UNEP

CONVENTION ON BIOLOGICAL DIVERSITY

Distr.
GENERAL

UNEP/CBD/SBSTTA/9/INF/36
29 October 2003

ENGLISH ONLY

SUBSIDIARY BODY ON SCIENTIFIC, TECHNICAL
AND TECHNOLOGICAL ADVICE
Ninth meeting
Montreal, 10-14 November 2003
Item 4.1 of the provisional agenda*

THE SCOPE OF ORGANIC AGRICULTURE, SUSTAINABLE FOREST MANAGEMENT AND ECOFORESTRY IN PROTECTED AREA MANAGEMENT

Report submitted by the Food and Agriculture Organization of the United Nations

Note by the Executive Secretary

1. At the request of the Food and Agriculture Organization of the United Nations, the Executive Secretary is circulating herewith, for the information of participants in the ninth meeting of the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA), a document entitled "The scope of organic agriculture, sustainable forest management and ecoforestry in protected area management", prepared by the Food and Agriculture Organization of the United Nations.

2. The document is being circulated in the language and the form in which it was received by the Secretariat of the Convention on Biological Diversity.

* UNEP/CBD/SBSTTA/9/1.

**Information Document for the Ninth meeting of the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA-9)
Montreal, Canada, 10-14 November 2003**

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SUSTAINABLE FOREST MANAGEMENT AND ECOFORESTRY IN

PROTECTED AREA MANAGEMENT

**Food and Agriculture Organization of the United Nations
Rome, Italy**

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1. AGRICULTURE AND NATURE CONSERVATION: CONNECTIONS

Protected area management, including biodiversity conservation and local community participation (especially of indigenous people) are main discussion themes of the protected areas constituency. Although relationships and alliances between local communities and conservationists are considered (IUCN, 2002), what is less addressed are options for sustainable livelihoods within and around protected areas. Farmers and forest dwellers are the main inhabitants and users of protected areas as well as lands connecting these areas. In protected area categories where agricultural activities are allowed, there is need to consider productive activities which provide livelihoods in an equitable and environmentally-friendly way.

The ability of organic agriculture, ecoforestry and sustainable forest management to build self-generating food systems and connectedness between protected areas is addressed in this paper. Also, farmers' involvement in income-generating activities such as agro-ecotourism, is considered. This paper argues that integrated landscape planning is necessary for the effective management of protected areas and that multi-sectoral policy and planning, including the agriculture, forestry, tourism and environment sectors, have a role to play in such a collaborative resource management. The ultimate objective is to recognize the interdependence between sustainable agriculture and biodiversity conservation and in so doing, promoting options that address food and livelihood needs while protecting the natural heritage.

1.1 Islands of protected areas in agricultural landscapes

The aims of protected areas and approaches to their management have recently expanded. Land managers can use protected areas as a tool for a wide range of functions. Among the six IUCN protected area categories, Categories V and VI recognize that maintenance of biodiversity is not always the primary reason for protection and that (management) choices may be determined by cultural values, environmental management, sustainable land use and recreational needs. In particular, these categories are suited for sustainable use by indigenous communities, tourism and small-scale agriculture.

The definition of protected areas as "an area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means" implies that management of protected areas is inclusive of government-sponsored reserves, indigenous communities or private landowners. Control and management by stakeholders concerned have proven to be effective while providing livelihoods to local communities (Dudley, 1998).

Protected area categories

Category Ia: Nature reserve
Strict nature reserve/wilderness protection area managed mainly for science or wilderness protection – an area of land and/or sea possessing some outstanding or representative ecosystems, geological or physical features and/or species, available primarily for scientific research and/or environmental monitoring.
Category Ib: Wilderness area
Protected area managed mainly for wilderness protection – large area of unmodified land or sea, retaining its natural characteristics and influence, without permanent or significant habitation, which is protected and managed to preserve its natural condition.
Category II: National park

Protected area managed mainly for ecosystem protection and recreation – natural area of land and/or sea designated to (a) protect the ecological integrity of one or more ecosystems for present and future generations, (b) exclude exploitation or occupation inimical to the purposes of designation of the area, and (c) provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible.

Category III: Natural monument

Protected area managed mainly for conservation of specific natural features – area containing specific natural or natural/cultural feature(s) of outstanding or unique value because of their inherent rarity, representativeness, aesthetic qualities or cultural significance.

Category IV: Habitat/species management area

Protected area managed mainly for conservation through management intervention – area of land and/or sea subject to active intervention for management purposes as to ensure the maintenance of habitats to meet the requirements of specific species.

Category V: Protected landscape/seascape

Protected area managed mainly for landscape/seascape conservation and recreation area of land, with coast and sea as appropriate, where the interaction of people and nature over time has produced an area of distinct character with significant aesthetic, ecological and/or cultural value, and often with high biological diversity. Safeguarding the integrity of this traditional interaction is vital to the protection, maintenance and evolution of such an area.

Category VI: Managed resource protected area

Protected area managed mainly for the sustainable use of natural ecosystems – an area containing predominantly unmodified natural systems, managed to ensure long-term protection and maintenance of biological diversity, while providing at the same time a sustainable flow of natural products and services to meet community needs.

Source: IUCN, 1994

The focus of protected area management has shifted away from individual protected areas towards protected area networks, as part of wider landscape. The effectiveness of protected area management depends on this network as well as on the type of land use in between these areas: islands of biodiversity in an otherwise degraded landscape will not fulfil protection objectives. Opportunities for conservation of biodiversity outside protected areas include links between protected areas through corridors and provision of environments free of pollutants, especially but not exclusively, along migration pathways.

Protected areas cover only about 10 percent of the earth's cover: 45 percent of the world's protected areas maintain 30 percent or more of their land in agriculture (McNeely and Scherr, 2001). Most wild plants and animals live outside protected areas, often in agriculture-dominated landscapes: about 30 percent of the global land surface is occupied by crop and managed pasture lands (Wood *et al*., 2000). People live inside and near protected areas and use land, plants and animals to meet their basic livelihood needs. Depending on the type of management practices, farmers and foresters will have varying impacts on habitat quality, which can increase or decrease pressure on biodiversity within and around protected areas.

1.2 Pressure placed by agriculture on biodiversity

Over the last century, population, market pressures and the development of new agricultural technologies have encouraged patterns of agricultural development tending towards agricultural intensification (i.e. increasing scales of monoculture production, intensive mechanical tillage, irrigation, and the use of synthetic fertilizer, pest control agents and a restricted diversity of crop and livestock varieties), often leading to natural resources degradation. The growing food demand by a wealthier and larger global population is expected to induce further encroachment of agriculture on unmodified ecosystems (10 billion hectares by 2050), with inevitable negative impact on biodiversity (WEHAB, 2002).

The majority of the human population increase is expected to take place in the biodiversity-rich developing countries of the tropics (e.g. the Caribbean, the Philippines, Sri Lanka and the Western Ghats of India), where 19 out of 21 regions of concentrated biodiversity ("biodiversity hot-spots") and human population in these areas is increasing faster than anywhere else). These areas of high population growth (many of which lie adjacent to protected areas) are also experiencing rapid changes towards urbanization where demand for agricultural products is expected to increase as income levels in these areas rise. The anticipated result of such demographic changes is that increased production pressures will be placed on both the wild lands and the agricultural production systems in and around protected areas (McNeeley and Scherr, 2003).

The simplification of agro-ecosystems to monoculture production and the removal of non-crop vegetation from the farm unit (e.g. hedgerows, shelter belts and field margins) has contributed to the homogeneity of agricultural landscapes by reducing botanical and structural variation, resulting in both a reduced capacity of agricultural areas to serve as habitat for wild species as well as to effectively internally regulate populations of pests and disease causing organisms which affect crop productivity (Soil Association, 2000; Defra, 2003). This has resulted in a widespread decline in farm species abundance and diversity across many taxonomic groupings, including high rates of wildlife mortality and reduced reproductive success of many species (Stolton *et al.,* 1999; Gliessman, 1999; Kegley, 1999; Edge 2000; Soil Association 2000; Bugg and Trenham, 2003, Benton *et al.,* 2003). This loss of biodiversity has also resulted in a reduced capacity of agro-ecosystems to perform many essential ecosystem functions such as purification of water, internal regulation of pests and diseases, carbon sequestration, and degradation of toxic compounds (Altieri, 1999).

Elevated nitrogen and phosphorus levels in aquatic ecosystems have led to extensive eutrophication and degradation of freshwater and marine ecosystems in many areas where agriculture is concentrated. Synthetically compounded nitrogen fertilizer poses multiple risks to both wildlife populations and human health. Dissolved nitrate levels of 2 ppm or greater are known to interfere with normal development of amphibians with levels above 10 ppm known to be lethal (Environment Canada 2002; Bugg and Trenham, 2003).

The use of pesticides (i.e. herbicides, fungicides, rodenticides and insecticides) poses both known and unknown risks to biodiversity, impacting wildlife on many different levels, from direct to indirect lethality to non-lethal but severely debilitating effects. Each of these impacts has the potential to interfere with the reproductive success of wildlife and further reduce the habitat quality and biodiversity of agricultural and surrounding ecosystems (Edge, 2000). It is estimated that 70-90 percent of ground applied pesticides and 25-50 percent of aerially applied pesticide reach their target (WWF, 1999). The remaining amount is released into surrounding ecosystems and enters the food chain, affecting animal populations at every trophic level (Gliessman, 1999). Over 672 million birds are exposed to pesticides each year in California alone with an estimated 10 percent of these animals dying from this exposure. Birds exposed to sublethal doses of pesticides are often afflicted with chronic symptoms that affect their behaviour and reproductive success (Kegley, 1999). Pesticides are also known to negatively affect insect pest-predator population dynamics in agro-ecosystems (Landis, 2002) and to disproportionately effect insect predator populations, resulting in pest population resurgences and the development of genetic resistance of pests to pesticides (Flint, 1998). In addition, endocrine-disrupting compounds found in many pesticides still in use pose an additional and unknown long-term risk to wild biodiversity. Significant evidence of endocrine disruption from pesticide exposure has been documented for many different taxonomic groups including: birds, reptiles, fish, snails and oysters resulting in adverse effects to growth, development, or reproduction (US/EPA, 1997; Environment Canada, 2000).

Recent studies have also provided evidence of the impacts and risks to agro-ecosystems and wild biodiversity from genetically engineered crops. Transgenic crops pose a suite of ecological risks to native and cultivated ecosystems through: the spread of transgenes to related wild types via crop-weed hybridization; reduction of the fitness of non-target organisms; the evolution of resistance of insect pests to pesticide producing crops; soil accumulation of the insecticides produced by transgenic crops; unanticipated effects on non-target herbivorous insects; and the creation of new pathogenic organisms via horizontal gene transfer and recombination (Altieri, 2001).

Considering the above processes, it appears that agriculture management will have a considerable impact on the structure, composition and quality of the landscape that predominate in and around protected areas. The simplification and pollution of agro-ecosystems must be avoided or countered by adopting chemical-free and diversified agricultural systems to reverse the decline in species and habitat diversity in and around protected areas.

1.3 Antagonistic views on agriculture development and biodiversity conservation in protected areas

Due to the predominant agriculture's negative impact on biodiversity, conservation groups and protected area managers have historically viewed agricultural activities as being in conflict with stated conservation goals (McNeely and Scherr, 2003). This view has often led to attempts by protected area managers at excluding agricultural and other productive activities from protected areas. Similarly, community members in and around protected areas have often viewed measures to conserve biodiversity (e.g. land takings or land and/or water use restrictions) as a threat to personal freedom, livelihoods and the economic viability of their agricultural enterprises. The imposition of such restrictions has often led to real conflicts between protected area managers and farmers.

This perceived and actual antagonism has been compounded by the historic strategies of protected area management that have tended to marginalize the economic, social and political interests of community members around protected areas by excluding them from land management decision-making processes that effect their lives (FAO/UNEP, 1999). Additionally, strategies of excluding agriculture from protected areas have often fallen short of conservation objectives as many species require human-induced disturbances created by agriculture and other land use activities (Didier Le Coeur, 2002). On the other hand, agriculturalists in and around protected areas are often directly impacted by wildlife. The US Department of Agriculture estimates that annual losses from wildlife damage to crops are 1 billion dollars each year (USDA 2002). In developing nations the losses of crops to wildlife are often even more significant and potentially life threatening, with large game animals disturbing fields of staple crop and small rodents causing considerable damage to post-harvest staple goods (McNeely and Scherr, 2003).

Recently, agriculturalists have become more aware of the value of the biodiversity "input" for agriculture. The ecological functions of diverse ecosystems (such as balanced predation, pollination, nutrient cycling, degradation of toxic compounds, carbon sequestration) are today recognized to be central to sustainable food production. Moving away from simplified agricultural systems offers opportunities to produce food while enhancing natural landscapes.

After decades of struggle, only recently have conservation biologists, protected area managers, agriculturalists and policy makers begun to recognize the biodiversity contribution and potential of agricultural landscapes and started working together in developing strategies to effectively integrate these two land-use activities which will increasingly occupy the same areas of land. However, much research remains to be done in developing agro-ecosystems that serve both human needs and biodiversity.

2. BENEFITS FROM ORGANIC AGRICULTURE IN AND AROUND PROTECTED AREAS

2.1 Ecological principles behind organic agriculture

The Convention on Biological Diversity "encourages the development of technologies and farming practices that not only increase productivity, but also arrest degradation as well as reclaim, rehabilitate, restore and enhance biological diversity and monitor adverse effects on sustainable agricultural diversity. These could include, *inter alia,* organic farming, integrated pest management, biological control, no-till agriculture, multi-cropping, intercropping, crop rotation and agricultural forestry" (Decision III/11, 15 e).

