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Biodiversity

Assessing biodiversity impacts of trade: a review of challenges in the agriculture sector

J R Treweek, Claire Brown and Philip Bubb

Agricultural expansion is a major driver for loss of biodiversity; changes in land use or intensity associated with trade liberalisation can therefore have major consequences. Assessments of the impacts of agricultural trade have tended to neglect biodiversity, despite its crucial role in maintaining productive agro-ecosystems. Advice on assessment of biodiversity impacts is required to support trade negotiations and reduce risks of unforeseen consequences for important biodiversity and those who depend on it for their livelihoods. This paper explores linkages between biodiversity and trade and draws on examples from the agriculture sector to reinforce the need to build a biodiversity-inclusive process for assessing impacts of trade policies and agreements.

Keywords: agro-biodiversity, conservation, global 200, hotspot, livelihood, millennium development goals, poverty, protected area, sustainable use, trade policy, trade impact assessment

Dr J R Treweek is at Chancery Cottage, Kentisbeare, Cullompton, Devon, EX15 2DS, UK; Tel: +44 1884 266798; Email: jo@treweek.fsnet.co.uk. Dr Claire Brown and Philip Bubb are at UNEP World Conservation Monitoring Centre, 219 Huntingdon Road, Cambridge, CB3 0DL, UK; Tel: +44 1223 277 314; Email: claire.brown@unep-wcmc.org; Email: philip.bubb@unep-wcmc.org.

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THIS PAPER REVIEWS the need for assessing impacts of trade on biodiversity in the agriculture sector, taking into account the linkages among biodiversity, farming and poverty alleviation and the scale of impacts from agriculture on 'important biodiversity'. It summarises some of the ways in which trade-related policies, agreements and measures can act as drivers for impacts of agriculture on biodiversity, and then sets out some key considerations for biodiversity-inclusive trade policies.

The first four sections of the paper identify the main biodiversity issues in the agricultural trade policy context. The next section reviews the extent to which these issues have been addressed in past impact assessments of trade-related measures. Recommendations are then developed for fuller assessment of biodiversity impacts in the trade impact assessment process.

Biodiversity in the policy-making process

A special case can be made for assessing the implications of agricultural trade policies and agreements for biodiversity, and for building safeguards into them to ensure conservation and sustainable use. Some of these reasons are set out in Box 1.

The goal is to develop policies that promote development and support livelihoods through sustainable use of ecosystems and biodiversity. This requires systematic assessment at a policy or strategic level, preferably carried out as an integral part of the policy-making process. The results of such assessments need to be built into policy-development and trade-negotiation processes to avoid risks of unforeseen consequences for both 'important' biodiversity and

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Box 1. Reasons to assess impacts of trade-related policy on biodiversity

There is a particular need for guidance on assessing the impacts of trade-related policy on biodiversity because:
the agriculture sector is growing in some countries and is expected to continue to grow in response to increasing human population and food demand;

- agriculture is a major factor in biodiversity decline, both within and outside protected and other sensitive areas (Mittermeier *et al*, 1998; Myers *et al*, 2000; Scharlemann *et al*, 2005);
- sustainable farming relies on healthy ecosystems and these rely on biodiversity (FAO, 2004);
- the values of ecosystem services are generally ignored or under-estimated (Costanza *et al*, 1997);
- achieving the millennium development goals (particularly goal 1) depends on food security and this depends on biodiversity (Millennium Ecosystem Assessment, 2005);
- agriculture has a direct influence on natural resource and land use: changes are often incremental and appear individually insignificant but have a significant cumulative impact on biodiversity;
- incremental changes in land use take place over large areas and are largely unregulated;
- many areas of global significance for biodiversity are believed to be approaching critical thresholds in terms of species loss and ecosystem function (Millennium Ecosystem Assessment, 2005).
- Failure to assess the social, economic and ecological impacts of proposed policies can result in policies that concentrate economic opportunity in the hands of a few, reduce local food security, and promote farming that causes environmental damage and exceeds limits of sustainable yield (WRI, 2005)

those people depending on it for their livelihoods and wellbeing. Advice is also required on the development of policies that will build biodiversity in the wider farmed environment as a basis for sustainable farming and food security.

The challenge for policy-makers is to develop policies and instruments that recognise biodiversity as the basis for sustainable development and to achieve the millennium development goals. Although sustainable agricultural practices, fairer markets and healthy, biodiverse ecosystems are increasingly recognised as prerequisites for poverty reduction, food security and equitable development, agricultural expansion (both in area farmed and intensity of management) is one of the major drivers for loss of biodiversity worldwide, even within recognised global biodiversity hotspots (Streets and Glantz, 2000; Glantz, 2003; Donald and Evans, 2006).

