Biodiversity IN Development

Biodiversity Brief 1

The links between biodiversity and poverty

Poor people, especially those living in areas with low agricultural productivity, depend heavily and directly on genetic, species and ecosystem biodiversity to support their livelihoods. This support takes the shape of contributions to health and nutrition, reduced vulnerability, crop and stock development, and off-farm resource use. However, their livelihood needs are often subordinated to the interests of more powerful groups, so they receive fewer benefits from biodiversity, and bear most of the cost of development actions that reduce biodiversity.

Values of biodiversity goods and services

Biodiversity's role in supporting livelihoods is important at a number of levels.

Genetic diversity confers resilience. A broad genetic base allows crops and livestock to adapt to changing conditions. This is vital for the poor who cannot afford to rely on chemical fertilisers or the pesticides which protect monocultures from disease, pests and soil problems. Genetic information also provides the raw material which breeding programmes use to enhance crop and stock productivity, for example, for higher yield or disease resistance. It further provides information (real and potential) for medical science (see BB7) and biotechnology. This often-hidden value of genetic biodiversity is illustrated by California's barley crop, worth US$160 million a year, which has been protected from yellow dwarf virus by the introduction of a gene from Ethiopian barley.

Species diversity supplies a range of wild plant and animal products on which people rely for subsistence, barter and trade:

- foods, including fruits, nuts, fish, mammals, insects, birds and roots;
- wood for fuel, building, making tools, household implements and furniture;
- grasses, reeds and leaves which are used for thatch, mats, baskets, wrapping and livestock fodder; leaf-litter is used as fertiliser;
- various other products (such as oils, resins, bark, etc) are used as medicines, soap, for ritual purposes, etc.

Estimates show that, in rural Zimbabwe, wild products provide 37% of total household income and are as important as other income sources. Moreover, the poor are more dependent on a variety of natural resources than other segments of society: the poorest 20% of the community receive 40% of their total income from environmental products, whereas it only provides 29% for the richest 10%.

In addition, in times of shortage when staple products (e.g. crops) become unavailable, the poor fall back on a wide range of gathered

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species. In dryland India, for example, whereas wild products normally provide 14–23% of the rural poor's income, in times of drought this rises to 42–57%.

Ecosystem diversity involves interactions between plants, animals and micro-organisms, such as crop pollination and pest control, which are crucial for maintaining wild and agricultural landscapes. The interaction between living and non-living parts of the environment also provide ecosystem services, such as soil formation, water recycling, carbon sequestration, and climate regulation on which productive livelihoods depend. It is rare to see valuations of these services, because they are often invisible and difficult to measure, and are not traded in any market. However, the results of ecosystem destabilisation can be devastating: for example, floods in the Mekong Delta which have forced 1 million people from their homes, and the loss of 50,000 ha of farmland in Laos alone, have been directly linked to deforestation upstream.

Furthermore, many people maintain strong cultural and religious links with natural habitats or species within them: the natural world can provide people with a sense of place and well-being, not only for living populations but also for future generations.

Opportunities for poverty reduction

All these values provide opportunities for supporting or enhancing the livelihoods of poor groups. However, the greatest opportunities are likely to be where:

- biodiversity is of local, national or international significance, as it is more likely to attract funds and policy support;
- communities depend directly on biodiversity, and are more likely to have a commitment to long-term investment in managing the biodiverse resource;
- prevailing policy, institutional and labour constraints can be addressed. By removing these constraints, relatively small investments result in sustainable livelihood gains in areas usually marginalised by conventional development activity.

High biodiversity gives tropical regions a significant comparative advantage in linking livelihoods with biodiversity management. In the first place, investing in the conservation and sustainable use of biodiversity will allow communities to continue to rely on them for their present and future needs.

To date, most activities explicitly targeted at biodiversity in tropical regions have focused on conservation. This has usually been aimed at minimising human use of, or access to, areas containing unique landscapes and/or high levels of endemic, charismatic or rare species. As much of the world's biodiversity is found in tropical countries, this approach has merit. However, some of the needs of poor communities may not be compatible with conservation. In many cases, this has led to the modification of protected area management in favour of sustainable use parks and buffer zone development, which allow local communities access to resources (see BB15).

In addition, there are opportunities for enhancing peoples' livelihoods through establishing and exploiting biodiversity outside protected areas. The marketing of sustainably harvested plants can be geared towards organic or biodiversity-friendly markets in the West, and can be linked with certification and eco-labelling schemes. Sport hunting and fishing can attract tourists who pay high prices to cream-off a controlled quota of trophy animals or fish. The use of traditional knowledge is already gaining prominence in the context of medical science, where local knowledge on traditional medicine is helping guide the pharmaceutical industry in the search for new drugs.

The management of ecosystem or existence values (which are of value to society as a whole, rather than something that can be appropriated for private gain) can also be used to generate income. Ecotourism is an example of managing natural habitats for their beauty and recreational value which has some proven successes (see BB9). A less tested, but topical

The role that mini-fish play in many peoples' diets is crucial: the fish are often eaten whole, providing a number of essential protein, oils and vitamins (Okavango Delta, Botswana).

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Links between local livelihoods and biodiversity

	Decline in livelihoods	Improvement in livelihoods
Biodiversity loss	**1. Intensive and large-scale resource extraction of valuable resources by private companies** Target species (e.g. timber) are no longer available to local communities. Logging can lead to loss of other biological resources (e.g. non-timber forest products) which may be important for subsistence or income.	**2. Conversion of natural habitats to agriculture** Commercial agricultural systems favour monocultures, which lead to losses in crop genetic diversity, as well as natural habitat. It enables the large-scale supply of food to urban centres, and efficiency gains from economies of scale can bring product prices down thereby benefiting the poor.
Biodiversity maintenance or increase	**3. Strict protected areas** Protected areas yield conservation benefits, but local communities may suffer if their access to resources is restricted, or where crop raiding and livestock predation by protected wild animals increases.	**4. Sustainable management of biodiversity** Poor and indigenous communities in marginal tropical areas depend upon biodiversity, and their management techniques are often designed to maintain biodiversity for the use of future generations.

opportunity is investment in carbon sinks for reducing greenhouse gas emissions into the atmosphere. The conservation of natural forests in developing countries as sinks can provide communities with continued access to forest resources. Opportunities for carbon-trading, whereby rich countries trade their carbon emissions against carbon sinks in poorer, biodiversity-rich countries, may provide poorer countries with an important source of revenue (see BB12).

Constraints to linking biodiversity and poverty reduction

However, despite the opportunities presented, a number of constraints stand in the way. Improved livelihoods and enhanced biodiversity are not necessarily coincidental and the opportunities for a 'win-win' solution are limited. The table above illustrates the complexity of balancing the different values, interests and goals which converge in biodiversity management. In many if not most cases, there will need to be trade-offs between different activities, based on biodiversity and poverty criteria.

A principal constraint is that biodiversity is rarely assigned the same value by all stakeholders. Commercial interests tend to outweigh ecosystem services, socio-cultural values, future generations' needs, and the potential that genetic diversity has for scientific advances. Poor people themselves are often the cause of biodiversity degradation and loss, especially if lack of income alternatives drive them to over-exploit the resources. This over-use of biodiversity will only be reduced when tangible livelihood gains are derived from its sustainable use. However, there are few demonstrable examples of such gains, which tend to be long-term and difficult to measure.

It is important that mechanisms are in place to ensure the rights of poor people are respected, and that benefits accrue to them. Only in certain situations (e.g. low population density) are local populations able to freely reap benefits from biodiversity. Elsewhere, constraints such as lack of respect for local ownership and access rights make the equitable benefit sharing difficult. The equitable sharing of benefits arising from genetic resources is one of the aims of the Convention on Biological Diversity (see BB16). However, the equitable sharing of benefits arising from species and ecosystem values is also crucial for poverty alleviation. To exacerbate such constraints, the poor have little access to information, communication, technology and markets, leaving them at a disadvantage in negotiations and markets which could yield benefits.

Compensation or mitigation should be provided where the disadvantaged, particularly the poor, bear the costs of development activities.

Development cooperation

Development agencies have an opportunity to play an active role in supporting ways of making biodiversity work for the poor. Development cooperation should therefore address policy, institutional and legislative

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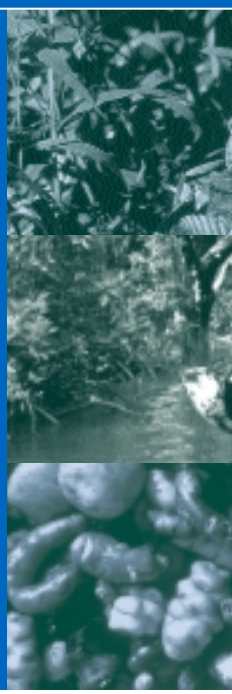

constraints at local, national and international levels:

- **Improving poor peoples' access to, and tenure of, biodiverse resources.**
  Support is necessary for the development of systems that recognise and accommodate the needs, rights, roles and responsibilities of diverse groups.

- **Involving the poor in decision making.**
  Investment is needed to ensure transparency in the processes of governance, and that policy development incorporates a much wider range of views. This might involve capacity building of representative groups, or the provision of accurate information to poor groups.

- **Better marketing of tropical biodiversity products from sustainable sources.**
  Much work needs to be done on market reform to make such products competitive, e.g. through the repeal of restrictive licensing rules, creation of incentives etc. (see BB4). Furthermore, participation of poor groups in markets is often hindered by their inability to meet quality and supply requirements. Development cooperation should support improvements in local production skills and technologies, plus capacity building and provision of market information.

- **More investment in research and development allocated to poor people's priorities.**
  There has been a tendency to invest in improving highly-productive agricultural systems that use only a few food species/varieties. This has undoubtedly yielded important benefits, especially for urban consumers, but smallholder, multi-species and organic production systems have suffered a lack of investment. This imbalance needs redressing to encourage biodiverse production systems, especially with the emergence of new markets that value the organic products of such smallholder systems. There is a need to demonstrate tangible benefits from the conservation and sustainable use of biodiversity.

- **Developing new mechanisms for exploiting the public interest in biodiversity maintaining products and services.**
  There is much potential for generating significant livelihood benefits from the contribution of biodiversity-rich areas to global public good values (e.g. climate regulation). This potential is likely to increase as biodiversity declines, and as international awareness of the consequences of this decline grows. At present, there exist few suitable transfer mechanisms, either voluntary or compulsory, but this is an opportunity for developing new approaches which should be investigated.

Further information

- Community wildlife management. http://www.biodiv.net
- Financial resources, incentive measures, impact assessment, and economic valuation themes. http://economics.iucn.org
- General information on biodiversity policy. http://iucn.org/themes/biodiversity
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- 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

Biodiversity IN Development

Biodiversity Brief 2

Trade policies and biodiversity

Trade liberalisation policies can have positive environmental impacts. They can improve the efficiency of resource allocation and contribute to economic growth and welfare improvement. But such policies can also lead to over-exploitation of natural resources, loss of wildlife habitats and the replacement of mixed production systems with monoculture practices. The poor in developing countries require additional support to take advantage of the opportunities provided by new trade policies, in ways that do not cause large scale losses of biodiversity.

Improvements in communications and transport, the removal of policy barriers and the integration of subsistence producers into national markets are enhancing the role of prices and markets in determining patterns of trade and production. Natural resources are frequently undervalued in these markets because little or no account is taken of external social and environmental benefits. Efficient markets require good information and mechanisms to ensure the users of any resource bear the full costs of its use. This presents two difficulties: first, tracing the path from increased trade to the impact on resources and biodiversity, and second, the design and enforcement of regulations and incentives (see BB4).

Trade liberalisation and biodiversity – unpredictable outcomes

Trade policies can influence biodiversity in different ways, and the impacts of trade liberalisation are often unpredictable. Even the global decline in primary commodity prices has had unexpected impacts. For example, some farmers in Cameroon did not harvest their cocoa and coffee trees when prices plummeted, but nor did they cut them down and replace them with other crops. They kept them in case there were future price rises.

The likely impacts of trade liberalisation on biodiversity have been considered below, under six themes:

a) Trade liberalisation can lead to **an increased demand for natural resources from developing countries.** This has led to over-exploitation in the past, especially where resource prices do not reflect the full environmental and social costs of consumption. But improved trading conditions could also provide incentives for sustainable management of natural resources. The latter route is possible where management institutions have sufficient capacity to regulate harvesting processes, where benefits of resource use are equitably shared, and where ownership of resources gives value to future benefits that might be gained from sustainable harvesting.

Where increased demand for endangered species is considered a threat to wild biodiversity, compliance with the Convention on

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The impact of trade demand for prawns means that fisheries focus only on these valuable species (caught here in the Moluccas Islands, Indonesia), and a substantial by-catch of other less profitable species are thrown back into the sea, dead.

International Trade in Endangered Species (CITES) can monitor and control this trade. Its effectiveness, however, depends on national legislation, and on the number of signatory countries. Another limitation is that CITES was not drafted to recognise that international trade can sometimes support conservation by providing financial incentives to protect species and habitats through sustainable use, although this role has been recognised at recent CITES conferences (see BB20).

b) Trade liberalisation can also give rise to **a shift in production between countries.** For example, liberalisation of trade in agricultural products between Europe and developing countries, through the dismantling of the European Union's Common Agricultural Policy (CAP), would be expected to provoke a global shift in agricultural production towards developing countries. Impacts on biodiversity will depend on associated changes in land use, such as conversion of forests and rangelands to agriculture. There is concern, but as yet no evidence, that global trade may encourage countries to adopt low environmental standards in order to attract investment and gain competitive advantages, and developing countries are concerned that the inclusion of environmental standards in trade negotiations could be used in trade protectionism.

c) Another consequence of trade liberalisation can be **a shift in the type of crops produced.** Within developing countries, trade liberalisation would be expected to stimulate a shift towards export production and away from production for domestic consumption. As a result, wealthy countries leave a 'footprint' in regions where liberalised trade policies allow global market demands to determine local land-use practices. Impacts on biodiversity may be negative, for example if sustainable mixed farming is replaced by large-scale exotic monocultures, as is the case with soya bean production in northern Brazil. They can also be positive, for example, where annual food crops in farm-fallow systems are replaced by biodiversity-friendly perennial crops, such as coffee growing under forest shade.

d) The **local availability of imported manufactured goods** is likely to increase in associa-

The Common Agricultural Policy (CAP)

The CAP restricts imports of food into the European Union, and subsidises exports (to dispose of the surpluses created by higher prices within the EU). It also raises the costs of European manufactured goods and other non-agricultural products (by imposing the price and tax costs of the CAP on European economies). The effect of the CAP is to increase the price of imported goods from developing countries, thus reducing demand for their products, and hampering growth of the agriculture sector. It also distorts local markets in developing countries, because cheaper imported foods from Europe remove incentives to develop local agricultural systems.

Green labelling and green trade

Voluntary labelling is becoming widespread, and can be valuable in informing the consumer about the biodiversity consequences of their choices. At the same time, it is important to ensure that green labelling does not unfairly restrict access by developing countries to the markets of developed countries. According to the World Trade Organization, compulsory green labelling constitutes a restraint on trade and is considered discriminatory.

Labelling raises questions about who should set standards. In forestry, it is set by independent, commercial organisations such as the Forestry Stewardship Council. A similar scheme, the Marine Stewardship Council, is being developed for fisheries. Both organisations are gaining credibility, increasingly being accepted by commercial producers and sellers, and making a valuable contribution to biodiversity conservation. As the costs of certification (labelling) will be higher for small producers and low volume sectors, it is possible that green trade and environmental regulations might lead to the exclusion from markets of some developing countries that cannot afford the necessary technologies. Development cooperation assistance could help to address this problem.

tion with trade liberalisation, depending on demand and distribution. The implications for biodiversity will depend on whether local goods are currently being produced sustainably, and whether the natural resources going into their manufacture will continue to be valued if imports replace them. Similarly the impacts of increased availability of fertilisers, pesticides and other imported goods on biodiversity will depend on whether current use levels are excessive. Input use is often relatively low in developing countries and, especially in the case of fertiliser applications, may be regarded as sub-optimal where depletion of soil fertility and reduced productivity encourages the clearance of new land.

e) Trade liberalisation provides **greater consumer choice**, and choices can be biodiversity-friendly or biodiversity-degrading. What is important is that consumers should be provided with information on the biodiversity impacts of their consumption, and that prices accurately reflect the full environmental costs of consumption.

Global trade encourages standardisation, as global markets prefer products that are uniform (in size, colour and taste, for instance) so that these can be graded and priced consistently. Again, implications for biodiversity are probably negative as production concentrates on relatively few varieties and production systems. On the other hand, increased global trade liberalisation can also create opportunities for niche products, such as green fair trade products that can be important in creating markets for, and adding value to, biodiversity.

f) The introduction of **new technologies** and new production standards in developing countries can be rapid, especially where trade liberalisation is associated with new opportunities for direct foreign investment. In some cases, such as improved technologies and standards for pollutant emissions and waste management, these will be biodiversity-friendly. In other cases, access to new technologies may speed biodiversity degradation: if new weapons become available for poaching, or new extraction machinery assists tropical deforestation, for example.

In many countries, the poor do not have access to the resources they need to respond rapidly and effectively to trade liberalisation, such as information and credit. Trade liberalisation may well promote economic growth, but it does not necessarily follow that it will also help with poverty elimination. The poor may be marginalised in the process, and forced to fall back on unsustainable natural resource exploitation during the transition period.

Recommendations

- Undertake strategic environmental and social assessments of trade agreements and related measures as part of negotiation processes. Issues identified should be addressed systematically at the international, national and local levels.

- Ensure that information is available for consumers to make informed choices, through support to voluntary labelling that is based on research and monitoring of the effects of different production systems or processes.

Consumer preferences, consistent pricing and ease of packaging can define the types of products which are successful in world markets. This means that a few species and varieties tend to predominate while local varieties are lost.

WWF-CANON/OHN MEWBY

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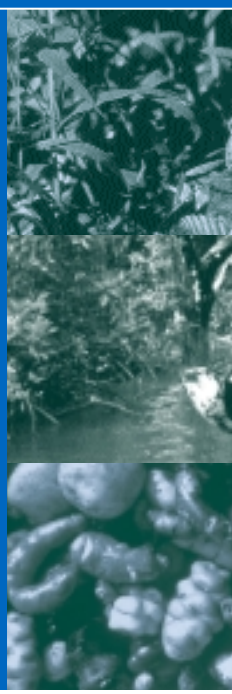

The World Trade Organization (WTO) and biodiversity

The WTO, established in 1995 to replace the GATT, is an international membership organisation that aims to abolish quotas and reduce tariff duties. It enforces multilateral trade rules through its dispute settlement process, and these rules, and a code of conduct, have been developed through successive negotiations under the General Agreement on Trade and Tariffs (GATT), the General Agreement on Trade in Services (GATS) and Trade-Related Aspects of Intellectual Property Rights (TRIPS).

The WTO includes some provisions specifically allowing environmental protection, for example import restrictions to meet national environmental and health and safety standards. The WTO agreement also allows payments to farmers through environmental programmes, subject to certain conditions, and it allows government support to industry to cover the cost of adapting to new environmental legislation. However, current multilateral trade rules prevent governments from setting high environmental standards or labelling imported products, even in accordance with local consumer preferences, because these measures could be used to protect national trading from the open market. Greater international harmonisation of environmental standards is one way to circumvent this problem, but in some cases it may be important to retain a flexible response by governments to local conditions.

The WTO's Committee on Trade and Environment is concentrating on analysing the trade impacts of environmental policies and, more recently, on ways in which international markets can promote environmentally-friendly production in addition to conventional gains in income and development (win-win scenarios).

- Develop international markets sensitive to biodiversity concerns, and trade in products and services from biodiverse ecosystems, for example, nature tourism (see BB9).
- Correct perverse incentives and develop positive incentives that encourage improved use of biodiversity products (see BB4).
- Strengthen national capacity to design, implement and enforce appropriate policies and regulatory systems to safeguard the environment and biodiversity. Note, however, that the World Trade Organization is inclined to rule against environmental regulations that it views as restricting free trade (see text box).
- Work with the poor to enable them to benefit from the opportunities provided by trade liberalisation, in ways which do not deplete biodiversity, for example, by assisting poor farmers to diversify if output prices fall as a result of new trade policies.

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

Website

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Biodiversity Brief 3

Sharing the benefits from genetic resource use

Genes, and the biochemicals they encode, are used to develop products by a variety of industries: pharmaceutical, herbal medicine, personal care, cosmetics, horticulture, crop production and biotechnology. Despite the potential gains, however, few local communities have benefited from bioprospecting[1] to date.

Genetic resources often originate from tropical regions, where they are found in greatest diversity. In some cases they are collected from lands inhabited by local communities, and traditional knowledge is used to identify potentially valuable resources. However, the benefits from the commercial use of these genetic resources have largely been enjoyed by companies and research institutes in the North.

What constitutes genetic material and resources?

The Convention on Biological Diversity (CBD) defines genetic material as *'any material of plant, animal, microbial, or other origin containing functional units of heredity'*, and genetic resources as *'genetic material of actual or potential value'*. It calls for *'the fair and equitable sharing of the benefits arising out of the utilization of genetic resources'*.

These organisations have the technology for product development, and can obtain intellectual property rights (IPRs) and patents on novel products to protect investments in research and development.

Although the CBD highlights the need for benefit-sharing with local and indigenous communities, it leaves benefit-sharing policy to be defined in national law.

The problem of *ex situ* collection

Although the global markets for crops and pharmaceuticals that have been developed from genetic resources are considerable, benefit sharing with local communities is limited because genetic resources are usually acquired from *ex situ* sources (e.g. gene banks and botanic gardens). The majority of these resources are not bound by the CBD because they were collected before its entry into force. Similarly, ethnobotanical knowledge is usually obtained from published sources rather than directly from indigenous and local communities. However, almost all pharmaceutical companies use some *in situ* material collected from protected areas or community lands, and this demand is likely to continue, provided national access legislation does not become too restrictive.

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What the Convention on Biological Diversity has to say about benefit sharing

Article 15(7) requires Parties to *'take legislative, administrative or policy measures…with the aim of sharing in a fair and equitable way the results of research and development and the benefits arising from the commercial and other utilization of genetic resources with the Contracting Party providing such resources'*. Access should be subject to *the prior informed consent* of the Party providing the resources, and on *mutually agreed terms.*

Article 8 (j) requires Parties to *'respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles…and encourage the equitable sharing of the benefits arising from the utilization of such knowledge, innovations and practices'.*

Recognising community rights

Indigenous and local communities play an important role in the management and conservation of genetic resources, and in the development of traditional knowledge, and often depend on these resources for their livelihoods and cultural practices. However, the CBD does not provide clear legal rights to local communities over their knowledge or genetic resources.

Legislation on access to genetic resources[2] should be developed with the active participation of local and indigenous communities and require their prior informed consent (PIC) for the use of their genetic resources and/or traditional knowledge. For example, PIC from indigenous communities in the Philippines is required for collections of genetic resources within their ancestral domains. Applications will only be approved when a 'PIC certificate' is submitted, signed by the local community or local authority.

Countries should also develop *sui generis*[3] laws to protect traditional knowledge, that are in accordance with customary law, have the active support of indigenous people, and form part of a broader strategy for implementing Article 8(j) of the CBD (see text box). Much traditional knowledge is ineligible for patent protection because it is in the public domain. Furthermore, applying an Intellectuel Property Rights (IPR) model that is based on the notion of private property to knowledge which is collectively owned by a community or ethnic group, could undermine the cultural basis on which the existence of such knowledge depends.

The WTO Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) does not recognise the contribution of traditional knowledge, or the need for benefit-sharing. To improve compatibility with the CBD, certificates of origin could be introduced at national and/or international level, obliging patent applications to provide evidence of PIC from the country of origin and local community. Another option is to introduce a global system to protect traditional knowledge at WTO level.

Local communities have long relied upon a range of wild medicinal plants. Pharmaceutical companies that wish to make use of these plants need to engage in benefit-sharing contracts, based on the rights of the local community as recognised in national law, over genetic resources, traditional knowledge, natural resources and land.