While several agricultural approaches make sustainability claims, organic agriculture is the only well-defined agricultural management system, including recommended and restricted practices that aim at environmental protection and food production. The decades-long implementation of organic agriculture, including inspection and certification to ensure compliance, as well as the steady growth of organic food sales on the global market, offer a living example of a viable system that reconciles conservation and production needs.

The Codex Alimentarius Commission defines organic agriculture as "a holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity. It emphasises the use of management practices in preference to the use of off-farm inputs, taking into account that regional conditions require locally adapted systems. This is accomplished by using, where possible, agronomic, biological, and mechanical methods, as opposed to using synthetic materials, to fulfil any specific function within the system" (WHO/FAO, 2001).

All definitions of organic agriculture converge in recognizing that this food system is based on ecological principles and that it relies on using adaptive management for building long-term farm productivity. As such, the principles behind organic agriculture are in line with the Ecosystem Approach advocated by the CBD (Decision V/6) and its application focuses on functional relationships and processes within ecosystems; enhances benefit sharing; uses adaptive management practices; carries management actions at all level, and where a legislative framework exists, it ensures intersectoral cooperation[1].

For practical purposes, organic agriculture guidelines and norms specify minimal requirements to label foods as "organic". These requirements contain mandatory and voluntary practices for organic management. Therefore, throughout the world, the contribution of organic agriculture to biodiversity has different levels of achievements, depending on whether the mandatory requirements only are implemented to obtain certification or whether the broader voluntary requirements are also adopted. As such, biodiversity achievements of organic farms range from pollution reduction (of systems based on agro-chemical substitution) to fully-fledged holistic systems that harbour semi-natural habitats and a wide range of biodiversity.

Generally, farm habitat quality in organic farms is enhanced through practices that build below- and above-ground diversity, with a view to establish ecological processes that serve agricultural production. It must be understood that no single organic agriculture practice alone will sufficiently serve to enhance biodiversity but it is the result of the suite of practices, used in concert, that have the net effect of increasing farm habitat heterogeneity and thus, biodiversity.

2.2 Reduction of agricultural pollutants

Building of soil fertility and avoiding the use of synthetic agricultural inputs (including fertilizers, pesticides and genetically-modified organisms) is common to all organic agriculture norms (e.g. EU Regulation 2092/91, USDA National Organic Programme, the WHO/FAO *Codex Alimentarius* Guidelines on Organically Produced Foods, IFOAM International Basic Standards). In order to ensure the agro-ecosystem productivity, a set of practices are adopted. The main strategies and their benefits on biodiversity are outlined below.

Biological control and least-toxic approaches to pest management. Pest management in organic systems is achieved through a number of general and site-specific physical, biological and accepted biological pest control methods. The primary strategy for pest management in organic agriculture is preventative, where the use of sound soil fertility management serves to improve the physical, chemical and biological properties of soils, leading to elevated soil fertility and optimal conditions for plant growth. Crops grown in healthy soils tend to be more resistant and resilient to pest and pathogens and require little to no applications of pest control materials (Flint, 1998). The reduction or absence of synthetic soil fumigants, insecticides, herbicides, fungicides, etc. serves to prevent exposure of agricultural and surrounding ecosystems to the toxic effects of pesticide pollution. Because pesticides have a direct suppressive effect on many organisms within the agro-ecosystem, the elimination of pesticide use removes a major obstacle to the diversification process of agro-ecosystems (Gliessman, 1999). In protected area landscapes, the avoidance of pesticide use by organic farmers is conducive to wildlife conservation (see Examples 1 to 4 in Annex).

The use of natural soil amendments. The rational use of soil amendments is a critical aspect of organic system management. The use of soil analysis and nutrient budgets matches agricultural inputs with the nutrient demands of crops in order to make more efficient use of available

[1] For an analysis of the application of the ecosystem approach in organic agriculture, see Settle, 2003.

resources and avoid the pollution problems resulting from the over application of agricultural nutrients. The use of naturally occurring mineral soil amendments (e.g. rock phosphate, sulphate of potash) serves to supply essential plant nutrients while reducing nutrient leaching and/or runoff. Compost is used to improve and maintain soil organic matter levels and, when combined with an appropriate legume/grass cover crop and the incorporation of crop residues, it helps support larger and more diverse populations of soil organisms. Higher soil biodiversity has shown to increase the rate of nutrient cycling, improve soil aggregation and aggregate stability and improve the disease suppression of agricultural soils (Tugel, 2000; Mader, 2002).

Use of adapted genetic resources. While there are no, as yet, specific requirements for the use of genetic resources in organic certification systems, the restriction on use of synthetic inputs and genetically-modified organisms leads organic farmers to use and regenerate locally adapted landraces and genotypes resistant to climatic stress and diseases. It is also economically advantageous for organic farmers to use traditional varieties that are productive under low-input conditions, that can survive adversities and that can grow in marginal environments. The organic market often valorises endangered under-utilized and threatened species, including varieties and breeds that have specific nutritional characteristics (e.g. gluten-free crops). Research on selection, improvement and distribution of open-pollinated varieties is at early stage of development[2].

Polycultures (intercropping and strip-cropping). Polyculture is the intentional cropping of multiple species within a farm, in a planned spatial sequence. Intercropping is a direct way of increasing the diversity of an agro-ecosystem by introducing much more structural and chemical variation to smaller areas of the agricultural landscape and thereby encourages more complex interactions between crops and other organisms (Gliessman, 1999). Strip cropping, where strips of one crop are planted next to strips of another is a less management intensive form of multi-cropping. When compared to monocultures, polycultures have consistently shown lower populations of pest insects and weed populations. Increases in the variety of food sources, the creation of micro-habitats as well as the increased difficulty of pest populations within polycultures to locate dispersed patches of crop hosts serve to limit the growth of pest populations and stabilize predator-prey and parasitoids-host population dynamics (Vandermeer, 1989; Altieri, 1999).

Crop rotation. Crop rotation is the intentional planting of crops in different areas within a farm, in a planned temporal sequence. Crop rotations serve to provide new above- and below-ground habitats, as each new crop has a distinct chemical and biological make-up, introducing new vegetation types to the landscape and eventually, crop residues to the soil ecosystem. Different crop residues promote or inhibit different soil organisms which may have inhibitory or growth promoting effects to subsequent crops or pests. By interrupting the continuous presence of a crop host, crop rotation serves to break the build-up phase in the cycles of weeds, insects and diseases, thus eliminating the need for pesticide application. Fallow periods, where ground is left uncultivated for an extended period of time (a few months to one year), allow a limited amount of secondary succession to advance and hence, the recovery of the diversity of both terrestrial and below-ground species.

Cover cropping. Cover cropping is a type of non-crop cover grown specifically for soil improvement purposes. Both annual and perennial cover crops may be used, with varying

[2] For a study on the contribution of organic agriculture to genetic resources, see El-Hage Scialabba *et al*., 2003.

benefits to above- and below-ground biodiversity (Sustainable Agriculture Network, 2001). Cover crops may provide a physical temporary habitat for many different species of ground-nesting birds and small mammals as well as nectar and pollen sources for many species of insects. The habitat value of cover crops varies by species and variety; therefore, cover crops must be carefully selected to meet specific management objectives. Cover crops root system improves water penetration and prevents soil erosion. Cereal cover crops planted as an over-wintering rotation may also capture plant available nitrogen, thus preventing nutrient leaching into sensitive water ways. Cereal and legume cover crop mixes can be an important source of organic matter when incorporated into the soil. The use of perennial cover crops in orchards and vineyards is an effective means of enhancing the biodiversity and productive capacity of cropping systems and avoiding the labour and environmental risks associated with herbicide use. In Mediterranean climates, economic and agronomic advantages may be gained through the use of native perennial grass species in vineyards having a summer dormant growth cycle. As a result, they provide the advantages of a perennial cover crop without the disadvantage of excessive competition or water use (Costello, 1999).

Minimum tillage. Although reduced tillage is not a required practice in certified organic agriculture, it is a practice that is consistent with the objectives of organic system management and encouraged by most certifying programmes. The minimization of tillage will often lead to increased earthworm abundance and activity, increased populations and diversity of decomposer organisms and an associated increase in the organic matter content and aggregate stability of soils. When compared to conventionally tilled soil, low and no-till systems exhibit improved nutrient and water holding capacities, improved nutrient cycling and more desirable physical properties. The enhanced biodiversity of these systems lend themselves to improved cropping performance and greater resistance and resilience to various kinds of disturbances. Farming systems using no and low-till approaches are also less likely to incur soil erosion and require less inputs of energy (Vakali, 1999; Magdoff, 2000).

Impact of organic agriculture on biodiversity

Numerous studies have provided evidence of the positive role organic farming plays in both above and below-ground biodiversity, reduction of agricultural pollutants and the preservation and restoration of on-farm biodiversity. Long-term comparisons with conventional agriculture systems demonstrated that organically farmed soils showed higher biological activity (30-100 percent) and higher total mass of soil micro-organisms (30-40 percent). Nitrate leaching rates on organic farms were shown to be significantly lower (40-64 percent) and energy use to be more efficient (30-50 percent) on a per hectare basis (FAO, 2002). Studies taking place between 1988-2001, comparing conventional and organic agricultural practices in both the US and UK have repeatedly shown higher levels of wild biological diversity (e.g. birds, arthropods, weedy vegetation and soil organisms) in organically managed farms (Benton, 2003; Stolton, 1999). The influence of organic agriculture and landscape diversity was further illustrated in over 30 separate studies contrasting organic and conventional farms in the UK between 1983 and 2000. The findings showed that organic systems consistently had higher levels of: wild plants (5 times more biomass and 57 percent more species); arthropods, non-pest lepidoptera and spiders; and birds. In particular, 25 percent more birds were found at field edges, with 44 percent more in-field birds in the fall-winter, and higher numbers of breeding pairs of rare bird species (Soil Association, 2000).

2.3 Creation of habitats

Although biodiversity conservation is implicit in most national and international organic standards, explicit biodiversity conservation requirements for non-agricultural purposes remain under-developed at this time. In recognition of the need to establish standards for biodiversity conservation in organic agriculture, the 2002 revision of the IFOAM[3] Basic Standards for Organic Production and Processing outlines a set of recommended practices that may serve as a foundation for establishing certification standards for biodiversity conservation in agriculture. These standards' section on "Organic Ecosystems" requires measures for maintaining and improving landscape and enhancing biodiversity quality as well as prohibition on clearing of primary ecosystems. General recommendations are made on the maintenance of an appropriate portion of the farm as wildlife refuge habitat through, *inter alia*: the establishment of hedges, hedgerows and ecologically diversified field margins as well as areas with ruderal flora and wildlife corridors that provide linkages and connectivity to native habitats (IFOAM, 2002).

Agro-ecosystem heterogeneity (and therefore biodiversity of the landscape) may be increased through the conservation, management and/or restoration of various on-farm landscape features such as soil, water and native non-crop vegetation. The techniques outlined below require varying degrees of modifications of current agricultural practices. Not all organic systems implement habitat enhancement practices and there is scope for improving organic standards for biodiversity conservation. Additional research in restoration ecology will be necessary to make specific recommendations on how to best restore native vegetation to altered landscapes in particular areas. Also, the cost implications of restorative measures need to be compensated for the effective uptake of truly holistic systems, especially in the neighbourhood of protected areas.

Minor farm habitat enhancement strategies. A number of on-farm management techniques may be used to protect or enhance on-farm habitat for wild biodiversity. Leaving natural snags and the erecting of artificial perches or houses for native song birds, raptors and bats may provide on-farm roosting, nesting sites and refuges to support populations of wildlife (Imhoff, 2003). Where mechanical equipment is used for on-farm vegetation management, harvest or clearing of land, the postponing of such operations until after ground-nesting fledge lings have emerged may significantly decrease nesting losses (Edge, 2000).

Development of wetlands and multi-purpose farm ponds. The extensive loss, worldwide, of natural wetlands makes agricultural wetlands most important to wildlife. In particular, flooded rice fields have an enormous significance in creating temporary wetlands for reproduction and feeding of migrant birds and other wildlife (e.g. reptiles, amphibian). These important agriculture wetland functions are best addressed by organic management that avoids using synthetic pesticides and fertilizers (see Example 2 in Annex). In other environments, the development of farm ponds may serve to attract diverse wildlife and may be an economical source of water for small farmers. Planted with native aquatic vegetation, farm ponds provide food and cover, resting and breeding areas for wildlife. Migratory waterfowl may be attracted to these ponds for food resources and may become occupied year around with salamanders, turtles, shorebirds and certain species of ducks. Wide ranging animals may also use small farm ponds for watering holes. In agricultural areas reliant on furrow irrigation, tail water pond systems are an effective way of recycling irrigation water, trap and filter sediments and provide year around water habitat for wildlife (Imhoff, 2003; WFA, 2003).

[3] International Federation of Organic Agriculture Movements (IFOAM).

