Secretariat of the Convention on Biological Diversity

CBD Technical Series No. 34

MAINSTREAMING BIODIVERSITY ISSUES INTO FORESTRY AND AGRICULTURE

Abstracts of Poster Presentations at the 13th Meeting of the Subsidiary Body on Scientific, Technical and Technological Advice of the Convention on Biological Diversity
18-22 February 2008, Rome, Italy

Convention on Biological Diversity

UNEP

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Published by the Secretariat of the Convention on Biological Diversity. ISBN: 92-9225-081-7

Citation
Secretariat of the Convention on Biological Diversity (2008). Mainstreaming Biodiversity Issues into Forestry and Agriculture, Abstracts of Poster Presentations at the 13th Meeting of the Subsidiary Body on Scientific, Technical and Technological Advice of the Convention on Biological Diversity, 18-22 February 2008, Rome, Italy, Technical Series no. 34, i–xii + 150 pages.

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Typesetting: Black Eye Design

Cover Photos
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FOREWORD

Over the past two decades the world population has increased by almost 34 percent, world trade has increased 2.6 times, and global economic output has grown by 67%, according to the fourth Global Environmental Outlook published by UNEP. However, the land available to each person on earth has shrunk by 2005 to 2.02 hectares, from 7.91 hectares in 1900 and is projected to drop to 1.63 hectares for each person by 2050. Population growth combined with unsustainable consumption has stressed our planet to a point where natural disasters and environmental degradation endanger millions of people as well as plant and animal species.

Production sectors of the world such as forestry and agriculture are under increasing pressure not only to provide for the growing population, but also to reduce their global footprint – and this in the shadow of climate change. Yvo De Boer, speaking at the first Forest Day in December 2007, stated that forests are a key issue for climate change discussion. Targets such as the 2010 biodiversity target and the Millennium Development Goals outline paths toward climate change adaptation and mitigation, poverty reduction and the conservation and sustainable use of biodiversity. These targets are serious challenges for forestry and agriculture, especially considering that they themselves are main drivers of global biodiversity loss.

By operating through the Ecosystem Approach the interactions of these issues are considered in the Programme of Work on Agricultural Biodiversity and the Expanded Programme of Work on Forest Biodiversity of the Convention on Biological Diversity (CBD). Agricultural biodiversity is broadly defined, including all components of biodiversity relevant to food and agriculture, and those that constitute the agro-ecosystem. Forest biodiversity includes all the life forms found within forested areas as well as the ecological roles they perform.

These two Programmes of Work are under in-depth review at the thirteenth meeting of the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA 13) 18-22 February 2008 at FAO Headquarters in Rome, Italy. This edition of the Convention on Biological Diversity's Technical Series was prepared to accompany poster session presentations at SBSTTA 13. Accordingly, the theme of the poster session for SBSTTA 13 is "Mainstreaming Biodiversity Issues into Forestry and Agriculture". Parties, other Governments and relevant United Nations, inter-governmental, non-governmental, regional and international organizations, indigenous and local communities, and the private sector were invited to contribute posters and extended abstracts on mainstreaming biodiversity into forestry and agriculture sectors. Contributors were encouraged to relate their topics to climate change, the 2010 biodiversity targets, the Millennium Development Goals, poverty alleviation and/or any other goals agreed within relevant inter-governmental processes.

These submissions illustrate multiple ways and tools to integrate biodiversity into these sectors. It is my hope that they encourage consideration of this important issue, and further, that they inspire action towards reducing the rate of loss of biodiversity.

I sincerely thank all of the contributors to this Technical Series for their efforts, and for their enhancement of the implementation phase of the Convention.

Ahmed Djoghlaf
Executive Secretary

DISCURSO PRINCIPAL: FORESTERÍA, AGRICULTURA Y MEDIOAMBIENTE PUEDEN TRABAJAR EN CONJUNTO?

En los actuales momentos que vive la humanidad y el planeta, nadie puede dejar de considerar la importancia y la responsabilidad que tenemos para con el medio ambiente, dentro del cual ocupa un lugar importantísimo todo lo que tiene que ver con la biodiversidad, con esa presencia de las diversas especies animales y vegetales en el planeta, que nos da la posibilidad, gracias a esa riqueza, de la supervivencia de los seres humanos sobre la faz de la tierra, concepto este que no debe hacer que caigamos en un antropocentrismo a ultranza, sino en una equilibrada concepción de lo que entraña este planeta, esta "Gaia" de la que nos hablaban los antiguos, en toda la acepción del término.

Nuestra visión no puede ser de corto plazo, las metas que la humanidad se traza deben ser de largo aliento, y allí, la preservación de la biodiversidad juega un papel trascendente, y en este punto, los decisores políticos tienen una gran responsabilidad, que no sería ético evadirla.

Por ello, es menester no perder de vista temas que definitivamente tienen que ver con 1) el tema de la bioenergía (plantaciones para biodiesel y etanol), que ya está afectando la agricultura, por ende la seguridad alimentaria, sobre todo de los países no desarrollados, acrecentando las asimetrías ya existentes y que también afecta la biodiversidad, 2) tiene que ver con el cambio climático, que también agudizará los fenómenos de desertificación y sequía, 3) los avances en las negociaciones ligadas a la ronda de Doha, la incidencia de la baja de subsidios agrícolas en los países desarrollados que acarrearían efectos radicales en el hemisferio norte y en el sur. Por ejemplo, podríamos sugerir que los subsidios eliminados en los países desarrollados, vayan a constituir un gran fondo que apoye a la Convención sobre Biodiversidad.

No podemos dejar de reconocer que la biodiversidad es la base para el desarrollo agrícola y agroforestal del mundo, sin variedad de especies para seleccionar productos y sin variedad de individuos dentro de una especie, no se puede mejorar la producción, de ahí los riesgos de invasión de especies extrañas o la introducción de los organismos genéticamente modificados. Es decir, sin biodiversidad el desarrollo agrícola y agroforestal se limita sustancialmente.

La relación entre biodiversidad y el equilibrio ambiental en la producción agrícola y agroforestal demuestra que eventualmente, ambientes artificiales se han mostrado adecuados para una producción agrícola extensiva, pero no para el medio ambiente y la preservación de la diversidad. Por ello, deben profundizarse los estudios que nos hagan pensar en reales posibilidades de producción agrícola extensiva para atender necesidades a escala mundial, pero en condiciones ambientalmente amigables. La investigación sobre las relaciones naturales entre especies y entre individuos en ambientes naturales (biodiversidad), puede enseñarnos sobre un mejor manejo de los ambientes artificiales, con técnicas menos agresivas (ej. control de plagas).

La conservación de la biodiversidad puede ayudar al equilibrio en el desarrollo socio económico, la conservación y el manejo de la biodiversidad, con amplia participación social adecuadamente remunerada (que incluye los pueblos locales y sus conocimientos tradicionales), y orientado en parte hacia sostener sistemas agrícolas (dotación de insumos nuevos para la agricultura, semillas, especies y conocimientos), puede ayudar a equilibrar el desarrollo socio económico de diversos países, principalmente de aquellos en los cuales generalmente la producción agrícola se realiza con sistemas extensivos "modernos", donde se concentran tierras, insumos, producción y beneficios, en pocos propietarios. Es decir, la conservación y manejo adecuado de la biodiversidad, con participación social, puede ayudar a distribuir los beneficios del desarrollo agrícola, cuando conservación y producción agrícola hacen parte de un mismo sistema de desarrollo.

Si analizamos estos temas, podemos también enfocar otro conexo, que es la interrelación entre biodiversidad y los servicios ambientales para el desarrollo agrícola, ya que solamente en ambientes naturales (biodiversidad), se guardan y protegen además de individuos naturales, culturas, saberes, conocimientos, y se pueden proteger adecuadamente el agua, el aire, el suelo (control de erosión). Estos servicios ambientales son extensivos, de manera directa, para el beneficio de los sistemas y la producción agrícola. Es decir, si no se conserva la biodiversidad, se amenaza el desarrollo agrícola, la seguridad alimentaria, subsecuentemente no se alcanzan las metas del milenio, y tampoco se garantiza la calidad de la vida humana en el planeta.

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KEYNOTE ADDRESS: FORESTRY, AGRICULTURE AND ENVIRONMENT- CAN THEY WORK TOGETHER?[1]

At the present time, the planet and humanity are going through many changes. Everybody should consider the importance and responsibility that we all have to the environment. Special consideration is given to everything that has something to do with biodiversity, which includes the presence of diverse animal and vegetal species and microorganisms. Because of the presence of all this richness, the survival of human beings is possible. This concept should not let us fall into anthropocentrism, but instead we should consider a balanced conception containing the planet as a whole– the "Gaia" which was told to us by the ancients.

We cannot have a short term vision, instead the goals established by humanity should have a long breath, and that is exactly where biodiversity plays a transcendent role. On this point, policy makers have an enormous responsibility that must not be avoided.

This is the reason why some topics, such as the following, cannot be left behind: 1) bio-energy (e.g. bio-diesel and ethanol plantations) which is already affecting agriculture and consequently food security, especially within undeveloped countries. This fact increases already existing asymmetries, which also affect biodiversity; 2) climate change, which will exacerbate phenomena such as desertification and drought; 3) the advances accomplished in the Doha Round negotiations related to the incidence of the fall of agricultural subsides in developed countries, which will bring radical effects in both hemispheres. We could suggest for example, that the eliminated subsidies in those developed countries could constitute a big fund that will be able to support the Convention on Biological Diversity.

We must recognize that biodiversity constitutes the base for agricultural and agroforestry development in the world. Without a variety of species from which to select products and without varieties within species, production cannot be improved, and there is the risk of the invasion of alien species or even the introduction of genetically modified organisms. In other words, without adequate biodiversity agricultural and agroforestry development will be substantially limited.

The relation between biodiversity and environmental balance in agricultural and agroforestry production, demonstrates that eventually, artificial environments have proven to be adequate for extensive agricultural production, but are not necessarily appropriate for the environment and biodiversity conservation. For these reasons, research should be developed and deepened in areas that demonstrate real possibilities of extensive agricultural production, which will be able to meet global needs, but in environmental friendly conditions. Research on the natural relations between species and between members of natural environments (biodiversity) can teach us how to manage in a more correct way the artificial environments by using less aggressive techniques (e.g. forest pest control).

Biodiversity conservation can contribute to the balance between socio-economic development, conservation and biodiversity management, including a large social participation, suitably compensated (including local people and their traditional knowledge). It should also be directed, partially, to support agricultural systems (endowment of new agricultural inputs: seeds, species, and knowledge). It can also help balance socio-economic development between countries, mainly of those where agricultural production is generally carried out with "modern" extensive systems, where the land, the inputs, the production and the benefits are concentrated in very few owners. That means that both, conservation and proper management of biodiversity, in addition to social participation, can help to distribute the benefits obtained through agricultural development. This works if conservation and agricultural production form a single development system.

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1 Translated from the Spanish.

If we analyze these topics we will be able to focus on another related context, which is the interrelation between biodiversity and environmental services for agricultural development. In natural environments that are being conserved, biodiversity is protected, along with endemic species, cultures, and traditional knowledge. In addition, elements such as water, air, and land (e.g. through erosion control) can also be conserved. These environmental services are extensive and they directly benefit systems and agricultural production. In other words, if we do not conserve biodiversity, we are putting agricultural development at risk as well as food security. Consequently, the Millennium Development Goals will not be achieved and the quality of human life on the planet cannot be guaranteed.

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1

MAINSTREAMING BIODIVERSITY ISSUES INTO AGRICULTURE

01. AN OUTCOME-BASED PAYMENT SCHEME REWARDING ECOLOGICAL GOODS IN AGRICULTURE

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Keywords: agri-environment schemes, auctioning, ecological services, plant diversity

INTRODUCTION

Aims of both agriculture and nature conservation have scarcely met each other in the past. Agri-environment schemes (AES) in which farmers are signed to certain measures or omissions suffered from a lack of acceptance and could often not achieve the desired positive results for the environment. This refers especially to action-orientated schemes where compensation payments are conducted for certain measures. High administrational efforts and other administrative regulations that restrict the flexibility of the farm management also slow down farmer's initiative and willingness to participate. To overcome these negative effects, a novel approach has been developed within a German case study in which farmers are regarded as active providers of ecological goods and services. For these goods and services the farmers are rewarded within an outcome-based payment scheme consisting of auctioning procedures that are applied to a defined agricultural region. The implementation of this proposed AES has been investigated since 2004 in a model-district of Lower Saxony, Germany.

A market-based agri-environment scheme

In this outcome-based payment scheme farmers are remunerated for the provision of ecological goods of plant biodiversity independent on the measures taken to achieve theses desired goods. Biodiversity on the plant species level includes species richness or the abundance of certain species that have to be present in arable or grassland fields.

Although biodiversity is a public good**,** mechanisms adapted from market situations for private goods can be introduced into AES aiming at conservation of biodiversity. A regional market can therefore be created wherein such ecological goods are demanded by society according to principles of consumer sovereignty and can be supplied by private landowners such as farmers.

Different surveys in the model-district revealed that the local population is interested in ecological goods and willing to pay for these goods but that population prefers to delegate the demand-decisions for ecological goods to a Regional Advisory Board (Fischer, 2003; Rüffer, 2004). This Regional Advisory Board has been established in 2000 in the model region and consists of the following regional stakeholders: representatives of the district council, the regional administration of agriculture and nature conservation, as well as NGO-institutions for nature conservation, the farmers' union and the organisation of landowners. The Regional Advisory Board defines the demand for ecological goods and decides about the allocation of the available budget to the different goods in the region.

A payment scheme has been developed and implemented in the model region. To achieve higher efficiency regarding the production of ecological goods and the allocation of available financial budget, an auctioning procedure conducted according to market-orientated principles has also been included in the payment scheme. Within the auctioning procedure every farmer in the project region can place a bid containing the ecological good on his farm land and a self-calculated price for the production of these ecological goods. Price discrimination is than used to choose between those bids with the highest price efficiency. Following this selection procedure, farmers receive a letter of acceptance or rejection for their bids. Farmers with accepted bids produce the ecological goods in the following vegetation period. The success of production of ecological goods is monitored afterwards and payments are conducted in case of a successful production.

Implementation of the project scheme

Based on the decisions of the Regional Advisory Board, three auctions have already been conducted for ecological goods in grassland and in arable fields. In grassland, two auction procedures were conducted in 2004/2005 and 2006. Grassland ecological goods are characterised by a set number of forb species and the abundance of rare species that had to be present in control plots (Richter gen. Kemmermann et al., 2005). 38 farmers participated in the scheme. A total amount of 52.000 € was assigned to reward for an area of 289 ha and 238 ha in 2004/2005 and 2006, respectively (Groth, 2007; Klimek et al., 2007). In 2007 an auction for weed species-rich arable fields has been conducted where a total of 63 offers had been received. A group of 18 farmers will participate in producing ecological goods on 102 ha arable land in 2008. The ecological goods on arable fields are characterised by a defined number of weed species and by the occurrence of endangered species (Gerowitt et al., 2003).

Outlook

In order to further develop the outcome based schemes the following topics required in-depth analysis:

1. Future perspective of participation processes in a model-district
   - Evaluation of the present participation process with special focus on members of the Region Advisory Board in order to define criteria for successful implementation of regional decision making
   - Assessment of the possible continuation of the Region Advisory Board under the present agri-environment policy

2. Evaluation of the regional population preferences with contingent valuation methods
   - Analysis of hypothetical and actual willingness to pay for ecological services
   - Investigation of gender-specific differences in statements for the willingness to pay

3. Cost-effective implementation of the proposed scheme into future agri-environment policy
   - Evaluation of transaction costs by means of comparison of the presented AES and governmental AES currently implemented in the federal state of Lower Saxony
   - Development of a implementation concept for other regions within Germany

4. Evaluation of environmental and management factors influencing the production of ecological goods in grassland and in arable systems

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02. GUIDELINES FOR THE MANAGEMENT OF ANIMAL GENETIC RESOURCES FOR FOOD AND AGRICULTURE

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Keywords: animal genetic resources management, policies, strategies, developing countries

The term "animal genetic resources for food and agriculture" (AnGR) refers to avian and mammalian livestock species. These animals make an essential contribution to food and agriculture and to rural development, providing, meat, milk and eggs, fibre, fertilizer for crops, manure for fuel, and draught power. They also make an important contribution to farmers' ability to manage risk, to employment and to community culture. Their importance is increasing as human population growth, urbanization and income growth in developing countries is fuelling a massive increase in demand for food of animal origin. The projected dramatic increase in demand over the coming decades has been termed the *Livestock Revolution*, and is expected to lead to major changes in the livestock sector.

MANAGEMENT OF ANIMAL GENETIC RESOURCES

Management of AnGR includes characterization, inventory and monitoring of trends and associated risks, sustainable use and development, conservation, and assuring appropriate policies, institutions and capacity-building.

Inventory, monitoring and characterization of AnGR are necessary to guide decision-making and determine priorities for sustainable use and development as well as conservation of AnGR. Diversity of AnGR is usually discussed in terms of breeds. "Breed" is a cultural concept rather than a physical entity, which may differs from country to country. This renders characterization of AnGR more difficult.

The utilization of AnGR is the best way to ensure that they remain available for future generations. To be sustainable, this utilization must efficiently meet current economic and social objectives without compromising the natural environment and resources. Developing countries facing immediate needs to feed their populations often encourage peri-urban high-input production systems and the use of high-performing exotic breeds. This can be justified under proper management conditions. However, in rural contexts farmers often face difficulties in securing basic management requirements. Under these conditions, exotic breeds have problems to reproduce and even to survive. Increased attention should therefore be given to *sustainable use and development* of local breeds.

According to *The State of the World's Animal Genetic Resources for Food and Agriculture* (FAO, 2007a), 20 percent of all breeds are at risk of extinction. *Conservation* of AnGR diversity requires a combination of *in situ* and *ex situ* measures. *In situ* conservation measures allow for the continued co-evolution of the breed with its production environment, and can serve as a springboard for economically and socially profitable sustainable use; initial investments may be needed, e.g. to create niche markets. For *ex situ in vitro* conservation measures, regional and global strategies may be preferred over the duplication of national efforts, provided that modalities are developed for sharing facilities and that the conserved genetic material remains under national sovereignty.

Coherent development of *policies, institutions and capacities* is an integral part of the management of AnGR. These policies should balance food security and economic development goals with long-term sustainability and adaptation objectives.

CHALLENGES FOR THE MANAGEMENT OF ANIMAL GENETIC RESOURCES

Policy-makers, nationally and internationally, are seldom sufficiently aware of the values and roles of AnGR. The management of AnGR has been, and generally continues to be, a low priority in developing agricultural, environmental, trade, and human and animal health policies. The result has been a failure to invest adequately in essential institutional development and capacity-building. The lack of human capacity and financial resources is an obstacle to planning and implementing a sound approach to the management of AnGR in many developing countries. Another major obstacle is the lack of comprehensive policies and strategies.

FAO'S EFFORTS TO MEET THESE CHALLENGES

FAO's work on AnGR started in the early 1990s with the development of the Global Strategy for the Management of Farm AnGR. Since then, the efforts became increasingly important, culminating with the release of *The State of the World's Animal Genetic Resources for Food and Agriculture and* the adoption of the *Global Plan of Action for Animal Genetic Resources* through the *Interlaken Declaration*, and their endorsement by the FAO Conference (FAO, 2007a,b). The *Global Plan for Action* requests FAO to develop approaches, procedures and guidelines for the wise management of AnGR.

FAO GUIDELINES FOR THE MANAGEMENT OF ANIMAL GENETIC RESOURCES

FAO has developed primary and secondary guidelines on the management of AnGR for country use. The *Primary guidelines for development of national farm animal genetic resources management plans* (FAO, 1998a), mainly targeted at policy-makers, are designed to help countries to start identifying the main elements and objectives of an AnGR management plan, and to outline the strategic policy directions required to fulfil these objectives. It takes the form of a step-by-step manual: the first step being to develop country management capacity; the second to conduct resource assessments; the third to develop and implement the management strategy; and the fourth to evaluate and report on progress. These primary guidelines are complemented and supported by secondary guidelines, targeted mainly at those who implement policy, administratively and technically. These secondary guidelines cover the following issues: characterization, sustainable use and development, and conservation; they are briefly described below.

The *Guidelines for animal recording for medium input production environment* (FAO,1998b) focus on i) the role of animal recording in development, with emphasis on the identification of beneficiaries and on opportunities to use animal recording schemes both as a source of information to improve animal production and productivity and as a platform for rural economic development; ii) planning and conduct of animal recording schemes, providing step-wise and detailed guidance on institutional and operational organization of such schemes; and iii) special issues involved in managing animal recording schemes and the utilization of resulting information in medium-input production systems.

The *Guidelines for management of small population at risk* (FAO, 1998c) provide technical arguments, assist decision-making among the various options available, and offer guidance on how to design and establish animal conservation programmes and gene banks. The guidelines take the form of a step-by-step manual, the first step being to evaluate the present situation by population censuses and surveys; the second to choose between the various conservation options available; the third to make a technical design for the chosen conservation option; and the fourth to construct a thorough organization, communication and training plan for the project.

The *Guidelines for measurement of domestic animal diversity (MoDAD)* (FAO, 1993a,b,c) address the establishment of a global programme aimed at characterizing genetic distances among breeds for each livestock species. The guidelines detail strategies and procedures for the implementation of such a programme, including the choice of the genetic markers, sampling of breeds and animals, laboratory requirements for genotyping, data recording and analysis, and the coordination and management of the programme. A second version of these guidelines contains the recommendations of the joint International Society for Animal Genetics (ISAG)/FAO standing committee on new microsatellite marker sets for cattle, buffaloes, yaks, goats, sheep, pigs, horses, donkeys, chickens and camelids (FAO, 2004).

The *Guidelines for formulation of breeding policies and strategies in low-input production systems* are currently being developed to assist countries to better utilize their limited capacity to plan and develop effective genetic improvement programmes, and to maximize the chances of these being sustained. They will also serve researchers and educators for capacity-building purposes. The guidelines have been tested among specialists and policy-makers in several countries.

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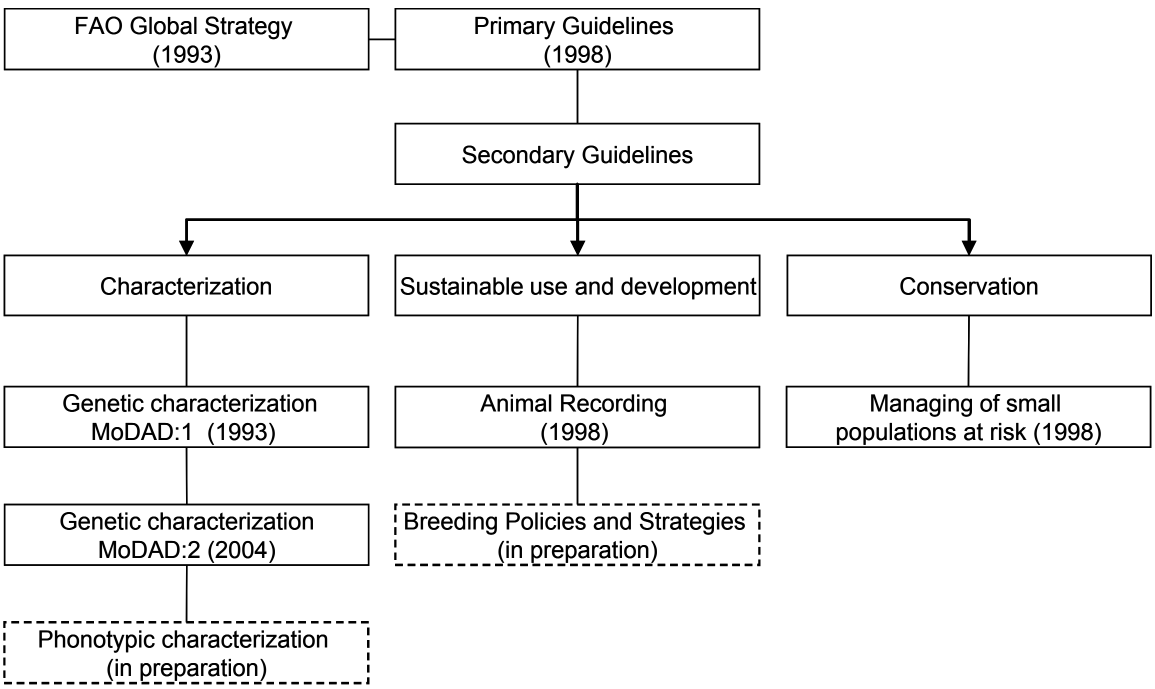

03. NUTRITION INDICATOR FOR BIODIVERSITY: FOOD COMPOSITION

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Keywords: food composition, biodiversity, nutrition, indicator

INTRODUCTION

Development of nutrition indicators for biodiversity is an international collaborative process, led by the Food and Agriculture Organization of the United Nations (FAO), together with Bioversity International and other partners. This initiative responds to an emerging global consensus that the simplification of diets, the growing incidences of chronic diseases related to nutritionally poor, energy rich diets, and the neglect and decline in the use of locally available nutritionally rich foods are linked; and that biodiversity is the source of many foods and dietary components that can reverse this unhealthy trend (Johns and Sthapit. 2005). While biodiversity is considered essential for food security and nutrition and can contribute to the achievement of the Millennium Development Goals (MDGs) through improved dietary choices and positive health impacts; it is seldom included in nutrition programs and interventions. This is due in large measure to insufficient data on the nutritional value of local foods sourced from biodiversity, and lack of methods for obtaining, analysing, and using data on biodiversity in food composition studies and nutritional programmes.

In 2004, the *Convention on Biological Diversity*'s Conference of the Parties to the Convention on Biological Diversity (CBD-CoP) recognized the linkage between biodiversity, food and nutrition and the need to enhance sustainable use of biodiversity to combat hunger and malnutrition, and thereby contribute to Target 2 of Goal 1 of the MDGs (Decision VII/32). The initiative on biodiversity for food and nutrition was formally established by decision VIII/23 A of the Conference of the Parties, in March 2006. During this same period, the Commission on Genetic Resources for Food and Agriculture (CGRFA 10th session) requested the Intergovernmental Technical Working Group on Plant Genetic Resources for Food and Agriculture to "provide guidance to FAO on how it could best support countries, on request, to generate, compile and disseminate cultivar-specific nutrient composition data, as well as indicate the relative priority of obtaining cultivar-specific dietary consumption data, in order to demonstrate the role of biodiversity in nutrition and food security."

FOOD COMPOSITION INDICATOR OBJECTIVES

- To <u>identify</u> existing data and data sources needed to develop a nutrition indicator for biodiversity related to food composition
- To <u>propose</u> a nutrition indicator for biodiversity related to food composition
- To <u>identify</u> data gaps and research needs (e.g. sampling, reporting) to improve the indicator
- To <u>develop</u> a mechanism for reporting, which will allow FAO to monitor the indicator over time
- To <u>identify</u> agencies and institutes that will report to FAO on the indicator on a yearly basis

RESULTS

On 22 October 2007, in Sao Paulo, Brazil, a group of 22 experts met and developed the food composition indicator for biodiversity. At the food level, the indicator will include genus, species and subspecies. In cases where information on subspecies is not provided, the food item will not be included as part of the biodiversity indicator; foods described simply as "wild green leaves", "reef fish", etc., will be excluded. Exceptions to this general directive are wild or underutilized foods identified by local name with country / region / culture of origin, as well as a photo or voucher sample.

All food components — nutrients and bio-active compounds — will be considered for the indicator. The minimum requirement for a food to be considered for the indicator is one component. The component(s) can be determined analytically, borrowed or imputed from the same species in another database.

All published and unpublished data, as long as they are well documented, will be used for the indicator. This includes, but is not limited to, food composition tables and databases, peer-reviewed articles, laboratory reports, reports from research institutes, conference proceedings and poster presentations, and theses.

Reporting on the indicator will be undertaken as follows:

- national and regional food composition databases — foods fulfilling the criteria, and analytical and non-analytical[1] data are acceptable;
- specialist databases — foods fulfilling the criteria, and analytical and non-analytical data are acceptable;
- other published and unpublished literature — foods fulfilling the criteria; only analytical data are acceptable.

Reporting on national and regional food composition databases will be undertaken through the INFOODS Regional Data Centre coordinators.

CONCLUSION

Baseline data will be collected in early 2008, and the indicator will be monitored yearly through 2015, and possibly beyond. The expectation is that food composition researchers and practitioners will generate, compile and disseminate data at the levels of species and subspecies, and diet surveys will report consumption at this level, thus mainstreaming biodiversity into a vast range of nutrition initiatives, and encouraging its sustainable use for food and nutrition security.

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1 Non-analytical data include data that are borrowed, calculated, imputed or estimated.

04. THE PREPARATION OF THE SECOND REPORT ON THE STATE OF THE WORLD'S PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

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Keywords: conservation, sustainable utilization, plant genetic resources, monitoring, Global Plan of Action

INTRODUCTION

Plant genetic resources for food and agriculture are the biological basis of world food security and, directly or indirectly, support the livelihoods of every person on earth. Plant genetic resources consist of the diversity of genetic material contained in traditional varieties and modern cultivars grown by farmers as well as crop wild relatives and other wild plant species that can be used as food, and as feed for domestic animals, fibre, clothing, shelter, wood, timber, energy etc.

In 1996 at the Leipzig International Technical Conference on Plant Genetic Resources, the first State of the World's Plan Genetic Resources was received as the first comprehensive worldwide assessment of the status and use of plant genetic resources for food and agriculture (FAO, 1998). Through the Leipzig Declaration, the Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture (Global Plan of Action) was adopted in 1996. The Global Plan of Action provides a coherent framework of recommendations and activities in the field of in situ and ex situ conservation, in sustainable utilization of plant genetic resources, as well as in institution and capacity building, which grows logically out of the Report on the State of the World's Plant Genetic Resources for Food and Agriculture.

The State of the World's Plant Genetic Resources and the Global Plan of Action are closely linked. Countries monitor the implementation of the Global Plan of Action through the establishment of national information sharing mechanisms, which promote a country-driven, participatory and capacity building process. The new monitoring approach for the implementation of the Global Plan of Action and the preparation of the second report on the State of the World's Plant Genetic Resources are two processes that have been fully integrated.

Approximately 60 countries have finalized or are in the final steps of establishing their national information sharing mechanisms, while 35 countries have, as of December 2007, prepared a country report on the state of plant genetic resources. The guidelines for preparing country reports are available at: **ftp://ftp.fao.org/ag/cgrfa/cgrfa10/r10i8e.pdf**. The information collected from these mechanisms, country reports, but also information from Thematic Background Studies, will provide a concise, up-to-date picture of the key changes occurred since 1996 and emerging issues, and identify priorities that will be reported in the Second Report on the State of the World's Plant Genetic Resources (CGRFA, 2007).

THE CONSERVATION AND SUSTAINABLE UTILIZATION OF PLANT GENETIC RESOURCES

The conservation and sustainable utilization of plant genetic resources is necessary for sustainable agricultural production, to ensure food security and meet the related challenges of changes in the environment, including climate change. The erosion of these resources poses a severe threat to the world's food security in the long term.

Plant genetic resources can be conserved both in-situ and ex-situ. When they are conserved in-situ, plant genetic resources need to be carefully managed, in such a way as to maintain interactions with other diversity present in the farming system, contribute to maintaining ecosystem resilience, and contribute to nutritional diversity.

Some examples of key changes based on country reports are the following (CGRFA, 2004):

Surveying and inventorying plant genetic resources for food and agriculture:

The number of inventory activities reported by countries has steadily increased since 1998. More than 1400 surveys and inventories were carried out since 2001 — of which 1079 in India alone. Increases can be observed in all regions with the exception of the Near East, as shown in Figure 1.

Sustaining ex situ collections:

Countries continue to accord high priority to this Activity area with about 278 projects being implemented in 29 countries. Despite the large number of projects, there was an actual reduction in budgets in more than 40 per cent of reporting countries. Some countries (Cuba, Kenya, Ghana, Ecuador, and the Czech Republic) reported that one of the main challenges they face is the lack of long-term funding for their main collections, which they currently sustain on the basis of fixed-term projects.

Promoting sustainable agriculture through diversification of crop production and broader diversity of crops.

Few studies have been undertaken to assess genetic diversity and vulnerability of cultivated varieties. Yet, the majority of countries are taking measures to increase diversity by encouraging diversification of crop production.

Developing markets for local varieties and "diversity-rich" products.

As shown in Figure 2, half of the reporting countries indicated that the range of local varieties and products available in the market have not changed over the last three years, with some relative increases in the African region.

Developing monitoring and early warning systems for loss of plant genetic resources for food and agriculture:

The development of monitoring systems to assess genetic erosion showed slight improvement from the previous reporting period, increasing from 62 per cent to almost 70 per cent of reporting countries having in place a monitoring system to assess, at least partially, the genetic erosion of their in situ conservation areas. However, significant regional differences were observed. Only about 50 per cent of the African countries reported having a monitoring system in place.

CONCLUSION

A wide range of information, relevant for activities that contribute to the conservation and sustainable utilization of plant genetic resources, as well as information of all the programmes, projects and activities cited in the monitoring system can be viewed on the portal of the Information Sharing Mechanism on the Implementation of the Global Plan of Action for the Conservation and Sustainable Use of Plant Genetic Resources. See: http://www.pgrfa.org/gpa

The new monitoring approach, which is a participatory, country-driven and capacity-building process, has a strong and positive role in strengthening partnerships among national stakeholders, raising awareness on the importance of plant genetic resources among policy makers, and its value as a tool for identifying gaps and defining priorities for future collaborative action.

The second report on the State of the World's Plant Genetic Resources for Food and Agriculture will provide a concise and succinct assessment of the status and trends of these resources, to identify the most significant gaps and needs, in order to provide a sound basis for updating the rolling Global Plan of Action. Countries are encouraged to complete and submit to FAO by August 2008 their country reports for consideration in the Second Report of the State of the World's Plant Genetic Resources for Food and Agriculture– which will be reviewed at the 12th regular session of the Commission on Genetic Resources for Food and Agriculture in fall 2009.

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FIGURES

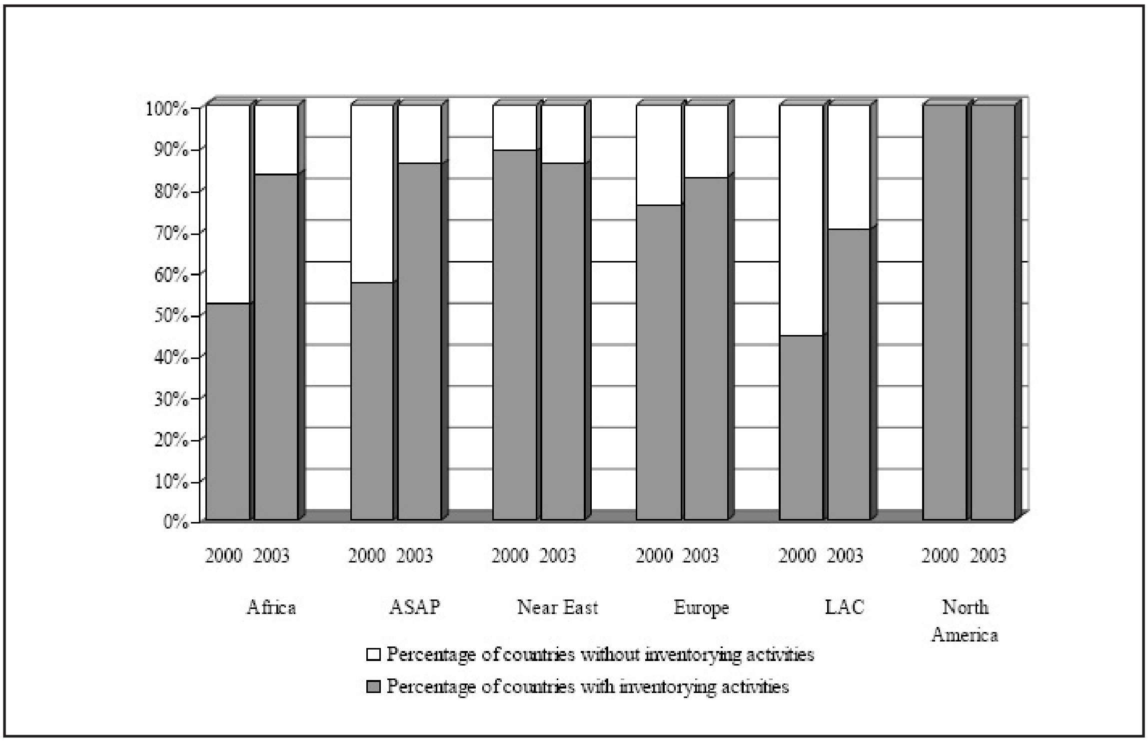

FIGURE 1: Survey and inventory activities.

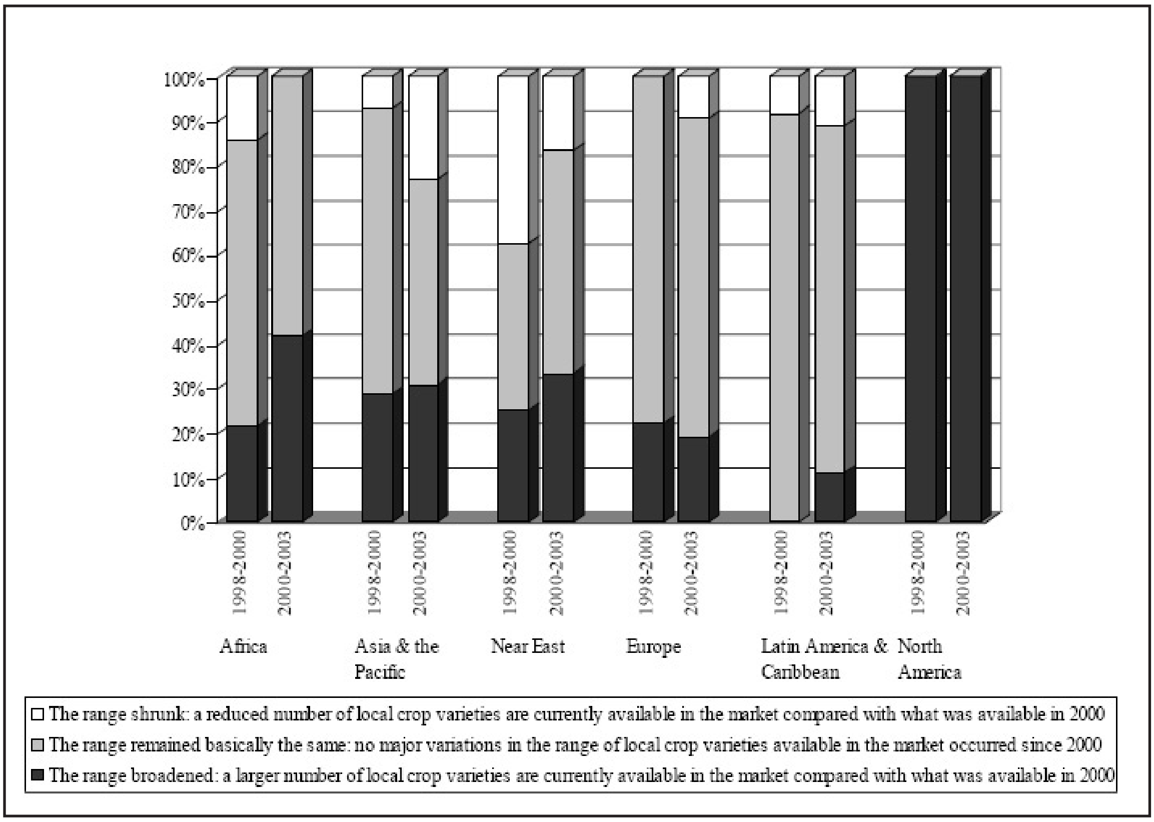

FIGURE 2: An example of data on the changes in the range of local crop varieties available in the markets.

05. CLIMATE CHANGE AND POLLINATION SERVICES

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Keywords: climate change, crop pollination; adaptation; mitigation, synchronicity, phenological shifts

INTRODUCTION

Many key ecosystem services provided by biodiversity, such as nutrient cycling, pest regulation and pollination, sustain agricultural productivity. Promoting the healthy functioning of ecosystem services can ensure the sustainability of agriculture as it intensifies to meet growing demands for food production. Climate change, however, has the potential to have major impacts on key functions, such as pollination services. Learning to strengthen the ecosystem linkages that promote resilience, and mitigate the forces that impede the ability of agroecosystems to deliver goods and services remains an important challenge. Here we consider the interactions of climate change and pollination services, from the standpoint of impacts, adaptation and mitigation.

IMPACTS

Increasing attention is being given to the existing and potential impacts of climate change on agriculture. Amongst key issues is the recognition that changing climates lead to alterations in the timing of growth, flowering and maturing of crops, with consequent impacts of (and on) crop-associated biodiversity, particularly pollinators.

Although rising oceans and expanding deserts garner much of the headline attention in the media coverage of climate change, the most insidious changes may be more subtle: the intricate and precisely timed interactions of plants and animals, fine-tuned over thousands of years of evolution, is inevitably impacted when environmental and biological events lose their synchronicity. Key biological events such as insect emergence and date of onset of flowering need to occur in synchrony for successful pollination interactions. Effective crop pollination is heavily dependent on biological timing, of both the crop and its pollinators in a number of respects that can best be illustrated by examples:

Some crops such as chili peppers give a maximum yield by flowering over a long season, not building up to one particular harvest point. These crops need a diversity of pollinators that taken together have life cycles occurring over the long flowering period of the crop. Studies have shown that having good pollination can lead to many chili pepper plants producing at least three "waves" of fruit production rather than two, and getting chili peppers to the market earlier than usual, with consequent better prices.

Other crops such as almonds or cherries, in temperate regions, and mangoes in tropical regions, have periods of mass blooming over relatively short periods, requiring a tremendous peak in pollinators. To be maintained in the ecosystem, and "available" for these peak periods of pollination needs, alternate resources for pollinators are needed to bracket crop flowering.

Climate change may have profound impacts on the timing of these events. The date of onset of flowering for cherry trees in Japan, for example, has shifted dramatically over the last 100 years (Figure 1), a period of time most likely too short for effective co-adaptation of the full suite of cherry blossom pollinators, or for their "bracketing" resources to also shift their flowering times even earlier as would be needed to build up large populations in time to service the cherry trees. In mountain ecosystems, where large changes in climate may be felt over short distances, the impacts of global warming have been shown to be disrupting the timing of pollination with serious negative impacts to both plants and pollinators. Plants have responded by flowering earlier, while pollinators have not responded in the same way in their timing of by emergence or migration (Inouye 2007). With present species extinction rates thought to be 100 to 1000 times higher than background levels due to anthropogenic impacts (Millennium Ecosystem Assessment 2005), and insects considered likely to make up the bulk of future extinctions (Dunn 2005), the greater risk is not that pollinators fail to adapt, but that too many of them fail to survive.

ADAPTATION

Ecosystem services build in important measures of resilience and risk mitigation into agriculture -- elements that are increasingly important under changing climates. The greater number and kinds of facilitative interactions in an ecosystem- any ecosystem, but even more so in a simplified farming system- means that as conditions change, there are different groups of organisms that are favored to continue providing ecosystem services. Pollination provides one of the best examples of this; the suite of wild pollinators servicing crops may change dramatically from year to year, yet the level of service will remain the same if good management is in place to promote a diversity of beneficial insects. In both watermelon farming systems in the USA (Kremen 2002), and bitter gourd systems in Kenya (Gemmill-Herren, unpub.) large year to year asynchronous variations in bee populations that pollinated crops were documented (Figure 2). A diversity of the native bee community buffered against these asynchronous fluctuations in abundance; in one year, a sufficient pollination function may be carried out by a suite of twenty species, while in another year only a few species, that had been relatively unimportant the year before, were crucial functional dominants.

MITIGATION

Many good agricultural practices that sustain the ability of agroecosystems to deliver ecosystem services involve measures to increase ground cover and crop-associated biodiversity. For example, measures to promote beneficial insects that mitigate against crop pests, similarly to measures to promote pollinators, include providing more non-crop flowering resources in fields, such as cover crops, strip crops or hedgerows. Similar practices reduce soil degradation and desertification, by increasing soil matter in the surface layer. All of these measures, taken together, contribute to the long-term stability of agroecosystems by helping to provide greater and more continuous biomass cover on-farm (Figure 3). These same practices, retaining large quantities of biomass and soil organic matter, may serve to enhance the ability of agricultural systems to sequester carbon (Hajjar et al. 2008).

CONCLUSION

Climate change poses serious threats to the healthy functioning of ecosystem services and its dependence on interlinkages between different aspects of biodiversity. In agroecosystems, human societies have the potential to undertake measures that can conserve and strengthen these linkages, and contribute to long-term stability.