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Non-binding measures can be used to reinforce community resource rights. Examples include community biodiversity registers, local access protocols and codes of conduct for collectors and users. Motivation on the part of companies and intermediaries, who collect resources on their behalf, will be essential to ensure that benefits are shared with local and indigenous communities.

Benefit-sharing in practice

Although benefit-sharing with local communities is still uncommon, a number of examples exist, particularly in the pharmaceutical and herbal medicine sectors (see text box). The benefits can include fees per sample, up-front payments, milestone payments and royalty payments on product sales, and can provide short- and long-term employment as well as finance for community development and biodiversity projects. Non-monetary benefits include training, capacity building and involvement in research and development.

Local communities can benefit most when:

- a range of benefits are shared, including non-monetary benefits, to enable communities to add value to their resources;
- the resources are supplied by the community after initial collection, and harvested on a sustainable basis;
- initiatives are community-driven as with the sale of medicinal plants and related products.

Specific benefit-sharing arrangements are subject to mutually agreed terms, on a case by case basis. In the pharmaceutical sector, royalties are only possible if a commercial product is developed[5], which can take 10–15 years, while in the herbal medicine sector, benefits are usually greater in the short- and medium-term, and lower in the long-term.

Establishing benefit-sharing agreements

The practical difficulty of obtaining PIC represents an important constraint to benefit-sharing with local communities. For foreign users or in-country scientists, the challenge is to know from which community PIC is required, and how to undertake the consultation without excessive complication or delay.
For a community, the challenge is to understand the proposed terms and negotiate a fair deal. PIC will be facilitated if indigenous and local communities are represented on a committee or by a focal point established to approve access applications.

Examples of benefit-sharing agreements

1. Kani people, India
The Tropical Botanic Garden and Research Institute (TBGRI) in Kerala, developed an energy-giving drug 'jeevani' using information from two Kani tribes. TBGRI obtained a patent for the drug and granted a licence for its manufacture and sale to an Indian pharmaceutical company for a fee of $25,000. TBGRI agreed to share 50% of the fee and royalties with the Kani of Kerala, through a trust fund for development and biodiversity activities.

2. Aguaruna people, Peru
The International Cooperative Biodiversity Group[4] in Peru involves Washington University (WU), Aguaruna and Huambisa communities, two Peruvian universities and Monsanto-Searle Co (M-S), in three agreements:

- Biological Collecting Agreement between the Aguaruna and Huambisa Peoples (represented by four organisations) and WU, with basic terms of sample collection and benefit sharing;
- licence option agreement between WU and M-S that covers financial benefits including royalties;
- know-how licence between the Aguaruna and M-S that outlines the use of traditional knowledge by M-S and specific benefits.

Short- and medium-term benefits from research activities and advance payments were dedicated to those communities actively involved, and long-term contingent benefits (e.g. royalties) to all Aguaruna communities.

Trust funds can be used to share benefits equitably at local level through projects identified by the community. They should be managed by the community according to agreed objectives. It may be necessary to consult and compensate a number of communities if, for example, there is a common cultural heritage and shared traditional knowledge in the area. Two funds might be established, one for the communities that are directly involved and a 'common fund' to which eligible communities can apply. This type of arrangement will be facilitated if traditional systems of governance are still in place.

Complications arise if the genetic resources or knowledge occur over large areas, since ownership of the resources may then be contested. If the same genetic resources occur within regions occupied by many communities and several countries, then some form of international agreement backed by national legislation would be required to regulate bioprospectors going to places where no licence is required.

The role for development cooperation

The CBD obliges developed countries to provide finance through the Global Environment Facility (GEF) for implementation of the CBD

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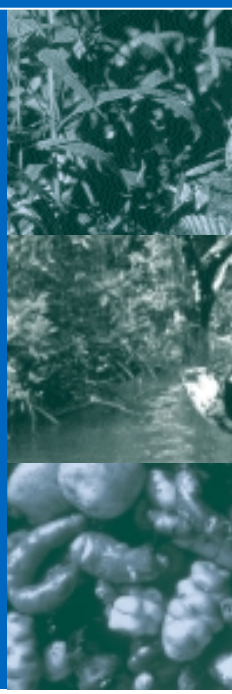

in developing countries. However, additional assistance is needed to enhance benefit-sharing with local communities, for example to:

- Encourage benefit-sharing of genetic resources from *ex situ* resources, such as gene banks and botanical gardens (e.g. by developing a protocol to the CBD), and improve compatibility between the CBD and WTO/TRIPS.
- With the participation of local and indigenous communities, develop clear and efficient legislation (a) to regulate access to resources that require PIC, (b) to protect traditional knowledge and (c) to strengthen the capacity for implementation of benefit-sharing.
- Reinforce PIC requirements through community biodiversity registers, local access protocols, codes of conduct, monitoring of exports, and improved recognition (in law and in practice) of community rights over land and natural resources.
- Facilitate the establishment of benefit-sharing partnerships with indigenous and local communities by developing PIC guidelines, strengthening representation of indigenous and local communities at national level, and raising awareness of communities in potential collection areas.
- Build the capacity of local communities to add value to resources, strengthen links to markets and establish community-driven ventures.
- Engage the private sector in access debates and facilitate dialogue between stakeholders.
- Support measures in user countries by promoting best practice for industry, complementary legislation, monitoring of imports and information sharing.

1 Bioprospecting is the search for useful genes and biochemicals.
2 Access laws have been introduced, or are being developed, in some 50 countries.
3 *sui generis* means 'unique' or 'of its own kind'. Peru is the only country so far to have developed such a law.
4 Established by the US National Institute of Health, National Science Foundation and USAID to promote bioprospecting and share benefits with local communities in a number of countries.
5 Approximately 1 in 10,000 genetic samples will result in a commercial drug.

Further information:

- CBD http://www.biodiv.org.
- Genetic biodiversity http://www.rafi.org and http://www.grain.org.
- IIED http://www.iied.org.
- ten Kate, K. and Laird, S. (1999) *The Commercial use of Biodiversity: Access to Genetic Resources and Benefit-Sharing.*
- Research http://www.idrc.ca.
- Workshop on 'Best Practices for Access to Genetic Resources', co-sponsored by DGXI, EC, January 1998, Cordoba, Spain.
- 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

Biodiversity IN Development

Biodiversity Brief 4

Incentive measures for the conservation and sustainable use of biodiversity

Incentive measures seek to address the underlying causes of biodiversity depletion, particularly the fact that some individuals or organisations benefit from exploiting biodiversity without covering the full costs borne by society as a whole. Article 11 of the Convention on Biological Diversity (CBD) requires that *"each contracting party shall, as far as possible and as appropriate, adopt economic and socially sound measures that act as incentives for the conservation and sustainable use of components of biological diversity."*

Removal of perverse incentives

The removal or reform of perverse incentives (i.e. policies which encourage biodiversity losses) is the first priority. Perverse incentives can include subsidies, tax relief and below-cost resource pricing in the agricultural, energy, forestry, fisheries, mining and transport sectors, as well as marketing restrictions and seed distribution systems which encourage a narrower range of agricultural species and varieties. Their reform can be a very cost-effective approach to biodiversity conservation and sustainable use, sometimes generating additional economic benefits. Obstacles to their reform or removal may include opposition by stakeholders (from small farmers to multinational companies) who benefit from the *status quo*, lack of financial transparency and problems in identifying indirect impacts on the environment.

What is an incentive?

According to the CBD *'An incentive is a specific inducement designed and implemented to influence government bodies, business, non-governmental organisations, or local people to conserve biological diversity or to use its components in a sustainable manner. Incentive measures usually take the form of a new policy, law or economic or social programme.'*

UNEP/CBD/COP/3/24

Economic incentives

Economic incentives seek to address economic causes of resource depletion, such as inappropriate prices, unclear ownership of biological resources and the often high but short-term returns available from over-exploitation of resources, and thereby to encourage sustainable use of biodiverse resources. They include:

- Well-defined and secure property rights (common, private or state), including rights of exclusion. These are an incentive for sustainable resource use as they give greater security over future use and allow for long-

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WWF-CANON/MAURI RAUTKARI

Subsidies to support the development of export-based monoculture agriculture can lead to the loss of small-scale biodiverse mixed farming systems (this picture shows a field in Cameroon which combines yam and cassava cultivation).

term planning. They are a necessary, rather than sufficient condition, as the economic return also needs to be higher than from alternative uses. This normally requires additional marketing of resources, for example through ecotourism or fair trade practices in order to increase the value of biodiversity.

- The potential of bioprospecting deals combined with intellectual property rights (IPRs) has received much attention (see BB3). But developing mechanisms for assuring the IPRs of local and indigenous communities is a complex political, institutional and legal challenge, and the potential for new discoveries may be limited by diminishing discovery rates.
- Promotion of alternative income-generating activities aimed at reducing exploitation pressures is commonly a major component of conservation and development projects. However, such activities have often been additional to, rather than instead of, past unsustainable activities. An approach more promising than direct substitution of activities (e.g. livestock-keeping to reduce bushmeat hunting) is to focus on increasing the economic return for labour and other inputs into conservation and sustainable use activities.

The impact of economic incentive measures is uncertain, and they are often complex and difficult to implement. Great caution is needed. They are as likely to lead to over-exploitation as to sustainable management or conservation, and should be complemented by regulatory measures, at least in the short-term.

Regulation and market-based instruments

Regulation allows governments directly to enforce or restrict biodiversity-depleting activities. Standards, quotas and trade restrictions can be clearly documented, are legally-binding and are important in safeguarding biodiversity because they fix the maximum levels of resource depletion. Examples include emissions standards, game hunting quotas and international instruments such as CITES (see BB20). However, standards and quotas may frequently be ignored, and under these circumstances market-based instruments (MBIs) may be economically more efficient and flexible.

Fiscal MBIs, like taxes, fees and charges, give the user more choice over the level of resource use than is provided by regulations, while narrowing the gap between costs to individuals and to society (which include costs to the environment). Fiscal levels can be changed more easily than regulatory standards, and they can generate revenue for environmental activities. Examples include access fees for protected areas, pollution taxes and trophy fees from game hunting.

Other MBIs are based on trade in new forms of property rights. For example:

- Tradable permits, such as fishing and hunting quotas, combine the regulatory and market approach. Tradable permits encourage economic efficiency of resource use, since they are supposed to be traded until allocated to those able to realise the highest value. Permits distributed to local communities can become an important source of income.
- Forest-based carbon-offset trading involves a country or company which emits CO_2 paying another country or resource manager to absorb CO_2 in biomass growth, thereby gaining carbon credits to set against its own emissions. Forest conservation is a possibility under the Clean Development Mechanism (CDM) of the Kyoto Protocol, if ratified. The real concern for biodiversity, however, is that the CDM could encourage fast-growing tree monocultures, possibly leading to clearance of natural biodiversity-rich forests in the process.
- Tradable development rights work by compensating landholders for non-development or non-exploitation of land through purchase of the development rights (e.g. by a conservation organisation), or by providing them with development rights in less sensitive areas. In the former case the landowner retains the right to ecotourism or other sustainable land-uses.

It is an obvious caveat that MBIs depend on well-functioning markets, and these are notoriously absent in much of the tropical world. The more economically efficient measures tend to be complex, and politically and administratively demanding. In consequence, changes in political commitment and both administrative and technical capacity building are usually required for the effective implementation of MBIs. Another constraint is that the regulations, and the reasons for them, are often poorly understood by local communities.

Funding instruments

Environmental, conservation or trust funds are blunt financial instruments, in the sense that they do not provide direct incentives to the resource user. They can be valuable where biodiversity or natural habitats contribute a great deal to the public good, and where the scope for economic incentives or regulation is limited (as in the conservation of biological resources without any recognised commercial value). However, they can result in inefficient resource allocation. They have been successful when managed by independent organisations that have built effective, responsive and focused programmes, based on broad consultative processes. Examples of these funds include:

- the Global Environmental Facility (GEF) which covers the 'incremental costs' of providing global biodiversity benefits over and above national costs and benefits;
- provision of national funds for the environment, including capital endowment funds, national environmental taxes (an MBI) and debt-for-nature swaps.

International funding instruments are an important mechanism to capture the global 'willingness-to-pay' for conservation and sustainable use approaches, and to ensure that global benefits arising from biodiversity are met with global funding. They aim to bring national benefits and costs closer to global

Costa Rica's experience with market-based instruments

Costa Rica has been a pioneer in using MBIs to promote biodiversity conservation. In recent years, new institutional frameworks have been established for the commercial sale of rights to exploit forest genetic resources, carbon sequestration services and rights to watershed protection. In 1982, Merck & Co. and the National Biodiversity Institute (INBio) entered into a long-term bioprospecting deal, in which Merck made a one-off payment of $1 million, and will pay an undisclosed share (probably 1–3%) of the profits of any drug developed, while keeping the patent-rights. Carbon trading is also seen as a means of financing biodiversity conservation: Certifiable Tradable Offsets have been sold on the Chicago Stock Exchange and the proceeds used to help finance the country's protected area programme.

In the area of fiscal MBIs, private forest owners conserving their forests are entitled to environmental service payments of $280 per ha over a five year period in recognition of the carbon, hydrological, biodiversity and aesthetic benefits. The money to pay for this is raised through a combination of 'polluter and beneficiary' pays taxes, including a vehicle fuel 'eco-tax', a tourist tax and a 'forest conservation' tax on hydropower and water companies.

Stakeholder involvement

Depletion of biodiversity often leaves poor groups worse off, but efforts to protect biodiversity may also cause losses to local populations through restrictions on use of resources. In designing and implementing incentive measures, attention should be paid to promoting fair and equitable sharing of costs and benefits arising from biodiversity conservation and sustainable use. Stakeholders who depend on local resources for their livelihood, and who are often the *de facto* stewards of the resource, need to be compensated for losing income and opportunities as a result of conservation activities.

The private sector has a significant role in managing and using biological resources. Incentive measures affect a wide range of private sector activities, especially those in the agriculture, forestry, fisheries, biotechnology, pharmaceutical and energy sectors. It is essential to incorporate private sector interests and expertise in the development of incentive measures aimed at sustainable resource use.

It is a challenge to make the conservation of long-term values of biodiversity, such as climate regulation, viable. Instruments such as environmental funds, covering the incremental costs over and above national costs and benefits, provide a means of ensuring this.

WWF-CANON/EDWARD PARKER

This Biodiversity Brief is based on a draft by Charlotte Boyd of the Overseas Development Institute, and was edited by the BDP and Martyn Murray (MGM Consulting Ltd). Additional technical input was provided by Michael Richards of ODI and Britt Groosman.

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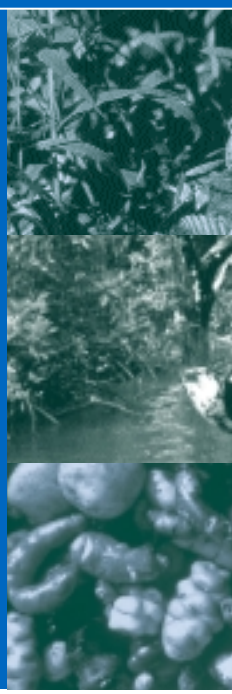

Underlying causes of biodiversity loss and suggested policy responses

Underlying causes	*Policy response*
Market failures leading to unsustainable patterns of production and consumption	Address externalities (costs of commerce born by others) through economic incentives, regulation and market-based instruments
Open access leading to over-exploitation	Establish and clearly define property and use rights
Policy failures (e.g. subsidies to activities which exert pressure on biodiversity)	Remove or reform perverse subsidies

Source: adapted from OECD 1999

benefits and costs. This transfer of resources is necessary because most biodiversity is concentrated in tropical countries with insufficient funds, and there may be costs from lost opportunities to biodiversity conservation and sustainable use approaches.

Framework for incentives

Incentive measures function within a broader set of existing incentives, derived from a complex interaction of society's laws, policies, property rights, social conventions, cultural norms and levels of compliance. The effectiveness of incentive measures will therefore depend on a supportive framework, including institutional reform, capacity building, information, education and awareness-raising. For example: weak inter-sectoral coordination (e.g. between mining and forestry activities) can seriously impede conservation and sustainable use policies. Lack of information can impede objective decision-making, and enlightened education and awareness-raising may be significant in influencing public support in favour of biodiversity conservation, and sustainable use.

Conclusions

Emerging principles lay emphasis on: the identification and removal of perverse incentives; effective regulation to support positive incentives; the best incentives address underlying causes of biodiversity loss, but are usually the most complex to implement. From an economic perspective, the main underlying causes of biodiversity loss are failures in markets, resource ownership and policy. They can be addressed through a combination of regulations, MBIs and incentive measures. The CBD has (through its Conference of the Parties) encouraged countries to review existing legislation and policies so as to identify and promote biodiversity incentives, and invited them to share experiences in using different incentive measures.

Further information

- Global Environment Facility http://www.gefweb.org
- IUCN economics unit http://www.economics.iucn.org
- OECD (1999) *Handbook of Incentive Measures for Biodiversity:* design and implementation. Paris: OECD
- WWF-MPO (1999) *Socioeconomic Root Causes of Biodiversity Loss: an analytical approach paper for case studies.* http://www.panda.org/resources/programmes/mpo/library/
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Website

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Biodiversity IN Development

Biodiversity Brief 5

Regional approaches to biodiversity management

National policies and planning for biodiversity management take place at the country level, but biodiversity and ecological processes, such as migration and species dispersal, do not conform to national boundaries. Nor is the impact of human activity on biodiversity limited by political frontiers. Trans-frontier and regional initiatives are needed to address cross-boundary issues, although they involve range of management and institutional complexities.[1]

Ecoregional approach to biodiversity management

An ecoregion is defined as a relatively large unit of land or water containing a geographically distinct assemblage of species, natural communities and environmental conditions. Ecoregions typically cross several international boundaries, such as the Pantanal Flooded Savannas (Bolivia, Brazil, Paraguay) and the Western Congo Basin Forests, (Cameroon, Equatoial Guinea, Congo, DRC, Gabon).

The main elements of ecoregion-based management include:

- defining the critical areas of land and/or water to be managed, ensuring that they are representative of the ecoregion, and sufficiently extensive to maintain ecological processes and viable populations over the long-term;
- analysing the causes of biodiversity loss and understanding how local, national, and international activities contribute to this process;
- working with local communities, governments and other stakeholders (including the private sector) to help define and implement a management vision for the ecoregion that includes development of regional institutions.

Many species migrate across international frontiers. Migratory mammals, such as wildebeest (East Africa) and saiga antelope (Central Asia) move hundreds of kilometres between two or three countries on a seasonal basis. Some species, including pests such as locusts and quelea birds in arid regions of Africa, move across many countries or even continents. Most marine species have much larger ranges than terrestrial species (whales travel between oceans for example). The distributions of non-migratory species tend to be restricted to a particular region – including the ancestral populations of crops and stock that are widespread today, but the regions may cross national boundaries.

The ecoregional approach may focus on biological issues. However, not only plants and animals span national boundaries, but also the threats to species and their habitats. For instance, high demand for natural resources may encourage unsustainable harvesting in several countries and necessitate a regional

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Mesoamerica Barrier Reef System

At the western edge of the Caribbean Sea, the MBRS is the largest barrier reef system in the northern hemisphere, with offshore atolls, sand cays, mangrove forests, beds of seagrasses, coastal lagoons and estuaries. It has spectacular underwater scenery with "blue holes" and is an important habitat for threatened turtle species.

There is a long history of reef use by local people, dating back to the Maya Indians. Today the barrier reefs are extremely important to the well-being of the local fishing and tourist industries. But the full economic potential of reef resources has yet to be realised, and the environmental protection they provide to the shoreline is under-valued. Potential threats arising from human activities include siltation from soil erosion, pollution from herbicides and pesticides, coastal construction and developments, oil production, collection of coral and shells, and dynamite fishing.

The governments of Belize, Guatemala, Honduras and Mexico have agreed to manage the entire reef cooperatively. Institutional development to achieve effective management of regional fisheries and a network of protected areas will be an essential part of this agreement.

approach to management, as illustrated by the conservation and sustainable use of some coral reefs (see text box).

Regional projects and programmes covering several different countries enable the promotion of biodiversity management on a larger ecological scale than is usually possible. This means that areas large enough to maintain viable plant and animal populations, or even ecoregions, can be managed coherently.

Many animals, such as these Burchell's zebra, need to make large scale migrations in order to survive, and may cross international frontiers as a result.

WWF/MARTIN HARVEY

The EC and regional cooperation

A regional perspective has become increasingly important in the political dialogue, trade relationships and development cooperation of the European Community. It is widely recognised that no other international donor has as many means, or as much expertise, to support and foster regional initiatives. Regional integration and cooperation are now key elements of sustainable development, including tackling of transboundary, social and environmental problems. The European Commission supports regional economic initiatives in three interrelated areas:

- building the capacity of regional institutions and national governments to assist regional economic integration;
- assistance to the private sector to facilitate restructuring in the larger regional and world market, including improvements to the financial sector;
- support to governments committed to implementing regional integration to help with transitional effects (complementary to national economic adjustment support).

Opportunities and benefits

Regional programmes provide an opportunity to coordinate the management of shared ecosystems, in response to common threats, or the regulation of harvesting of shared resources. The EC-supported South Pacific Regional Tuna Resource Assessment and Monitoring Project is one example. Starting in 1994, SPR TRAMP aimed to provide a scientific basis for managing tuna fishing in 10 countries, through biological research, scientific observer programmes, sampling and monitoring of tuna landings, and development of population dynamic models. During the course of the project, the need to manage the regional problem of by-catches of sharks, turtles, dolphins and other species arose as an additional focus.

Other benefits of regional programmes include standardisation and coordination of survey, training and research programmes. The ASEAN Regional Centre for Biodiversity Conservation, for example, provides an information and networking service to countries of the same ecoregion or geographic zone. It serves as the central focus for networking and institutional linkage among ASEAN Members Countries and between ASEAN and European Union partner organisations to enhance institutional capacity, and conserve biodiversity. The EC provides the means to support networking, applied research, training and technical assistance

while ASEAN provides the institutions and support personnel. Similarly, regional training programmes can be very effective – the Southern African Botanical Gardens Network (SABONET) being a good example.

Regional biodiversity projects can also advance the cause of intergovernmental cooperation on other issues. One of the most successful instruments for promoting regional cooperation and biodiversity conservation is transfrontier conservation areas (TFCAs), sometimes known as Peace Parks. TFCAs usually extend far beyond designated protected areas, and can incorporate such innovative approaches as biosphere reserves, bioregional planning, establishment of dispersal, buffer or support zones and migration corridors, together with a wide range of community-based natural resource management programmes.

Other advantages of regional cooperation include shared culture and language, shared management problems, and proximity to shared facilities in neighbouring countries.

Lessons learned

A particular issue for biodiversity is that, at an early stage in the development of regional programmes, all Authorising Officers (or equivalent) of member countries have to agree on a project which is in their mutual interest and for which they wish to secure EC funds. This in itself may tend to favour non-controversial projects that are likely to be popular, such as

WWF-CANON/ANTHONY B. RATH

A red mangrove and shallow water coral reef in Belize, part of the Mesoamerican Barrier Reef System.

Constraints and risks of a regional approach – the Mekong River Delta example

The Mekong's watershed includes six of Southeast Asia's richest and poorest nations. In 1995, Cambodia, Lao PDR, Thailand and Vietnam (the other two watershed countries being China and Myanmar) signed the Agreement on Cooperation for the Sustainable Development of the Mekong River Basin. Potential benefits of regional action include the establishment of a regional electricity grid, and a regional growth plan. The Agreement could also have environmental advantages, by encouraging countries to consider the downstream affects of their activities.

Disparities in the power and wealth of the countries involved pose problems in reaching solutions that are acceptable to all, especially how to balance obvious economic development opportunities (such as dam construction) with the river's livelihood benefits to the 55 million people who live in the river basin. Around 30% of these people live below the poverty line, and rely, for example, on the fish they catch from the river. Similarly, the silt load that the river produces is crucial for intensive farming systems in Vietnam and Cambodia, but less so elsewhere.

The Agreement on Cooperation specifies that the countries involved have neither the right to use nor to veto the use of the water of the Mekong, implying that consensus is necessary to move forward. The solution for the Mekong seems to be a balance: the careful selection and construction of environmentally 'good' dams over 'bad' ones, for example. But the financial and political clout of some countries may pose a threat even to this approach.

