Biodiversity IN Development

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Crops and biodiversity

Increases in crop production, necessary to feed the growing world population, will depend on both improved yields and increased areas under crops. However, this must be done without undermining the biological functioning of the farming system and the wider environment, and without losing the genetic information so crucial to future plant breeding programmes.

Food crop species

There are around 7,000 plant species recorded as food and agricultural crops (out of an estimated 270,000+ higher plant species). Only 150 of these are commercially important, and only four (wheat, rice, sugar and maize) account for 63% of the world's plant-derived calorie intake. However, a range of other crops (for example yams, cassava and plantain) provide staple diets for millions of people across the world; and others, such as fonio and bambarra nut, have localised importance. Food security also depends on a varied diet to supply the nutrients not provided by staple crops.

In addition to food for human consumption, 32% of the world's cereal harvest, is used in concentrate feeds for pigs and poultry, generating an additional demand on agricultural land.

Supporting functions and services

Agriculture is underpinned by a range of biodiversity components, including:

- soil micro-biota (such as mycorhizal fungi and *Rhizobium* bacteria) which facilitate nutrient cycling, soil conservation, and nitrogen fixing;
- pollinators (for example, bees) which allow crops to reproduce;
- natural predators which keep pests in check.

Furthermore, services provided by the wider ecosystem include clean air and water, soil formation, and erosion control. While largely invisible, and therefore undervalued, these supporting systems are non-negotiable, and agriculture would be threatened if they ceased to function effectively.

Farming systems

UNDP figures estimate that traditional low-input cropping systems provide up to 20% of world food supply. These small-scale systems rely on agro-ecological practices such as leaving fields fallow to recover lost fertility, use of organic fertilisers, and natural pest management. Farmers also use and manage large

Horticulture

Horticulture is an important livelihood activity in some developing countries. In Burkina Faso, horticulture involves around 30,000 and generates up to 10 times as much income as traditional subsistence crops. In Kenya, the number of people involved in horticultural export (for example, of flowers) may be as many as 2–3 million. Small-holders growing for the export market derive around 80% of their total farm income from this source, meaning that they are likely to devote most of their resources to it, rather than to subsistence farming, or growing for local markets.

European Commission

DFID Department for International Development

IUCN The World Conservation Union

numbers of plant varieties, many of which would not be formally classified as crops. For example, agroforestry plots where trees and crops are mixed may contain up to 100 plant species per field. Local and indigenous knowledge systems have developed alongside these farming practices, and are crucial in their maintenance and enhancement.

Plant breeding allows the selection of desirable traits in an attempt to increase productivity. Modern varieties are often developed to grow in different latitudes and seasons, but for a particular set of growing conditions (e.g. soil fertility, water availability). They can be more resistant to pests or diseases that affect local growing conditions, and tend to perform better than local landraces so long as conditions are favourable. Improved modern varieties of rice and wheat are estimated to have contributed as much as $2 billion/year in Asia alone.

Modern varieties of a selected number of species and varieties have been steadily released into agricultural systems across the world, and by 1990, these Green Revolution varieties covered more than 50% of all rice fields in the South, with inevitable losses of crop biodiversity (see BB6). However, modern varieties do not necessarily result in loss of agricultural biodiversity. For example, in Peru, modern varieties of potato are grown for their high productivity, but local varieties are prized for their taste and high market price. Furthermore, interbreeding can take place through in-field hybridisation between modern and local varieties, leading to broadening of the local genetic base.

However, the risk associated with this spread of modern varieties is that they are genetically uniform, making them less able to adapt to changing conditions or to perform well in marginal lands. Modern varieties are also often more responsive to fertiliser and pesticide applications than local varieties, and their use has often been linked with heavy use of chemicals, encouraged by chemical companies and government subsidies.

Aspects of both traditional and modern systems can been drawn on to maximise crop productivity, whilst maintaining biodiversity goods and services. This can be done, for example, through the promotion of agro-ecological principles, which can enhance biodiversity in agricultural landscapes, and the participatory selection of improved crop varieties. This should involve: combining modern breeding techniques and gene selection with participatory techniques that incorporate farmers' priorities in the field, store, kitchen and market.

Access to and control of genetic resources

The privatisation of plant breeding has led to the establishment of plant breeders' rights which have little consideration for small-scale farmers, their food security, or their intellectual property. Patenting local crop varieties needs particular attention (see BB3+6).

Tropical countries are disadvantaged in terms of property rights over their resources. *Ex situ* collections established before the Convention on Biological Diversity (CBD) came into force are not subject to national sovereignty, mean-

Examples of differences between high yield and local crops

High yield crops	*Local crops*
One product (e.g. grain)	Several products (e.g. grain, feed for livestock, straw)
Homogenous products suitable for export	Heterogeneous products, difficult to export
Seed has to be bought	Part of the harvest may be saved as seed for the next season
Often not adapted to mixed farming systems	Traditionally adapted to mixed farming systems
Highly sensitive to climate	Locally adapted to climate variations
Replacement of natural vegetation	May correspond to natural vegetation
Traditional role of women may be undermined	Traditional role of women maintained

Source: Adapted from Thies 2000.

ing there are no mechanisms for prior informed consent and sharing of benefits. However, an important first step in achieving government responsibility over seed stocks was taken in 1994, when CGIAR/FAO decided to manage the International Agricultural Research Centre (IARC) collections to be held in trust for the world community.