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FIGURES

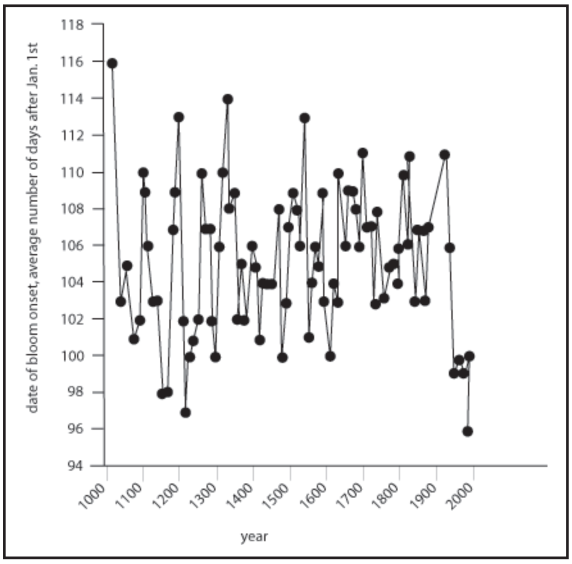

FIGURE 1. Date of onset of cherry bloom in Kyoto, Japan, 1000-2000, University of Wisconsin-Milwaukee Geography Department, Phenology and Climate Change Overview (http://www.uwm.edu/Course/416-941/).

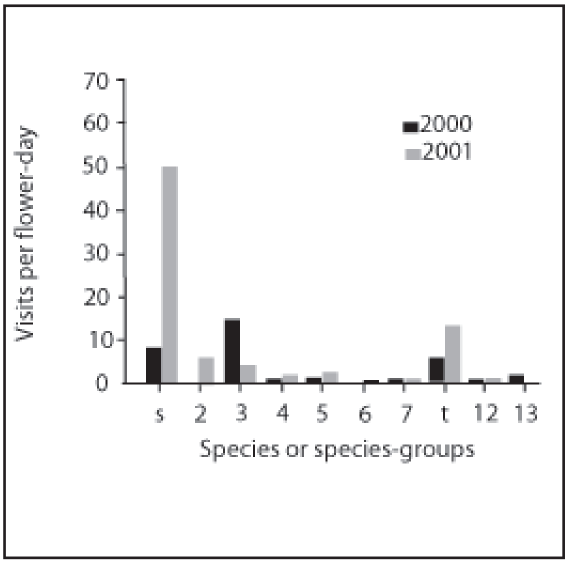

FIGURE 2. Abundance of bees species at watermelon in two subsequent years (from Kremen et al. 2002)

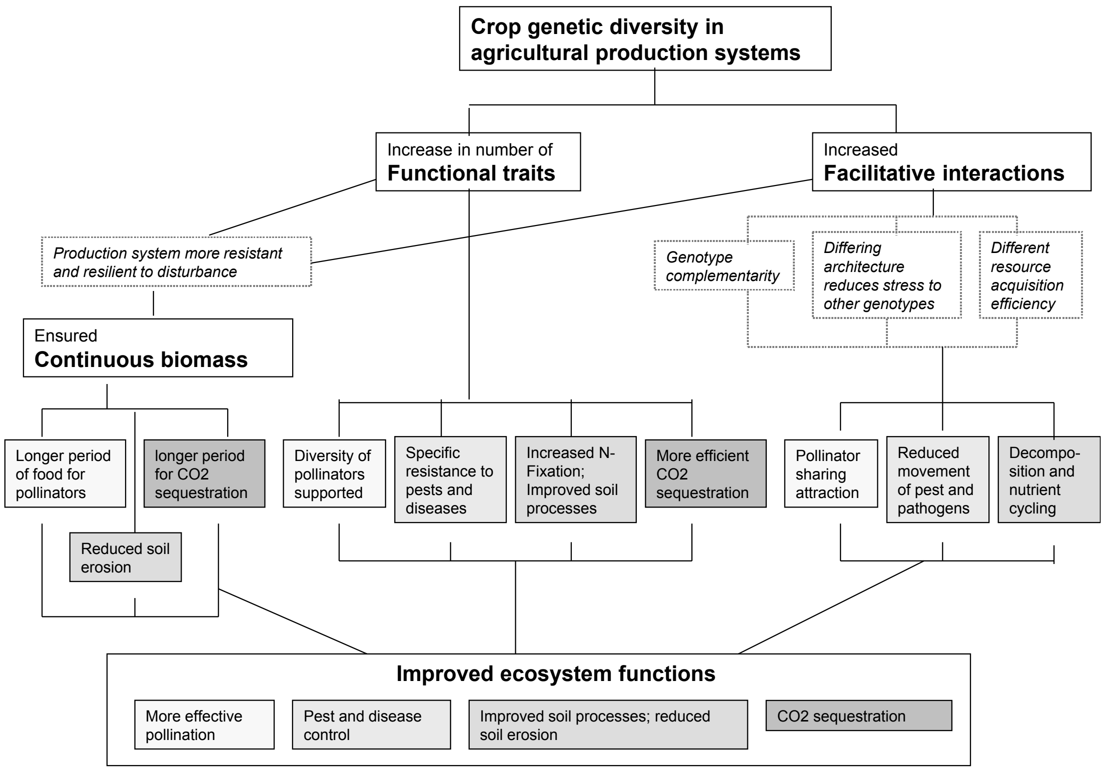

FIGURE 3: The potential benefits of crop and crop associated genetic diversity in directly and indirectly enhancing agroecosystem functioning and provision of services (from Hajjar et al. 2008)

06. THE BIOFUEL WEEDY MENACE: WEED RISK ASSESSMENT AS A MANAGEMENT TOOL TO HALT LOSS OF FARMLAND BIODIVERSITY IN ITALY

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Keywords: Biofuel, WRA, Alien Species, Weed Risk Assessment, CAP,. Agroecosystem

Biofuel policy

Increase population growth, greater energy requirements for industrialised countries, geopolitical instability due to fossil fuel market, concerns for global warming and need of "carbon neutral" energy enhanced the development of biofuels cropping systems (agriculture and forestry), that is the use of plant biomass for the production of energy. One of the main energy policy targets of the European Union-EU- is to increase renewable energy sources by 2010. Various legislative actions have been undertaken in order to facilitate this target, for example, the Biofuel Directive (2003), the Biomass Action Plan (2005) and the Biomass Strategy (2006) which promoted biofuels for transport, heating and electricity, in EU and developing countries, due to their positive effects on the environment. Furthermore the Common Agriculture Policy-CAP-for the financial period 2007-2013 transfers funds from Pillar I (direct payments and market expenditure) to Pillar II (rural development of agricultural areas as an instrument to deliver environmental benefits and to improve farmland areas biodiversity) which includes subsidies for biofuel crops.

Since 2004, when subsidies were introduced as part of the reformed CAP in order to stimulate the European biofuels sector, farmers' interest in the production of energy crops has significantly increased. In Italy, the current Government policy looks at the promotion of the use of crops and of short rotation forestry as a source of energy also through Regionals Rural Development Plans. Concern, however, is growing on the potential harm that new extended and intensive cultivation could produce on the territory.

In 2006 the European Environment Agency (EEA 2006) has pointed out the potential harm of bioenergy cropping system which could set incentives for a more intense use of agricultural land and forests, with the risk of additional environmental pressures on biodiversity, land use, soil and water resources. In general any potential benefit or harm on the environment needs to be assessed through a full comprehensive life-cycle. Among the many factors to consider a recent paper (Ragu et al. 2006) highlighted the potential harm for the biodiveristy of biofuel crops as their ecological traits are commonly found among invasive plant species. Within the EU, the spread of invasive alien species is becoming of great concern. Indeed, in the CAP, importance has been given to process of weed control and eradication, especially in farmland areas of High Nature Value (HNV).

Biofuel menace: the weedy merging combination

In agroecosystems, where anthropogenic manipulation of the territory for agricultural production has changed the original natural ecosystem (Gliessman 2000), habitat degradation, fragmentation, disturbed field margins and altered nutrient cycle are all factors contributing to the creation of new temporary free niches increasing the invasibility of the habitat with the subsequent exposure to invasion of alien plant species.

In addition, biofuel crops have many traits in common with invasive species such as: broad ecological amplitude, high ductility, high seed production, high vegetative reproduction, paucity of pest and diseases. Furthermore planting large quantity of vigorous plant varieties in large scale by repeated introductions in different climate and soil condition increases the change of "crop escape" of new biological invaders that have the potential to spread and harm the semi-natural environments of vegetation remnant. Community invasibility and species invasiveness are the merging combination for plant invasion (Richardson and Pysek 2006)

Aim

Aim of this study is investigating whether there is a risk of biofuel species, once introduced in widespread and intensive cultivation for biomass production, becoming invasive and altering the functionality of the vegetation remnant in agroecosystems, thereby reducing the associated biodiversity. Attempt of this research was to investigate for the Italian Peninsula the possibility of developing a pre-entry screening method, for biofuel crops, through a Weed Risk Assessment-WRA. The main aim is to provide decision makers a screening tool to preventing mass propagation of new plant cultivations that could be potentially invasive. The development of a WRA system is a management tool that will help understand the potential harm of alien species used for biomass and develop cultivation criteria to avoid the risk of new biological invasions in Italian agroecosystems.

Methods

To test biofuel crops invasiveness a specific WRA was adapted for the Italian geographic, climatic and weed management context from Pheloung et al. (1999) which was originally developed for the mediterran-type region of Western Australia. Before assessing biofuel species the adapted WRA was tested for accuracy on alien species of known invasiveness/frequency. The geographical area used to test accuracy was the Mediterranean climate area of Central Italy; subsequently "climate and distribution" features were set for this region, with parameters and values used in Blasi 1994. Climatic suitability was compared with the values of the native distribution and the reliability was calculated on the numbers of parameters available. Weeds elsewhere were considered in regions with similar climate. Accuracy was over 80% (Crosti *et al*. 2007), consequently the adapted WRA was used to assess the main species suggested for biofuel cultivations.

Results

As expected many species of biofuel crops have an high score and consequently an high potential of invasiveness; between the others trees such as *Ailanthus altissima*, *Robinia pseudoacacia*, *Melia azedarach*, shrubs such as *Jatropha curcas*, *Acacia saligna*, and *Kochia scoparia*, annuals such as *Helianthus tuberosus* or the herbaceous perennial *Miscanthus sinensis*. For some species, however it was difficult to obtain all the needed information and consequently the final score could be overestimated (Table).

Discussion

Within the Convention of Biological Diversity-CBD-many decisions concern the threat of alien species to ecosystems, habitats or native species. Within the EU, the spread of invasive alien species is becoming of great concern and many documents (CE 2003; EC 2006; FP7 2006) highlight the necessity for each country of both the development of a national strategy and the determination of management priorities of alien species. Worldwide, many crop species used in cultivations escaped from agriculture fields into disturbed/invasible habitats becoming a threat to natural plant communities (Heywood 2005).

In the Italian Peninsula most of the invasive plant species are disturbance weeds (Celesti 2005) and agriculture/horticulture weeds (Viegi 2001).

Some biofuel crops have the potential to escape the enclosure of cultivated areas and on this issue APAT has already published a first report (Crosti & Forconi 2006); a WRA assessment will give further useful information on invasiveness of the crop species. Other countries have already adopted a WRA with the purpose of identifying high-risk species, thereby allowing decision-making on prevention and eradication in order to avoid ecological and economic harm. In some of these countries that have isolated ecosystems, the primary concern of the WRA is to prevent the entry of new weeds species. For Italy, the WRA process could both prevent the entry and spread of new invasive bioenergy crops and could be used as a management tool to eradicate and prevent the proliferations of weed species that are already present in farmlands and that can harm vegetation remnants in agroecosystems. WRA for the Italian peninsula is at the early stage of its experimentation and needs further practices and modification to increase its accuracy. The WRA assessment could be one of the first stages of the procedures of a "post-border weed risk management- WRM" (HB 2006; FAO 2006) for Italy and could be functional for the development of cultivation criteria to reduce risk of biofuel proliferation outside arable lands that could harm biodiversity, habitats and native species. A listing of "Good Practices" includes: 1) reduce propagule dispersion during transportation, as well as severe phytosanitary regulations; 2) specific cultivation practices such as harvest before seed production and promoting crop vegetative growth; 3) subsidies schemes connected to crop processing and not based on historical entitlements (decoupling) which could bring to reduced production through no harvesting and consequent potential propagules dispersal; 4) dedicated study on autoecology; 5) assessment on landscape, land use, on disturbance events -such as fire or natural clearings- in the nearby wild habitats and on invasibility of the surrounding communities prior localization of dedicated arable fields for biofuel crops; 6) monitoring/surveillance sites located in the surroundings of the arable lands, in habitats likely to be invaded and in vegetation remnants so to have an early warning of possible escape from crop fields.

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SPECIES	WRA SCORE	INVASIVENESS
Acacia saligna	10	major
Ailanthus altissima	16	major
Crambe abyssinica	0	unknown
Helianthus tuberosus	12	major
Hibiscus cannabinus	5	unknown
Jatropha curcus	15	unknown
Kochia scoparia	11	unknown
Melia azedarach	12	minor
Miscanthus sinensis	11	unknown
Panicum virgatum	4	non
Paulownia tomentosa	4	non
Robinia pseudoacacia	15	major
Sorghum bicolor	6	unknown
Zea mais	1	non

TABLE1: WRA score and *a priori* invasiveness of proposed biofuel species

07. *IN SITU* CONSERVATION OF CROP WILD RELATIVES

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Keywords: crop wild relatives, in situ conservation, crop improvement, climate change

The wild relatives of crops (CWR), which include crop ancestors as well as other related species, have been used to improve crop resistance to pests, diseases and adverse climate conditions for over 100 years. Many species of CWR are used directly for food, medicine and income and thus are critical to the livelihoods of local communities.

The natural populations of many crop wild relatives are increasingly at risk. They are threatened primarily by habitat loss, degradation and fragmentation. A relatively new and increasingly significant threat is climate change. At a time when biodiversity is being lost at an unprecedented rate, much depends on using it to facilitate agricultural adaptation to changing environmental and socio-economic conditions. The UNEP/GEF-supported global project, '*In situ* conservation of crop wild relatives through enhanced information management and field application' aims to conserve CWR in the wild and thereby ensure that these valuable genetic resources remain available to improve the performance of modern crops. The project brings together five countries — Armenia, Bolivia, Madagascar, Sri Lanka and Uzbekistan — to enhance the conservation status of the CWR through gathering and analyzing information to support conservation actions specific for CWR. Each country has significant numbers of important and threatened crop wild relatives. Each country is also among the world's biodiversity hotspots — places that have the highest concentrations of unique biodiversity on the planet.

Countries have prioritized genera and species for conservation attention (Table 1). Twelve of these genera are listed in Annex 1 of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). Based on assessments of geographic distribution, level of threat, conservation status and economic importance, partners are implementing conservation actions for selected populations and developing guidelines and plans for their management. Threats assessment is also factored in to selection of priority areas for protection (Figure 1). As a direct result of project activities, CWR are now included in national level biodiversity policies and strategies in the five project countries.

Analysis of the impact of climate change on distribution of selected CWR species has shown that many species important for crop improvement could be threatened with extinction in the wild within 50 years. Preliminary results of analysis of potential distribution of populations of wild cassava, *Manihot tristis* in Bolivia (Figure 2) indicate that within ten years, there will be a substantial reduction in the distribution and size of potential suitable areas for this species (Zapata Ferrufino *et al.* in press).

Countries have initiated studies to evaluate promising traits of CWR species that could be used to improve crop tolerance and resistance to biotic and abiotic stresses as well as improve nutrient content (Table 2). Some of these species are relatives of crops included in Annex 1 of the ITPGRFA, while others such as quinoa and *Dioscorea* have high economic and cultural value at a local level.

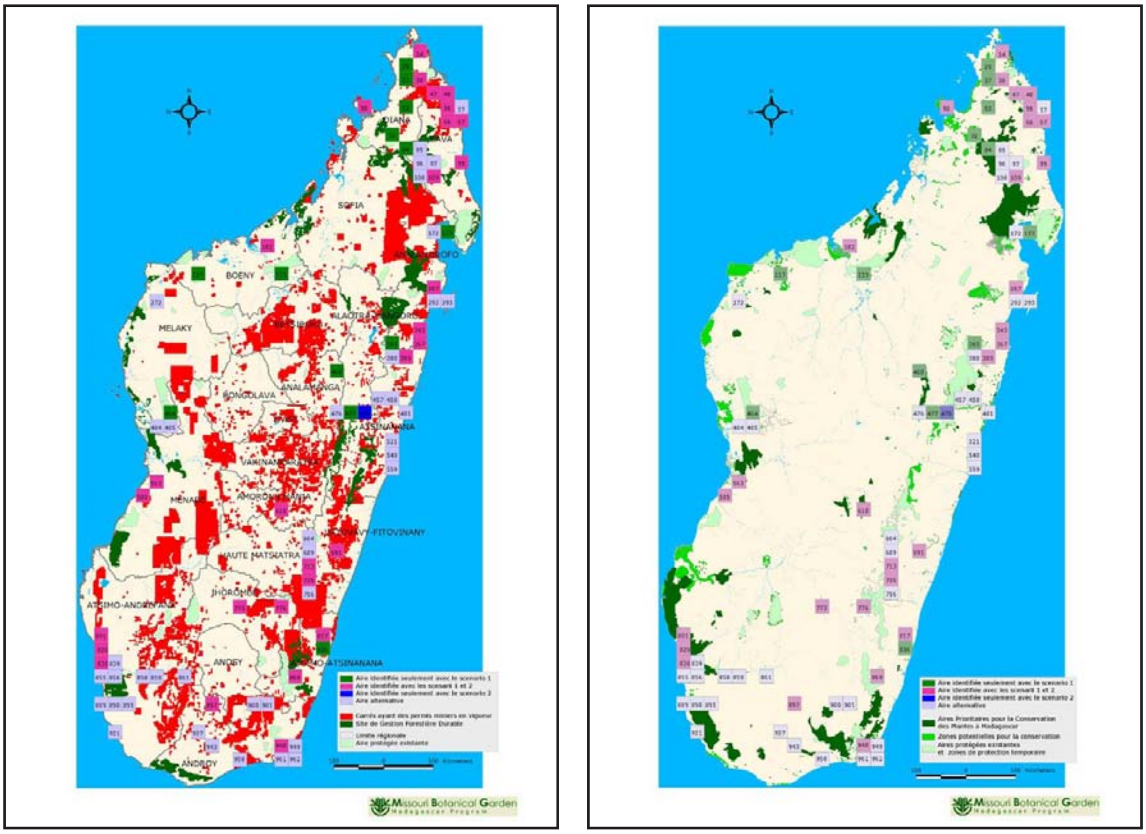

FIGURE 1. A) Analysis of threats, B) priority areas for conservation of CWR in Madagascar

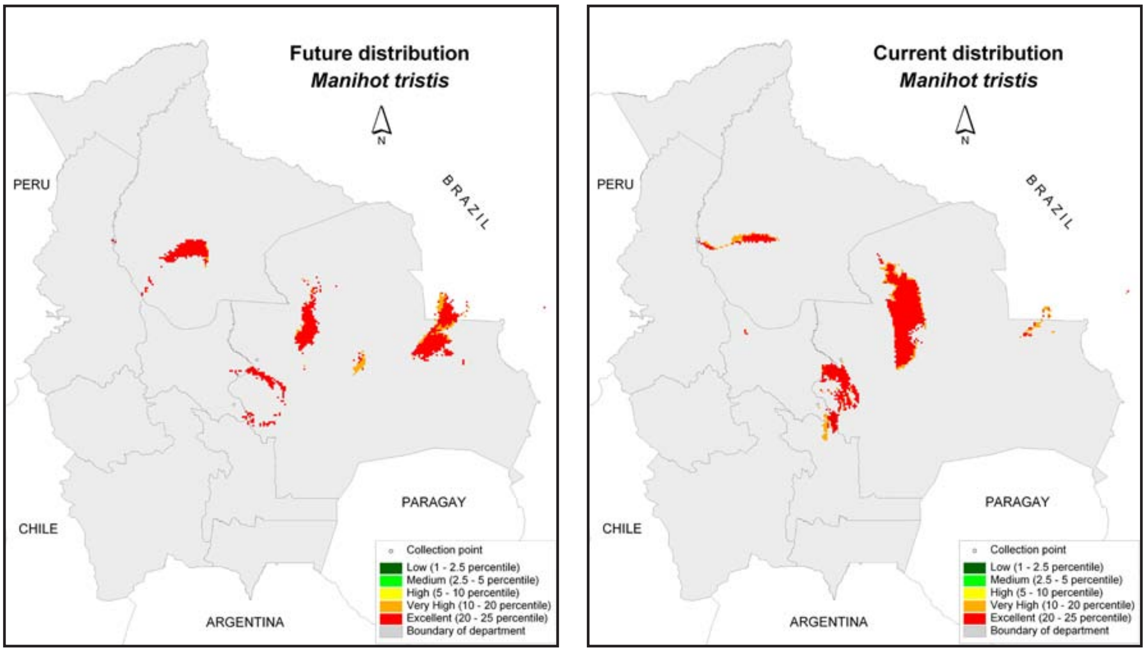

FIGURE 2. Changes in potential distribution of Manihot tristis over 10 years in Bolivia

COUNTRY	CROP
Armenia	Wheat*, beet*, pear, high mountain pea
Bolivia	Potato*, Quinoa, Peanut, Beans*, Cassava*, Sweet Potato*, Chile pepper, Pineapple, Custard apple, Papaya, Mora, Tree tomato, Cocoa, Cayu, Palm
Madagascar	Rice*, banana*, yam*, vanilla, coffee
Sri Lanka	Rice*, banana*, cinnamon, cowpea*, pepper
Uzbekistan	Apple*, barley*, almond, walnut, pistachio, onion

TABLE 1. Crops whose wild relatives are prioritized for conservation action

*Crops included in Annex 1 of the International Treaty on Plant Genetic Resources for Food and Agriculture.

COUNTRY	WILD RELATIVES OF...	DESIRABLE TRAITS
Armenia	Wheat and pear	Resistance to adverse environmental conditions
Bolivia	Peanut	Pest and diseases resistance of selected species from three generat
	Quinoa, Cañahua,	Nutritious properties of Quinoa and Cañahua.
Madagascar	Coffee	No or low caffeine, high content of Chlorogenic acid
	Rice	Resistance to Rice yellow mottle virus (RYMW)
	Yam	Potential for domestication
Sri Lanka	Rice	Resistance to biotic and abiotic stresses
Uzbekistan	Apple, Pistachio	Resistance to biotic and abiotic stresses

TABLE 2. Crop wild relatives with potential for breeding for crop improvement

08. THE NEW APPROACH FOR MONITORING THE GLOBAL PLAN OF ACTION ON PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

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Keywords: *plant genetic resources, Global Plan of Action, information-sharing*

INTRODUCTION

The rolling *Global Plan of Action* (GPA) *for the Conservation and Sustainable Use of* plant genetic resources for food and agriculture (PGRFA) was unanimously adopted by 150 countries in 1996, at the International Technical Conference, Leipzig, Germany. It consists of 20 priority activity areas for *in situ* conservation and development; *ex situ* conservation, utilization, and institutions and capacity building. These priorities were derived from a participatory process, involving National Programmes and international organizations, which led to the preparation of the first report on the *State of the World's PGRFA*, through 159 country reports, 12 regional/sub-regional syntheses. Following the *Plan*'s adoption, 167 countries of the Commission on Genetic Resources for Food and Agriculture (i) requested FAO to develop a transparent and efficient process for monitoring the implementation of the GPA, based on a core set of indicators for all 20 priority activity areas of the *Plan*, and (ii) reiterated the need to periodically assess the *State of the World's PGRFA* to facilitate the analysis of changing needs and gaps, as well as to contribute to update priorities under the rolling *Global Plan of Action*.

With the entry into force of the *International Treaty on Plant Genetic Resources for Food and Agriculture* in June 2004, both the *Global Plan of Action* and the *State of the World's PGRFA* have become supporting components of the Treaty (Articles 14 and 17.3). In June 2006, at its first session, the Treaty's Governing Body adopted a Funding Strategy whose "initial priorities will be the priority activity areas of the rolling *Global Plan of Action* for further development by the Governing Body."

APPLICATION OF THE NEW MONITORING APPROACH

During 2000-2004, FAO, in collaboration with National PGRFA Programmes, international experts and IPGRI (now Bioversity International), designed and fine-tuned a new approach for monitoring implementation of the *Global Plan of Action*. It relies on the four main components: (i) a list of indicators for monitoring the implementation at the country level of all priority activity areas of the Global Plan of Action; (ii) a reporting format, which is a structured questionnaire based on these indicators; (iii) a computer application, which has been developed to facilitate and simplify recording, processing, analysis and sharing of the information addressed by the indicators and the questionnaire; and (iv) guidelines and manuals for initiating and coordinating this process.

The new monitoring approach promotes a country-driven, participatory and capacity building process, culminating with the establishment of National Information Sharing Mechanisms on PGRFA, which constitute the skeleton of a global monitoring system under the FAO World Information and Early Warning System on PGRFA (WIEWS). Following a pilot testing of this process in eight countries[1], the Commission on Genetic Resources for Food and Agriculture recognized the importance of this process in terms of planning, priority-setting and achieving the mobilization of financial resources to support national plant genetic resource

1 Cuba; Czech Republic; Ecuador; Fiji; Ghana; Kenya; Mali; and Papua New Guinea.

programmes. It supported its world-wide application in close integration with the preparation of the second report on the *State of the World's PGRFA* (FAO 2004).

The full scale application of the new monitoring approach commenced in November 2004, and at present, it has been or is being applied in 60 countries world-wide. As at December 2007, 31 countries have completed the whole process and have made publicly available their national database including information on the indicators adopted by the Commission in November 2004, as well as comprehensive inventories of national PGRFA-related institutions, experts, publications, laws and projects, as well as of cultivated varieties (see Table 1).

RESULTS ACHIEVED

As a result of the application of the new monitoring approach each country has:

- conducted 3 national workshops involving a wide range of stakeholders, dealing with *in situ* conservation, on-farm management, *ex situ* conservation, plant breeding and seed production;
- established a National Information Sharing Mechanism on PGRFA, a network which counts with the participation of the above national stakeholders and has its own published web portal;
- built and made available through the Mechanism's portal, a national database on PGRFA, with information on *in situ*/*ex situ* conservation and PGRFA utilization, as well as inventories of national PGRFA-related projects, publications, laws, institutions, experts and cultivated varieties; and
- prepared a Country Report of the State of PGRFA, based on the information gathered, which identifies achievements, gaps and priorities.

The achievement of all the above outputs has implied in each country the mobilisation of a considerable amount of resources as well as technical assistance. These resources were supplied through external financial assistance and the National Programme, its main organizations and staff. Technical assistance was provided by FAO with the collaboration of Bioversity International, as well as by expertise coming from countries which had already successfully conducted this process.

Overall more than 716 stakeholders, representing governmental and non-governmental organisations, including the private sector, universities and research organisations have contributed to this process in the 31 countries, which have completed this process (see Table 1). The total number of national professionals, experts, technicians and farmers involved, exceeds by several times the number of participating organizations (stakeholders).

From the early evaluation of the results achieved at national level through this participatory process, countries reported an overall positive impact. Benefits included: (i) institutional capacity-development, (ii) enhanced data management, and (iii) increased stakeholder commitment to the implementation of the Global Plan of Action (FAO 2003). Additional benefits, as reported by several other countries, which were specifically surveyed on this issue, included: (i) raised awareness of the importance of PGRFA among policy makers, (ii) increased understanding of PGRFA status, as well as of PGRFA existing efforts among stakeholders, and, at the same time, (iii) strengthened capacity to monitor PGRFA over time, identify gaps and define priority areas for future collaborative action.

These positive effects are playing an important role for the future sustainability of the established Mechanisms and partnerships. In all countries National Focal Points and established steering committees are working for a full institutionalization of the Mechanism as a supporting tool of existing advisory or decision making bodies. Concrete results in this regard are being achieved in a number of countries, including, Azerbaijan, Cuba, Ecuador, Ethiopia, India, Jordan, Kenya, Malaysia, Oman, the Philippines, Thailand and Togo. Five countries (Cuba, Ecuador, Ghana, Kenya and Mali), which carried out the first stakeholders' data gathering process during the pilot testing, have reiterated it two years later and are producing a national report on the state of PGRFA, in line with the FAO guidelines made available in 2005.

At its 11th Session in 2007, the Commission on Genetic Resources for Food and Agriculture invited the Governing Body of the International Treaty to consider utilizing National Information Sharing Mechanisms established through WIEWS, as contributions to the development of the Treaty's Global Information System (FAO, 2007).

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TABLE 1. List of countries, which have completed the GPA monitoring process as at December 2007, number of participating stakeholders and output produced.

FAO REGION	COUNTRY	NUMBER OF PARTICIPATING STAKEHOLDERS	COUNTRY REPORT	NATIONAL INFORMATION SHARING MECHANISM'S PORTAL
Africa	Ethiopia	20	√	http://www.pgrfa.org/gpa/eth or http:/ www.ibc.gov.et/gpa_nism/ethwelcome.html
	Ghana	8	√	http://www.pgrfa.org/gpa/gha
	Kenya	26	√	http://www.pgrfa.org/gpa/ken
	Mali	27	√	http://www.pgrfa.org/gpa/mli
	Togo	8	√	http://www.pgrfa.org/gpa/tgo
Asia	Bangladesh	20	√	http://www.pgrfa.org/gpa/bgd
	India	114	√	http://www.pgrfa.org/gpa/ind or http://202.141.12.147/gpa/ind/
	Kazakhstan	13	√	http://www.pgrfa.org/gpa/kaz
	Laos	7	√	http://www.pgrfa.org/gpa/lao
	Malaysia	29	√	http://www.pgrfa.org/gpa/mys or http:// mega.mardi.my/gpa/mys
	Pakistan	25	√	http://mega.mardi.my/gpa/pak
	Philippines	24	√	http://www.pgrfa.org/gpa/phl or http://202.86.205.234/gpa/phl
	Sri Lanka	34	√	http://www.pgrfa.org/gpa/lka or http://220.247.224.71/gpa/lka
	Thailand	28	√	http://www.pgrfa.org/gpa/tha or http://210.1.58.30/gpa/tha
	Uzbekistan	12	√	http://www.pgrfa.org/gpa/uzb
	Vietnam	48		http://www.pgrfa.org/gpa/vnm
Europe	Azerbaijan	13	√	http://www.pgrfa.org/gpa/aze
	Czech Republic	16	*	http://www.pgrfa.org/gpa/cze
Latin America and the Caribbean	Argentina	68	√	http://www.pgrfa.org/gpa/arg
	Bolivia	23	*	http://www.pgrfa.org/gpa/bol
	Cuba	19	√	http://www.pgrfa.org/gpa/cub
	Ecuador	21	√	http://www.pgrfa.org/gpa/ecu
	Peru	30	√	http://www.pgrfa.org/gpa/per
	Uruguay	30	√	http://www.pgrfa.org/gpa/ury
Near East and North Africa	Algeria	10	√	http://www.pgrfa.org/gpa/dza
	Jordan	9	√	http://www.pgrfa.org/gpa/jor
	Lebanon	14	√	http://www.pgrfa.org/gpa/lbn
	Morocco	8		http://www.pgrfa.org/gpa/mor
	Oman	5	√	http://www.pgrfa.org/gpa/omn
South West Pacific	Fiji Islands	1	*	http://www.pgrfa.org/gpa/fji
	Papua New Guinea	6	*	http://www.pgrfa.org/gpa/png
		Total 716		

* A report on GPA implementation was produced, as at the time the process was carried out the FAO Guidelines for Country Report preparation were not yet available.

09. FARMERS, SEED AND CROP DIVERSITY — AN INTEGRATED APPROACH FOR FOOD SECURITY

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Keywords: plant genetic resources, seed systems, plant breeding, crop diversity

INTRODUCTION

Seed and planting materials perform crucial roles in agricultural systems, food security and livelihoods. They are not only the most essential input for crop production, transferring advanced technology to farmers to increase the yields and the resistance to biotic and abiotic stresses of their crops, but also represent the basic elements used by farmers in the management of the diversity of crops and crop varieties in their agro-ecosystems. Farmers are thus managers in the preservation of diversity of traditional and local crops and varieties in their farms. In fact, they created crop diversity by domesticating wild plants and adapting foreign crops to new ecosystems and new human needs.

The modern technologies used in both plant breeding and seed production and supply systems have permitted the technical specialization of these activities and have increased farmers' access to good quality seed and planting materials of improved varieties. Also, important efforts have been made in the last decades for the conservation of crop diversity in *ex situ* collections (mainly in genebank collections for long-term storage) and also, more recently, in their natural habitats *in situ* (farm fields, forests, rangelands) attempting to slow the pace of genetic erosion in crop diversity. All these elements form a complex and dynamic range of activities with inter-linkages and interdependencies. Farmers have a key role in this scheme as providers and users of services and materials in this complex and integrated system.

CONSERVATION OF PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

Plant genetic resources for food and agriculture (PGRFA) comprise the diversity of genetic material contained in traditional varieties and modern cultivars, as well as wild relatives of crops and other wild plant species that can be used now or in the future for food and agriculture. Whether used directly by farmers in their farming systems or by plant breeders in the production of new cultivars, PGRFA are a reservoir of genetic adaptability which acts as a buffer against potentially harmful alterations in the environment like climate change. The erosion of these resources poses a severe threat to the world's food security in the long term. Although often undervalued, the urgent need to conserve PGRFA as a safeguard against an unpredictable future is clear.

Until recently, most conservation efforts have concentrated on *ex situ* conservation, including seed genebanks, field genebanks and in vitro collections. In contrast, *in situ* conservation permits plant populations to be maintained in their natural or agricultural habitat, thus allowing the evolutionary processes that shape the genetic diversity and adaptability of populations to continue. In the case of on-farm conservation, traditional varieties continue to evolve influenced by selection pressures imposed by the farmer, thus providing opportunities for continuous crop adaptation to a changing environment. *In situ* conservation can, therefore, be consistent with enhanced PGRFA utilization at the local level.

PLANT BREEDING

Plant breeding, relying on sustainable use of the genetic diversity provided by PGRFA, supplies adapted crop varieties worldwide. Improved varieties have raised production levels, provided food security and generated income for many developing country farmers. The process of producing improved varieties is slow and requires long-term sustained commitment to plant breeding. In many countries application of biotechnology to agricultural research and production has hailed a new era. Public sector investment in plant breeding and biotechnology has been in decline over recent times, and private sector investment has increased only for profitable commercial crops. Scarce attention is paid to crops with low profit potential and which are often important for subsistence agriculture in developing countries.

Participatory plant breeding has been proposed as a way to link small farmers with conventional plant breeding in order to develop improved varieties for marginal environments and to meet the diverse smallholder needs of varietal characteristics. In this way, improved varieties can be developed more rapidly and the adoption rate particularly in developing countries can be improved. Rates of adoption by farmers are higher, risks are minimized, and the investment in seed production is nearly always paid off by farmers' higher adoption rate.

SEED SYSTEMS

In general, seed systems in subsistence agriculture are largely based at the farming community level. They comprise a dynamic "cycle" of practices, embedded in normal crop production. Seed is typically produced on farm, though frequently there are inputs of seed through various mechanisms, such as seed exchange, or purchase in local seed markets. Local markets are important when there is insufficient material for planting, or in order to access new varieties. In community-based seed systems the varietal selection process, seed production and seed exchange are integrated into crop production and into the socioeconomic processes of farming communities. In most cases, community-based seed production takes place outside the framework provided by regulated seed production standards. Rather, they are guided by indigenous technical knowledge within the context of local social structures and norms.

Market-oriented seed systems, whether public or private, tend to operate as a "chain" and encompass the elements of varietal improvement, seed production, seed conditioning, seed storage and distribution and seed quality control, often in the form of seed certification. This system includes both private, or commercial, and public components. In most countries these seed systems are subject to government regulation. Varieties produced by the market-oriented farming strive to meet quality standards required for international markets. Nevertheless, their reliance on well established infrastructure, limited crop coverage and susceptibility to disruption has limited their efficiency in developing countries. The community-based seed system is currently the primary source of seed, particularly in developing countries.

In emergency situations, PGRFA aspects should be taken into consideration by using locally adapted crop varieties when restoring local seed systems. Response to seed insecurity requires assessment of the seed systems and how they have been affected by the crisis. Based on the seed security assessment, it should be ensured that interventions provide the right crops and varieties of those crops. Strategies include direct seed distribution of locally-sourced seed, market-based approaches using seed vouchers and fairs and community seed production as a longer term rehabilitation strategy.

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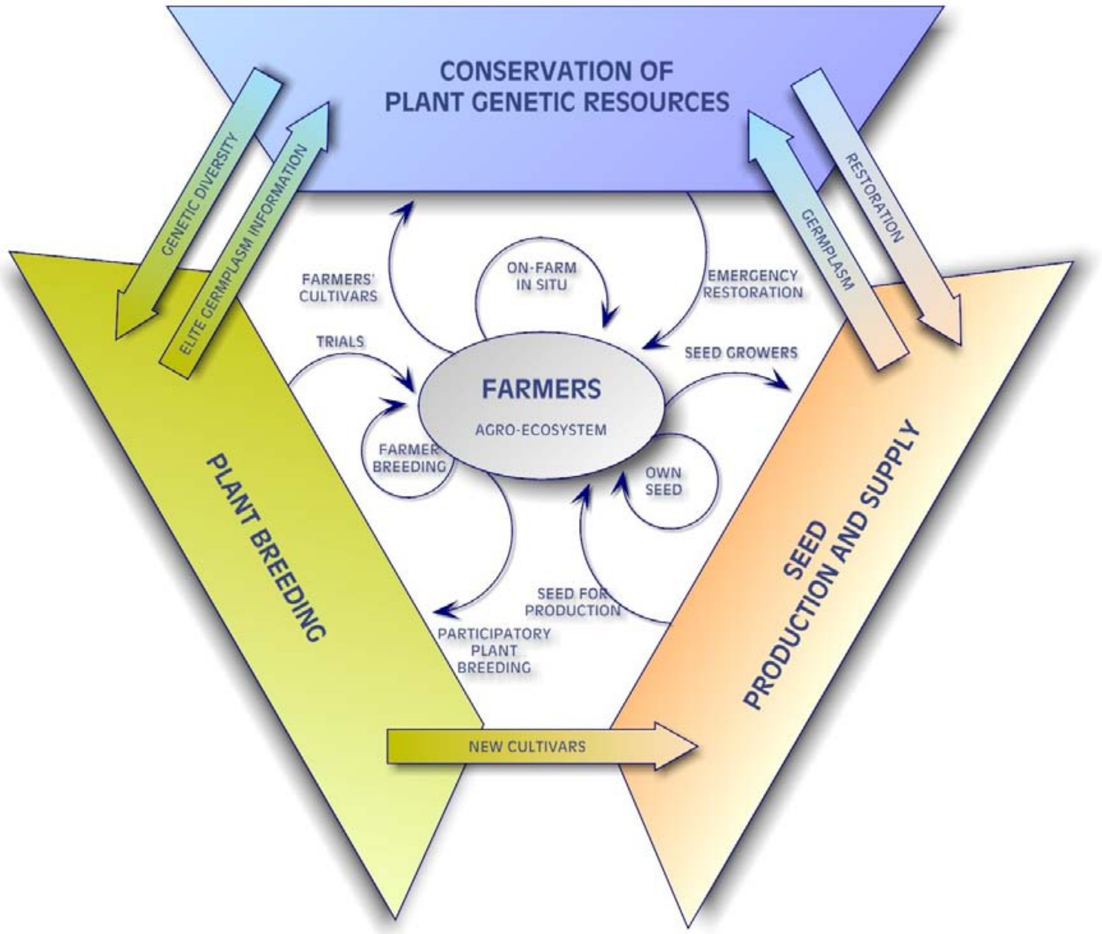
FARMERS, SEED AND CROP DIVERSITY

AN INTEGRATED APPROACH FOR FOOD SECURITY



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10. BEST PRACTICE PROFILES FOR MANAGEMENT OF POLLINATION SERVICES FROM AROUND THE WORLD

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Keywords: crop pollination; best practices; adaptive management; ecosystem approach

INTRODUCTION

Just as the agricultural community is taking stock of the contribution of pollination to orchard, horticultural and forage production, populations of managed pollinators (the honeybee and its Asian relatives) are experiencing new and poorly understood threats. With a greater appreciation of the role of pollination in food production comes a greater understanding of the major contribution of wild pollinators: a recent review has shown that 87 leading food crops, profit in experimental studies to some degree from animal pollination. Biodiversity in agricultural landscapes can provide important pollination services, and serve as well as a critical form of insurance against the risks of pests and diseases amongst managed pollinators.

Specific practices that farmers can undertake to promote pollinators on their farms, however, are less well understood or appreciated. There are urgent reasons to identify, in multiple agro-ecosystems and ecologies, pollinator-friendly management practices that serve to enhance yields, quality, diversity and resilience of crops and cropping systems. The Food and Agriculture Organization of the United Nations (FAO) along with its partners in countries in South America, Africa and Asia, will be developing demonstration sites of pollinator-friendly good agricultural practices, to showcase and assess the contribution of good management of pollinators. It is essential to base the demonstration activities on existing local practices that conserve pollinator diversity in farming systems before such practices are lost under intensification. It is also essential to survey all other land management that can be applied to pollinator conservation and use, in consultation with farmers, land managers and researchers, and evaluate them for their effectiveness. FAO, working with the International Centre of Insect Physiology and Ecology (ICIPE) in Nairobi, Kenya, has undertaken to carry out an initial global survey of good practices to conserve and manage wild pollination services.

RANGE OF PRACTICES

The practices profiled are described in Table 1. Practices occurred at a variety of scales: field, farm and landscape. Profiled practitioners developed practices through adaptive means, tailored to specific needs.

Field scale: At the field scale, pollinator-friendly practices included minimizing the use of farm chemicals, through organic production, integrated pest management, or finding alternatives to agrochemicals. A reduction in the use of herbicides, as well as pesticides, was recognised by profiled farmers as having benefits for keeping pollinators in the crop fields. For example, one innovative mango farmer in Ghana switched to clearing the weeds manually instead of chemically, despite a seven-fold increase in costs. The farmer had observed that herbicides killed weeds to their roots, whereas they were quick to regenerate with the rains when cut by machete; by allowing the weeds to selectively flourish when the mangos were in bloom, he could pull more pollinators into his fields and boost fruit yields.

Within farmers' fields, important pollinator-friendly practices included the use of indigenous, on-farm biodiversity such as weeds, unproductive male papaya trees, fence creepers, and hedgerows (Figure 1).

Growing crops under agroforestry systems, such as forest grove coffee plots in Ethiopia, ensured intact ecosystems supporting substantial pollinator populations. Amongst the most innovative practices at a field scale was that of cardamom farmers in the Western Ghats, who subtly manipulate shade-tree cultivation in their fields to ensure continuity of pollinators. Because cardamom requires pollinators for fruit production it is crucial to ensure that large numbers of pollinators are available during the blooming season; this requires maintaining pollinator populations in plantations throughout the year. Most pollinators of cardamom are wild and thus move freely through the landscape. Because cardamom does not bloom year round, pollinators may leave cardamom plantations once blooming finishes and they do not necessarily return the following season. Many cardamom farmers also cultivate coffee, with an even shorter mass blooming season. Farmers are beginning to use managed, on-farm forestry to create "sequential blooms" in mixed coffee and cardamom plantations, by planting a diversity of flowering tree species that provide reliable pollen and nectar resources for valuable native bees at times of the years when neither cardamom nor coffee is blooming. One well-documented example is the use of two species of *Schefflera* (*S. venulosa* and *S. wallachiana*). Both of these tree species have flowers attractive to bees and both flower almost immediately after coffee finishes blooming in the region and just before cardamom begins (Figure 2), thus greatly reducing the number of bees that leave plantations during the off-season.

Farm scale: The way farmers organise different land uses across their farm can influence pollination services. Smaller blueberry farmers in Maine, USA carry out a number of farmscale practices that ensure that their blueberry crops are well-serviced by wild pollinators, by encouraging the growth of wild flowering plants within their farms, and maintaining areas of woodland on their properties. In Colombia, farmers recognised that they encouraged pollinator populations by conserving diverse cropping patterns in their farms, for example by combining mixed cropping, kitchen gardens and agroforestry systems.