Changes in land use, or the intensity of use, associated with agricultural trade policy have major consequences, both for biodiversity itself and for future provision of the biodiversity-based ecosystem services that are essential to support productive farming in the future. Failure to consider the implications of trade policies and associated incentives and other activities on biodiversity and ecosystems can disadvantage the environment and some sectors of society, particularly during transitions or adjustment periods, as markets and patterns of production shift.

Global rates of biodiversity loss are such that a relatively low level of conservation effort confined to protected areas is no longer adequate to safeguard the world's ecosystem services. It is therefore necessary to ensure that all activities, including trade, are managed with biodiversity in mind.

To build biodiversity considerations into the policy-making process it is necessary to understand:

- how agriculture and biodiversity interact;
- the agricultural trade policy context;
- linkages between trade (policy) in the agriculture sector and drivers of change influencing outcomes for biodiversity;
- what opportunities or 'insertion points' exist for biodiversity in the policy-making process.

Scale of the problem

Biodiversity is declining globally and there are clear links between agricultural change and declines in biodiversity across a wide range of agricultural systems (Donald and Evans, 2006). Growth in the global human population is driving an unprecedented global expansion in the area of land used for growing crops, forage for livestock and timber production, accompanied by escalating use of energy, water, fertiliser and other agrochemicals.

These trends in agricultural land use and inputs are associated with increasing evidence of environmental damage and growing concern that the capacity of ecosystems to sustain food production is being undermined. Globally, 40% of agricultural land is seriously degraded, with crop productivity reduced to 13% of its maximum potential. The most affected are the poor of sub-Saharan Africa and Central America. Around 25% of the world's land is suitable for agriculture, but only 3.5% is problem-free (WRI, 2005).

The state of the world's ecosystems has recently been assessed in detail by an international team of experts under the Millennium Ecosystem Assessment (2005), who concluded that:

> Human actions are fundamentally, and to a significant extent irreversibly, changing the diversity of life on earth, and most of these changes represent a loss of biodiversity. Changes in important components of biological diversity were more rapid in the past 50 years than at any time in human history.

The risk of agriculture–biodiversity conflicts is expected to rise: in the most important protected areas, in the 'wider' farmed landscape and in areas not actively farmed where induced changes may occur. The scale of potential conflict is considerable: global food output has doubled since 1970 and demand for food is predicted to grow by at least 50% in the next few decades.

Biodiversity conservation effort has focused traditionally on designation of protected areas, and listing and protection of species. However, most of the world's protected areas contain agricultural land or are used in some way to produce food for people. Formal protection does not therefore guarantee protection of biodiversity from agricultural impact. Moreover, not all biodiversity-rich or sensitive areas are under formal or legal protection, so avoiding activity in protected areas does not necessarily guarantee avoidance of impacts on important biodiversity.

There have been a number of initiatives to identify other areas of global biodiversity significance to try to enhance their recognition and protection. These include Conservation International's Global Biodiversity Hotspots (Myers, 1990; Myers *et al*, 2000); Birdlife International's Important Bird Areas; areas identified through the Worldwide Fund for Nature's Global 200 Ecoregions Programme and Centres of Plant Diversity (International Union for the Conservation of Nature).

There have also been recent attempts to identify and safeguard important centres of endemism for agricultural crops. These may or may not overlap with areas under formal protection, but nevertheless represent places where any loss of biodiversity driven by trade policy/agriculture would be of global significance. The Global Biodiversity Hotspots, for example, collectively house the majority of species on the planet and threat was a key factor in their selection (Myers, 1990). They therefore represent areas where there is very important biodiversity, which is already highly threatened, and where scope to absorb additional pressures from agriculture could be limited.

Malnutrition and hunger are pervasive among people living in at least 16 of the world's global biodiversity hotspots, placing considerable and increasing pressure on 'wild' biodiversity to supplement food production. These hotspots are also major commercial crop-growing regions, coffee and cocoa being produced in nearly all those in the tropics. Production goals are likely to conflict with maintenance of biodiversity in these hotspots, for example, cocoa in Ghana, palm oil in Indonesia, coffee in Vietnam, and soybeans in Brazil (Conservation International, 2004).

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Failure to test the compatibility of trade policies with goals for protection of biodiversity and its maintenance in hotspots and centres of endemism (both for wild and agricultural biodiversity) could result in exacerbation of risks to biodiversity of global significance. In fact, recent studies have shown that areas of high biodiversity importance have been particularly affected by agricultural expansion. Analysis of the expansion of agricultural areas has shown that endemic bird areas (EBAs), for example, tend to be in areas with high human population densities, and consequently have been much more extensively transformed by agricultural expansion than the rest of the world. The proportion of land in agricultural use in EBAs is currently 42% compared to 37% in the rest of the world (Scharlemann *et al*, 2004).