Organic rice cultivation and migratory waterfowl conservation, California, USA

Three to five million ducks, geese and swan winter in California. During their annual cycle, large number of shorebirds, cranes, pelicans, egrets, herons, ibises and songbirds utilize the Central Valley wetlands. The total annual water bird count (including migrants) in the region has been estimated as high as 10-12 million. In the Central Valley of California, over 95 percent of the wetland ecosystems have been lost to agriculture and other forms of development in the last 100 years. The agricultural wetlands created by rice cultivation have provided an important mitigation for the extensive loss of natural wetland habitats. California rice fields provides for over 141 species of birds, 28 species of mammals and 24 species of amphibians and reptiles. Thirty of these species (27 birds, 2 reptiles and 1 amphibian) are listed as endangered, threatened or species of special concern by the California or federal government. No other crop comes close to providing this level of benefit to such a vast array of wildlife. Since 60 percent of all the waterfowl on the Pacific Flyway winter in the Central Valley, both natural and agricultural wetlands are indispensable to them. Some 230 000 shorebirds winter annually in the Central Valley and, during fall migration, their numbers can swell to over 400 000. Rice fields provide feeding habitat for nearly 70 percent of these migrant shorebirds during their journey south (Page *et al.* 1994). Without rice farming, wetland habitats would be reduced by as much as 45 percent, with disastrous effects on waterfowl and a host of other wetland-dependent species. Equally important, the waste grain left after the rice harvest is a major source of food for a number of waterfowl species. Rice farmers also benefit by receiving large amounts of natural fertilizer left behind in the droppings of these feeding flocks. In addition to the wetland conservation and the leaving of crop stubble for wildlife forage, many rice growers in the region have adopted organic farming practices in order to capture a price premium for their products and protect the habitat value of these artificial wetlands.

Source: California Rice Commission, 1997

Leaving strips of unharvested crops for wildlife. Leaving some unharvested portion of fields for wildlife forage has proven a highly effective means of maintaining or enhancing population levels of many species. Food plots provide over winter food for wildlife which is particularly useful during times of stress or in areas when habitat modification has been significant. Location, size and spacing are several factors to consider when planning food plots. Although plot size and shape may vary according to the type of planting and the intended wildlife use, it is commonly recommended that wildlife lots be scattered over the entire property if possible. Corn is the most common forage plant for wildlife, but annual rye, millet and buckwheat are also beneficial for both mammals and waterfowl. In temperate climates, perennial crops such as clover, alfalfa and other legumes can be planted to provide food for turkeys, songbirds, rabbits and deer in the summer. In addition, sunflower beds along field edges provide more food for birds and small animals (Mississippi Fish and Wildlife Foundation, 2003; Edge, 2000). Constraints of this method of wildlife habitat enhancement may include unintended attraction of animals to production areas, leading to crop losses and artificially elevating the carrying capacity of lands resulting in population declines upon discontinuance of practice.

Native hedgerows. Intentional plantings of complex assemblages of native trees and herbaceous and woody perennials along field margins and areas of marginal or highly erosive soils is an effective means of enhancing biological diversity and the production capacity of agro-ecosystems. Hedgerows introduce greater micro-habitat diversity to agriculture lands and can reduce the velocity of winds and runoff when planted along field margins. As a result, hedgerows reduce soil degradation, increase crop yields by conserving soil moisture, increase livestock productivity by buffering extreme temperature variations (Le Coeur *et al.,* 2002). The functional role of hedgerows is being researched to enhance biological control of agricultural pests through specific hedgerow species assemblages (Bugg and Picket, 1998; Landis *et al.*, 2000). Complex hedgerows provide shelter and food (e.g. a diversity of pollen, nectar and seeds) which serve to elevate the carrying capacity for wildlife in an otherwise simplified agricultural landscape. They also serve as a corridor for the movement of animals between intact patches of habitat that have been interrupted by agricultural development (Le Coeur *et al.,* 2002). When hedgerows are planted between natural ecosystems and agricultural lands, they can also help to reduce the potential impacts of agriculture on native plant and animal communities by modifying winds, moisture levels, temperature levels and solar radiation (Gliessman, 1999).

Biodiversity associated with ancient hedgerows in the United Kingdom

Hedgerows are the most significant wildlife habitat over large stretches of lowland in the UK and are essential refuge for a great many woodland and farmland plants and animals. Over 600 plant species (including some endemic species) 1 500 insects, 65 birds and 20 mammals have been recorded at some time living or feeding in hedgerows. Currently 77 percent of the land area of the UK is under some form of agricultural land use where ancient hedgerows play a central role in supporting wildlife species through providing food, shelter, breeding grounds and migratory pathways to other patches of native vegetation. Hedgerows in these areas are preferred habitat for numerous birds, insects, small mammals and amphibians. The loss of species abundance in the UK is positively correlated with the intensification of agriculture and the removal of historic hedgerows. They are a primary habitat for at least 47 extant species of conservation concern in the UK, including 13 globally threatened or rapidly declining ones, more than for most other key habitats. They are especially important for butterflies and moths, farmland birds, bats and dormice. In recognition of the important role hedgerows play in the preservation of biodiversity in the UK, the Environment Act 1995 introduces an enabling power to protect important hedgerows throughout Britain.

Source: Scottish Executive, 2003

Vegetative buffer strips. Vegetative buffer strips are mixed native vegetation of various widths that are planted along field margins, irrigation and drainage ditches, tail water ponds or between agricultural areas and sensitive native habitats to serve both an environmental protection and biodiversity enhancement function. Being climate adapted, regionally specific native grasses and woody perennials will need only minimal care until they become established (many perennial native grasses and shrubs will also re-seed themselves). Grass species often have extensive root systems that may serve to prevent erosion and catch sediment and nutrients, thereby filtering runoff and improving water quality. Such forms of vegetation management serve to increase the complexity of vegetation in agricultural landscapes, providing diverse pollen and nectar and micro-habitat for native species of insects, birds and small mammals. In organic agriculture, vegetative buffer strips also function to protect from the negative impacts of neighbouring conventional farms, as they catch sediment and excess nutrients or agricultural chemicals. Vegetative buffer strips can also serve to reduce the spread of fire from the agricultural areas to the native vegetation. Planting complexes of regionally specific native perennial grasses and other herbaceous and wood perennial species in buffer strips can be an effective and inexpensive way to address the common management problem of weed control in these areas.

Riparian corridors. Due to the fragmentation of habitat common in agricultural areas, the maintenance or re-establishment of corridors between intact habitat remnants is an important component of enhancing the habitat value of agricultural areas. Riparian vegetation connects terrestrial and aquatic ecosystems creating extensive ecotone areas and serve as corridors for the movement of plants and animals between areas of undisturbed habitats. Riparian corridors are considered to be one of the most diverse and complex terrestrial habitats on earth (Naiman, 1993). Riparian corridors play a critical role in filtering sediments, providing organic matter to aquatic organisms, regulating water temperatures and dissolved oxygen levels, sequestering excess nutrients and absorbing surface runoff and preventing or reducing flood damage (ISU, 2001). Loss of riparian vegetation can significantly alter the function of these systems leading to loss of migration corridors, colonization of invasive exotic plant and animal species, stream bank erosion, alteration of streambed habitat, reduced ability to assimilate chemical and soil losses from agriculture lands and associated degradation of water quality (Wild Farm Alliance, 2003b). Maintaining the quality of the water mitigates the need for watercourse clean-up, and encourages wildlife and aquatic life. The UK Soil Association standards for riparian buffer zones for water quality protection recommend a minimum of 2 metres buffer of riparian vegetation on each side of a stream (Soil Association, 2003). In Northern California agricultural areas, a minimum of 30 metres on both sides of the stream is often recommended to provide significant ecological values such as wildlife corridors and biological control of agricultural pests (Imhoff, 2003).

The role of riparian corridors in agricultural areas, California, USA

The results of a recent study comparing the species abundance and diversity of mammalian predators in three types of riparian corridors adjacent to California vineyards indicate that both the number and composition of mammalian predators change based on different widths of natural vegetation along creeks. A greater diversity of all mammalian predators and more native mammal predators were found in wide riparian corridors (more than 30 metres of natural vegetation on each side of the creek), compared to narrow corridors (vegetation ranging from 10 to 30 metres on each side of the creek) or denuded corridors (very little natural vegetation along the creek). A separate study also indicated that overall levels of vineyard use by these mammal predators was very low compared to riparian corridor use, a result which indicates the preferential use and importance of these riparian zones for wildlife movement between undisturbed patches of habitat.

Source: Hilty *et al.,* 2002

Buffer zones. Buffer zones link protected areas to one another through the preservation of habitat. By definition, these areas are intended to remain under wild cover or be managed in such a way as to ensure that human land use is compatible with the maintenance of a high degree of biological connectivity. Buffer zones are used in protected areas to delineate areas where human activities such as grazing, non-extractive agroforestry, under-story cropping, hunting and gathering may occur. Depending on the species selected and how the area is managed, buffer zones may serve to reduce the pressures placed on intact native vegetation for the production of foods and fuels for human consumption. Buffer zones play an essential ecosystem function by allowing for the dispersal of plants and the movement and migration of animals between intact habitat types. To be effective, buffer zones must offer suitable habitat to wildlife and therefore the preservation of such environments free of pollutants along such pathways is of critical importance.

Under-story cropping. Under-story cropping is one the most effective ways to conserve native habitats and biological diversity of tropical forest areas that are used for agricultural production. Many traditional cropping systems integrate crops into the under-story vegetation of thinned primary or old secondary forests for the production of coffee, cacao, yerba mate and some tea varieties (Rice, 1996). Those traditional systems, which minimally modified the native habitat, are currently replaced by intentionally planted polyculture systems composed of native and non-native species that serve various ecologic, economic and cultural functions. In the last decade, the biodiversity value of shade cropping and its role in the sustainable management of protected area landscapes has emerged and a return to traditional polycultures is being achieved through organic agriculture and other biodiversity-friendly approaches. Under-story cultivations present enormous opportunities for the conservation and enhancement of protected areas and buffer zones while securing food and livelihoods for millions of people living in tropical forests (see Examples 3 and 4 in Annex).

Organic and shade-grown coffee in El Triunfo Biosphere Reserve, Mexico

Coffee plantations that are designed to mimic natural systems may have even higher numbers of species than natural forest. Central American coffee agroforests are second only to moist tropical forests for species diversity (Perfecto, 1996). Studies of the Smithsonian Migratory Bird Centre indicate that at least 180 species of birds live in Mexican shade coffee and cocoa fields and that 90 percent fewer bird species live in Colombian sun coffee plantations where original forest cover has been reduced or removed. The biodiversity of shade coffee ecosystems is currently under threat as a result of changes in production practices. In response to low coffee prices, many of the traditional shade coffee plantations are now intensifying production with the use of higher-yielding sun-tolerant coffee varieties that do not require the native tree canopy. In transitioning to sun tolerant varieties, forest canopy is thinned or removed, plantation life is reduced, use of agricultural chemicals is greater, and the risk of erosion is higher. In the highlands of the El Triunfo Biosphere Reserve in Sierra Madre Occidental of Mexico, Conservation International is supporting a Conservation Coffee Programme. The purpose of the project is to protect forest biodiversity while supporting economic development for local producer cooperatives through the encouragement of understory and certified organic coffee production in the buffer zone of the Reserve. Currently 1 250 farmers (working approximately 3 500 ha of organic coffee) are involved in the project (GEF, 2002).

3. COMPLEMENTARY STRATEGIES

3.1 Landscape planning to further reduce habitat fragmentation

In addition to on-farm management through organic and habitat enhancement practices, the success of biodiversity conservation in protected areas will depend upon how well individual farms are integrated into the wider landscape. Through proper planning at a landscape level, natural and managed areas may be suitably integrated into the landscape in order to reconcile human activities with the goals of biodiversity conservation. In order to best integrate the multiplicity of objectives within protected areas, land managers need effective planning tools to properly manage multi-use areas for the benefit of all interests.

Landscape ecology is the study of environmental factors and interactions at a scale that encompasses more than one ecosystem at a time. Because landscape ecology helps to understand how different parts of the landscape mosaic are formed and how they interact, it may provide a basis for the effective management of agricultural landscapes within protected areas. Landscape planning provides a tool for the integration of agro-ecosystems with the broader landscape in a manner that minimizes habitat fragmentation and that confer the beneficial aspects of biodiversity to agro-ecosystems. (Gliessman, 1999).

The tools commonly used in landscape planning are mapping, and where available, aerial photography and geographical information system analysis. Such tools provide a means through which historical, current and proposed landscape features and land-use activities may be contrasted to specific conservation goals. With this information, recommendations for changes in land-use practices and agro-ecosystem design may be made that serve to best integrate agricultural ecosystems and other human land uses into the broader landscape. In doing so, impact to critical habitat and sensitive areas may be mitigating or minimized and greater coherence between on-farm habitat and the surrounding landscape may be made (Smeding, 2000). Such management tools may also serve in monitoring the effects of specific land-use practices in order to gauge the effectiveness of interventions (see Example 5 in Annex).

Landscape ecology and planning may be used at various scales. At a larger scale of analysis, landscape planning may be used to determine the most appropriated placement of agriculture and other land-use activities when attempting to reconcile human livelihoods and habitat needs for biodiversity conservation. By looking at the landscape of which individual agriculture ecosystems are a part, key ecological features (e.g. surrounding plant associations/vegetation patterns) may be identified for use to determining appropriate on-farm habitat restoration efforts that may best serve to re-establish continuity of habitat types and thereby reduce habitat fragmentation. If such ecological features are managed successfully between a number of contiguous farms and wild surroundings, a landscape that is more compatible with the needs of a more diverse number of plants and animals may result (Smeding, 2000).