Farmers'practices even with small landscape elements within a farm may have significant outcomes on pollinators. A profiled farmer in Colombia had made himself familiar with the nesting and foraging habits of both social stingless and solitary bees. He encouraged a number of bee nests in trees and different structures on his farm- including in roofs, in hollow logs and in wood on the farm. He also rescued bee colonies from land before it was planned to be burned. Similarly, farmers in Tanzania understood and encouraged the nesting of carpenter bees in their houses, despite some minor structural damage.

Landscape scale: Profiled farmers from many regions recognised that they benefited from large areas of natural vegetation in close proximity to farmland. Such habitat patches provided flowering resources and nesting sites that sustain pollinators. Pollinator resources — such as Acacia trees- often had multiple benefits for farmers, providing not just food for pollinators but tradable commodities or livestock feed at critical points, or sources of traditional medicines. A progressive farmer in Colombia recognised the importance of maintaining biological corridors across the landscape for native flora and fauna.

RESEARCH, TRADITIONAL SYSTEMS, OR COMMUNITY STRUCTURES IN SUPPORT OF GOOD PRACTICES

To better promulgate good practices, it is helpful to know where innovative farmers gained their knowledge of good practices. The sources of knowledge for the practices profiled here are as diverse as the practices themselves. In the case of the mango farmer in Ghana, this farmer's excellent skills of observation helped him to notice that when the weeds flourished on adjacent uncultivated plots with the coming of the rains in May, their flowers were visited by large numbers of insect pollinators, leading him to restrict his weeding operations within the plantation. In many cases, farmers indicated that they had copied practices from their peers who had been seen to have better yields through specific farming practices, or had gotten information on pollination through farmers' groups that meet periodically.

The development of hedgerows, often with a rich diversity of creepers and associated local species of plants is a traditional practice in many areas, sometimes based on the need to enclose livestock at night. Agroforestry systems and the cultivation of crops such as coffee in secondary forest is an extension of the traditional farming systems that have been practiced for several centuries.

The extension and research efforts of government agricultural stations, universities and non-governmental organisations, have often been key in extending training to farmers on practices beneficial to pollinators, and introducing practices to promote wise use of native vegetation. At the Zonal Agricultural Research Station in Mudigere, India, cardamom and coffee planters are trained to understand the importance of pollinators. Some of these programs were conducted in villages rather than at the research station to ensure that the information provided in the programs reached poor farmers with small land holdings. In other profiles, university researchers have pursued research agendas that have helped farmers to understand more sustainable forms of farming, including better practices to promote pollination. One study, focusing on the need for community awareness, achieved its results by working directly with community groups.

CONCLUSION

Practioners learning to manage pollination services should find these profiles informative, as they explain practical applications of good practices in on-the-ground settings. Beyond the value of sharing experiences, these profiles can help to develop a means of assessing practices for their impacts on pollinators, and their relative costs and benefits to farmers. The value of these practices must withstand the test of providing sufficient benefits, for the time, effort and costs of implementing them, to farmers and land managers.

FIGURES AND TABLES

CONTINENT	CROP	LOCATION/FARMING SYSTEMS	PRACTICES
Africa	Papaya	Kerio Valley, Kenya	Bomas, hedgerows, native plants and conserving male trees
	Pigeon Pea	Mwanza district, Tanzania	Natural vegetation and traditional building materials provide resources for bees on-farm
	Vanilla	Western Uganda	Benefits of natural habitat near farms
	Coffee	Jimma, Ethiopia	Agroforestry cultivation
Asia	Cardamom	Western Ghats, India	Managing bloom sequences to keep pollinators in fields
North America	Blueberries	Maine, USA	Small-scale cultivation practices
	Fruit, vegetables, nuts and oil crops	California, USA	Habitat corridors and hedgerows
South America	Lulo (tree tomato)	Columbian Andes	Management and conservation of wild bees

TABLE 1. Range of good pollination practices profiled

FIGURE 1. Papaya pollinator (hawkmoth) visiting hedgerow plants in Kerio Valley, Kenya (Dino Martins)

FIGURE 2. Mixed coffee and cardamom plantation, Karnataka, India (coffee on the left, cardamom on the right, diverse shade trees interspersed.

11. KNOWLEDGE MANAGEMENT FOR CONSERVATION AND USE OF POLLINATION SERVICES FOR SUSTAINABLE AGRICULTURE

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Keywords: crop pollination; knowledge management; information system;

KNOWLEDGE MANAGEMENT OF POLLINATION SERVICES

Crop pollination, as the first step and therefore key factor in food production and security, is little understood and appreciated, in part because it has been provided by biodiversity and is not determined by costs to human communities in healthy environments. As farm fields have become larger, and the use of agricultural chemicals that impact beneficial insects such as pollinators along with plant pests has increased, pollination services are showing declining trends. The process of securing effective pollinators to "service" large agricultural fields is proving difficult to engineer, and there is a renewed interest in helping nature provide pollination services. A major barrier to enhanced pollinator conservation and management is that the existing knowledge base is scattered and often inaccessible to people who need such information to intervene successfully on behalf of pollinators. Information is often highly technical or specialised, and has not been interpreted for field practitioners such as extension agents. The Food and Agriculture Organisation of the United Nations (FAO), with support from UNEP/GEF (United Nations Environment Programme/Global Environment Facility) and the Government of Norway has coordinated a response to these needs.

DESIGN OF A POLLINATION INFORMATION MANAGEMENT SYSTEM

An initial feasibility study for a Pollination Information Management System (PIMs) was carried out by the Centro de Referência em Informação Ambiental (CRIA, Reference Center on Environmental Information) in Brazil. The first modules of the system should help pollination practitioners find answers to the following key questions:

1. What are the pollination needs of a particular crop?
2. What is the current understanding of managing pollination for this crop?
3. What studies have been carried out on the pollination of this crop?
4. What is known about the pollinators of this crop in different areas where studies have been carried out, and what are the key interactions of these pollinators?
5. What pollinator-friendly practices can promote the conservation and management of these pollinators?

The design guidelines proposed are currently being implemented by FAO to build the PIMs, utilising data sources as described below.

CROP POLLINATION NEEDS

The central database for the PIMS is built upon a recent review that updated the pollination requirements for crops important at the global market (Klein et al. 2007). This study found that 35 percent of the world's crop production produced for direct human consumption, including 87 leading food crops, profit in experimental studies to some degree from animal, especially from insect- and mainly bee pollination. Few crops profit only from bat- and bird-pollination (Figure 1). The studies available up to date mainly focus on the effects of honey bees for pollination services; some consider bumble bees, but the effect of solitary bee species for crop production is not studied for the majority of crops. Recent studies focus on the effects of agricultural and landscape management and show for a set of crops that pollinators of different taxonomic groups suffer from land-use intensification at local (farm) and landscape scale. Up to date, these studies fail to give details about the specific habitat requirements of the most important pollinators and therefore we need to increase our knowledge about the life history and pollinator interactions (see Pollinator Life History and Interactions section, below). These recent studies also fail to include information about the effects of pesticides to pollinator communities and therefore we need to establish a database to the toxicity of pesticides to pollinators (see Pesticide Toxicity to Bees, below).

EXISTING KNOWLEDGE BASE AND POLLINATION BIBLIOGRAPHY

FAO has been given rights to reproduce, in digitised form, the major reference book on crop pollination, long out of print and largely inaccessible to practitioners in developing countries (Free 1993). To ensure that its extensive bibliography can be readily searchable, library specialists in Kenya are working with FAO to enter all references into the bibliographic management software that will be used in the PIMs. Additional new references will be regularly included.

POLLINATION GLOSSARY AND THESAURUS

A knowledge base and bibliography is only as useful as it can be efficiently searched for relevant information, based on careful selection of search terms and key words. With contemporary full-text search engines and widely available tools such as Google, it may seem that the need for careful searches on the basis of keywords becomes less important. But the biodiversity and agriculture communities suffer not from too little information, but from too much, or too much that is not of good quality or relevant to the questions being asked. FAO is working with the University of Queensland, Australia to construct a pollination glossary and thesaurus, as a means of making searches of bibliographies and other information systems more effective, and more accessible to non-specialists.

POLLINATOR LIFE HISTORY AND INTERACTIONS

Little understanding of the ecological needs and life histories of effective pollinators often challenge informed management of pollinator services. According to the recent review by Klein et al. (2007) there are around 60 clearly documented species of wild bee pollinators (and undoubtedly far more, yet to be documented) and 23 genera. FAO is working with the University of Reading, UK to construct species pages, and genera pages for the presently documented bee pollinators of crops, giving information on their natural history, nesting needs, and alternate resources that they are known to make use of, in addition to crop flowers.

PESTICIDE TOXICITY TO BEES

The selection of environmentally friendly pesticides is an important agricultural management practices with critical implications for pollinators. FAO is working with Oregon State University, USA to assess the current status of information on pesticide toxicities for pollinators, and the development of a database that provide relevant information for management of pollination services.

CONCLUSION

Consolidating the current knowledge base on management of pollination services, and making this accessible to field practitioners is the first, and most fundamental step, in building human capacity to secure the benefits of biodiversity for improved management of pollination services.

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FIGURES

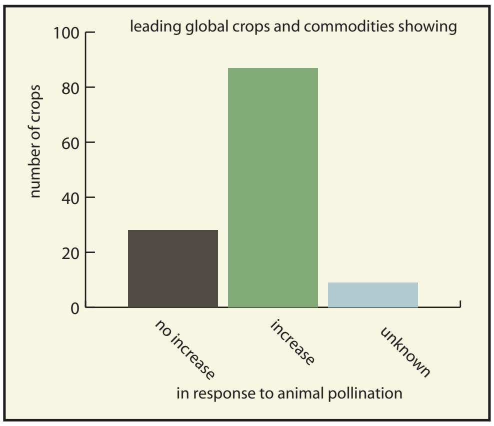

FIGURE 1. Response of leading global crops and commodities to animal pollination.

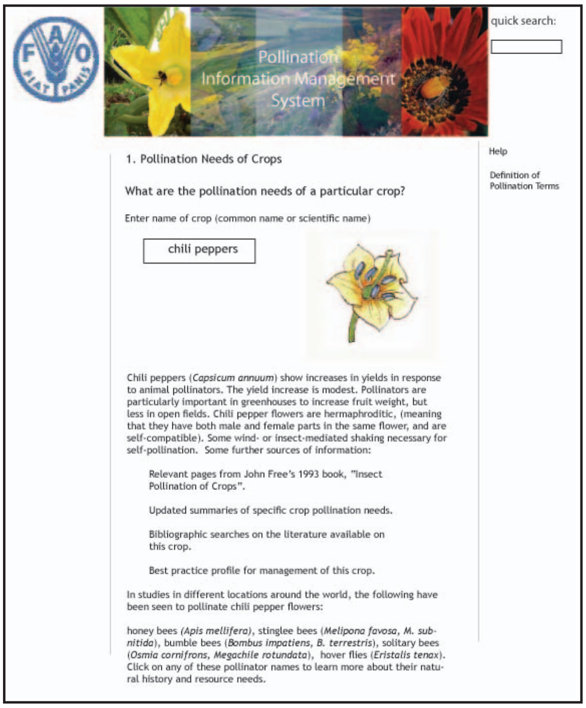

FIGURE 2. Provisional sample interface for Pollination Information Management System

12. AGRICULTURAL ECOSYSTEMS MAY SUPPORT HIGH LEVELS OF POLLINATOR DIVERSITY AND ABUNDANCE

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Keywords: biodiversity, pollinator conservation, agriculture, forests

INTRODUCTION

Natural habitats and protected areas have largely been assumed to support greater biodiversity than do neighbouring agro-ecosystems (Driscoll 2005). But recent studies have shown that pollinator density and diversity can increase across a gradient from natural forests to cultivated areas (Gikungu 2006, Winfree et al. 2007a). Similarly, pollination services delivered to watermelon crops by wild bees was not affected by forest cover remaining on the farm or in the surrounding landscape (Winfree et al. 2007b). We present these findings here and suggest their implications for the management of pollination services.

BEE DIVERSITY IN A GRADIENT FROM FOREST TO AGRICULTURAL SITES AROUND KAKAMEGA FOREST, KENYA

Kakamega Forest in western Kenya is one of the most species-rich tropical rain forests in Kenya but is heavily impacted by past and current human disturbances, including high population pressures at the perimeters of the park, illegal deforestation and bushmeat hunting (Figure 1). Seven sites were selected along a forest maturity gradient. Bees were sampled using sweep nets along belt transects for a period of two years, from May 2002 to April 2004. About 234 species of bees representing four families (Apidae, Halictidae, Megachilidae and Colletidae) were recorded during the study. The abundance and diversity of bees increased with floral diversity. The highest species richness and bee diversity were recorded in farming areas, followed by secondary forests (Figure 2). In general there was a decrease of bee species richness with forest age. The surrounding farming areas- with higher availability of floral resources, and bare ground and pithy plants for nesting — seemed to support bee communities especially when most of the flowering plants in the forest were not in bloom. Contrary to expectations, greater generalization was found amongst the bee communities in more mature forests, and more specialized and rare bee species were found in the open and agricultural habitats

This research documented the much greater quantities and diversity of floral resources in agricultural sites for bees. But bees require additional resources beyond floral resources for their survival. Examples of such resources are resins, mud, water, and "safe" nesting sites such as slope-exposed soils, dead wood, pithy herbs and shrubs. Cavity-nesting bees such as honey bees, stingless bees, leafcutter bees, and carpenter bees prefer to nest in large trees with 10-40 % dead wood (Byarugaba 2004). The large trees that normally provide nesting sites for bees have been the target of loggers over the years. During this study, few colonies of bees such as *Meliponula bocandei* and wild honey bees colonies were found, and only in mature forests with large trees. However, some cluster-building stingless bees such as *Hypotrigona gribodoi* were found nesting in muddy house walls, suggesting that at least some bee species can find alternative nesting resources in disturbed habitats. The linkages between forests of different ages, farmland and human settlements are undoubtedly complex and need more documentation.

The bee fauna in the farms neighbouring Kakamega forest may be less threatened by human factors than in other agroecosystems. This is because of the existing mode of cultivation and the degree of land intensification. The local community cultivates their land during the Long Rains season, which starts in March facilitating the growth of crops that are harvested in July and August. After the harvest the land is left fallow until the next Long Rains season. This enhances the growth of herbs and shrubs, which provide rich food sources for bees. In addition, farmers around the forest were found not to overuse chemicals such as fungicides insecticides and herbicides, unlike many farmers in other parts of Kenya. The study clearly indicates that bees require a diversity of microhabitats.

BEE COMMUNITIES IN AGRICULTURAL AND FORESTED ECOSYSTEMS IN NEW JERSEY, USA

Research in southern New Jersey, USA looked at how bees are affected by human land use at the landscape and local scales (Winfree et al. 2007). Forty sites differing in surrounding landscape cover or local habitat type were sampled, and 2551 bees of 130 species were collected within these sites. The natural habitat in this ecosystem is a forested, ericaceous heath. Bee abundance and species richness within forest habitat decreased, not increased, with increasing forest cover in the surrounding landscape (Figures 3 & 4). Similarly, comparing across local habitat types, bee abundance was greater in agricultural fields and suburban and urban developments than in extensive forests ($X^2 = 14.4$, $P = 0.008$), and the same trend was found for species richness. Particular species groups that might be expected to show greater sensitivity to habitat loss, such as floral specialists and bees of small or large body size, did not show strong positive associations with forest habitat. Species accumulation curves indicated that extensive forest contained fewer unique species than agricultural fields or fragmented forest sites. However, there were some bee species positively associated with forest cover; several of these are known to be associated with the native ericaceous plants. Results suggest that at least in this system, moderate anthropogenic land use may be compatible with the conservation of many, but not all, bee species.

In a second study, conducted in New Jersey and Pennsylvania, USA, pollination services provided by wild bees to watermelon crops were measured at 23 farms. Wild bees fully pollinated the watermelon crop at 91% of farms, including farms set in landscapes with as little as 8% forest cover remaining at a 2000 m radius (Winfree et al. 2007b). The extent of wild bee pollination was not related to forest cover at either the landscape or the local scales). A similar lack of relationship to forest cover was found for wild bee visitation to several other crops (Winfree et al. 2007c). Farms in this study system are typically small with field sizes of < 1 ha, and this low-intensity farming style may facilitate wild be abundance.

CONCLUSION

The research suggests that at least in some systems, conservation of native bees and the pollination services they provide depends on management of both natural forests and secondary forests together with the surrounding agro-ecosystems. Disturbed habitats in low-intensity farming systems may provide suitable resources for many bee species in otherwise forested systems.

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FIGURES.

FIGURE 1. Kakamega Forest, Kenya and surrounding agricultural areas

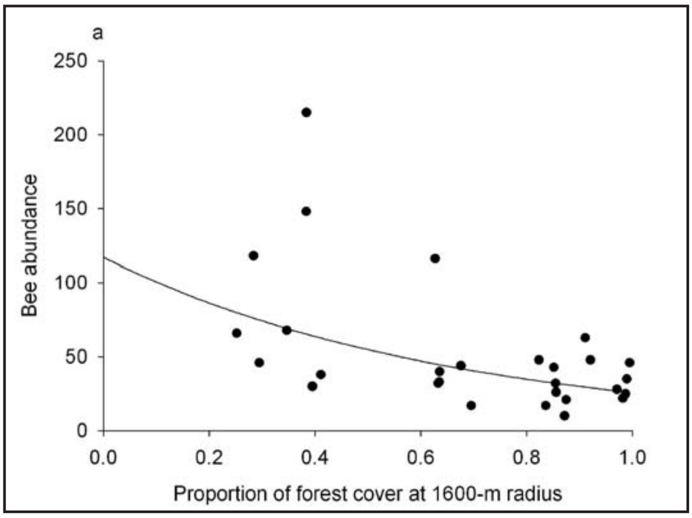

FIGURE 2. Cumulative number of bee species collected at seven study sites over 24 months, Kakamega Forest, Kenya.

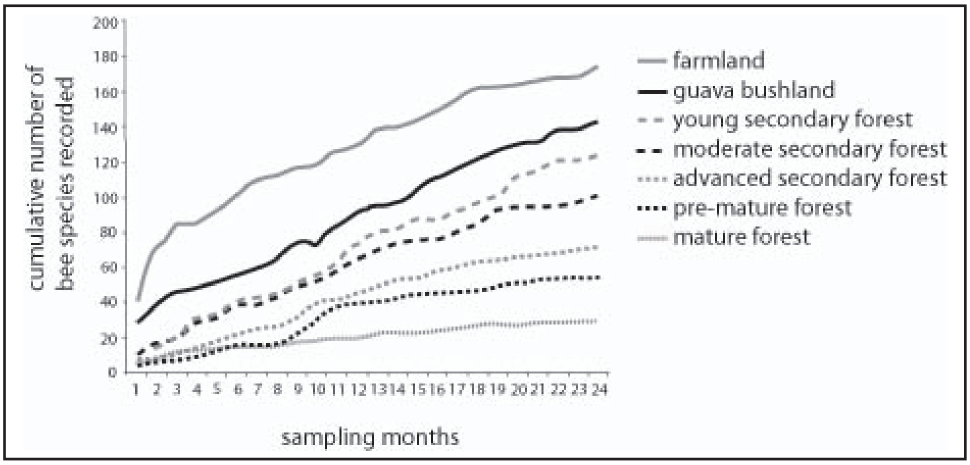

FIGURE 3. Bee abundance as a function of the proportion of forest cover in the surrounding landscape at a 1600 m radius. Analysis done on log-transformed variable; $R^2 = 0.32$, $P = 0.01$.

13. AUCTIONING BIODIVERSITY CONSERVATION CONTRACTS: CURRENT NEED FOR RESEARCH

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Keywords: conservation auction, plant biodiversity, agri-environmental policy, EAFRD-Regulation

INTRODUCTION

The European Union's Council Regulation (EC) No 1698/2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) has introduced auctioning as a new instrument for granting agri-environmental payments and awarding conservation contracts for the current multi-annual budgetary plan (2007-2013). Even though the discussion concerning the use of economic instruments in environmental policy aimed at the conservation and protection of biological diversity has already expanded in the 1990s, most states still had relied on regulatory (Latacz-Lohmann and Hodge, 2003). Market-based instruments have only recently gained more attention and their implementation is still characterised by a serve shortage of knowledge and practical experiences. In Europe, the practical evaluation of conservation auctions is mainly restricted to isolated and scientifically supported case studies or pilot programmes.

Therefore this abstract deals with a brief overview of current need for research and first conceptual ideas by the author, concerning a worldwide comparative study of conservation auctions, the question of how to evaluate the ecological quality of plant biodiversity especially against the background of ecological stock dynamics under uncertainty and the design of a specific environmental benefits index for plant biodiversity.

EVALUATION OF CONSERVATION AUCTIONS

Taking into account the currently growing importance of cost effective instruments for meeting conservation provision targets, upcoming research will include a comparative study of the current state of the practical implementation of conservation auctions. The objective of the survey is to analyse practical conservation auctions based on standardised criteria and to learn about the specific auction performances from an ecological, economical and political perspective. Based on the findings, critical factors for success as well as requirements for the practical design and implementation of upcoming conservation auctions will be deduced and made available to the scientific community as well as to policy makers. Within the currently planned survey the different ways of how conservation auction components have already been used in the United States, Britain, Australia and Germany will be analysed.

The conservation auctions will be evaluated by various criteria, as follows: i) general auction design (one-shot or repeated auction; single-unit or multi-unit auction), ii) rewarded ecological service and ecological objective, iii) payment format (uniform- or discriminative price auction), iv) bid valuation, v) auctioneers institutional integration, vi) regional demarcation, vii) number of participants, viii) number of (submitted and successful) bids, ix) ecological effectiveness, x) efficiency gains and xi) private and administrative transaction costs.

INFORMATION AND ECOLOGICAL STOCK DYNAMICS UNDER UNCERTAINTY

Another specific field of further research is the question of how the auctioneer (the administration) should deal with information about the sites, the ecological goods and ecological stock dynamics under uncertainty. The initial situation within a conservation auction is characterised by the situation that the auctioneer is the only supplier of a specific agri-environmental or conservation programme and therefore decides about the demand for ecological services. On the other hand, the supply-side of environmental services is made up of a large number of landowners and is therefore — at the beginning of the first auction — characterised by a comprehensive competition about payments for ecological services. Within the following bidding process and bid valuation not all farmers' bids will be accepted. The successful landowners are now making specific investments to provide the environmental goods or environmental services on their sites. If the ecological service is provided contractual and in due time, this may result in incentives for lock-in-effects both from the perspective of the auctioneer and the farmer to keep up the contractual relationship. In the case of repeated auctions the main question arises how the administration should deal with the information about the hitherto successful sites, now offered again, as well as new bids for yet unknown sites and ecological stock dynamics in repeated auctions under uncertainty. That there is an empirical evidence of ecological stock effects or stock dynamics in the case of long-term biodiversity change has been recently proven by Hanley et al. (2007).

The starting point of further research within this not widely applied field will be a conservation auction model. The main objective is to analyse the interaction of the ecological quality $q(t)$ as a stock figure, the ecosystem service $s(t)$ as a flow figure, the farmer's management effort $x(t)$ as a flow figure as well as the convex management cost $c(x)$ and the bid price (p) over time and under uncertainty for a specific site. Uncertainty will be integrated by the factor λ, whereby uncertainty is determined by, for example, production risk due to environmental influences as well as the actors' bounded rationality or opportunistic behaviour. Thereby within every period t there will be an auction, the landowner's management effort, an initial and a final ecological or biodiversity quality, an ecosystem service and a payment to the farmer. Consequently only the initial ecological or biodiversity quality $q(t)$ is secure and can be measured by the administration. The ecological quality at the end of the contractual period is determined by the initial ecological quality, the uncertain landowners management effort and the uncertain ecological service: $q(t+1) = q(t) + \lambda[s(t)x(t)]$.

This approach will be developed by taking into account current state-of-the-art adaptations of standard auction theory and conservation auction models, experiences from laboratory experiments and already implemented conservation auctions as well as approaches of how to value ecological or, in this specific case, biodiversity quality.

ENVIRONMENTAL BENEFITS INDEX FOR PLANT BIODIVERSITY

A promising solution to meet the practical requirements of the bid valuation as part of most repeated conservation auctions seems to be the use of an environmental index. Current research especially deals with the definition and design of a specific environmental benefits index for plant biodiversity. Therefore two different environmental indices will be used as role models: the Environmental Benefits Index (EBI) as part of the Conservation Reserve Program in the United States (Szentandrasi et al., 1995) as well as the Biodiversity Benefits Index (BBI) within the BushTender trial in Australia (Stoneham et al., 2003).

Based on an evaluation of these environmental indices as well as further approaches and objectives, a specific so-called 'Environmental Benefits Index for Plant Biodiversity' (EBIPB) will be developed. This EBIPB will combine both elements of the EBI and the BBI as well as new criteria to reach the objective of a differentiated bid valuation within repeated auctions, based on economical, ecological and social criteria. Criteria will for example be i) the number of different species, ii) the relative abundance of different species, iii) the expected additional negative and positive ecological spill over effects, iv) the relevance of conservation priority areas, v) the expected sustainability of management efforts, vi) the ecological performance per euro in previous auctions, vii) regional populations' preferences, viii) the bid price per hectare and ix) a risk factor.

The use of an environmental benefits index and the change of its parameters and their valuation also seem to be a promising way of how to reduce the opportunity for bidders to learn in repeated auctions.

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14. THE IMPORTANCE OF AQUATIC BIODIVERSITY IN RICE-BASED ECOSYSTEMS FOR RURAL LIVELIHOODS IN LAO PDR

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Keywords: aquatic biodiversity, rice-based ecosystems, livelihood, human consumption

INTRODUCTION

The Lao PDR is a country with a rich aquatic biodiversity in its rivers, lakes and wetlands. This richness has always been tapped by humankind for food, barter and income, and its importance for the nutrition and livelihood of the people is well known. Rice-based ecosystems, i.e. rice fields and the small water bodies in their immediate neighborhood have been less recognized as a source of aquatic animals for human nutrition and food security — in fact, rice fields are usually considered as the place for rice production only. Consequently, national development plans, policies, and/or strategies generally look at the rice crop only and aim at increasing rice production to satisfy the demands of growing populations and markets. At present, there is no regulation or law in Lao PDR that addresses aquatic biodiversity in rice-based ecosystems and its importance for rural households. The National Strategy for Fisheries of Lao PDR, which provides guidelines for the development of fisheries, including aquaculture and fishing practices in order to satisfy the demands of the consumers as well as to contribute to the establishment of food security, does not mention fish and other aquatic animals from rice fields.

One of the reasons why rice field ecosystems have never been in focus is that beyond the rural household level, existing information on the catch and consumption of fish is somewhat unreliable. Moreover, there is limited information on catch and consumption of other aquatic animals (OAAs) apart from fish. So the rice crop associated aquatic biodiversity tends to get forgotten which is not surprising considering that aquatic organisms caught and collected from rice fields never get recorded in any statistics due to their small quantities and dispersed nature. Nevertheless, small amounts collected by many people on a daily basis add up to significant numbers and hence may play a key role in sustaining food security. It was the purpose of this study to investigate the importance of aquatic animals from different habitats and to inform policy makers who need hard evidence to formulate policy or to take decisions on resource allocation. The insights gained from this study are expected to highlight the importance of non-rice products from the rice-base ecosystem to people's livelihood in terms of being a main source for food security in the country.

ASSESSMENT OF THE IMPORTANCE OF RICE-BASED ECOSYSTEM

The Living Aquatic Resources Research Center (LARReC) and the Department of Livestock and Fisheries (DLF) of the Ministry of Agriculture and Forestry (MAF) with support from the Food and Agriculture Organization of the United Nations (FAO) under the FAO-Netherlands Partnership Programme (FNPP) have carried out a series of studies to assess the aquatic organisms coming from rice-based ecosystems and the contribution to the consumption of households. The first study, conducted in 2002-2003, established that there is a rich variety of aquatic species that are utilized in many ways by rural households. The current study which started in 2006 was initiated to provide information on the quantities of aquatic animals consumed by rural households To do this, a household survey was designed and field tested to collect data on fish catch and consumption on a large scale.

Three provinces (Xiengkhouang, Savanakhet, and Champasack) representing different topographical and agro-ecological zones were selected in the northern, central and southern part of Lao PDR. A household questionnaire was designed and field tested, and the field staff of the provincial offices of the Department of Livestock and Fisheries (DLF) were trained to conduct the survey interviewing 240 households of 48 villages from 12 districts on a monthly basis during dry season (October 2006 – March 2007) and wet season (May – October 2007). The survey was designed to cover information on the species and source of aquatic animals which are brought into and are used by the households, including all types of possible aquatic habitats such as rivers/streams, private and natural ponds, irrigated canals, and rice fields. Respondents were asked to recall: (a) all the fish and other aquatic animals (OAAs) that had come into the household in the last 24 hours; (b) where it had come from; (c) how it was subsequently used; (d) how the food had been prepared and consumed; and d) additional information on household members that allowed consumption to be calculated on a kilogram per household member basis.

Capacity building was a critical component of the project and field staff was trained to familiarize themselves and increase their understanding on the purpose, scope and process of data collection through several seminars and workshops. Following data collection at household level, all data were submitted via the provincial DLF offices to LARReC where data have been entered into a comprehensive database to allow statistical analysis. Also, staff of LARReC received training for handling of data input process and database management.

The processed data available to date (10 months) revealed the significant importance of rice fields for the rural livelihoods, even in the dry season, when people still go to the rice fields quite often to collect food, particularly amphibians. However, the importance of ricefield habitats greatly increases in the wet season: Two thirds of all the aquatic animals caught and consumed or processed by households in the surveyed areas came from ricefield habitats! Over 40 different fish species were caught by farmers in the study area during study period, and in terms of consumed quantity approximately 50% come from rice fields. This implies that the value of rice fields as a source for utilized aquatic animals has apparently increased and the connectivity to other aquatic habitats as well as a healthy rice-based ecosystem are likely to be key determinants in this process. As for household consumption, people consume a lot of fish and other aquatic animals. Surprisingly, amphibians were also found to be very important in the diet; and more than 90% of these amphibians originated from ricefield habitats. Moreover, rice fields were found to be an important source for a wide range of crab and snail species and to a lesser extent for aquatic insects, all of which play a valuable role in the Lao diet. Compared to other type of proteins, e.g. meat or eggs, the results show that fish, both fresh and fermented, are consumed much more frequently than these other food items. With significant quantities consumed, the results suggest that these aquatic resources play a key role for a balanced diet in human nutrition.

IMPACTS ON AGRICULTURE, FISHERIES, NUTRITION AND ENVIRONMENT

It is expected that the figures derived from this study will serve as a reliable source of information for the Lao government to improve legislation and decision making. The immediate impact this previously unavailable information is expected to have is for the National Fisheries Bill which is currently in the drafting process. Moreover, it is expected that this result will increase the awareness on the importance of aquatic animals from rice-based ecosystems among policy makers, natural resources managers, and other stakeholders. For long-term impact, once the information is more widely known and documented also in the official national statistics, it would contribute to improving the national agricultural development plan, particularly the natural resource management sections. It is also expected that the importance of fishery in rice-based ecosystems to people's livelihoods is reflected in the development of fisheries and other related policies and plans such as the National Strategy for Fisheries and the Nutritional Policy and Strategy for Lao PDR at both micro and macro levels.

CONCLUSION

This study has shown that in the areas surveyed the rainfed and irrigated rice fields are not only important for rice production but also provide extremely valuable ecosystem services in terms of capture fisheries for better nutrition of rural households. Rural dwellers are aware that rice fields provide a tremendous amount of aquatic animals for them, and significantly contribute to their nutrition and livelihood. It should be ensured that this traditional knowledge does not get lost, but finds its way into the national statistics and to the desks and minds of the policy makers whose decisions impact rice fields, aquatic biodiversity and livelihoods. This study provides a robust and relatively straightforward and inexpensive framework which is hoped to be institutionalized into the national system of data collection in the future. Ultimately, this type of monitoring is expected to lead to an improved recognition and valuation of ecosystem services which are fundamental for the food security of rural households in Lao PDR.

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15. ASSESSMENT OF ARTHROPOD POLLINATOR SERVICES IN FRUIT ECOSYSTEM IN MALAYSIA

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Keywords: pollinator, sapodilla, mango, Stingless bees, computer vision system.

INTRODUCTION

Pollinator population in agro-ecosystem is threatened due habitat loss, land management practices, agricultural chemicals, parasites and diseases, and the introduction of alien species (Biesmeijer et al., 2006; Palmer et al., 2004). However, most people, including decision makers, are poorly informed about the enormous biological disaster when pollinator services are not available. The fifth meeting of the Conference of Parties (COP) of the Convention on Biological Diversity (CBD) established an International Initiative for the Conservation and Sustainable Use of Pollinators (also referred to as the International Pollinators Initiative (IPI)). One of the objectives of the initiative is to assess the economic value of pollination.

The current study was initiated in response to this CBD decision. It consists of two parts. The first part was aimed to determine pollinator requirement on sapodilla (*Manilkara achras*). Sapodilla was selected because lower fruit sets observed in a newly introduced clone, namely 'Mega'. The second part dealt with the development of a computer vision system (CVS) (Figure 1) for monitoring arthropod pollinator behviour when they were visiting mango (*Mangifera indica*) flowers. Mango was selected because of its current cultural practices may detrimental to arthropod pollinators.

MATERIALS AND METHODS

In the first part, fruit set of 'Mega' clone grown in open field was compared with the one that grown under conditions. Cage of 10m X 10m X 10m covered with fine mesh was constructed over ten plants. Open flowers and fruit sets counted daily from open field and caged plants. In addition, arthropod pollinators visited flowers in open field condition were identified and counted. This procedure was carried out twice in 2006. On each occasion, the observation was carried out for four days between 0700 – 1800 hours. It was also observed that 'Mega' require pollen from other clones in order to set fruits. Thus, an experiment was carried where fruit sets of 'Mega' planted under mono clone condition was compared with the one planted under mixed clone condition.

In the second part, CVS was developed. It consists of hardware and software parts. The hardware parts are 1/2 inch 220X Digital Zoom CCD Camera, multifunction camera controller, 120 GB 4-channel stand alone DVR, 5 inch TFT-LCD display, and cables (Figure 3). The software parts are PXC frame grabber and MARDI-Picture Viewer software. PXC frame grabber was used to capture still pictures and save into jpeg format. MARDI-Picture Viewer software was developed with the aim to count the pollinators and determine their species. The system was setup in mango field, and image of pollinators that visited mango flower were recorded at a specific area of selected mango tree. The video was recorded and stored into Digital Video Recorder (DVR). The system was programmed to record between 0800am – 1200. This specific time was chosen because pollinators are active at this period and it coincides with time of mango flower anthesis. The video captured images were analyzed to identify pollinators up to family level; and to record how frequent and how long they take part in pollination activity. Data on number of pollinator counts were generated by integrating total number of pollinator observed at pre-determined time.

Results

Stingless bees (*Trigona apicalis* and *T. thoracica*) and honey bees (*Apis dorsata*) were three common arthropod pollinator visited sapodilla 'Mega' flowers. Figure 2 give a picture of the abundance and daily temporal distribution of major arthropod pollinators visited sapodilla 'Mega' flowers. They visited the flowers in the early morning, about 0700 hours. There were 0 and 1% of fruit set were recorded for 'Mega' grown under caged and open field respectively. The percentage of fruit sets seemed very low because of lacking of pollenizer clones. This is obvious as fruit sets of sapodilla 'Mega' increased to 36% when planted in mixture with another clones.

Stingless bees and flies were the two major groups of pollinator visited mango flowers. Majority of them visited mango flowers in early morning (0800-1100) (Figure 3). The CVS was able to capture and record images of these pollinators and their behaviour while visiting mango flowers. The system provides high quality images of pollinators.

CONCLUSION

Data of this study indicated that arthropod pollinators were essential for both sapodilla and mango fruits. Stingless bees were the most common pollinators in both fruit ecosystems. The pollination services seemed to be more critical for sapodilla flowers as it needs pollens from another clones to set it fruits. Result of CVS development suggested that the system capable to capture the pollinator behaviour while visiting mango flowers. It may dispense methodologies, which will strengthen the knowledge and the instruments for monitoring and assessing the value of pollinators in agricultural crops. Knowledge on the pollinator behaviour is imperative to develop effective strategy for their conservation and management (Ricketts, 2004).

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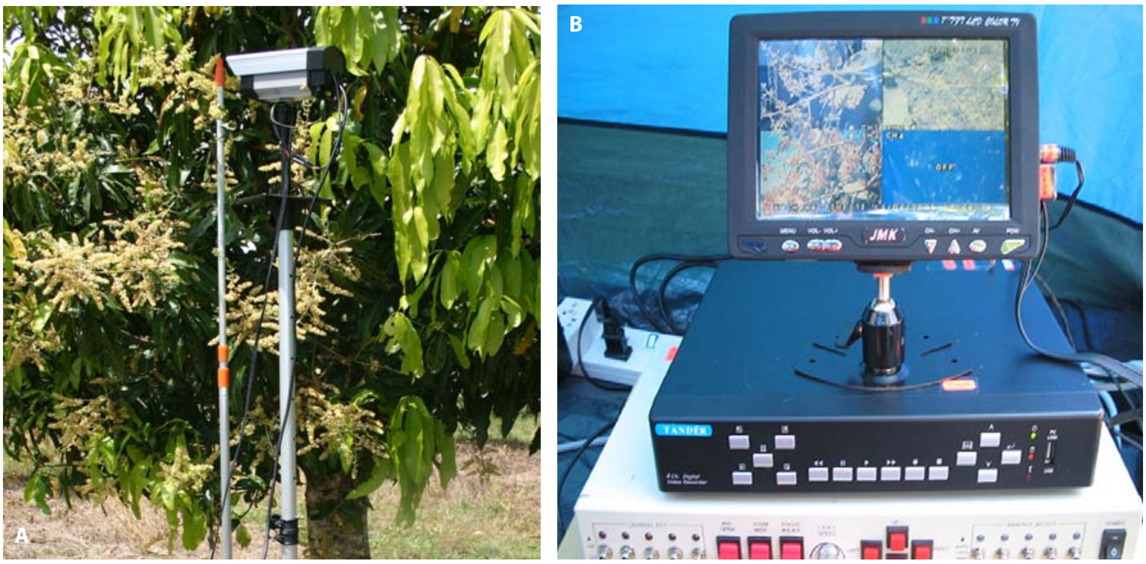

FIGURE 1. The hardware component of CVS. It consists of 1/2 inch 220X Digital Zoom CCD Camera (a), and Multifunction camera controller, 120 GB 4-channel stands alone DVR, and 5 inch TFT-LCD display (b). The system can be programmed to record pollinator activities according pre-determined period

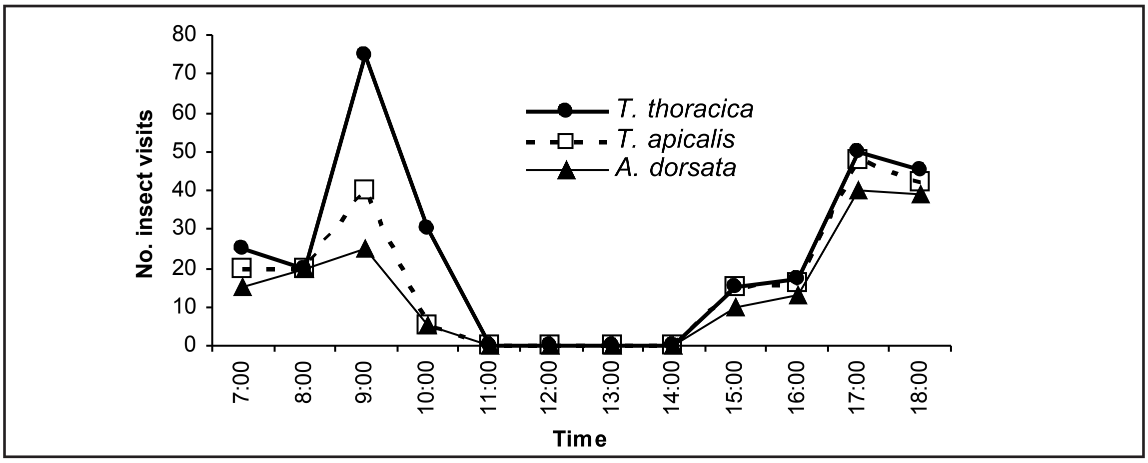

FIGURE 2. Numbers of arthropod pollinators visit to sapodilla 'Mega' flowers daily.

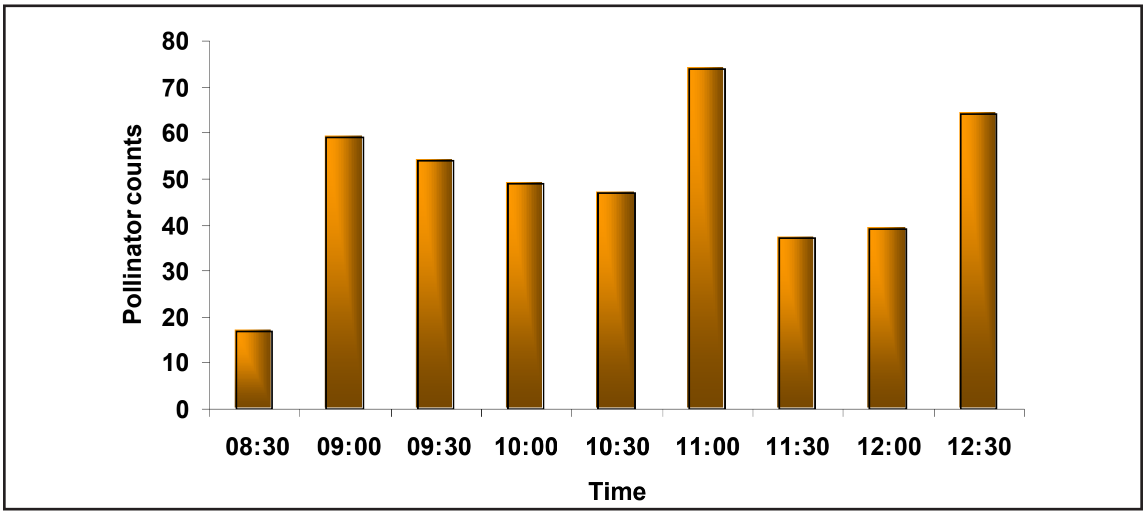

FIGURE 3. The distribution of pollinator counts visiting mango flowers in the morning. It seems to peak around 1100 hours.

16. LINKAGES BETWEEN ANIMAL AND PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

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Keywords: genetic resources for food and agriculture, rangelands, ecosystems, livestock

COMMON FEATURES OF PLANT AND ANIMAL GENETIC RESOURCES FOR FOOD AND AGRICULTURE

Biodiversity, the variety and variability of animals, plants and micro-organisms at the genetic, species and ecosystem levels, is important to sustain key functions of ecosystems, their structure, processes, and services. Agro-ecosystems are ecosystems in which humans exercise a deliberate selection on the composition of living organisms. Agro-ecosystems are distinct from unmanaged ecosystems as they are intentionally altered, and often intensively managed, for the purposes of providing food, fibre and other products; hence they inherently have human community, economic and environmental-ecological dimensions.

Different types of genetic resources for food and agriculture — crops, livestock, micro-organisms and aquatic and forest genetic resources — each have specific traits. However, genetic resources for food and agriculture share common features that distinguish them from other genetic resources: They are the results of human intervention and continue to co-evolve with economies, cultures, knowledge systems and societies. Due to millennia of exchange and adaptation in new production systems, countries are interdependent upon their use.

They contribute to food security and rural development, and provide ecosystem functions and services. Their management, within productive landscapes and agricultural ecosystems, is a complex task. Most genetic resources for food and agriculture are currently maintained *in situ*, by farmers, pastoralists and their communities, as integral components of their agricultural ecosystems, economies and cultures. In the field, genetic resources are not managed in isolation. Farmers and livestock keepers also manage the interactions between different types of genetic resources and the different components of landscapes.

Genetic resources for food and agriculture also share many of the same threats and risks of erosion. This erosion has many causes, including changes in production systems, mechanization, the loss of rangeland grazing resources, natural calamities, disease and pests outbreaks, inappropriate breeding policies and practices, inappropriate introduction of exotic breeds or species/varieties, loss of farmers' and livestock keepers' security of tenure on land and access to other natural resources, changing cultural practices, the erosion of customary institutions and social relations, the influence of population growth and urbanization, and the failure to assess the impact of practices in terms of sustainability, and to develop adequate policies and economic measures. Climate change has recently been recognized as an additional factor driving the erosion of genetic resources. Yet, erosion of genetic resources threatens the ability of farmers and livestock keepers to respond to environmental and socio-economic changes.

