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.

European Commission

DFID Department for International Development

IUCN The World Conservation Union

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.

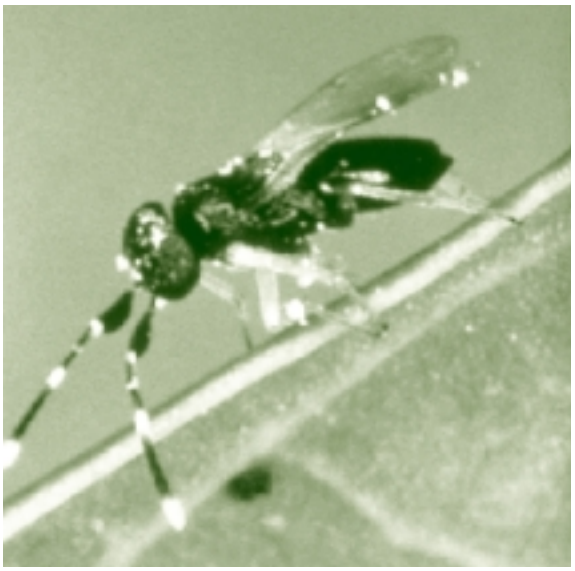
One response to these outbreaks of pests and disease is Integrated Pest Management (IPM), which was developed as a consequence of the negative impact of pesticide overuse. It is based on the principle that, if predators, parasites and other pathogens exist in balance with a pest species, then depredations 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.



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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).

Further sources of information:

- Grifo, F. & J. Rosenthal (eds). 1997. *Biodiversity and human health.* Center for Biodiversity and Conservation (American Museum of Natural History). Washington DC: Island Press.
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- Russell-Smith, A. 1999. Integrated pest management and biodiversity conservation. In: *Biodiversity conservation and rural development, 2 –Background papers.* R. Grimble and M. Laidlaw eds. 32-45. NRI Report for World Bank and DFID.
- Speight, M., Blench R.M. and D.M. Bourn (2000). Insect biodiversity. In: I. Koziell & J. Saunders (eds.) *Living off biodiversity.* London: IIED.
- 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