutting is forbidden. No people or animals are allowed to enter the mountain god forest and village god forest.

The conservation of the forest of the Hani is largely based on their ecological culture, or the culture of sacred forest. Forest, as the theme of the traditional culture of the Hani, has always been regarded as the most important element in their cultural development. In ancient history and legend, forest was the refuge and shelter of the Hani and the source of their food and other daily necessities. The forest is and always has been the home of the Hani. Therefore, the Hani call the sacred forest Pu Ma E Bo", which means forest or village.

The sacred forest culture of the Hani is notably represented by religious rituals. The Hani will hold grand rituals every year to worship their village gods, which are called "Ang Ma Tu", "Ang Ma Weng", "Pu Ma E Bo", etc. "Ang Ma Tu" is a traditional festival held by villages to worship their god and

provide entertainment. Every village of the Hani has its own sacred village forest and village tree. They will choose an evergreen tree with erect trunk and luxuriant leaves to be appointed as "Ang Ma Abo" (the sacred village tree), which is regarded as the incarnation of the god of the village.

This culture of the Hani is transmitted from generation to generation in the form of legend, story, poetry, ballad, saying and children's song with the forest linked to mountains, the world, seasons, climate change and the water for terraced fields. The Hani used to plant three trees in the forests on the border of the village when a baby was born and would bury the placenta of the baby under the trees, which were then watered by the water used to wash the baby. The babies would grow up with the trees and the more babies grew up, the more trees would develop into forest. This kind of custom strengthened the interrelation of forest and people.

The Hani people have gradually developed the idea of "coexistence of Man and nature" in the process of living activities to adapt themselves to the environment. The worship of various natural substances as god is the reflection of this idea in their religious beliefs and legends. The Hani believe that everything in the world has life. They are manipulated and controlled by a supernatural power, or there is a "totally alien, omnipotent and unconquerable power standing against Man". We can come to this conclusion by studying the stories in the ancient songs of the Hani like "the creation of the earth", "the worshiper of Abo", "flood disaster", "marriage between a brother and a sister", "human race and living organism", etc. The Hani hold that nature and mankind are the carriers of god's will, that god has determined the position of nature and mankind and the law of nature is the expression of the god's will. Being in compliance with the law of nature is the lofty principle of the Hani people to deal with the relationship between Man and nature and between Man and the earth. Satisfied with the position determined by god, they live in harmony with nature and turn themselves into a part of it.

The significance of sacred forest of the conservation of biodiversity

The Hani do not have their own language but we can still detect their value of the ecosystem, or the idea to realize the harmonious development of Man and nature from the existing legal information of historic relics written in Chinese and legendary legal rules. In view of folk law, village rules and ethnic convention, the Hani have long formulated regulations on the conservation of the ecological environment, especially on the strict protection of sacred forest.

They usually appoint certain people, or rangers, to execute the management of the forest, who are responsible to patrol the forest. They have the duty to stop any activities associated with felling trees, grazing, etc. in the sacred forest, water conservation forest and landscape forest. Firewood collection is also brought under control. It is stipulated that firewood shall be collected in certain places and of a certain amount, and only the withered branches can be cut. Firewood shall not be carried home before the rangers check it. Any violation of this regulation will result in the violator being fined to pay money, rice or wine or plant trees, build roads, etc. Those who refuse to pay the fine shall be expelled from the village with a resolution made by the villager committee in extreme cases.

The culture of sacred forest of has proven to be an effective way to protect the sacred village forest and village trees for it has conserved a lot of primitive forest and maintained large forest coverage in the local area. However, the economic development, population growth and shifts in culture undoubtedly pose a great challenge to the culture of sacred forests. Apart from the state-owned forest, all forests other than the sacred forest are faced with the threat of degradation caused by overuse. Some mountain ridges which were once covered by forest have degraded into meadows. This also is a great risk to the existence of the terraced fields of the Hani.

Handout 18

Participatory village assessment and planning

This Handout is an outline of a three-day assessment and planning exercise conducted by a group of technicians together with the inhabitants of one village. It gives an overview of the possible results of such an exercise and it provides an example of detailed programming.

Participatory village assessment and planning is in line with the policy stipulated in the 11th and also the 12th Five-Year Plan. It helps to build up a healthy civil society in the villages.

Participants

All trained project personnel of the county administration, including three technicians with knowledge on crop growing techniques. The technicians of the suitable technical departments of the county were invited for the feasibility evaluation of proposed measures.

Outputs

1. Agricultural staff has learned how to initiate village planning in a participatory way.
2. The current general situation of the village is identified.
3. The possible scope of activities to promote the sustainable management of ABD is discussed with villagers.
4. Additional measures for the development of the village are identified.