Biodiversity is not just at risk in and near protected areas and recognised hotspots. One of the most significant trends over the last 50 years has been the loss of biodiversity in the wider environment as a result of both changing agricultural practice and increasing population pressure. Agricultural impacts are characterised by their incremental nature. They often appear insignificant when examined on a case-by-case basis, but can be seen to have major cumulative effects when appraised collectively and at a landscape scale.

There are well-documented declines in biodiversity associated with agricultural intensification in Europe, for example, population declines of once common farmland birds. European countries with the most intensive farming have suffered the most rapidly declining bird populations. A report by Birdlife International (2004) showed that intensive farming was causing serious population declines in about a third of Europe's 515 bird species, including 12 of the 16 most threatened species.

Agricultural biodiversity itself is also under threat: the diversity of animal breeds, plant/crop varieties and the genetic resources they contain is generally declining. More than 90% of crop varieties have been lost in the past century and livestock breeds are disappearing at the rate of 5% per year. As a result, the Food and Agricultural Organisation of the United Nations (FAO), the Convention on Biological Diversity (CBD), and the Global Environment Facility (GEF) are now placing greater priority on conserving wild relatives of crops and vegetables.

The former Soviet Union published the first national list of wild relatives of crops in 1981.

Turkey has protected 22 genetic management zones, Mexico has a special biosphere reserve to protect the wild relatives of maize and India has one for citrus trees. The United States is trying to protect the wild relatives of grapes, onions and potatoes. Armenia has also carried out extensive work to map and locate important wild relatives of crops.[1]

The presence of valuable biodiversity on agricultural land suggests that efforts should be made to conserve these attributes by managing farmland in an environmentally friendly way (for example, as currently promoted in Europe through agri-environment support). However, it has been pointed out that this may lead to greater overall biodiversity loss if environmentally friendly management limits yields. This is because larger areas of remaining natural or uncultivated land of high biodiversity value may need to be converted to agriculture to offset the reduced yields. Thus there may be a trade-off between the benefits of land sparing (by maximising yields) and those of environmentally friendly farming (if this limits yields).

Models of this trade-off suggest that the best type of farming for species persistence depends on the demand for agricultural products and on how the population densities of different species on farmland change with agricultural yield. Green *et al* (2005), note that empirical data on such density–yield functions are sparse, but evidence from a range of taxa in developing countries suggests that there are cases where high-yield farming may allow more species to persist, provided that it is not also associated with an expansion in the area farmed. This is an issue that requires further monitoring and analysis.

This confirms that there are two risks to biodiversity from agriculture, which are:

- low input but extensive in area occupied;
- high input (intensive commercial production);

These risks may be experienced within protected areas and global biodiversity hotspots, in the wider farmed environment or even in areas not directly used or affected by farming. It is important to note that farming activities are often relatively unregulated and require no formal consent, meaning that opportunities to assess and manage the environmental impacts of farming can be limited. They represent a case where decisions taken by individual landowners and managers at the farm-scale can have major cumulative effects when considered in aggregate, but which may appear insignificant when considered in isolation.

Agriculture, biodiversity and poverty

Biodiversity is an essential and integral part of healthy environments and, if too much biodiversity is lost, many essential environmental services, currently seen as 'free goods', will be undermined (Costanza *et al*, 1997). Many of these services are fundamental to productive farming and their loss is a particular risk to poor communities with direct dependency on local natural resources to meet their needs. The rural poor often make use of a variety of sources of income and subsistence activities to make a living. These might include small-scale farming and food growing, also hunting, fishing and collecting of firewood, herbs, medicinal plants and other natural products from 'the bush'.

In other words, "environmental income" (WRI, 2005) often complements income from other sources, particularly during 'lean periods' or economic decline, when people often rely more heavily on the harvesting of wild food (for example Dei, 1992). Ecosystem degradation (often characterised by loss of biodiversity) represents a direct threat to this nature-based income and can therefore exacerbate poverty. On the other hand, restoring the productivity (and diversity) of local forests, pastures and fisheries can have the opposite effect and increase local incomes (WRI, 2005).

More than 1.3 billion people depend on fisheries, forests and agriculture for employment (FAO, 2004). A great many more depend on some form of farming for their livelihoods. Biodiversity therefore underpins a major source of income and employment in rural areas.