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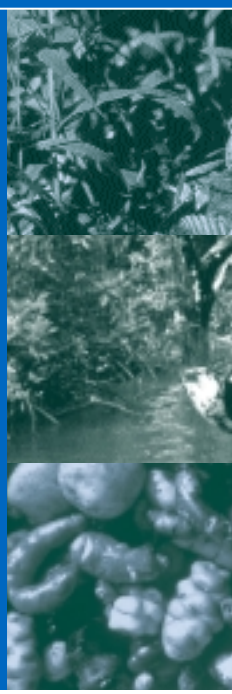

ECOFAC – addressing common problems

Anticipating increasing pressure for conversion of African rainforests for timber and agriculture, the EC-funded Programme for Conservation and Rational Utilisation of Forest Ecosystems in Central Africa was started in 1992. It has received some 40 million Euro to fulfil the request by the region's governments that a substantial part of EC European Development Fund funds be allocated to forest conservation.

A key to the success of ECOFAC has been a strong coordination unit based in Libreville that provides a forum for interested stakeholders from all six countries, brings together international and central African experts on a regular basis, and ensures that ECOFAC maintains a regional outlook.

the construction of a highway between capitals, rather than natural resource management projects.

In the case of projects involving natural resources, therefore, mechanisms that facilitate lengthy negotiations may be needed, especially if one country stands to gain more than others from some programme components. The result of negotiations must be a clear commitment from all concerned on the aims and objectives of the cooperation, which must also involve all stakeholders including local communities, other ministries, interested agencies, and the private sector. This means a clear definition of goals, and coordination of actions, with strong political support.

Another challenge is to ensure donor complementarity so as to increase the efficiency, synergy and scope of regional programmes. These will benefit from close attention during intergovernmental policy dialogues, such as the EU-ASEAN Senior Officials Meetings. Monitoring of programme performance will require greater than usual organisation and coordination, and evaluators will need to ensure that regional biodiversity concerns are adequately taken into account at later stages in the project cycle.

Effective implementation of regional programmes may require development of new legislative and regulatory mechanisms. However, lack of capacity for regional cooperation in existing institutions is frequently encountered, especially for environmental matters. Regional initiatives should nevertheless be based as far as possible on existing structures, since there is a danger that new institutions will not be sufficiently embedded in existing processes.

[1] In this BB, unless otherwise stated, 'regional' refers to actions involving more than one country.

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Biodiversity IN Development

Biodiversity Brief 6

Food security and biodiversity

The husbandry of domesticated species and the harvesting of wild plants and animals are the mainstay of human food production. 840 million people in the world do not have enough to eat – and the population is growing. This means that food production will have to increase 50% by 2020. Biodiversity is part of the solution, in that it provides the genetic information used in plant and animal breeding. Furthermore it makes vulnerable livelihoods more resilient by providing risk spreading options across a range of domesticated and wild species rather than relying on a few staples that may become susceptible to disease, pests, climate changes, and market collapse. It also provides diversity for a varied diet.

Biodiversity pyramids

The greater part of the world's food supply depends on a very limited number of plant and animal species. About 7,000 plants (2.6% of all plant species) have been collected or cultivated for human consumption. Of these, a mere 200 have been domesticated and only a dozen contribute about 75% of the global intake of plant-derived calories: bananas, beans, cassava, maize, millets, potatoes, rice, sorghum, soya, sugarcane, sweet potatoes and wheat. On the animal side, more than 95% of world consumption of livestock protein derives from poultry, cattle and pigs. There are about 1,000 commercial fish species, but in aquaculture fewer than 10 species dominate global production. Human food production therefore rests on the tips of pyramids of biodiversity, leaving the majority of species little-used and undomesticated.

Long-domesticated species tend to be highly diverse: for example, there are some 25,000 cultivars of wheat, more than 1,300 breeds of sheep, and over 20 varieties of common carp. In recent years, however, this variety has been reduced by genetic erosion. It is estimated that the number of wheat cultivars in China has dropped from 10,000 to 1,000 in 50 years; that over 90% of cabbage, field maize and pea varieties no longer exist; and that over 30% of livestock breeds are at risk of extinction. The causes of this genetic erosion are many, but replacement of local varieties as a result of the spread

Biodiversity and nutrition

The quality of food, especially in terms of supplying essential vitamins and other nutrients, is central to achieving food security and avoiding nutritional diseases. Although staple crops and stock provide most protein and energy requirements, they are often deficient in other nutrients. In rice-consuming countries, for example, common nutritional deficiencies include: iron, vitamin A, iodine, thiamine, riboflavin, calcium, vitamin C, zinc, fat, and ascorbic acid. Many of these nutrients are supplied by foods gathered from wildlands and fallows, upon which millions of people rely. They include green leafy vegetables which are cooked and eaten along with the meal, and which can provide important iron and vitamin A supplements. Other such 'minor' products include nuts, oils, insects, mini-fish, birds, roots/tubers providing a range or fats, vitamins, minerals, and oils.

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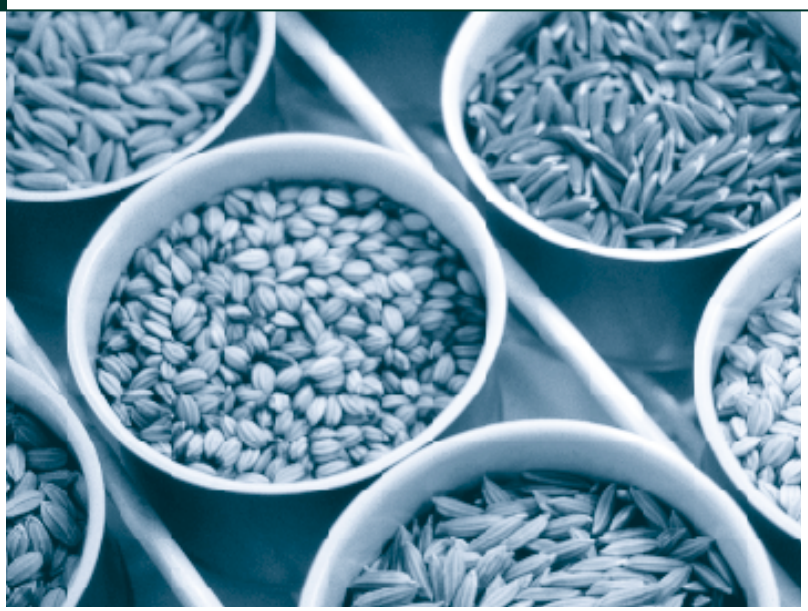


IRRI/CGIAR

Estimates of the number of rice varieties in the world vary; however their importance in providing a reliable and robust staple food for millions of people is undeniable.

of modern agriculture is the most consistently cited reason.

This loss of agro-biodiversity presents risks to food production, in three main ways:

- a narrowing of future options, through the loss of genetic information and genetic material that could be introduced into domesticated crops and stock through breeding;
- an increased susceptibility to disease and pests because fewer varieties and species are grown over large areas, which may also lead to pesticide (and even fertiliser) dependence;
- the destabilisation of ecosystem processes, through disrupting soil formation, predator-prey cycles, etc.

These risks apply particularly to poor farmers who have little access to technology or gene-banks for solutions, but they also apply to commercial breeders who depend on the diversity inherent in local crops and breeds, as well as in wild relatives of domesticated species, for future breeding programmes. Many varieties that have been developed locally, such as the 3–5,000 potato cultivars in the Andes, offer a vital starting point in future breeding programmes.

Crop and livestock biodiversity hotspots (areas with high genetic diversity), together with *ex situ* gene-banks, are the main repositories of genetic information. As a result they are at the centre of a conflict over ownership, because genetic resources have been treated as 'global goods', and multilateral agencies which develop gene-banks have sent seeds, semen and other materials to researchers anywhere in the world. The Convention on Biological Diversity (CBD) urges nations and communities to assess their biodiversity and establish their rights to its exploitation, but access to genetic resources that were gathered before the CBD came into force remain largely unregulated.

Small-scale and subsistence agriculture

Many poor farmers, especially those in environments where high-yield crop and livestock varieties do not prosper, rely on using a wide range of crop and livestock types. This helps them maintain their livelihood in the face of pathogen infestation, uncertain rainfall, fluctuation in the price of cash crops, socio-political disruption and unpredictable availability of agro-chemicals. So-called 'minor crops ' (more accurately, companion crops) play a disproportionately large role in food production systems at the local level. Plants that will grow in infertile or eroded soils, and livestock that will eat degraded vegetation, are often crucial to household nutritional strategies. In addition, rural communities, and the urban markets with which they trade, make great use of companion crop species, especially green-leafed pot-herbs.

Fallow fields and wildlands can support large numbers of species useful to farmers. In addition to supplying calories and protein, wild foods supply vitamins and other essential micro-nutrients. In general, poor households rely on access to wild foods more than richer ones (see table), although in some areas pressure on the land is so great that wild food supplies have been exhausted.

Government and donor policies to promote food production through monocultures may overlook these resources, distort farmers' decision-making and threaten biodiversity. A common problem has been the introduction of new varieties, or species, with high input-

Proportion of food from wild products, for poor, medium and relatively wealthy households

Survey site	Date	Very Poor	Middle	Better off
Wollo – Dega, Ethiopia	1999	0–10%	0–10%	0–5%
Jaibor, Sudan	1997	15%	5%	2–5%
Chitipa, Malawi	1997	0–10%	0–10%	0–5%
Ndoywo, Zimbabwe	1997	0–5%	0	0

Source: Save the Children Fund (ANA).

needs, and then subsidising chemical inputs. Programmes for maize production in drought-prone environments of southern Africa, for example, have deterred the use of a wide range of local crop varieties. And redirecting Indus River water to irrigated agricultural schemes, caused salination of the river's mangrove delta which changed from a diverse and highly productive region, supporting a large human population, to a sparsely vegetated area dominated by a single species, *Avicennia marina*.

Ecosystem disruption: introductions and agro-chemicals

Despite the benefits to local farmers of biodiversity-rich agriculture systems, indigenous varieties often have co-evolved pests and pathogens and may therefore have relatively low yields. In this sense, the introduction of crop species from outside their centre of origin has been extremely beneficial, and much agricultural development has relied upon it. But some introductions, accidental and intentional, have had significant impacts on local ecosystems, often with major implications for food security.

A common pattern is for a newly-introduced crop to be initially successful and then show declining yields, either through attack by evolving local species or from the introduction of a pest or pathogen from its region of origin (see BB7).

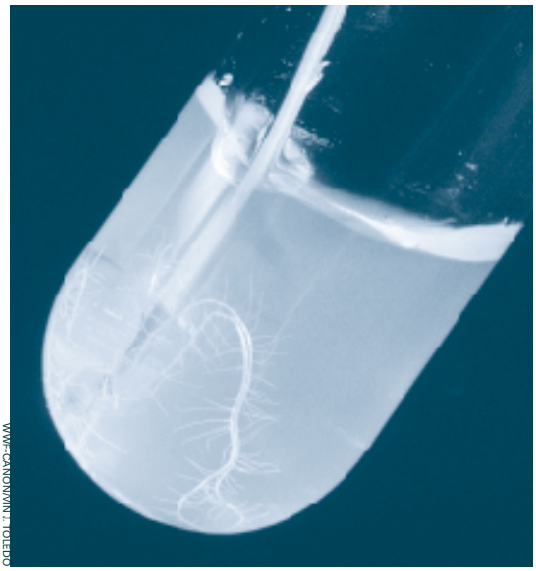
A different ecosystem balance that needs to be maintained for food production is in the soil, where invertebrates and microbes are central to decomposing dead materials and recycling nutrients as part of soil formation processes. Furthermore, there are important plant-soil relationships which should not be disrupted: certain soil fungi form mycorhizal associations on plant roots which enhance nutrient uptake from the soil; *Rhizobium* bacteria produce nitrogen-fixing nodules on plant rootlets. Applications of organic fertiliser, such as manure in mixed farming systems, tend to fortify these interactions and increase soil fertility, but loss of organic matter and/or large applications of inorganic fertilisers can lead to reduced soil fertility and pollution of waterbodies.

Breeding and biotechnology

A large part of the success of the Green Revolution can be attributed to genetic biodiversity that was harnessed to breed new, high-yield crop varieties. Modern plant breeding often aims for wide adaptability and tries to develop varieties that are insensitive to day-light length (and can therefore grow anywhere). It has often been directed to producing varieties that respond to fertiliser applications, and may be grown where pesticides and irrigation are available. The result is an increase in production, but a narrowing of the number of varieties grown. This can make them less accessible to poor farmers, and lead to the various problems noted above. A careful balance needs to be struck.

Part of the solution to addressing this clutch of problems is through participatory approaches to plant breeding and selection of new varieties. These attempt to decentralise plant breeding and incorporate the priorities and constraints of farmers more closely into the selection of new varieties. Farmers test them, often with low- level or no fertiliser, adopting them only if they outperform local varieties grown under the same conditions. In western India, participatory plant breeding has helped to conserve plant genes by crossing indigenous rice varieties that are more heterogeneous than those resulting from centralised breeding.

The most well-known and controversial examples of biotechnology are transgenic crop varieties, or genetically modified organisms (GMOs). These are the product of the transfer of genes from one organism to another, often resulting in genetic exchange between unrelated species (e.g. daffodil genes into rice). Most GMOs offer herbicide tolerance or insect resistance and are commonly directed at commercial farming in the North. The potential of GMOs to outcross with wild relatives of crops is prompting concerns: if a trait from a GMO conferred adaptive advantage on a wild relative it could alter the plant populations that act as a reservoir of genes for cultivated species in the future.



WWF-CANON/WIN J. TOLEDO

Biotechnology is used here to transfer a trait from a wild *Oryza* sp. to domesticated, high-yield rice. While such techniques are highly controversial in the West, estimates by CGIAR suggest that biotechnology might improve food yields in developing countries by up to 25%.

This Biodiversity Brief is based on a draft by Roger Blench of the Overseas Development Institute, and was edited by the BDP and Martyn Murray (MGM Consulting Ltd). Additional technical input was provided by Robert Tripp and Elizabeth Cromwell of ODI, and John Seaman of SCF.
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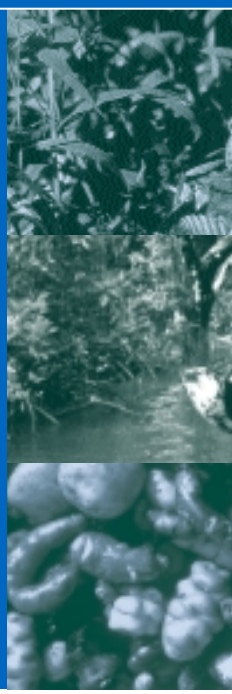

Conclusions

- Programmes of collection and characterisation of indigenous crop, livestock and fish stock varieties should be supported and extended, paying particular attention to their ability to yield under low-input conditions. In conjunction with this, economic incentives and institutional barriers to maintaining crop, livestock and fish biodiversity, and biodiversity-rich farming systems must be reviewed.
- Support should be given to developing countries in their efforts to assess their genetic resources, establish systems for its use which brings benefits to the country, and ensure that the benefits from international and national breeding programmes reach rural communities. Many rural communities were involved in the production of a broad genepool of domestic and semi-domesticated populations in the first place, and recognition of this contribution is important.
- Plant and livestock breeding needs to be decentralised, and efforts made to include local needs and constraints into the criteria for selection of new varieties. This will reduce the risk of imposing high-input varieties on farmers that do not have the resources to pay for them.
- All introductions of alien species, varieties and breeds, especially from other continents, should be subject to increased vigilance, through risk and impact assessments to ensure environmentally sound and sustainable food production, and pose no threats to human health.
- The potential risks of GMOs underline the importance of establishing adequate biosafety procedures. However, the capacity to implement the provisions of the CBD Biosafety Protocol is weak, and needs substantial strengthening in many developed and developing countries.
- Priority should be given to projects seeking environmentally-friendly ways of improving soil fertility, and reducing pesticide applications (e.g. through biological control approaches).
- Development programmes must ensure that areas providing wild foods remain productive and accessible.
- A global policy is urgently required on who owns the genes in international and national genebanks, and these policies must clarify the CBD principles of intellectual property and benefit sharing.

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Biodiversity IN Development

Biodiversity Brief 7

Health and biodiversity

Biodiversity can contribute to the health of humans, and to the health of animals and plants on which they depend, by keeping populations of disease-causing organisms and pests in check; providing the basic materials for medicines and a balanced diet; providing genetic information as a raw material for medical research; and keeping people healthy by contributing clean water and air.

Disease and pests

Many diseases and pests have been controlled successfully through a combination of measures which include the use of modern medicines and agro-chemicals. However, in some important cases, such as malaria, controls have not been successful, or their efficiency has declined over time. Frequently, high technology solutions to these problems are expensive imports, beyond the means of poor people in developing countries.

Relationships between predators and prey, and parasites and their hosts, have co-evolved over very many years; their interactions keep each other in check and are a system of biological control. The genetic variability of crops, fish, livestock and human populations is a vital base from which new defences can evolve against ever-changing parasites, diseases and pest attacks. Changes in genetic, species or ecosystem biodiversity can disturb this equilibrium.

Forest clearance may destroy the habitat for many pathogens and vectors, but it had the opposite effect on one vector for malaria: *Anopheles darlingi* mosquitoes. These will not breed in shady, forest waters, but thrive instead in standing water created by human activities. Malaria studies in West Africa have shown a close correlation between human encroachment on forests and the rise in its occurrence. Predictions are that the incidence of malaria will increase in the Amazon as mining, construction and forest clearance continue to advance.

Modern techniques of propagation, selective breeding, and biotechnology have all resulted in a range of highly productive crops and livestock breeds, but at the cost of reduced genetic variety and fewer preferred species (see BBs 6, 10 & 13). This makes crops and livestock particularly vulnerable to disease and pests because pathogens spread most easily when hosts are more uniform and abundant. Greater biodiversity among pathogens and pests combines

Changes in balance between predator and prey

Viral hemorrhagic fevers are emerging infections that are that are almost always fatal to humans. The *machupo* virus, carried by previously rare rodents, appeared in human populations in Bolivia quite suddenly. This coincided with the widespread use of DDT in agricultural areas that killed off cats that had preyed on the rodents and kept their populations down.

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Ayurvedic medicine in Sri Lanka

In Sri Lanka, *ayurvedic* medical preparations form part of the traditional system of health care which has treated illness for over 2,000 years. There are a number of *ayurvedic* clinics and teaching hospitals run by the government, and about 25% of the population use these on a regular basis. Some 1,414 plant species are used, and are widely held to be effective, particularly for treating long-term illnesses.

Increasing demand, both for local use and for export, has led to unsustainable exploitation of some plant species, exacerbated by the rapid depletion of natural habitats. Also at risk is the traditional knowledge of (often elderly) practitioners about plants and their medicinal uses, and the records remaining in the ancient and scattered *ola* manuscripts.

with rapid reproduction rates for faster evolutionary change, which enables them to overcome host defences in a relatively short time – 10 years may be ample. The result can be a devastating loss of crops, like the one which followed a fungal mould infestation of hybrid maize in Zambia, and the tungo virus epidemic which hit rice production in the Philippines and Indonesia.

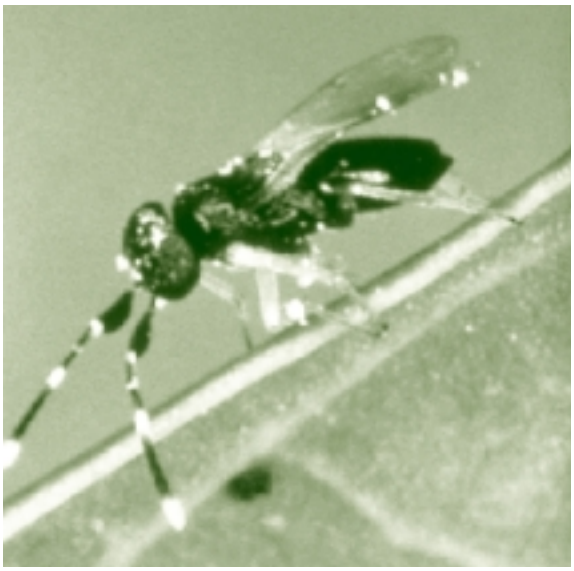
One response to these outbreaks of pests and disease is Integrated Pest Management (IPM), which was developed as a consequence of the negative impact of pesticide overuse. It is based on the principle that, if predators, parasites and other pathogens exist in balance with a pest species, then depredations on useful plants are minimised. This lesson was learned from the widespread use of broad-spectrum insecticides which killed off many insect pests' natural predators and parasites, and allowed pest numbers to build up, with large-scale and unhindered destruction of crops.

Movement between countries, and between hosts

The movement of crops, livestock and fish species has had enormous benefits for development around the world, in particular because introduced species may have no predators, parasites nor pathogens and can flourish unchecked in their new environment. Eventually their old enemies catch up with them, or local pests and pathogens evolve, although this does not necessarily nullify the ongoing benefits.

One example of when a livestock introduction was not immediately successful was European cattle introduced into the New World; nearly all of them died of screw worm infections. Those animals which survived developed some tolerance to screw-worm attack over time but, unsurprisingly, North African cattle showed almost no resistance when the screw-worm was unintentionally introduced recently. The movement of pathogens, pests and disease vectors therefore needs to be controlled through secure animal health and phyto-sanitary regulations; an increasingly important issue as more diseases are spread to new areas as a result of human and stock movements.

Interactions between humans and other animals allows the evolution of new pathogens, as diseases and pathogens pass between species to humans (zoonoses). For instance, many new forms of the human influenza virus are believed to originate in ducks: husbandry systems in Asia are believed to facilitate the passing of the flu virus from ducks to pigs, and thence to humans.



CGIAR

Mealy-bugs were accidentally introduced to Africa from Latin America and caused significant losses in cassava, a New World crop which has become a staple in large areas of the continent. The control of the mealy-bug is being carried out with some success using an introduced parasitic wasp from Latin America.

Integrated Pest Management in SE Asia

An IPM programme initiated in Indonesia in the 1980s restricted the use of non-selective insecticides, introduced resistant cultivars and trained farmers in pest recognition. This resulted in impressive yield gains, and substantial cost savings; the use of 57 pesticides was banned and US $100 million of annual government subsidies were saved. In response brown planthopper rice damage has been largely avoided by farmers practising IPM, whereas where natural predators have been killed by broad-spectrum insecticides, crop damage has increased.

Similar results have been shown in Vietnam, where the introduction of carp into paddy-fields has been effective in controlling the Latin American golden apple snail, which seriously threatened rice production in the mid-1990s. In addition to pest control, the carp now also provide vital food security, supplementing local diets and generating income.

WWF-CANON/MAURI RAUTKARI

This pharmacist at Yaounde University, Cameroon, is sorting pills containing wild plant extracts. Of the 150 most-prescribed drugs in the United States, some 56% derive in some way from wild sources.

Medicines

Western and non-western medicines make extensive use of plant materials and animal products. The world market for plant-derived chemicals runs to billions of dollars annually and global trade in medicinal plants is estimated at US$800 million/year.

It has been estimated that 80% of the world's population relies on primary health care based on traditional medicines. Many traditional health systems make use of hundreds of medicinal plants, often integrated into sophisticated systems of traditional healthcare. Medicinal plants are also used by farmers and pastoralists in livestock healthcare; for example *Polakowskia tacacco* for intestinal disorders in Mexican cows. There has been a substantial return to traditional systems due to the lack of alternative medical care or the high cost of (imported) prescription drugs. WHO figures show in China, for instance, traditional herbal medicines account for 40% of total medicine consumption.

The loss of species used, or with potential, for medicinal purposes is growing, both because of increased demand, and through loss of habitat. The use of animal-based remedies has had unfortunate consequences for species which provide products of medicinal value, such as rhinoceros, tigers and bears. Decreasing supply has forced prices up and made 'hi-tech' poaching with powerful modern equipment profitable. Efforts to regulate trade in animal products, through CITES (BB20), have had limited success in protecting these highly prized species.