Importance of livestock

Animal genetic resources for food and agriculture (AnGR) contribute to the livelihoods of 1.3 billion people worldwide, with one billion in developing countries. For 120 million pastoralists worldwide livestock is the only means of survival. Domestic animal breeds provide key agro-ecosystem functions, such as nutrient cycling, seed dispersal and habitat maintenance. AnGR and animal management systems are an integral part of ecosystems and productive landscapes throughout the world. By moving their herd seasonally, pastoralists connect different ecosystems. Land-based production systems that have both plant and animal components require co-management of the various components of biological diversity, including soils, crops, rangelands and pastures, fodder crops and wildlife. Animals are thus dependant on plants and vice versa.

470 million hectares of arable land are somehow dedicated to animal feed production (ca. 33% of overall arable land) (FAO, 2006). In 2002, one third of total cereal harvest was fed to livestock, and protein-rich processing by-products were used as feed. Therefore, the quality and processing ability of by-products and their use as animal feeds are criteria for plant selection.

LIVESTOCK, RANGELANDS AND GRASSLAND — A SPECIFIC INTERACTION

Although plant and animal genetic resources interact in many ways, their most direct interaction is in grasslands and rangelands, ecosystems which can only be productively used by ruminants. Rangelands are geographical regions dominated by grass and grass-like species with or without scattered woody plants. Many rangelands are the result of the co-evolution of livestock activities with other components of the ecosystem, including plants, forests and wildlife. Although they appear 'natural', some rangelands are very old, and grazing by herbivores has changed the composition of landscape and vegetation even before human interference. Other rangelands are very recent formations, created by man. However, there is still a strong reliance on natural vegetation.

Rangelands and grasslands cover more than 25% of emerged lands and are utilized in a wide range of production intensities. They are home to significant numbers of wildlife, plants and livestock whose products contribute to rural income and development, with a high value in both leisure and scientific terms, and to human populations. The economic importance of rangelands world-wide is extremely variable according to the socio-economic system in which they are embedded. Pastoralism, the use of extensive grazing on rangelands for livestock production, is an important — and often the only — ecological and economic adaptation that exploits the diverse, constantly changing, yet inherently resilient arid and semi-arid rangeland ecosystems. Thirty percent of the world's grazing lands are classified as drylands, which maintain 6% of the world's human population, 9% of the world's cattle and 18% of the world's sheep and goats.

There is currently no evidence of direct dependence of specific breeds of livestock on specific plant varieties or vice versa. However, both specific animal breeds and types of rangeland — with specific vegetation compositions — are dependent on each other as they are both adapted to specific climatic and other environmental conditions. A case in point is the problem of the invasion of grasslands by shrub species as a typical manifestation of degradation and a serious environmental and economic problem. It is now recognised that the natural flora in many areas under protection for nature conservation purposes may only be maintained through well managed grazing by livestock. This implies the need to maintain livestock breeds that are adapted to those particular environments.

PROBLEMS AND SOLUTIONS

Driven by poverty, population growth and other factors, humans increasingly expand into the marginal land frontier. Currently at least 20% of rangeland are estimated to be degraded through overgrazing, over-collection of timber, fuelwood, food, medicinal plants, or abandon and overgrowth. This leads to a decline of rangeland productivity, and subsequently also a decline of livestock productivity, with major economic and livelihoods implications. Besides a loss of biodiversity, there is an evenly unquantifiable loss of ecosystem functions, e.g. C-sequestration or water retention. Because of the marginal nature and location, many rangeland livestock breeds and plant species have not been characterized, and knowledge gaps prevail on rangelands' ecosystem functioning and services. From ca. 12000 grasses and 18000 legume species recorded globally., only 150 species are being cultivated. The data quality related to livestock genetic diversity is much lower for drylands than for other production systems. Thus, it is probable that the number of dryland breeds is underestimated as some breeds have never been officially reported. This might particularly be the case for goats, asses and camelids.

Better characterization and data collection would also foster better recognition of the values and manifold roles of lant and livestock diversity in rangelands. Apart from the need to better understand the diversity of plants and livestock and their values, we must also gain a better insight into the relationship between both types of genetic resources, particularly in rangeland environments. Only then will governments and other stakeholders be able to fully appreciate this biodiversity and make strategic decision for their conservation and use.

Because of the complex linkages of the different components of agricultural biodiversity, the ecosystems approach should be applied and cross-sectorial linkages addressed. In particular, the role of local and indigenous communities, farmers, pastoralists and breeders as custodians of much of the world's agricultural biodiversity should be strengthened.

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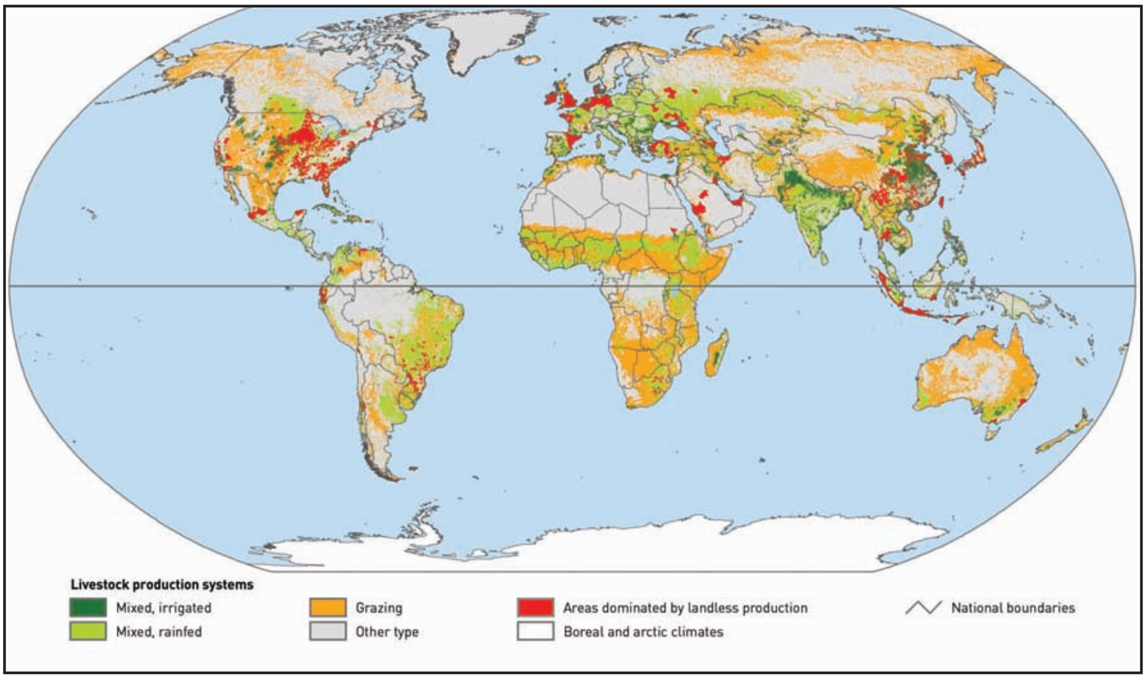
FIGURE 1: Estimated distribution of livestock production systems



Source: FAO, 2006

TABLE 2. Number of local breeds (including extinct breeds) reported per region

SPECIES	AFRICA		ASIA		LATIN AMERICA		NEAR EAST		TOTAL	
	Σ	dryland	Σ	dryland	Σ	dryland	Σ	dryland	Σ	dryland
Cattle	176	76	257	55	148	17	44	34	625	182
Yak	0	0	26	26	0	0	0	0	26	26
Goat	86	45	184	81	26	17	34	31	330	174
Sheep	114	68	276	149	47	12	51	46	488	275
Ass	18	17	39	27	21	7	17	17	95	68
Horse	42	17	142	43	65	4	14	14	263	78
Alpaca	1	1	0	0	2	1	0	0	3	2
Bactrian Camel	0	0	8	7	0	0	0	0	8	7
Dromedary	44	43	13	13	0	0	23	23	80	79
Llama	0	0	0	0	3	2	0	0	3	2
Σ	481	267	945	401	312	60	183	165	1921	893

17. THE GLOBAL PLAN OF ACTION FOR ANIMAL GENETIC RESOURCES

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INTRODUCTION

Since the 1960s, FAO has worked on genetic resources for food and agriculture. Initially, it concentrated on plant genetic resources, but since 1990, it increasingly developed work in the area of animal genetic resources for food and agriculture (AnGR). The Commission on Genetic Resources for Food and Agriculture (CGRFA) is a permanent intergovernmental forum and currently has 168 countries, plus the European Community, as members. It has developed several international agreements, voluntary undertakings and codes of conduct, to promote and facilitate wise management, and access and benefit-sharing, of genetic resources. These achievements were recently joined by the results of the International Technical Conference on Animal Genetic Resources for Food and Agriculture, held 3-7 September 2007 in Interlaken Switzerland.

The Interlaken Conference's main achievement was the adoption of the *Global Plan of Action for Animal Genetic Resources*, the first ever international framework to promote the wise management of AnGR adopted by an intergovernmental forum. Additionally, at its 11th Regular Session, in June 2007, the CGRFA adopted a Multi-year Programme of Work to facilitate the coordination and coherence of efforts in the various areas of genetic resources management, as well as to address cross-sectorial linkages. FAO and its CGRFA play a crucial role in supporting the CBD's programme of work on agricultural biodiversity.

THE INTERLAKEN CONFERENCE

At the Interlaken Conference *The State of the World's Animal Genetic Resources for Food and Agriculture* (FAO, 2007a) was launched. The report provides the first comprehensive global assessment of the roles, values, status and trends of AnGR, as well as the capacity of countries to manage these resources. The Interlaken Conference noted that the report would enhance understanding of the roles and values of AnGR and its publication was an important step in achieving the improved management of AnGR, including enhancing the basis for further policy development. The report highlights the importance of the livestock sector within agriculture, the importance of AnGR to rural development and food security, and the nature and gravity of the threats to these resources. It also provides an overview of the state of the art in the management of AnGR and identifies areas for capacity-building and research. The preparation of the report, evidenced by the 169 Country Reports submitted to FAO, considerably enhanced worldwide interest and recognition of the importance of AnGR.

ADOPTION OF THE GLOBAL PLAN OF ACTION FOR ANIMAL GENETIC RESOURCES

The main achievement of the Interlaken Conference (FAO, 2007b)was the adoption of the *Global Plan of Action for Animal Genetic Resources.* It represents a milestone for the livestock sector and a major building block in the development of a coherent international framework for the wise management of agricultural biodiversity as a whole. It also represents a contribution to the implementation of the Programme of Work on Agricultural Biodiversity of the CBD. It provides an international framework to support and increase the overall effectiveness of national, regional and global efforts for the sustainable use, development and conservation of AnGR. It replaces the Global Strategy for the Management of Farm Animal Genetic Resources as the *de facto* framework for efforts in AnGR management. The *Global Plan of Action* was adopted through the *Interlaken Declaration on Animal Genetic Resources*, in which governments affirmed their commitment to implement it (FAO, 2007c).

The *Global Plan of Action for Animal Genetic Resources* consists of three parts: I. the Rationale; II. the Strategic Priorities for Action; and III. Implementation and Financing of the *Global Plan of Action for Animal Genetic Resources*:

Rationale

The Rationale describes the objectives of the *Global Plan of Action for Animal Genetic Resources* and provides an overview of its underlying assumptions. It describes the roles and values of AnGR and their diversity, highlighting their actual and potential role to achieve food security and alleviate poverty, and to achieve the Millennium Development Goals, in particular Goal 1*: eradication of extreme poverty and hunger*, and Goal 7: *ensure environmental sustainability.* It describes the specific characteristics of AnGR and their management, recognizing that all AnGR are the result of human intervention: they have been consciously selected and improved by pastoralists and farmers since the origins of agriculture, and have co-evolved with economies, cultures, knowledge systems and societies. It acknowledges that all countries are interdependent with regard to AnGR, and that substantial international cooperation is necessary. It also recognizes the important roles of livestock keepers, pastoralist and local communities in the use and development of AnGR, and that broad involvement of stakeholders is necessary.

Strategic Priorities for Action

The *Global Plan of Action* contains twenty-three Strategic Priorities, clustered into four Priority Areas: Area 1: Characterization, inventory and monitoring of trends and associated risks; Area 2: Sustainable use and development; Area 3: Conservation; and Area 4: Policies, institutions and capacity-building. Each Strategic Priority includes individual actions that are needed to achieve the desired outcomes or improvements in current conditions.

Implementation and Financing

Most of the implementation of Strategic Priorities in the area of characterization, monitoring, sustainable use and conservation will take place at national level, while international organizations will support countries through the development of standards, guidelines and protocols, and institutional development and capacity building. International actors, particularly FAO, are also expected to further contribute to the generation of global public goods related to AnGR, through the development of international policies.

While the main responsibility for implementation of the *Global Plan of Action* rests with national governments, the *Global Plan of Action* calls upon governments of developed countries to "attach due attention, including funding, to the implementation of activities within the Strategic Priority Areas of the *Global Plan of Action* through bilateral, regional and multilateral cooperation." The CGRFA was requested to oversee and follow-up on the implementation of the *Global Plan of Action*.

THE INTERLAKEN DECLARATION ON ANIMAL GENETIC RESOURCES

The *Global Plan of Action* was adopted through the *Interlaken Declaration on Animal Genetic Resources* in which governments reaffirmed their common and individual responsibilities for the conservation, sustainable use and development of AnGR. The *Declaration* notes the significant ongoing loss of livestock breeds and calls for prompt action through the implementation of the *Global Plan of Action* to conserve breeds at risk. It acknowledges that maintaining the diversity of AnGR is essential to enable farmers, pastoralists and animal breeders to meet current and future production challenges resulting from changes in the environment, including climate change; to enhance resistance to diseases and parasites; and to respond to changes in consumer demand for animal products. It also recognizes the enormous contribution of indigenous communities and farmers, pastoralists and animal breeders have made and continue to make to the sustainable use, conservation and development of AnGR. By adopting the *Declaration*, governments have committed themselves to implementing the *Global Plan of Action*, and to facilitating access to AnGR and ensuring the fair and equitable sharing of the benefits arising from their use.

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18. LIVESTOCK DIVERSITY AND CLIMATE CHANGE

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Keywords: livestock, animal genetic resources, climate change

INTRODUCTION

For the assessment of the linkages between climate change and food security, the Food and Agriculture Organization of the United Nations (FAO) uses a comprehensive definition of climate change that encompasses all changes in the climate system, including the drivers of change, the changes themselves, and their effects. The Intergovernmental Panel on Climate Change (IPCC) analysis remains at global, or best, continental level, due to the recognized complexity of local-level environments and related problems for modelling. Without going into detail of the IPCC model predictions, we will analyse the potential implications of climate change for livestock and its genetic diversity.

The 40+ domesticated animal species, encompassing more than 7600 reported breeds, contribute directly and indirectly to 30 – 40 percent of the total value of food and agricultural production. 1.3 billion people depend to some extend on livestock production, and in marginal environments livestock is often the only means of survival. Today, there are 6536 local breeds (reported by only one country), and 1080 transboundary breeds (those that occur in several countries) (FAO, 2007a). Animal genetic diversity allows farmers to select stocks or develop new breeds in response to environmental change, threats of disease, new knowledge of human nutritional requirements, and changing market conditions and societal needs, all of which are largely unpredictable. What is predictable, is the future human demand for food. The global population is expected to increase from 6.2 billion to 9 billion in the next 40 years. This demand will be felt most acutely in developing countries, where 85 percent of the increased food demand is expected. Given the above facts, livestock diversity is critical for food security and rural development. However, animal genetic diversity worldwide is under threat. About 20 percent of reported livestock breeds are currently reported as being at risk; loss of within-breed diversity is not quantified (FAO, 2007a). Livestock producers will have to cope with both slow climatic changes and more frequent extreme climatic events. Producers can adapt to climate change by adapting their animals' genetics to the changed environment, or by adapting the production environment while maintaining the genetic portfolio. It is expected that climate change will affect livestock production and productivity directly and indirectly.

DIRECT IMPACT OF CLIMATE CHANGE ON LIVESTOCK PRODUCTION AND DIVERSITY

Loss of animals through droughts and floods, or disease epidemics related to climate change may increase. If breeds occur only locally, there is a risk of them being lost in localized disasters. To counteract this risk, it is necessary to characterize animal genetic resources, and to build inventories, including spatial information on breeds and valuable breeding stocks. This may include precautionary cryoconservation of their genetic material, or other measures to ensure that in case of a disaster genetic material can be conserved. Stored material is also useful for restocking — if there is wide scale culling, animals of the same genetic background should be available for restocking.

Temperature is predicted to increase globally, with reduced precipitation in many regions. Heat stress reduces reproduction and production in livestock, especially when the temperatures go beyond the range within which animals can thermoregulate by sweating alone. Water requirements are likely to increase. However, there is a general lack of experimentation and simulations of livestock adaptation to climate change.

Drylands are some of today's most extreme environments. In the Near East, 90% of all the region's breeds are bred and kept in drylands. In Africa, 56 percent of its total livestock diversity is adapted to drylands, 42 percent in Asia and 19 percent in Latin America. On average, 46 percent of the breeds in the four regions are adapted to drylands. There is a wealth of literature on adaptation differences between Zebu and Taurine cattle in general (Prayaga *et al*., 2006; King 1984), but less at the breed level or on other animal species.

The high-output breeds originating from temperate regions that provide the bulk of market production today are not well adapted to heat stress. A variety of technologies exist for dealing with climate stress in animal husbandry. Access to such technologies and to capital will determine the ability of livestock producers to adapt their herds to the physiological stress of climate change. Intensive livestock production systems have more potential for adaptation through the adoption of technological changes. The widespread adoption of such technologies will also depend on the availability and prices of energy and water, which are expected to become scarce. However, the rate of technology adoption is generally low in extensive or pastoral systems, and breeds in regions which have a low adaptation capacity may, already today, be more at risk.

Further selection for breeds with effective thermoregulatory control will be needed. However, it may be difficult to combine the desirable traits of adaptation to high temperature environments with high production potential. At higher temperatures, it may be difficult to develop breeds that remain productive; in this case species substitution could be an option. The speed of adaptation will be crucial. If the available breeds cannot be selected fast enough to adapt to climate change, an increased need for movement of breeds which carry the desired traits will arise. This would require that livestock keepers, particularly pastoralists, continue to have access to a wide portfolio of genetics.

INDIRECT IMPACT OF CLIMATE CHANGE ON LIVESTOCK PRODUCTION AND DIVERSITY

Livestock contributes to and will be affected by climate change. Livestock now use 30 percent of the earth's entire land surface, mostly permanent pasture but also including the 33 percent of global arable land which is used to produce feed for livestock. The sector is crucial for adaptation and mitigation of climate change — because the livestock sector is a large producer of greenhouse gases (GHG) (18 percent of GHG emissions as measured in CO_2 equivalent are attributed to livestock, through enteric fermentation, land use and land-use change (directly for grazing or indirectly through production of feed crops), and manure management) (FAO, 2006). Therefore, the various climate change mitigation policies and technologies are expected to influence the livestock sector. Long-term breed survival, in economic terms, depends on the comparative advantage of the breed to provide the desired goods and services in a given environment. The past century has seen a very dynamic development in input and output prices, and climate change will be one factor in addition to human population and technological advance, that affects prices in the future, with socio-economic and biophysical components interacting at different scales.

Water, feed and fodder are the most important inputs for livestock production. Their overall and relative availability may be affected by climate change. The non-food sector demand for feed inputs, especially for biofuel and other industrial use, is expected to increase, thereby potentially exacerbating the impact of climate change for the livestock sector. If the present increase in feed prices continues, the comparative advantage of monogastrics with their better feed-conversion ratio as compared to ruminants will increase, and commercial breeds may outcompete local breeds.

The predicted temperature increase will further the geographic expansion of vector-borne infectious diseases to high elevations and higher latitudes (e.g. Rift Valley fever, bluetongue and West Nile virus). Such disease pressure will favour genotypes that are resistant or tolerant to the disease. FAO (2007a) lists breeds, mainly from developing countries, that were reported to be resistant or tolerant to trypanosomiasis, tick burden, tick-borne diseases, internal parasites (59 cattle breeds, 33 sheep breeds, 6 goat breeds, 5 horse and 4 buffalo breeds). There is thus a potential for genetic improvement of disease resistance. The importance of molecular methods and marker assisted selection will increase.

Many governments are monitoring the GHG emissions from their livestock sector as part of their overall efforts to comply with the UNFCC (2006) and the Kyoto Protocol, and research into mitigation technologies has been increasing. Productivity differentials among livestock species or breeds, and price elasticities between livestock and other sectors may play a role under emission trading schemes arising from the Kyoto Protocol. Optimization of feed rations and feed additives or other technologies may be used to reduce GHG emissions from the livestock sector. Dairying might become the major focus of cattle production, while meat may be produced from species that emit less GHG (poultry and pigs). Breeding in dairy cattle has to improve milk production, longevity and functional traits simultaneously. Ruminants kept in marginal rangelands and providing the backbone of the livelihoods of their owners, or those used for landscape management, should not be included in GHG regulations.

Improved, high-input management system are needed to express the genetic potential of the high-output breeds. The question is how such management can be maintained in view of expected higher feed, energy and water prices and how fast the breeds can genetically adapt to changing environments, including higher disease pressure. If this is not possible, the local breeds of the tropics are expected to cope better with the consequences of climate change. This may lead to a reverse in the current flow of genetics and increase attractiveness of South–South exchange of genetics, and may provide incentives for genetic improvement of local low-input low-output genetics.

For the livestock sector to be able to adapt to different climate change scenarios,, the international community must ensure the availability of a wide portfolio of animal genetic resources for food and agriculture to livestock keepers and breeders. It must also undertake to facilitate exchange of animal genetic resources for food and agriculture and to promote technology transfer. The recent adoption of the *Global Plan of Action for Animal Genetic Resources* and the *Interlaken Declaration* by the international community provide for the first time an internationally agreed framework to promote creating these crucial conditions for the global livestock sector (FAO, 2007b).

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19. BRIDGING THE URBAN-RURAL DIVIDE WITH PAYMENTS FOR ECOSYSTEM SERVICES – A LANDSCAPE-BASED APPROACH TO SUSTAINABLE LIVELIHOODS

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Keywords: Ecosystem services, payments for ecosystem services, ecosystem management, landscape approach

THE UNIFYING LANGUAGE OF ECOSYSTEM SERVICES

As environmental impacts become accentuated by unsustainable economic development, urbanization and globalization are currently threatening the world's cultural and biological diversity. Urban markets are calling for a growing supply of food, turning many diverse landscapes into large monoculture plantations. While economies of scale allow for greater productivity, the resulting threats to cultural and natural diversity could very well undermine the entire food production process. Consequently, it is believed that the current trend of rural agricultural industrialization is currently jeopardizing the continued provision of the many ecosystem goods (e.g. food, water, building materials) and services (e.g. erosion control, pollination, scenic beauty) upon which cities – and society as a whole – depend (Appleton, 2007).

It has been argued that a new type of relationship between urban and rural landscapes is necessary in order to ensure that valuable ecosystem services are sustained and that cultural and biological diversity are maintained (Gutman, 2007). While the preservation of diverse socio-ecological systems should be self-justified, the 'public good' nature of these assets has meant that biodiversity, as well as the ecosystem services supported by biodiversity, are often undervalued and neglected (MA, 2005).

Recently, attempts have been made to evaluate the potential of the 'ecosystem services' concept to serve as an appropriate means of valuing biodiversity (IUCN – UNEP, 2007). The attractiveness of the 'ecosystem services' concept is also largely due to its capacity to provide a unifying language between the economic, business (including agriculture) and environmental communities; as beneficiaries of valuable services are identified, previously uninvolved actors are recognizing that they have a stake in conserving the environment. This offers a strategic opportunity to further jointly engage resource 'exploitationists' and 'preservationists' in sustainable rural development.

TOWARDS ECOSYSTEM SERVICE DISTRICTS?

In the search for a lasting balance in favor of sustainable rural development, the common language between 'exploitationists' and 'preservationists' will need to develop a way of comparing and negotiating the different values they associate with the natural environment. Thus, the idea of implementing payments for ecosystem services (PES) as a means of linking resource providers and beneficiaries has been gaining in popularity. With various PES schemes implemented around the world, there still is no clear sense of direction with regards to where the real potential of this new policy tool lies in terms of positively contributing to sustainable development.

A good step in the right direction towards using PES as a means of encouraging a more sustainable and equitable relationship between urban and rural systems could be to institutionalize PES at the landscape scale. More concretely, this would mean the establishment of 'ecosystem service districts' (Heal et al., 2001) that could be inspired from watershed-type PES schemes and that would aim towards the formal recognition of the upstream-downstream dependencies within a specific region, or municipality.

Such developments would need to go hand-in-hand with a re-shifting of social, political, and economic activities down to regional watershed-scale ecosystems. Here, ecosystem management would prevail as an approach to policy implementation, and markets for ecosystem services would flourish through the strengthening of local communities.

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20. CONSERVATION AND USE OF ON-FARM CROP GENETIC DIVERSITY TO REDUCE PEST AND DISEASE DAMAGE ON-FARM: PARTICIPATORY DIAGNOSIS GUIDELINES

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INTRODUCTION

The potential negative consequences of planting large areas to single crop cultivars with uniform resistance to pests or diseases were recognized as early as the 1930s. The resulting economic and food resources costs from this loss are a major consequence of the continuing evolution of pests and pathogens able to overcome resistant genes introduced by modern breeding. Breeding programmes are in place to develop new varieties and to replace varieties that have lost their resistance, however, the maintenance cost of the current system is estimated to be very high and is leading erosion of the traditional crop diversity. Small-scale farmers in developing countries continue to depend on genetic diversity to maintain sustainable production and meet their livelihood needs. Loss of genetic choices, reflected as loss of local crops cultivars, therefore, diminishes farmers' capacities to cope with changes in pest and disease infection, and leads to yield instability and loss. Local cultivars are a primary source for the new resistant germplasm.

Integrated pest management (IPM) strategies, which have focused on using agronomic management techniques to reduce pesticide use, but concentrate on modifying the environment around predominantly modern cultivars, and have tended to exclude the potential of using within-crop diversity, for example, through genetic mixtures (crop variety mixtures) or the planned deployment of different varieties in the same production environment. A diverse genetic basis of resistance (e.g., crop variety mixtures) is beneficial for the farmer because it allows a more stable management of pest and disease pressure, than a monoculture allows. This is because when resistance in a monoculture breaks down the whole population succumbs, while in a genetically diverse field it is much less likely that different types of resistance will all break down in the same place for comparable pest or disease damage.

PARTICIPATORY DIAGNOSIS GUIDELINES

Knowledge about the management practices involved, and how they might be optimised within a framework of crop diversity maintenance, is limited. Understanding the co-evolutionary forces at play between farmers, the environment and host and pest species is needed to develop tools for combating diseases. A key starting point is to understand farmers' knowledge, practices, problems and needs for using diversity to control pests and diseases (*Jarvis and Campilan, 2006*). Through participatory assessment combined with laboratory and field analysis, a determination can be made on when and where genetic diversity of the target crop can be recommended to manage pests and diseases. In this regard a set of methodological guidelines has been developed. Guidelines go much further than providing guidance to produce descriptions of host-pest/pathogen systems on-farm. They feed into a six-step decision-making tool. The steps are listed below that will enable the determination of when the use of crop genetic diversity on-farm would be an appropriate option to minimize crop loss due to pests and diseases. Each step includes assessments of farmers' beliefs and practices and measured data.

Step 1. Are pests and diseases viewed by both farmers and scientists as a significant factor limiting production? If so –; *Step 2.* Does intraspecific diversity with respect to pests and diseases exist within project sites and, if not, do other sources of intraspecific diversity with respect to pests and diseases exist from earlier collections or from similar agroecosystems within the country? And/or –; *Step 3.* Does diversity with respect to pests and diseases exist but is not accessed or optimally used by the farming communities? If so –; *Step 4.* Is there diversity in virulence and aggressiveness of pathogens and/or diversity in biotypes in the case of pests?; *Step 5.* Are, and if so how, pests and diseases moving in and out of the project sites, and what is the role of the local seed/propagation material systems?; *Step 6.* What "genetic choices" do farmers make, including using or discarding new and old genotypes, selecting criteria for hosts that are resistant, and managing mixtures to minimize crop loss due to pests and diseases?

Step 1 is used to ensure that before an investment in resources is made for project implementation, it is in areas where specific pest and disease problems are identified as being a major issue for farmers. Step 2 includes quantification of the amount and type of diversity of local crop varieties on-farm, not only for identifying resistant varieties, but also for understanding the potential trade-offs among resistant and non-resistant varieties in terms of production and quality traits preferred by local communities. The participatory guidelines that exist (*Sadiki et al., 2007*) to determine whether the same named varieties from within and among different regions are genetically the same, are modified for participatory determination of to what extent the variety names and traits used by farmers to describe these varieties can be used to identify amounts of diversity in respect to resistance found on-farm.

Resistance may exist in earlier collections from project sites, or from similar agroecosystems within the countries, which is not being optimally used on-farm. Farmers may be using varieties for other purposes not associated with minimizing pests and diseases, or they may not be able to access materials that they know are resistant. In Step 3, barriers and constraints — including social, economic and knowledge barriers to diversity access — will be examined. Step 4 includes surveys of pathogen variation (e.g. screening samples of isolates against a range of crop genotypes), and pest biotypes. Measurements will be made on insect pests and pathogens of importance and the time of their occurrence; varieties will be surveyed in situ for infestation levels at the appropriate times. Step 4 includes gaining an understanding of farmer classification systems for pests and pathogens. Perceptions by farmers of pest and disease variation, including whether farmers perceive that varieties are becoming more susceptible over time or more susceptible when planted in different plots or environments, and whether pesticides have become less effective, will help provide insights to the reasoning behind pest and disease management practices and the management of genetic diversity.

Step 5 is concerned with the mechanisms that are responsible for movement and transmission of pests and diseases within and among communities, and thus requires an understanding of the mechanisms and components of local seed systems. Identifying which persons or groups are involved in movement of seeds and other propagating material, and their awareness of pest and disease transmission mechanisms, will be key for mainstreaming and replicating practices involved with seed and clonal cleaning discussed later in this document. Step 6 leads the decision-maker into an understanding of farmer management practices that use crop genetic diversity. Do farmers use mixtures; how are the mixtures arranged? Do farmers select for resistance: do they choose particular varieties because they have known resistant traits, do they select particular plants within a variety to have a more resistant population, do they plant particular parts of their fields for seeds to be used the next generation? Answers to these questions will guide the development of practices and procedures that enhance the use of genetic diversity to minimize pest and disease pressures.

CONSERVATION AND DEVELOPMENT IMPACT

Determining when and where the use of crop genetic diversity by farmers, farmer communities, and local and national institutions can be used to minimize pest and disease damage on-farm has both conservation and development impact. Rural populations will benefit from reduced crop vulnerability and crop loss to pest and disease attacks. Increased genetic diversity of crops in respect to pest and disease management on farmers' fields will occur as an outcome of the use of mixtures of crop varieties, and participatory breeding based on improving locally resistant varieties with quality traits, and locally adaptive varieties with higher resitance. Finally participatory diagnostics guidelines set the framework for increasing the capacity and leadership abilities of farmers, local communities, and other stakeholders to make diversity rich decisions in respect to pest and disease management.

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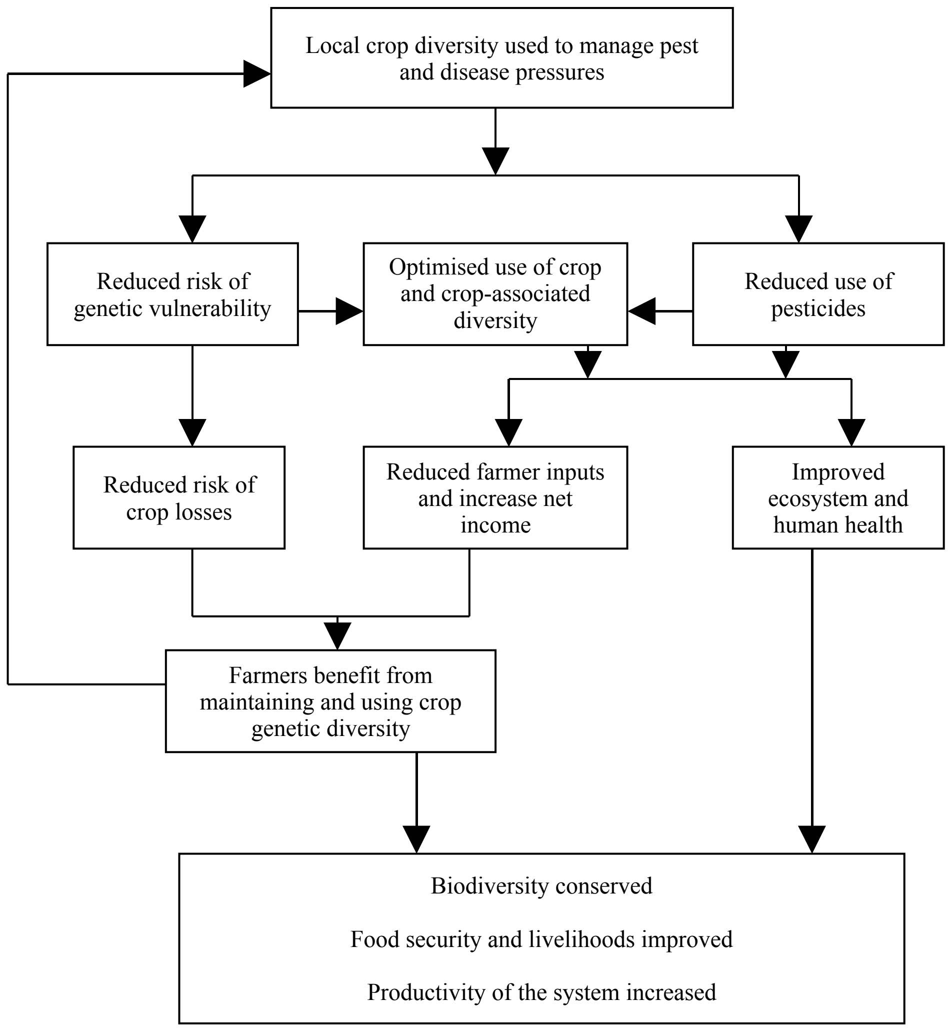
ACKNOWLEDGEMENTS

The authors would like to thank the United National Environmental Programme/ Global Environmental Facility, the Food and Agriculture Organization of the United Nations, and the governments of Switzerland (Swiss Agency for Development and Cooperation) and the Ford Foundation for their financial support.

FIGURE 1: Flowchart indicating how the use of local crop genetic diversity can conserve crop genetic diversity, improve livelihoods and promote system productivity.



21. ANALYSIS OF FOOD COMPOSITION DATA ON RICE FROM A PLANT GENETIC RESOURCES PERSPECTIVE

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Keywords: rice, food composition, biodiversity, nutrition

INTRODUCTION

Rice accounts for 21, 14 and 2 % of global energy, protein and fat supply respectively. There are thousands of different rice varieties; some have been in the diet for centuries, while others are new hybrids promoted for qualities such as high yield and drought and disease resistance. This paper presents the nutrient composition of rice by variety, and sets out a preliminary basis for assessing the significance of differences among rice varieties using nutrient content as one marker for genetic diversity in rice. While many post harvest factors, such as milling, preparation and cooking can influence nutrient content of rice, this paper focuses on the importance of first understanding differences in the nutrient content of rice varieties. Although there are at least twenty-one species of rice, only two are cultivated: Oryza sativa and Oryza *glaberrima*. Oryza sativa can be divided into three sub-species: *indica, japonica* and *javanica*. At present, 80% of all cultivated rice is from the *indica* sub-species. Despite the world's heavy reliance on this agricultural product, rice genetic resources are dwindling. The influence of modern agricultural practices and focus on high-yield crop varieties has contributed to this decline. Increasing land pressure, indiscriminate use of fertilizers and pesticides and destruction of much of the world's forested areas have also contributed to the decline in plant genetic resources.

METHODS

A thorough literature search was performed to gather existing information on nutrient composition of rice by variety. Food composition tables from China, Korea, Malaysia, Nepal, Pakistan, the Philippines, Thailand and the United States, all provided some information on the variety (or type) of rice analyzed. A series of journal articles and book chapters containing some nutrient information of rice by variety were found, as was one book on protein content by variety. In order to draw comparisons across numerous data sources, only raw, unpolished samples were compared. Nutrients were standardized to g/100g dry matter, in the case of proximates and mg/100g dry matter for vitamins and minerals. All nutrients were standardized to common units. For example, when protein values were expressed as N x 6.25 they were recalculated to N x 5.95 for standardization purposes.

RESULTS

Varietal difference in nutrient composition were found for every nutrient analyzed. Table 1 provides the range and average found within varieties for protein, iron, zinc, calcium, thiamin, riboflavin, niacin and amylose. The difference in nutrient content for the highest and lowest values within varieties was large. For example, there was a three-fold difference for protein, a 40-fold difference for riboflavin (vitamin B2), and 64-fold difference for calcium.

CONCLUSIONS

There are large differences in nutrient composition within varieties of rice. However, many of the varieties which are higher in nutrient content are less favored in the current yield-driven market. Too often, nutritional considerations rank far lower than other aspects of crop production. Nutritionists, dietitians and health educators are in part responsible for this, due to a lack of interest and attention drawn to differences within crop varieties. A concerted effort should be made to incorporate varietal information when conducting food intake surveys, compiling food composition data and providing dietary guidance.

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TABLE 1: Rice varietal differences in nutrient composition

NUTRIENT	RANGE	AVERAGE	VARIETY WITH HIGHEST NUTRIENT CONTENT	VARIETY WITH LOWEST NUTRIENT CONTENT
Protein (n=1339)	5.55 – 14.58 g/100g	8.55	Indica CR1707	Indica Rd 19 (Thailand)
Iron (n=95)	0.70 – 6.35 mg/100g	2.28	Long grained[a] red (China)	Undermilled Red[a] (Philippines)
Zinc (n=57)	0.79 – 5.89 mg/100g	3.34	Ganjay Roozy(IRRI)	Long grain[a] Fragrant (China)
Calcium (n=57)	– 65 mg/100g	26	ADT-21, red (India)	Brown Japonica[a] (Korea)
Thiamin (n=79)	0.117 – 1.74 mg/100g	0.475	Juchitan A-74 (Mexico)	Glutinous rice[a] special grade (China)
Riboflavin (n=80)	0.011 – 0.448 mg/100g	0.091	Tapol Dark Purple (Philippines)	Mun-pu red (Thailand)
Niacin (n=30)	1.97 – 9.22 mg/100g	5.32	Long grained[a] purple (China)	Glutinous round[a] grained (China)
Amylose (n=1182)	– 76.0 g/100g	22.4	Ingra 410 (Brazil)	Bpi-Ri-3 (Philippines)

[Many of these data come from food composition tables and in some cases may not be strictly reflective of varietal differences.]

22. CONSERVATION AND ADAPTIVE MANAGEMENT OF GLOBALLY IMPORTANT AGRICULTURAL HERITAGE SYSTEMS (GIAHS)

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Keywords: agricultural heritage, Agricultural Biodiversity of Global Significance, adaptive management

INTRODUCTION

The biodiversity that underpins agricultural systems[1] spans a continuum from simple human use of wild species (whether directly for sustenance or indirectly for increasing yields from desired species) to the creation and intensive management of genetically modified organisms. Within this spectrum, "agricultural biodiversity" represents that group of organisms which has been domesticated, maintained and adapted in a process of co-evolution with human management systems[2]. Thus, landraces and wild species of animals and plants are the essential source of genetic variability for responding to biotic and abiotic stress through genetic adaptation. The agricultural biodiversity in any form can only be effectively maintained and adapted with the human management systems that have created it, including knowledge systems and technologies, specific forms of social organisation, customary or formal law and other cultural practices. Agricultural practices in many parts of the world have led to landscape-scale ecosystem variation, and provided mosaics of micro-habitats, that support associated plant and animal communities, which now depend largely on continued management for their viability. In many regions of the world, especially where natural conditions of climate, soil, accessibility and human presence militate against intensification, there still persist agro-ecosystems and landscapes that are maintained by traditional practices developed by generations of farmers and herders. Based on a high diversity of species and their interactions, the use of locally adapted, distinctive and often ingenious combinations of management practices and techniques, such agricultural systems testify to millennia of co-evolution of human societies with their natural environments. These systems often reflect rich and globally unique agricultural biodiversity, within and between species but also at ecosystem and landscape level. Having been founded on ancient agricultural civilizations, certain of these systems are linked to important centres of origin and diversity of domesticated plant and animal species, the *in situ* conservation of which is of great importance and global value. Built on local resources and dynamic knowledge and experience, these Globally Important Agri -"cultural" Heritage Systems (GIAHS) reflect the evolution of humanity, the diversity of its knowledge, and its profound harmony with nature. They have resulted not only in outstanding aesthetic beauty, maintenance of globally significant agricultural biodiversity, resilient ecosystems and valuable cultural inheritance but, above all, in the sustained provision of multiple goods and services, food and livelihood security and quality of life. The Globally Important Agricultural Heritage Systems (GIAHS) are defined as "Remarkable Land Use Systems and landscapes which are rich in globally significant biological diversity evolving from the ingenious and dynamic adaptation of a community/population to its environment and the needs and aspirations for sustainable development"(FAO, 2002).

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1 A broad concept of agriculture is applied, including cropping, animal husbandry, forestry, swidden agriculture, fisheries, hunting, gathering and combinations thereof.

2 According to the CBD, agricultural biological diversity is "...a broad term that includes all components of biological diversity of relevance to food and agriculture, and all components of biological diversity that constitute the agro-ecosystem: the variety and variability of animals, plants and micro-organisms, at the genetic, species and ecosystem levels, which are necessary to sustain key functions of the agro-ecosystem, its structure and processes..." (decision V/5)

GIAHS AND AGRICULTURAL BIODIVERSITY OF GLOBAL SIGNIFICANCE

The major selection criterion of the GIAHS is the richness of the system in its agricultural biodiversity of global significance. By definition, agricultural biodiversity of global significance has been domesticated, maintained and adapted in a process of co-evolution with human management systems, which include traditional knowledge systems and technologies, specific forms of social organisation, customary law and other cultural practices. The biodiversity can only be maintained within the *agri-cultural* systems that have created it. If the integrity of these systems is threatened, the biodiversity will be lost.

Agricultural biodiversity of global significance is a unique subset of GIAHS, sharing the following major characteristics:

- The *domestication, maintenance and adaptation* of the Agricultural Biodiversity of Global Significance itself;
- The Agricultural Biodiversity of Global Significance *is managed holistically*, this includes: (i) integration at the level of inter and intra-species dynamics; (ii) integration of different scales: genes, species, ecosystem and landscape; (iii) integration of the sustainable management of biotic and non-biotic natural resources (land and water); (iv) integration of the biodiversity and ecosystem characteristics with human needs, aspirations and cultural views and preferences; and (v) adaptive management
- The Agricultural Biodiversity of Global Significance *has co-evolved* with these systems over centuries, even millennia

However, the accelerating pace of globalization and the changes in modern political, social and economic systems and excessive "foot print" of human activities on environment and ecological systems, pose enormous challenges for maintaining these complex, often subsistence and family agro-ecosystems that are not promoted commercially, but widely valued in terms of their agricultural Biodiversity, knowledge systems and cultural values of global significance. The GIAHS programme explicitly recognises that changes in traditional and subsistence farming are inevitable and GIAHS cannot be frozen or re-created. Consequently, programme aims at the "adaptive management" approach to explore and develop novel social, economical and governance processes that strengthen the existing livelihood and management practices that generate sustainable biodiversity outcomes — that is, maintenance and or increase of the number of landraces, species and agro-ecosystems, enhance the ecosystem goods and services and provide other globally important outcomes such as cultural diversity and indigenous knowledge. Thus, the development processes may be different from the ones presently promoted and contain new and modern elements that maintain the functionalities and principal values of these agro-ecosystems. The GIAHS programme ultimately, assist the traditional and family farming communities living in and around GIAHS, to establish strengthened socio-political (governance) and economic processes (eco-tourism, niche markets and new employment opportunities) that help them address the challenges of globalization and let them to take advantage of the opportunities of modern living, while at the same time maintaining the agro-ecosystems of global importance.

PROGRAMME GOAL

The overall goal of the programme is to foster the dynamic conservation of each GIAHS with tangible global benefits, while simultaneously favoring the target rural communities in a way that this process can be sustained by them through building innovative alliances rooted in values of equity and mutual support, able to collectively implement needed natural resource management and socio-economic development that contribute to the implementation of Article 8(j) and 10(c) of the CBD "protect and encourage customary use of biological resources in accordance with traditional cultural practices that are compatible with conservation or sustainable use requirements", specifically within these agricultural systems.