Although ecosystems and biodiversity perform a fundamentally important and well documented role in supporting livelihoods and represent crucial assets, particularly for the rural poor, they are often neglected in development planning. More importantly, they are often omitted from commercial evaluations of natural resources. Review of 15 poverty reduction strategy papers by Bindraban *et al* (2004) found only one (for Zambia) that integrated biodiversity conservation and poverty reduction; only those for Ethiopia and Mozambique included any provision for maintaining the diversity of agricultural crop varieties (an important aspect of agro-biodiversity).

A range of ecosystem services is needed to sustain viable agriculture. Essential functions such as nutrient cycling, rehabilitation of degraded soils, regulation of pests and diseases, control of water quality and pollination are maintained by a wide range of biologically diverse populations in both 'natural' and agricultural ecosystems. Maintaining important ecosystem services and the biodiversity that provides them reduces external input to agriculture requirements by increasing nutrient availability, improving water use and soil structure, and providing natural control of pests.

As a general rule, more diverse ecosystems (in terms of structure and/or composition) tend to be more stable. Diverse agro-ecosystems provide more niches for wild biodiversity to coexist with crops and livestock and more opportunities for people to harvest a variety of biodiversity-based products alongside, or in conjunction with, their main crops,

for example medicinal plants, or building materials. Loss of diversity at any level reduces ability to adapt and respond to environmental change (for instance, climate change) and can therefore restrict the future supply of ecosystem services. This is why biodiversity is sometimes referred to as the 'life insurance for life itself'. For example:

- wild gene pools are often a critical source of resistance to pests and diseases: loss of genetic diversity in wild relatives of agricultural crops removes future opportunities to breed new crops to adapt to changing environmental conditions;
- one pest or pathogen can wipe out crop monocultures, whereas genetically diverse crops may have some resistant individuals.

However, agricultural ecosystems and biodiversity have a complex and dynamic relationship. It is not invariably true that modern agricultural practices reduce biodiversity or that low-input, traditional farming is compatible with high biodiversity. For example, tropical irrigated rice systems are planted as monocultures but are often constructed in such a way that they are one of the most stable agricultural ecosystems on the planet. Key to this stability are diversity in landscape temporal planting patterns, use of soil organic matter and low levels of pesticide use. Dykes between paddies are also able to support habitat for fish, insects, amphibians and water birds such as waders.

Entirely artificial habitats, such as croplands can therefore support much biodiversity, for example, in cases where they form a small part of the landscape and are not managed intensively. In fact, various semi-natural habitats that are now highly valued, such as many open grasslands, are the result of human actions (such as the clearance of trees and regular burning of vegetation). It is therefore difficult to categorise agricultural ecosystems according to their biodiversity. Data on the biodiversity value of cultivated habitats in the developing world are not always readily available. However, there is evidence that about half 4Costa Rica's native forest species of birds, mammals, butterflies and moths also occur in agricultural areas.

Biodiversity is the basis for evolution and therefore essential for adaptation to changing environments, for example, those resulting from climate change. Agriculture in the future will rely on crops and livestock that are able to adapt to new environmental conditions, and it may be necessary to derive these from wild ancestors and relatives of modern crops.

Agricultural trade policy context

This section sets out the main trends in agricultural trade reform and explains how environmental (and biodiversity) issues are currently addressed in key agreements.

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Agriculture provides many crucial benefits, including food security, domestic employment and export-related economic growth. The process of trade reform in the agriculture sector is based on the premise that reducing policy distortions and market failures will lead to more efficient allocation of resources and more sustainable patterns of production. The current global trend in the agriculture sector is therefore towards trade liberalisation, as embodied in the Agreement on Agriculture, which forms part of the Final Act of the 1986–1994 Uruguay Round of trade negotiations.

This agreement provides a framework for long-term reform of agricultural trade and domestic policies, with the general objective of increased market orientation. It also includes provisions for adjustment and specific measures to assist net food-importing countries and least-developed countries. Trade liberalisation is generally seen as an important tool for sustainable agricultural development, improving equity and fairness in global trade of agricultural commodities and ensuring that more people have access to markets and to economic opportunity.

Rules and commitments made under the Agreement on Agriculture apply to:

- market access — various trade restrictions on imports;
- domestic support — subsidies and other programmes, including those that raise or guarantee farm-gate prices and farmers' incomes;
- export subsidies and other methods used to make exports artificially competitive.

The agreement allows governments to support their rural economies, preferably through policies that cause least distortion to trade. It also allows some flexibility in the way commitments are implemented. Developing countries do not have to cut their subsidies or lower their tariffs as much as developed countries, and have extra time to complete their obligations, whereas least-developed countries do not have to do this at all.