There is also a relative lack of interest in research and development of local crop species and landraces. Less commercial species are rarely used in modern breeding: for example, cassava, a vital food crop in Africa, only makes up 0.5% of *ex situ* accessions.

Biotechnology

Biotechnology processes, such as transferring genes from one organism to another, can improve productivity through properties such as pest resistance. CGIAR estimates that transgenic crops could improve food yields by up to 25% in developing countries. Biotechnology methods can also improve the nutritional value of crops, or introduce edible vaccines. However, the technology is still in its infancy and needs extensive testing.

A number of potential problems of transgenic products have been raised, although the actual risks are uncertain:

- the transfer of genetically-modified traits to wild relatives;
- loss of effectiveness as insects develop resistance to a transgenic toxin;
- commercial biotechnology companies are likely only to invest in commercially-interesting characteristics;
- health risks linked to consumption of genetically-modified crops;
- loss of genetic diversity due to replacement of landraces by uniform genetically engineered varieties;
- movement away from crop species diversification by focusing on a few species;
- negative impacts on soil biota populations.

Impacts of agriculture on biodiversity

The spread of commercial agriculture is cited as the main cause of crop biodiversity loss. 75% of the genetic diversity of crops is estimated to have been lost in the last 100 years.

In addition, the expansion of agriculture is the prime cause of habitat loss in developing countries. For example, 37% of forest cover was lost to agriculture in developing regions for the period 1960–1980. Other impacts include the over-exploitation of water (irrigated croplands account for 65% of global withdrawal) and the application of agricultural chemicals which has polluted many freshwater and coastal ecosystems, and eliminated beneficial insects and micro-organisms.

JIM THORSELL/IUCN

The value of agriculture in allowing people self-sufficiency and autonomy should not be forgotten. Small-scale subsistence allows farmers to support themselves, and to make decisions concerning their futures.

These direct causes of biodiversity loss are prompted by market and policy failures, such as subsidies which encourage agricultural expansion and agro-chemical use. Lack of secure tenure also means that people fail to take long-term decisions concerning their land.

Recommendations

Removal of incentives which encourage unsustainable agricultural practices: by changing economic incentives against local varieties, minor crops, etc.; institutional barriers (e.g. collaborative plant breeding); institutional capacity; and policy barriers (e.g. seed regulatory framework).

Support national policies which promote a strategic approach to agricultural intensification and expansion, according appropriate

International framework for farmers rights

To address farmers' rights, FAO members established the Global System for Conservation and Utilization of Plant Genetic Resources for Food and Agriculture. Its components are:

- The non-legally binding *International Undertaking on Plant Genetic Resources for Food and Agriculture* adopted in 1983, whose focus is assisting farmers and communities in the conservation of plant genetic resources. The *Undertaking* is currently under review.
- The Commission on Genetic Resources for Food and Agriculture monitors the implementation of the *Global Plan of Action for the Conservation and sustainable utilization of Plant Genetic Resources for food and agriculture*, adopted in Leipzig in 1996.

http://www.fao.org/ag/cgrfa.

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Convention on Biological Diversity and agriculture

The Convention on Biological Diversity (CBD) (see BB15) has a programme of work on agricultural biodiversity and CBD conferences of the parties have produced three decisions on agricultural biodiversity (III/11, IV/6 and V/5) which emphasise the importance of mitigating negative impacts of agricultural activities on biodiversity. *http://www.biodiv.org*

Once it enters into force, the CBD Cartagena Protocol on **Biosafety** (see BB15) will be a legally-binding agreement to limit the risks from the trans-boundary transport of living modified organisms (LMOs) created by modern biotechnology. *http://www.biodiv.org/biosafety*

weight to conservation and sustainable use, and agro-ecological principles. This implies an assessment of the impacts of agricultural policies on other sectors (e.g. forestry). In addition, there is a need to address the underlying causes of agro-biodiversity loss. Implementation of these policies will require capacity building of sustainable structures.

Support benefit sharing, in particular, careful regulating of trading activities for fair pricing (e.g. through the WTO/TRIPs process). Support for the implementation of the Global Plan of Action and International Undertaking, with a focus on farmers' rights is crucial.

Investing in agricultural research with a decentralised, farmer-directed focus. This should involve the full participation of all stakeholders, including farmers and local communities, and especially women farmers. There is also a need for long-term research capacity building on biotechnology.

Support for participatory approaches to development of crop breeding and crop selection, taking farmers' priorities into account.

Support for effective participation by developing countries in global negotiations on the ownership of and access to genetic information, technologies, the products of breeding and new varieties, and implementation of intellectual property protection measures to protect the rights of developing countries.

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Further information

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- Cromwell *et al* in Koziell I & Saunders J (eds). 2000. *Living off biodiversity: exploring livelihoods and biodiversity issues in natural resources management.* IIED, London.
- FAO. 1998. *The state of the world's plant genetic resources for food and agriculture.* FAO, Rome.
- FAO Crop Genetic Resources *http://www.fao.org/sd/epdirect/Epre0040.htm*
- Food First *http://www.foodfirst.org*
- IPGRI *http://www.ipgri.cgiar.org*
- Thies, E. 2000. *Promising and underutilized crops and breeds.* GTZ.
- TRIPS *http://www.wto.org/*
- World Resources Institute *http://www.wri.org*

- reference to other Biodiversity Briefs is denoted as (see BB#).

Website

All Biodiversity Development Project (BDP) documents can be found on the website: http://europa.eu.int/comm/development/sector/environment