3.2 Agro-ecotourism to further sustain rural areas

Several CBD references mention the link between ecotourism and agriculture: "ecotourism provides for full and effective participation and viable income-generating opportunities for indigenous and local communities" (Decision V/25, 4a). "In order to contribute to the sustainable use of diversity through tourism, there is a need to implement flexible mix of instruments such as integrated planning … ecolabelling …" (Decision V/25, 4g). "In some areas, low-input and small-scale agricultural activities that result in both an attractive environment and the maintenance of high levels of biological diversity can offer an opportunity for tourism. Sale of products derived from sustainably harvested natural resources may also provide significant opportunities for income-generation and employment" (Decision V/25, 12 e).

Ecotourism. Under the right circumstances, ecotourism has proven to be one of the most effective means to finance biodiversity conservation. In most rich biodiversity areas, actual revenue flows for ecotourism are better than non-timber forest products and biopharmacy, and comparable only to agroforestry (European Preparatory Conference 2002). Because the dominating land use in protected areas and buffer zones is agriculture and forestry, ecotourism is an opportunity for the creation of additional income to farmers/foresters and to generate financial means for the management of protected areas, especially where governmental park management agencies have little resources.

Agrotourism. The symbiotic relationship between tourism and agriculture that can be found in agrotourism (i.e. holidays on farmland) is a key element of an environmentally and socially responsible tourism in rural areas. Rural hospitality offers new employment and income generating opportunities for rural populations, including agrotourism as expression and cultural exchange of agricultural practices, artistic heritage and craftsmanship and culinary traditions. Agrotourism may take several forms: holiday farms, farmhouse bed-and-breakfast, farm camping, mountain resorts, equestrian centres and other forms of rural accommodations. Such facilities are an innovative payment system for environmental services generated on and around agricultural lands.

Agro-ecotourism. While ecotourism is nature-based and agrotourism is farm-based, agro-ecotourism is a combination of both. The rural landscape, usually a combination of wild and agro-ecosystems, is the most important resource for tourism development. It is obvious that a diversified agricultural landscape, with semi-natural habitats, has a greater aesthetic and recreational potential over uniform, degraded and/or polluted agricultural areas. In Europe, agri-environmental policies often promoted organic agricultural activities as a most effective means for landscape conservation: for example, the European Union Life Environment project run by the French Federation of Parks and Reserves adopted extensive animal husbandry to prevent the negative impacts of unmanaged forests on some botanical meadow species and to promote a landscape quality attractive to tourists. Examples from the Alpine Region showed that agriculture (e.g. in Carinthia, Austria) maintained an ecological value much more attractive to tourists than areas where agriculture activities were extremely reduced. Tropical countries that harbour extraordinary biodiversity have an untapped potential for generating tourism business around biodiversity-rich farms. For example, shade cacao and coffee farms have a higher biodiversity than forest habitats: families could receive money for visitors access to their land for bird-watching or could be actively involved in the agro-ecotour (see Examples 3 and 4 in Annex). Agro-ecotourism in certain locations provides a strong economic incentive to small farmers to commit to biodiversity-friendly agriculture management.

Eco-organic tourism. When agro-ecotourism evolves around an organic farm, it is referred to as eco-organic tourism. The valorization of specific elements of the agro-ecosystem landscape offers an additional economic resource for environmental protection. Conversion to organic management in agricultural areas and the development of connected activities such as tourism are increasing. When farms are organically-managed, they increase the motivation for tourists' visits. New tourist expectations have enhanced the quality of the supply such as diversified farm landscape, environmentally-sound farm-house architecture and local/typical gastronomy.
In many industrial countries, protected area landscapes including farmland experience land abandonment. In this context, small-scale agriculture can become economically viable if quality products could be marketed and income is supplemented by tourism activities, especially in areas rich of biodiversity and history (see Example 7 in Annex). While the establishment, by local authorities, of land protection systems was historically opposed by farmers unions, there is a recent growing awareness that a reserve/park increases "green" tourism opportunities and that visitors are increasingly sensitive to quality, both in ecological and gastronomic terms. This trend favours organic farmers because they can easily meet these new tourists' demands.

Different studies in the European Union demonstrated the ability of organic agriculture to create attractive landscapes. Eco-organic farm practices and activities which benefit the environment while rewarding farmers include: accommodation in buildings renovated/built according to ecological architecture (natural materials, bioclimatic criteria, landscape planning); on-farm consumption or selling of organic foods and beverages; educational programmes and training (e.g. organic gardening, compost making, wild herbs collection and drying, traditional food and beverage processing), and sensitising guests on rational use of natural resources (e.g. in-house solar energy but also in greenhouses or for processing, wood for heating, water re-use and re-cycling). A 1999 survey in Italy reported that eco-organic holiday farms performed the following activities: 35 percent arrange visits to nearby protected areas; 30 percent plan naturalistic didactical activities; 24 percent set up didactical and demonstrative laboratories on organic agriculture and the environment; and 11 percent offer visitors instruments and equipment for the observation of fauna and flora (AIAB, 2001).

Ecolabels are important marketing instruments for agro-ecotourism in general, because price premiums encourage farmers' commitment to the conservation and maintenance of biodiversity. The most well-known forms of certification include organic farming operations, organic and specialty foods (i.e. geographical denomination of origin) and forest stewardship products. Organic certification of farmhouse structure and facilities is less known but where implemented (e.g. Austria, Italy), it attracts more environmentally-conscious tourists. Requirements for such farms include: organic agriculture production; naturalistic and didactic activities; natural resources tutorship (e.g. at least 5 percent of the farm must be devoted to ecological infrastructure and at least 40 botanical local species must be present in the infrastructure); recreational green areas; ecological buildings (with respect to construction materials and cleaning agents used, energy saving and waste management, and prevention of air pollution); tourist offers (both on-farm and in neighbouring natural reserves); gastronomic offers (organic, seasonal and local); and sustainable transportation facilities.

The dependence of organic farmers on neighbouring protected areas to attract tourists to their farming enterprise and rural hospitality qualify them as best allies for the sustainable management of protected areas and buffer zones. Furthermore, eco-organic tourism offers opportunities for rural economies and sustainable tourism.

Eco-organic holiday farms in Italy

In 1998, the Italian Association for Organic Agriculture (AIAB) developed a national programme on sustainable tourism, based on the concept of eco-organic holiday farms. The main objective is to convert rural tourism activities to environmentally-friendly tourism through the involvement of organic farmers. While organic farms that undertake agrotourism or restaurant/catering activities are the main targets for such conversion, particular attention is given to organic farms operating within or near protected areas. Adherence to eco-organic holiday farms includes basic compulsory requirements and optional requirements, including organic agriculture, landscape management and valorization of local culture and products. Farms are inspected and granted a number of daisies on the label, from 1 to 5. The number of optional requirements fulfilled determines the farm classification: five daisies indicate adherence to all requirements. This system of classification indicates to tourists the level of commitment to the quality of the environment and of agrotourism services. In 2003, the AIAB directory included 143 eco-organic holidays farms but many more are being assessed for inclusion.

Several Italian Regions (e.g. Tuscany, Emilia-Romagna, Lazio) have adopted organic agriculture as a best agricultural practice in parks and protected areas in order to support tourism activities: financial support is granted to convert to organic management, information desks are established for farmers within parks and demonstration activities are undertaken. In order to monitor implementation (and assist conflict resolution between agriculturalists and environmentalists), the Italian Association for Organic Agriculture (AIAB), the Italian Federation of Protected Areas (Federparchi) and the Environment Protection Association (Legambiente) have established in 2003 a virtual "Parks Observatory" in order to collect experiences and answer questions on how organic agriculture is managed in protected areas.

Source: AIAB, 2003

3.3 Ecoforestry and sustainable forest management

The importance of ecoforestry and Sustainable Forest Management (SFM) to protected area management is that these approaches to forestry provide opportunities to generate financial and livelihood benefits to local communities which give them an incentive to support conservation initiatives such as protected areas. Ecoforestry has its roots in environmentalism, whereas SFM originates in production forestry.

Ecoforestry

According to the Ecoforestry Institute of British Columbia in Canada, ecoforestry is a long-term ecologically sustainable and economically sound alternative to current conventional forest management. It is predicated on maintaining the "natural capital" of the forest ecosystem, while allowing a wide range of values and benefits to be derived from the "interest" of the forest.

Nature knows best how to manage forests. By working within the limits of natural processes, we can be sustained in perpetuity. Ecoforestry strives to conserve the structure, function and composition of the forest.

Self-sufficient and stable human communities can grow strong from a sense of place, recognition of interdependence and respect for the forest. Some key values of ecoforestry are ecological integrity, community vitality and economic opportunity. Its methods are specific to bioregions and forest ecosystems and are evolving as we learn more. Ecoforestry favours value-added manufacturing and local jobs by providing a continuing, diverse and local supply of forest products.

Ecoforestry is a low-impact approach to forest management that maintains a fully functioning forest within the natural historic range of spatial and temporal variability. Its practices favour native tree and plant species which provide for the needs of wildlife and their habitats.

Examples of the basic ecoforestry principles and practices are:

- observing the structure, function, composition and natural changes of forest ecosystems, learning from these and using management practices that mimic them;
- preserving the natural diversity of ages, heights and species of trees;
- protecting wildlife and their habitats;
- managing for logs as just one possible product among many non-timber forest products;
- focusing on what should be left after harvesting (in order to keep the ecosystem functioning) rather than focusing on what one takes;
- using low-impact logging systems;
- the volume of trees removed is less than the forests growth rate in order to provide for forest structures such as standing and downed dead trees;
- promoting natural regeneration;
- appreciating all the other forest values (aesthetic, spiritual, genetic, recreational, protective …) at least as much as the monetary value of marketable products;
- the precautionary principle: when in doubt, as to whether a potential action in the forest may be harmful to the ecosystem or not, don’t do it!

Values and the benefits of ecoforestry

The archetypal ecoforester is Merve Wilkinson of Vancouver Island off the coast of British Columbia, who describes his practice in words which exemplify the values and the benefits of ecoforestry: "I'm just completing the 13th cut since 1945 on my 137-acre mixed-species forest. Years ago, before the computer age and complicated forest policy, I established my growth rate to be 1.9 per cent using longhand arithmetic. This has determined my annual cut ever since. Several years after I determined my growth rate researchers starting knocking on the door: a German forester came in at 2.0 per cent, an American at 2.1 and Forest Renewal BC at 2.1 with their computerized methods. So I was pretty close. In fact, I've been undercutting for all these years yet making a good living. In 53 years, I've taken out two-and-a-quarter times the original volume but still have 110 per cent of the original volume remaining. We carefully conserve the forest - our capital - and live off the interest. Now that's sustainable forestry. And it is a stark contrast to official forestry practice in BC which is specifically designed to liquidate the old-growth forest - our province's one-time only forest capital."

Certification is being used as a mechanism for promoting ecoforestry, with the Forest Stewardship Council being the preferred approach for the Ecoforestry Institute. During the last ten years, the Forest Stewardship Council has certified over 30 million hectares of forest and other 70 million hectares have been certified under other schemes. Although certification initially focused on large-scale industrial logging, community-owned forest enterprises and small holders, including indigenous people, are now being certified (CIFOR, 2003).

Ecosystem Based Management is another way in which ecoforestry is being characterized and this has been taken up on a large scale. The "Great Bear Rainforest" agreement announced by the provincial government of British Columbia in April 2001 between environmental organizations, First Nations communities, and forestry companies working on the north-central coast heralded an environmental coup, the reverberations of which will challenge the British Columbia forest industry. The agreement signalled the success of an international boycott campaign aimed at forestry companies singled out for environmentally degrading operations. As well, the agreement protects huge tracts of land from logging, including 96 458 hectares to preserve essential habitat of a rare white subspecies of black bear popularly known as the "Spirit Bear".

But the real environmental victory forged in the agreement lies in the announcement that all development activity in the plan area, which covers about 4.8 million hectares (equivalent to approximately 12 000 Stanley Parks) of marine, foreshore, and upland area on the north-central coast, will be based on the principles of Ecosystem Based Management.

In the northwestern United States, Ecosytem Based Management will be applied to 25 million ha in the Interior Columbia Basin Ecosystem Management Project. Small-scale ecoforestry stories are also emerging (see Example 6 in Annex).

Sustainable Forest Management

The broad introduction of the concept of Sustainable Forest Management can be traced to the so-called *Forest Principles* and Chapter 11 of Agenda 21, which were prominent outputs from UNCED. The guiding objective of the *Forest Principles* is to contribute to the management, conservation and sustainable development of all types of forests and to provide for their multiple and complementary functions and uses. Principle 2b specifically states that "Forest resources and forest lands should be sustainably managed to meet the social, economic, ecological, cultural and spiritual needs of present and future generations." It goes on to specify that: "These needs are for forest products and services, such as wood and wood products, water, food, fodder, medicine, fuel, shelter, employment, recreation, habitats for wildlife, landscape diversity, carbon sinks and reservoirs, and for other forest products." And that: "Appropriate measures should be taken to protect forests against harmful effects of pollution, including air-borne pollution, fires, pests and diseases, in order to maintain their full multiple value".

Although the *Forest Principles* form a "non-legally binding statement of principles", they bear the marks of a negotiated text with some repetitions and passages with ambiguous or very general text and are, in places, focusing on guidance for the establishment of an enabling framework for SFM, rather than specific guidance for application at the field level.

The concept of SFM has continued to evolve since 1992 through the international forest policy dialogue (IPF/IFF/UNFF[4]) and a large number of country-led and ecoregional initiatives aimed at translating the concept into practice.