There are also special provisions to deal with the interests of countries that rely on imports for their

food supplies. Some importing countries depend on supplies of cheap, subsidised food from major industrialised nations. They include some of the poorest countries and, although their farming sectors might eventually benefit from the higher prices caused by reduced export subsidies, they might need temporary assistance to make the necessary adjustments to deal with higher-priced imports, and eventually to export. The agreement therefore includes certain measures for the provision of food aid and aid for agricultural development, including the possibility of assistance from the International Monetary Fund and the World Bank to finance commercial food imports.

The Agreement on Agriculture is built on the premise that policies that support domestic prices, or subsidise production, tend to encourage overproduction, squeezing out imports or leading to export subsidies and low-priced dumping on world markets. It therefore distinguishes between support that stimulates production directly and that considered to have no direct effect.

World Trade Organisation (WTO) members have to modify domestic policies that have a direct effect on production and trade, and to cut back associated levels of support. WTO members calculated their 'total aggregate measurement of support' or total AMS for the base years of 1986–88. Developed countries agreed to reduce these figures by 20% over six years starting in 1995; developing countries agreed to make 13% cuts over ten years and least-developed countries do not need to make any cuts. This category of domestic support is referred to as 'amber box', because the agreement requires a phased slowing down.

Measures with minimal impact on trade can be used freely and are referred to as 'green box' measures. They might be used to address many non-trade concerns, such as food security, the environment, structural adjustment, rural development or poverty alleviation. Examples include certain forms of direct income support and direct payments under environmental programmes. Direct environmental payments are therefore, to some extent, de-coupled from trade, and governments have some leeway to use them without negotiation.

Article 20 of the Agreement on Agriculture says the negotiations have to take non-trade concerns into account. While it is generally accepted that agriculture has functions other than food production, WTO members differ concerning whether 'trade-distorting' subsidies, or subsidies outside the green box, are appropriate to help agriculture perform its many roles, or whether environmental concerns are best addressed through comprehensive liberalisation and green box supports that are "targeted, transparent and non- or minimally-distorting".

Some argue that it may be necessary to link support more directly to production in some cases, particularly where potential for agricultural production is actually limited, but there are strong environmental reasons to sustain farming, for example, promoting rice fields as a means of preventing soil erosion. Some countries (Norway, for example) have also argued that more effort should be made to ensure that policy reform under the WTO agreements is undertaken in ways consistent with other relevant multilateral commitments, such as the Convention on Biological Diversity (WTO, 2001). This is an aspect that has, hitherto, received relatively little attention, but which is gaining momentum as critical dependencies of agricultural production and livelihoods on biodiversity are increasingly recognised.

Past assessments of trade-related measures

This section reviews some of the assessments of the impacts of trade policy and related measures that have been undertaken to date, to ascertain the extent to which potential implications for biodiversity have been identified.

Agricultural trade policy drives changes in agricultural production and distribution by altering markets for products and levels of subsidy. Farmers make production decisions in the light of the changes in revenue and cost structures. These decisions in turn change land use and ultimately affect the compatibility of land and farming practices with the conservation and sustainable use of biodiversity. Changes in agricultural production patterns as a result of changes in trade policy vary depending on the initial conditions in a country in terms of production, trade and consumption of agricultural commodities (for instance, whether there have been high or low levels of protective subsidy, or whether the country is a net importer or exporter of food).

To assess the impacts of trade agreements on biodiversity in the agriculture sector, it is necessary to recognise circumstances in which changes in markets or conditions of trade might either exacerbate existing adverse trends in biodiversity status or generate new risks. This might be through loss of biodiversity units (different genes, species), declines in their abundance (for instance, population decline of a key pollinator resulting from pesticide use), or changes in their structural organisation (for instance, fragmentation of habitat containing wild predators of agricultural pests).

Loss of biodiversity might cause deterioration or collapse of ecosystems, and the services they provide, as the basis for sustained food production. However, biodiversity conservation also requires recognition of situations in which changes in agricultural trade policy might represent risks to biodiversity outside the agro-ecosystem, causing irreversible losses.

Generally speaking, at the global level, trade liberalisation leads to increasing agricultural activity and increasing world market prices. However, in a country that has had relatively high protection of its domestic markets, liberalisation would tend to lead to falling producer prices in relation to production input prices and a reduction in production. In this situation,

high-protection producers would suffer, whereas consumers would benefit because of lower prices.