The programme works on three distinct levels of intervention:

1. *at Global level:* by identification, selection and recognition of GIAHS;

2. *at National level:* by capacity building in policy, regulatory and incentive mechanisms to safeguard these outstanding systems and use them as sustainability bench mark systems; and
3. *at Local Level:* by empowerment of local communities and technical assistance for sustainable resource management, promoting traditional knowledge and enhancing viability of these systems.

GIAHS can be viewed also as benchmark systems that can provide principles and lessons for national and international strategies for the *in-situ* conservation of biodiversity, sustainable agricultural development, climate change mitigation and adaptation, and addressing the rising demand to meet food and livelihood needs of poor, small scale and traditional family faming and indigenous communities. The programme shall promote "dynamic conservation" approach that:

- Allows farmers to nurture and adapt the systems and sustainably use the biodiversity they have developed, while improving their living condition;
- Recognises right to food and cultural diversity of local farmers community members and indigenous peoples; and
- Crystallizes the need for the approaches that integrate the *in situ* conservation of genetic resources with related traditional knowledge and adapted technologies, as a way to ensure continuous co-evolution with a changing environment and human pressure.

The programme will be implemented initially through a GEF project in five pilot systems represented by 12 pilot sites in 6 countries: Chile, China, Tunisia, Algeria, Peru, and the Philippines. Agricultural biodiversity characteristics of these systems of global significance are shown in Table 1 while detailed information about these systems is available at the website: www.fao.org/sd/giahs.

THE WAY FORWARD

GIAHS programme is an initiative that calls for safeguarding agricultural legacy and their associated landscapes, agricultural biodiversity and knowledge systems, by mobilising world-wide recognition and support to outstanding traditional and family agriculture. The programme also involves enhancing local, national and global benefits derived through dynamic conservation and economic viability. The programme attempts to mitigate threats to resilience of GIAHS by supporting rural farmers and their communities' capacities to continue to manage agricultural heritage systems, with the involvement of national governments, scientists and other stakeholders. It also seeks to support these communities and their local institutions by developing enabling and appropriate policy environments conducive to their continued existence and which allow their sustainable evolution and development. Over the last four years of developing the programme concept and project preparatory phrases, GIAHS with its innovative, integrated and holistic approach, have created awareness, interest and enthusiasm from a wide audience of both local and international bodies. Several countries have expressed interest in participating in the programme to promote sustainable agriculture and rural development of unique traditional and family farming systems.

The programme has gone so far as defining the concept, methodologies and framework of intervention strategies, and how it will contribute substantively to the implementation of the various international efforts and multilateral instruments such as the CBD, MDGs and climate change conventions (UNCCD, UNFCC). This includes strengthening collaboration between line institutions in the environmental and agricultural sectors to implement national strategies and action plans (NBSAPs, ITPGRFA and PGRFA). GIAHS programme is now on its full scale implementation for a 5-year period in selected countries.

The Globally Important Agricultural Heritage Systems (GIAHS) of the world will be continuously identified, classified and internationally recognized and specific policies and actions programs will be devised for their conservation and adaptive management similar to Cultural sites of UNESCO-World Heritage. An interim Secretariat will be established during the project, which will be mainstreamed in FAO program of work and budget. Ultimately, it will expand to a long- term open ended programme that could encompass 100 to 150 Globally Important Agricultural Heritage Systems worldwide.

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TABLE 1: The agricultural biodiversity and associated biodiversity features of the pilot agricultural heritage systems.

Pilot GIAHS	*Globally Significant Agricultural biodiversity and Associated biodiversity*
Chile **Chiloé agriculture**	***Agricultural biodiversity:*** *Chiloé Island is one of the Vavilov centers of origin of crop diversity. It is a centre of origin of potatoes (Solanum tuberosum), and a centre of mango (Bromus mango) and strawberry (Fragaria chiloensis). Some 200 documented varieties of native potatoes are still managed today, together with a variety of garlic (Ajo chilote) that is unique to the islands and its volcanic soils. The island supports an indigenous horse race, the hardy Caballo Chilote.* ***Associated biodiversity:*** *WWF has listed Chiloe Island as one of the 25 priority areas for ecosystem conservation in the world. Both primary and secondary temperate rainforest are found on Chiloe Island in the patchwork landscape shaped as a result of 10,000 years of co-evolution with human livelihoods. They hold a wide range of species including 15 rare to endangered bird species, 33 endemic species of amphibians (3 rare to endangered), 9 species of endemic mammals (all rare to endangered), and 4 species of vulnerable to endangered freshwater fish; Wild species provide fruit (8 species), dyes (9 species), ethno-medicines (41 species) and used for sculpture (5 species).*
China **Rice-fish system**	***Agricultural biodiversity****: Rice paddies (20 native rice varieties; many threatened), home gardens, and livestock / poultry; Trees and field hedges; Numerous native vegetables and fruits including lotus roots, beans, taro, eggplant, Chinese plum (Prunus simoni), mulberry; 6 native breeds of carp.* ***Associated biodiversity****: 5 species of fish, and amphibians and snails in paddies; 7 species of wild vegetables collected in borders of fields; 62 forest species are used (21 as food); 53 medicinal plants.*
Algeria, Tunisia **Oases of the Maghreb**	***Agricultural biodiversity:*** *50 date varieties in Gafsa, Tunisia; 100 in Beni, Algeria* *A wide range of fruits (pomegranates, figs, olives, apricots, peaches, apples, grapes, citrus) and cereals, vegetables, spices, medicinal species, forage and ornamentals* ***Associated biodiversity:*** *Migratory birds, Gazelle (Gazella cuvieri),Fennec (Vulpes zerda).*
Peru **Andean agriculture**	***Agricultural Biodiversity:*** *Primary centre of origin of potatoes, quinoa, kañiwa, chilis, the chinchona tree, the coca shrub, oca, olluco), mashwa), amaranth, leguminous plants such as beans and lupins, and roots such as arracacha, yacón, mace and chagos; Extraordinarily polymorphic groups of the soft corn have been differentiated; Domestication of llamas, alpacas and guinea pigs.* ***Baseline Caritamaya****: Potatoes (28 varieties). Bitter potatoes (13 var.)* **Quinoa (43 var.), Ka-** *ñiwa (8 var.), Oca, Olluco, Llamas, Alpacas (all 24 colors, 3 mayor breeds).* ***Baseline Microcuenca de San José****: Potatoes (80 var.), Mashua (14 var.), Olluco (18 var.), Kañiwa (12 var.) Oca (20 var.) Llamas, Alpacas .* ***Baseline Cuenca de Lares****: Potatoes (177 var.), Oca (20 var.), Olluco (11 var.), Mashua (17 var.), Maiz (23), Quinoa, Kañiwa, Lupins, Llamas, Alpcas, wild relatives* ***Baseline Micro de Carmen****: potatoes (105 var.), Oca (25 var.) Olluco (14 var.), Mashua (20 var.), Maiz (34), Quinoa, Kañiwa, Lupins, Llamas, Alpcas, wild relatives* ***Associated biodiversity:*** *Vicuña; Endemic grassland and wetland birds (including many North American migrants); Wild medicinal and food plants; Wild crop relatives*
Philippines ***Ifugao Rice Terraces***	***Agricultural biodiversity****: Traditional rice varieties of high quality for rice wine production; Associated mudfish, snails, shrimps, and frogs in paddies, some of which are endemic; Managed forest re-growth (muyong) after shifting cultivation, with enhanced biodiversity (264 species, most indigenous, 47 endemic), including 171 tree species (112 species are used), 10 varieties of climbing rattan, 45 medicinal plant species, 20 plant species which are used as ethno-pesticides* ***Associated biodiversity****: 41 bird species, 6 indigenous mammal species and 2 endemic reptiles*

23. GENETIC AND BIOCHEMICAL CHARACTERIZATION OF CROP COLLECTIONS AT THE VAVILOV INSTITUTE FOR HUMAN NUTRITION AND HEALTH

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Keywords : agrobiodiversity, germplasm collection, nutrition, phytochemicals, microsatellite markers

INTRODUCTION

The N.I. Vavilov Institute of Plant Industry (VIR) is the only research institution in Russia whose activities and responsibilities include the collecting, conservation, study and use of plant genetic resources. VIR maintains one of the largest and oldest germplasm collections worldwide representing plant diversity of crop species and their wild relatives encompassing 320,000 accessions of 155 botanical families, 2,532 species of 425 genera. However, much of this historically-significant material remains poorly characterized, particularly the vegetatively-propagated accessions which cannot be stored as seeds such as potatoes, small berries and grapevine. In recognition of both the scientific and societal value of these collections VIR is undertaking a collaborative program of research with the Centre de Recherche Public Gabriel Lippmann (CRPGL) and Bioversity International. The contribution of this agricultural biodiversity to nutrition and human health is recognized as an important value that needs to be documented. The documentation of the nutritional value of these plant genetic resources will contribute to its continued conservation and to new uses.

PROJECT OBJECTIVES

The project aims to investigate the genetic diversity in subsets of several crops including *Solanum tuberosum* (potato), *Ribes* (current), *Rubus* (raspberry, blackberry), *Lonicera* (blue honeysuckle), *Sorbus* (rowan, mountain ash) and *Vitis* (grape), with the specific objective of assessing diversity in nutrient and phytochemical components which are recognized as important for human health. Health priorities include micronutrient nutrition and amelioration of non-communicable disease such as diabetes, cardiovascular disease and cancer. Laboratory analysis directed by CRPGL include minerals (calcium, zinc and iron) and vitamins (beta-carotene, alpha-tocopherol), as well as glycemic and antioxidant properties assessed with a variety of *in vitro* assays.. Antioxidant compounds identified as part of this screening include anthocyanins and other polyphenols (Figure 1), and non-nutrient carotenoids such as lutein and lycopene.

Molecular Markers of Genetic Diversity

Diversity at the DNA level is being investigated by CRPGL with the help of microsatellite markers. Preliminary results indicate that the collection contains a high level of polymorphism (mean of 11 different alleles per marker and 29 different patterns across 130 samples).

Biodiversity for Food and Nutrition

Bioversity International has undertaken the implementation of the Convention on Biological Diversity's *Cross-cutting Initiative on Biodiversity for Food and Nutrition* (CBD/COP8 Decision VIII/23. Curitiba, 2006) in conjunction with the CBD Secretariat and the Food and Agriculture Organization (FAO). Accordingly, this project endeavours to ensure that research results on the health and nutritional properties of agricultural biodiversity reach policy-makers in the Russian Federation and in the European Union. By establishing links between the research community and policy makers, the project hopes to identify and build support for policies that can harness agricultural biodiversity in Europe to create new economic opportunities for producers and deliver health and nutrition benefits to consumers.

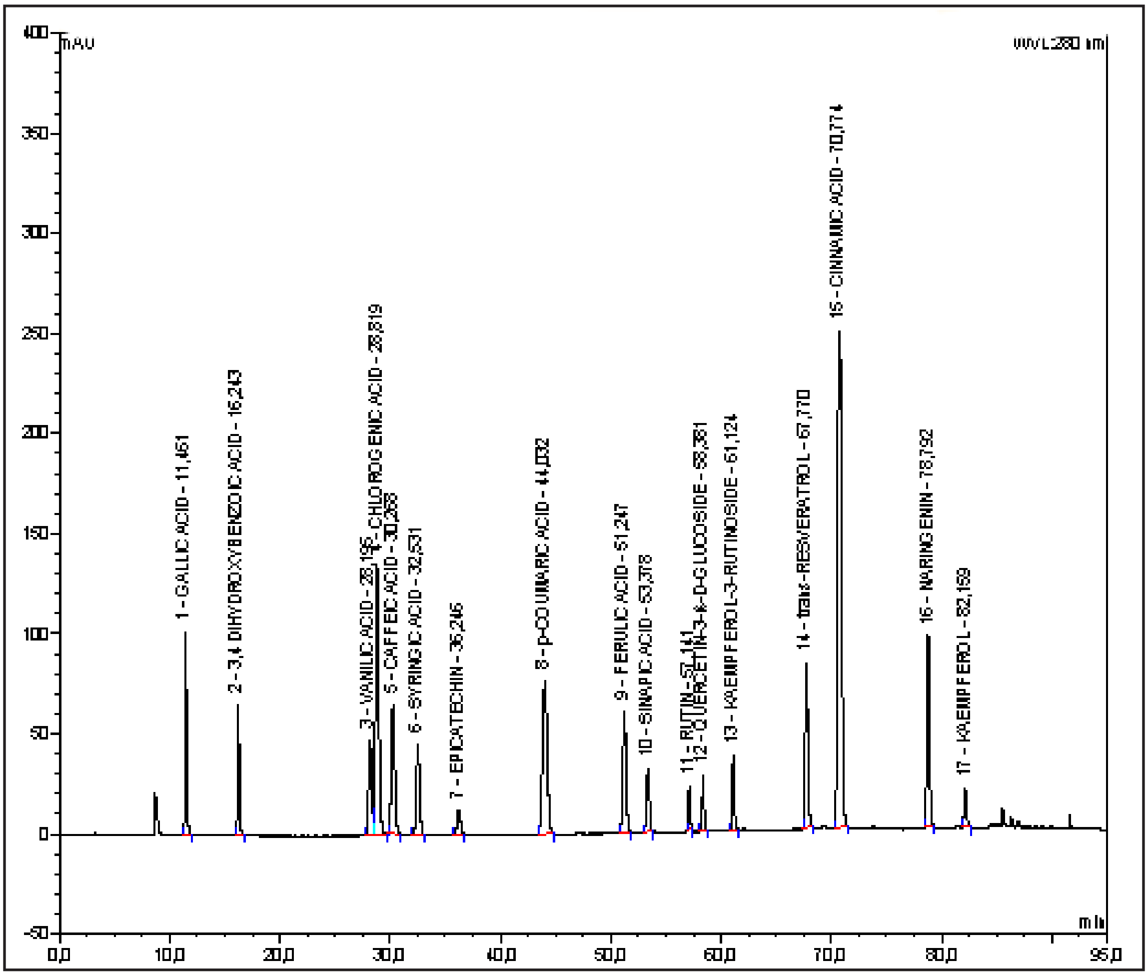

FIGURE 1: Accessions of small fruits and potato landraces contain a variety of simple phenolic and polyphenolic compounds.

24. INTEGRATING WILDLIFE CONSERVATION AND FARM PRODUCTION ON THE SOUTH WEST SLOPES OF NEW SOUTH WALES, AUSTRALIA

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Keywords: plantings, woodland remnants, wildlife conservation, agricultural production, south-eastern Australia

INTRODUCTION

Since European settlement about 220 years ago, it is estimated that over 85% of the native vegetation of the South West Slopes region of New South Wales (in southeastern Australia) has been removed (Benson, 1999). The majority of this vegetation would have been native woodland. Over-clearing of native vegetation has caused major problems such as soil salinity, erosion, waterway sedimentation, dieback of remaining trees and loss of farm productivity (Lindenmayer & Fischer, 2006). It has also had significant negative effects on native wildlife, with many species either extinct or endangered (Reid, 1999).

In the past decade, millions of dollars have been spent on revegetation (National Land & Water Resources Audit, 2002). While the resulting plantings are undeniably important in helping to curb landscape degradation, the loss of wildlife is a more complex problem. Since 2000, Professor David Lindenmayer and his team have been conducting the Restoration Study to explore the relative contribution of plantings and remnant vegetation to wildlife conservation on the South West Slopes of New South Wales.

THE RESTORATION STUDY

The Restoration Study addresses the following general questions:

- Is there an overall difference in the reptile and arboreal marsupial fauna between farms where re-vegetation has taken place and where it has not?
- Does the presence of particular species of mammals and reptiles differ between vegetation types? If so, is this difference consistent across farms with or without plantings?
- Are there relationships between patterns of species occurrence and measured attributes at the site, farm and landscape levels? If so, are they of practical use as predictors to help guide future landscape restoration efforts?
- Is there evidence that random variation in mammal and reptile data at the farm-level and/or landscape-level is greater than at the site level (i.e. scale effects)?
- Are plantings and other existing vegetation types interchangeable for reptiles and arboreal marsupials?

This extensive study is being conducted on 46 production farms across the South West Slopes, spanning 200 x 100 km and many different landscapes. A range of factors was considered to ensure the study's scientific validity. For instance, farms and landscapes with varying levels of remnant woodland and plantings were chosen. Sites were selected to include old growth woodland, multi-stemmed (coppice) regrowth woodland, natural regrowth woodland and native vegetation plantings. Planting sites were chosen to include different shapes and sizes. The amount of paddock trees, native grass, logs and other farm variables were measured.

Studying Wildlife

The Restoration Study focuses on arboreal marsupials, small mammals, birds and reptiles. Studying such a diverse range of animals requires many kinds of survey techniques, including spotlighting, hair sampling, active searches for reptiles and audio-based bird surveys. To date, the team has found: 169 species of birds, including the Crested Shrike-tit, whose numbers are in decline; 21 species of reptiles; four species of frogs, such as the Eastern Banjo Frog; four species of arboreal marsupials, including the endangered Squirrel Glider; and two species of native small mammals.

KEY FINDINGS

Statistical analysis of Restoration Study data is yielding many exciting and novel findings:

- Farms and landscapes with more remnant vegetation support more animals than those with less remnant vegetation, irrespective of the amount of native vegetation plantings. For instance, in terms of bird species gained, the remnant native vegetation index is about three times more important than the replanting presence index. This is because remnant vegetation provides animals with key habitat features such as hollows for nesting and dead limbs for perching. These features are not commonly found in younger plantings.
- While plantings are not a direct habitat substitute for old growth remnants, they do have a valuable ecological role, as they are tomorrow's old growth woodland. In the meantime they provide habitat for many species (including rare birds), discourage aggressive and introduced species (such as Noisy Miners and Starlings), and provide a refuge in areas where clearing has otherwise been extensive.
- Planting size and shape matters. Large plantings provide better wildlife habitat than small plantings and blocks provide better habitat than strips.
- By manipulating farm-level remnant native vegetation and planting size/shape, the number of bird species added can be increased on average by up to 20.
- Not all remnant woodland is equally suitable habitat for wildlife. Old growth woodland, coppice regrowth woodland and natural regrowth woodland vary in attractiveness to a range of different animals.
- Farms with good levels of fallen timber, remnant vegetation, paddock trees and native grass are favoured by many animals, particularly declining species.
- Farm management makes a difference. Activities such as bush rock removal or ploughing can have negative impacts for wildlife, while activities such as fox-baiting, particularly when done in conjunction with neighbouring farms, can have positive impacts.
- The integration of conservation and production on farms needs to extend beyond simple minimum woodland patch sizes for retention or expansion or percentage threshold vegetation cover levels. The **combined** effects of many components of vegetation cover at the farm level (e.g. including scattered paddock trees) requires careful consideration, as does the cumulative and/or complementary contributions of replanted areas to wildlife responses.

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25. DISTRIBUTION OF SOIL ORGANISMS IN DIVERSE TROPICAL ECOSYSTEMS: THE IMPACT OF LAND USE ON ABUNDANCE, RICHNESS AND DIVERSITY

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Keywords: Biodiversity loss, land use intensity gradients, tropical ecosystems, macrofauna, mesofauna, nematodes, arbuscular mycorrhizal fungi (AMF), legume nodulating bacteria, phytopathogenic fungi

The major of objective of the project "Conservation and Sustainable Management of Below-Ground Biodiversity" is to explore trends in diversity and abundance of soil organisms (belonging to functional groups like macrofauna, mesofauna, nematodes, arbuscular mycorrhizal fungi (AMF), legume nodulating bacteria, phytopathogenic fungi and other) across land use intensity gradients in benchmark areas located in Brazil, Cote d'Ivoire, India, Indonesia, Kenya, Mexico and Uganda. Sampling is done within 'sampling windows' located within the benchmark area to capture the relevant land use systems, using a grid sampling approach.

The conclusion is that comparable trends may be found, but that is very much dependent on the functional group. Often land use is not even found to be an exploratory factor of the observed variation in richness or diversity and abundance.

For example, for termites we generally find evidence that species richness as well as abundance is declining with increasing land use intensity. However, when found in relatively low numbers within the benchmark area, the pattern is no longer evident. When the abundance is low, more common species are observed.

Ants present a less strong case. Variation in species richness is not consistently found to be explained by land use system (LUS). But in those cases where we do find significant differences between LUS, a pattern of loss of diversity with increasing land use intensity is observed. At the same time, abundance is not significantly affected by the LUS in any of the cases. The 'window' (or location) does seem to have an effect on species diversity, suggesting that species diversity is driven by landscape level characteristics.

Earthworm species richness is found to vary significantly with LUS in only very few cases, in contrast to earthworm abundance, though there is no consistent pattern of abundance in relation to land use intensity, suggesting that there are confounding effects that determine the variation in abundance. The 'windows' do partly explain the variation in species richness, suggesting that also in this case landscape level factors, rather then plot level or land use lay a role. This is confirmed by the marked differences in species diversity that we find between the benchmark sites. Further analyses should reveal whether species composition is more clearly influenced by land use. There is some evidence that species richness is associated with pH and in some cases a positive correlation between abundance and soil carbon content is found.

Significant differences in species diversity, spore abundance and evenness of the species distribution of AMF in relation to land use is found, though not in any way in related to land use intensity. High spore abundance coincides with high species richness and low evenness scores. At the same time the 'window' is also an explanatory factor. The data suggests that higher species richness and abundance is found in more degraded systems, which seems to be confirmed by the negative correlation between soil C content and species richness in some cases and the (negatively) correlation of abundance with soil carbon, N, P and well as pH.

26. OVERCOMING THE TAXONOMIC IMPEDIMENT TO POLLINATOR CONSERVATION AND USE

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Keywords: pollinators, taxonomy, identification, DNA barcoding, georeferenced databasing

INTRODUCTION

Bees are essential components of almost all of the world's terrestrial ecosystems. They are best known for their role in pollination. However, there is another critical arena in which bees are important: bees are excellent indicators of the state of terrestrial environments including biotic responses to global warming. This is because they are more extinction prone than almost all other organisms due to an enormous genetic load caused by their unusual sex determination mechanism. Thus, it is imperative that worldwide georeferenced databasing for the bees be initiated in earnest. The main impediment to progress in this area remains the taxonomic one: bee experts, whether taxonomically or geographically focused, can, *in toto*, deal with only a small proportion of the global fauna. Furthermore, a beginner trying to identify bees faces immense obstacles. Yet this taxonomic impediment is not insurmountable. In this poster we discuss ways to overcome this considerable impediment.

SOLUTIONS

Web-based, illustrated identification guides

There are numerous computer-assisted methods that can help with the construction of user-friendly identification guides, in standard dichotomous or matrix formats. Dichotomous keys are easier to construct, but more difficult to use. Conversely, matrix-based keys are much easier to use because they can be entered at any point and the user can start off with the most easily observed characteristics, such as the country from which the specimen was collected or its colour. But, construction of a matrix-based key is considerably more work for the producer because (optimally) every taxon has to be coded for every variable, whereas in a dichotomous key, only those taxa that "key out" further along the decision-chain need be coded for the characteristics at any one point. Web-based keys are available for many North American bees (www.discoverlife.org/mp/20q?search=Apoidea; www.biology.ualberta.ca/bsc/ejournal/pgs_03/pgs_03.html — see figure 3 for an example), genera of European bees (www.iczn.org/ALARM/ALARM_home.html), *Bombus* of the world http://www.nhm.ac.uk/research-curation/projects/bombus/lucid/index.html and generic keys to bees of Vietnam and Africa are in progress.

What is needed, are locally-relevant, beautifully illustrated (with both live and pinned specimens), preferably matrix-based interactive keys for each region for which bee identifications are required. These should be easy to understand and a joy to use. This is a tall order. Nonetheless, where the interest and resources are available, starts may be made on these — publication of a global generic checklist by nation would help considerably (see poster by Ruggiero et al.).

DNA barcoding

DNA barcoding uses a 650 base pair fragment of the cytochrome oxidase I (COI) gene. For the vast majority of animals it has been shown to have minimal variation within species, but considerable divergence between closely related species. DNA barcoding works for bees, both for regional faunas (Figure 1) and for entire difficult species complexes. For the latter, the % divergence among COI sequences for closely related species are smaller than is usually the case for other organisms, but intraspecific variation is as low as usual (Figure 2). Barcoding assists with association of the sexes and the discovery of cryptic species.

The long term objective of the barcoding enterprise is to have almost all organisms on the planet identifiable with a hand-held device that can generate a DNA sequence and communicate with a global database through wireless technology. Although this seemed far-fetched only a few years ago, recent advances in miniaturization suggest that a similar system may be available within a decade or two. This places the emphasis upon data-providers to make the system desirable, and thus more economically viable through high demand. Consequently, a global bee-barcoding campaign is being developed, with the first planning meeting scheduled for May, 2008. Presently, the cost required to produce a barcode sequence has been reduced to approximately $3.00 (and declining), and the Guelph barcoding facility can generate hundreds of sequences per day.

Georeferenced Databasing

As part of several initiatives, accurately georeferenced databases showing distributional data for bees are beginning to come on-line. Although these activities rely more upon solving the taxonomic impediment than they contribute to overcoming it, distributional data provides a means for exploring the identity of related organisms. Disjunct distributions provide evidence that two or more regions are not necessarily inhabited by the same species-level unit. Having the world's major bee collections databased in an open access format will contribute to the detection of disjunct distributions (among other things) and suggest taxa that are deserving of further investigation through morphological and molecular approaches.

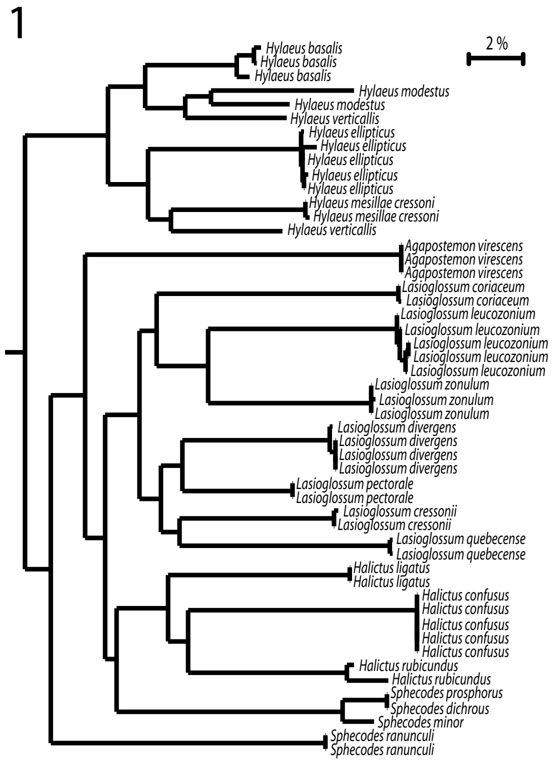
The Need for Experts

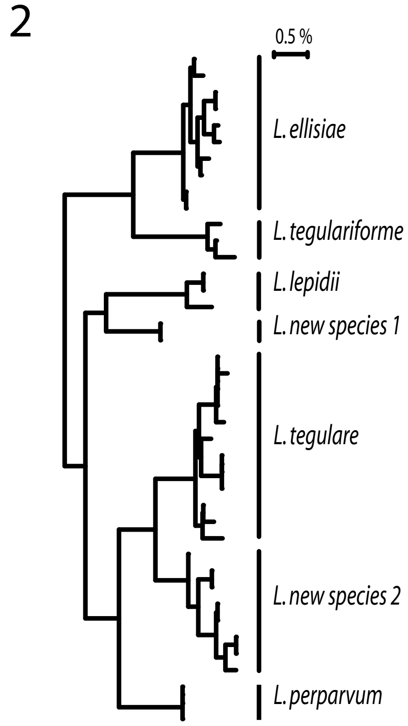
All of the aforementioned solutions ultimately rely upon the availability of experts to verify the quality of the data. The lack of expert taxonomists remains the most important impediment. The most important products of taxonomic research are revisionary studies that deal with all species in a group and, optimally, all specimens ever collected for that group. For anything other than the smallest number of species, these studies take inordinate amounts of time, resulting in apparently low research productivity in comparison to many branches of biology. This leads to a lack of job opportunities with a concomitant decrease in training of the next generation and continued decline in research output: a taxonomic extinction vortex.

This shortage is exacerbated by the increasing pressures upon practicing taxonomists to engage in the extremely time consuming activities of identifying specimens for pollination and biodiversity studies rather than to work on their own revisions. DNA barcoding may reduce this time sink. Another approach, adopted in the Brazilian Pollinator Initiative, is to use a network structure: taxonomic experts are training "identifiers" who will be capable of performing the more routine identifications leaving the experts more time to complete revisions.

CONCLUSIONS

In order for society to be able to capitalize upon the value of bees in pollination and environmental monitoring, a variety of solutions to the taxonomic impediment will be required: locally relevant, open access, web-based, easy-to-use identification guides; DNA-based taxonomy; georeferenced databasing and networks of "identifiers" trained by, and continuously associated with, expert taxonomists. All these activities ultimately rely on the ability of taxonomists to complete large scale taxonomic revisions, and all require financial support.





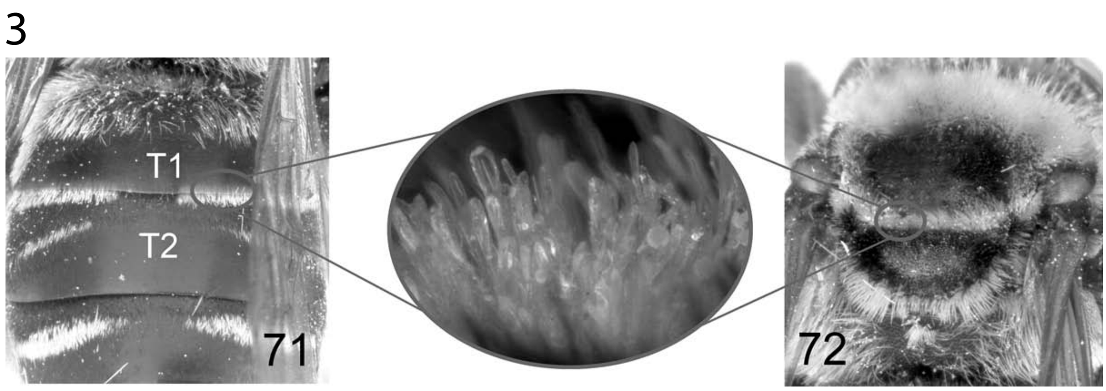


FIGURE 1. Neighbour-joining (N-J) tree based on DNA barcode data from a subset of taxa

FROM A REGIONAL FAUNA (NOVA SCOTIA). Deep divergences are seen between taxa with little intraspecific variation.

FIGURE 2. N-J tree based on DNA barcode data of a closely related species complex. The average minimum interspecific variation (2.9%) is less than that reported for some animals but is still distinctly more than the average maximum intraspecifc sequence divergence (0.5%). Lasioglossum tegulare was formerly believed to include the erroneously synonymised names, L. ellisiae and L. lepidii, it now also contains two undescribed species.

FIGURE 3. High quality images, such as these that show the position and structure of spatulate hairs on the bee species, Svastra obliqua, greatly improve the ability of non-experts to accurately identify taxa.

27. *THE STATE OF THE WORLD'S ANIMAL GENETIC RESOURCES FOR FOOD AND AGRICULTURE* — THE FIRST GLOBAL ASSESSMENT

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Keywords: animal genetic resources, state of the world, livestock, assessment, capacity

INTRODUCTION

Sustainable management of agricultural biodiversity is vital to rural development, food security and the environment. *The State of the World's Animal Genetic Resources for Food and Agriculture* (FAO, 2007a) is the first comprehensive global assessment of biodiversity in mammalian and avian livestock species — origins, utilization, distribution and exchange, risk status and threats — and its management — institutions, policy and legal frameworks, and breeding and conservation programmes. Needs and challenges are assessed in the context of forces driving change in livestock production systems. A section on "the state of the art" covers methods for characterization, genetic improvement, economic valuation and conservation.

THE STATE OF THE WORLD REPORTING PROCESS

In 1999, the Commission on Genetic Resources for Food and Agriculture (CGRFA) requested the Food and Agriculture Organization of the United Nations (FAO) to coordinate a country-driven report on *The State of the World's Animal Genetic Resource for Food and Agriculture* (SoW-AnGR). In 2001, FAO invited 188 countries to submit Country Reports on animal genetic resources (AnGR). By the end of 2005, 169 Country Reports had been received. These key resources for the preparation of the SoW-AnGR were complemented by nine reports from international organizations, 12 specially commissioned studies, and by the knowledge and expertise of more than 90 authors and reviewers. FAO's Global Databank for Animal Genetic Resources was the basis for assessment of risk status and trends in AnGR diversity.

KEY FINDINGS

Status of animal genetic resource diversity

Thousands of years of husbandry and selective breeding — along with the effects of natural selection — in diverse ecosystems and societies, have given rise to great diversity among the world's livestock populations. This diversity is a key resource for breeders and livestock keepers. Its value lies not only in current use, but in the options it provides for the future (e.g. in the face of climate change or emerging diseases). A total of 7 616 livestock breeds have been reported to FAO. Among these, 20 percent are classified as at risk, 9 percent are already extinct, and a further 36 percent are of unknown risk status (Figure 1). Breed extinctions continue to occur — 62 were recorded between December 1999 and January 2006.

More than 1 000 breeds can be classified as "transboundary" (present in more than one country) and among these 557 are present in more than one geographic region. The most widespread is the Holstein-Friesian — the ubiquitous black and white dairy cow — present in at least 128 countries. Other widely distributed breeds include Jersey cattle, Large White and Duroc pigs, Suffolk sheep, Saanen goats and Rhode Island Red chickens. As this list suggests, much of the flow of genetic material has been from temperate, industrialized countries to the rest of the world, but there has also been significant exchange among developing countries (Figure 2). For example, Zebu cattle of South Asian origin are of great importance in Latin America.

Threats to animal genetic resources

The rapid changes affecting livestock production systems — driven by surging demand for animal products, changes to the structure of the food processing and retail industries, changing natural environments (including climate change), and technological developments — present a threat to many breeds. Traditional production systems and the associated genetic resources are often being marginalized or transformed as a result *inter alia* of crowding out by large-scale intensive production, changing lifestyles and customs, mechanization and loss of grazing areas. Inappropriate policies (e.g. subsidies favouring large-scale production) and management strategies (e.g. unplanned cross-breeding) contribute to genetic erosion. Acute events such as natural or human-induced disasters, disease epidemics and their control measures are also a threat, particularly to breeds confined to limited geographical areas.

Capacity to manage animal genetic resources

The Country Reports indicate that in many developing countries and countries with economies in transition, technical and institutional capacity to manage AnGR remains weak. Structured breeding programmes are a key means to increase output and product quality, improve productivity and cost efficiency, and support the conservation and sustainable use of specific breeds. However, throughout much of the developing world the impact of such programmes is very limited. Where valuable AnGR are at risk, conservation measures are urgently needed. A number of approaches are available, including a range of *in vivo* methods (zoos, farm parks, protected areas, and support measures for livestock keepers who maintain AnGR in their normal production environments), as well as *in vitro* conservation of genetic material in liquid nitrogen. However, many countries (48 percent) report no *in vivo* conservation schemes. An even greater proportion (63 percent) report that they have no *in vitro* programmes. The situation is variable from region to region. Conservation measures are much more widespread in Europe and the Caucasus and in North America than in other regions. A further important conclusion is that legal and policy frameworks affecting the management of AnGR need to be adapted and strengthened at both national and international levels.

It remains the case that the custodians of much of the world's AnGR diversity are the poor farmers and pastoralists of developing countries. It is vital that the roles and the traditional knowledge of these livestock keepers are not ignored, and that their needs are not neglected.

Accepting global responsibility

Sustainable use, development and conservation of AnGR can make an important contribution to meeting the Millennium Development Goals, in particular Goals One (to eradicate extreme poverty and hunger) and Seven (to ensure environmental sustainability), and to feeding a human population set to rise to 9 billion during the next 40 years. Securing the policies and resources needed to ensure that livestock biodiversity is well managed and remains available for future generations is a global responsibility. The adoption of the *Global Plan of Action for Animal Genetic Resources* and the *Interlaken Declaration* (FAO, 2007b), at a UN Conference in 2007, is a significant step towards addressing these needs and to mainstreaming biodiversity issues into agriculture.

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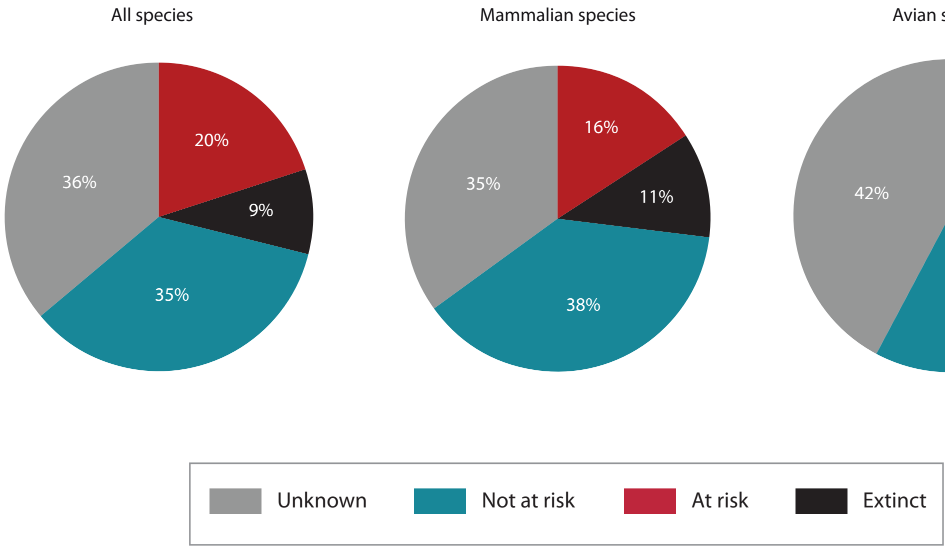

FIGURE 1. Proportion of the world's breeds by risk status category

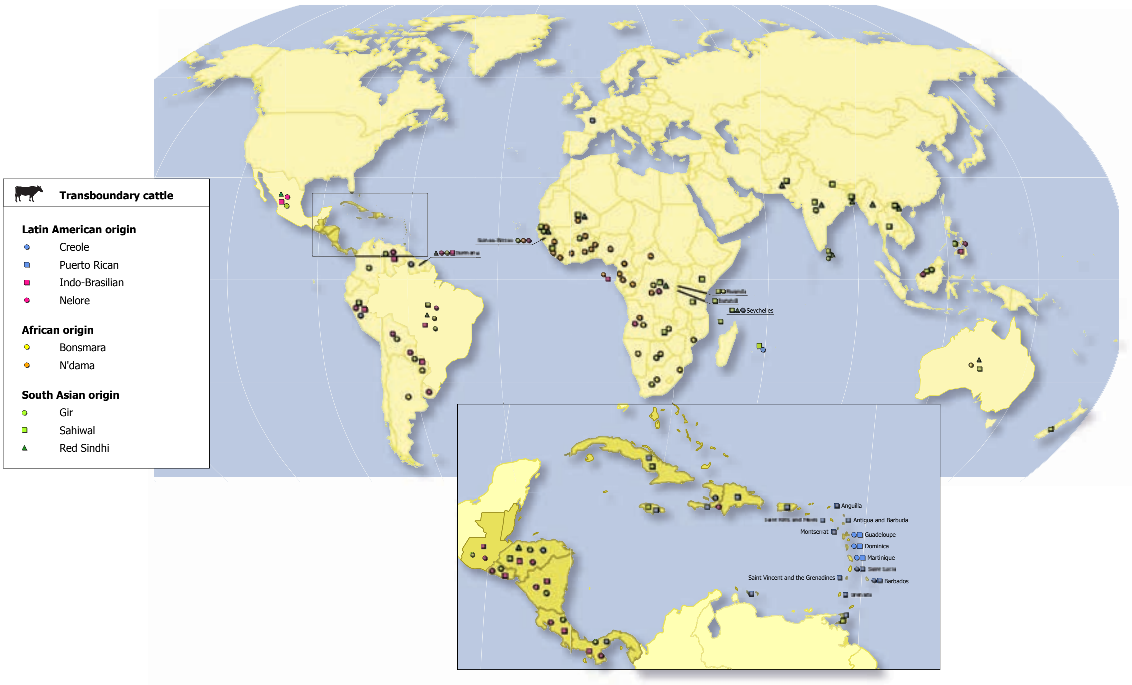

FIGURE 2. Distribution of transboundary cattle breeds with Latin American, African or South Asian origin

28. LIVESTOCK FARMING WITH NATURE

Ilse Köhler-Rollefson*, E. Mathias, H.S. Rathore, P. Vivekanandan, J. Wanyama
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Keywords: Global Plan of Action for Animal Genetic Resources, LIFE-Network, Pastoralism, Value Addition

INTRODUCTION

Pastoralists and other small-scale and indigenous livestock keeping groups and communities play a crucial role in the in-situ conservation of farm animal genetic resources. This is recognized in the Global Plan of Action on Animal Genetic Resources (GPA) which states in its Strategic Priority Action No. 6 that the "*adaptive animal genetic resource management strategies of these communities continue to have economic, cultural and social significance and to be highly relevant to food security in many rural subsistence societies, particularly though not exclusively in dry lands and mountainous regions*" and suggests various actions to support indigenous and local communities, such as (1) *provision of veterinary and extension services, delivery of micro-credit for women in rural areas, appropriate access to natural resources and to the market, resolving land tenure issues, the recognition of cultural practices and values, and adding value to their specialist products,* (2) *the promotion and facilitation of relevant exchange, interaction and dialogue among indigenous and rural communities and scientists and government officials in order to integrate traditional knowledge with scientific approaches,* and (3) *the development of niche markets for products derived from indigenous and local species and breeds.*

THE LIFE-NETWORK

LIFE stands for Local Livestock For Empowerment of Rural People. The LIFE Network originated from the participants of a workshop held in Rajasthan (India) in 2000 that was the first effort to link conservation of local breeds with rural livelihoods (Lokhit Pashu-Palak Sansthan, 2002). It is a learning and advocacy network of non-government organizations (NGOs) and individuals that support collective and community-based conservation of animal genetic resources and endeavour to strengthen rural livelihoods through the development and valorisation of indigenous livestock breeds and species. The main approaches of the LIFE-Network so far have been (1) documentation of indigenous livestock breeds, (2) lobbying and advocacy for Livestock Keepers' Rights, and (3) exploration of value-addition and niche-marketing as sources of additional income for rural livestock keepers (www.lifeinitiatve.net).

LOCAL BREEDS AS FOUNDATION FOR RURAL DEVELOPMENT

Local breeds should not just be saved for the sake of conserving biodiversity per se, but instead form a much better basis for livestock development than introduced or cross-bred animals, because of their many ecological and social advantages.

- They are part of the local agro-ecosystems, representing important links in the web of wild and domestic biodiversity. These eco-systems **depend** on the continued presence of the availability of these breeds, and collapse if they are removed (Köhler-Rollefson and LIFE-Network, 2007).
- Being able to exploit the natural vegetation of their environment and low-grade crop by-products that are high in roughage, local breeds are not dependent on expensive concentrate feed. By contrast, high performance breeds require commercially produced animal feeds that are usually imported and have been transported over long distances, sometimes from other continents, carrying a huge carbon footprint.
- Indigenous breeds have co-evolved with, and adapted to, local disease causing micro-organisms and are thus much less likely to fall prey to sicknesses, thereby reducing the need for veterinary inputs as well as the risk of catastrophic losses.

Local breeds have been developed and owned by local people over many generations and are the product of local knowledge about animal breeding. In stark contrast to the situation with hybrid chicken and hybrid pigs — where farmers have lost their breeding function and have to continuously buy new replacement stock — , the control over the breeding and reproductive processes remains under the control of local people.

The products of local breeds (be it eggs of indigenous chickens, meat of local pigs, or milk of adapted cattle breeds) are often much more popular with consumers than those of industrial livestock because of their better taste. The number of examples of high-value niche-market products developed from local breeds is increasing.

EXAMPLE FOR THE LIFE-APPROACH: SAVING THE CAMEL IN RAJASTHAN THROUGH HERDERS' CAPACITY-BUILDING AND VALUE-ADDITION

Camel husbandry is an ingenious way of converting the scattered and seasonally varying vegetation of the Thar Desert into animal protein and energy. But with the emphasis given by the government on irrigation agriculture, and the availability of motorized transport, camels came to be seen as backwards, and even as a threat by farmers. As a consequence, the camel population of Rajasthan dwindled by almost 50% and this important component of Indian biodiversity appeared threatened.