Medical research

Only around 2% of the existing 270,000+ species of higher plants have been investigated for medicinal value, the great majority from temperate regions. The World Health Organization lists 21,000 medicinal plants; of these some 5,000 have had their medicinal properties investigated in-depth.

Ethnobotanical studies have been of increasing importance in guiding pharmaceutical companies in their search for new drugs from tropical

Malaria – a constant battle

Malaria is undoubtedly one of the most serious and widespread human diseases, infecting around 300 million people worldwide, giving rise to 120 million clinical cases and up to 1 million deaths each year. It is caused by a protozoan parasite (*Plasmodium* spp).

Anopheles mosquitoes are the vector which carry the malaria parasite, and the insecticide DDT was extensively used to kill mosquitoes in the 1950s. Resistance to DDT among *Anopheles* spp. began to occur during the 1960s, although DDT use was reduced from this time due to its serious side-effects for human health and the environment. Calls to reintroduce DDT to control mosquitoes may have initial success if implemented, but DDT-resistance is the most likely evolutionary response. More needs to be invested in alternative approaches, such as biological control.

Quinine, made from the bark of the *Cinchona* tree, has been used to treat malaria for 350 years, although today it has largely been replaced by synthetic drugs such as chloroquine. Treatment of the disease has been hampered by the protozoan's ability to evolve rapidly: chloroquine-resistant malaria parasites, first seen during the 1960s had spread throughout the world within a decade.

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sources. Recently, concern about the ethics of exploiting indigenous knowledge and resources from tropical countries, without sharing the benefits with those who are the traditional custodians of the knowledge and land, has gained attention through the Convention on Biological Diversity (CBD). Some companies have begun to develop 'ethical' agreements with source communities (see BB3).

Whereas disease and illness will always be part of human life, biodiversity has provided tools with which to address them. Hirudin and hemetia from leeches, and haemotoxins from snakes are used in surgery as anti-coagulants, and genetic engineering relies on the transferral of genes from unrelated species. As species are being lost, without ever having had their potential investigated, any benefits they can offer is being lost too.

Conclusions

Biodiversity has a role to play in controlling levels of crop pests such as locusts, and disease vectors such as mosquitoes and tsetse flies. Policy should support its maintenance in favour of biological control or IPM strategies, to reduce damage from agrochemical use. The use of alien species in biological control programmes, however, should be treated with extreme caution.

In addition to offering the means of developing co-evolved solutions for communicable diseases, biodiversity-rich wildlands and fallows provide an array of important foods that supply essential nutrients (vitamin A, calcium, oils, etc.) that are often lacking in staple crops. Without the varied diets these products supply, nutritional diseases are inevitable (see BB6).

The value of genetic diversity, as a source of information – and ingredients - for future medical research, should be recognised. The needs of local populations with regard to traditional healthcare should be respected, and support offered to improve the management of sources where medicinal plants are threatened. The protection of intellectual property over traditional healthcare systems also needs attention (see BB3).

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Website

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Biodiversity IN Development

Biodiversity Brief 8

Road infrastructure and biodiversity

The transport sector receives large development cooperation investments from the European Commission. The EC and most of its partner countries are signatories to the Convention on Biological Diversity (CBD), and Article 14 of the CBD identifies impact assessment as a key tool for achieving the conservation of biodiversity and the sustainable use of its components. Biodiversity issues therefore need to be included in impact assessments of transport policies, plans, programmes and projects.

Transport is a large and expanding EC development sector, accounting for approximately 40% of European Development Fund (EDF) expenditure. Road maintenance, upgrading and redevelopment of existing road routes dominates the programme, for which Africa, Caribbean & Pacific country projects received € 1.33 billion in 1990–95, with a further € 2.25 billion allocated in 1995–2000. Much less went to Asian and Latin American countries: € 2.5 million allocated in 1995–2000. Very little has been spent on new roads, and less than 15% of transport spending /allocations between 1975 – 2000 has been for rail, sea and air transport.

There are many ways to avoid significant impacts on biodiversity, and mitigate adverse effects. If these are considered at the earliest stages in the planning and design processes, outcomes are likely to be less harmful and transport projects will help achieve the EC commitment to ensure *'the impact of transport networks ...must not threaten ecosystems'*, while supporting sustainable development.

Threats to biodiversity

Transport systems often cover large distances or form widespread networks, affecting biodiversity locally and regionally. Direct impacts include road kills (mostly mammals), disturbance (felling of roadside trees, increased noise, etc.), spills and contaminated runoff. Most such impacts occur during the construction stage, or result from vehicle operations. **Indirect impacts are generally more critical** for biodiversity, as improved access to remote areas frequently leads to unsustainable resource exploitation, and land-use and population change. Strong efforts must be made to ensure economic development is not at the expense of natural resources which support rural livelihoods.

a) Loss and disturbance of habitat

Most transport projects reduce the area of natural habitat. Losses occur in areas permanently occupied by infrastructure and also in areas mined for construction or maintenance materials. Temporary losses of habitat occur during construction, and disturbance occurs both during construction and operation. Levels of disturbance caused by traffic noise tend to be high and escalate with time, discouraging wildlife from heavily disturbed areas (up to 400 m on either side of roads in open habitat with high levels of traffic).

European Commission

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IUCN The World Conservation Union

WWF-CANON/MICHEL GUNTHER

The careful routing of roads through already disturbed areas, avoiding blocks of little disturbed habitats, is one way of reducing negative impacts on biodiversity.

In the case of both habitat loss and disturbance, careful routing will reduce the negative impacts. Also, extra resources can be allocated to maintain or rehabilitate habitat, away from the construction sites, to offset lost and disturbed habitat. This 'exchange' of disturbed land for healthy habitat is increasingly common practice in Europe but is very costly. In very sensitive areas, screening with trees or shrubs can help reduce disturbance, although roadside planting is seldom carried out in rural areas.

b) Barrier effects occur when species are unable or unwilling to cross a transport route, which impedes gene flow within a population. Roads, railways and waterways all act as barriers, so bridges, tunnels and wildlife passes are important: for small species with low mobility; on known migration routes; or along access paths to feeding areas, watering holes or breeding sites. People can use the same constructions to reach important areas and traditional lands.

c) Habitat fragmentation and isolation occurs when natural habitats are separated, grow smaller and become surrounded by an inhospitable landscape. In general, large continuous blocks contain more undisturbed habitat, and support more species, than an equivalent area of fragmented habitat blocks. Fragmented habitats have proportionally more edges exposed to disturbance, pollution and invasion by alien species.

d) Mortality may have a variety of causes. Large numbers of mammals are commonly hunted near construction camps or maintenance facilities, and are hunted/trapped wherever improved transport systems provide quicker access to wildlife habitats and markets. Collisions with vehicles can occur anywhere, but are commoner where migration or access paths have been crossed by new roads. These collisions can be reduced using speed restrictions, road bumps, and a combination of wildlife passes (see b above) and fencing. However the practicality of introducing these measures needs careful assessment: speed limits may not be complied with; fencing may be too expensive or stolen. Projects need to take these factors into account, and focus on careful siting of transport routes as a preferred way of reducing mortality.

e) Pollution may affect air (vehicular emissions, dust), soil (oil leaks) or water (road run-off or sumping). Atmospheric deposition of pollutants and soil contamination cause changes in vegetation along roads, railways and at airports. Adjacent to sensitive vegetation, particularly wetlands, contingency plans should be made to deal with spills or leaks.

f) Invasion of alien species is commonly associated with transport corridors, often unintentionally. Weeds disperse along roads and railways and parasitic, predatory or destructive organism along waterways. Settlement along transport corridors can result in domestic livestock competing with wildlife, spread of disease, or new crops displacing local varieties.

Procedures

For impacts on biodiversity to be managed effectively, impact assessment must be discussed with all stakeholders and integrated with programming and project implementation from the first stages of planning (see EC Environmental Integration Manual, 2001). Thereafter, mitigation measures must be written into road construction contracts.

a) Environmental Impact Assessment (EIA)
This is designed to balance environmental (including biodiversity), economic and social considerations in development planning. It is commonly applied at project level, often as part of consent procedures for individual proposals. An EIA should be initiated at the same time as pre-feasibility or feasibility studies. At the project level, impacts on biodiversity may be attributable to:

1. route selection or siting;
2. construction activities;
3. operation or use (including maintenance of infrastructure).

Integrating biodiversity considerations with project EIA

EIA Procedural Stage	Biodiversity considerations
Screening Are there important biodiversity concerns that indicate the need for EIA?	The need for EIA might be indicated if the proposed project affects: ■ designated or protected areas, or protected species, ■ areas of cultural importance (e.g. sacred groves), ■ areas where biodiversity components support local livelihoods, ■ watercourses, wetlands, river catchments or fragile ecosystems, ■ large continuous areas of 'pristine' habitat, even if not protected.
Scoping Derive terms of reference (ToR) for the EIA	Ensure EIA takes account of potential impacts on biodiversity: include assessment of biodiversity in ToRs. Consult widely and early with all stakeholders, especially people with dependence on biodiversity in the affected area, and widely circulate the scoping report.
Focusing Refine the ToR on the basis of biodiversity values, which will be used in decision-making.	Select biodiversity components for more detailed study, for example, focus on: ■ indicators (e.g. of disturbance or pollution), ■ species valued for hunting, medicines, ecotourism, crop/livestock gene stocks, ■ keystone species (on which others depend), ■ important ecosystem functions (e.g. flood attenuation provided by wetlands), ■ key breeding or feeding sites, especially for protected species, ■ migratory routes and stopover sites etc.
Impact Assessment Predict impacts: identify, describe and provide the data necessary to quantify the effects of proposal(s) on measures of biodiversity.	Specify magnitude (and quantify where possible), duration and range of impacts, e.g. for: ■ areas of habitat to be lost (include breeding, feeding, refuge areas), ■ habitual routes to be severed (number and relative importance to maintenance of mobility in the landscape), ■ number of individuals likely to be killed, ■ proportion of population to be disturbed, ■ quality of remaining habitat for key species, ■ ecosystem functions lost or impaired etc. (e.g. hydrology of watersheds).
Impact Significance Rank impacts, taking into account biodiversity values and the reversibility of impacts.	Consider: ■ magnitude, duration, timing and reversibility of impacts, along with their predictability, ■ effectiveness of mitigation measures, ■ post-development carrying capacity of remaining habitat, ■ viability of remaining populations, ■ 'utility' and sustainability of valued biodiversity components, ■ ability of affected habitats, populations or species to recover.
Impact Mitigation Most EIA law requires proponents to suggest measures to avoid, reduce or remedy adverse impacts.	Ensure mitigation is recommended for significant adverse impacts on biodiversity. Avoidance is always the best form of mitigation. To what extent will proposed mitigation measures reduce impacts? Have they been successful elsewhere? Mitigation for biodiversity may require land acquisition for compensation.
Impact Evaluation Are the impacts identified important or significant?	How important or significant are residual impacts on biodiversity?
Environmental Impact Statement (EIS)	Explain biodiversity impacts clearly, and disseminate baseline information widely. Provide detailed, practical advice concerning measures to protect biodiversity during construction or to mitigate for operational impacts. Provide a schedule for activities, clear maps and a contingency plan in the event of mitigation failure.
Review and monitoring What really happened?	■ Did impacts on biodiversity happen as predicted? ■ Were mitigation measures effective and implemented successfully? ■ What was the outcome for biodiversity?

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Route selection should take account of sites, which are important for biodiversity and avoid them if possible. These might be sites supporting protected species, important feeding or breeding areas, staging posts on migration routes, sites supporting unusual local variants or endemic species, or simply hotspots which are relatively rich in biodiversity. Construction activities should be timed to avoid sensitive periods, e.g. bird breeding seasons, and should be carried out according to an environmental management plan.

Qualified advice must be sought from the earliest stages of project design, and examples of the biodiversity considerations which should be taken into account at different stages in an EIA are listed in the table (see page 3).

b) Strategic Environmental Assessment (SEA)

SEA is intended to identify the environmental, economic and social impacts of policies, plans and programmes, by identifying impacts on biodiversity further in the planning process, over a longer timeframe, and often for wider geographical areas than with an EIA. A project EIA can help improve project design, but it does little to address the cumulative impacts of different projects in a geographical area or sector, and allows little flexibility for avoidance or mitigation of impacts on biodiversity at a national scale.

SEA operates in this wider frame, provides opportunity for integrated analysis (social, economic and ecological) of alternative options. An SEA should be applied to a National Transport Policy, a regional transport plan or a road-building programme, when they are being negotiated as part of Country Support Strategies or Country Strategy Papers.

Biodiversity considerations for SEAs are well reflected in the table on EIAs, but rather than taking a local focus, adopting a national or regional perspectives, and longer time horizons.

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Biodiversity IN Development

Biodiversity Brief 9

Tourism and biodiversity

The quality of their natural environments gives many developing countries a comparative advantage in tourism. Tourism can capture some of the global willingness-to-pay for biodiversity by raising funds for investment in conservation and sustainable use, and can raise the awareness of developing countries of the value of their biodiversity. But at the same time, tourism can threaten the biological resources on which it and other economic activities depend. A major challenge is therefore to enhance the economic benefits of tourism while limiting its negative environmental and social impacts.

Global significance of tourism

Tourism is an important part of the global economy. According to the World Travel and Tourism Council, global travel and tourism directly and indirectly generates 11% of global GDP. This supports 200 million jobs, which accounts for 8% of the world's employment; an estimated 5.5 million new jobs will be created in tourism each year until 2010.

The opportunities for tourism development continue to expand as the number of tourists increases, but tourism activities are not evenly distributed between or within different continents. In Africa, for example, about 50% of tourists only visit the north, and most of the rest go to southern and eastern Africa.

Benefits of tourism

Tropical countries need to use tourism benefits to encourage local people to support biodiversity conservation and sustainable management. This is one of the greatest challenges for development, which can be done especially where there are:

- relatively secure access or tenure rights over land and other biological resources (including exclusion rights) – this is fundamental to the local people's ability to participate in decision-making and gain benefits from tourism;
- local communities with the management and marketing skills to participate in tourism;
- direct linkages to the economy through employment of local labour, or purchase of local goods and services.

Some definitions

Nature-based tourism incorporates all forms and scales of tourism that are based on the enjoyment of natural areas and wildlife. It is often used to promote national development objectives rather than conservation objectives.

Ecotourism is nature-based tourism generally promoted as consistent with conservation because of its small scale and limited ecological and social impact. It is based on the principle that nature tourism should support the conservation of nature, and that local communities should benefit.

*'In the long-term, with regard to current and future generations, **sustainable tourism** is ethically and socially equitable, culturally compatible, ecologically viable and economically appropriate and productive.'*

European Commission

DFID Department for International Development

IUCN The World Conservation Union

WWF-CANON/ANTHONY B. RATH

Coral reefs and the fish they attract are an important resource for ecotourism development.

Tourism can reduce local access to natural resources, for example, where game-viewing leads to tighter access restrictions on the areas in which local people can harvest wild resources. This could have negative impacts on biodiversity by concentrating local resource use in smaller areas and/ or by undermining local management systems. The scope for improving livelihoods through tourism is therefore very variable, as are its impacts.

In the wider development framework, tourism can be an important mechanism for stimulating private sector support for biodiversity conservation. It can also provide essential economic justification for improved biodiversity management, within and outside protected areas. Moreover, tourism can be a tool for enhancing public education and raising awareness of the value of local resources, especially where nationals are encouraged to participate in nature-based tourism.

International tourist arrivals (millions)

	World	Africa	Americas	E.Asia & Pacific	South Asia
1999	662.9	27.3	123.0	96.6	5.7
% increase 1998/99	4.1	9.1	2.5	10.5	8.3

Source: World Tourism Organisation (WTO) from WTO database May 2000

The nature of the link between local communities and economic development can alter the pattern of incentives to improve biodiversity use. Where local people earn significant income through participation in tourism, tourism can shift livelihood strategies away from unsustainable use of biological resources. But where benefits from tourism are smaller, they may be invested in activities that do not support biodiversity or even threaten it (for example, investment in livestock in areas of wildlife/ livestock conflict). Serious disagreements over biological resource use may emerge, where some local groups benefit more than others.

Impact of tourism

Mass tourism with destinations in urban or resort areas, is often considered to have limited negative impacts on biodiversity, especially where destinations are already developed. But all forms of mass tourism depend to some extent on environmental processes and ecosystem functions. Mass tourism can have significant impact through excess demand for resources (notably water and aviation fuel), through pollution (particularly when linked to inadequate waste management) and through construction.

Benefits and impacts of tourism

Potential benefits of tourism	*Potential impacts of tourism*
Revenue creation for the maintenance of natural areas	Environmental impacts, including: ■ use of land and resources, ■ impacts on vegetation, wildlife, mountain environments, marine and coastal environments, water resources, ■ waste management
Contribution of tourism to economic development, including: ■ funding infrastructure, ■ providing jobs, ■ enabling communities to receive revenue from biodiversity, ■ generating incomes, ■ supporting public education and awareness	Socio-economic and cultural impacts, including: ■ influx of people and related social degradation, ■ impacts on local communities, ■ impacts on cultural values

Source: adapted from CBD Decision V/25

Nature-based tourism attracts tourists to fragile ecosystems and therefore has the potential to inflict significant damage through habitat degradation and disturbance of wildlife. The impact of increasing visitor numbers on wildlife behaviour is not well researched, but available evidence gives cause for concern.

Consumptive tourism, such as game hunting and sport fishing, is often assumed to have negative implications for biodiversity through overuse of target species, and secondary impacts on non-target species. In fact, such tourism – if well managed, properly monitored and based on an understanding of population dynamics and the principles of sustainable use – can generate significant funds, and provide incentives for habitat and species conservation. Consumptive tourism can also be one of the few options for realising the value of ecosystems where other forms of tourism are not viable.

Relatively little attention has been paid to the rapid growth of **domestic and regional tourism** which has been especially evident in the Indian sub-continent and East Asia. Analysis of the development impacts of domestic and regional tourism suggests that it may be less demanding on local resources than international tourism. Domestic tourism may encourage the emergence of a valuable in-country constituency that supports the improvement of environmental management.

Opportunities

Different types of tourism generally depend on different types of biodiversity. Some ecosystems are naturally better suited for generating significant tourism revenue than others:

- Open savannas, with large populations of charismatic animals in a landscape that allows them to be easily seen, are well-suited to game-viewing.
- Wetlands can be attractive centres for bird-watchers and anglers.
- Mountains and other scenic landscapes are important for recreational tourism, especially trekking.
- Coastal ecosystems have high potential for watersports and other recreational tourism.
- Despite a high biodiversity, forests and closed woodland have relatively low recreational value due to low populations of charismatic species and poor visibility. They can however be attractive for some specialist tourism, such as sport hunting and bird-watching, and for short visits from nearby, more-popular tourism destinations.

Domestic and foreign visitors to national parks

	Gonarezhou NP, Zimbabwe 1995–6	Keoladeo NP, India 1995–6	Komodo NP, Indonesia 1994–5
Total no. visitors	6,179	2,873	173,000
% domestic visitors	53.4	70	7
% foreign visitors	46.6	30	93

Source: Goodwin *et al.* (1997)

Constraints

Most forms of tourism require easy access and developed infrastructure. Where new developments are planned, it may be necessary to establish participatory structures for decision-making, with capacity building of institutions capable of managing tourism activities and sharing benefits equitably. Constraints on the local population are particularly severe where the inhabitants lack ownership or control over marketable tourism resources, as this limits their bargaining power with investors. Local people may also lack financial capital, entrepreneurial skills and access to tourism markets.

Research into the impacts of tourism on national parks revealed that revenues were generally below operating budgets, although entrance fees were often below what visitors were actually willing to pay. In many cases, such revenues are passed directly to national treasuries, so that these funds are not necessarily reinvested in park management. A further problem is that park managers who are dependent on tourism revenues may be required to manage conservation areas for tourism rather than for biodiversity benefits.

A further concern is the volatility of the international tourism industry, which is sensitive to changes in purchasing power and to political

NEPAL TOURISM BOARD & SIRUBARI VILLAGE RESORTS

Sirubari in western Nepal – Nepal's first model for village tourism.

This Biodiversity Brief is based on a draft by Charlotte Boyd of the Overseas Development Institute, and was edited by the BDP and Martyn Murray (MGM Consulting Ltd).

This Brief was funded by the European Commission Budget Line B7-6200 and the UK DFID. Opinions expressed in this document are the contributors' alone, and do not necessarily reflect those of the European Commission, DFID or IUCN. The Brief does not imply any opinion on the legal status of any country, territory or sea, or their boundaries.

instability. Domestic and regional tourism may be less volatile, but they are still vulnerable to domestic or regional economic cycles. The table on page 3 indicates the percentage of foreign and domestic visitors to three national parks in different continents. The implications for conservation are ambiguous – foreign visitors are generally assumed to spend more (and often pay higher admission fees), but the spending patterns of domestic visitors may contribute more to the local economy in the vicinity of the park. More research is needed to clarify the impact of either type of tourism on biodiversity.

Recommendations

- Ensure an appropriate allocation of tourism revenues between national governments, tourism site managers and local populations.
- Use participatory strategic environmental assessment, including tourist carrying-capacity assessments and zoning (in space and/or time), to keep tourists away from the most fragile and significant areas for biodiversity. Develop destination-level environmental management plans that encourage appropriate forms of transport, accommodation and a mix of activities.
- Develop appropriate national and international standards or codes of practice (for example guidelines on waste management), and prepare licensing systems which incorporate environmental criteria and which can be supported by effective monitoring and enforcement capacity.
- Strengthen local tenure rights over land (including access to wildlife, scenic destinations and other tourism assets).
- Support local communities with targeted capacity building, and access to finance (including micro-finance) to enable them to participate effectively in tourism. This should include education and training to disadvantaged and poor groups (particularly women), to enable them to take up employment and self-employment opportunities.
- Develop core tourism assets and infrastructure in relatively poor areas where there is potential for commercially viable products.
- Encourage tourism developments which take place gradually and avoid crash developments which rely on outside investment. This requires business and private sector support to improve quality, reliability, and transport links.

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Website

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Biodiversity IN Development

Biodiversity Brief 10

Livestock and biodiversity

It has been estimated that livestock contribute to the livelihoods of at least 70% of the world's rural poor. However, many livestock breeds are under threat, and the consequent genetic erosion needs to be addressed to ensure that future development options are not closed. In addition, the impact of changing patterns of livestock production on the environment as a whole needs consideration.

Animal domestication began over 12,000 years ago. Of the 40,000 vertebrate species on the earth, 40 were selected as useful by different human cultures and domesticated. Of these, only 14 species account for over 90% of today's global livestock production.

Livestock, livelihoods and development

An estimated 1.96 billion people rely on livestock to supply part or all of their daily needs. Livestock and their products supply at least 30% of human needs for food and agricultural production in the form of meat, milk, milk products, eggs and fibre. About 250 million animals provide draught power for 60% of arable land in the tropics, which is of great importance in Africa and South America, and livestock manure accounts for about 70% of soil fertility inputs in developing countries.

Livestock not only provide smallholders with a source of food but also income. In Mali, for example, 78% of cash income on small-scale mixed (crop/livestock) farms comes from livestock. Moreover, livestock provide a buffer against risk at critical periods, as a readily convertible store of assets. Poor families often choose to maintain a variety of livestock species and breeds to benefit from these multiple benefits.

Global meat production figures show that 54% comes from livestock reared on grasslands, 37% from industrial animal production systems, and 9% from mixed farming systems. Livestock can be successfully reared in arid and semi-arid areas unsuitable for crops, and despite droughts, livestock production has continued to increase in arid lands because pastoralists have been mobile and adapted to making the best use of these dynamic but resilient ecosystems.