The opposite occurs in low protection countries, where production is likely to increase because of the higher world market prices. Low protection country producers would benefit, whereas consumers could suffer if world market prices became higher than the previous domestic price. For an importing country, decreasing prices that the domestic producers can charge would mean a loss to producers and decreased domestic production. For an exporting country, increasing the price the producers can charge would benefit producers and would probably result in higher production.

Experience gained from sustainability assessments of trade agreements (For example ODI and IARC, 2005) reinforces the inherent difficulties of tracing supply chains and quantifying changes in patterns of trade directly attributable to trade agreements themselves, as opposed to those driven by market forces in general. It can be very difficult, if not impossible, to draw clear-cut conclusions on a global level about the impact of trade liberalisation on biodiversity. Analysis frequently leads to the identification of both beneficial and detrimental effects, with an overall ambiguous outcome (Secretariat of the CBD, 2005).

Appraisals have tended to draw on case studies to illustrate the kinds of impact that might occur and to identify possible trends, but have not had the resources to evaluate actual outcomes for biodiversity. One of the main challenges in these assessments is determining the extent to which biodiversity is already at risk and where even small incremental changes could result in critical thresholds being reached. This kind of analysis has to be carried out at country-level.

UNEP (2002) carried out an integrated assessment of the effects of trade liberalisation on Nigeria's export crop sector and this was followed by a series of integrated assessments of the effects of trade liberalisation in different countries within the rice-sector (for example, UNEP, 2005a; 2005b; 2005c). The UNEP assessments of impacts within the rice sector were all carried out *ex post*, as exercises in following up on trends and effects as a basis for future predictions and assessments. Although some assessments refer to biodiversity as an issue, they do not include comprehensive analyses of biodiversity impacts or suggest development of biodiversity mitigation measures of any kind.

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A handbook on integrated assessment of trade-related measures (UNEP, 2005d) reinforced the need for integrated approaches to policy development that identify both threats and opportunities and involve relevant stakeholders (for example, see UNEP, 2005a; 2005b; 2005c). For biodiversity, this is best achieved by taking an ecosystem approach, as advocated by the Convention on Biological Diversity, that considers the interaction among agricultural activity, development, livelihoods and ecosystems.[2] It involves consideration of the demands made by agriculture on ecosystems and biodiversity, the services that ecosystems can provide to support productive agriculture and the policies that need to be in place to support types and levels of use that are within ecosystem limits.

A country study on the export crop sector in Nigeria (UNEP, 2002) identified "loss of biodiversity and degradation of soil through expansion of hectarage cultivated" as one of the main implications of increased production of export crops in the post Structural Adjustment Programme (SAP) period (1986–1993) relative to the pre-SAP period. A liberalised trade policy regime and the development of a workable rural (agricultural) infrastructure and efficient markets were seen as keys to the success of the SAP. The integrated assessment reviewed the implications of the National Policy on the Environment and noted that trade liberalisation could have had implications for "land use and soil conservation" and for "forestry, wildlife and protected areas".

Impacts on protected areas were not assessed, although, in relation to "the depletion of forests", the assessment concluded that loss of vegetation as a result of clearing whole forests to establish new export crop farms would be only temporary, as cocoa seedlings would rapidly establish into trees and a forest ecosystem would be "more or less re-established". While it is possible that cocoa plantations might perform a similar role to native forest in terms of soil stabilisation and protection, it is unlikely that they are an effective substitute in terms of biodiversity.

The environmental valuation did not address the issue of land conversion/loss of biodiversity and the other services or values that this might provide, even in terms of the role of soil biodiversity in maintaining soil productivity. The policy recommendations made as a result of the study did not address biodiversity in any detail and it was not seen as a fundamental concern.

Recommendations for fuller assessment

To include biodiversity more effectively in trade impact assessments, the causal relationships between

trade and biodiversity need to be explicitly identified. Some examples of how trade can drive changes in agriculture with negative impacts on biodiversity include:

- pressure to produce more products for export leads to intensification and increased area of production;
- pressure to produce more increases natural resource-use, for instance, of surface water supplies for irrigation;
- price changes of agricultural inputs make it cheaper to use fertilisers, pesticides and other agro-chemicals that can damage biodiversity;
- pressure to grow crops for export reduces local food security and indirectly increases pressure on local biodiversity (for instance, harvesting of wild species for food).

Examples of positive impacts of trade liberalisation on biodiversity include:

- policy reforms that remove impediments to intensification, which can help increase agricultural production while easing pressure on biodiversity in 'unconverted' land;
- new opportunities for trade in organic products, which can promote production methods that are relatively more compatible with biodiversity;
- emphasis on comparative advantages leading to more efficient production systems in locations where biodiversity loss will be minimised.