But camels can also provide a huge range of products that fill modern consumer needs. Examples include ethnic rugs from camel hair, chairs from camel leather, jewellery and inlaid furniture from camel bone, as well as camel safaris to experience desert romance. With the help of the Rajasthan based NGO Lokhit Pashu-Palak Sansthan (LPPS), the camel breeders of the Thar Desert are now seeking to realise this economic potential. Current efforts are focusing on value-addition to camel milk. Camel milk is different from cow's and buffalo milk, in a very healthy way: it contains enzymes with anti-bacterial and anti-viral properties, which help to fight diseases. It has been used traditionally to cure tuberculosis and typhoid, and also contains an insulin-like substance that reduces blood sugar levels in diabetes patients.

Awareness-raising and education of consumers about the beneficial effects of camel milk has established demand for fresh camel milk by 35 Diabetes patients in Jaisalmer. Low calorie ice cream is also made from camel milk and in demand by both Indian and foreign tourists.

CONCLUSIONS

Local breeds have the potential to serve as foundation for socially sustainable livestock development that is attuned to local environmental conditions and has beneficial linkages with local ecologies and cultures. In order to utilize this potential, there needs to be a paradigm shift in livestock development towards organisational strengthening of livestock keepers and support for value-addition and niche-marketing. Besides invigorating regional economies and reducing rural-urban migration, such an approach would contribute to the sustainable use of both domestic and wild biodiversity, reduce problems of desertification, and have positive impact on climate change by reducing the need for transporting animal feeds around the globe.

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Contribute to Saving
Rajasthan's Camel Herds
Camel Milk Ice
a healthy treat by:
Lokhit Pashupalak
JAISALMER (Raj.) Tel.:
e-mail: camelherds


Desert Health Food...
Camel Milk Ice Cream
LOKHIT PASHU PALAK SANSTHAN
JAISALMER (RAJ.) PH.: 02992 250652

29. A NETWORK FOR POLLINATOR INFORMATION AND EXPERTISE IN THE WESTERN HEMISPHERE

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Keywords: pollination, pollinators, IABIN, bioinformatics, taxonomy

THE PROBLEM FOR POLLINATORS

Pollinators provide an essential ecological service to over 90 percent of the world's wild and cultivated flowering plants and an estimated one-third of the food consumed by humans. There is a positive correlation between plant diversity and pollinator diversity. Recent studies in Europe and the Americas have concluded that rapid declines are evident in some very important pollinator populations including honey bees (*Apis mellifera*). While declines are suspected in populations of many other species of pollinators, in many cases, data and experts are not available to test this hypothesis. The successful monitoring, management, and conservation of pollinators will depend on the availability and accessibility of pollinator data and information. In 2002, the Conference of the Parties to the Convention on Biological Diversity (CBD) invited "Parties and other Governments, and relevant organizations to contribute to the implementation of the International Pollinators Initiative," which promotes "coordinated action worldwide to monitor pollinator decline, its causes and its impact on pollination services; [and] addresses the lack of taxonomic information on pollinators" (COP Decision IV/5 2002).

BUILDING A HEMISPHERIC NETWORK

The Inter-American Biodiversity Information Network (IABIN) Pollinators Thematic Network (PTN), one of five thematic networks of the IABIN, was initiated in May 2006 with $180,000 in funding from the World Bank. A considerable amount of matching and in-kind funds have also been raised. The network will address the needs and information gaps identified by the CBD, and by the pollinator research and conservation communities through a questionnaire administered in 2006-07. Coordinated by the Coevolution Institute, the PTN is being developed by a consortium of organizations consisting of the University of São Paulo (Laboratory of Agricultural Automation and Bee Laboratory), the Integrated Taxonomic Information System, and the National Biological Information Infrastructure (NBII) of the United States Geological Survey.

In December 2006, a joint workshop was held in collaboration with the Global Biodiversity Information Facility (GBIF) and with expert participation from the pollinator research and conservation communities, including from the Food and Agriculture Organization of the United Nations (FAO), the Reference Center on Environmental Information (CRIA) in Brazil, the National Biodiversity Institute (INBIO) in Costa Rica, the American Museum of Natural History, and others. The workshop participants worked together to design the PTN Architecture, plan the network's development and identify user needs, data availability, and data standards for pollinator information collection, exchange, and management.

MAKING POLLINATOR DATA AND INFORMATION AVAILABLE

Recognizing the contributions of the GBIF to making pollinator specimen and observation data widely and freely available, the PTN will cooperate with GBIF to make the data available through the GBIF portal. Where necessary, the PTN will provide data hosting services to pollinator data owners. The PTN will also work to implement standards and develop tools for the management and dissemination of pollinator observation data.

The first of many tools planned for development by the PTN, the Pollinator Experts Database will provide access to experts in pollinator species biology, ecology, taxonomy, research, habitats, and other related aspects. This and other products of the PTN will be made widely and freely available via the Internet.

To support the continued growth of the IABIN PTN, the University of São Paulo developed an intranet portal and listserv that is hosted by the Foundation for Research Support of the State of São Paulo (FAPESP) online at <http://pollinators.incubadora.fapesp.br/portal>. The NBII developed and hosts the PTN Web site at <http://pollinators.iabin.net>. Through these and other tools the PTN will facilitate communication and collaboration among international pollinator information owners.

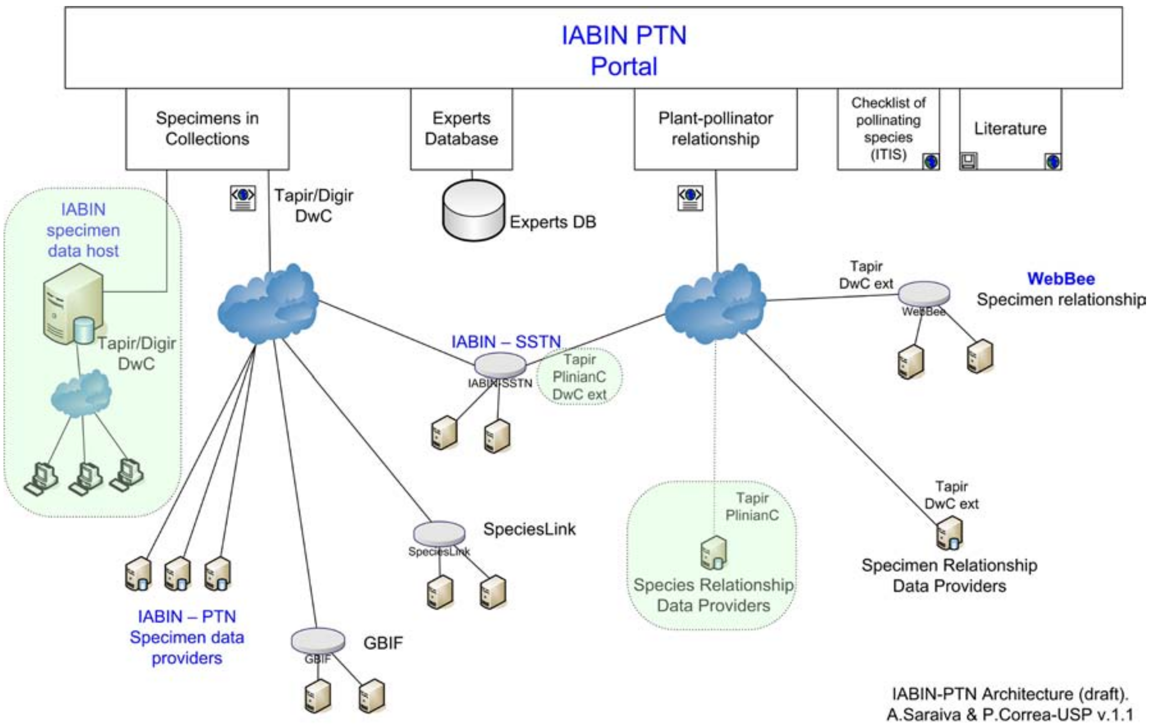

FIGURE 1. PTN Architecture

30. SUPPORTING POLLINATOR CONSERVATION WITH INTEGRATED TAXONOMIC KNOWLEDGE: A GBIF CAMPAIGN

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Keywords: pollination, pollinators, GBIF, bioinformatics, taxonomy

POLLINATION IS A CRITICAL ECOSYTEM SERVICE THAT IS THREATENED GLOBALLY

At least one-third of the world's major food crops are pollinated by animals. Of the world's 250,000 described species of flowering plants, 75% are pollinated by animals. Bees are by far the most dominant pollinator group (about 20,000 described species), although other insects, birds, mammals, and reptiles are also important. The annual monetary value of pollination services in global agriculture could be as high as $200 billion p.a. and 75% of the world's leading fruit, vegetable, and seed crops are dependent on animal pollination. Klein et al. (2007) reviewed the importance of pollinators for food security, using data from 200 countries. Recent reports of Colony Collapse Disorder in honey bees in the United States have placed pollinators on the front pages of newspapers and on the evening news. This has resulted in calls for legislation and funding to support both honey bee and wild pollinator conservation and research. The public and politicians have made the connection between pollinators and food supply as well as pollinators and floristic biodiversity. Regional pollinator initiatives are underway in the Americas, Europe, Africa, and Oceania. The Food and Agriculture Organization of the United Nations (FAO) is coordinating a project that will develop good agricultural practices for managing pollination services provided by wild biodiversity in countries of Asia, Africa, and South America.

APPLYING TAXONOMIC KNOWLEDGE TO THE PROBLEM

The Global Biodiversity Information Facility (GBIF) has incubated and endorsed a global campaign that will help increase the amount of and provide easier access to taxonomic information on pollinators. Initial work will focus on bees, birds, and bats; other pollinator groups (e.g., wasps, moths, butterflies, flies, and beetles) will be added later. Five major information products are proposed.

A World Checklist of Bees and other Pollinating Species

Global taxonomic checklists will be developed and maintained for bees and other pollinating species. The lists will include currently accepted names, synonyms and common names. This will provide a taxonomic "Rosetta Stone" to enhance communication about the many thousands of pollinators. An Internet-based tool will be developed to allow the world taxonomic community to assist in the continued maintenance of the checklists (see Figure 1).

Searchable Digitized Records from Major Bee Collections and Observation Programs

Several collections (containing about 1.5 million specimens) have been identified for high priority funding that will enable their data to be digitized and made available to internet search programs. For the remaining several million records, an aggressive approach will be taken to find additional sponsors. In addition, there are many local and regional species observation and recording programs that can provide useful data and links are being sought with major data-gathering projects.

Information on Plant and Pollinator Associations

Information on pollination interactions has been identified as highly desirable content for agricultural and conservation applications. Through collaboration with several international organizations, data structures, tools and standards are being developed to handle species interaction data that is critical for pollination management.

Pollinator Identification Capability

The ability to identify bee species correctly is a necessary first step for optimal pollinator management and conservation. Content needed for development of keys, including electronic interactive keys, and other means of species identification, such as images (e.g., e-types) and genetic barcodes, can also be developed and linked. The campaign will work directly with producers of identification keys to make this information available through the Internet. The campaign will also collaborate with the Consortium for the Barcode of Life, Canadian Barcode of Life Network, and others on a developing Bee Barcode Initiative and other pollinator bar code databases.

Status and Trends of Pollinators

Knowledge of the status and trends of pollinator populations from local to global scales has been identified as a priority need in most major assessments regarding pollinators. Data from observation and monitoring programs will be made available for use by others to analyze and predict species distribution and population dynamics and to develop pollinator species vulnerability information at local, regional, continental, and global scales.

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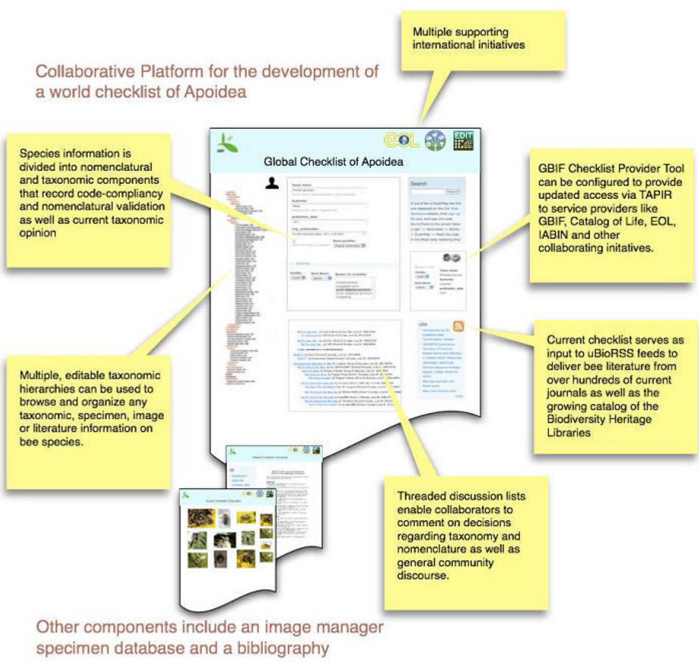
FIGURE 1. A PROPOSED COLLABORATIVE PLATFORM GLOBAL SPECIES CHECKLISTS



31. DOMESTIC ANIMAL DIVERSITY INFORMATION SYSTEM — A CLEARING HOUSE MECHANISM

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Keywords: inventory, monitoring, information system, animal genetic resources, livestock

INTRODUCTION

The Domestic Animal Diversity Information System (DAD-IS) developed by the Food and Agriculture Organization of the United Nations (FAO) is a multilingual, dynamic database driven Web-based communication and information tool based at http://www.fao.org/dad-is. Since the mid 1990s, DAD-IS has been recognized as a clearing house mechanism and early warning tool for animal genetic resources for food and agriculture (AnGR) by the Convention on Biological Diversity (CBD). The recently adopted *Global Plan of Action for Animal Genetic Resources* (FAO, 2007a), the first agreed international framework for the management of AnGR, calls on FAO to continue to develop DAD-IS to strengthen these roles.

DAD-IS contains a wide range of information on AnGR. It not only provides countries' National Coordinators for the Management of Animal Genetic Resources (NCs) for AnGR with a means to manage and disseminate data, but also offers governments, international agencies, NGOs, universities and research organizations access to information that can strengthen their activities in AnGR management. Information drawn from DAD-IS was utilized during the preparation of *The State of the World's Animal Genetic Resources for Food and Agriculture* (FAO, 2007b), a report which provides a global assessment of the state of livestock diversity. The information contained in DAD-IS is available to the general public via the Internet. It has been accessed by users from more than 100 countries.

DAD-IS is the centre of an expandable global network of national and regional information systems, which facilitates the coordination of national, regional and global efforts in AnGR management, while allowing scope for national or regional specificities in the management and dissemination of information (Figure 1). At the time of writing, one regional (EFABIS at http://efabis.tzv.fal.de) and twelve national systems (Austria, Cyprus, Georgia, Estonia, Ireland, Italy, Netherlands, Poland, Slovakia, Slovenia, Switzerland and the United Kingdom) had been established and linked to DAD-IS. Thus, Europe serves as a pilot for other regions of the world.

HOW WAS DAD-IS DEVELOPED?

The AnGR Group at FAO began work on the development of a database driven dynamic global Web-based information system for AnGR in 1993. In 1996, the first version of DAD-IS was launched. An improved multilingual version (DAD-IS:2) followed in 1998. These developments were influenced by the earlier work of the European Association for Animal Production (EAAP), which had already established a breed database for Europe known as EAAP-AGDB (Animal Genetic Data Bank). The latter system, which also became accessible online, comprised textual breed descriptions as well as numerical data (particularly annual figures for breed population size and structure).

FAO's global system had to meet the needs of a broader group of countries than were served by EAAP-AGDB. Moreover, the entry into force of the CBD which enshrines countries' sovereignty over their genetic resources meant that it was necessary to allow countries to manage their own data. The information in DAD-IS was therefore organized on the basis of country-level breed populations rather than breeds. These developments meant that the two systems were incompatible and unable to exchange data. European NCs had to enter their national data into both systems. Furthermore, both systems had aged and became progressively more difficult to maintain and to develop further.

To address this situation, the European Farm Animal Biodiversity Information System (EFABIS) Project funded by the European Commission created a network of information systems under the Open Source Model, based on merger and redevelopment of the two existing systems. This process has provided greater functionality and opened the way for further development. As a direct result of the project, in addition to the establishment of the regional European Farm Animal Biodiversity Information System (EFABIS) and the above-mentioned national systems, DAD-IS:3 was launched in March 2007 as an improved, more a user-friendly version of the DAD-IS system.

WHAT DOES DAD-IS OFFER USERS?

DAD-IS provides access to information on 14 000 national breed populations, representing 37 species and 181 countries. It features data on breed characteristics, performance-related statistics, and population size, structure and trends. It also includes more than 4 000 high-quality images. NCs take full responsibility for maintaining data quality and quantity. Contact details of NCs are listed, so that users can seek further information about a particular breed if they wish to do so. DAD-IS also provides users with up-to-date news on AnGR management and an extensive library of full text publications and links to other Web resources. The new version of DAD-IS is characterized by more user-friendly interfaces. It has a multilingual interface and content; it is currently available in English, Spanish and French (Arabic, Chinese and Russian are in preparation). Users can switch languages according their needs. Search functions allow users easily to locate breed information and publications within the system. Another important aspect of the improvements made to DAD-IS is the provision of new reporting and analytical tools. These include a set of tools designed especially for NCs, with which they can identify gaps in their national data sets. Reporting tools such as a cross-table generator allow users to get quick customized data overviews. Figure 2 shows some screenshots taken from the DAD-IS.

WHAT IS THE FUTURE FOR DAD-IS?

DAD-IS has for many years facilitated global and regional analysis of the status and trends of livestock diversity. It has been periodically reviewed and updated. Comments provided by the DAD-IS users are essential in this context. These voices have often resulted in the development of new features such as the cross-table generator, or provided breed-related success stories from around the world. However, much remains to be done, not only to increase data quality and quantity and provide a more complete picture of breed diversity and trends (the work of NCs), but also the ongoing maintenance and further development of the system. Increasing the effectiveness/efficiency of the system is essential. The DAD-IS of the future may integrate additional features such as a georeferencing function to link breeds to geographic locations and allow overlays such as climatic and environmental conditions. Such a georeferencing tool could greatly contribute to improving inventory and monitoring at national, regional and global levels and facilitate better utilization of AnGR. Needless to say, assisting interested countries with the installation, development and customization of the system are important tasks for FAO.

In the future, DAD-IS may have new features, but its role as a global communication tool and clearing-house mechanism for AnGR management will remain as important as it is today.

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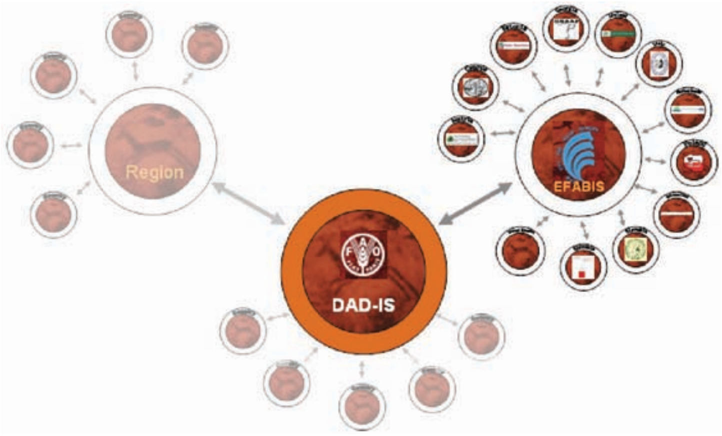


DAD-IS (http://www.fao.org/dad-is)

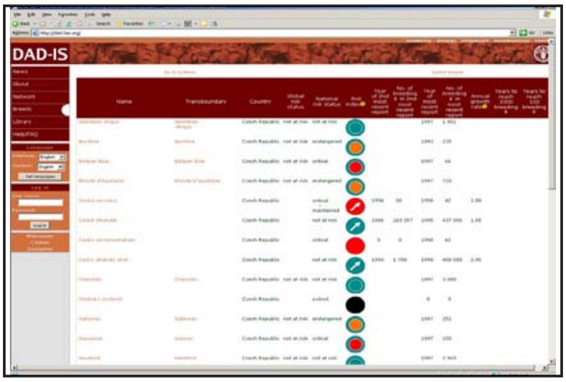
EFABIS (http://efabis.tzv.fal.de)

- **Austria** (http://efabis.raumberg-gumpenstein.at)
- **Cyprus** (http://efabis.ari.gov.cy)
- **Estonia** (http://efabis.vet.agri.ee)
- **Georgia** (http://efabis-georgia.ge)
- **Ireland** (http://efabis.gov.ie)
- **Italy** (http://85.35.185.58)
- **Netherlands** (http://efabis_nl.cgn.wur.nl)
- **Poland** (http://efabis.izoo.krakow.pl)
- **Switzerland** (http://efabis.ch)
- **Slovakia** (http://efabis-sk.scpv.sk)
- **Slovenia** (http://efabis_si.bfro.uni-lj.si)
- **United Kingdom** (http://efabis-uk.adas.co.uk)

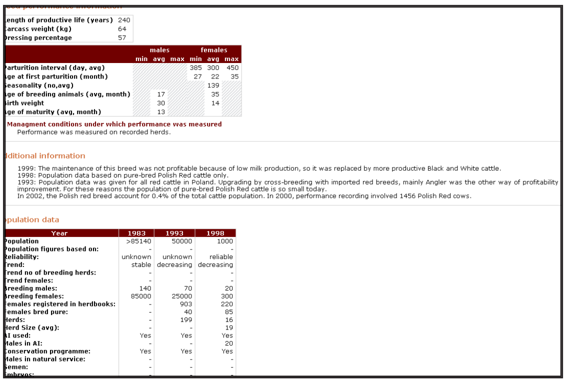
FIGURE 1: Structure of the global network

News (DAD-IS top page)

Early Warning Tool



Breed Data Sheet



Cross-table generator (Analytical tool)

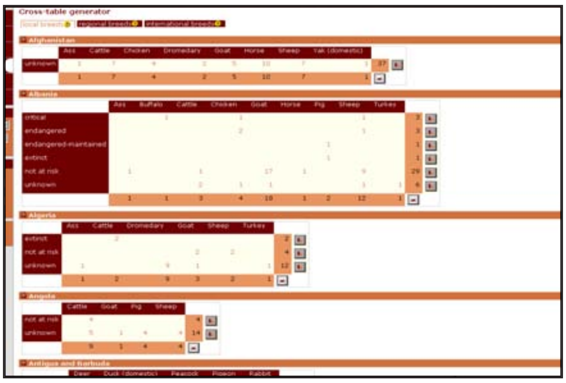
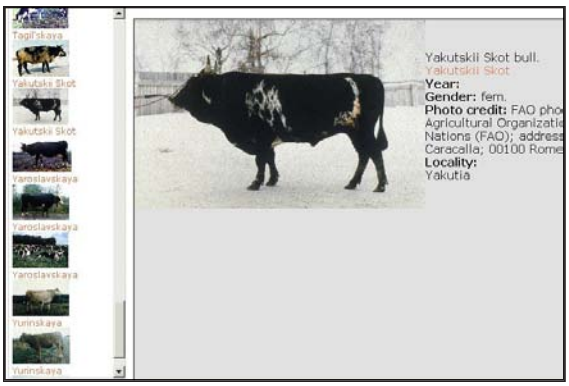


Image Browser



Library

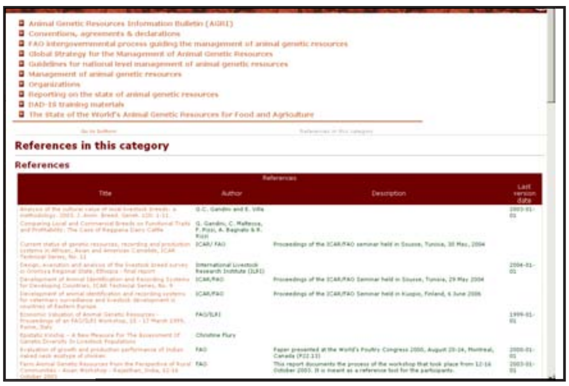


FIGURE 2: Domestic Animal Diversity Information System

32. BIODIVERSITY CONSERVATION AND AGRICULTURAL SUSTAINABILITY: TOWARDS A NEW PARADIGM OF 'ECOAGRICULTURE' LANDSCAPES

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Keywords: Ecoagriculture, landscape, biodiversity conservation, agricultural production

ABSTRACT

The dominant late 20th century model of land use, which assumed and promoted the strict segregation of agricultural production from areas managed for biodiversity conservation, is no longer adequate for ensuring conservation in much of the world. The Millennium Ecosystem Assessment confirmed that the extensification and intensification of agriculture have dramatically increased the ecological footprint of crop, livestock, fishery and forest production. Moreover, rural communities themselves depend for sustainable production and livelihoods on key components of biodiversity and ecosystem services that are found in non-domestic habitats. Conservation of much of the world's biodiversity will necessarily take place in or around agricultural regions.

Fortunately, a growing body of research suggests that agricultural landscapes can be designed and managed to host wild biodiversity of many types (though not all), with neutral or even positive effects on agricultural production and livelihoods, through innovations in farming systems and in the spatial layout and management of natural areas within agricultural landscapes. Innovative practitioners and scientists, as well as indigenous land managers, are adapting, designing and managing diverse types of "ecoagriculture" landscapes to generate positive co-benefits for wild biodiversity, production and local people. This paper synthesizes the results of a large number of sectoral review papers and case studies to assess the state of knowledge of ecoagriculture. We assess the potentials and limitations for successful conservation of biodiversity in productive agricultural landscapes, the feasibility of making such approaches financially viable, and the organizational, governance and policy frameworks needed to enable ecoagriculture planning and implementation at a globally significant scale. We conclude that effectively conserving wild biodiversity in agricultural landscapes will require significantly scaled-up action, through targeted research, policies coordinated across sectors, and strategic support to agricultural communities and local conservationists actively seeking to reconcile livelihood needs and biodiversity conservation.

33. NEED FOR MONITORING SOIL BIODIVERSITY IN ARABLE LAND

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Keywords: indicators, land-use change, climate change, long-term field experiment

REQUIREMENTS AND APPROACHES FOR MONITORING SOIL BIODIVERSITY

Soil biodiversity is functionally relevant for the course and control of important soil processes (overview in Bardgett et al. 2005), the formation of characteristic soil properties and the provision of ecosystem goods and services (Lavelle et al. 2006; Wall 2004). Monitoring measures of soil biodiversity on selected sites provide information on the current state or the modification of soils. These results may be used in modelling for prediction purposes of future soil developments. Particularly, monitoring of soil biodiversity related to land-use and soil threat is important concerning the overall aim of soil protection and also under the aspects of climate change. Furthermore, legal and contractual obligations require monitoring measures in many cases. Overall, monitoring soil biodiversity contributes to decision-making for achieving the 2010 biodiversity target of the CBD to reduce biodiversity losses and meets the requirements of biodiversity conservation, soil protection, ecosystem maintenance and human well-being.

Soil biodiversity is a vital part of the associated biodiversity within the agricultural biodiversity. As recently shown in a compilation of more than 140 scientific projects related to agricultural biodiversity in Germany (Weigel and Schrader 2007) from the Federal Research Centres in the portfolio of the Federal Ministry of Nutrition, Agriculture and Consumer Protection (BMELV), soil biodiversity research activities are not very well represented. In contrast to agricultural biodiversity in the context of, for instance, genetical resources for animal breeding and plant cultivation, there is still strong need for raising and increasing public awareness to acknowledge the importance of soil biodiversity for ecosystem functioning. The application of sustainable management systems is imperative for soil biodiversity conservation to rehabilitate, maintain and improve soil processes and below-ground-above-ground-interactions.

Monitoring soil biodiversity aims at the investigation of functional relevant site properties in the context of soil forming processes. For this purpose indicator species, which play a key role in the soil system, have to be identified out of the whole soil biodiversity to determine and interpret current conditions or modifications in the soil system. In cases of process related issues it is useful to sum up species within functional groups. In land-use systems soil biodiversity is normally monitored on selected plots at representative sampling sites. Sampling may be carried out as a single comparative event or repeatedly following a chronological sequence. The conditions for data evaluation and interpretation of both procedures can be improved when the sampling design considers a spatial grid of defined sampling sites. Three topics are given here to demonstrate the need for monitoring soil biodiversity in arable land:

- Soil biodiversity after land-use change
- Soil biodiversity under climate change
- Soil biodiversity in long-term field experiments

SOIL BIODIVERSITY AFTER LAND-USE CHANGE

Monitoring measures along with land-use change are an important tool to recording modifications of soil properties and processes in the context of precautionary soil protection. In rural environments monitoring soil biodiversity is essential during reclamation of former mining areas, in case of set-aside programmes of arable land as well as in connection with conversions from conventional to conservation tillage or even direct-drill and from conventional to organic farming. With respect to climate change mitigation measures, land-use change from food production to energy production (e.g. biofuels) is becoming an emerging issue in agriculture for the near future. In all cases of management conversions, far reaching changes in soil biodiversity and its functional role can be anticipated.

SOIL BIODIVERSITY UNDER CLIMATE CHANGE

According to present knowledge, the dynamic of biodiversity issues and climate change are directly linked. Chemical changes in the atmosphere due to green house gases modify matter input into soil while extreme weather events modify the water regime. For example, modifications of the community structures of soil microorganisms and soil fauna may be the consequence of changed quality and quantity of rhizodepositions and crop residue input as well as changed soil water conditions. Furthermore, changes in seasonal temperature variations directly influence biological activity. Limits of variability and adaptability across different scales of genotype, species composition, population size and ecosystem functions may cause loss of biodiversity. Monitoring measures in manipulative field experiments and agro-ecosystem modelling are suitable tools to improve our understanding of complex feedback loops during coming climate scenarios.

SOIL BIODIVERSITY IN LONG-TERM FIELD EXPERIMENTS

Long-term field experiments are conducted mostly for several decades, at least more than ten years. They are indispensable sources of knowledge and are extremely worth both scientifically and practically in terms of different land-use scenarios. Their main value is a comprehensive database obtained by long-time monitoring which provides the possibility of present assessments in view of future developments. Soil biodiversity monitoring in long-term field experiments describes the current state of soil functioning, indicates changes in soil processes and serves as an early warning system for emerging soil threats. A soil biodiversity database helps to identify new indicators, to determine structural and functional diversity and to characterize stress limits and regeneration capabilities.

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34. GOOD PRACTICES *IN SITU* AND ON-FARM: CONSERVATION AND USE OF CULTIVATED AND WILD FRUIT DIVERSITY IN CENTRAL ASIA

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Keywords: Traditional fruit crop varieties, wild fruit species, in-situ and on-farm conservation and use

INTRODUCTION

Central Asia is one of the five most important centres of origin of cultivated plants, and the richest in specific and intraspecific diversity for many globally important agricultural crops. Plant species in the region number 8,100; 890 of which are endemic. About 400 of them are listed in the IUCN "Red Data Book" as endangered. Particularly important crops in Central Asia are the temperate fruit species. Apple (*Malus domestica*), apricot (*Armeniaca vulgaris*), peach (*Persica vulgaris*), pear (*Pyrus communis*), plum (*Prunus domestica*), grape (*Vitis vinifera*), almond (*Amygdalus communis*), pistachio (*Pistacia vera*), pomegranate (*Punica granatum*), and fig (*Ficus carica*) are among the best known crops cultivated in the region where, over the course of several centuries, the diverse natural and climatic conditions have helped farmers produce varieties adaptable to drought and resistant to a number of environmental stress factors. These locally-developed traditional varieties have been shown to be essential components of crop production in difficult environments. Wild apple (*Malus* spp.), wild pear (*Pyrus* spp.), wild plum (*Prunus* spp.), wild almond (*Amygdalus* spp.), wild pomegranate (*Punica granatum*), wild grape (*Vitis* sp.), and other wild relatives of fruit crops still grow in forests throughout the region. Many of them are used as rootstocks. Their resistance to biotic pressures — insects and disease — make them valuable genetic resources for reducing crop vulnerability on-farm and providing genetic material for crop improvement. Many of these species are also important nutritional resources for local people.

Due to the collapse of the Soviet Union and the transition from a centralized economy to a market-driven one, the Central Asian countries — Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan — face serious development problems. These include food insecurity, poverty, and degradation of the environment. Issues of food security and poverty are driving agricultural development with consequent loss of biodiversity. Overgrazing, deforestation, logging and industrialization in the wild, and use of uniform high-yield varieties, chemical fertilizers and pesticides, and increased mechanization in home gardens and on small farms result in the loss of traditional diversity-based farming systems, the degradation of arable lands, pollution and genetic erosion. Legal and policy frameworks in the region that address biodiversity conservation do not adequately support the conservation of fruit species. Farmer and research knowledge about wild and cultivated fruit genetic resources is dispersed, fragmented and out of date. Linkages within and between stakeholder groups are weak.

A project supported by the United National Environment Programme (UNEP) and coordinated by Bioversity International aims to address these obstacles. Global benefits of the project are the conservation of globally significant fruit species varieties and their wild relatives, and development of models (good practices) for their conservation and sustainable use that can be applied both within and outside the five project countries.

GOOD PRACTICES

A good practice, in genetic diversity terms, is defined as a system, organization or process, that over time and space maintains, enhances and creates crop genetic diversity and ensures its availability to and from farmers and other actors for improved livelihoods on a sustainable basis. It could encompass:

- Improving local genetic material through traditional and participatory plant breeding

- Increasing the demand for local genetic resources in local and national markets through increased recognition of nutritional, agronomic/adaptive and quality traits that they may possess
- Providing information and access to genetic materials for farmers and forest dwellers
- Increasing the value of the sustainable management of forest species/wild relatives of target crops, through sustainable harvesting, minimal silvi-agricultural practices and public awareness
- Providing benefit sharing and empowering mechanisms to farming and forest communities and national and local institutions

KNOWLEDGE BASE AND LOCAL, NATIONAL AND REGIONAL CAPACITY

Approaches to the conservation and management of genetic diversity for longer lived perennial species, such as fruit species, have received inadequate attention. Methodologies have focused primarily on the maintenance of annual crops in agroecosystems, and the maintenance of forest stands in natural ecosystems. Understanding the extent and distribution of the diversity of fruit crops and their wild relatives, and existing systems for their use and maintenance, is the first step toward establishing the basis for project implementation. This information is derived not only from the documentation and collections held at scientific institutes, but also from farmers and local communities who can contribute knowledge about the resource, documentation on characteristics and distributions, and sustainability of use. Providing improved knowledge in conservation and sustainably use of fruit species genetic diversity which includes farmer information on distinguishing varieties and particular adaptive and qualitative variety traits together with good practices, will improve resilience to variable *in situ*/on-farm environment conditions and help to strengthen national agricultural economies and eradicate poverty in the region. Strengthened policies and legislation will support farmers and local communities in conserving local varieties of fruit crops and their wild relatives.

CONSERVATION IMPACT

The temperate fruit species of Central Asia represent a wealth of genetic diversity, with varieties developed on-farm, and promising forms selected in the wild over the course of centuries. The outcome of this project will be the conservation and sustainable use of horticultural crops and wild fruit species genetic diversity in Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan. Local varieties of horticultural crops and wild fruit species will be conserved *in situ*/on farm through the enhanced capacity of stakeholder groups including policy-makers, researchers, agricultural extension workers, farmers and their associations, local communities, and NGOs. Land area contributing to the conservation and sustainable use of temperate fruit genetic resources will be increased and ecosystem services will be enhanced from sustainable managed forest and agricultural production systems.

FIGURE 1. Grapevine.

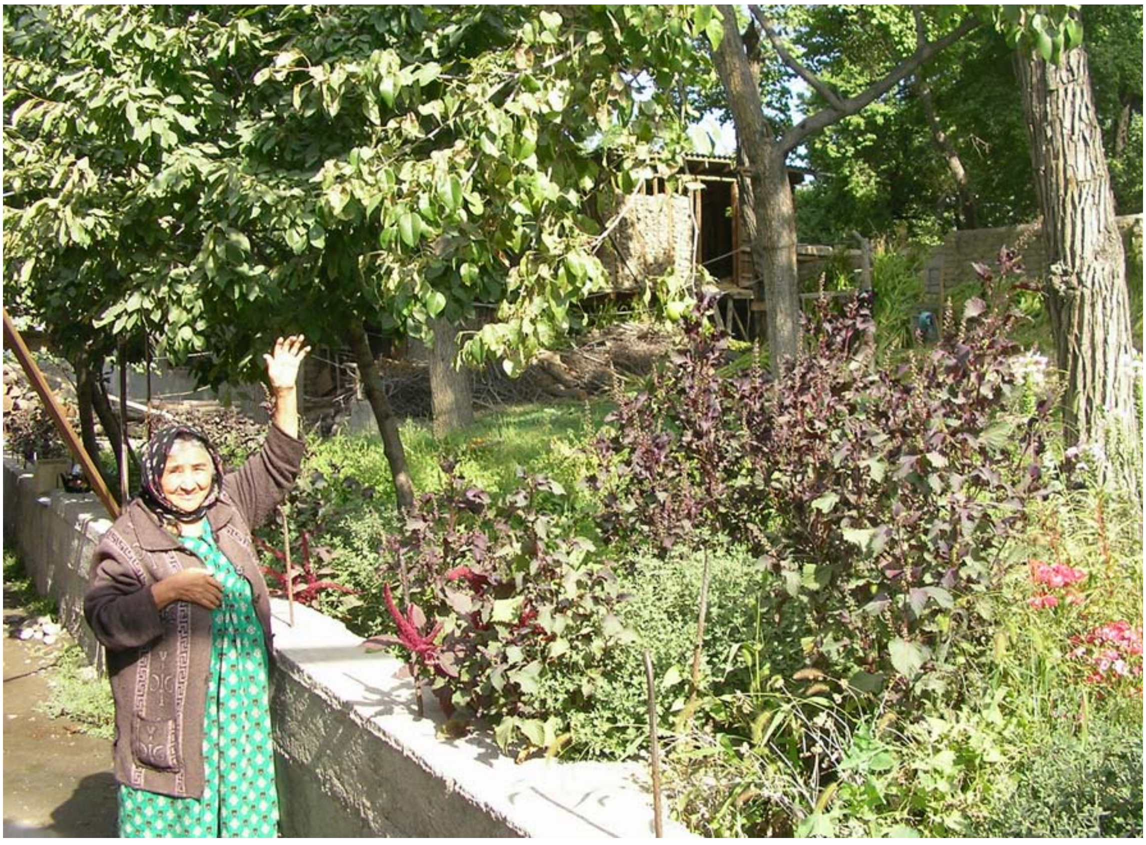

FIGURE 2. Woman with apple tree.

35. CONSERVACION Y USO SOSTENIDO DE LAS VARIEDADES NATIVAS DE PAPA EN CAJAMARCA — PERÚ

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Palabras clave: agrobiodiversidad, conservación in situ, papas nativas, tecnologías tradicionales, Perú

INTRODUCCION

La palabra Papa es de origen quechua y significa "tubérculo". En los andes del Perú se encuentran más de 2.000 de las 3.800 variedades de papas que existen; aunque la mayoría de investigadores coinciden que el centro de origen de la papa (*Solanum sp.*), se encuentra en la región de Lago Titicaca, los andes del norte conservan también variedades de papas silvestres y cultivadas, material genético que ha sido conservado hace muchos años por los campesinos en los andes.

El Centro IDEAS-Cajamarca ha desarrollado una experiencia de más de 15 años en conservación y uso sostenible de la agrobiodiversidad en la Provincia de San Marcos, Cajamarca — Perú; formando a más de 60 agricultores conservadores de variedades de papas nativas, y promoviéndola como una estrategia de desarrollo económico local.

El trabajo ha conseguido la propagación, difusión, valoración y el reconocimiento de las papas nativas existentes en la zona, muchas de las cuales estuvieron a punto de perderse en el lugar. Además de las distintas formas, sabores y material genético, se ha recuperado también el rico bagaje de conocimientos, ritos y tradiciones que han desarrollado por años los campesinos en torno al cultivo de papa.

Los objetivos del trabajo realizado han sido los siguientes:

- Rescate, revaloración y uso sostenido de las variedades nativas de papa
- Promoción de estrategias de conservación de variedades de papa nativa
- Promoción de experiencias de transformación y comercialización de papas nativas

METODOLOGIA

En todo momento se han utilizado metodologías dinámicas y participativas durante los eventos de capacitación, intercambio de experiencias y pasantías, destacando el Desarrollo Participativo de Tecnologías (DPT), la transferencia de conocimientos de Campesino a Campesino (CC), y la Investigación Participativa. Los productores han sido parte y dueños de los resultados de este proceso de rescate, valoración, conservación y uso sostenido de las variedades de papa nativa.

La estrategia utilizada por el Centro IDEAS-Cajamarca para promover la conservación y el uso sostenido de variedades de papa nativa, consiste en la implementación de las siguientes técnicas:

Técnicas para mejorar la Producción de Papas Nativas

Se han implementado parcelas agroecológicas incluyendo prácticas físicas de conservación de suelos, asociación y rotación de cultivos con tubérculos andinos tales como oca (*Oxalis tuberosa*), olluco (*Ullucus tuberosus*) y mashua (*Tropaeolum tuberosum*), así como haba (*Vicia faba*) y shayuas de chocho (*Lupinus mutabilis*) en el contorno (bloque cultivado) para evitar el ataque de plagas como el gorgojo de los andes (*Premnotrypes spp.*). Se ha producido orgánicamente, incorporando abonos orgánicos y practicando el Manejo Integrado de Plagas y Enfermedades. Los Concursos de Parcelas Agroecológicas, han motivado la recuperación de semillas de las variedades que ya las estaban perdiendo, y se han recuperado y revalorado tecnologías tradicionales de producción, almacenamiento, transformación y uso de las variedades, tales como el majadeo, la elaboración de papa seca, chifles, guisos, sopas, etc.

Técnicas de Investigación:

Se ha investigado tanto participativamente como utilizando el conocimiento científico: se implementaron experimentos campesinos utilizando el Desarrollo Participativo de Tecnologías (DPT), para determinar los rendimientos de las variedades promisorias, control de plagas y enfermedades, sistemas de abonamiento y uso adecuado de las variedades nativas de papa de acuerdo a los conocimientos tradicionales rescatados; por el método tradicional se han caracterizado fenológicamente 120 variedades de papa nativa durante dos años.

Técnicas de Motivación:

Los participantes resultaron efectivamente motivados a conservar variedades de papas nativas a través de su participación en Ferias de agrobiodiversidad (agropecuarias y agroindustriales) y Festivales de Papas Nativas. Se realizaron concursos de Variabilidad de Papas Nativas entre los agricultores conservadores de los caseríos y concursos de Platos Típicos elaborados por las mujeres conservacionistas. Se realizaron además Talleres de Equivalencias e Intercambio de Semillas con la finalidad de homogenizar nombres y criterios de clasificación. Los agricultores conservacionistas explicaron y expresaron las razones del nombre de las variedades nativas, identificando el equivalente de su variedad en las otras comunidades.

Técnicas de Promoción

Se utilizó la transformación de Papas Nativas, dándose valor agregado a las variedades elaborando papa seca de colores, chifles de colores y pure de papa amarilla. Estos productos fueron promocionados y comercializados en Ferias de Productos Ecológicos y Ferias Agropecuarias a distintos niveles, lográndose aceptación del público consumidor.

RESULTADOS

- 30 agricultores dedicados a la conservación de variedades de papa nativa en la Provincia de San Marcos
- 280 variedades de papa nativa conservadas en Shitamalca, 125 variedades en Muyoc, 80 variedades en Chucsen.
- 120 variedades de papa nativa caracterizada en Shitamalca
- 40 platos típicos elaborados en base a variedades de papa nativa inventariados.
- Investigación participativa en sistemas de producción, abonamiento, almacenamiento, transformación y comercialización para mejorar la gestión de las variedades de papa nativa.
- Inventario de tecnologías de producción, clasificación y almacenamiento.
- Nuevas formas de uso, transformación y comercialización de papas nativas.

CONCLUSIONES:

- Existe una gran variabilidad de papas nativas
- Las variedades de papa nativa que se conservan son usadas para la alimentación familiar y muy pocas van al mercado
- Todo proceso de desarrollo que promueve la participación activa de los productores garantiza la sostenibilidad del mismo.
- Todo proceso de desarrollo que se promueve debe ser ecológicamente amigable, socialmente justo y económicamente rentable.
- Es necesario conservar los conocimientos tradicionales desarrollados en torno a los cultivos nativos.