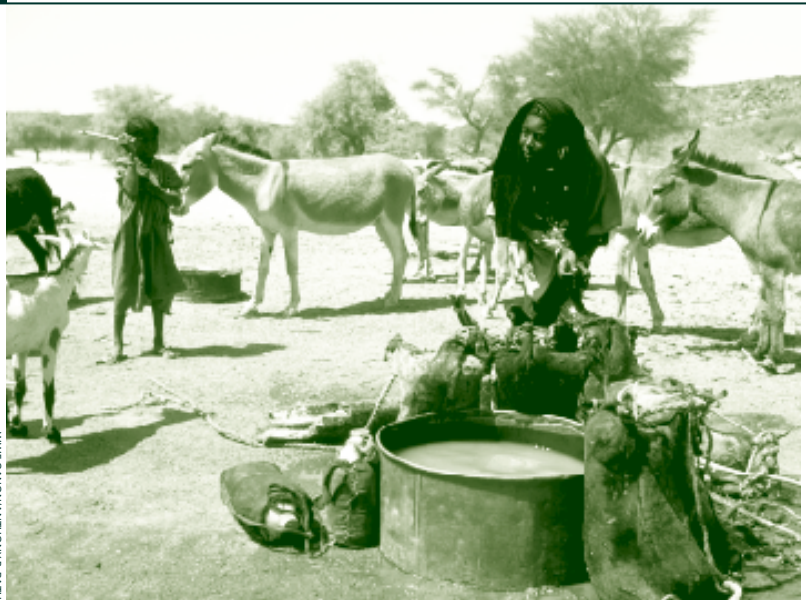
Breeds – what are they?

A breed refers to a group of domestic livestock with definable and identifiable characteristics that distinguish it from other groups within the same species. Differences between breeds account for much of a species' genetic variation, which in turn supports different livelihood needs. Some breeds are adapted to specific local conditions: disease resistance (N'dama cattle in West Africa are tolerant to trypanosomiasis) and drought tolerance (fat-tail sheep, zebu cattle and camels in arid or semi-arid zones); others for special qualities: the Tuareg in Niger breed two types of camel – one for milk and the other for transport.

European Commission

DFID Department for International Development

IUCN The World Conservation Union



WWF-CANON/ANTHONY B. RATH

Livestock are an integral part of many poor peoples' lives, providing meat, milk, blood, hides, draught power and, here, skins for carrying water.

Global trends in livestock production

Significant increased demand for livestock products occurs with expanding urban populations and is predicted to gather momentum in East Africa, Southern Asia and Latin America. This is encouraging industrial production systems, and a shift away from ruminant livestock (ie cattle, sheep and goats) to others (mainly pigs and chickens). Industrial production systems are predicted to provide 70% of food from livestock by 2010.

Already, poultry and pigs can be mass-produced using concentrate feeds, which means that global livestock production will become increasingly dependent upon crop products. 21% of the world's arable land has been given over to livestock feed production without, so far, affecting human food consumption even during low production years. But the trade in concentrate feeds could deplete local food supplies, combined with increasing pollution problems in areas where high concentrations of livestock exist in industrialised production units.

The status of breeds within species of domestic livestock worldwide

Species	On FAO database	No. at risk	% at risk
Cattle	787	135	23.1
Chicken	606	274	53.5
Dromedary	50	2	5.0
Duck	62	29	46.8
Goat	351	44	16.5
Pig	353	69	26.0
Sheep	920	119	18.1

Source: Blench 2001.

Loss of livestock biodiversity

Of the 14 domesticated species there were 3,831 breeds at the beginning of the 20th century. Of these 618, or 16%, have become extinct, and a further 15% are classified as critical or endangered. This loss is important. The livestock gene pool is small because few wild relatives exist, meaning that losses cannot be compensated for by tapping into other genetic resources.

Livestock genetic erosion is caused by the replacement of the existing domestic breeds with a small selection of specialised 'improved' breeds. This is due not only to substitution, but also to cross-breeding, and the elimination of livestock through changes in production system. Subsidies or incentives to encourage use of certain breeds or production systems have lead to changes in livestock breeding strategies with the loss of local breeds or dilution of their adaptive characteristics.

Once subsidies or incentives are removed, local livestock populations are often not able to recover (see box). An urgent review is needed of what constitute important and useful breeds, with a clear indication of the unique qualities that need to be maintained.

Impacts on the environment

The impact of livestock on grasslands can be positive under optimum conditions:

- grazing can increase the ground layer plant species diversity of rangelands/grasslands;
- low and moderate grazing activity in semi-arid regions increases soil water infiltration.

However, they can also have negative impacts. In semi-arid (more than 90 days growing season) areas, pasture **degradation and soil erosion can result from** trampling and over-grazing where dense livestock populations occur. This is linked with increasing human settlement, and the multiple effects of: increasing crop encroachment on grazing lands, fuel-wood collection, over-stocking of remaining lands and decreased mobility of pastoral herds. In addition, land tenure disputes and incentive policies have undermined traditional sustainable land use practices. This includes fertiliser and feed subsidies, or concentrate feed hand-outs,

that are accelerating the degradation through over-stocking.

In densely populated areas such as East Asia, where human and livestock densities are high and livestock markets are accessible, nutrients are imported for industrial livestock production and animal waste exceeds the absorptive capacity of land and water, resulting in biodiversity losses, groundwater contamination, eutrophication of aquatic systems, and soil pollution. In contrast, high livestock numbers associated with intensive smallholder cropping systems in East Africa and Southeast Asia make positive contributions to agricultural sustainability by enhancing soil fertility through the provision of manure, and contributing draught power.

Subsidised large-scale commercial ranching in the 1970s and 1980s has led to the **loss of large areas of forest** through conversion to pastures. It is estimated that 44% of deforestation in Central America is a consequence of ranching in forest frontiers; in the past this was largely due to wealthy land owners, but is increasingly caused by small-holders.

At a global level, livestock activities contribute significant amounts of CO_2, NO_2, and CH_4, all of which are greenhouse gases that accelerate **global warming**.

Opportunities for development cooperation

- Ancient lineages that have evolved different qualities need to be maintained preferably in local areas, but also in research station or zoo flocks/herds, so that the genetic diversity is not lost. High technology options for *ex situ* conservation include frozen semen and embryo banks, or DNA/RNA storage and cloning. However, these rely on technology, secure resource supplies (electricity, liquid nitrogen) and political stability which are often lacking in developing countries.

  There is a lack of information with which to plan *ex situ* conservation programmes, requiring a global plan of action to develop country-based action plans for management of animal genetic resources, including data-gathering and storage, training and capacity building, and technology transfer. This needs to catalogue key characters of livestock breeds.

- There is a need to establish full and active dialogue between local livestock keepers (especially marginalised groups), government agencies, private sector organisations and both national and international research organisations. This should be used to facilitate integration of local needs and indigenous knowledge into *in situ* and *ex situ* conservation efforts. Traditional livestock keepers should be granted protection of their intellectual property in the traditional management of local breeds.

- Consideration must be given to the negative impacts of the promotion of intensive livestock production systems and high performance breeds. The subsidies available for these approaches create artificial economies of scale. Mitigation measures are needed to reduce the impacts of nutrient surpluses and pollution, including biogas centres and manure digesters.

Nguni cattle of South Africa

The Nguni cattle of South Africa are hardy, thrive on poor pastures and are resistant to local diseases. However, in the 1960s and 70s homeland herds were 'up-graded' by cross-breeding with high yield European breeds. A small stock of pure Nguni cattle were conserved in research stations, but farmland populations disappeared. With socio-economic change in the 1990s, the high inputs and veterinary services needed by the cross-bred cattle were no longer available, and they began to die or severely under-produce. The only way small-scale farmers could regain the pure-bred Nguni cattle they had domesticated, was to buy them back from wealthier large-scale ranches. With no government money to do this development cooperation assistance had to provide the funds.

Source: R.Blench 2001.

WWF-CANON/MAURI RAUTKARI

Conversion of forest to rangelands has often been in areas unsuitable for livestock rearing. In Amazonia, for example, up to 50% of all pastures are abandoned because the soil is too poor to support cattle.

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International context

Livestock has received less attention than crop agriculture in international agreements or global plans of action; for example, livestock is incorporated into agriculture in the World Food Summit (1996) statements. As a result, the processes establishing global agreements are less well advanced, although recent multi-lateral reviews of livestock/biodiversity/environment issues have been carried out.

The Global Plan of Action for Management of Farm Animal Genetic Resources (FAO, 1998) focuses on gathering information and setting up national/regional focal points, as the first steps that must be taken to drawing up action plans. The first Intergovernmental Technical Group on Animal Genetic Resources met in September 1998. CBD COP III, IV & V have acknowledged the importance of the Global Strategy for the Management of Farm Animal Genetic Resources.

- In the semi-arid zones where ecosystems are easily degraded, increases in production must be supported by ecologically-sound land practices and policies. In these regions there is also an option to look at co-management of wild animals. For example, a 20% reduction in cattle stocking would allow the full range of African savannah antelopes to co-exist on some cattle rangelands, and in flooded grasslands and swamps of South America, capybaras have been successfully ranched alongside cattle and horses.

- In arid zones it is crucial that traditional livestock management systems that are adaptable, and involve long-range movements of cattle and sheep, are not undermined by fencing and prohibitive policies.

- In higher potential areas where the conventional resource base cannot support further intensification, consideration must be given to more intensive production in mixed farming areas; where ruminant livestock can be grazed in marginal areas not suitable for crops, eat fibrous crop residues and providing the means (through manure) by which nutrients can be rapidly and efficiently recycled to crops.

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Biodiversity IN Development

Biodiversity Brief 11

Fish and biodiversity

Global fisheries are commercially extremely important for developing countries, who are the chief global exporters. However, the role of fish in supporting the livelihoods of rural communities is also important. Small-scale exploitation of a wide-range of species provides crucial sources of protein, fats, oils and vitamins, as well as a resource in times of hardship. However, these resources are under threat from a range of pressures, from over-fishing to pollution of waterways.

Richness in the water

Some 75% of the earth is covered with water. Living in this water, there are around 28,000 recorded species of fish, 40% of which are freshwater. Some 25% of all marine fish species are associated with coral reefs: the Indo Malay archipelago for example contains over 2,000 species. Freshwater systems can be equally diverse: the Amazon basin has over 1,300 species, whilst old, deep lakes such as Lake Tanganyika and Lake Baikal each have more than 200. Other ecosystems such as mangroves are important in providing shelter for the young of many species.

Diverse catches in Lake Tanganyika

Lake Tanganyika, in the rift valley of East Africa, is home to 7 million people. The lake has more than 240 fish species, most of them endemic, and supports a fishery which can produce up to 100,000 mt per year. The bulk of this fishery is commercial and is based on only six species, comprising two small sardines which form the bulk of the catch, and their predators, four species of perch. By contrast, the artisanal and subsistence fisheries carried out by communities around the lake have over 100 species in their catches. Artisanal fishing is carried out using a variety of equipment in varied habitats along the rocky and sandy shoreline, where biodiversity in the lake tends to be concentrated.

A resource for people

Species caught are often small, but are an important source of protein, oils, vitamins and minerals in many developing countries. Some 60% of animal protein in Indonesia and 50% in Ghana is reported to come from fish. Over 13 million people on the floodplains of Bangladesh are directly or indirectly involved in fishing at some point in the year, and the vast majority of the population, over 114 million people, will eat fish if they have access to it. In Bangladesh most fish will be consumed, no matter how small; one such fish – the *mola* – has been shown to have very high levels of vitamin A.

Much of the fishing which goes on across all the major river basins in the developing world is largely unrecorded and therefore 'invisible'. This is because the fish do not enter the market place, and the fishing is carried out as a small-scale artisanal activity, often part-time or informal, particularly by women and children. It is frequently important to the poorest sections of communities, including landless people, and often becomes the default liveli-

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WWF-CANON/JOHN E. NEWBY

It is estimated that inland waters produce at least 10 million mt of fish/year, often by artisanal and small-scale fishers.

hood, with the variety of species used spreading the risk. This food security function of fish biodiversity is an undervalued aspect of natural capital.

A resource for industry

Over the last two decades world fish production for capture fisheries has been relatively stable. It was most recently estimated at 94.6 million tonnes of which 7.8 million are recorded inland catches. At present, some 44% of global marine stocks are fully exploited, 25% are over fished, whilst 31% may allow some further exploitation. Modest increases of 20-25% may be achieved if proper management measures are more widely implemented. Of the global catch 25% is estimated to be taken by artisanal fisheries and 40% of fish are for home consumption.

Commercial maritime fleets tend to be very targeted in their choice of fish. Just six species: anchoveta, Alaska pollock, Chilean jack mackerel, Atlantic herring, chub mackerel, and capelin account for 25% of total capture fish production. Commercial fisheries tend to have a specific effect on certain species, distorting the relative frequency within the ecological community. For instance, the upsurge in trigger fish in the Eastern Atlantic during the 70s and 80s, at the time of massive exploitation of small pelagic species, may have been a dramatic example of nature filling a vacuum left by fishing.

There is also the considerable problem of the discard of non-target species (the by-catch), usually dead, back into the water. This is particularly a problem in shrimp boats which have limited hold capacity and therefore tend to discard most fish species caught. It is suspected that discards might amount to an equivalent of some 25% of world capture fish production and includes a wide range of species.

Aquaculture is one way of augmenting fish production. Global production by aquaculture has been increasing year by year and now stands at 26.4 million tonnes or 26% of total fish production. This is derived, however, from only 55 marine species and 96 freshwater species of fish, with the majority coming from a few carp and tilapia species. Escapes of both exotic species or genetically selected strains are always a potential threat to local biodiversity.

Causes of biodiversity loss

Over-exploitation has a major impact on biodiversity leading to impoverishment of stocks of target species. This can have knock-on effects to other aspects of the marine ecosystem, including its productive capacities. There is a need for conservation regulations and incentives for responsible fishing, to maintain stocks, biodiversity and the environment. However, fisheries are an open access and mobile resource, which makes the definition and enforcement of limits problematic. This is exacerbated by a lack of accurate information on which to base regulation and international fishing agreements which can contribute to over-fishing.

Problems are compounded by the commercial success of fisheries, especially in developing countries. For example, the ACP share of the world trade has risen from Euro 309 million in 1986 to Euro 946 million in 1996. 60% of the global catch is taken from waters in the South, and 40% of the catch enters international trade. Distant water fleets of developed countries contribute greatly to catches off LDCs, accounting for example, for 45% of the catches off West Africa. In addition to the impacts on fish stocks and the marine environment, this has often led to conflict with coastal artisanal livelihoods.

For inland fisheries, the main conflicts come from other sectors, such as agriculture, water abstraction and hydro-power. Increased use of water resources is growing; more than 60% of the water flow from the Ganges is used for irrigation and other purposes, whilst over 40% of the floodplain in Bangladesh is empoldered for farming and 85% of the Parana is regulated for hydro-power. Pollution increasingly affects ecosystems and habitats important for fish, and can also directly affect stocks.

Genetic diversity can be at risk in cultured fish partly due to the small gene pool that the parental broodstock represents compared to the wild population. Selective breeding of carp strains has been going on for centuries in China, whilst most recently programmes of breeding and selecting beneficial traits from a number of Nile tilapia strains produced the GIFT (Genetically Improved Farmed Tilapia) which has been widely distributed to small-scale fish farmers in developing countries.

Wider problems can arise if cultured strains escape into the wild, which they inevitably do. For example, monosex hybrid Nile Tilapia escaped into the wild in Israel, where they contaminated the wildstock and diluted the ability to produce the all male hybrids that made them valuable to fish farmers. This trait had to be virtually recreated in the laboratory.

There also emerges the issue of fish as genetically modified organisms (GMOs). It has been proved possible, for example, to insert the DNA for genes, such as that for the growth promoting hormone or cold tolerance, into a fish species to give improved performance. If selective breeding and GM fish are to play a useful role with secure biodiversity, meticulous record keeping and tight protocols are essential.

This is particularly true where the cultured species is an exotic to the region. The intentional introduction of exotic species has been a common practice but with unpredictable results as, for example, the Nile perch in Lake Victoria. There does need to be a precautionary element and follow-up monitoring should be an essential part of the process.

Policy framework

The protection of aquatic biodiversity is subject to overarching agreements on biodiversity, including the 1992 Rio Declaration on Environment and Agenda 21. More specifically, diversity in aquatic systems is the subject of:

- UN Convention of the Law of the Sea, 1982;
- Ramsar Convention, dealing with vulnerable wetlands;
- Jakarta Mandate on Marine and Coastal Biological Diversity of 1995, which is a global concensus on the importance of marine and coastal diversity.

Biodiversity is incidentally the target of measures to conserve fish stocks through fisheries regulations and conventions, most prominently in:

- Convention on the Conservation and Management of Straddling Fish Stocks and

JM THORSELL/IUCN

In developing countries, biodiversity is a grass-roots issue, and people must, therefore, be involved in management measures and biodiversity must be an element in the development of community and co-management approaches, with national or regional institutions.

This Biodiversity Brief is based on a draft by Ian Payne (of Imperial College of Science, Technology and Medicine, University of London), and was edited by the BDP.

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Highly Migratory Fish Stocks;

- FAO Code of Conduct for Responsible Fishing, formulated in 1995. The Code of Practice is the most all-embracing attempt to codify how fisheries can become sustainable. It provides protocols for open water capture fisheries, aquaculture, post harvest activities, trade, zonal management and research. It is a voluntary code; nevertheless most countries, including the EU, have agreed to observe it.

Conflicts are arising within the WTO agreements, although the WTO has yet to turn its attention to fishing as such.

Conclusions

The importance of artisanal fisheries in food security needs to be given higher priority in development policy. This means addressing the causes of its loss (i.e. examining the policies of other sectors for impacts on fish-based livelihoods) and introducing conservation and sustainable use measures in habitats important for fisheries. Management of a fishery or maintenance of biodiversity can often only be considered in more holistic terms, through coastal zone or basin management or with reference to the ecosystem as a whole.

Natural ways of increasing stock can be encouraged through habitat improvement or restoration in such a way as to encourage spawning or development of the young. This can also include protected areas to protect spawning and enhance recruitment. There is recent evidence of the importance of the role of marine protected areas, in allowing fish stocks to regenerate or maintain viable and productive populations. The questions governing the role of genetic diversity in aquaculture through in-breeding, selective breeding and GM fish need to be resolved so that they will not be an impediment to the use of these techniques in the development process or as an environmental hazard. Protocols on the introduction of exotic species should be observed.

The management of biodiversity and of fisheries themselves relies upon possession of accurate information, and developing countries need access to the best available at all institutional levels: community, national and regional. This is where the capacity-building of informational, education and research capacities of developing countries is of particular importance.

In protecting fisheries and for the pursuance of aquaculture, the FAO Code of Conduct should be adhered to and fishing nations should play a more dynamic role in the assessment of the stocks they have access to and should help enhance the capacity of developing countries to implement the code.

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Biodiversity IN Development

Biodiversity Brief 12

Forests and biodiversity

Tropical rainforests contain an estimated 50% of all species on earth. They provide livelihoods to some 400 million people, and ecosystem services that are important at local, national and global levels. Forests also contain species of high commercial value, and 31% of tropical rainforests are currently allocated for commercial timber production. However, unsustainable practices commonly disrupt forest biodiversity and degrade or eliminate forest habitats. Furthermore, the land that forests occupy is under pressure from agricultural expansion, mining and other developments.

Based on FAO definitions (which define forests as 10% crown cover or above), forests cover 1,900 million hectares in developing countries, of which around 720 million are tropical rainforests. The latter are found in 85 countries, but 50% of tropical rainforest are found in Brazil, Indonesia and Democratic Republic of Congo alone.

Around half of all the world's species, and 80% of tree species, are thought to occur in tropical rainforests. The species richness, constant evolution and radiation of new species, and long life of trees give a dynamic ecosystem with myriad species' interactions and long cycles of change and growth: a mosaic of gap, growth and mature phase forest patches. Dry zone woodlands are prone to dramatic changes as a result of fires and droughts.

Despite their apparent vigour, which allows rapid recovery from low-impact changes, tropical rainforests are sensitive to large scale changes in structure or compositon. Only 20% of the nutrients found in rainforests are in the soil, the rest being within the living biomass. This makes many of them prone to 'nutrient erosion' if degraded. They also contain 'old growth' species which are vulnerable to habitat change.

Forest values

Humans and forests have a long history and there are few, if any forests that are entirely untouched by human hand. This means that humans and their environment have adapted together resulting in a multi-functional resource, and many of the benefits of forest goods and services cannot be provided by other forms of land-use.

Commercial exploitation of forest products

The global forest industry is worth around US$330 billion in annual timber sales. 122 million cubic metres of wood are produced annually by tropical countries, which accounts for one quarter of the world's traded timber. Demand for roundwood is expected to increase by 1.7%/year until 2010. It has been estimated that traded forest goods provide up to 10% of GDP in some African countries. However, many traded products do not enter formal markets, and are not included in these figures. In addition, most timber is consumed domesti-

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Forests as carbon sinks

Forests act as reservoirs by storing carbon in biomass and soil. They are sinks of carbon when their area or productivity is increased, resulting in the uptake of atmospheric CO_2. They can become a source of CO_2 when the burning and decay of biomass and disturbance of soil result in emissions of CO_2. Net CO_2 emissions from changes in land use (primarily deforestation occurring mainly in tropical areas) currently contribute about 20% of global anthropogenic CO_2 emissions.

Forest-based carbon offset trading is a mechanism which may allow tropical countries to provide an environmental service to industrial countries: promoting actions which absorb carbon (conservation, reforestation) or avoiding actions which release carbon (e.g. felling, burning), in exchange for payments by the purchaser of the carbon offset.

There are doubts, however, that reducing forests to just one value (their carbon value) will address the underlying causes of forest loss. It is also feared that trading in carbon 'sink' credits may open the way for conversion of natural forests to quick-growing, carbon-absorbing, commercial monocultures, which serve neither conservation nor poverty-reduction aims.

cally and therefore not included in the figures for international trade: over 80% of timber felled in Brazil, for example, is not exported.

Subsistence, barter and local trade

Forests yield a wide range of non-timber forest products (NTFPs) which support local peoples' livelihoods through subsistence, barter or trade, including food and feed; construction materials and fibres; medicines; and fuel. For example, in developing countries some 80% of energy requirements are met by wood products (much from on-farm sources), and developing countries produce and consume around 90% of the world's fuelwood and charcoal.

The use of gathered products from the forest form the basis of the livelihoods of 50 million indigenous peoples who live in tropical forests. Here a woman pounds wild palm kernels gathered to make oil for cooking.

WWF-CANON/PAUL S. SOCHACZEWSKI

Biodiversity-rich forests also provide a supplement to on-farm production, contributing to food security (e.g. bushmeat), and providing a fallback in times of need. World Bank figures for example show that 90% of people who earn less than US$1/day depend on forests for their livelihoods. Furthermore, biodiverse crop or tree systems are less prone to widespread disease and pest attacks.

Indirect benefits

Forests provide a range of services which have been estimated to be worth 4.7 trillion US$/year worldwide (global annual GNP is around 18 trillion US$). These services are often ignored because they are not easy to measure, and are rarely traded in any market:

- **ecological processes**, such as carbon-cycling and hydrological regimes, which stabilise climatic systems, and provide clean air and water, and underpin functions such as soil and water conservation;
- **sense of identity** including cultural associations and existence values. These are values which give peoples' lives a sense of meaning, and can also confer autonomy and self-sufficiency;
- **keeping options alive** by avoiding the loss of genetic information and maintaining the conditions for adaptation and evolution. This is important to prevent narrowing of the genetic base which provides raw material for future breeding programmes, or biotechnology.

Forest loss and degradation

Nearly half the world's forest has been converted over the last 8,000 years. Between 1980 and 1995, there was a net loss of 200 million hectares of forest in developing countries. Both Brazil and Indonesia lost 1 million ha each/year, together equalling 45% of the global total.

In addition to outright habitat loss, forests are also being degraded – 28% of the 8,600 threatened tree species are declining because of unsustainable felling. Tropical forest loss and degradation will be the single greatest cause of all species extinctions in the next 50 years. At current rates, this means 13% of the world's species could be lost by 2015.

The commercial timber trade and conversion to agricultural land outweigh all other causes of forest loss. Almost all current logging practices significantly reduce biodiversity, and sustainable operations are rare. Some 90 million hectares of land will need to be brought under

WWF-CANON/OLIVER PHILLIPS& WILKIN

Forest fires have been a major cause of forest loss in recent years, due to a combination of climatic changes and human activity.

agriculture by the year 2010 to achieve global food security, probably half of which will be from forested lands. These processes are compounded by the removal of vegetation for fuelwood, building materials and livestock feed, insect pests and disease, fire, extreme climatic events, resettlement, and infrastructure, and invasion of forests along logging roads by commercial hunters.