Effective assessment has been hampered in the past by the inability to attribute changes in biodiversity to specific aspects of trade policy or agreement and to quantify these changes. It is also difficult to recognise critical 'tipping points' or early warning signs of terminal biodiversity or ecosystem decline. However, it is possible to identify situations where biodiversity (protected and otherwise) is already greatly affected by agriculture and, further, to identify when trade policy change might exacerbate existing adverse trends. As a minimum, this should be done for globally important hotspots, but it is also necessary to ensure that the needs of the rural poor for biodiversity are taken into consideration.

Table 1 presents some possible questions to discover the extent to which assessments of proposed trade policies in the agriculture sector address issues of biodiversity conservation and its sustainable use. Table 2 suggests how similar assessment questions might be developed to assess impacts on different levels of biodiversity. This approach, and the need to build biodiversity values and ecosystem services

Table 1. Biodiversity-related questions to assess sustainability issues in assessment of agricultural trade policy

Question	Rationale
Does the policy recognise the fundamental role of biodiversity in supporting productive and sustainable food production?	Biodiversity provides a range of services to agriculture. Loss of biodiversity undermines the capacity of ecosystems to support agriculture and a sustained stream of income.
Does the policy recognise the importance of ecosystems (and biodiversity) as a key source of additional environmental income?	Many of the rural poor rely on 'other' biodiversity (outside the agro-ecosystem) for food (especially in scarce times) and to meet other needs.
Does the policy recognise the need for biodiversity and sustainable ecosystem management as the basis for food security?	Food security (eg as climate changes) needs genetic diversity as the means of adaptation to new environments. Agro-biodiversity also buffers production (eg against drought)
Is the policy compatible with millennium development goals targets?	Eg maintain at least 60% of the country under forest cover in perpetuity (Bhutan); increase areas protected for biological diversity from 8% in 1990 to 12% in 2015 (Senegal)
What are the impacts of economic growth on environmental sustainability, maintenance of critical ecosystem functions, biodiversity resources needed by the poor for their livelihoods?	The impacts of biodiversity decline as a result of increasingly intensive agriculture, geared primarily towards commercial production are rarely addressed.
Does the policy address issues of natural resource access, allowing the poor to increase their income security?	Expansion in commercial agriculture can reduce the availability of wild biodiversity and reduce access to biodiversity as a source of 'environmental income'.
Does the policy make provision for building capacity in good governance and environmental regulation?	Necessary to ensure that biodiversity is protected and its use regulated.
Does the policy support community-based natural resource management and cater for its recognition in law?	This is an effective form of local empowerment and has had demonstrable and documented benefits in boosting the incomes of rural poor people.
Does the policy make provision for maintaining biodiversity-based 'environmental income' and food security?	People relying on biodiversity as a source of environmental income may not benefit from new opportunities associated with commercial agriculture.
Does the policy include arrangements for biodiversity monitoring to track the impacts of trade and associated economic changes?	Trade policy can affect the scale, location and intensity of farming activity with significant consequences for biodiversity.
Is the policy based on quantifiable targets for improving outcomes with respect to biodiversity-based income? Does it include indicators for both biodiversity and poverty?	Biodiversity is critical for sustainable agriculture, and for poverty alleviation.

Table 2. Impacts on different levels of agro-biodiversity and 'other' biodiversity

Level of biodiversity	Agro biodiversity	Other biodiversity
Genetic diversity	Does the intended activity cause a local loss of varieties/cultivars/breeds of cultivated plants and/or domesticated animals and their relatives, genes or genomes of social, scientific and economic importance?	Does the policy/agreement accelerate extinction rates for genomes that are already threatened?
Species diversity	Would the policy/agreement affect the diversity of natural predators of agricultural pests or the variety of species farmed, eg by promoting commercial agriculture based on a limited range of species and on use of chemicals that reduce populations of natural predators?	Would the policy/agreement reduce overall species diversity, eg through expansion in the area farmed and a reduction in area available for other biodiversity?
Ecosystem diversity	Would the policy/agreement encourage (directly or indirectly) destructive or non-sustainable use of ecosystems (ie cause the loss of ecosystem services essential to support productive agriculture in future?	Would the policy/agreement exacerbate negative trends in biodiversity in the wider landscape, eg through land conversion, fragmentation of remaining wildlife habitat, increased use of agro-chemicals?

Source: After Secretariat of the CBD (2006)

firmly into the impact assessment process, are further articulated in recent guidance on biodiversity-inclusive impact assessment issued by the CBD (Secretariat of the CBD, 2006).