36. GUIDELINES FOR SUSTAINABLE AGRICULTURE-WETLANDS INTERACTIONS: TOWARDS A BALANCE FOR SUSTAINABLE PRODUCTION AND BIODIVERSITY

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Keywords: Wetlands, Agriculture, Mainstreaming Biodiversity, ecosystem services, management responses

INTRODUCTION

The Millennium ecosystem Assessment (MA) (2005) highlighted the ongoing decline of many ecosystems, especially wetlands, and attributed much of this decline to excessive exploitation of provisioning services and neglect of regulating, supporting and cultural services, which include the biodiversity. More recently the Comprehensive Assessment of Water Management in Agriculture (CA) (2007) showed that the need for increased global food production will double by about 2050, thereby increasing pressure from agriculture on natural resources, in particular wetlands and water. The CA acknowledged that whilst food production must increase there is a growing concern about converting or altering ecosystems, such as wetlands, and loosing the wider services they provide. Indeed there is a fear that agriculture expansion could undermine existing food production and livelihood activities, e.g. fisheries downstream of irrigation developments.

The FAO and the Netherlands mediated conference on Water Food and Ecosystems (WFE)(2005) specifically addressed the issue of how to achieve a new balance between ecosystems (biodiversity) and food production and how to establish an ecosystem approach to agriculture while also seeking a more productive services approach to ecosystem management. The Global Agricultural and Wetlands Initiative (GAWI) builds on this. It also links with interests from the Ramsar Convention on wetlands and agriculture and Ramsar's collaboration with the Convention on Biological Diversity to stem the loss and degradation of wetland biodiversity.

Wetlands are often the frontier of interaction and competition between biodiversity and agriculture. There is growing recognition that pitting conservation against increased food production is futile; but the issue of how to re-balance conservation and agriculture is still hotly contested. One way of moving forward to re-dress the balance is to review how ecosystem services are valued and exploited and devising effective response strategies to effect such a re-valuing. GAWI works on devise such strategies and effecting such a rebalancing through an analysis of key issues and responses. As shown in Figure 1, the rebalancing of ecosystems services, and food production against biodiversity loss remains a major issue.

FRAMEWORK FOR ANALYSIS AND ASSESSMENT

Wetland-Ecosystems in their socio-economical environment

Wetland ecosystems are subject to numerous drivers, and pressures from the surrounding social, economic and ecological environments. These lead to specific uses, management activities and impacts that tend to skew the use of ecosystem services by human society towards satisfying their provisioning needs, such as food production, rather than supporting the regulating services that often have implications beyond the boundaries of the wetland. In order to consider the relative and comparative importance of the drivers, pressures and state changes in wetlands as manifested through agriculture GAWI elaborated a framework combining the ecosystem services concept of the MA with a DPSIR (drivers, pressures, state (changes), impacts and responses) model.

Agricultural practices and resources utilizations, and the state changes they lead to in ecosystem and their services, are particular responses to drivers, pressures and impacts in the socio-economic environment, or causal chains of DPSI. Effecting changes in agricultural practices that better suit a sustainable (balanced ecosystem services) state of wetlands, will require multiple response strategies that address the multiple level of the drivers, pressures, state changes and impacts. Responses are thereby not only agricultural or ecological, but also economic, regulatory, social and political / policy, with the aim of reorienting the socio-economic environment of drivers, pressures and impacts towards favorable impulses for sustainable agriculture-wetland interactions.

Assessment of the socio-economic environment and state-changes in wetlands

To assess these dynamics, a data-base has been built up with circa 80 cases (RAMSAR and non-RAMSAR sites) where wetlands interact with agriculture, either in-situ or indirectly within the river basin. By using the DPSI model an assessment could be made of the causal chains through which agriculture operates and the state to which the wetland ecosystem is subdued. The environment is furthermore classified according to wetland type, market orientation of the economy, geographical region and economic development, level of water control and typology of agriculture. This allows analysis of DPSI causal chains across the different socio-economic and biophysical environments.

The loss of biodiversity is reported as a major and frequent occurring negative state change (Figure 1). Driven by high population intensities, food shortages, but also sectoral policies and market opportunities, current responses lead to considerable gains in production and socio-economic development through market oriented agriculture, and considerable losses in subsistence agriculture due to resource depletion by either the former or the latter. Both affect the state of ecosystems and cause biodiversity loss — the former through pressures of intensification, the latter through pressures of expansion. Both feed the frequently reported impact of increasing economic differentiation and rise in conflicts. The relation between ecosystems (biodiversity), agriculture and poverty alleviation, and the achievement of the MDGs, is thus complex and ambiguous at best.

The few instances of reported gains in biodiversity or increases in regulatory services in the state of ecosystems are limited to the OECD region. Here different drivers and pressures are at play, and growing concerns with climate change and sustainability has enabled the adjustment of the socio-economic environment in favor of recuperating past lost biodiversity and, in particular, the water regulating services of wetland ecosystems.

TOWARDS GUIDANCE IN SUSTAINABLE AGRICULTURE-WETLANDS INTERACTIONS

Drivers, pressures and impacts for food, economic growth, and poverty reduction are huge and need to be acknowledged in any viable response strategy. In doing this it will also be necessary to address trade-offs between agriculture (provisioning services) and regulating services on two fronts: (i) target intensive production in wetlands, and concentrate on alleviating direct and indirect impacts; and (ii) exploit/ recognize and value regulatory services, which include biodiversity, as the primary function of wetland that meets specific socio-economic demands, and subdue provisioning services as a secondary function. This implies that in order to support the reaping of wider benefits from wetlands, we need to place more emphasis on the balance between provisioning and regulating services and on how these benefits can be reaped at the local, rather than the global, level. In other words conserving biodiversity in wetlands is an integral part of ensuring that societal needs for both provisioning and regulating services are met. A key issue therefore is recognition of the multiple scales at which wetland biodiversity operates and how this brings benefits to many people, far away and particularly locally.

The GAWI initiative is developing a framework document and guidelines for RAMSAR, together with FAO, in direct response to the RAMSAR resolution viii.34. This will provide methodological guidance through a framework for analysis and the formulation and targeting of multiple response strategies. This is to be complemented by reference guidance material, to build up multiple response strategies, covering the following fields: (i) Good Agricultural Practices to tackle indirect interactions; (ii) enhancement of in-situ secondary function provisioning services; (iii) making regulatory services functional in the socio-economic environment and getting their value compensated. The framework document and data-base, as well as the first drafts of the guidance documents will be presented at the forthcoming RAMSAR COP 10 in November 2008.

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Figures

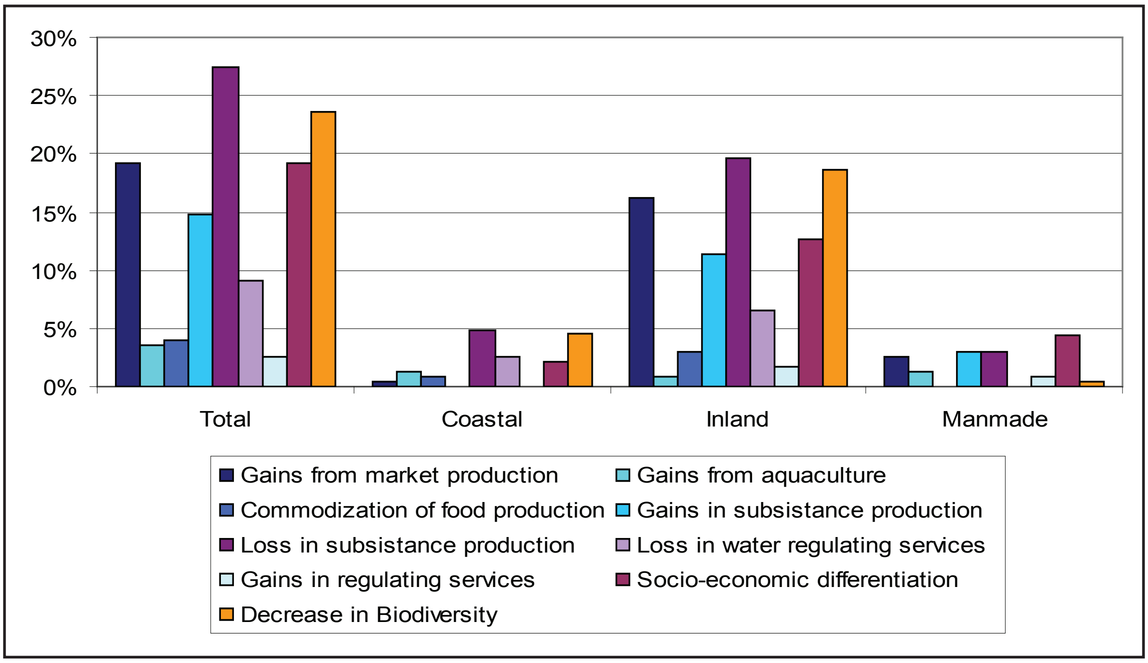

FIGURE 1: Reported Impacts (percentage of total impacts reported) per wetland type

37. LANDSCAPE HETEROGENEITY ENHANCES THE DIVERSITY OF PADDY WEED SPECIES IN A LOWLAND AREA OF JAPAN

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Keywords: land form, soil type, farmland consolidation, rice paddy field, threatened arable weed

INTRODUCTION

Species richness in agro-ecosystems has dramatically declined during the last decades, mainly as a result of the intensification of land-use practices (e.g. Krebs et al. 1999). On the one hand, intensification has occurred at the field scale through the increased use of pesticides and mineral fertilizers. On the other hand, intensification has also occurred at the landscape scale because of the aggregation of intensively managed arable fields together with land consolidation that has resulted in a transformation of formerly complex landscapes to simple ones. In European countries, local factors, regional or landscape-scale factors and their mixed effects affecting species diversity of arable weeds have become the focus of attention (Gabriel et al. 2006, Roschewitz et al. 2005).

Paddy rice field is a major arable land in Asia including Japan. Rice fields had originally been reclaimed in various land forms, such as alluvial fan, meander plain, delta and valley bottom plain. Traditionally cultivated paddy fields might have functioned as alternative habitats for such wetlands. A possibility is that remnant wetland plant species representing natural land forms may remain in conventional paddy fields. However, floristic composition in different types of natural land condition, and relative contribution of such broad-scaled factors to local factors are rarely understood. This study focused on relative contributions of overall diversity across a range of spatial scales.

MATERIALS AND METHODS

The study area covers 40 km^2, ranging 35°53'40" – 36°03'40 "N and 139°59'00" – 140°14'45"E (Figure 1). All occurred species were recorded in 1 × 10-m plots with their densities (relative frequencies in 10 1 × 1 subplots). Three plots were situated in fields within the radius of 200 m, where same land-consolidation history is performed. Sampling units comprising such three plots were surveyed at least 1 km away from each other. Floristic survey was carried out after rice harvest in September to October, 2007. A total of 103 species was recorded, of which 92 were used for analyses because 11 species were favored of dry condition and very common in roadside or dry ruderal habitats.

Pre-analysis using Detrended Correspondence Analysis (Hill 1979) showed that land-form, potential soil moisture condition derived from different soil types, and the intensity of farmland consolidation were the main factors affecting floristic composition. In the study, factors of former two natural conditions were integrated and used for analyses as a “natural land unit”.

Additive partitioning is a useful tool for quantifying diversity components across multiple spatial scales (Allan 1975, Lande 1996). Total diversity of a given number of samples (gamma diversity) is divided into the additive components alpha (mean diversity) and beta (between sample heterogeneity), thereby allowing species diversity at several spatial scales to be scaled up to whole regions. We partitioned species richness at four spatial scales, the field (267 plots), neighboring 3 fields under the same farmland consolidation (267/3 = 89 farmland consolidation units), natural land unit (3 natural land units of 25 to 37 farmland consolidation units) and a region. Variations of diversity between field, between farmland-consolidation and between natural-land-unit were defined as β_1, β_2 and β_3, respectively.

RESULTS AND DISCUSSION

The variability of diversity components was mainly explained by between-farmland-consolidation diversity (β_2, 48.4 spp.), followed by the component of between-natural-land-unit diversity (β_3, 22.7 spp.) (Table 1). Relative contribution to diversity component concerning disseminule form varied according to the scale of components (Table 1). Within-plot diversity (α diversity) was attributed mostly by hydrochorous species, while larger scale components had lower contribution of hydrochorous species. Among 92 species, five were listed in nationally threatened species, of which three species have enough frequency to analyze their distributions. *Isoetes japonica* was represented in valley bottom plain, while *Eusteralis stellata* was observed in meander plain under damp soil condition. *Rotala pusilla* was common in each natural land unit.

In dry arable land, regional scale factors were important affecting diversity of weed species (Gabriel et al. 2006, Roschewitz et al. 2005). While in this study, contribution of between-natural-land-unit diversity was not great. This is explained by different dispersal mode of arable weeds between dry fields and paddy fields. In dry fields dispersal events across field are very limited (Bischoff & Mahn 2000), while frequent irrigation should greatly enhance the dispersal of paddy weed species because most paddy weeds were water dispersed species. Regarding threatened species, natural condition was likely the determinant factor confining their distributions. Disseminule form of *E. stellata* is barochory, meaning less dispersal ability. *I. japonica* is likely to observe in oligotorophic wetlands, implying more suitable in valley bottom plains where spring water is more or less introduced to fields.

This study shows that difference of broad-scaled natural condition less contributes to the diversity of paddy weed species than weed species of dry fields. However, there are threatened species of which distributions were confined to a certain natural land condition. Thus it is essential to take natural land condition into account for the conservation of threatened paddy weed species. Further researches should be carried out in various land condition with larger sample size to clarify diversity components of paddy weed species especially of threatened ones.

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FIGURE 1. Study area. Black and gray shading represent open water and paddy rice field, respectively.

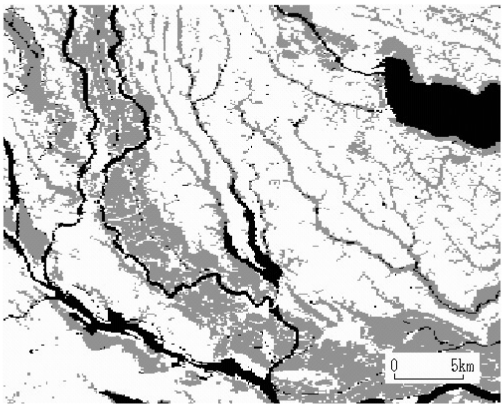

TABLE 1. The alpha, beta and gamma diversity of species and relative contribution to diversity components concerning disseminule form.

DIVERSITY	ALL SPECIES	BAROCHORY			
		NUMBER OF SPECIES	PERCENTAGE	NUMBER OF SPECIES	PERCENTAGE
α	12.3	8.6	69.8	3.0	24.3
+ β1	8.6	5.7	66.7	2.3	27.0
+ β2	48.4	28.4	58.5	17.0	35.1
+ β3	22.7	11.3	50.0	9.7	42.6
= γ	92.0	54.0	58.7	32.0	34.8

2

MAINSTREAMING BIODIVERSITY ISSUES INTO FORESTRY

38. THE IMPACT OF BUSHMEAT HUNTING ON BIODIVERSITY IN NEOTROPICAL FORESTS

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Keywords: bushmeat, primate hunting, forests, Neotropical forests, seed dispersal, forest composition and biodiversity

PRIMATE HUNTING IN THE NEOTROPICS

The devastating effects of bushmeat hunting on primates in Central and Western Africa are well recognised. In contrary, the largely uncontrolled hunting of monkeys in Central and South America has so far received little attention, although the extent of this hunt has dramatically increased in recent decades due to the introduction of modern weapons, changes in infrastructure, growing human populations and socioeconomic changes. In most Neotropical countries bushmeat hunting poses a serious threat to primate populations (Altherr 2007). Rural human populations in the Brazilian Amazon alone are estimated to consume between 2.2 and 5.4 million primates per year (Peres 2000). Because of their slow reproduction rate and low population densities most Neotropical primate species cannot sustain this immense offtake. As a consequence, mainly large and medium sized primates have vanished from many sites in Amazonia (Peres & Palacios 2007). Woolly monkeys (*Lagothrix* sp.), spider (*Ateles* sp.), howler (*Alouatta* sp.) and capuchin (*Cebus* sp.) monkeys are the most hunted species due to their body size. Their population sizes at sites with high hunting pressure are reduced by up to 96 percent, compared to sites with few hunting (Peres & Palacios 2007, Nun ez-Iturri & Howe 2007). Hunting for bushmeat, rather than habitat loss is predicted to pose the most serious threat to the survival of these primates (Wilkie & Godoy 2001, Peres 2001). For example, hunters now have access to most areas of lowland Amazonia, even to remote and protected areas.

IMPACT OF PRIMATE HUNTING ON FOREST BIODIVERSITY

The impact of unsustainable hunting goes far beyond the effects on the primate community: There is a domino effect on the forest ecosystem as a whole. Even in apparently "pristine" rain forests a selective defaunation, focusing on large and medium sized target species, is expected to have a deep impact on the complex ecological interactions and forest ecosystem dynamics (Peres & Palacios 2007).

Up to 98 percent of canopy and sub-canopy trees in Neotropical forests are vertebrate-dispersed (Stoner *et al.* 2007, de Castro 2003). Most large- and medium-sized primates are frugivorous and key seed dispersers. Woolly monkeys, for example, consume the fruits of over 200 different woody plants (Di Fiore 2004, Ráez-Luna 1995). As large-seeded fruits are generally dispersed only by large-bodied vertebrates they directly rely on those species (Stoner *et al.* 2007). The removal of larger primates therefore significantly affects the ability of plants to disperse their seed and changes the dominance relationship between tree species. In the medium term this leads to changes in forest composition, structure, and biodiversity (Wright *et al.* 2007, Roldán & Simonetti 2001), in the long-term it could affect forest regeneration, ecosystem function and services such as carbon storage (Muller-Landau 2007).

RECOMMENDATIONS TO RANGE STATES

The expansion of protected areas and surrounding buffer zones as well as the creation of biological corridors would be relevant measures to support the survival of Neotropical primate populations. However, as bush-meat hunting is the major threat for medium and large sized primate species, a review of existing hunting regulations, their implementation and enforcement is urgently recommended if the survival of the primate community and their contribution to the forest biodiversity shall be ensured in the long-term.

Recommendations for the CBD Expanded Programme of Work on Forest biological diversity

The CBD Parties should explicitly address the issue of the Neotropical bushmeat crisis in the context of its Bushmeat Liaison Group (BLG). Under Goal 4, Objective 2 of the Forest Work Programme the sub-regions, in which bushmeat hunting is a serious problem, should be explicitly named, including the Central and South American region. The BLG should not only discuss the harvesting of bushmeat and related products, but also the impact of their removal on the forest biodiversity.

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39. ROLE OF MONITORING AND CONSERVATION MANAGEMENT IN HYRCANIAN FORESTS BIODIVERSITY

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Keywords: Hyrcanian Forest, Conservation Management, Geographical Information System, Remote Sensing

INTRODUCTION

The Islamic Republic of Iran comprises a varied harsh climate and a large number of the plant and animal species because of its special topography and climatic situation. Number of animal species of Iran is approximately equal to total number of Europe mammals. The Iranian habitats support 8000+ recorded species of plants, of which almost 22 percent are endemic.

Iran's topography have given rise to five floristic zones, namely: Irano-Touranian, Zagrosian, Hyrcanian, Arasbaranian and Khalij-o-Omanian which the main forests of Iran are located in three zones of Hyrcanian, Arasbaranian and Zagrosian (Figure 1).

The forest ecosystems have many important ecological values such as conserving genetic resources, supporting animal and plant biodiversity, tempering climate, sinking carbon, and controlling the flood and erosion.

Since Iran has located in the arid and semi-arid area and its forests area is less than the global standards, the conservation and monitoring of Iranian forests has considerable importance. The Iranian forests have gradually experienced a quantitative and qualitative destructive trend as a result of population growth.

HYRCANIAN FORESTS

The north Hyrcanian forests of Iran belong to old ancient world forests, and are a part of the remaining forests after ice age. These forests are related to the Terias and have an old age of about 60 million years. These forests have a rich biodiversity of unique and numberless plant and animal species with industrial, medicinal, nutritional and conservational values.

Utilization of these forests is based on national forestry management plan (conservation and sustainable use). However reviews show that this plan is not implemented perfectly due to insufficient attention to the conservation aspect of the management plan. Local communities have not benefited from the implementation of the management plan since more their social and economic conditions were not considered in the plan. Also since these forests are very fragile and have high ecological values and potentials; focus on utilization aspect of the management plan has resulted in a decline in the forest density and biodiversity.

STUDY AREA

Khoshkedaran National Natural Monument has a land area of 254ha. And lies in hyrcanian forests between latitudes of 36º 42' 55" and 36 º 44' 25" N and longitudes of 51 º 03' 40" and 51 º 04' 35" E.

The average altitude is -22 m, under the sea level. It's located 30 km off western of the Chalus City in Mazandaran Province, along the Caspian coast in the north of Iran.

This area has diverse plant species of different communities including: *Populus caspica Alnus glotinosa, Punica granatum, Mespilus germanica, Crataegus sp., Ulmus minor, Buxus hyrcana, Parrotia persica, Pterocarya fraxinifolia, Prunus sp., and Rubus sp.*

The main animal species of this rea are wild boar, jackal, common fox, night heron, gray heron, pheasant, and different birds of prey.

Under national jurisdictions and as one of the four categories of formal Protected Area definitions, Iranian Department of the Environment (DoE) manages a small part of hyrcanian forests in the Khoshkedaran National Natural Monument by using a conservation management method, which is a pure conservation approach.

METHODOLOGY

Remote Sensing (RS) and Geographical Information System (GIS) techniques have been used to compare the trends of changes in forest cover in two sampling areas (Khoshkedaran and surroundings).

Satellite images of two different years (1975 and 1995), land measurement, land control sampling by Globalization Positions System (GPS) and related software are some of tools were used in this study.

For this reason the satellite images of the Khoshkedaran were referenced geologically. After that the border of the National Natural Monument was determined by using GPS and then overlaid by based map (satellite image). In the next step, supervised classification and re-control of features in the area applied.

FINDINGS AND OBSERVATIONS

The result of this study didn't show any reduction in quality and quantity of Khoshkedaran ecosystems. Also any type of land use conversion was not seen in the area; but in the surroundings with utilization and conservation management approach, the situation was different, and natural forests were converted to farmlands, orchards, and residential lands (Map 1).

The results demonstrate that over-logging in forests without consideration of socio-economic situation of local communities; ecological potential of the area and also without rehabilitation and/or reforestation activities will result in a declining habitat and loss of biodiversity.

While expansion of agricultural lands is a very normal and common practice in most parts of the world, the impact of agricultural expansion has been particularly severe in the old natural forests of native species like Hyrcanian forests.

It seems that due to the fragile condition of the Hyrcanian forests conservation with involvement of the local community is more effective than integrating conservation and utilization (for commercial purposes) methods.

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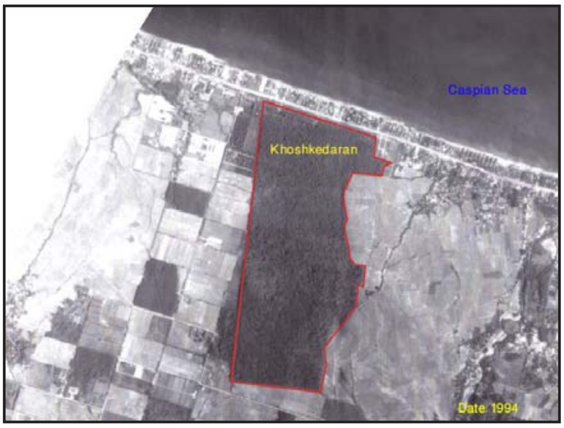
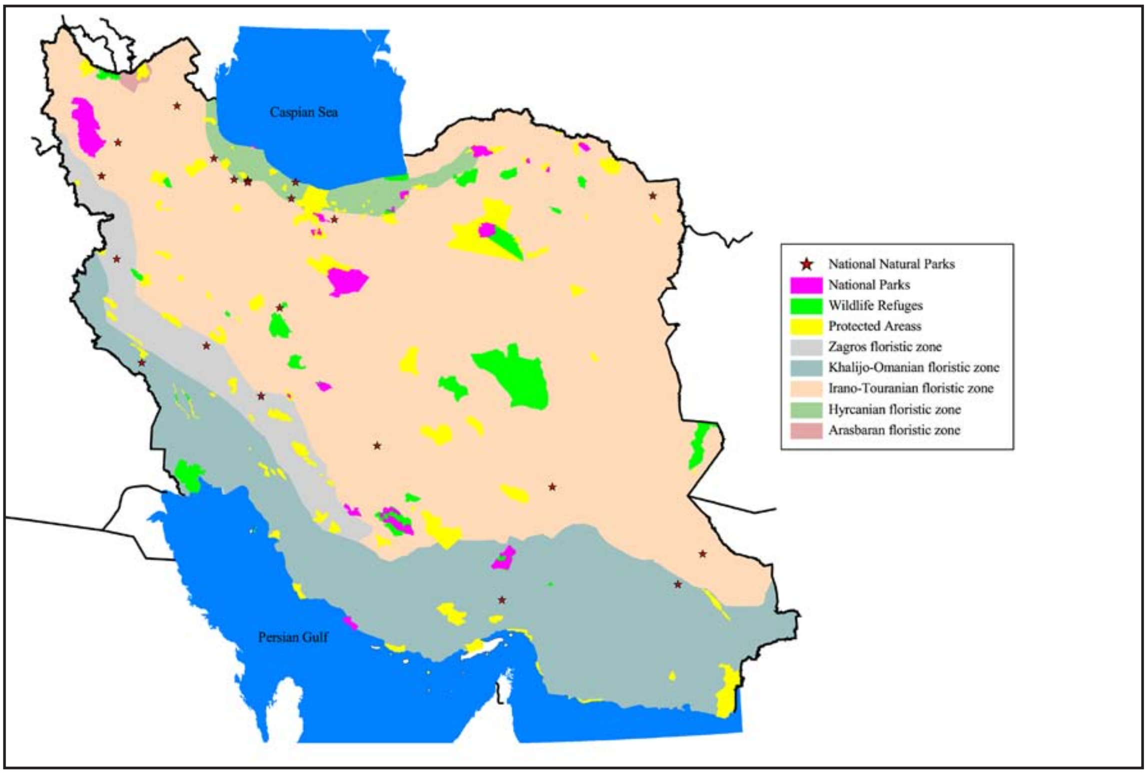
Expert reports, Habitats and Protected Areas Bureau, Iranian Department of the Environment.
Map credit: National Surveying Organization of Iran.
Photo credit: Geographical Organization, Defense Ministry of the Islamic Republic of Iran.

FIGURE 1. Distribution of the protected areas in relation to the Iranian floristic zones





MAP 1. Comparison of the maps of place of study in two different years of 1975 and 1994

40. EUROPEAN FOREST TYPES: CATEGORIES AND TYPES FOR SUSTAINABLE FOREST MANAGEMENT REPORTING AND POLICY

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Keywords: European forest, forest classification, assessment, planning

The EUROPEAN FOREST TYPES have been elaborated by an international consortium of experts aiming at European-level forest assessments and strategic planning.

The classification system reflects the diversity of European forests determined by the main natural and anthropogenic factors creating the variety of forest conditions found nowadays throughout Europe. On the highest level European forests can be characterised by 14 Categories, which can be further subdivided into 75 Types. For European-level harmonisation the Category level is recommended while countries wishing so may make use of the presented Types in a flexible way. Presently European forest-related reporting processes, like the Ministerial Conferences for the Protection of Forests in Europe and the Streamlining European 2010 Biodiversity Indicators are considering presenting indicators by the proposed Categories. It is suggested National Forest Inventories and other monitoring programmes use the Categories for stratifying plots to provide for data for international reporting. Providing data by Categories will moderately increase the reporting burden, the number of categories found at country level ranges from 1 to 12 and is on average 6.

41. SYSTEMIC FOREST MANAGEMENT FOR MAINSTREAMING BIODIVERSITY CONSERVATION AND SUSTAINABLE USE IN FOREST ECOSYSTEMS IN ITALY: TWO CASE STUDIES

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Keywords: forest biodiversity conservation, forest biodiversity sustainable use, systemic forest management, systemic silviculture, naturalization

INTRODUCTION

Biodiversity issues are becoming increasingly important in forest planning and management. In Italy, the recent forest law issued by the Ministry of Environment and Territory "Guidelines for forest planning" (D.M. 16 June 2005) encourages Italian Regions to take actions through forest plans in accordance to the "Pan-European Criteria and Indicators for Sustainable Forest Management" adopted through Resolution L2 during the Lisbon Conference (MCPFE 1998) and the "Improved Pan-European Indicators for Sustainable Forest Management" adopted through the Vienna Conference (MCPFE 2003). Further to those indications, sustainable forest management can be pursued, *inter alia*, through the "Maintenance, Conservation and Appropriate Enhancement of Biological Diversity in Forest Ecosystems".

In this framework, systemic forest management (Ciancio 1998) represents a valid approach for mainstreaming biodiversity conservation and sustainable use in forest ecosystems in Italy. After a brief discussion on the theory of systemic forest management and associated operational guidance, this paper presents two examples of practical application of the above approach in forest planning.

SYSTEMIC FOREST MANAGEMENT

The theory of systemic forest management

In the last decades, forest management has shifted from an output-oriented paradigm (based on the constrained optimisation of commodities – marketable or not) to a new one (where forest perpetuity arises from the equilibrium between standing volume, increment and allowable cut) (Ciancio and Nocentini 1997).

In this new vision, forest is not seen as a group of trees with commercial value, but as a complex biological system that must be managed with the aim to sustain its functionality, diversity and resilience. The pursuit of system functional efficiency becomes the fundamental objective of forest management. The acceptance of such a paradigm leads to systemic forest management, characterized by the following aspects (Ciancio and Nocentini 1995, 1996; Ciancio et al. 1999):

- the forest is perceived as a self-organising system with intrinsic value;
- management practices are guided by an adaptive approach based on reversible interventions (maximising future intervention options);
- actions in monitoring and interpreting the reactions of the system to abiotic, biotic and anthropic factors have a key role;
- productivity, yield and economic value depends on ecosystem natural processes and sustainability does not depend on high inputs of energy.

Strategies for implementing forest biodiversity conservation

Italian forest systems have been deeply modified by human influence throughout centuries, thus resulting extremely simplified in composition, structure and functionality (Ciancio et al. 2007).

Strategies to conserve biodiversity in forest ecosystems rely on three aspects (Ciancio and Nocentini 2004):

- the preservation of habitat and ecosystems (basically through protected areas);
- the naturalization of forest systems simplified by past management:
- the maintenance of traditional forms of forest use where these are truly a part of the local culture and traditional knowledge.

Following the principles of systemic forest management, actions oriented toward naturalization should support the restoration of natural processes (self-organization and self-regenerating mechanisms), allowing the increase of complexity and diversity within the system and among different systems (Nocentini 2000).

In Italy naturalization urges in reforestation sites, by encouraging spontaneous introduction of local species, as well as in self-originated stands, characterized by simplified composition and structure due to the application of classic silviculture methods (e.g. clear-cutting).

Strategies for implementing forest biodiversity sustainable use

Sustainable use of forest biodiversity can be pursued through the application of operational methods characterizing systemic silviculture (Ciancio et al. 2003):

- a lack of rigid schemes; different specific objectives need to be adopted for each case, adapting to each particular environment and site; instead of necessarily trying to converge on predetermined, so-called normal structures, interventions are based on detailed comparative evaluations of the effects of preceding actions;
- following and sustaining natural regeneration processes; this is done by enhancing the forest's structural complexity, favouring natural irregularities in the spatial and temporal distribution of regeneration;
- linking tree felling criteria, in very general terms, to conditions of single trees or tree groups; the risk of reducing diversity, inherent to all artificial interventions, should be minimised, avoiding early and uniform treatments that alter natural selection processes; dishomogeneities should be favoured, maintaining rare species, trees with cavities that are potential nesting sites, etc.;
- minimising alterations in nutrient cycles, only removing what is truly important to remove, leaving dead or decaying trees and decomposing branches, which may offer suitable habitats for woodpeckers, birds of prey, insects and many lower plants;
- suitable timing and localization of harvesting operations so as to prevent both interference with the reproductive season of animal species and disturbance of rare or threatened species.

CASE STUDIES

The principles of systemic forest management have been translated into practice through the redaction of the "Plan of Management of the National Biogenetic Natural Reserve of Vallombrosa 2006-2025" (Ciancio 2007a) and the " Plan of Management of the National Biogenetic Natural Reserve of «Tomboli di Cecina» 2007-2021" (Ciancio 2007b). The two Reserves are located in Tuscany (Italy) and cover respectively 1273 ha and 406 ha. Taking into account the public property of the two Reserves, the plans have been drawn up with the aim to conserve and increase the biological functionality of forest resources. Those plans will be applied through the so-called "Biodiversity Local Office" of Vallombrosa and Cecina, managed by the National Forest Police.

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42. PROTECTING THE FUTURE: CARBON, FORESTS, PROTECTED AREAS AND LOCAL LIVELIHOODS

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Keywords: Reduced Emissions from Deforestation (RED), protected areas, deforestation, livelihoods, carbon

INTRODUCTION

The current proposals on reducing emissions from deforestation in developing countries (RED) being discussed under the UN Framework Convention on Climate Change (UNFCCC) would have significant implications for biodiversity conservation and associated livelihoods. The potential for RED to deliver multiple benefits for biodiversity conservation, livelihoods and other ecosystem services is well documented, but there are also potential risks for conservation and for the livelihoods of those people dependent on forests or forest conversion. The UNFCCC is concerned with *stabilizing greenhouse gas concentrations* in the atmosphere at a level that prevents dangerous interference with the climate system. Decisions made under UNFCCC can therefore be expected to focus on stabilizing emissions, and not necessarily to make explicit provision for maximizing other benefits of reduced deforestation.

The general principle of RED is that developing countries receive credits from decreasing their deforestation rate in the post-2012 period. Depending upon the exact mechanisms decided upon, protected areas could have a role to play in reducing national-scale deforestation, through strengthening forest protection within existing protected areas, and/or declaring new forest areas. In addition, lessons can be learnt from past experiences with protected area management, regarding successes in reducing deforestation and impacts upon community livelihoods. These findings could inform the development of appropriate mechanisms for RED.

HOW SUCCESSFUL ARE PROTECTED AREAS AT REDUCING DEFORESTATION?

The drivers of deforestation are complex; they vary between regions and over time, and interact. An analysis of the literature has shown that protected areas generally have reduced deforestation rates relative to their surroundings, although large areas of forest may still be lost. A more complex issue which needs to be addressed, particularly in the context of RED, is whether protected areas reduce deforestation overall or merely displace the pressure elsewhere. Due to differing methodologies and classifications, it is difficult to make firm conclusions on the efficacy of different strategies for protected area management in reducing deforestation. It appears likely that strictly protected areas (IUCN categories I to II) are more effective in limiting deforestation than other protected area types. Even where studies have investigated deforestation with regard to IUCN management categories, they rarely consider governance and community involvement, and there is some evidence that community based forest management can also be successful in reducing deforestation. This is an issue that needs further investigation if the potential for RED mechanisms to provide both biodiversity and livelihood benefits is to be assessed.

WHAT ARE THE LIVELIHOOD IMPACTS OF PROTECTED AREAS?

The costs and benefits of protected areas to community livelihoods have been well documented. Costs can range from displacement of local communities and denied access to resources to crop damage; and benefits can include direct revenue from environmental protection and environmental benefits such as watershed protection. A large number of the rural poor rely on forest resources. The social impacts of protected areas are not just important in terms of human rights, but also in influencing the extent to which local communities clear forests. An analysis of the literature has suggested that the livelihood impacts of protected areas vary according to protected area management strategies and governance, but that methodologies for assessing net livelihood costs and benefits are lacking. Management can provide direct benefits but can restrict access to resources, alter local power structures, and

change social/traditional values and behaviours. Strictly protected areas with top-down management structures can have major livelihood impacts and cause conflict between local communities and protected area management. Community management schemes and protected area management allowing sustainable use of forest resources have met with varying degrees of success in terms of provision of livelihood benefits; and have been shown to provide tangible benefits in some cases. However, significant costs can still be incurred by communities if management and institutional capacity is lacking, and issues of governance and tenure are not resolved. Inequitable distribution of livelihood costs and benefits between and within both communities and households is an obvious issue in some cases.

FACTORS FOR CONSIDERATION: PROTECTED AREAS IN THE CONTEXT OF RED

The establishment of RED as a mechanism for avoided deforestation could create an international market or fund for forest carbon. The impact on protected areas and livelihoods will depend upon the national as well as global mechanisms selected. However, an analysis of livelihood costs and benefits in existing forest carbon markets has identified issues similar to those identified for protected area management; including lack of established tenure and the inequitable distribution of resources; particularly for the landless members of society. Increased finance could exacerbate these issues, and there is the potential for the protection of carbon areas to intensify livelihood impacts through a strict 'fences and fines' approach. Alternatively, the potential exists for RED mechanisms to remove the large scale drivers of deforestation, secure land tenure rights in forest areas, and increase the potential benefits to local communities from conservation through community management regimes. Careful consideration of the potential impacts of RED mechanisms based on past experience is therefore required. Involvement of local people in planning and implementation of RED, and ensuring sharing of the benefits from RED finance is likely to result in a more sustainable long-term solution to deforestation.

There is much uncertainty regarding the efficacy of protected areas in reducing deforestation and impacts on local livelihoods, and there is a clear need for a detailed assessment of these factors in order to inform climate change policy. Further study is required into the impact of community management and governance types within protected areas on deforestation rates, and clear methodologies for assessment of livelihood impacts of the various methods of protection are required.

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43. *TODOS SOMOS HOJAS DE UN MISMO ARBOL: EL ARBOL DE LA VIDA*

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Keywords: biodiversity, Mexico

Our national territory is home to almost every natural landscape in the planet, from desert zones to exuberant jungles, including tropical brush lands and Paramus located in the high elevations, between the upper forest line and the permanent snow line.

Even though it only occupies 1.4% of the total territory of the earth, 10% of all the known species in the world can be found here, many of which are endemic. That places Mexico in the group of the so-called mega diverse countries. As for number of species, Mexico occupies the fifth place in plants, the fourth in amphibians and the second in mammals as well as in reptiles. It also has the most species of pine trees and cactae in the world. It is one of the 5 centers of origin of cultivated edible plants such as maize, beans and vanilla among others.

Along with its biodiversity Mexico has a great cultural diversity, both of which are interrelated. The rural and indigenous communities own more than 80% of the well-cared-for ecosystems, where a great part of the biodiversity of the country is concentrated. Nearly 18 million ha. Of the 24 million occupied by indigenous communities are covered by primary and secondary vegetation. Half of the jungles and rainforests, and one fourth of the temperate forests are located in indigenous territories. 21.7% of all the water gathered in the country is done in many of the basins where the indigenous people are situated. This shows the importance of those communities and the territories they occupy for the conservation of the biodiversity and the environmental services.

The conservation of the ecosystems and species of flora and fauna in the country requires more knowledge in order to achieve sustainable management. The most effective mechanisms for the conservation of the biodiversity are: the establishment of reservoirs in which the natural resources are protected and the implementation of models for sustainable management that allow the integration of the conservation of the natural resources along with social welfare and economic development.

44. RESTORATION OF TROPICAL DRY FORESTS

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Keywords: Information services, forest loss, ecosystem function

SUMMARY

Tropical dry forests are one of the most threatened forest ecosystems globally and are under pressure from cattle grazing, farmland, production of fuel wood and charcoal. Restoration efforts have occurred around the world, and there are a number of case studies, which provide valuable information. The Forest Restoration Information Services (FRIS) is an online tool that offers information on completed and ongoing restoration projects for tropical dry forests and other forest ecosystems.

TROPICAL DRY FORESTS

Tropical dry forests are found in tropical regions with seasonal rainfall resulting in several months of severe drought (Mooney *et al.* 1995) (see Figure 1). Such conditions have provided the selective pressures for the evolution of highly distinctive vegetative forms (Aaronson *et al.* 2005). Tropical dry forest is thought to be the "most threatened of all major tropical forest ecosystems" (Janzen 1988; Vieira and Scariot 2006). Once covering 40-45% of all tropical lands (Bullock *et al.* 1995), today intact tropical dry forests comprise only 1-2% of their original area (Aaronson *et al.* 2005). 97% of this remaining area is currently exposed to a high level of threat (Miles *et al.* 2006). Tropical dry forests were exploited from early times for their valuable timber, in addition to being cleared to allow access to mineral deposits (Aaronson *et al.* 2005). As the tree canopy giants were selectively harvested in the 1800s, many tropical dry forests were increasingly used for cattle grazing, farmland, or extractive production of fuel wood and charcoal (Aaronson *et al.* 2005). At present, fragmented tropical dry forests and adjacent areas are often used for livestock grazing. Within and around cities, such areas are often cleared for urban development.

Why restore tropical dry forests?

There is great need to restore tropical dry forests due to their rich and unique biodiversity as well as their function as sources of timber and non-timber products (Aaronson *et al.* 2005). Some tropical dry forests could also generate income through eco- and cultural tourism programmes, while also promoting community involvement (Aaronson *et al.* 2005). In urban areas, it would be cost-effective to restore native tropical dry forests for amenity planting since their maintenance would require less effort than the usual horticultural plantations of exotic species or lawn grass (Aaronson *et al.* 2005). Tropical dry forest species may also be capable of withstanding the drying of terrestrial ecosystems linked with global warming (Aaronson *et al.* 2005).

Restoration methods

Tropical dry forests can be restored by controlling the pressures caused by livestock, invasive species, and land conversion. Passive control methods such as fences or enclosures are frequently used but in some cases direct action such as removal of invasive species are taken (Aaronson *et al.* 2005). In many cases restoration requires the planting of common, framework or rare/endangered species native to the original ecosystems (Aaronson *et al.* 2005). Their germination and growth are studied in nurseries, and then experimental plantations are carried out with individuals, mixed species and presumed functional groups (Aaronson *et al.* 2005). These projects sometimes aim to create "islands" of animal-dispersed trees that will encourage the return of forest

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fauna. Tree planting programmes must consider the risk of drought, sources of good-quality nursery stock, as well as the timing and method of planting (Aaronson *et al.* 2005).

Some future needs

- An ecological economic valuation of tropical dry forests (Aaronson *et al.* 2005)
- A better understanding of tropical dry forests biodiversity for setting structural, functional and compositional objectives for restoration projects (Aaronson *et al.* 2005)
- Developing and testing methods of vegetative propagation for tropical dry forests restoration (Vieria and Scariot 2006)
- Promoting a landscape-scale approach to reforestation planning in order to create connectivity and maximise community benefits

FOREST RESTORATION INFORMATION SERVICE (FRIS)

The Forest Restoration Information Service (FRIS) aims to: 1) provide an open-access internet information service to support forest restoration projects world-wide, 2) facilitate exchange of knowledge and experience among forest restoration projects, and provide a basis for analysing factors determining success, and 3) facilitate the prioritisation, design and execution of forest restoration efforts by FRIS users.

The online services available at www.unep-wcmc.org/forest/restoration/index.htm, include definitions of key terms and concepts in forest restoration; an introduction to key approaches and tools; case studies; database of projects; and maps and databases

In relation to tropical dry forests, FRIS provides information about their distribution and restoration. Information about individual tropical dry forests restoration projects as well as case studies from Costa Rica, Ethiopia, India, Hawaii and Thailand can also be accessed through FRIS.

ACKNOWLEDGMENTS

This study is supported by the Restoration-of-Forest-Landscapes-for-Biodiversty-Conservation-and-Rural-Development-in-the Drylands-of-Latin-America (REFORLAN) project (European Community Sixth Framework Programme contract number 032132).

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45. NATIONAL FOREST REPORTING AND BIODIVERSITY

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Keywords: Biodiversity, sustainable forest management, criteria and indicators, forest reporting, forest inventory

SUSTAINABLE FOREST MANAGEMENT

Good forest management is part of Sustainable Development -- Following the Earth Summit in 1992, the forest management community struggled with how to respond to the goal of sustainable development. The phrase "forest sustainability", although in vogue, had little meaning. Forest decision makers and the public had not agreed to a framework by which to discuss or report on the sustainable management of forests. From this confusion came criteria and indicators for sustainable forest management.

Society expects foresters to manage for biodiversity. Foresters can be justifiably proud of 100 years of leadership in the wise use of forests**.** However, it has been clear for some time that society expects more from forest managers than a continuous supply of wood. The maintenance of biodiversity, among other things, must be a forest management goal if it to be considered sustainable.

The management of forest as ecosystems – The management of forest as ecosystems was a foundation for the identification of criteria for the sustainable management of forests. For this reason, many country forest sustainability reports must now describe trends in biodiversity at the landscape, species and genetic levels.

REALITIES OF DATA COLLECTION

Landscape level forest biodiversity data is expensive – Few countries regularly and systematically inventory the biodiversity of their forests. Reliable, statistically based, forest biodiversity data for an entire country is rare.