These direct causes of loss are usually triggered by other, underlying causes which often lie outside the forestry sector. The low price of unprocessed timber, for example, takes no account of the true costs of forest management and biodiversity losses. Many national policies also provide disincentives for sustainable management, such as land tenure or resource access legislation which encourages clearance, subsidising unsustainable livestock and agriculture programmes, and failure to integrate biodiversity values into other sectors. In addition, the lack of coherence at the international level between trade and environment debates is a significant factor affecting the sustainable use of forest resources.

The challenge

The way ahead is to plan productive landscapes so that:

- key forest areas are protected (e.g. for public good benefits, such as watershed protection);
- local people can continue to rely on NTFPs which are sustainably managed, which could be enhanced through establishing market-links with fair returns, based on sustainable harvesting practices (see BB1);
- production forests are properly managed, sustainably harvested and as much biodiversity maintained as possible;
- areas that are destined to be deforested (e.g. for agricultural expansion) are those that are most suitable for other purposes (i.e. suitable soils/climate, low biodiversity and few dependent populations).

Such approaches require good governance, transparency and participation of all stakeholders. The development of community-based approaches to forest management and use, and the use of indigenous and local knowledge, often provide the most effective means for ensuring success of long-term approaches.

However, such approaches are not enough by themselves. Forests are lost because the timber trade (legal and illegal) is profitable, and

Sustainable Forest Management

'The stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regenerating capacity, vitality and their potential to fulfil, now and in the future, relevant ecological, economic and social functions, at local national and global levels, and that does not cause damage to other ecosystems' (pan-European Ministerial Conference 1993).

Although investments in SFM are costly and complex, they can yield acceptable returns, especially when coupled to certification schemes aimed at environmentally-conscious European and North American markets. However, it should be noted that such markets are small, and only 10% of roundwood is traded internationally. Moreover, it can be costly for small operators to comply with strict certification procedures, calling attention to the need for systems of "verification" which cost small-operators less.

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International framework

There is no binding global treaty specifically dealing with forests. The proposal to draw up a forest convention has been under discussion since UNCED (1992), but deep divisions between countries have meant that no convention has yet been adopted; the non-legally binding forest principles were adopted in its place. There have been numerous bodies leading the international negotiations. The United Nations Forum on Forests (UNFF) was created in 2000, which now takes the lead in international forest policy discussions. *http://www.un.org/esa/sustdev/forests.htm*

Under the Convention on Biological Diversity, an *ad hoc* Technical Expert Group on Forest Biological Diversity has recently been formed. Forests will be a major agenda item at the 6th Conference of the Parties in 2002, and parties are expected to adopt a work programme on forest biodiversity for 2002–2010. *http://www.biodiv.org/areas/forest/default.asp*

Members of the ITTO, a commodity organisation, represent 95% of world trade in tropical timber, and 75% of the world's tropical forests. One of the ITTO's objectives commitment is to move *as rapidly as possible towards achieving exports of tropical timber and timber products from sustainably managed sources. http://www.itto.or.jp/*

Discussions on the Kyoto Protocol to the Climate Change Convention may have wide-reaching implications for forests. However, the latest talks, in the Hague, November 2000, were suspended and no agreement has yet been reached on the rules governing forests as carbon sinks. *http://www.unfccc.int*

because forest production systems are undervalued compared to other activities. Therefore, the challenge is to create the conditions (supportive policies, effective implementation) that encourage the recognition and management of forest assets with multiple values, and to ensure that those who reap the benefits also foot the costs. To bring private returns into line with social returns, and to make sustainable forestry more profitable, requires incentive measures (see BB4), such as:

- **Transfer payments**: market based incentives and subsidies (e.g. 'polluter and beneficiary pay' taxes; debt-for-nature swaps); innovative forest pricing (e.g. performance bonds);
- **Market approaches based on public good benefits**: protection rights; ecotourism charges (see BB9); carbon offset trading; certification; bioprospecting (see BB3);
- **Property rights**: community usufruct rights; intellectual property rights.

In addition, development cooperation should support the removal of perverse incentives such as subsidies which encourage agricultural clearance. Social and environmental costs and benefits need to be regulated by government policy and law enforcement, as market forces alone may not bring about socially or environmentally desired outcomes.

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Biodiversity IN Development

Biodiversity Brief 13

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.

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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.

JIM THORSELL/UCN

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.

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.

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 transboundary 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.

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 transboundary transport of living modified organisms (LMOs) created by modern biotechnology.

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Biodiversity IN Development

Biodiversity Brief 14

Wildlife and biodiversity

Wild mammals and birds are important food sources to millions of people who cannot afford to buy or rear them. In addition, trade in animals captured from the wild is a multi-million dollar business, providing significant local and national income. However, unsustainable use is leading to losses and extinctions of wild animals; in addition, many species are threatened by loss of wild habitats due to clearance and other disturbances.

There are 4,763 recorded species of mammals (75% of which are small rodents, bats and insectivores), 9,946 species of birds, and more than 35,000 species of reptiles, amphibians and fish. Their ecological characteristics vary with habitat; larger savannah species are often migratory, and/or undergo substantial population changes in response to extreme conditions such as fires or drought. Damage caused by large mammals is an integral part of savanna and forest ecosystems; it is often cyclical, and facilitates dispersion and germination of colonising plants.

Importance of wildlife for human development

Wildlife provides many goods and services which are important in subsistence livelihoods:

- **bushmeat** can include anything from caterpillars to large mammals and is an important source of protein. In Africa, 236 genera of animals are consumed, including antelopes, monkeys, rodents, reptiles, snails, termites and beetles. In addition to meat, wildlife products include honey, milk, eggs, and flavourings;
- wildlife (particularly small species) is a crucial component of food security, in providing a safety net in times of hardship, and can thus **reduce vulnerability**;
- various parts of wild animals can be used as medicines in the treatment of ailments, and animals or their products are used in Western medical systems for surgery as well as biomedical research;
- **clothing**, can be made from skins, pelts, feathers and teeth, and bones may be used as tools or weapons;
- many species have **spiritual values**, or may be used as cultural artefacts and trophies; as well as adding to the quality of life, cultural values can be important in ensuring sustainable off-take or local conservation of key species;
- various **ecosystem functions** provided by wildlife species, such as seed dispersal, pollination, and manure are an integral part of the functioning of wild and semi-domesticated systems.

In addition to its role in subsistence livelihoods, wildlife is also **traded** in many forms:

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Trophies collected by a safari client who shot a crop-raiding elephant on the Dande communal land, Zambezi Valley, Zimbabwe.

- the commercialisation of **bushmeat** provides important revenues – for example, it accounts for 10% of GDP in the Central African Republic, and in the Amazon Basin wild meat yields over US$175 million/year;
- much wildlife is traded as live **pets** (e.g. parrots, frogs), and dead **ornaments** (e.g. butterflies, cat skins, ivory). In 1968, 13,500 jaguar skins were legally imported into USA in 1968, compared to 50 legally traded worldwide in 1979, after CITES (see BB20). However post-CITES trade continues: between 1976–79 over 21.5m wildlife specimens were exported from Buenos Aires, worth over US $ 245m;
- income generated from **sport hunting** in 1991 ranges from 1.4 million Euro in Burkina Faso to 10 million Euro in Tanzania;
- wildlife can also provide revenue through **non-consumptive** uses such as wildlife tourism: annual income from wildlife viewing has been estimated at more than 300 million Euro in Kenya and 75 million Euro in Zimbabwe (equivalent to 2–5 % of GDP) (see BB9).

As well as these resources, wildlife can be destructive to humans, their livestock and crops, and property. For example, monkeys eat grains and fruits (cocoa, coffee, bananas, etc); rodents and many bird species focus on seeds (annual losses of cereals to red-billed quelea in Sudan amount to $1–$6 million); elephants eat or trample most crops; and large cats pose a threat to livestock in remote areas. Some wildlife can also be a source of disease, for instance trypanosomiasis, which can pass to domesticated livestock. These pose management issues that must be addressed in development planning.

Loss of wildlife biodiversity

Overall, one in four mammal species is threatened with extinction, but the proportion of species threatened varies between families: 63% of wild horses, rhinos and tapirs; 45% of monkeys and apes; and 33% of pigs, cattle and antelopes.

The direct causes of these declines are almost universally the loss, degradation and fragmentation of habitats. For larger species hunting and trapping are also major causes of population decline, and this is increasingly problematic as inaccessible habitats are opened up with new roads. Timber companies, for example, are frequently cited as one of the major players in opening up forests, and bushmeat can fetch very high prices in urban markets.

Indirect causes of biodiversity loss include the fact that wildlife is a common resource, which makes it vulnerable to unregulated and unsustainable harvests. Local people tend to suffer from a lack of control which allows outsiders to exploit the resources which they have traditionally managed. Another underlying cause is the high price or shortage of domestically produced meat.

Opportunities

Through the conservation and sustainable use of wildlife, these losses can be avoided and sustainable benefits for human development can be sought. The equitable sharing of these benefits (which can be cash, products or other benefits) is crucial.

Wildlife tourism and sport hunting provide opportunities for the maintenance of wildlife

International context

- The Convention on the Conservation of Migratory Species (or Bonn Convention, 1979) includes a provision for setting up regional agreements (legally-binding or not) to protect or manage sites used by species or groups of species. *http://www.wcmc.org.uk/cms*
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, 1973) (see BB 20) regulations seem to have supported recovery of some wild populations of rare species (e.g. vicuñas), but have proved less effective for others, such as the tiger. *http://www.cites.org*
- Regulation of trade to reduce the risk of species extinction has been constrained by disputes with World Trade Organization (WTO) agreements on free trade. Following rulings against USA embargoes on goods that were deemed to be inappropriately harvested, it is clear that environmental issues must be integrated into WTO/GATT agreements and procedures. *http://www.wto.org/english/tratop_e/envir_e/envir_e.htm*

populations in their natural habitats, through non-consumptive viewing or controlled off-take. It is a particularly good method of conserving large animals (so-called 'charismatic megafauna', such as elephants, zebra and lions) which tourists (usually foreigners) will pay to come to look at, or to kill for trophies[1]. Few rainforest sites have been developed for large-scale tourism, due to the poor visibility, although a few forest lodges exist for game viewing in clearings in Kenya and India, and these are increasingly being developed in Amazonia and Mexico.

Sustainable harvesting from the wild can ensure that benefits continue to accrue over time, rather than being short-term. The most successful ways of achieving such sustainable production have been based on community participation (see text box next page), although such approaches are time-consuming, costly and sometimes controversial.

Ranching and domestication can provide food and so reduce pressure on wild populations. Various fairly successful attempts have been made, such as crocodile farms in Africa and Asia and cayman farms in Latin America. But developing small-scale cane rat ('cutting grass') and paca farms in west Africa and meso-America respectively has had less good results.

Less intensive production systems have been developed in rangelands of Latin America (e.g. for capybaras in Venezuela), and more thoroughly in the rangelands of Africa where there are over 30 species of suitable bovids and antelopes. Using species adapted to local food, water and disease conditions has allowed production / ha to exceed those for cattle under some circumstances, and areas fenced-in for this type of production are rapidly increasing in southern Africa - generally in combination with cattle rearing and sport hunting.

Conclusions

- Traditionally, policies concerning wildlife have been protectionist and have excluded local people from either protected areas or from harvesting the wildlife resource. The criminalisation of people who rely on wildlife means that much harvesting becomes illegal and more difficult to monitor and control. The conservation and sustainable use of wildlife must be done in collaboration with local communities, with effective regulation from government.
- The private sector needs to be fully involved in attempts at improving wildlife (and the biodiversity) in wildlife habitats, such as through innovative codes of conduct being developed with logging companies, which commit to monitoring hunting and transport of wildlife by their employees.
- Planning procedures and land-use management which supports sustainable use of wildlife needs to integrate extractive and protected zones in a landscape. This should be based on accurate assessments of the resources, and allow sufficient place for wild animals to reproduce and migrate. They should also address issues of competition and conflict between wild and domestic stock and human populations (e.g. over water, grazing, crop losses, etc).
- Improved management is only possible where there is clear ownership and/or access which allows for the clear definition of rights and even the exclusion of 'outsiders'. These should complement laws to protect vulnerable species from hunting, to control wildlife trade, and to control sale of weapons. It may be necessary to formalise relationships in legal terms.

WWF-CANON/MICHEL GUNTHER

In Cote d'Ivoire, for example, twice as much bushmeat is eaten as livestock (bushmeat hunter with duiker and guenon monkeys).

This Biodiversity Brief was written by the BDP and edited by Martyn Murray.

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Community-based wildlife management (CWM)

CWM can be defined as *the regulated use of wildlife populations and eco-systems by local stakeholders*. Benefits can include the sale of products and sale/leasing of hunting rights. In southern Africa, in particular, significant revenues have been made from the sale or leasing of hunting concessions. World wide, significant revenues have also made on internationally traded products such as ivory, vicuña fibre and iguanas.

Factors which favour CWM largely concern the nature of the wildlife assets (clear boundaries, relative scarcity, substantial value, proximity to communities, predictability and ease of monitoring), but factors such as clear tenure rights, and the capacity of communities to undertake the necessary managerial roles are also crucial to success.

However, the costs of CWM, such as labour inputs and investments, or the opportunity costs of not using land for other purposes, can offset any such benefits. Furthermore, commercial interests tend to capture the benefits over local communities, so there is a need to assess who bears the costs of CWM, who benefits, and whether the communities involved perceive their benefits outweigh costs.

- Some interventions may require the control of wildlife populations that pose a threat to livelihoods. Problem animal control (PAC) needs to build on existing knowledge and trapping/hunting experience to reduce numbers and provide bushmeat benefits.

- Many of the opportunities for improved management of wildlife rely on access to finance, markets (including infrastructure) and information that are beyond the means of local communities. Innovative approaches are therefore required to ensure that local communities get access to these resources, and are involved in planning and decision-making, and are able to derive benefits from new activities.

- Addressing the loss of wildlife biodiversity means addressing the underlying reasons why it is being lost. In many cases this means looking at policies in other sectors (such as agricultural, forestry and trade), and ensuring that effective environmental appraisal procedures are carried out.

- Greater international funds will need to be directed to local government departments and communities that are carrying the costs of maintaining wildlife in protected areas if developing countries are to maintain global biodiversity.

[1] It is worth noting studies which have shown the lifetime value of some large mammals (e.g. lions) may be greater from wildlife viewing than sport hunting.

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Website

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Biodiversity IN Development

Biodiversity Brief 15

Protected areas

Many protected areas were established to protect fragile environments, outstanding scenery, wildlife or places for recreation and hunting. This approach excluded many groups and has led to conflicts with local livelihoods and with other forms of land-use, leaving protected areas as a low priority for many developing countries. However, protected areas provide a range of potential benefits for human development: from the provision of wild products, to ecosystem services which underpin development, and these values are being increasingly integrated into protected area management.

There are approximately 560 million hectares of protected areas (PAs) in tropical countries. In tropical areas this accounts for 7.7% of the land area, with coverage being fuller in Africa and South America than elsewhere in the tropics (see figure on page 2).

Recent research indicates that PAs are effective in protecting biodiversity, at least at the level of habitat maintenance. The most crucial factors in ensuring effectiveness are resources and staff capacity (particularly the number of guards employed), deterrents to discourage unsustainable practices, clear demarcation of the park boundaries, and incentives and compensation to local people.

A protected area (PA) is defined by IUCN as *an area of land and/or sea especially dedicated to the protection and maintenance of biodiversity, and of natural and associated cultural resources, and managed through legal or other effective means.*

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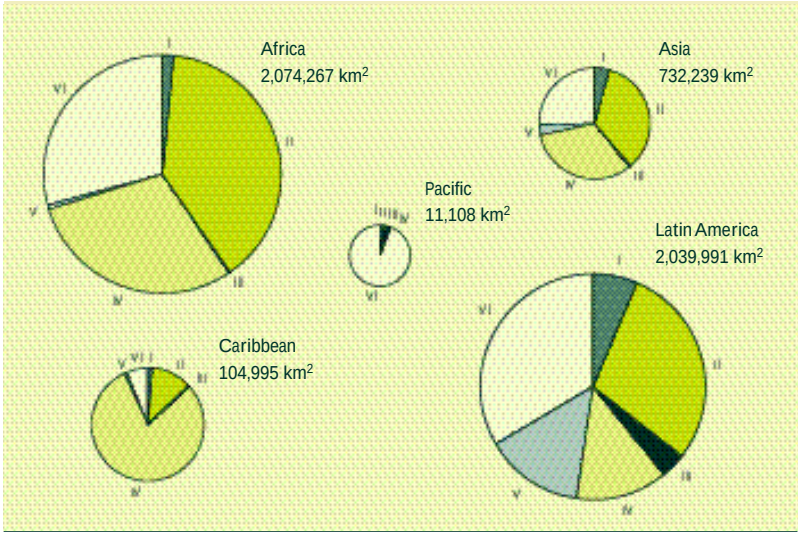
The changing approach to protected areas

Selection of PAs has been chiefly driven by the aim of protecting fragile habitats, preserving a representative sample of a nation's, or the world's, habitats or species, or for scenic beauty, recreation and sport. These selection criteria have been tested over time by changing social, economic and political circumstances. Lessons learned from PA experience have shown that failure to address the livelihood needs of local people, or actions which alienate them from the resources on which they rely, are unlikely to succeed. Building on the Man and the Biosphere Reserve concept of multiple-use landscapes managed for human benefit and biodiversity maintenance, PAs are today being managed for a wider range of aims: for public and private benefit at local, national and global levels, and over short and long time-scales. This is reflected in IUCN's current classification of PAs (e.g. the addition of categories V and VI).

There has been a move to consider PAs not as 'islands' in a sea of development, but as networks linked by nature-friendly corridors within a bioregional landscape. This is most obviously important where populations range widely or migrate long-distances, but it also

Distribution of protected areas in tropical countries by IUCN categories[1]



[1] *The relative size of each pie is to scale with the land area of PAs in each region.*

IUCN protected area categories

Each country has its own nomenclature for protected areas, with their own management principles, but the following generic categories have been drawn up to show the international range:

I. **Strict Nature Reserve/Wilderness Area:** managed for scientific purposes;
II. **National Park:** managed for ecosystem protection and recreation;
III. **Natural Monument/Natural Landmark:** mainly managed for the conservation of a specific natural phenomenon;
IV. **Habitats/Species Management Area:** mainly actively managed for conservation;
V. **Protected Landscape/Seascape:** mainly managed for the conservation of a landscape/seascape;
VI. **Managed Resource Protected Area:** mainly managed for the sustainable use of natural resources.

allows exchange of individuals (and genetic material) between isolated populations to avoid negative in-breeding effects. This issue extends beyond national borders, and trans-boundary protected areas systems (sometimes called Peace Parks) have been developed as a result (see BB5).

There is a risk that PA management may now no longer serve its conservation function if, for example, biodiversity maintenance is given lower priority than raising tourism revenues. Conversely, the importance of conservation and sustainable use outside protected areas should not be overlooked because it is assumed that it only occurs in PAs.

Opportunities for income generation can include sport and trophy fishing, but require clear cost- and benefit-sharing to ensure that local people do not lose out. Effective regulations and monitoring are also needed.

WWF-CANON/EDWARD PARKER

Development perspective

In assessing how a PA might contribute to local development it is important to take into account all values – both use and non-use. Many non-use values are difficult to quantify, or have no obvious markets, but they contribute substantial long-term and intangible benefits.

Economic valuations can identify the goods and services suitable for capturing revenues, which can be crucial in ensuring the long-term sustainability of a PA. For example, annual tourism revenues of around US$330 million in Costa Rica more than cover PA outlay of US$12 million/year. Opportunities for income generating include sport and trophy hunting, but require clear cost- and benefit-sharing to ensure that local people do not lose out, and also effective regulations and monitoring to ensure that extraction does not exceed a species' ability to recover.

In addition, PAs can have other commercial benefits. In St Lucia, for example, one third of the country's fishing grounds were designated as no-take areas in 1995. Within 3 years commercially important fish stocks had doubled in the seas adjacent to those reserves.

Not all PAs have easy income generating potential. However, various approaches can increase opportunities for PAs to support

Long-term versus short-term benefits

Research indicates that – within a long-term development vision in which depreciation of natural capital is taken into account – the sustainable exploitation of tropical rainforest products provides a realistic alternative to the combined oil exploitation, cattle-rearing and coffee growing found in the Ecuadorian rainforest. Analysis shows that while oil/cattle/coffee generate a net benefit of US$ 316,344,662/hectare during the first 10 years of exploitation (compared to only US$ 122,762,156 /hectare from sustainable use of forest products), once the oil reserves are used up, the sustainable production alternative will be providing 168% more benefits than the cattle/coffee production.

livelihoods and address poverty. Integrated conservation and development projects (ICDPs) have commonly been developed to provide benefits for local livelihoods through sustainable use of natural resources (including tourism). The main lesson learned from this approach is that the development-related activities should be integrated into overall PA planning, and not grafted onto an existing design. New approaches also need to be built on, and work with, existing socio-cultural practices, rather than against them. Any economic appraisal that fails to take all values into account will consistently undervalue natural resources and PAs, making it difficult to assess which stakeholders gain or loose, and undermining proposals for effective management.

Effective management

PAs are subject to a range of pressures, such as in-migration of displaced populations, or those who wish to exploit the land and its resources. To resist (or reverse) these pressures it is necessary to:

a) safeguard sites which serve several important biodiversity functions and provide ecological services (such as water supply);
b) design PAs systems with corridors and buffer zones;
c) develop appropriate economic, legal and policy framework to engage the support of all stakeholders.

However, even if these principles are followed, many PAs already suffer due to lack of resources and capacity. According to a WWF-World Bank survey of 10 countries, only 1% of PAs are wholly secure. Many PAs in developing countries have been termed 'paper parks' because they are not managed effectively. This is largely a result of changing circumstances, with increasing stakeholder conflicts, more complex objectives and fewer central government resources. In cases where the state pays for PA maintenance, as in much of Africa, other demands on the treasury tend to hold sway, and PAs are commonly given lower priority.

Potential values of protected areas

Goods
- access to natural resources, improved management and sustainable harvesting
- generate revenue through marketing of sustainably harvested goods
- reservoir of genetic material from ancestral stocks of domesticated species
- representative sample of indigenous plants animals and micro-organisms that are used, or potentially useful
- conservation of wetlands which act as nurseries for fish, or marine PA networks that maintain fish stocks in adjacent areas

Services
- conservation of soil, watersheds and coastlines
- provision of clean water
- maintenance of biotic processes such as pollination which are important in supporting agricultural systems
- the sequestration of carbon
- climate regulation
- maintenance of buffers to natural disasters

Non-consumptive use
- education and research
- recreation and tourism, providing benefits for local economies

Others (non-use)
- preservation of cultural heritage, spiritual beliefs, sacred sites, cultural/traditional practices and traditional knowledge
- the conservation of genetic materials in natural habitats, which can be used in medicine, and plant and animal breeding
- preservation of scenic beauty and rare species
- preservation of options for future use
- promotion of peace and international cooperation

Conclusions

The lack of attention to the costs being borne by local communities has resulted in unrealistic management plans and negative local attitudes to PAs. To address this short-coming, PA establishment and management must be participatory, building on communities' expressed needs and involving them in the development and implementation of the PA.

This Biodiversity Brief was written by the BDP. Additional technical input was provided by the World Commission on Protected Areas.

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Buffer zones

A buffer zone is an area, usually on the periphery of a PA, designed to be managed to provide support for PA, and to:

- buffer the PA from the negative impacts of neighbouring communities
- protect neighbouring communities from wild animals leaving the PA
- provide local communities with opportunities lost from the PA, such as sustainable harvesting of resources.

Buffer zones therefore provide an important means for fulfilling both conservation and development aims, and are often linked with integrated conservation and development projects (ICDPs).

Management systems that address equitable cost and benefit sharing require a new approach to conflict resolution, and need to develop partnerships with local communities for co-management in buffer zones. Initiatives for community wildlife management in southern Africa, and sharing forest management in south Asia, are examples of management models that incorporate these needs. However, co-management systems must be adapted to different local situations, especially where population growth and immigration are important factors.