Criteria and indicators for sustainable forest management

Nine ecoregional forestry initiatives or processes involving 149 countries, whose combined forest area equals 97.5 percent of the total forest area in the world, have been established since 1992 with the aim of translating the concept of sustainable forest management into practice. They continue to meet on a regular basis to further refine the concept through the development of criteria - or elements - defining SFM and sets of indicators for each of these aimed at facilitating monitoring of progress in the practical application of the concept.

Although evolving independently, these ecoregional processes are conceptually similar in objectives and overall approach and have shared information and experiences resulting in a convergence as regards the main elements constituting SFM.

The 2003 International Conference on the Contribution of Criteria and Indicators for Sustainable Forest Management (CICI) was held in Guatemala gathering representatives from all of the above processes, international organizations (including NGOs), government officials and experts in the field. Participants at this Conference agreed that SFM comprises the following seven common thematic areas:

- extent of forest resources
- biological diversity
- forest health and vitality
- productive functions of forest resources
- protective functions of forest resources
- socio economic functions
- legal, policy and institutional framework.

[4] Inter-governmental Panel on Forests (IPF), Inter-governmental Forum on Forests (IFF), United Nations Forum on Forests (UNFF).

Of these, four are related to the environmental aspects of SFM and the remaining three to the social and economic aspects – the two other "legs" of SFM.

As would be expected, the indicators vary widely among initiatives owing to differences in forest types and environmental, social, economic, political and cultural conditions. National-level criteria and indicators are being complemented by the development and implementation of criteria and indicators defined at the forest management unit level in a number of the processes as well as by other actors such as NGOs and the private sector.

The degree of implementation of criteria and indicators at the national level varies considerably. In many cases, action is limited by the lack of trained personnel or institutional capacity for collecting and analysing information and for following up the development and implementation of improved management prescriptions based on the information obtained.

The results of CICI 2003 and other technical meetings held since UNCED demonstrate a move from the focus on whether conservation and sustainable development of the world's forest resources is possible, to a focus on how to implement sustainable forest management practices.

Recently a discussion has emerged about the relationship between SFM and the Ecosystem Approach. During a CBD meeting in July 2003, a consensus was reached to the effect that SFM amounts to a practical application of the Ecosystem Approach. It is thus evident that there is a convergence between ecoforestry and SFM in the sense that both now explicitly involve ecosystem based management.

4. CHALLENGES FOR THE EFFECTIVE MANAGEMENT OF PROTECTED AREAS

The main challenge in protected areas is to conserve biodiversity while providing the basis for the social and economic development of local residents. In most parts of the world, biological fragmentation compares with social and economic fragmentation (see Box below). For biological diversity to be conserved and restored through the agronomic and planning practices outlined above, it must be understood that a considerable number of social, economic and or policy factors must be changed to encourage the adoption of such programmes. Ecological knowledge and economic feasibility are key to the further advancement of initiatives designed to increase the biodiversity of agricultural landscapes within protected areas. More importantly, collaborative management between both local communities and sectoral policy makers (e.g. agriculture, environment, tourism) is a pre-condition for success.

Biological fragmentation	Social fragmentation	Economic fragmentation
Species and ecosystem Extinction	Food insecurity	Vulnerability of local economies
Micro-climate alterations	Loss of life forms and practices	Decreased production alternatives
Alteration of vital cycles (land, water, air)	Loss of identity	Homogenization of local economy

Species break-in	Trust in local capacity lost	Relationship with other economies lost
Landscape rupture and vulnerability	Geographic and cultural uprooting	Resources valued from a strictly economic point of view

Source: Solis Rivera *et al.,* 2002

4.1 Generation and dissemination of ecological knowledge

Consumers awareness. To date, few agricultural lands in or around protected areas are managed organically and considerable knowledge (and subsequent policy efforts) will be required to convert current agricultural practices to organic practices. Lack of awareness on the benefits of organic agriculture, especially of policy-makers, remains a main constraint to its promotion and adoption. Increased awareness of both environmentalists and agriculturists of the promise of organic agriculture and connected tourism activities in protected areas (see Examples 2, 3, 4 and 7 in Annex) is key to the scaling-up of numerous but scattered successful experiences. An increased consumers' awareness of organic agriculture and connected biodiversity conservation practices creates a market demand, which in turn creates market-incentives for farmers to adopting biodiversity conserving practices. Studies conducted to date provide a strong basis to move forward to mobilize market and policy forces on behalf of organic agriculture.

Agro-ecological research. The promotion of food production in protected areas requires a commitment to expand research, which results are needed to direct choices made in policy, funding and markets. The lack of basic knowledge of biodiversity patterns in agricultural landscapes inhibits sound conservation practices. Understanding the complexity of trophic and other ecological relationships that are maintained in a structurally diverse farm require substantial research investments. Agro-ecological research, building on local or indigenous knowledge, is key to provide financially realistic management recommendations for farmers and to gain environmentalists acceptance of the agricultural activities in protected areas.

Restoration ecology is in its infancy and much research is required to provide practical answers on vegetation configurations and ecological processes in the food chain. Reclamation of degraded farmlands located near corridors, riparian habitats or protected areas deserves special attention (see Example 2 in Annex). Some natural products used in organic agriculture (e.g. pyrethrum, rotenone) are harmful to fauna and there is urgent need for more research to find suitable alternatives.

For tropical forest conservation, understory cropping associations deserves targeted research to better understand what mix and density of shade trees best enhances biodiversity and crop production (see Examples 3 and 4 in Annex). Assessments of the use of shade trees by forest organisms should be overlaid with information on the silvicultural and agronomic properties of those tree species. There is need to evaluate the impact of different management intensities and landscape settings on the long-term viability of birds, trees, epiphytes, invertebrates or mammals, especially those assumed to be dependent on vanishing wetlands and tropical forest habitats. In particular, the influence of surrounding land use on agro-ecosystem capacity for harbouring sensitive biodiversity (understudied taxa that are sensitive to anthropogenic disturbances) requires better understanding. Such knowledge is important in developing education and training programmes as well as advisory services to producers and protected areas managers.

Education and training. Multi-disciplinary education and training is key to the adoption of ecological production approaches by both agriculture and protected areas managers. Networking and joint ventures between producers and technical experts increase information flow and mutual learning: alternative forms of educational ventures facilitate exchange on production and on-farm biodiversity management and support training of local communities. Extension work may reinforce small farmers' knowledge on the need of biodiversity enhancing management for sustainable production (for example, on the low pest density value of a less common tall shade trees over cacao – see Example 3 in Annex). Extension workers could also provide materials and seedlings to build community nurseries (for improved intercropping) as well as cooperative assistance for reaching markets for certified products. Improved understanding of the value of integrating conservation planning with development, coupled with an improved foundation for additional incentives for farmers to grow biodiversity-friendly crops, has demonstrated to be successful (see example 7 in Annex).

Continued development of organic standards. Voluntary environmental and social certification schemes exist for agriculture products (plants and animals), fish farming, forest products and products gathered in the wild. Ecolabelling varies from Organic, through the Rainforest Alliance "Eco-OK", Bird Friendly, Predator Friendly, Forest Stewardship, Marine Stewardship to Fair Trade and Ethical Trade labels. These voluntary standards have the potential to both raise consumer awareness of sustainable and equitable land-use practices and offers financial incentive to farmers to raise their management standards.

What qualifies organic agriculture as the preferred management tool in protected areas is the prohibition on synthetic agricultural inputs and the organic inspection and certification system that ensures compliance with defined practices. However, requirements for practices which specifically target biodiversity in organic systems remain underdeveloped. Biodiversity standards for low-input agriculture in tropical forests exist (i.e. those of the Rainforest Alliance) and management principles and recommendations for biodiversity-compatible farms have been established by a number of scientists and institutions[5]. Although the latter standards are not inconsistent with organic standards, moderat use of agro-chemicals is allowed; however, provisions are made for maintaining a percentage of the farm area under forest, establishing riparian buffer zones, fostering diverse native canopies, creating processing plants that divert pulp and liquid wastes from local streams, and improving livelihoods (e.g. workers' rights).

Considering that organic products enjoy an established (and steadily growing) market demand, a combination of organic standards and biodiversity standards specific to tropical forests would be an optimal mix to improve the ecological and economic performance of agriculture in protected area landscapes. The organic agriculture community has started to move in this direction (see Box below). Such international standards would provide the foundation for developing standards tailored to local environments, traditions and specific production systems. In addition, there is need to develop certification schemes and labels proper to protected areas and buffer zones in order to create an improved market demand and supply for commodities produced in these areas. Such labels would increase adherence of farmers to schemes promoting biodiversity conservation and would encourage consumers' support to stewardship farmers and protected areas. The development of appropriate organic standards and certification for protected area landscapes can

[5] For cacao, see Parrish *et al.*, 1999; for coffee, see Mallet, 2001.

become an important tool for environmental regulations, conservation policies and programmes, extension services and environmental and agricultural financial schemes.

Standards for biodiversity on organic farms

Few countries have schemes which encourage farmers to conserve and create habitat for wildlife and to set aside a farm area for biodiversity purposes. Few national organic agriculture standards include specific provisions for biodiversity conservation: a biodiversity management plan for organic farms is requested in Sweden and Australia and is recommended in the United Kingdom. The provisions of the Codex Alimentarius guidelines are limited to the creation of habitat for natural enemies of pests. The IFOAM International Basic Standards for Organic Production and Processing include, *inter alia*, provisions for organic certification of products from Organic Ecosystems (2.1) and Wild Harvested Products (2.4) as well as draft standards for Forest Management (IFOAM, 2002). IFOAM is currently involved in further developing the Biodiversity Standards of its International Basic Standards in order emphasize the biodiversity objective of organic agriculture and enable the monitoring of its positive impact.

Organic farmers will be expected to set biodiversity conservation objectives and to develop a comprehensive biodiversity conservation management plan. Recommendations will include use of native and local varieties and breeds and mixed production, based on traditional practices. Organic systems will be required to safeguard wild habitats through clear restrictions on land clearing and to conserve habitats for beneficial organisms and wildlife. Standards are being developed for the establishment and maintenance of semi-natural areas on a representative size of the farm, conservation of trees and bushes, and proper management of grasslands. Habitat for endangered, migratory or keystones species is also addressed in a standard that request minimal conservation action when such species are recorded on the farm. Field boundaries, which are important corridors that link natural or semi-natural areas, will be required on organic farms, along with buffer zones and border between the field and natural ecosystems. A proposal will be made to request operators to minimally participate in landscape planning tools and habitat conservation projects concerning their region.

4.2 Market and capital incentives

Off-farm income generation. Organic agriculture has developed in response to market-demand and farmers' innovations and commitment to environmental quality. As discussed earlier, off-farm income generating activities such as agro-ecotourism, and eco-organic tourism in particular, provide a promising alternative to both small holders livelihoods and sustainable economic activities in and around protected areas.

Secure land tenure. Market pressures and the security of farmers over a given piece of land will largely determine the degree to which farmers are willing to adopt organic agriculture and other biodiversity conservation practices. The 2-3-year transition period required by organic certification schemes and the associated cost of transition represents a considerable investment for farmers. Farmers need to have secure and long-term access to lands in order to commit to the adoption of biodiversity conserving practices. For farmers without legal land tenure, tenure could be granted to farmers in exchange for adopting a defined set of conservation land use practices. In protected areas where land is legally owned by farmers, conservation easements may be used to identify land-use practices that must be maintained in exchange for cash payments from the purchaser. The purchaser is often a local, national or international land trust which holds conservation easements and monitors compliance with the legal agreement. A conservation easement is a legally binding plan that is attached to the deed of the property and transferred to anyone who may purchase the land in the future (INECE, 2002).

Securing capital incentives. Capital incentives are necessary to transition from strictly economically-driven activities to environmentally and socially sound productive activities. The adoption of technologies and approaches necessary for biodiversity conservation in agriculture include business partnerships, private capital investments and public incentive payments. Market-based and other private and public incentives compensate organic farmers for their stewardship efforts. Special interest business groups can provide a sizeable interested market (such as the “Bird Friendly” chocolate) and thereby secure some level of demand for the product (see Examples 2, 3, 4, 6 and 7 in Annex).

While market forces provide a sufficient drive for certified organic products, public support and other biodiversity schemes are of key importance for the start-up phase: during the 2-3 years conversion period, farmers cannot capture prices premiums and do incur yield losses. In particular, payment for ecosystem services should be transferred to farmers who grow crops in forests and other natural systems (e.g. wetlands, pastures) which are degraded and of great biodiversity concern. Financial incentives should also apply to buffer zone land holders, with a view to encourage farming practices that harbour dispersing native flora and fauna, cushion the impact of invasive species on protected areas, and stabilize agriculture encroachment at the park boundary.

Considering that 60 percent of terrestrial biodiversity is found on a mere 1.4 percent of Earth land area, support to farmers operating in these biodiversity “hot-spots” is a priority. Hotspots as well as all protected areas are islands where anything except collaborative management is not sustainable. Collaborative management requires intensive local science (agro-ecology and other ecosystem-based approaches) and a conducive political process. Investments in intensive local science and political processes is a pre-condition for the effective management of protected areas and biodiversity hot-spots.

Examples of capital incentives for biodiversity investments in organic systems

The Nature Conservancy (TNC) and the Environmental and Natural Resource Law Centre (CEDARENA) have fostered over 60 contracts with private land holders in protected areas, protecting over 2 834 ha of cloud forest in the Monte Verde Preserve in Costa Rica. CEDARENA experts are helping landowners survey their lands and develop management plans that, for example, permit low impact farming in one area and preserving intact forest in another. At present, TNC and CEDARENA are working with Monte Verde land owners in drafting conservation easements to expand the biological corridor between Monte Verde and surrounding protected areas (INECE 2002).