Forest inventory statistics are an option-- Sustained forest biodiversity inventories are unlikely to be funded for an entire country. Forest biodiversity information must be drawn from existing institutionalized data systems. The forest management community has collected such data, in some countries for over 100 years. New forest inventories can be justified by potential economic or social returns they promise.

Forest inventories can be modified to satisfy biodiversity inventory needs – Forest management inventory data goes beyond ecosystem descriptions in that it provides statistics on forest biodiversity extent, condition and change. This is called forest cover type data. Such data is essential for the management and protection of forest biodiversity

CRITERIA AND INDICATORS FOR SUSTAINABLE FOREST MANAGEMENT

Montreal Process coordinates forest biodiversity reporting– The 12 counties that encompass 90% of the world's temperate forest have agreed to produce coordinated forest reports that will include forest biodiversity. This data will by landscape, species and genetic level and how it may be changing in response to natural and human caused events.

Forest Cover type serve as a proxy for forest biodiversity – Hundreds of forest plant community associations can be listed for any forest region of the world. Although these community types have been described, data as to their extent, condition and changing status is not available. Forest inventory cover type (associations of forest plant communities) data can be broken down by a hundred or more variations and serve as a biodiversity measure. Modern forest inventories provide such data specific to a local, regional and national scale depending on the size of the country and the density of samples plots.

There are three active forest Criteria and Indicator processes in the world – These include the 33 producer countries of the International Tropical Timber Association (ITTO), the 35 countries of the Ministerial Conference for the Protection of Forests in Europe (the MCPFE) and the Montreal Process. All are working to improve member country inventories that will provide tread information on forest biodiversity.

THE CBD AND REGIONAL CRITERIA AND INDICATOR PROCESSES ARE NATURAL PARTNERS IN FACILTATING THE INVENTORY, SUSTAINABLE MANAGEMENT AND PROTECTION OF FOREST BIODIVERSITY

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46. EUROPEAN FORESTS – ECOSYSTEM CONDITIONS AND SUSTAINABLE USE

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Keywords: European forests, forest policy, 2010 Biodiversity Target

ABSTRACT

The European Environment Agency is currently preparing an assessment 'European forests – Ecosystem conditions and sustainable use' which will be presented at the upcoming CBD COP-9 in May 2008. The report presenting the assessment aims to provide background information on European forests for the CBD discussions on forests. The following main themes will be addressed: the policy context of safeguarding the biological diversity of the forests in Europe, the development of forest and forest biological diversity in Europe, use of forest resources and other factors impacting forest biodiversity and ecosystems, actions and capacity building for sustainable forest management and safeguarding biodiversity and finally a preliminary assessment with respect to forests in Europe of meeting the 2010 biodiversity target and the goals of the CBD EPOW on forest biological diversity.

47. THE FORESTS NOW DECLARATION: "FORESTS NOW IN THE FIGHT AGAINST CLIMATE CHANGE"

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Keywords: Forests, Climate Change, Ecosystem Services

If we lose forests, we lose the fight against climate change. Human induced climate change is real and upon us. Deforestation in the tropics and sub-tropics contributes between 18 and 25 percent of global carbon emissions, second only to the use of fossil fuels. Policy debates have been dominated by clean energy solutions, yet forests indisputably offer one of the largest opportunities for cost effective and immediate action and must now be treated with equal urgency. Mitigation must continue across all sectors, including additional limits on industrial emissions, but efforts to meet vital reduction targets by 2030 will be negated unless we tackle emissions from forests now.

This is not just about carbon. Tropical forests, their soils and peatlands absorb and store carbon, but they also support half the species of life on Earth. This complex of biodiversity maintains our atmosphere and provides vital ecosystem services upon which all of humanity depends. These services include rainfall generation, regional climate regulation, habitat conservation, watershed protection, and soil stabilisation – at local to global scales. Every person on the planet benefits from these services, but none of us pay for them.

Developing nations are the stewards of the world's tropical forests. They are not responsible for climate change, but its effects will fall heavily on those with the least resources to adapt. Their forests sustain the livelihoods of 1.4 billion of the world's poor, and with no other source of fuel, fodder or income many of them have no choice but to degrade forests to survive. Unless addressed urgently, climate change will lead to decreased agricultural production, increased poverty, forced migration and human conflict. Dealing with forests now will help the poor and address food, energy and environmental security for everyone – increasing the likelihood of meeting the UN Millennium Development Goals. Forest peoples, communities and governments need real incentives to maintain and grow their forest capital. Deforestation and forest degradation are driven by external demands – for timber, beef, soya and biofuels – which destroy trees for land, raising the stakes of global warming. Yet tropical forests continue to be excluded from carbon markets that could provide the alternative strategies needed. Instead, perverse incentives are in force, encouraging continued conversion and degradation of forests and discouraging their restoration and capacity to contribute to sustainable development. The science is now clear and the technology is available, however conservation alone has proven no match for commerce. There is not enough donor funding available to have the large-scale impact necessary, but new market mechanisms can sustainably provide the additional sources of finance required.

Action on forests now is a win against climate change, a win for vital forest ecosystems, and a win for the whole of humanity.

We therefore call on Governments to:

1. Ensure that carbon credits for reduced emissions from deforestation and the protection of standing forests are included in all national and international carbon markets, especially those created by the UN Framework Convention on Climate Change.
2. Simplify and expand carbon market rules, including the Clean Development Mechanism, to encourage reforestation, afforestation and sustainable forest management.
3. Include tropical forest and land use carbon credits in the European Union Trading Scheme, while maintaining strong incentives to reduce industrial emissions.

4. Encourage early action and new market mechanisms that recognise the value of carbon stocks and forest ecosystem services, and support appropriate voluntary carbon market standards.
5. Provide assistance for developing nations to build capacity to fully participate in the carbon markets, and to evaluate the ecosystem services their forests provide.
6. Incentivise the sustainable use of degraded land and ecosystems, and remove incentives that encourage forest destruction.

The Forests Now Declaration has been signed by over 300 high–level endorsers including leaders from right across the world's great tropical forests.

48. IN BIO VERITAS - COMPETENCE CENTRE FOR THE CONSERVATION OF BIODIVERSITY IN THE ATLANTIC FOREST OF BRAZIL.

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Keywords: Forestry: Conservation, sustainable use and benefit-sharing

On September 22nd, 2007 the **CENTRO INTEGRADO PARA A CONSERVAÇÃO DA BIODIVERSIDADE DA MATA ATLÂNTICA [Competence Centre for the Conservation of Biodiversity in the Atlantic Forest of Brazil]** was founded in the city of Curitiba, Paraná, Brazil. The following organizations participated: Staatliches Museum für Naturkunde Karlsruhe (SMNK), Zoological Department of the Federal University of Paraná, Soil Sciences and Agricultural Engineering of Federal University of Paraná (UFPR), Society for Wildlife Research and Environmental Education (SPVS).

The main objective of the Centre is:

- **To concentrate competences in order to improve and disseminate knowledge on biodiversity of the Mata Atlântica in a planned and coordinated way to be applied for its conservation.**
- The foundation of the Competence Centre was motivated and based on the following considerations:
- The demand for scientific knowledge on biodiversity has been recognized by the Parties of the Convention on Biological Diversity (CBD), however it is an extraordinary challenge for the megadiverse countries and those in development to know their own biodiversity;
- The situation of Natural Heritage of the Mata Atlântica is critical, due to continuous anthropic interference and missing integration of the parties interested in the conservation of its biological diversity, as well as to the dissemination of existing knowledge designated to subsidize practices in conservation management;
- The Southern Coastal region of São Paulo and the Northern Coastal Region of Paraná represent the major continuous remnant of Mata Atlântica and thus make it imperative to conciliate conservation of biological diversity with regional development in this area;
- The positive results of the developed activities in partnership with members of the projects SOLOBIOMA – Soil biota and biogeochemistry in southern Atlantic Rainforests of Brazil and TAXon-line – Network of Biological Collections of Paraná and the NGO SPVS – Society for Wildlife Research and Environmental Education show how cooperation rises the potential of individual activities and optimizes conservation efforts in the Mata Atlântica;
- The founders of the "Competence Centre for the Conservation of Biodiversity in the Atlantic Forest of Brazil" together with their partners in the running projects are already well skilled in research on taxonomy, ecology and conservation of the biological diversity of the Mata Atlântica.

Specific objectives of the Centre:

1. To produce, integrate and disseminate scientific knowledge for the development of models for a rational use of natural resources and for subsidizing public politics in conservation of biological diversity of the Mata Atlântica;
2. To identify, consolidate and consolidate ongoing initiatives on surveying biodiversity which might be used to define a National Base for Knowledge Administration on biological diversity of the Mata Atlântica;
3. To develop programs in environmental education, scientific visits and improvement of graduate and post-graduate students, subsidized by scientific researches;

4. 4) To represent a permanent initiative of valorisation of regional conservation organisations, both public and private, on the base of scientific research, educational activities and the search for continuous progress in structure and human capacities needed in those protected areas;
5. To standardize proceedings and methods by using specific protocols that allow future comparisons and integration of the results obtained by projects related to and/or coordinated by the Centre;
6. To define politics and procedures for a management of the collected biological material, e.g. for a deposit in scientific collections and accessibility of the non-sensitive data;
7. 7To decide about the possibility of integrating further representative regions in Paraná State giving priority to the Araucaria forests and the "Campos Gerais" after an evaluation of the results obtained during the pilot phase of 2 years.

Based upon the implementation of the above listed activities the **Competence Centre for the Conservation of Biodiversity in the Atlantic Forest of Brazil** aims for turning itself a generator and a pool of knowledge, integration, qualification of human resources, subsidy for activities, scientific and educational dissemination and a reference centre for the conservation of biodiversity of Mata Atlântica.

49. ACHIEVING FOREST BIODIVERSITY OUTCOMES ACROSS SCALES, JURISDICTIONS AND SECTORS

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Keywords: forest biodiversity, conservation, sustainable use, criteria and indicators, adaptive management

Mots clés: biodiversité forestière, conservation, utilisation durable, critères et indicateurs, aménagement adaptatif

INTRODUCTION

Throughout its history, the forest sector has been a mainstay of the Canadian economy. Canada's forests are 93% publicly owned, with primarily provincial/territorial management. The adoption of the ecosystem approach (Decision V/6) and Decision VII/11, recognizing sustainable forest management as a means of applying the ecosystem approach to forests, emphasized the need for synergy between forest management and conservation policies and action plans in order to maintain biodiversity.

The National Forest Strategy is one of the tools used by the forest community to build consensus, establish commitment to and governance over implementation of action plans and to assess success of outcomes. As Canada's framework for forest stewardship, it delineates objectives to deliver on the Convention on Biological Diversity's (CBD) program of work on forest biodiversity along with actions from other conventions and multilateral agreements. In 1995, the Canadian Council of Forest Ministers (CCFM), composed of federal, provincial and territorial ministers responsible for forests, developed a framework of criteria and indicators (C&I) to assess the progress in implementing commitments in the strategy and to measure progress towards sustainable forest management. The potential for the CCFM C&I to integrate information across scales, jurisdictions and sectors through cycles of adaptive management has not yet been fully realized. Development of necessary partnerships for full implementation of this mechanism could greatly enhance the ability to deliver on national commitments for the conservation and sustainable management of forest biodiversity and for extending and sharing the benefits derived from biological resources.

ADAPTIVE MANAGEMENT ACROSS SCALES: PRACTICAL EXAMPLES FROM THE FOREST SECTOR

Objectives for biodiversity are included in sustainable forest management policies in most Canadian jurisdictions and are considered to be as important as production objectives. Adaptive management, is a structured process of "learning by doing", whereby policies are deliberately designed to test and increase understanding of the effects of management activities on the system being managed (Holling 1978, Taylor et al. 1997, Walters 1997). Managing forest biodiversity using adaptive management principles is a commitment in the National Forest Strategy, the Canadian Biodiversity Strategy and is often incorporated into provincial/territorial legislation and policies on natural resources management. Although policy drivers exist, data and mechanisms to make information on forest biodiversity available for the assessment, reporting and adjustment phases of adaptive management are not well established.

MAINSTREAMING MULTI-SCALE ACTIVITIES THROUGH THE C&I FRAMEWORK

While Canada's ability to fully assess or provide a complete report on stewardship of its biological resources may be constrained by the lack of a national biodiversity monitoring program or standardized monitoring protocols, our analysis (McAfee et al., 2006) demonstrates the utility of the C&I framework as a common mechanism for information transfer across scales (Figure 1). The National Forest Inventory (NFI), the only extensive network of plots covering 1% of the land base of Canada, is a national monitoring grid with standardized protocols for collecting and aggregating information on biodiversity which, with appropriate partners and enhancement, could become the national ecosystem monitoring program. Criteria and indicators systematically used in conjunction with a national monitoring grid can result in harmonization of information and facilitate integration of biodiversity and forest policies with planning, management, monitoring, reporting and certification activities. The C&I provide a national framework to connect international, provincial/territorial, regional and local processes, systems and community initiatives for sustainable forest management through a national framework. Full integration of C&I, NFI and adaptive management, applied across spatial scales and sectors (e.g. agriculture, forestry, energy, mining) provides a road map for ecosystem based decision-making.

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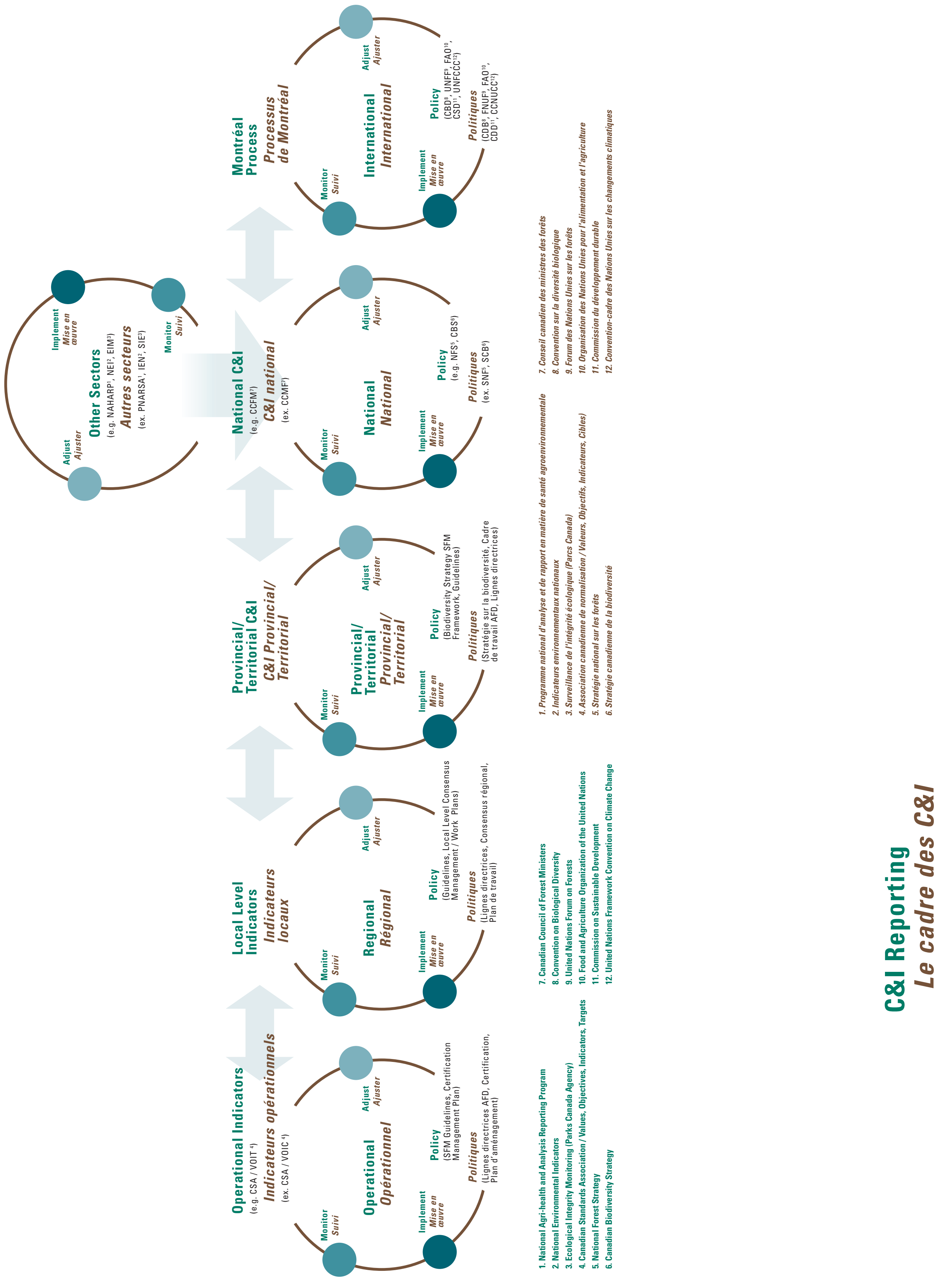

FIGURE 1: Criteria and indicators of sustainable forest management: an enabling tool to integrate cycles of adaptive management across spatial scales, jurisdictions and sectors.

50. TOWARDS A EUROPEAN FOREST STATUS INDICATOR

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Keywords: 2010 biodiversity target, indicators, forest, Europe

ABSTRACT

In order to support the Streamlining European 2010 Biodiversity Indicators (SEBI2010) process developing specific indicators to address the 2010 biodiversity target of reducing biodiversity loss an investigation has been carried out on feasibility of an aggregated 'Forest Status Indicator', comprising a number of indicator elements: forest structure, deadwood, crown condition, vegetation and naturalness. The indicator is proposed to be presented as a 'spider diagram' showing the current value of the different elements put in relation to target values.

The data for the indicator can be provided by existing and developing forest monitoring networks in Europe: National Forest Inventories, ICP Forests and ICP Integrated Monitoring plot networks, European LTER (Long Term Ecological Research) plots etc. A planned project 'Future forest biodiversity monitoring in Europe (FutDiv)' will ensure a coordinated European the dataflow for the Forest Status Indicator.

51. FOREST CERTIFICATION: HOW DO LATIN AMERICAN STANDARDS ADDRESS BIODIVERSITY?

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Keywords: forest management, sustainable use, indicators, criteria, standards

SUMMARY

The area of forest under sustainable management is an indicator for measuring progress towards 2010. The proposed basis for this indicator is the area of forest that is being managed under the different forest certification schemes. Questions have arisen around whether forest certification schemes do in fact do provide an adequate measure for the conservation and sustainable use of biodiversity within forest ecosystems. This study examines how standards for different forest certification schemes in Latin America address biodiversity to determine, which forest areas should be included to develop the 2010 indicator.

FOREST CERTIFICATION SCHEMES

Sustainable forestry and forest conservation have often been viewed as being incompatible as they are trying to achieve different objectives. For example forestry services are managing land for sustainable timber supply and forest conservationists are managing land for a wider range of ecosystem services and other conservation values. One approach to combining these two objectives in environmental sustainable management is the use of forest certification schemes. A range of forest certification schemes exist throughout the world, such as Forest Stewardship Council (FSC) accreditation, Programme for the Endorsement of Forest Certification Schemes (PEFC), Canadian Standards Association (CSA) forest products marking program, Sustainable Forest Initiative (SFI), Malaysian Timber Certification Council (MTCC), the Indonesian Ecolabelling Institute (LEI), Keurhout, Green Tag Forestry, American Tree Farm System (ATFS), ISO 14001 Environmental Management System, SCS's Independent Forest and Chain of Custody Certification Program, and The Climate and Biodiversity Alliance.

Forest certification is seen as one component of sustainable forest management and provides an assurance mechanism to providers of certified products and purchasers of forest products that they are promoting sustainable management as well as the conservation of biodiversity. Forest certification schemes operate in isolation from each other. There is a need for a more consistent picture of how forest certification currently and potentially contributes to biodiversity conservation.

THE 2010 BIODIVERSITY INDICATORS

The international community has committed "*to achieve a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on earth by 2010*". This 2010 Target was formally adopted by governments at the 6th Conference of the Parties of the Convention on Biological Diversity in 2002, and endorsed later that year at the World Summit on Sustainable Development. Subsequently, a number of indicators were proposed to measure progress towards this target. These indicators are in the process of being developed by a wide range of organisations worldwide, and are at varying stages of development and availability. One of these indicators has been identified as *the area of forest under sustainable management*. The study outlined below provides the background thinking to this indicator.

THE STUDY

The main objective of the study was to compare forest certification standards of Latin America to analyse how the standards address the conservation and sustainable use of biodiversity. The secondary objective of the study was to use the analysis to determine which forest areas certified under the different schemes would be used within the calculation of the 2010 biodiversity indicator, *Area of forest under sustainable management.*

Forest certification standards from FSC, PEFC, SCS, and SmartWood for seven Latin American countries were analysed. The analysis was undertaken by creating a matrix to compare the forest certification schemes using a set of biodiversity focal areas (see Table 1) which, were established based on different aspects of the conservation and sustainable use of biodiversity within production forests and previous studies of forest certification standards (Schulte-Herbrüggen & Davies, 2006; Meridian Institute 2002; Prabhu et al. 1996). The matrix examined the criteria and indicators set out in each forest certification standards and how each of these addresses biodiversity.

The area certified under each scheme was also examined and assessed in light of how biodiversity is addressed within the different forest certification standards.

SOME KEY FINDINGS

The conservation and sustainable use of biodiversity is addressed differently within the forest certification schemes. Standards do not just vary between forest certification schemes on how they address biodiversity but standards from the same forest certification scheme can vary between countries and even within countries, for example the FSC Standards developed for application in Chile address biodiversity in the most comprehensive manner, with the highest number of indicators forest managers need to be reported against and meet compared to other countries and standards (e.g. PEFC) examined. Interestingly, high demands of addressing biodiversity within any forest certified area in Chile, does not seem to have acted as a disincentive to certifying areas, with 13% of Chile's forest area being managed under a forest certification scheme (Table 2). This study highlighted that area certified by FSC, should form the basis of the indicator on based on forest certification schemes.

However, this study did not address the on-the-ground application of the standards, and even though standards may comprehensively address the conservation and sustainable use of biodiversity, the standard may or may not be implemented on the ground sufficiently for the benefits to be felt.

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TABLE 1: Biodiversity focal areas included in analysis

FOREST MANAGEMENT PLAN	ALIEN SPECIES	ECOLOGICAL FUNCTIONS (SOIL AND WATER MANAGEMENT)
Landscape connectivity	Conservation of ecosystems and habitats (High Conservation Value Areas, protected areas)	Off site impact
Genetic diversity at the forest management unit and in the project area	Conversion of natural forests	Environmental education
Rare, threatened and endangered species diversity	Monitoring systems	Mitigation and adaptation to Climate change
Native species diversity	Forest health (including the use of agro chemicals)	

TABLE 2: Area of forest managed under a forest certification scheme

COUNTRY	CERTIFIED AREA (HA)	% CERTIFIED AREA OF TOTAL FOREST AREA (HA)	FOREST CERTIFICATION SCHEME
Bolivia	2,090,353	3.56	FSC
Brazil	4,781,398	1.00	FSC
	835716	0.17	PEFC
Chile	399,801	2.5	FSC
	1,681,578	10.43	PEFC
Colombia	58,749	0.096	FSC
Guatemala	510,318	12.96	FSC
Mexico	719,156	1.11	FSC
Peru	388,686	0.56	FSC

52. TOWARDS A "GTI GLOBAL ASSESSMENT OF TAXONOMIC NEEDS AND CAPACITIES" – PRELIMINARY RESULTS AND ANALYSIS

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Keywords: GTI, Taxonomy, Global Assessment, Gap Analysis, Capacities

THE "GTI GLOBAL ASSESSMENT OF TAXONOMIC NEEDS AND CAPACITIES"

The Global Taxonomy Initiative (GTI) is a cross-cutting theme of the Convention on Biological Diversity (CBD) and has called for national, regional and global assessments of taxonomic needs and capacities (CBD/COP6 VI/8). Although at national and regional levels several assessments of taxonomic needs and capacities have already been conducted (see www.cbd.int), a global assessment is still pending. At its eighth meeting in Curitiba, Brazil, in March 2006, the Conference of the Parties (COP8) of the CBD has asked for the global GTI needs assessment to be completed as soon as possible (CBD/COP8/31 VIII/3).

CONTRIBUTION OF THE GERMAN GTI NATIONAL FOCAL POINT (NFP) TO THE GLOBAL ASSESSMENT

As a contribution towards a global assessment, the German GTI National Focal Point is currently compiling information on 1) the current state of taxonomic inventory of national biodiversity, 2) the availability of taxonomic collections and other relevant institutional resources per country, 3) the taxonomic information available for national conservation efforts and protected area management, and 4) the number of working taxonomists per country.

For information gathering two parallel approaches were followed: 1) available reports, publications and information sources, in particular through the internet, were searched for data and species numbers recorded or estimated per country for major taxonomic groups, specifically for microorganisms, plants (higher plants, ferns, and mosses), algae, fungi (including lichens), invertebrates (insects, other arthropods, molluscs), and vertebrates (fishes, amphibians, reptiles, birds, mammals); 2) a dedicated questionnaire (see http://www.gti-kontaktstelle.de/q.html) was sent to stakeholders and taxonomic experts worldwide, divided into three parts:

PART I: Assessing the relative state of knowledge of national flora and fauna. For each country, the number of known or recorded species for the larger taxonomic groups given above is queried, as well as the estimated number of expected species for the same groups. We will then use the proportion between the numbers of recorded vs. estimated species as an indicator of the state of knowledge. Reliable species numbers are more readily available for most vertebrates and higher plants (e.g., UNEP-WCMC 2007, WRI 2006), but are difficult to obtain for many other groups, especially micro-organisms, fungi, and most invertebrates, or in core areas of the tropics.

PART II: Identification of national and regional taxonomic institutional resources. In addition to biological collections and natural history museums, these resources also comprise taxonomic libraries, biodiversity databases, and other relevant information sources supporting taxonomic research and biodiversity inventories and assessments (e.g., ISIS 2007, WAZA 2007, Index Herbariorum 2007). Currently, there are no universal registries or comprehensive information sources for these institutional resources available, and data have to compiled through individual search.

PART III: Determining the availability of taxonomic knowledge for conservation. With most protected areas (PAs) and biodiversity conservation efforts being under national jurisdiction, PA and conservation management largely depends on nationally available taxonomic expertise and resources. As an indication for the nationally available taxonomic expertise, the comprehensiveness of biodiversity inventories and relative state of knowledge about biodiversity for specific PAs are being assessed for each country. Despite an increased emphasis on management plans and performance indicators for PAs and other conservation measures, information about the actual state of knowledge of their overall biodiversity is difficult to obtain. As a primary information resource, the UNEP/WCMC World Database on Protected Areas offers only limited data about the actual biodiversity for most PAs, and information has to be collected mostly case by case from individual sources (e.g., UNESCO 2007, ICE 2004, WDPA Consortium 2006).

PRELIMINARY RESULTS OF THE CONTRIBUTING STUDY

Preliminary results confirm that taxonomic expertise and resources are distributed unequally among different organism-groups and countries (Fig. 1). The number of taxonomists and the degree of knowledge about each country's biodiversity are positively correlated, whereas high species richness, both recorded and estimated, often is negatively correlated with the state of knowledge and availability of taxonomic resources. This underlines the urgent need for taxonomic capacity building in most biodiversity rich developing countries. Especially Central Africa needs more taxonomic expertise, as well as certain parts of Southeast Asia and Latin America (see example map of bird species, Fig. 2). Moreover, the taxonomic knowledge of many large but inconspicuous groups of organisms, such as algae, micro-organisms, fungi, and many arthropods is globally still very poor.

NEXT STEPS AND FOLLOW UP

The data obtained and an analysis will be presented as a separate study at CBD COP9 in May 2008. Results will also be made available online at the German GTI website [http://www.gti-kontaktstelle.de/], and distributed in digital form. Furthermore, it is planned that the data collected will be kept and updated as databases for further use, with the emphasis that the information can be stored sustainable for further assessments and reports, jointly with additional partners and stakeholders.

The study to be presented to the Conference of the Parties and the CBD Secretariat is expected to contribute towards the GTI Global Assessment, for which additional contributions and participation will be needed. It is hoped that this study will serve as a motivation for further contributions and participation, and additional input will be welcome.

ACKNOWLEDGMENTS

We thank the Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety (BMU) and the Federal Agency for Nature Conservation (BfN) for funding. We highly appreciate support from WCMC, UNEP, WDPA, UNESCO, BioNET International, IUCN, the Nees Institute, ETI BioInformatics, GBIF, EDIT, CLECOM, Algaebase, Pilzoek, UNEP-NEI, UNEP/GRID, UNO, CBD, fishbase, ICE UC Davis, ORNIS, MANIS, and all institutes and persons we did not mention here in person but supported us with data. Most valuable input was provided by numerous GTI NFPs (25) and additionally 84 experts.

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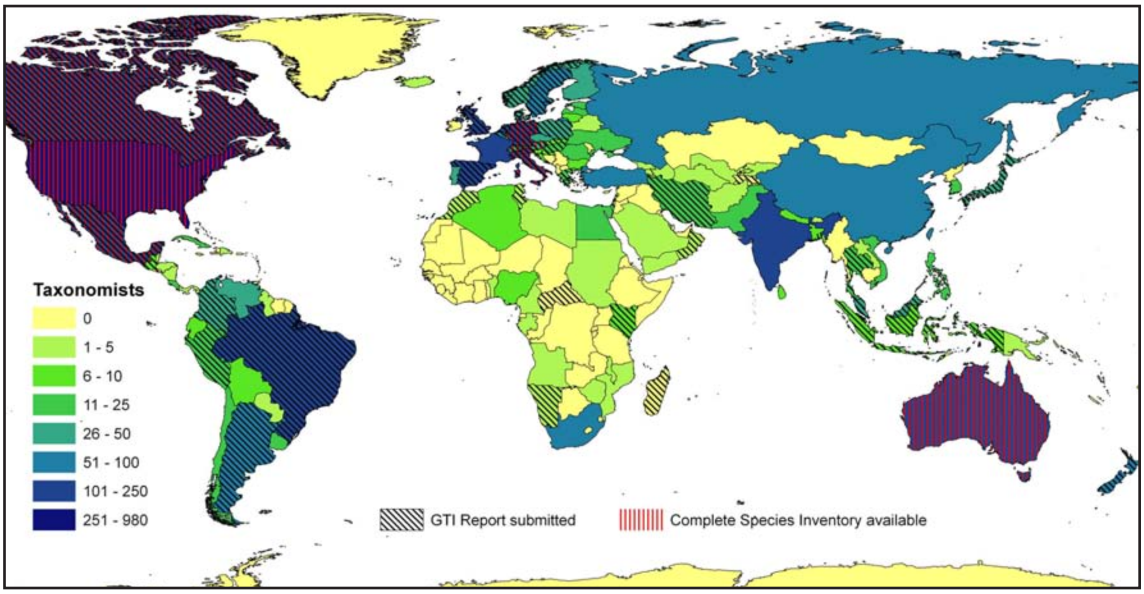

FIGURE 1. Numbers of (professional) taxonomists per country mainly derived from the ETI (2007). Total number of Taxonomists = 4,539 (ETI, 18 Oct 2007).

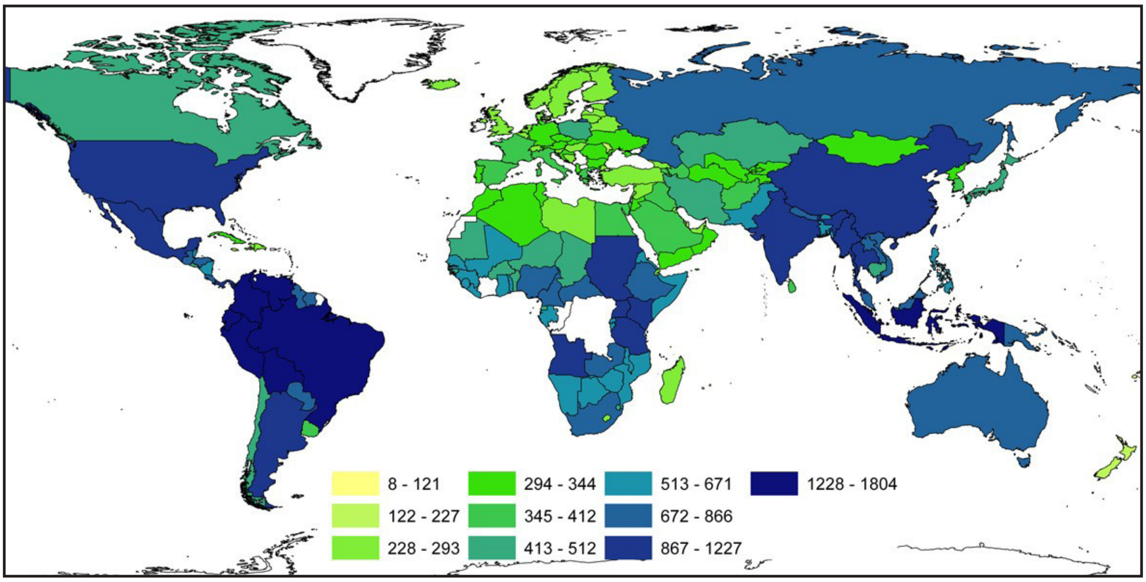

FIGURE 2. Preliminary results for bird species per country, derived from BirdLife International (2006) and UNEP-WCMC (2007).

53. THE EDIT NETWORK: MAKING TAXONOMY AVAILABLE FOR CONSERVATION EFFORTS

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Keywords: Global Taxonomy Initiative, biodiversity loss, taxonomic research, collections, expertise, infrastructures, IT, capacity building

INTRODUCTION

Measuring biodiversity change implies a sound basis of taxonomic knowledge, which presently is very far from sufficient. Overcoming the taxonomic impediment involves both having enough trained taxonomists and making taxonomic information available to those who need to use it. The European Distributed Institute of Taxonomy (EDIT) is a European Commission-sponsored Network of Excellence aimed at starting to overcome the taxonomic impediment through collaboration, integration and a joint work programme (http://www.e-taxonomy.eu). It is made up of 22 major European scientific centres in taxonomy, along with Russian and US partners. Through EDIT we hope to build capacity globally and provide information and tools for use by all. The EDIT proposal is an initiative of the Consortium of European Taxonomic Facilities (CETAF) which since 1996 has been working for better integration of the taxonomic effort in Europe.

ORGANISING TAXONOMIC WORK TO MAKE IT MORE USEFUL AND RELEVANT

The contribution of taxonomy to biodiversity conservation efforts is hampered by severe organisational and informational problems. EDIT fosters links between the world of taxonomy and conservation work in several ways. EDIT will create and maintain a list of taxonomical expertise and ways to reach it, in order to help conservationists find the relevant taxonomist partner to support their effort.

Similarly, EDIT is already organising the taxonomic survey of important areas in Europe, starting with a pilot program in the Mercantour (France) and Alpi Marittime (Italy) national parks. In this way, we increase taxonomy's relevance to the study and conservation of the world's biodiversity. We also make it scientifically viable, based on standards and protocols which allow repetition and measurement of change.

Documented specimens housed in taxonomic collections provide the only objective testimony of the occurrence of any species in any place at any time. Indeed, collections have already proven their value in this respect by allowing descriptions of new species, which have become extinct since sampled and would have remained forever unknown if specimens had not been preserved. EDIT works on the integration of this massive resource, and includes 30% of the world's existing collections.

EDIT is also working on facilitating scientific taxonomy in the field and in the lab, with the creation of web-based tools for taxonomists and non-taxonomist conservation workers alike. We support common work through new communication channels and methods, which will help coordinate large-scale research relevant to biodiversity indicators on a global level. The objective is to build up an Internet Platform for Cybertaxonomy, which will make interoperable the various existing components of the taxonomic activities and infrastructures, and will make them openly and freely available world wide. The EDIT activities will contribute to building up LifeWatch, the project for a new European very large distributed infrastructure for biodiversity information and analysis, and to the overarching GBIF.

THE EDIT CONSORTIUM

Muséum national d'Histoire naturelle – Project Leader (FR) ; Natural History Museum of Denmark, University of Copenhagen (DK); Consejo Superior de Investigaciones Científicas (ES); University of Amsterdam (NL); National Herbarium Netherlands (NL); Natural History Museum Naturalis (NL); Centraalbureau Schimmelcultures (NL); Freie Universitaet Berlin – Botanical Garden and Botanical Museum (DE); Natural History Museum, London (UK); Royal Botanical Gardens Kew (UK); Staatliches Museum für Naturkunde, Stuttgart (DE); Royal Belgian Institute of Natural Sciences (BE); Royal Museum for Central Africa, Tervuren (BE); National Botanic Garden of Belgium (BE); Museum and Institute of Zoology, Polish Academy of Sciences (PL); Institute of Botany, Polish academy of sciences (PL); Hungarian Museum of Natural History (H); Comenius University, Bratislava (SL); Institute of Botany, Slovakian Academy of Sciences (SL); Institut National de la Recherche Agronomique (FR); Society for management of European biodiversity data (IR); Species 2000 (UK); Komarov Botanical Institute of the Russian Academy of Sciences (RU); Zoological Institute of the Russian Academy of Sciences (RU); Missouri Botanical Garden, St Louis (USA); US National Museum of Natural History, Smithsonian Institution, Washington (USA)

54. THE EXPERIENCE OF THE "CARTA DELLA NATURA" PROJECT

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Keywords: map of nature, habitats, environmental quality, vulnerability, forested and rural areas biodiversity

INTRODUCTION

In Agreement with European policy, the Italian government has adopted European and International normative, such as the Rio Convention on the Biological Diversity, the Goteborg Strategy, the European Landscape Convention, the Habitat Directive and others, that have as objective the environmental and nature conservation of the biodiversity.

In order to evaluate the state of the natural environment in Italy, The *"Carta della Natura"* (The Map of Nature) Project was included into the Italian Law 394/91 on Protected Areas, this project identify the natural values and the environmental vulnerability of the country.

The Map offers a complex and synthetic representation of the reality, combining physical, biotic and anthropogenic factors belonging to ecosystems. The results is a framework of natural value but also anthropogenic pressure and habitats sensibility.

In order to carry out land management functions, this tool must be up-datable and multi-scalar.

Two main scales of investigations and representation were chosen, 1:250.000 and 1:50.000. At each scale, is chosen the distribution of the respective emerging aspect describing the environment as the basis for the assessment of value and vulnerability.

Landscape Types and Units Map (Landscape Ecology approach) at 1:250.000 scale and Biotopes or Habitats Map (modified CORINE Biotopes hierarchical classification system) at 1:50.000 scale.

PROJECT AIMS AND METHODS

The Physiographic Units of the Italian Landscapes Map, area the representation of the principal phyisiographic and landscape features of the whole national territory, while at scale 1:50.000 are mapped the Habitats, classified according to the European code of nomenclature CORINE Biotopes.

The Maps are realized starting from the employment of remote sensing images, and considering some diagnostic elements, as the litology, the digital model of terrain, and other existing thematic maps and to the calibrate the working method, are important field surveys. As for Habitats Map to warrant uniformity in habitats interpretation, has been structured a reference legend, consisting of 230 items that represent all mapping habitats in Italy at 1:50.000 scale, for each habitat there is a identification key and a report related to CORINE code. The second step of the project consist in evaluating environmental quality and vulnerability. The evaluations are realized through the use of standardized computer procedures, using a set of indicators related to the physical, biotic and anthropogenic components of the territory. This kind of indicators were selected in order of their meaningness, analysis scale, availability and homogeneous distribution on national territory according to scientific literature.

The employment of computer procedures and homogeneous data ensure both the uniformity of a "standard" product on national territory and allows to the evaluation of different scenarios from the actual state, due to environmental changes or availability of further new data.

RESULTS : "*CARTA DELLA NATURA*" AMONG LANDSCAPE AND BIODIVERSITY

Thanks to multi-scalar description of the territory, to the definition of areas of great natural value, sensibility, or vulnerability and to the software procedures, *"Carta della Natura"* is a useful dynamic tool for many applications.

The studies and the products of *"Carta della Natura"* are focused also, on Biodiversity components as: habitats and species.

The Biodiversity Action Plan (BAP), adopted by the European Community, in fact, foresee "protection measures for key species and habitats"; and it declares that the sustainable protection of the biodiversity includes Nature 2000 Network and the threatened species, as well not-protected rural areas.

In "Carta della Natura" are present many elements of the BAP. First of all the uniform elements of knowledge of the habitats for the whole national territory, including agricultural areas and not only the Nature 2000 Network or Protected Areas. From all these mapped areas necessary information can be extrapolated to every action of environmental safety as: habitat type, location, distribution, rarity, conservation status. Furthermore it is possible to associate to the habitats their biodiversity components as fauna and flora both in reference to the complete lists of national taxa and to the most important threatened species.

The classification of habitats on the national territory allows to individuate regions of great ecological value, that are usually concentrated in pristine sites, which, however, are often fragmented by rural or pasture areas, including old fields or underused rural areas. These areas are, in spite of their low quality, functional to habitats connectivity, ensuring exchanges and dispersion between/of species. It is important to consider, in fact, that re-colonization of native species of rural landscape is an interesting element for biodiversity conservation. In rural landscapes these areas bordering native vegetation can represent semi-natural elements with ecological corridors functionality (Figure). Although agriculture areas are widely expanse over the entire Italian Peninsula, thanks to different morphology of the territory, they include a great ecological variability and biodiversity especially in areas of extensive agriculture.

Such knowledge allows to make considerations at national level, about the state of the habitats and to their biodiversity, with important implications for monitoring, protection and restoration actions.

The *"Carta della Natura"* geographic information system can be easily updated with new biodiversity elements, both at national or local level and with different type of detail.

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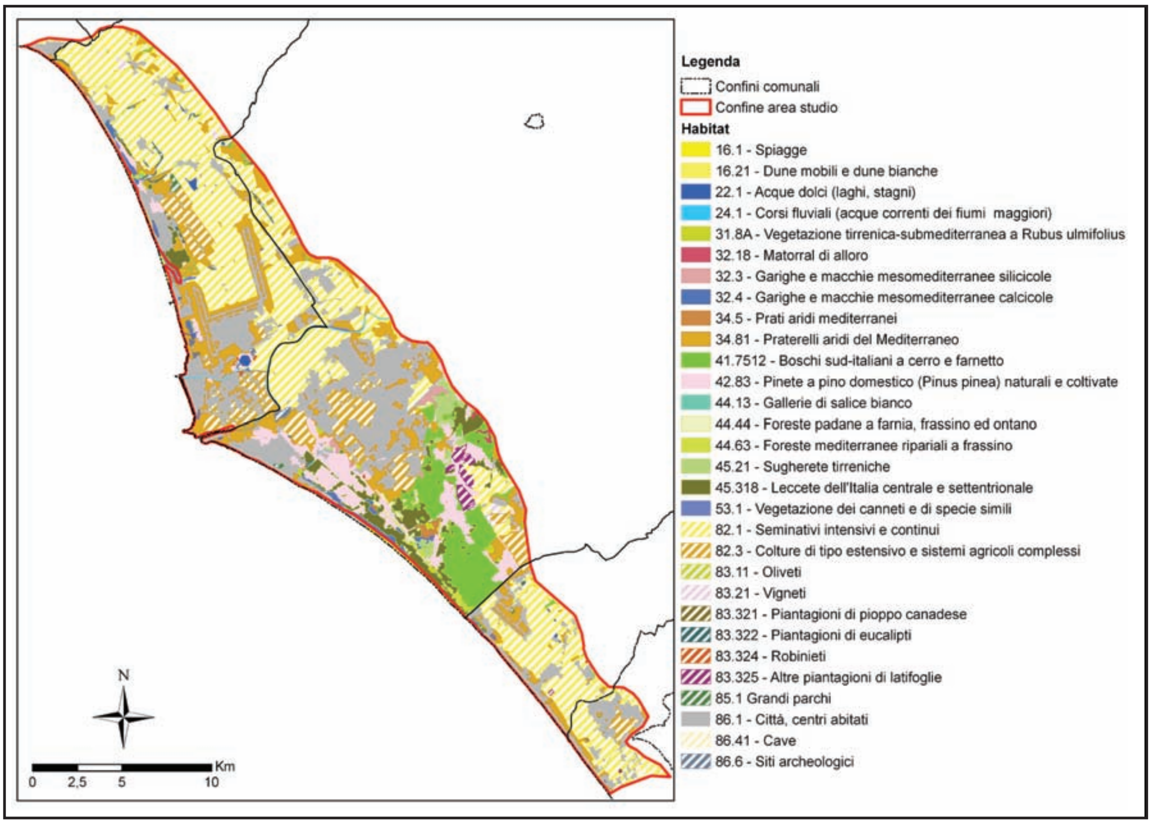

FIGURE. Habitats Map: Mouth of the *Tevere* River (Rome, Italy)

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