In supporting PAs, it is crucial that donors take a long-term perspective, and support financial sustainability. Where PA benefits are global, funding instruments such as the Global Environment Facility (GEF), and carbon-trading through the Kyoto Protocol, can provide financial support to weak national economies and poor rural communities. As a multi-national institution the EC needs to coordinate its investments in global environmental goods with GEF to ensure synergy and complementarity.

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Website

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Biodiversity IN Development

Biodiversity Brief 16

The Convention on Biological Diversity and related international agreements

The EC is a party to the Convention on Biological Diversity, the first convention to provide a comprehensive approach to the conservation and sustainable use of biodiversity. It is an ambitious international framework for reversing the losses of global biodiversity, upon which many development opportunities depend.

International context

The conservation and sustainable use of biological diversity was first identified as a priority at the United Nations Conference on Human Environment in Stockholm in 1972, and since then a number of international legal instruments have been adopted.

- **The Ramsar Convention on Wetlands (1971)** seeks to protect biologically-rich but undervalued wetland ecosystems. *(http://www.ramsar.org)*
- **The Convention for the Protection of the World Cultural and Natural Heritage (abbreviated to World Heritage Convention, 1972)** identifies sites of outstanding universal value, and provides support for their protection and management. *(http://www.unesco.org/whc)*
- **The Convention on International Trade in Endangered Species (CITES, 1973)** is a legally-binding international treaty, regulating trade in plant and animal species threatened with extinction. *(http://www.cites.org.)* (see BB20)
- **The Convention on Migratory Species (alias The Bonn Convention, 1979)** coordinates regional and global efforts to protect some 10,000 migratory species, including birds, dolphins, and marine turtles. *(http://www.wcmc.org.uk/cms)*
- **The UN Framework Convention on Climate Change (1992)** was negotiated in response to anticipated environmental damage, and aims to mitigate climate change impacts. *(http://www.unfccc.org)*
- **The UN Convention to Combat Desertification (1994)** is a comprehensive approach to reducing desertification and drought. *(http://www.unccd.int)*

What is biodiversity?

The Convention on Biological Diversity (CBD) defines biodiversity as ***'the variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems'.***

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A central element of biodiversity management for economic development is the sustainable use of wildland resources.

WWF-CANON/HARMUT JUNGIUS

The EC is a signatory or contracting party to over 30 other environmental agreements, as well as a number of non legally-binding agreements, such as the Forestry Principles drawn up in Rio (1992). Equally important are influential conventions and agreements not primarily concerned with biodiversity, but with great impact upon it, such as World Trade Organization (WTO) agreements and the United Nations Convention on Law of the Sea (UNCLOS).

The Convention on Biological Diversity

This was adopted in Nairobi in 1992; as of January 2001 there were 180 Parties. It comprises 42 Articles and two Annexes, and has three overall objectives:

- conservation of biological diversity;
- sustainable use of the components of biological diversity;
- fair and equitable sharing of the benefits arising out of the utilisation of genetic resources.

Full details of the text, and the decisions of the Conference of the Parties (COP) can be found on the CBD web-site: http://www.biodiv.org.

Conservation involves the *'conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species...'* (CBD Article 2), and includes the rehabilitation of degraded ecosystems.

Sustainable use is *'the use of components of biological diversity in a way, and at a rate, that does not lead to a long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations'* (CBD Article 2).

What the Convention addresses

The CBD takes a comprehensive rather than a sectoral approach to the conservation and sustainable use of biodiversity, and covers:

- genetic diversity – variability within a species, and the genetic information contained in individual plants, animals, and micro-organisms;
- species diversity – the variety and distinctiveness among species;
- ecosystem diversity – the variety of habitats, biotic communities, and ecological processes in the biosphere.

The themes for action are addressed under separate articles for: *in situ* and *ex situ* conservation (Art. 8 & 9); sustainable use (Art. 10); incentive measures (Art. 11); research and education (Art. 12); public education and awareness (Art. 13); impact assessment and minimising adverse impacts (Art. 14). Other articles deal with international cooperation and exchange of technology and information.

In the context of development cooperation, the CBD promotes integration of biodiversity management into economic development, arguing that sustainable development is only possible if the earth's renewable resources are used sustainably. It also emphasises the need for equitable benefit-sharing.

The first Protocol to the Convention was adopted on 29 January 2000: the Cartagena Protocol on Biosafety. As of 1 December 2000 the Protocol had 80 signatories and two ratifications; it will enter into force 90 days after the 50th ratification. It deals with potential risks to human health and the environment posed by the introduction of living modified

organisms (LMOs), including genetically modified organisms (GMOs). It establishes a procedure for ensuring that adequate information is available to allow countries to make informed decisions before LMOs are imported. It is based on the Precautionary Principle (see text box).

Rights and obligations

The CBD recognises the 'sovereign right' of nations to 'exploit their own resources pursuant to their own environmental policies' (Art. 3). In line with this, each Party has responsibility for its own biological diversity and should develop national strategies and action plans as tools to integrate biodiversity issues into national decision-making (Art. 6). Legal instruments allow countries to conserve and sustainably use their biodiversity, as they:

- confer jurisdiction and powers on public bodies and communities;
- establish and enforce procedures (such as Environmental Impact Assessments);
- provide for public participation;
- establish a legal basis for environmental agreements;
- implement obligations under international agreements.

Parties are required to manage their own processes and activities which may threaten biological diversity, regardless of where their effects occur, and are expected to cooperate on matters of mutual interest (for example, shared ecosystems and areas beyond national jurisdiction, Art. 5).

The Convention also calls on the Parties to take into account the special needs of developing countries, with new and additional financial resources (Art. 20) and appropriate access to, and exchange of, genetic resources and relevant information and technologies (Arts. 15–19).

Institutional arrangements

The COP is the key decision-making body responsible for monitoring the implementation of the CBD, which meets every two years: COP6 is planned for 2002 in the Netherlands. Parties are required to submit reports on measures taken for the implementation of the Convention and how effectively they have met the objectives of the Convention.

The Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) provides the Conference of the Parties with advice relating to the implementation of the Convention, including the status of biological diversity and the effectiveness of implementation measures. It also has a major role in identifying technologies for the conservation and sustainable use of biological diversity which are suitable for transfer to developing countries.

The Global Environment Facility (GEF) is the financing instrument for the CBD and provides grant and concessional funds to developing countries for projects and activities that aim to implement the CBD. These funds are intended to cover incremental costs (i.e. the difference between the cost of meeting a country's global environment obligations, and those of its national development programme). The GEF also meets the costs of developing countries to prepare national biodiversity strategies and action plans.

The Convention provides for the establishment of Clearing House Mechanisms (CHM), to allow the sharing of biodiversity-related information. The Cartagena Protocol also proposes the establishment of a Biosafety Clearing House, to facilitate the exchange of information on LMOs. Lists and contact details for national biodiversity focal points for the CBD and for national CHMs can be found on the CBD website.

Conservation and sustainable use

The conservation and sustainable use of biodiversity are central to development cooperation interventions.

The Precautionary Principle

This principle states that *'where there is a threat of significant reduction or loss of biological diversity, lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimise such a threat'.*

WWF-CANON/MARTIN HARVEY

This Cape Sugarbird, which is endemic to the Fynbos region of South Africa – an area of extremely high biodiversity - is a primary pollinator of *Protea* flowers, and therefore a crucial component in the maintenance of the ecosystem.

This Biodiversity Brief was written by Catherine Stoneman and edited by Martyn Murray.

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In situ conservation refers to conditions where genes and species are found in the surroundings where they evolved (including on-farm for domesticated species), and *ex situ* conservation where components of biodiversity are outside the habitats in which they evolved.
There is emphasis on the establishment and management of protected areas, which range from Strict Nature Reserves to Managed Resources Protected Areas. A network of interconnected protected areas of representative ecosystems is recognised as central to maintaining global biodiversity, but in tropical regions these account for less than 10% of the land area, so biodiversity also needs to be managed outside protected areas.

Sustainable use of biological diversity is fundamental to many development pathways: for instance the supply of food or medicine, and provision of ecosystem services such as soil formation, recycling of water and oxygen. Sustainable use therefore must look beyond biological issues, and include economic and socio-cultural needs. Conservation and sustainable use of biological resources should be integrated into national decision-making.

Equitable benefit sharing

There is a strong focus on the sharing of benefits from the use of genetic resources (Arts. 15–19), but development cooperation also needs to take into account of the sharing of costs, and consider species and ecosystem biodiversity. Article 8(j) recognises the links of indigenous peoples and local communities with biodiversity, and Article 10(c) encourages customary uses of biological resources in a way that is compatible with their sustainable use or conservation.

Equitable sharing must stem from this recognition, and respect for local communities' intellectual property rights, so that benefits of sustainable use and conservation flow to these groups. It relies on supportive policies for land ownership, resource access and co-management opportunities, and depends on favourable trade polices.

Impact assessment and minimising adverse impacts

Article 14 deals with the promotion of Environmental Impact Assessment (EIA), including Strategic Environmental Assessments (SEA) for policies, sector programmes, and long-term planning. It emphasises that these instruments are vital for identifying opportunities for ecologically appropriate measures to avoid adverse impacts of development activities.

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Website

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Biodiversity IN Development

Biodiversity Brief 17

Guiding Principles for biodiversity in development

Seven Principles for integrating biodiversity in development action have been compiled through consultation with experts in developing countries. The Guiding Principles are designed to ensure that development cooperation is sustainable and effective, and gives biodiversity proper consideration. The Principles are generic and robust, and relevant to a wide range of contexts. They correspond well with the 12 Principles of the ecosystem approach of the Convention on Biological Diversity.

The seven Guiding Principles are a distillation of the experiences and opinions of people from the EC, EU Member States and partner countries in tropical regions – from government, field projects, non-governmental and community-based organisations, and the private sector. Eleven case studies were reviewed and many other field experiences shared at five workshops (four regional and one international) to reach a consensus. The conclusions of this consultation are reported in *Guiding Principles for Biodiversity in Development: Lessons from field projects.* This Biodiversity Brief summarises the fuller report.

What is an ecosystem?

An ecosystem is defined in the CBD as *a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit.*

Principle A:

Adopt an ecosystem perspective and multi-sectoral approach to development cooperation programmes (taking into account the impacts on adjacent and downstream areas).

The ecosystem perspective moves away from a focus on single species, towards consideration of the connections within and between natural systems and the non-living environment. This gives more value to ecosystem functions that underpin human development, such as climate stabilisation and soil formation. The ecosystem perspective also encourages impact assessment over different time scales and spatial dimensions. Ecosystems, and their components, rarely correspond tidily with administrative boundaries, so natural resource management needs to be sensitive to species' movement, and the impact of interventions on adjacent and down-stream areas: for example, soil erosion, water pollution or effects on migrating animals.

The ecosystem approach is holistic and multi-disciplinary, and cuts across all sectors, integrating social, economic and biological issues. It is important to identify and reconcile conflicting objectives with the needs of different

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stakeholders in a land use programme for a given ecoregion.

Appropriate management can minimise the irreversible loss of biodiversity. Fostering sustainable exploitation, or respecting protocols on the introduction of alien species or genetically modified organisms, can contribute significantly. Restoration of degraded ecosystems may also be necessary.

Principle B:

Promote fair and equitable sharing of costs and benefits from biodiversity conservation and sustainable use at all levels: local, national, regional and international.

The benefits of biodiversity conservation and sustainable use should flow back to the people whose livelihoods are affected, and who are often the real stewards of a natural resource. All too often benefits flow to administrative bodies, or to companies based outside the areas affected. Local people can benefit financially, or from training, employment, infrastructure and equipment. Projects should build an appreciation of the long-term and intangible benefits of biodiversity (such as environmental security) which are difficult to see and measure.

Costs as well as benefits must be shared. Many stakeholders who live some distance from sources of biodiversity goods and services, benefit from them often at the expense of those who live nearby, especially poor communities. Unless some form of equitable cost and benefit sharing is set up, for example to offset the costs of being prevented from clearing watersheds supplying water to urban centres, local people are unlikely to see any reason to support new approaches to biodiversity management.

Those directly dependent on biodiversity resources are often the most vulnerable. Their unequal position in trade activities, and unclear ownership rights, can result in unsustainable use and rapid elimination of resources. Clear property rights, fair trade and fair prices are essential to support their livelihoods.

Economically viable alternatives take pressure off natural resource use, and can contribute to halting biodiversity losses. Experience shows that local communities are most likely to support sustainable use of natural resources when such activities are directly linked to the resource in question, and similarly, they are most likely to conserve wildlands if markets support their use for economic development (such as ecotourism).

Since biodiversity is concentrated in tropical countries, many of which are poor, investment from wealthier nations is necessary to reverse rapid declines in biodiversity. Global support needs to be offered to maintain global benefits. Only long-term investments will bring about the change in policy, institutions and actions that is needed for lasting improvements to biodiversity management and sustainable development.

Principle C:

Encourage full stakeholder participation, including partnerships between civil society, government and private sector.

It is generally accepted that projects work better and are more sustainable if all stakeholders participate in their design and implementation, taking into account local power relations, interests and understandings. Solutions generated at the local level are more likely to be

Biodiversity often plays an important role in the lives of local people, such as for ritual purposes (this Kayapo Indian in Brazil is collecting seeds for making red paint), and it can have important cultural significance. Development cooperation projects need to take heed of these values for long-term sustainability.

WWF-CANON/MAURI RAUTKARI

GLYN DAVIES

It is important that wildlands converted for agricultural purposes – such as the tea plantations shown here in Kenya – are suitable for the purpose in terms of rainfall, soil quality, access to markets etc.

acceptable than those developed elsewhere. Participation encourages the use of local knowledge, skills and resources in the development process whilst ensuring respect for local values and customs.

The participatory process should involve not only consultation but also shared responsibility. Donor agencies may be required primarily as facilitators, leaving implementation to local institutions. These, however, are not necessarily perfect partners for participation in projects, and participation is not equally possible with all groups. Some groups may be marginalised (for example, women, landless or indigenous peoples), and special efforts will be needed to involve them.

Conflicts will often arise, and will need appropriate conflict management measures at the local level. Successful biodiversity and development projects generally benefit from high-level political and administrative support, which provides essential backing to managers in resolving local conflicts and agreeing boundaries and land-use rules.

Principle D:

Ensure that institutional arrangements are effective, transparent, accountable, inclusive and responsive.

This Principle refers to good governance which is necessary to bring about the lasting change in behaviour that leads to improved integration of biodiversity into development. There was concern that many communities, or sections of communities, do not have the capacity to participate in natural resource management. Civil society capacity building has been the focus of many development cooperation projects, but as civil society has to interact with government and the private sector, this needs to be complemented with building private sector and government capacity also. This will require training in techniques such as facilitation, participatory management and conflict resolution.

Principle E:

Ensure that development cooperation projects and programmes are consistent with the wider policy framework, and/or changes are made for supportive policies and laws.

Experience shows that international investment in conservation and sustainable use of biodiversity will be successful only if there are enabling and supportive policies, backed up with effective legal framework.

Where the existing policy framework does not support conservation and sustainable use, assistance to develop new policies may be appropriate. For example, insecure property rights are an oft-cited cause of biodiversity loss, especially when large areas are considered common property (open access) resources. This lack of ownership and rights tends to lead to over-exploitation, and a lack of investment – nobody feels responsible for the resource, which remains vulnerable to 'land and resource grabbing' by powerful groups.

This Biodiversity Brief was written by the BDP and edited by Martyn Murray (MGM Consulting Ltd).

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The workshop participants were also concerned about the negative impact of market forces, trade polices and incentive measures on the poor and the environment, and felt that developing country interests were not adequately advocated in international fora. It was also noted that donor countries supporting conservation and sustainable use can have domestic policies, such as regulations on the import or export of certain goods, which have negative impact on developing regions.

Principle F:

Provide and use accurate, appropriate, multi-disciplinary information, accessible to, and understood by, all stakeholders.

The sharing of information is central to policy and programme development and project success. Project and programme transparency and accountability require a good flow of information between stakeholders at a local or regional level, and from local to national levels.

Crucial links can be established between projects and stakeholders by various means, from the gathering of data by local guides with indigenous knowledge, to public meetings for the discussion of questionnaires. This enables the interplay and interaction of local knowledge with technical and scientific information, which can be built upon by working with local research institutions.

Data gathering and monitoring systems should not be expensive and over-technical, and they should be sustainable during periods when external assistance is not available.

International partnerships (especially for technical and information exchange and technical and management capacity building) can be important for supporting local projects with training, information and ideas.

Principle G:

Development cooperation investments should be sensitive to, and complement, local and national structures, processes and capacities.

This Principle makes clear that the selection of projects and programmes is too often driven by development cooperation agency agendas.

There is evidence that projects perceived to be externally-driven have lower chances of success. Insufficient use of local consultants, lack of full stakeholder participation and insensitivity to local contexts all contribute to this. Another issue raised was that delays in agreed funding payments can be severely damaging, as project and programme continuation cannot be ensured and staff motivation declines.

Furthermore, many procedures for accessing development cooperation funds make it difficult for local NGOs, small-scale projects, and those with few partners in donor countries to obtain support.

Further information

- The full report *Guiding Principles for Biodiversity in Development: Lessons from field projects* can be found on the website below.
- reference to other Biodiversity Briefs is denoted as (see BB#).

Website

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Biodiversity IN Development

Biodiversity Brief 18

EC development cooperation and biodiversity

As one of the main themes of the Rio Earth Summit agreements, biodiversity has risen rapidly to prominence, and its continuing presence as a global issue is indicated by the increasing funds which have been committed to it. However, its importance for development is often poorly appreciated and it is weakly integrated into development cooperation policies, programmes and projects.

EC environmental commitments

The Amsterdam Treaty (1999) states that *'Environmental protection requirements must be integrated into the definition and implementation of other Community policies'* (Article 6). The Declaration on environmental impact assessments, annexed to the Treaty, notes that the Commission will undertake EIAs on any proposed action with potential negative implications for the environment. The EIA Directive of 1985 (amended 1997) also covered the use of EIA, requiring that the environmental consequences of projects be identified and assessed before authorisation is granted.

The recently adopted Communication on *Integrating Environment and Sustainable Development into Economic and Development Cooperation Policy* (Com (2000) 264) further states that *'EC economic and development cooperation should support developing countries' efforts to protect their environment and the shared global environment'*. Accordingly, both the Cotonou Agreement (with Africa, Caribbean and Pacific (ACP) countries), and the regulations governing EC cooperation with Asia and Latin America (ALA), provide for consideration of environmental aspects in all activities. Furthermore, 10% of financial assistance under the ALA budget lines must be spent on environmental measures.

EC biodiversity commitments

The European Community ratified the Convention on Biological Diversity (CBD) on 21 December 1993 (see BB16). It is one of 180 Parties to this Convention.

As a Party from the developed world, the EC commits itself to providing *'new and additional financial resources'* to assist developing country Parties to fulfil their CBD obligations.

For the period 1996–1998, the total amount committed from all sources to environment programmes and projects by DG Development was 274.3 million Euro (5.3% of total funds committed by DG Development), and the amount disbursed was 101 million Euro.

Using OECD DAC categories for classifying these environment projects, 181 million Euro were committed between 1996 and 1998 to

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EC Development Policy (COM (2000)212)

Central Objective	Poverty Reduction
Strategic Areas deriving from the Treaty	A. Sustainable development, in particular through promoting equitable growth, investment, employment, social and human development and environmental protection
	B. Integration into the world economy, including through support to regional cooperation and integration
	C. Fight against poverty
	D. Democracy, human rights, rule of law and when necessary peace-making and conflict prevention
Guiding Principles (mainstreaming)	1. Effect on poverty reduction
	2. Support for institutional development and capacity-strengthening
	3. Gender equality
	4. Sustainable management and use of environment and natural resources
	5. Enhancement of economic, social, political and cultural rights

projects that address the UN Conventions on Biodiversity, Climate Change and Desertification (see table below). This means that on average 1.2% of the total funds committed annually by DG Development were spent on implementing the CBD. In addition, 19 million Euro went on integrating the environment into development cooperation policy.

The OECD DAC categories of activities supporting the implementation of the CBD are broad, and include water resources protection, sustainable agriculture, combating deforestation, sustainable fishing and sustainable use of sensitive environments for tourism. Classification of European Commission projects for the purpose of updating the Evaluation Report (1997) adopts a much narrower definition of biodiversity: *the protection of natural resources, scarce natural resources and wildlife species.* Using this classification, around 3% of all environment spending was committed to biodiversity[2] (see figure on page 3).

Evaluating the spending

Following the *Evaluation of the Environmental Performance of EC Development Cooperation* covering the period 1990–1995 (ERM 1997), it is difficult to judge whether the level of support to the environment in ACP states is consistent with EC policy objectives. This is, for example, because the Lomé IV Convention defined no targets for the amount of funding to be allocated. There is some lack of priority to incorporating environmental issues into country and regional programming documents and activities because other sectors take precedence, and environmental institutions have limited capacity.

It was also noted in the Evaluation Report that biodiversity projects have a number of special characteristics that affect their performance:

EC commitments and disbursements[1] (MEuro) which support UN Conventions (1996–1998)

	1996		1997		1998		1996–1998	
Convention	Committed	Disbursed	Committed	Disbursed	Committed	Disbursed	Commited	Disbursed
Convention on Biological Diversity	20.55	4.8	18.39	8.8	25.80	10.1	64.74	23.7
Framework Convention on Climate change	23.54	3.2	15.38	3.8	19.27	5.0	58.19	12.0
Convention to Combat Desertification	28.43	7.2	10.22	10.2	19.51	6.9	58.16	24.3
	72.52	15.2	43.99	22.8	64.58	22.0	181.09	60.0

Source: Tractebel/ERM/Kampsax 2000

- there are often limited resources for the protection and management of biodiversity in developing countries;
- the demand for, and use of, biodiversity resources can lead to unsustainable exploitation.

The Evaluation made a series of recommendations that included:

- raising the awareness of Commission staff to the socio-economic and ecological importance of biodiversity;
- practical tools for Commission staff for integrating biodiversity.

At a general level, the integration of the environment into development cooperation policy and practice was also felt to be a cause for concern.

Addressing the Evaluation's findings

Since 1997, the Commission has put in place a number of tools and policy documents to address these recommendations:

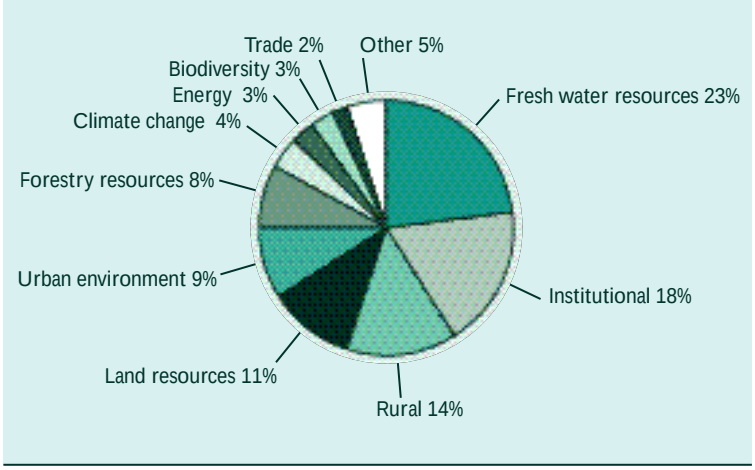
The EC adopted its *Biodiversity Strategy* (Com (98) 0042) in 1998 which calls for a number of Action Plans for integrating biodiversity into the ongoing work of other sectors. The *Biodiversity Action Plan for Economic and Development Cooperation* was adapted by the commission in March 2001 and identifies priority actions for:

- addressing institutional capacity constraints within the European Commission, such as the establishment of an Environmental Help Desk, and training programmes;
- integrating biodiversity into development cooperation projects and programmes in partner countries through: (a) support to national Biodiversity Strategies and Action Plans; (b) support for conservation and sustainable use of biodiversity; and (c) incorporating biodiversity into EIA and SEA procedures, and strengthening the capacity to carry out EIA/SEA;
- promoting EC/EU coordination, for example, through support to the Tropical Biodiversity Advisers' Group (TBAG) and improving EC/EU coordination with other organisations (e.g. GEF).