An innovative land-use agreement is the creation of networks of landowners and landseekers whereby land is granted to organic farmers to develop local food systems while contributing to landscape stewardship. For example, the Linking Land And Future Farmers Association in Victoria, B. C., Canada, established in 1994, provides partnership planning advice to landowners and farmers and assist organic farmers activities through a number of facilities, including start-up grants for new farmers (LLAF, 1996).

Terra Capital Investors, run by the US-based Environmental Enterprises Assistance Fund has developed an investment fund to support biodiversity enhancing industries in Latin America. Terra Capital Investors is a ten-year fund established with US$15 million with targeted investments in organic agriculture, sustainable forestry, nature tourism, sustainable harvesting of non-timber forest products and aquaculture. Similar funds have been established to provide venture capital to businesses with explicit social and environmental goals. These include: the EcoEnterprise Fund of the Nature Conservancy which invests in projects in Latin America and the Caribbean and Kijani Initiative run by IUCN and the International Finance Corporation which targets development projects in Africa (Stolton, 2002).

In the United Kingdom, the Department for Environment Food and Rural Affairs has established a series of incentives programmes, or agri-environment schemes, which focus on promoting environmental awareness and conservation practice with farmers. These voluntarily conservation agreements are an important tool in compensating farmers for income lost when establishing or improving environmentally beneficial aspects of farmland. Defra's Organic Farming Scheme was launched in April 1999. It provides producers with five years of area-based payments to support them through the conversion period, where additional costs and lower yields may be incurred. The programme includes seven separate schemes for land based preservation which serve to protect or restore rare elements the natural and cultural environment. Though such programmes exist on a voluntary basis at this time, they serve as foundation for developing production standards for the conservation of biodiversity (Defra, 2003b).

4.3 Governance and collaborative management

Participation and partnerships. Landscape management plans for protected areas often involve modifications of land-use practices or land tenure. Local cultural and livelihood needs must be considered along with conservation goals. The use of participatory appraisals of problems and solutions, collaborative management, and participatory monitoring/evaluation schemes are effective ways of integrating community member's interest and involvement and thus, generating long-term support to biodiversity conservation projects. Community-conserved areas are found in every region of the world and take a variety of forms, including indigenous reserves, community-managed ecosystems, managed landscapes, sacred forests and springs, partnership areas, and many privately or NGO protected lands. However, after a decade of implementation, community-based protected area management is still not widely accepted (or practiced) and more rigorous documentation of opportunities and constraints, including an analysis of effective incentive measures, is required for scaling-up (and sustaining) successful experiences (IUCN, 2002).

Eco-agriculture Partners

During the 2002 World Summit for Sustainable Development in Johannesburg, South Africa, Eco-agriculture Partners was established under the auspices of the World Conservation Union (IUCN) and the Future Harvest Foundation. Eco-agriculture Partners seek to transform landscapes where both agricultural production and natural biodiversity are highly valued to "eco-agriculture", defined as sustainable agriculture and associated natural resource management systems that simultaneously enhance productivity, rural livelihoods, ecosystem services and biodiversity. Eco-agriculture includes a wide range of systems and practices that integrate productivity goals (for crops, livestock, fish, trees and forests) with provision of ecosystem services (including biodiversity and watershed services) at a landscape level. Eco-agriculture systems make more space for wildlife by designating protected areas and corridors that also enhance local production and income, and improve the habitat value of productive areas by reducing pollution, improving resource management, or creating crop mixtures that mimic habitat conditions – while still maintaining or increasing productivity. Eco-agriculture Partners envision eco-agriculture systems wherever the demands for food, ecosystem services and rural livelihoods converge – in areas with large and small-scale farms, in developed and developing countries. IUCN and Future Harvest are also developing a complementary partnership to address the policy dimensions of integrating food production, environment, and poverty reduction goals, known as the Monterrey Bridge Coalition.

Source: Scherr S.J., 2002

Integrated policy and planning of protected areas and buffer zones. Organic agriculture alone cannot meet conservation challenges without landscape planning. Also, the ecosystem services on which organic agriculture depends can only be restored and maintained at the ecosystem level. The closed attempt to realign agricultural policy towards more environmentally sustainable systems is found in the agri-environmental programmes of the European Community; within this policy framework, organic agriculture has played a central role in many countries' policies, together with management agreements for biodiversity conservation (Stolton and Geier, 2002).

Globally, the fragmentation of natural habitats and the increasing livelihood needs of millions of people living in and around protected areas impose an integrated policy for nature conservation and agricultural development. Integrated policy, planning and management of protected areas represent a major challenge to the agriculture, forestry, environment and tourism sectors. Policies that reconcile the needs of both rural communities and nature conservation has been addressed on a number of occasions but implementation on the ground remains a major undertaking.

Public sector agencies and civil society institutions involved in environmental and agricultural and rural development, together with local community members, should establish cooperation agreements and plans to evaluate, implement and monitor a holistic approach to economic activities in protected area landscapes. Plans related to buffer zones for internationally supported parks should consider the positive environmental and economic effect of organically managed agro-ecosystems (e.g. in Latin America, biodiversity-friendly shade crops provide alternative corridors for large scale continental corridor initiatives as well as between parks within nations).

Financial support to stewardship farmers should be not be limited to agriculture agencies but should also be incorporated within park management plans and budgets. Specific strategies and programmes should be adapted to the specificities of each nation, region and area for agriculture, forestry, tourism and biodiversity conservation. Coordination is necessary with the landscape and town planning sectors in order to support mixed-use structures and facilities (e.g. recreational facilities, networks for tourist mobility). Strategic partnerships need to be established between farm operators and protected area managers with the involvement of community organizations and consumer associations, based on traditional cultures and living heritage.

FAO/UNEP International Technical Consultation on
Protected Area Management and Sustainable Rural Development
Harare, Zimbabwe, 1999
(Final Communiqué)

We, the participants, from 18 countries in Africa, Asia, Latin America and the Caribbean and six international and bilateral organisations, in the FAO/UNEP International Technical Consultation on Protected Area Management and Sustainable Rural Development held in Harare, Zimbabwe from 26 to 29 October, 1999:

Having considered the documentation on the issues arising from the interaction between protected area management and sustainable rural development,
Considering the deliberations of the consultation in plenary and working group sessions, which were enriched by the participants' broad variety of experience,
Recognising the legitimate needs for both conservation and rural development and the complexity of

reconciling these needs,

Recognising the diversity of ecological situations, and categories of protected areas and livelihood systems which were discussed in this consultation, and

Appreciating that there is a shared conviction that the past narrow, authoritarian approach to protected area management should be broadened to accommodate the wider needs and aspirations of society, and in particularly rural communities,

Advocate the following:

- Review and analysis of existing policies, legislation, strategies and programmes which govern the creation and management of protected areas with a view to strengthening both these institutions and the communities, so as to better assimilate the new paradigms of conservation and the sustainable development of rural communities.
- Promotion and evaluation of collaborative protected area management to develop replicable models of effective conservation and sustainable rural development.
- Increasing the flow of sustainable benefits to rural communities from resources located in, and activities based on protected areas, without undermining the objectives for which the areas were established.

Urge that governments focus on meeting the needs of marginalized populations and communities in and around protected areas by making special provision for them in rural development policy and planning.

Urge FAO, UNEP and other international intergovernmental and non-governmental organisations both to recognize the critical importance of the issues relating to protected area management and sustainable rural development, and to ensure that the dialogue on these issues is continued, especially at a regional level.

Source: FAO/UNEP, 1999

5. CONCLUSIONS AND AREAS FOR CONSIDERATION

Summary and conclusions

Protected areas are islands in a landscape dominated by agriculture. Agricultural management has a considerable impact on the structure, composition and quality of the landscape. Natural resources and wildlife conservation are managed by agencies distinct from those that address agriculture and rural development. Generally, community approaches to conservation touch on the periphery of agriculture activities. Exclusion of people and focusing only on ecological concepts has been an important source of difficulties for protected area managers. Increasing human needs, especially in biodiversity “hot-spots”, impose an integrated approach to agricultural development and nature conservation.

In the last two decades, organic agriculture has demonstrated that alternative market opportunities could reward farmers for practicing stewardship of their natural resources. By cooperating with nature (rather than emancipating itself from nature), organic agriculture can perform an important connecting role between protected areas by increasing landscape heterogenity and refraining from synthetic chemical use. Organic agriculture also halts the advancement of the agriculture frontier. Additional sources of income for organic farmers derive from agro-ecotourism, which value increases in proportion to the level of biodiversity.

In forested areas, ecoforestry and sustainable forest management can facilitate effective management of protected areas by expanding opportunities for income generation and sustainable livelihood enhancement for local people. Potential sources of income from forests include artisanally logged timber and a wide range of non-wood forest products, as well as ecotourism and the services needed to sustain it.

Ecolabels, including organic foods and fibres, non-wood forest products, ecoforestry and eco-organic tourism provide market-based incentives that reward producers for environmentally sound practices. This, in turn, secures resources for the conservation of natural capital. Ecolabelling and certification programmes provide indicators to measure and evaluate the extent of adoption of biodiversity-friendly practices. The CBD Global Strategy for Plant Protection includes outcome-oriented targets which provide a framework for regional and national targets: Target 12 on "30 per cent of plant-based products derived from sources that are sustainable managed" mentions organic foods and certified timber as indicators of direct measures to monitor progress (Decision VI/9).

In protected areas, a paradigm shift that considers farming within the context of the entire ecological landscape in which it functions is of key importance. Agricultural lands falling under Categories V and VI of IUCN protected areas should be encouraged to convert to organic management, supplementing basic requirements with biodiversity enhancing structures and landscape planning. Particular attention should be paid to extensive agricultural systems with a high scenic and naturalistic value and in areas of high conservation priorities. Enhanced ecological knowledge and especially incentive measures and payments for ecosystem services are necessary to assist organic farmers restoring degraded areas and protecting biodiversity.

Collaborative protected area management between farm operators and protected area managers are models of effective biodiversity conservation and sustainable rural development. However, weak linkages between conservation policies and agriculture, coupled with reticence of government officials, remain a major constraint for adopting collaborative protected area management. Integrated agriculture, forestry, tourism and environmental policy and planning could offer a solution for sustainable food production, rural development and biodiversity conservation in protected area landscapes. Only together can farmers, foresters, conservationists and consumers cultivate a future in which farms are integrated in landscapes that support a full range of native species.

Areas for consideration

In accordance with the above findings, and given the urgency of the need to improve human livelihoods in and around protected areas, the capacity of organic agriculture, ecoforestry and sustainable forest management to deliver a range of benefits to people and to the environment should be recognized and systematically encouraged by protected area managers.

Recalling CBD recognition of organic agriculture among the farming practices that increase productivity while rehabilitating and enhancing biological diversity (Decision III/11, 15e) and of the role of integrated planning, ecolabelling and low-input agriculture in offering tourism opportunities in protected areas and buffer zones (Decisions V/25, 4g and 12e), there is a need for promoting concerted action on organic agriculture as a viable management tool in protected areas.

In this regard, an International Ecological Agriculture Initiative in Protected Areas and Buffer Zones is proposed to encourage Parties to the CBD and FAO Member Nations to promote collaborative actions between their respective nature conservation and agriculture and rural development institutions.

The main objectives of such an initiative could, *inter alia*:

- document and assess ecological agricultural systems (organic and other low-input systems) in protected areas and buffer zones, their impact on food production, rural livelihoods, ecosystem services and wild biodiversity, with a view to identify research needs, incentive measures and policies that encourage the development of organic agriculture in areas of high conservation priorities;
- develop guidance on integrated protected area management and organic agriculture, ecoforestry and sustainable forest management and ecotourism, following an ecosystem approach and focusing on participatory landscape planning and collaborative resources management;
- strengthen capacities and partnerships among the agriculture, forestry, tourism and environmental sectors through the provision of adequate institutional support to interdisciplinary research, education and extension on biodiversity-friendly economic activities;
- stimulate multi-sectoral cooperation through joint programmes and projects linking protected area management and agriculture and rural development, at national and regional levels.

The suggested initiative would focus on the following user groups: resource-poor farmers, small holders and indigenous people living in and around protected areas; policy-makers and practitioners of sustainable agriculture and nature conservation, including research, training and extension institutions, NGOs and international funding agencies.

FAO, UNEP, Unesco-Man and the Biosphere, the International Federation of Organic Agriculture Movements, the Rainforest Alliance, Conservation International, the Future Harvest Foundation, IUCN-World Commission on Protected Areas, World Wildlife Fund, the Smithonian Migratory Bird Centre, the Natural Resources Defence Council and bilateral organizations could work together to foster this initiative.