One of the implications of the CBD's guidance is that those undertaking any impact assessment (including those of trade policies or agreements) should endeavour to identify situations in which the following areas might be adversely affected:

a. Areas playing an important part in maintaining biodiversity, including:
   i) protected areas;
   ii) areas containing threatened ecosystems outside formally protected areas;
   iii) areas identified as being important for the maintenance of key ecological or evolutionary processes;
   iv) areas with habitat for threatened species.
b. Areas with important regulating services for maintaining natural processes with regard to soil, water, or air (for instance, wetlands, forests providing watershed protection, vegetation protecting highly erodable or mobile soils).
c. Areas with important provisioning services, for instance, extractive reserves, land and water traditionally occupied or used by indigenous and local communities, fish breeding grounds.
d. Areas with important cultural services, scenic landscapes, heritage sites, sacred sites and so on.
e. Areas with other relevant ecosystem services (such as flood storage areas, groundwater recharge areas, catchment areas, areas with valued landscape quality).

The presence of such areas would be expected to flag the need for a more comprehensive assessment of impacts on biodiversity, using methods such as those currently being developed by UNEP (in press a; in press b). However, effective assessment requires information. Given the global magnitude of agricultural impacts on biodiversity, and their largely unregulated nature, it is essential that the monitoring base be improved as a basis for identifying and managing risks.

A number of initiatives are underway through UNEP, FAO and others to develop guidance on suitable biodiversity indicators. This needs to be supplemented by increased investment in capacity for biodiversity monitoring, planning and regulation, to ensure that biodiversity is maintained as the basis for sustained food production and other crucial services into the future.

In addition to recognising when significant impacts on biodiversity might occur, it is important to develop mechanisms to quantify impacts and then to encourage land use compatible with the conservation and sustainable use of biodiversity, whether these are treated as green box measures or are incorporated more directly into trade policies and agreements as mitigation. Biodiversity-friendly agricultural practices are not necessarily the most profitable from the perspective of individual land users (Pagiola *et al*, 2004), making it necessary to enhance their relative attractiveness.

In some cases, the profitability of biodiversity-friendly practices can be boosted by inducing consumers to pay a premium for their outputs, as in the case of shade-grown coffee (Pagiola and Ruthenberg, 2002). However, this approach requires complex certification schemes and is not always feasible (Pagiola *et al*, 2004). There have therefore been efforts to develop systems by which land users are paid directly for the environmental services they generate, thus aligning their incentives with those of society as a whole (Ferraro, 2001; Ferraro and Kiss, 2003; Pagiola *et al*, 2004). Costa Rica, for example, has developed a nationwide programme under its 1997 Forestry Law, through which land users can receive payments for specified land uses, including conservation of natural forests. There are also examples where proceeds of water tariffs have been used to pay landholders to maintain and reforest watershed areas (Castro, 2001).

Further efforts are required to develop effective mechanisms to support farming that is compatible with biodiversity. These are often recommended as mitigation to offset the impacts of trade-related impacts on biodiversity, but there is relatively little experience in their development and implementation.

Conclusions

Biodiversity is an integral part of any healthy ecosystem and there is a strong interdependence of biodiversity with food security and poverty. Agricultural ecosystems include cultivated biodiversity (crops and livestock) and also wild biodiversity, both providing a range of ecosystem services.

Biodiversity and agricultural systems can have a mutually beneficial relationship, with agricultural ecosystems supplying niches of habitat for wild biodiversity and wild biodiversity providing important services such as pollination and pest management in return. Agriculture has generated biodiversity-rich environments but is also a major cause of biodiversity loss worldwide. The relationship among biodiversity, agriculture, ecosystem services, livelihoods and trade policies is complex and cannot be managed effectively without understanding the main linkages and drivers of change.

There is tremendous scope for, and benefits from, addressing biodiversity as a cross-cutting issue within assessment of agricultural trade policies. Developing better understanding of the impacts of agricultural trade policies on biodiversity (and ultimately people's livelihoods and levels of poverty) will assist in promoting more informed policy- and decision-making and an understanding of trade-offs that may be necessary.

Until recently, biodiversity has not been prioritised within assessment of agricultural trade policies, resulting in possible ongoing risks to agricultural biodiversity and ecosystem services. Biodiversity-inclusive approaches to assessment can provide many benefits, encouraging sustainable trade, stimulating inter-governmental and inter-sectoral dialogue, strengthening good governance in trade policy and increasing transparency in decision-making.

Notes

1. See <http://www.cac-biodiversity.org/arm/arm_biodiversity.htm>, last accessed 10 November 2006.
2. See < www.biodiv.org>, last accessed 10 November 2006.

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