Produced, documented and detailed outputs

General situation

- Social and economic data of the village in regards to poverty, labour force, age distribution, migration, income, agricultural production, etc.
- Agricultural calendar
- Female/male labour division
- List of field crops and fruits grown (down to specific variety)
- List of recent or ongoing projects
- Resource map
- Transect walk with female villagers
- Transect walk with male villagers
- Village history
- Reports on semi-structured interviews with key informants

ABD management activities

- Map of existing biodiversity
- List of existing traditional crops
- List of existing marketing channels for traditional crops
- Evaluation report by agricultural technicians on the existing production techniques (traditional and intensive agriculture)

Additional measure for village development

- Listed and ranked measures to be supported by the project
- Feasibility evaluation of measures by technicians
- Planning map
- Activity plan for the village

Planning procedure and village assessment

Preparation

During a meeting at county level, the planned activities in the village were introduced and assigned to different facilitators. Each group of facilitators consisted of three persons, one from each project county.

Each of the proposed activities was discussed shortly and the important information and ways of information gathering were explained. The different facilitators were asked to work out the activity and the formats of visualization.

After a short presentation, the proposed outline was discussed again.

Activities in the village, first day

1. Presentation of the project by one representative of the county project office
2. Semi-structured interview
   This activity is used to agree with the village heads on the time in which the assessment and planning activities take place.
3. Common group discussion
   - Village history and history of replacement of traditional crops
   - Elaboration of a crop list
   - Detailed crop list with production size, utilization, importance and marketing strategy to be worked out and visualised together with the farmers
   - List of traditional crops production size, utilization, marketing channels and development possibilities
   - Agricultural calendar
   - Daily work calendar, female and male
   - Resource map
4. Small group activities
5. Transect walk with female villagers
6. Transect walk with male villagers

Activities in the village, second day

1. Problem analysis: Two groups, female and male
2. Problem ranking: Two groups, female and male
3. Elaboration of problem solutions: All available households
4. Solution ranking: All available households

Too many planned assessment exercises may cause time pressures, which influences the quality of the outcomes. Therefore it is advisable to carefully synchronize time available and tasks to fulfil with already experienced facilitators.

Activities in the county, second and third day

1. Presentation of results of participatory activities
2. The responsible facilitators presented each activity and discussed the methods. Each group of facilitators gave recommendations on improvement.
3. In a "final discussion" moderated by the director of the provincial project office, the two experts gave short evaluations on the process.
4. Discussion of measures proposed by villagers and ranking according to the support given to them by the facilitators
5. Presentation of the proposed measures with the ranking of the facilitators and the main arguments (pro and con) mentioned during the discussion
6. Selection of technicians to undertake a simple feasibility study
7. Two technicians were asked to investigate the proposed repair of the road and the technology currently applied in agricultural production.

Activity in the village, third day

1. Site investigation on proposed development measure by technicians
2. Site investigation by a crop expert on the possible improvement of agricultural technologies

Activity in the county

Decision of the project management which measures could be supported

Final planning activities in the village

3. Feedback session with villagers
   Presentation of reasoning and decision by the project management
   Presentation of possible activities to promote sustainable management of agrobiodiversity
4. Discussion on the possible scope of the discussed activities
5. Elaboration of an activity plan on the decided measures for village development

Handout 19

Procedure for an in-depth assessment of an agricultural environment

Fauna

Starting with the animals, it is important to look into the variety and quantity of all kinds of animals within the area to be investigated. This includes wild and domesticated mammals and poultry. Usually, surveys of domesticated animals and wild animals are carried out separately.

Sources of information on **wild animals** are secondary data of the region, field reconnaissance surveys and interviews with rural people. Field surveys (frequently seen, visible, and rarely seen) and the sample square method (exact number of a species in a restricted area with an exact relation to the whole investigated area) can provide observations on the present species and on their quantity. Beneath that, the conditions of migration, and the development population over time may provide useful information (migrating conditions for birds, multi-generation conditions of insects).

Information on **domesticated animals** (livestock and poultries) usually is gained by household interviews (husbandry conditions, quantities of livestock and poultries, economy of animal husbandry).

Flora

As with the fauna, the regional flora can be captured and understood with a couple of investigating steps:

1. In order to gain an overview of the area and distribution of vegetation, satellite images, aerial photos and topographic maps together with a field reconnaissance survey can be used. The area and distribution situation can then be documented on planar graphs.
2. In order to determine the plant species and vegetation type, usually already existing information and topographic maps can be used.
3. Plant communities can be investigated more intensively with the help of the sample square method. The minimum area can be decided by the type of plants to be researched (forest, shrub, meadow, etc.), the complexity of the community and the topography.

Many **wild plants** have specific functions for people. On the basis of a pre-survey with farmers, these plant species closely related to agricultural or medical use should be selected and further investigated.

Cultivated plants are usually determined by household surveys. For household surveys, it is advisable to interview the oldest people available, as they usually have the aggregated knowledge of decades working in agriculture. Interviewing should cover the topics of species and varieties planted, cropping and gardening areas and yields of plants as well as functions of specific plants. Usually a field survey follows this household survey. It is mainly to discover the species or varieties that the farmers forgot to tell or didn't tell by thinking that they might not be necessary. Animals and plants are parts of the ecological environment of a village.

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