Annex

CASE-STUDIES FROM PROTECTED AREA LANDSCAPES

The agricultural practices used within protected areas and buffer zones have varying degrees of impact upon the environmental quality which influences the ability of these areas to serve as quality habitat or important migration and dispersal pathways. The case studies below illustrate how conversion to ecological management in these areas may serve to:

- Detoxifying environments from agricultural pollutants through organic agriculture in order to prevent wildlife poisoning (e.g. threatened birds in Atlantias, Turkey). In all examples, protected areas proved to be incomplete measures to effectively conserve wildlife;
- Raising income of local communities through ecolabelling (organic, biodiversity-friendly, ecoforestry) which rewards farmers for their stewardship efforts. In all cases, relatively lower yields were compensated by higher commodity prices and additional environmental services;
- Reversing land and water degradation and restoring wetland environments vital to nesting and foraging of wildlife thus, enhancing lands carrying-capacity for both wildlife and agricultural production (i.e. birds, invertebrates and organic rice in the El Ebro, Spain). In particular, the loss of natural wetlands is countered by rice cultivations that create temporal wetlands, rich in crop residues and forage, suitable for wetland-dependent and/or migrant species;
- Reversing deforestation and reducing protected areas' fragmentation by enhancing the habitat value of neighbouring agricultural landscapes. In particular, retaining forest structures and diversity by growing crops under tree canopy is vital to many endemic, migrant and often endangered species. The functional role of shade cacao and coffee plantations in the Meso-American Biological Corridor are illustrated through the examples from the Talamanca-Caribbean Biological Corridor, Costa Rica, and the biological corridor between El Imposible and Los Volcanos National Parks, El Salvador;
- Integrating socio-economic development needs in protected area management through participatory landscape planning (i.e. Ba Be and Na Hang tropical limestone forests of Vietnam);
- Revitalizing small-scale village communities through ecoforestry activities, in response to destructive large-scale foreign logging (i.e. ecoforestry in Solomon Islands);
- Reversing abandonment of rural areas and re-valorization of ancient crops (i.e. Bergamot) and ecosystems (i.e. pastures) by raising the economic viability of farming through organic management and ecotourism (i.e. eco-organic holiday farms in Parco Rurale Alture di Polazzo and Aspromonte National Park, Italy).

Example 1. Organic agriculture for the protection of endangered wildlife, Altintas, Turkey[6]

Biodiversity features. The small Turkish town of Altintas (western Anatolia) harboured a marshy water body, Lake Aksaz, which supported thousands of resident and migratory birds, including the Great Bustard (*Otis tarda*), a bird locally called "Toy". As almost everywhere else in Europe, Toy is on the verge of extinction due to over-hunting, destruction of its natural habitat, disturbance of its breeding areas and poisoning from pesticides. The Toys' breeding biology is strictly dependent upon cereal agriculture areas, which it uses for nesting and feeding.

The problem. In 1956–1957, the lake was drained in order to expand the lands available for farming. A mass exodus of most of its birds followed, with only a few remaining, most notably the Toys. After the draining of the lake, local villagers (who traditionally relied on natural inputs for their integrated crop/livestock systems), started using synthetic pesticides and fertilizers. As a result, local wild animals, including the Toy, suffered drastic population decline.

Project interventions. In the early 1980s, Ibrahim Aksaz, a Kütahya municipality civil servant, farmer and then president of the Kütahya Hunters' Association, realized that the excessive hunting of Toys was threatening the birds' survival and so decided to take the initiative to protect it. For many years, Ibrahim travelled locally to speak to the area residents, along with government officials, municipalities, wildlife protection associations and NGOs, in order to make them aware of the problem. He steered clear of the press and reporters, however, fearing media attention could alert poachers to the Toys existence and lead to illegal hunting. He would show the birds only to those sincerely interested and whom he could trust would do the Toys no harm. Even today, the wildlife rangers do not show the Toys' nesting areas to visitors from outside the area or other persons unknown to them. Finally in 1993, with the help of various individuals, institutions and associations who were mobilized to the cause, particularly the Foundation to Promote and Develop Hunting and Wildlife, Ibrahim managed to convince the authorities to declare the area a "Protected Wildlife Refuge".

After succeeding in getting hunting banned in the area, Ibrahim's next major challenge was to translate this legal prohibition into a reality on the ground. In each of the small area villages, he selected one volunteer willing to help protect the birds. Known as wildlife rangers, these persons took on the responsibility for monitoring a given area and alerting the local police to any illegal hunters. To this end, Ibrahim gave each of the volunteers monetary support as well as a pair of binoculars and a ranger uniform, paid for out of his own money, with some help from the Foundation. In response to complaints from some area farmers that Toys were eating their crops, particularly chickpeas, Ibrahim compensated them for their losses, again from his own money.

In 2002, Ibrahim received a small grant from the Global Environmental Facility/Small Grants Programme to help support key activities such as: educating children, farmers and hunters; conducting ground-level studies of Toys; holding meetings with local officials; promoting bird-friendly organic farming methods, and creating small water resources in the area to help protect the Toys. The Turkish Bird Research Society (KAD) which is a research and conservation-oriented society established in 1998, got involved in the project. KAD was responsible for

[6] Source: The Aksaz family, Altintas/Kutahya Turkey, *pers. comm.,* 2003

baseline Toy survey and assessing organic agriculture practices based on conservation biology principles, mainly with regards to impact on Toy.

Results. At present, the population of Toys in the Altintas area has risen to about 50 individuals. As no scientific headcount of the Toys has ever really been done, it is difficult to accurately gauge the success of the local protection campaign. But what can be stated with confidence is that, just 30 years ago, populations of Toys were widespread throughout Turkey. Now, as illegal hunting has been reduced to limited and isolated cases, just a few small-scale colonies of Toys remain. As the fight against hunting has largely succeeded, today the deaths of birds (and other animals) are mainly caused by local farmers' intensive use of pesticides and other chemicals as well as a lack of adequate water resources within the wildlife protection area. It should be noted that this territory includes agricultural areas as well as wild upland steppes. During the course of each year, nearly half of the agricultural areas lie fallow. Recently, and to exacerbate the problem, other small wetlands inside the Wildlife Refuge have been drained. This has forced the Toys to search for drinking water outside the protected area thus, exposing themselves to great danger. Unfortunately, the declaration of the protected wildlife refuge alone has not proved fully up to the task of conserving and protecting this endangered bird species.

In October 2002, cancer took Ibrahim to an untimely grave but since then, we who write this letter, his wife and children, have worked to faithfully carry on his fight to protect the birds he so loved. We, Ibrahim's family, believe that the farms bordering the refuge should cease their use of pesticides. We consider crucial both the protection of the Toy natural habitat and the conversion of agricultural lands to organic management, in order to stop pollution and prevent further destruction of wildlife in Altintas. On behalf of our late father Ibrahim, we issue a call to the international community to build on his long personal efforts by preserving Altintas' natural habitats and helping local farmers to convert to organic farming methods.

Example 2. Organic rice in coastal wetlands of El Ebro Delta, Spain

Biodiversity features. The Ebro delta is the second most important bird area in Spain and one of the most important wetlands in all of Europe with 7 700 ha currently protected as Natural Park, Special Protection Area (SPA) and a designated Ramsar site. A total of 11 000 ha, including the Natural Park, other wetlands and rice fields, will be included in the Natura 2000 Network of the European Union. Rice cultivation plays an important role in the ecology and the economy of most wetland areas and most of the ornithologic studies which have focused on rice fields deal with their role as foraging bird areas. The rice fields within the delta occupy 21 000 ha (65 percent of the surface area). These artificial wetlands which are not currently included in the SPA are the primary habitat supporting the biodiversity of this important area. Among the most important species are Purple Gallinule (*Porphyrio porphyrio*), the Purple Heron (*Ardea purpurea*), Whiskered Tern (*Chldonias hybrida*) and the Fartet (*Lebias ibera*), an endemic fish of the Western Mediterranean threatened of extinction. Favoured habitats are the coastal lagoons and its associated vegetation and the Mediterranean pastures, both considered priority in the Habitats Directive. A total of 330 species of birds have been observed in the delta, including 81 species that breed regularly within the delta and another 28 species which occasionally breed on site. Among breeding species, 50 are aquatic birds with 40 000 breeding pairs. In January of each year, a mean population of 180 000 birds may be found in the Ebro delta. The Ebro delta has international importance for breeding of at least 24 species and for migration and wintering of 13 species, and occasionally for 14 additional species (SEO/Birdlife, 1997).

Problems. Environmental monitoring of the Ebro delta has raised a number of concerns over the use of pesticides and synthetic fertilizers on the environmental quality of the area. At particular times of the year, pesticide concentration in the water is known to reach high enough levels to produce harmful effects on the flora and fauna of the drainage channels, lagoons, rivers and bays (Manosa, 1997). In addition the release of rice field drainage water into the surrounding wetlands has periodically resulted in the eutrophication of the lagoons in the Ebro delta.

Project interventions. In 1997, a SEO/BirdLife project entitled "Improvement of Habitat Management in the Special Protection Area of the Ebro Delta" was initiated in order to improve the conservation status of the system of rice fields, wetlands and lagoons of the Ebro delta. The project was designed to have both an experimental and demonstration elements intended to quantify the environmental advantages of the application of new cultivation practices in the rice fields of the delta, as well as to define habitat management models that enhance the conservation of the natural values of this Special Protection Area. The new models tested in the study were organic farming techniques and the application of the agri-environmental measures of the European Union. These two techniques were compared to the commonly used rice production techniques of the region which included the use of both compounded organophosphate herbicides and synthetic fertilizers. A total of 35 ha were devoted to the study in which data was gathered on the following: bird populations (i.e. abundance, position and activity); abundance of aquatic fauna populations including fish, amphibians, reptiles, invertebrates; vegetation dynamics, and changes to water quality, including measurements of nutrient and presence of pesticides. The economics of the application of the alternative cultivation practices were also analysed to determine economic feasibility of the adoption of such practices.

Results. The findings of the first two years of the study indicated that organic agriculture had the best environmental performance of the three systems, followed by the agri-environmental plots and the conventional plots. Over the two years of study, bird biomass in the organic plots (9.75 birds/10 ha) was consistently higher than both the agri-environmental plots (6.27) and conventional plots (3.35). Higher densities of several species (*Egretta garzetta, Ardea cinerea, Bulbulcus ibis*) were observed in the organic crop, with the exception of one species (*Himantopus himantopus),* probably due to lowest water level. Densities of invertebrates and fish were double those existing in the agri-environmental and control plots and water quality was higher in terms of lower levels of dissolved nutrients and the presence and concentration of residual pesticides.

Equally important is the project in demonstrating that the organic rice farming is technically and economically feasible. Though production cost was determined to be 20 percent greater than the conventional production costs due to labour inputs and lower yields, the transitional and organic rice sold at a price double of that of the conventional rice (Ibanez, 1999). As a consequence of the project success, SEO/BirdLife decided to create a company with the objective of producing and marketing organic rice, as well as to promote education and research activities. The project has also purschased 60 ha of rice fields (16 ha of which have been reverted to natural wetlands and the rest are being devoted to organic rice farming), which are now Ornithological Reserves of SEO/BirdLife, and which are included in the Special Protection Area of the Ebro delta by the Catalan Government.

Example 3. Organic cacao agro-forestry in the Talamanca-Caribbean Biological Corridor, Costa Rica

Biodiversity features. The Talamanca-Caribbean Biological Corridor, founded in 1992, covers 2 800 km^2 of southeastern Costa Rica and is part of the greater Meso-American Biological Corridor. This area contains over 90 percent of the Costa Rican floral diversity with: more than 10 000 species of flowering plants (including roughly 1 000 orchid species); over 4 000 species on non-vascular plants (including nearly 1 000 of the 1 300 species of ferns); 350 species of birds (including 15 endemic species); 59 mammal species (13 endemic); 51 reptiles (10 endemic) and 43 species of amphibians (Nature Conservancy, 1997). Although 11 percent of land area in Costa Rica is currently under protection, it is estimated that the rate of biodiversity loss is 3.2 percent per year (Reitsma *et al*., 2001).

Cacao (*Theobroma cacao*) in Costa Rica is one of the most important crops. It covers more than 4 000 ha, of which 3 000 ha are grown under a shade canopy. Since the majority of the mid- and over-stories of the forest are left untouched except for some thinning, the rustic cacao farm is structurally diverse and expected to harbour a vast array of secondary plant and animal diversity such lianas, epiphytes, mosses, lichens, insects, herpetofauna and birds. Examples of natural rainforest trees that are left standing include: cachà (*Pithecelobium pseudotamarindus*), gavilàn (*Pentaclethra macroloba*), caobilla (*Guarea spp*.), cedro amargo (*Cedrela odorata*), higuera (*Ficus spp*.), guácimo colorado (*Luehea seemannii*) and ceiba (*Ceiba pentandra*) (Parrish *et al.,* 1999).

The problem. The Talamanca corridor area boasts three national parks, a large wildlife management reserve and five indigenous reserves throughout its range, which are relatively isolated from each other due to exploitive agricultural lands in between them. Over 25 000 people live in and around the Corridor region, living off commercial and subsistence agriculture. In the 1970s, the decline of the world prices for cacao and the spread of a fungal disease (*moniliasis*) severely affected much of the small holder's cacao farms. As a result of the collapse of the cacao industry, the region's economy has declined, leaving the rapidly growing and largely indigenous population of Talamanca with some of the highest rates of poverty in the country. As a result, shade cacao plantations were abandoned, farms were sold to large developers, more forests was cleared to grow plantains and remnant forest trees were extracted for tropical hardwood lumber. The intensive use of pesticides in the commercial banana monocultures and more recently, in many subsistence production systems, has made Costa Rica one of the world highest pesticide's consumer. This intensive use of pesticides in Costa Rica has led to very high rates of pesticide poisoning among its population and poses a significant risk to the conservation of ecological diversity (Damiani, 2001).