The recently revised EC *Environmental Integration Manual* covers the procedures to be followed and the tools available for integrating the environment, including biodiversity, at policy, programming and project levels. Tools include EIA, SEA, Environmental Audit, Environmental Management Plans and Environmental Management Systems. It also provides sections on best practice.

A programme of training seminars for EC staff (and other partners) on Environment in EC Development Cooperation was undertaken during 2000, covering such issues as Environmental Assessment, Environmental Economics,

Themes to which EC environment funds were committed (1996–1998)



Source: Adapted from Tractebel/ERM/Kampsax 2000

WWF-CANON/NIGEL DICKINSON

The links between poverty and environment are complex. It is those who depend most directly on biodiversity for their livelihoods who tend to be the most vulnerable to economic, social and environmental shocks (rice lost in Honduras during Hurricane Mitch).

This Biodiversity Brief was written by Catherine Stoneman and edited by Martyn Murray (MGM Consulting Ltd).

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Results of Environmental Impact Assessments are important in striking a balance between development actions which serve distant markets (here shrimp farms in Vietnam for export to Japan) and ensuring sustainable development for a broad range of local stakeholders.

Strategic Environmental Assessment and National Environmental Profiles, and has included a session specifically on biodiversity. A number of documents are also being produced by the Biodiversity in Development Project, to support EC development cooperation officers:

- a *Strategic Approach for Integrating Biodiversity in Development Cooperation*, outlining the basic framework for action determined by the Action Plan;
- 20 *Biodiversity Briefs*, designed to raise awareness of key issues amongst Commission staff for whom biodiversity is not a primary responsibility;
- *Guiding Principles for Biodiversity in Development: Lessons from field projects*. This summarises a consultation involving around 100 participants, from 35 developing countries, and 11 case studies of EC/ EU-funded development projects (see BB17).

These documents will be widely distributed in the EC, the EU and partner countries, as well as used in the training of EC staff in environmental issues.

What remains to be done

The tools are in place for a more integrated, strategic approach to EC development cooperation support for biodiversity. As always, political commitment is needed, followed by actions such as ensuring the implementation of legislation concerning the use of EIA. Many of the issues that are particular to biodiversity require long-term perspectives and the changing of entrenched opinions and behaviour.

[1] Approximations.

[2] The figure of 3% and the percentages shown in Figure 1 are approximate rather than actual commitments: they are based on an analysis in which many projects were scored for more than one theme.

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Website

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Biodiversity IN Development

Biodiversity Brief 19

Biodiversity – what is it, and why is it being lost?

The term 'biodiversity' is becoming more and more widely used, and the implications of its loss more widely recognised. However, biodiversity is a complex and vague term, which often does more to complicate a problem than to clarify it. This Brief attempts to identify the key characteristics of biodiversity, and the reasons for global biodiversity losses.

Biodiversity is very often equated with spectacular large mammals in the African savannahs, yet much biodiversity is microscopic, hidden in the soil, submerged under the sea, or cloaked in rain forest foliage. The concept relates to all life on earth; it goes beyond the organisms themselves to include their genetic make-up, and the invisible ecosystem processes of which individual species are a part (e.g. photosynthesis, soil formation and pollination). All of these aspects of biodiversity (or more correctly, biological diversity) underpin much of human development (see other BBs).

The Convention on Biological Diversity defines biodiversity in three inter-linked levels – genetic, species and ecosystem (see text box).

According to the Convention on Biological Diversity, biodiversity is ***the variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.***

Genetic biodiversity – evolution and information

Genetic biodiversity refers to the frequency and variety of genes within and between populations of the same species (varieties of plants or breeds of animals). Genetic variation is a key quality of all biological entities – domestic populations, their wild relatives and other wild populations. It is the engine room for evolutionary change. Genetic information provides the basis for plant and animal breeding programmes; by influencing processes of evolution through artificial selection, substantial improvements in crops and stock have been achieved.

Today's genetic biodiversity is the product of millions of years of adaptive evolution, and the information accumulated through geological time is a non-replaceable resource. Modern technology can duplicate but a fraction of these elements and thus any loss of genetic biodiversity is largely permanent.

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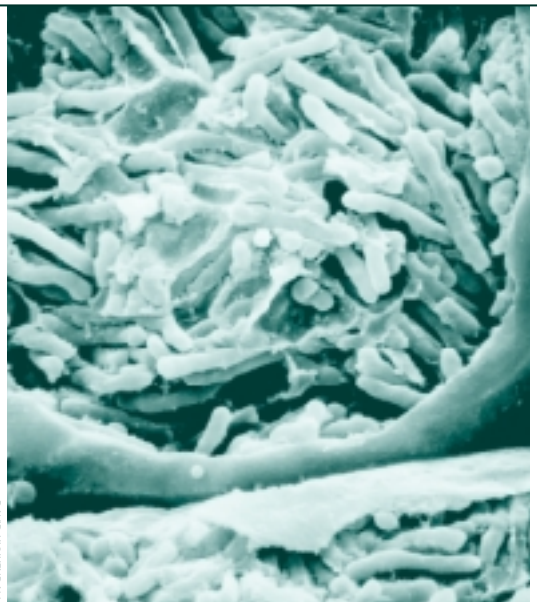


DAVID KUYKENDALL

Microbes such as viruses, bacteria, algae and protozoa, account for 6% (90,000 described species) and fungi for 4% of all described species. These rhizobium bacteria live in nodules on the roots of plants and assist plant growth.

Erosion of genetic capital

Genetic biodiversity can be lost even if species are not. The main cause of loss is the spread of commercial agriculture, which encourages monoculture cultivations. New crop varieties, often associated with commercial agriculture, have led to the replacement and loss of traditional, highly variable farmer varieties. Up to 90% of cabbages, field maize and tomato varieties have been lost in recent times, for example. Linked with these losses, is the loss of vital knowledge about how different varieties and breeds were produced and where they best flourish.

Species biodiversity – numbers, abundance and bioquality

The transition from genetic to species diversity is not always clear because evolution and population isolation are slow and erratic processes. Even taking this into account, estimates of the total number of species on earth vary between 10 and 100 million, with 14 million species currently being the best accepted estimate.

Recent habitat and ecosystem losses

- Some 37% of wildlands in developing countries were lost in the 20 years between 1960 and 1980.
- Up to 20% of tropical forests have disappeared in the 30 years between 1960 and 1990.
- Some 50% of wetlands worldwide were lost in the eight years since 1990.
- Worldwide, 35% of coral reefs are threatened with extinction in the next 30 years through sedimentation, and unsustainable use.
- At present, 6% of the land's surface comprises man-made deserts, which are increasing annually at the rate of 60,000 km^2.
- About 70% of irrigated and rain-fed croplands, and rangelands are degraded in Africa, Asia and Latin America.

Of these, about 1.75 million have been described worldwide, with about 15,000 new species being described annually.

Discussions about species biodiversity tend to focus on larger animals and plants. Yet, there are one million tiny invertebrate species (mostly insects), which account for 73% of all described species. The importance of these microscopic organisms is often overlooked unless they have conspicuous impacts, such as causing disease. Many of them, however, have important functions, such as maintaining soil fertility.

The number of species alone is not a measure of species biodiversity; it is merely a measure of the species richness of an area. As well as numbers, species diversity needs to include measures of abundance. With this information, the reproductive and regenerative capacity of individuals or populations can be linked with sustainable levels of cropping or harvesting.

In addition to quantitative measures (number, abundance and taxonomic relatedness), it is important to understand a species' biological qualities: for instance, whether a species has a role in recycling nutrients; or whether it can be eaten; whether it is a disease vector. These 'bioqualities' can all be important factors for supporting sound development.

An extinction spasm

Best estimates indicate that current extinction rates are 1,000 to 10,000 times faster than average extinction rates over geological time, leaving 1 in 4 mammal and 50% of some plant species threatened with extinction. The main cause of this extinction spasm is habitat loss, compounded by unsustainable harvesting levels. For example, 28% of 8,600 threatened tree species worldwide are declining because of over-felling. A widely recognised instance of trade pressure leading to species decline is capture fisheries, with 22% of commercial world fish stocks overexploited or depleted. Another major direct cause of species extinctions is the widespread introduction of alien species, cited as the single most common cause (about 40%) of documented causes of mammal extinctions.

Ecosystem biodiversity – processes and productivity

Ecosystem biodiversity refers to the dynamic complex of plant, animal and micro-organism communities and their non-living environment, interacting as a functional unit. Biological processes produced when different

species interact, include pollination, seed dispersal, predation, and symbiosis, and interactions between an ecosystem's biotic and abiotic components include nutrient recycling, soil formation and water filtration. These 'ecosystem services' underpin human development at the local level. Furthermore, ecosystem services can scale-up to impact at regional or even global levels, the loss of forest cover and climate change, or agricultural activities and coral reef sedimentation.

Maintaining landscape productivity

Human use of species products and ecosystem services is an integral part of ecosystem biodiversity, often a very long-standing one. Use brings about changes to ecosystem composition, structure and function. The magnitude of changes varies according to the intensity of extraction, the degree to which time is left for natural regeneration, or what resources are allocated to rehabilitation management.

Much human development depends on maintaining ecosystem services for productive landscapes (which can often be done despite many species losses). However, there are substantial habitat and ecosystems losses taking place in many developing countries as resources are over-exploited; areas are converted to farmlands, urban development and infrastructure and land, sea and air are polluted.

Other factors contribute to biodiversity loss. Natural phenomena and cycles such as the El Niño event of 1997/98 have been implicated in the spread of vast forest fires in Brazil and Indonesia, and the mortality of over 50% of coral reefs in the Indian Ocean is attributed to changes in sea temperature. And at even wider scales, human activity has released greenhouse and ozone-depleting gases into the atmosphere.

Underlying causes of biodiversity loss

In addition to the direct causes of genetic, species and ecosystem biodiversity loss that have been described above, there are various underlying factors which give rise to the conditions that encourage or allow the direct loss of biodiversity.

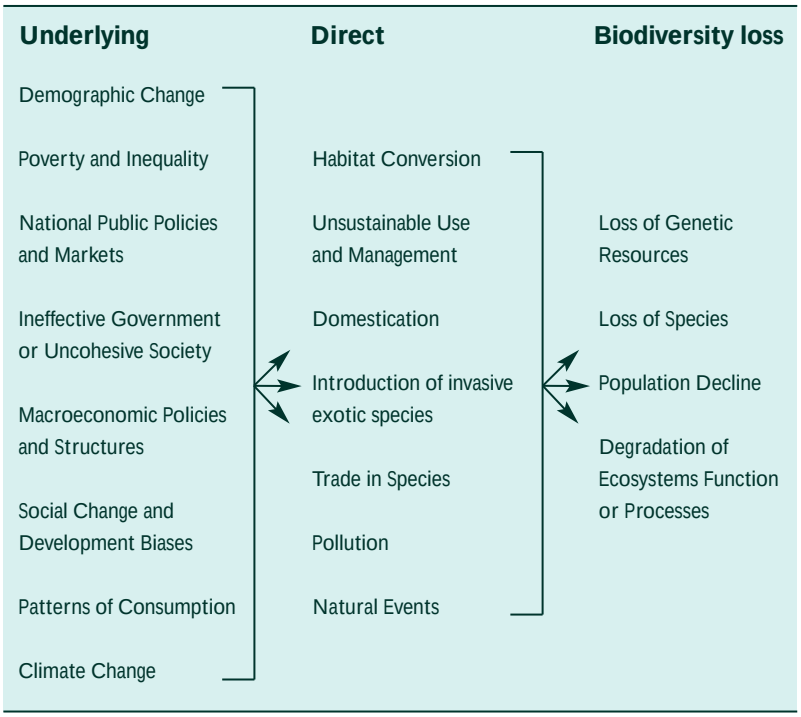
Human population growth, distribution and migration patterns are the most significant factors in environmental degradation. Four-fifths of world's population of 6 billion people live in developing countries and 95% of population growth by 2015 will occur in these countries. Large human populations have a direct impact through use or conversion of natural habitats, and urban areas create an indirect impact through demand for produce from natural habitats and farmlands. Local natural resources are further stressed by mass immigration because of wars or civil disturbance, government settlement schemes and the search for work.

The effects of these population pressures can be exacerbated or mitigated by changing patterns of natural resource use, which include the introduction of new technologies, and/or rejection or ignorance of traditional land management practices. In general, these combine to produce unsustainable natural resource use which results in biodiversity loss.

Poverty and inequality shape resource use at all levels. Poor people without access to financial and human resources, and without secure land tenure, are often forced onto unoccupied lands - protected areas or marginal lands: it is estimated that 60% of the world's poor live in areas of high ecological vulnerability. Without secure rights over use of the land and its resources, they have no incentive to invest in sustainable harvesting practices. This problem is compounded when land ownership laws require areas to be under cultivation before ownership rights can be registered.

Macroeconomic polices and trade practices have a major impact on biodiversity in developing countries because revenues are mainly

Causes of biodiversity loss



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generated from export of agricultural produce and natural resources. Many poor attempts have been made in structural adjustment programmes and other national economic reforms to internalise environmental or social costs in the price of traded goods. As a result, natural resources are being destroyed for short-term profits with few benefits to the poor who depend on such resources. Furthermore, trade practices can open a gateway for trading in illegally harvested goods, alongside those obtained legitimately.

National policies that fail to address the perverse incentives lead to biodiversity losses and environmental damage at various levels:

- Exploitation and use of land with no or unclear land ownership, for example in remote forest reserves, leads to unsustainable use.
- Subsidies for agriculture development, livestock rearing and other intensive production systems have resulted in unsustainable development programmes and large losses of biodiversity.
- Excluding local stakeholders from decision-making on land use plans and research programmes leads to unsustainable harvesting by powerful outside groups, to the detriment of local people and of environmental quality.

These underlying causes of biodiversity loss show how closely improved management of components of biodiversity that support human development depends on adopting sustainable development approaches that address issues of governance, poverty and equality.

The challenge

The challenge for development cooperation is to ensure that biodiversity continues to provide goods and services needed for human development. This means preserving a broad base of genetic resources and sustainably managing natural habitats to continue supporting livelihoods, especially in areas of low agricultural productivity. It also means addressing activities which impact on biodiversity, such as infrastructure, to prevent or mitigate negative impacts on biodiversity and poor communities.

This will only be effective if the institutional context and policy and market instruments, which influence the links between underlying and direct causes of biodiversity loss, and undermine sustainable use options, are corrected. Central to this process of policy development and capacity building is to try and ensure that the true costs and benefits of all levels of biodiversity need to be shared equitably. This needs to be achieved through promoting decentralisation, securing access or tenure of land/resource for communities dependent on them, and defining intellectual property and other rights, and capacity building to allow effective participation and negotiation between stakeholders.

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Website

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Biodiversity IN Development

Biodiversity Brief 20

CITES and wildlife trade

The scale of international trade in wild plant and animal species increased dramatically in the latter part of the 20th century. As a result, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) was negotiated, and entered into force on 1st July 1975, to regulate international trade in animals and plants, and their commercial derivatives.

The international trade in wildlife is dominated by the huge demand for pets and ornamental plants. In addition large quantities of fur, skins and timber are traded, along with articles manufactured from these materials. It is a highly lucrative business, estimated at between US$5 billion and $8 billion annually, and involves more than 350 million plants and animals every year.

Approximately half a million (legal) trade records are reported to CITES each year of which a substantial proportion refer to the European Union. From 1990–94, the EU imported 1,500 wild cats, 40,068 live primates and 808,896 live parrots, making up 44%, 27% and 44% of the total recorded in world trade, respectively. There is also a significant illegal trade to EU countries in live wildlife such as exotic reptiles, native birds of prey and rare parrots, and also in wildlife products, such as reptile skins, wool and fabric from wild mammals, foodstuffs, traditional medicines and ornaments. Some 30,000 CITES-listed plants and animals were seized whilst illegally entering just one country (UK) in a single year.

What is CITES?

CITES establishes the necessary international legal framework for the effective prevention or regulation of trade through national laws. The Convention regulates international trade in specimens of wild plant and animal species, and their products, through a system of permits and certificates, which can be issued to authorise shipment if certain conditions are met. These have to be presented before consignments of specimens are allowed to leave or enter a country. The species subject to different regulations are listed in three appendices:

- **Appendix I** includes species threatened with extinction, for which trade must be subject to particularly strict regulation, and only authorised in exceptional circumstances. Examples are: (mammals) the great apes, many monkeys, tigers, spotted cats, giant panda, elephants, rhinoceroses, addax, giant sable and Tibetan antelopes; (birds) numerous birds of prey, cranes, parrots and pheasants; (reptiles) sea turtles, many species of crocodiles, tortoises and snakes; (fish) the coelacanth; sturgeons; (molluscs) some mussels; (plants) some cacti and orchids, Brazilian rosewood.

- **Appendix II** species are not necessarily now threatened with extinction but may become so unless trade is strictly regulated.

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CITES regulations for export and import of plants and animals

An **export** permit for an Appendix I species shall only be granted where:

a) a Scientific Authority of the State of Export has advised that such export will not be detrimental to the survival of that species;
b) a Management Authority of the State of Export (MASE) is satisfied that the specimen was not obtained in contravention of the laws of that State for the protection of fauna and flora;
c) a MASE is satisfied that any living specimen will be so prepared and shipped as to minimise the risk of injury, damage to health or cruel treatment;
d) a MASE is satisfied that an import permit has been granted for the specimen.

An **import** permit for an Appendix I species shall only be granted where:

a) a Scientific Authority of the State of Import (SASI) has advised that the import will be for purposes that are not detrimental to the survival of the species involved;
b) a SASI is satisfied that the proposed recipient of a living specimen is suitably equipped to house and care for it;
c) a Management Authority for the State of Import (MASI) is satisfied that the specimen is not to be used for non-commercial or primarily non-commercial purposes.

For export of an Appendix II species, the same conditions a), b) & c) for issuing an export permit for an Appendix I species also apply. Import of an Appendix II species requires the prior presentation of either an export permit or re-export certificate. Similar regulations apply to the export and import of an Appendix III species.

These are jaguar skins which have been seized by patrol guards in the Pantanal, Brazil. Having local people working as guards is a particularly effective way of enforcing regulations and restrictions.

WWF-CANON/ADAM MARKHAM

Appendix II further contains so-called look-alike species, which are controlled because of their similarity in appearance to the other regulated species. Species listed in Appendix II include all those primates, cats, otters, dolphins, birds of prey, parrots, crocodiles and orchids not listed in Appendix I. Also included are other species, such as some fur seals, birds of paradise, tarantulas, some snails, birdwing butterflies, giant clams, all black and stony corals, carnivorous plants, and some tree species, such as Himalayan Yew and African Stinkwood.

- **Appendix III** species are those which any Party identifies as being subject to regulation within its own jurisdiction, and for which the cooperation of other Parties is needed to prevent or restrict their exploitation. Many bird species have been included in this Appendix by Ghana, Malaysia and several other countries. Other examples are several gazelle species from north African countries and the American mahogany from Costa Rica.

Full lists of the 30,000 or more species (of which 20,000 are plants) in these Appendices are given on the CITES web site (http://www.cites.org). The export and import of specimens listed in the Appendices are subject to CITES regulations, and a brief outline of the regulations is given here.

The control of illegal trade depends on strict verification of the above permits and certificates. For its enforcement, CITES relies entirely upon the adoption of appropriate legislation in each adhering country. Parties to the Convention are urged to adopt national legislation regulating or prohibiting international trade in an agreed list of species, their body parts and derivatives (e.g. tigers, tiger skins and tiger-bone medicines). The Conference of the Parties (COP) has recommended that management authorities coordinate with governmental agencies responsible for enforcement of CITES, including customs and police, by arranging training activities and joint meetings, and establishing inter-agency committees at national level. The COP has also recommended that the Parties promote incentives to secure the support and cooperation of local and rural communities in managing wildlife resources and thereby combating illegal trade, and that they consider forming specialised wildlife enforcement teams.

WWF/MARK N. BOULTON

The protection of African elephants under CITES (1989) prompted a long debate. Monitoring systems have now been set up in an effort to obtain accurate information on which to base trade decisions.

Procedures and legal requirements

As of January 2001, 152 countries had signed the treaty, making it one of the world's largest conservation agreements. In Europe, 37 countries are now signatories to CITES including all EU Member States except one. Each country must designate a Management Authority to issue permits for trade in species listed in the CITES Appendices. Member countries must also designate a Scientific Authority to provide scientific advice on imports and exports.

Abuses of the CITES trade measures have been detected in the past. These have included forgery of documentation and issuing re-export certificates for smuggled specimens. Much emphasis in CITES meetings has been placed on strengthening enforcement, and CITES' sister organisation, TRAFFIC (Trade Records Analysis of Flora and Fauna in Commerce), cooperates closely with national enforcement authorities and the Secretariat. INTERPOL has recently established a sub-committee on wildlife crimes.

How CITES functions

The Secretariat is located in Geneva, Switzerland, where it oversees implementation of the Convention on a global level. It organises the meetings of the COP, held approximately every two and a half years, to enable the Parties to discuss implementation issues and review and amend Appendices.

CITES has a very specific mandate which enables it to operate quite independently of other organisations. In practice, the importance of cooperating with other bodies is recognised by the Parties, and contacts between CITES and the Convention on Biological Diversity have explored possible synergies between the two Conventions. Equally, it is recognised that there are specific areas where the respective rights and obligations under CITES and the General Agreement on Tariffs and Trade (GATT) may give rise to questions of interpretation. It has been pointed out that CITES reflects the views of the international community, and that its provisions are more specific than any relevant provision of GATT. As a practical matter, CITES has been ratified by most World Trade Organization (WTO) members, and no challenge to any of its provisions has been raised directly in GATT/WTO dispute settlement proceedings.

Current issues and debates

CITES is considered to have been effective in conserving some species but not others. The decline of many species, in spite of their endangered status and Appendix I listing, is on-going because of continuing strong demand for parts and derivatives from long-standing and culturally-driven markets. In traditional Chinese medicine, for example, nearly every part of the tiger has had a medicinal use over the past 1,000 years.

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One of the fundamental policy questions facing CITES concerns the issue of sustainable use. Its principal objective is, and has always been, to make sure that international trade does not lead any species to extinction. However in 1992, the COP recognised that commercial trade may be beneficial to the conservation of species when well-regulated and effective management keeps this at sustainable levels. Illegal trade in the larger alligator and crocodilian skins has all but disappeared thanks to innovative measures of ranching and tagging. Similarly, commercial harvesting of its fleece has assisted recovery of the vicuña.

One of the most fiercely fought-over trade issues at CITES has been over the lifting of the ivory ban. The African elephant was added to Appendix II in 1977 and to Appendix I in 1989, but only after a prolonged debate. At the 1997 CITES conference in Harare, the elephants of Botswana, Namibia and Zimbabwe were removed from Appendix 1, but with stringent conditions. Following the meeting, two long-term systems for monitoring were designed: MIKE (Monitoring Illegal Killing of Elephants) and ETIS (Elephant Trade Information System). At the April 2000 CITES meeting in Gigiri (Kenya), the decision was made to defer any further decisions about the elephant and ivory trade until information from monitoring is sufficient to inform further debate.

Issues that have arisen in the debate surrounding the ivory ban are likely to occur in connection with other species at future CITES meetings, and many more questions concerning the promotion of biological diversity through economic use will arise. One of the main challenges for CITES and its Parties, therefore, is to find a proper balance between the sustainable use principle and the precautionary principle (see BB16).

In this context, two important issues require careful management. First, to ensure that there is full representation of all Parties in debates and decision-making; from a development perspective this would ideally incorporate the opinions of rural communities. And second, to ensure that attention does not become focused on only a few, headline species.

Further information

- CITES *http://www.cites.org*
- IUCN Species Survival Commission 1996. CITES: *A Conservation Tool – A Guide to Amending the Appendices to the Convention on International Trade in Endangered Species of Wild Fauna and Flora.* Fifth Edition.
- TRAFFIC *http://www.traffic.org*
- Wijnstekers, W. 2000. *The Evolution of CITES.* CITES Secretariat, Chatelaine-Geneva, Switzerland.
- 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