Project interventions. In recognition of the fact that improved management of structurally complex cacao agroforestry systems can greatly enhance biodiversity in the Corridor and that organic management has the potential to meet economic needs while preserving forest remnants, a number of projects have been initiated. In 1997, Nature Conservancy and Asociaciòn (ANAI) started promoting shaded crop agro-ecosystems as a conservation management tool to protect the Corridor. ANAI supports educational farms where "campesinos" are trained to train native Indian communities on crop and biodiversity management in the tropical forest (Borrini-Feyerabend, 1997). ANAI also provided new varieties of cacao that were more resistant to the Moniglia fungus as well as advice on some additional shade and intercropped trees (e.g. Brasilian arazà fruit (*Eugenia stipitata*) and guanabana (*Annona muricata*) (Parrish *et al.*, 1999). The Talamanca Small Farmers' Association (APPTA) was created in order to promote collective marketing of small organic farmers and to attract international donors. In 1998, the GEF-funded project "Biodiversity conservation in Cocoa Agroforestry" was carried in the buffer zones surrounding several protected areas in the Talamanca, Cahuita and Squirres cantons in order to improve biodiversity conservation and indigenous people livelihoods through changes in the design, management and use of cacao agroforestry farms (900 farms covering 1 500 ha), following organic principles for production and marketing (GEF, 2002).

Through contacts with foreign buyers, APPTA revived cacao production using traditional understory cropping patterns and organic agriculture practices, collective marketing, training and organizing an internal monitoring system. In addition to cacao, the organic agriculture programme is also helping farmers diversifying their production systems to include planting of coffee, blackberries, nutmeg, cinnamon, vegetables, ginger and chiefly bananas for home consumption and sale (Damiani, 2001). Additional incentives for farmers to grow biodiversity-friendly cacao include ecotourism, especially avitourism in cacao plantations: local communities are trained to identify birds and ecotourism packages include bird-watching, cacao harest experiences, local food and culture, raptor migration and forest reserve visits. In particular, farmers who committed themselves to biodiversity-friendly cacao criteria were added (by the ecotourism entity of the Corridor Commission) on the list of priority farms that could gain the benefit of avitourism visits to the region (Parrish *et al.*, 1999).

Results. Studies evaluating the cropping patterns and soil fertility management strategies used by APPTA's farmers concluded that the use of complex polycultural cropping patterns has resulted in reduced rates of soil erosion, nutrient and pesticides leaching and incidence of pest and diseases. In 2000, over 1 000 APPTA members had obtained organic certification, which accounted for more that 2 000 ha of cacao and banana farms in the region. The region is now the largest supplier of certified organic cacao to North America. As a result of the price premium paid for certified organic products, incomes have raised and farmers are clearing much less forest in the higher elevations, leading to a reduction in habitat loss (Parrish *et al.,* 1999; Reitsma *et al*, 2001).

Biotic surveys showed that shaded cacao agro-ecosystems contain structural characteristics of both forest and early successional habitats which harbour high species richness, surpassing that of forest. Surveys of bird communities found greater species diversity in managed cacao (144) than in forests (130) or than in abandoned cacao fields (131), likely due to the propensity of most migratory birds to utilize secondary habitats during the non-breeding period (Reitsma, 2001). The value of managed cacao habitats is also due to the fact that they are home to a number of at-risk bird species: of the 63 bird species of conservation concern encountered in the Talamanca habitats, 44, 41, 34 and 28 species are found in forest, managed cacao, abandoned cacao and wooded field, respectively. Data suggest that cacao has its greatest value when located near forest patches and that it may help enhance the size and health of protected areas when used as a buffer zone crop (Parrish *et al.,* 1999). This suggests that organic cacao agro-forestry help to enhance the integrity of protected areas and the functional size of the narrow Talamanca Corridor.

APPTA has been a catalyzing element for community-based efforts, establishing a forum for debate that allows member organizations to voice their concerns, exchange experience and work together to find alternatives and solutions to their natural resources challenges. For example, the

Association's Biodiversity Conservation Programme includes supporting local communities' efforts to secure payment for environmental services, promoting alternative approaches to environmental education in schools and supporting biodiversity protection activities (Solis Rivera *et al.*, 2002).

Example 4. Organic and shade coffee in the buffer zone between El Imposible and Los Volcanes National Parks, El Salvador

Biodiversity characteristics. El Salvador is part of the Neotropical realm, with serious environmental degradation: only 2 percent of the original natural forest is still intact. The few patches of remaining natural areas (including Montane Forest, Pacific Dry Forest, Sierra Madre Moist Forest, Pine-Oak Forest) present high levels of biodiversity and a high degree of endemism, such as birds, beetles, salamanders, bats and orchids. A total of 509 species of birds are found in the country, of which 310 are Neotropical residents and 128 species are restricted to forest habitats. Of these, two species are considered threatened and 24 vulnerable at the global level. In addition, there are over 420 species of birds migrating from North America, many of which are considered at risk because of rapid disappearance of habitats in breeding and non-breeding areas: approximately 40 species of migratory birds that visit El Salvador are species of global concern.

Much of the El Salvador's remaining natural forests known to be critical to the conservation of biological diversity lie adjacent to coffee plantations, many of which maintain a diverse mixture of both cultivated trees and remnant forest species. Coffee is traditionally grown under a canopy of shade trees, which structural and floristic complexity confers local species biodiversity within the same (or higher) order of magnitude as undisturbed natural forests (Perfecto *et al.*, 1996). Currently, 25 percent of the 196 000 ha of coffee plantations are shade coffee systems with a positive impact on biodiversity. These include traditional polycultures, whereby forest understory is replaced by coffee shrubs but the native forest canopy remains intact and commercial polycultures, whereby canopy shade trees are planted rather than remaining from the original forest. Surveys of coffee plantations and adjacent forests have shown the presence of: over 300 bird species, with many endemic and threatened birds (e.g. black hawk eagle, *Spizaetus tyrannus*); 31 mammal species, some of which being endangered (e.g. ocelot, cacomistle and Mexican porcupine); 26 reptile species; and 326 tree and bush species. Due to the species diversity supported by these shaded coffee plantations, such production systems effectively serve as both buffer zones and corridors linking two of the most biologically rich National Parks of the country: El Imposible and Los Volcanos. This corridor area (75 000 ha) is a strategic link in the regional Meso-American Biological Corridor (GEF, 2002b).

Problem. El Salvador has a limited natural resource base, is densely populated and coffee generates 30-50 percent of agricultural export earnings: 75 percent of the 20 000 coffee producers are small holders, working farms of less than 3 ha. In the late 1970s, the appearance of coffee leaf rust (*Hamileia vastatrix*) has led to replacing traditional coffee varieties (such as típica or bourbón) with varieties that responde well to synthetic fertilizers and pesticides. As a result, shade covers in coffee plantations were drastically reduced to a minimal diversity and density of canopy cover (30 percent of plantations) and to sun-tolerant coffee monocultures (40 percent of plantations). Forest clearing, coffee ecosystem simplification and intensive agricultural input use have inevitably resulted in decreased habitat quality and decreased species abundance and diversity. Given the small amount of land currently under protection, the extent of habitat fragmentation and the trend in shifting from shade to sun coffee plantations in El Salvador, the establishment of protected areas is not sufficient for conserving biological diversity. Restoring degraded lands and enhancing the habitat value of productive landscapes within the biological corridor are steps necessary for the preservation and enhancement of habitats important to both El Salvador's natural heritage and biodiversity of global significance.

Project interventions. A GEF project entitled "Promotion of Biodiversity Conservation within Coffee Landscapes" was initiated in 1998 to promote the maintain and enhance habitats within shade-coffee plantations in the biological corridor linking El Imposible and Los Volcanes protected areas. The project promotes organic and biodiversity-friendly coffee and is exploring opportunities for ecotourism, with a view to enhance rural livelihoods in the Apaneca mountain range.

Results: In 1996, there were some 4 900 hectares of certified organic coffee (Rice and Ward, 1996). However, not all organic coffee plantations have enough shade trees and organic standards do not contain measurable criteria for diversified shade cover. With GEF assistance, Salvanatura and the Rainforest Alliance are leading certification of ECO-OK coffee products, following specific biodiversity standards. Assessments of international markets indicate good opportunities for both certified organic and "biodiversity-friendly" coffees: several organic coffee companies offer "bird-friendly" coffee in USA. El Salvador having established infrastructure for extension and certification of organic coffee, the establishment of criteria for the creation of "bird-friendly" or "biodiversity-friendly" coffee has a good potential to build upon existing efforts.

Due to the reduced applications of agro-chemicals and the preservation of the forest canopy, there is a great potential for biodiversity conservation through the protection of wildlife habitats in the corridor dividing the two national parks. Although shade coffee yields are lower than in sun cultivated coffee, certified shade coffee is more profitable to farmers as it secures additional employment (due to greater labour demand), reduces incidence of pest and disease outbreak, and provides commodities such as firewood, fence posts, construction materials, fruits and medicinal plants. The development of ecotourism is expected to offer additional income and provides insurance against variations in coffee production and world prices (GEF, 2002b). With record declines in coffee prices at the farm gate, certified coffee increased income to small holders and local communities, demonstrating that owners of qualifying shade coffee plantations can be rewarded for the environmental services they provide (Rainforest Alliance, 2000).

Example 5. Landscape ecology and participatory planning in Ba Be National Park, Vietnam[7]

Biodiversity characteristics. The Ba Be National Park (Bac Kan Province) and the Na Hang Nature Reserve (Tuyen Quang Province) contain some of the best examples of protected tropical limestone forests in Vietnam. At their closest point, these two protected areas are only a few kilometres apart, and they are ecologically very similar. These forests are known to shelter a large part of the least known population of the endemic and highly endangered Tonkin Snub-nosed Monkey (*Rhinopithecus avunculus*), which was considered extinct until 1992. The Tainguen Civet (*Viverra tainguensis*), first described in 1997, and the little-known Owston's palm civet

[7] Adapted from the Protected Area Resource Conservation project (PARC) of the Government of Vietnam/UNDP-Vietnam, 1999

(*Chrotogale owstoni*) are other important species known to inhabit the forests of Ba Be and Na Hang. These forests also protect a large area of water catchment on the Gam river, which drains to the Red River and supplies water to thousands of people.

The problem. Although once widespread in Vietnam and Southeast China, the tropical limestone forest has been reduced to small and fragmented pockets, primarily due to the incidence of agriculture and land conversion. Other threats to biological diversity include timber exploitation, wildlife hunting, and the unsustainable harvest of minor forest products. Forest degradation depletes natural resources of great importance to local communities, including water quality and soil. Land-use planning for integrated nature conservation and socio-economic development is a relatively new concept in Vietnam. Closely associated with the objective of sustainable land use and biodiversity conservation is the need to harmonize community needs and expectations with the maintenance of local ecosystems.

Project interventions. In 1999, a Protected Area Resource Conservation project (PARC) was launched to reconcile socio-economic development and conservation needs in Ba Be and Na Hang. The strategy was based on four key programmes: conservation management; conservation awareness and ecotourism; community development; and resource use planning and forestry. The project identified a number of potential land uses on the basis of information collected through Participatory Rural Appraisals, Village Development Planning and agriculture and forestry experts and partners. This information was complemented with information generated by the project's Geographical Information System (GIS). Detailed land use and vegetation maps have been produced from digital data and stakeholder experiences, showing spatial links between human and natural land uses. In addition, common boundaries between lands used for agriculture, forestry and nature conservation have been defined to facilitate the enforcement of Government land-use policies and to support biodiversity conservation activities.

Results. Local community participation in protected area management, including involvement in the process of zoning core and buffer areas and increasing awareness of the rationale for conservation facilitated consensus on land management issues. It is hoped that this will lead to realistic decisions on the trade-offs between conservation and development. The GIS will assist in the decision-making process for conservation management interventions as well as in supporting long-term strategic planning for the protected areas and adjacent landscapes. In order to monitor project impact, and to assist protected area management, a biophysical, administrative, and socio-economic database is being put in place. For example, biological attributes such as forest cover are monitored to determine changes and opportunities for conservation. The impact of PARC project socio-economic development interventions is also being monitored, particularly in villages within and adjacent to the protected areas. An assessment of change against an established baseline is currently underway (summer 2002). The PARC Project is also collecting and updating biophysical, ecological, cultural and socio-economic data for collation within a specialized database monitoring system.

Example 6. Ecoforestry in the Solomon Islands[8]

The problem. In the Solomon Islands, a dire national financial crisis has left timber by far the most important source of revenue and pressurized the Government to turn a blind eye to illegal

[8] Lawler, 2003

logging. Besides natural resources degradation, indigenous forest owners were facing the threat of widespread industrial logging and the destruction of their communities.

Project interventions. In 1993, and at the request of indigenous forest owners, the Solomon Islands Development Trust, Greenpeace Australia-Pacific and the Imported Tropical Timber Group of New Zealand jointly launched an ecoforestry project. The project's objective was to strengthen the quality of village living through conservative and sustainable utilization of the nation's forest wealth. Since 1995, the ecoforestry programme has trained 56 land-owning groups and consistently provides extension support services and monitoring to eco-timber producers. The programme's marketing arm, Village Eco-Timber Exporters, links village producers to overseas customers and acts as a direct selling agent for trained eco-timber producers in the Solomon Islands. VETE was set up in 1996 to handle, grade, bundle and export the increasing volumes of eco-timbers. VETE has developed strong market relationships with New Zealand and Australian-based timber merchants who have agreed to pay a premium price on all eco-timbers sourced from well-managed indigenous forests. In its first three years of operation, VETE exported 1 800 cubic meters of freshly milled eco-timbers, which brought a total net profit of SBD$3.21 million (US$466 000) to the local communities.

Results. Although 1999-2002 was seen as the most difficult period in the nation's history due to the violent ethnic conflict on Guadalcanal, most eco-timber producers in other provinces increased their production volume by almost 80 percent and there was a steep increase in overall eco-timber production. Participating communities have been encouraged to build their own houses using timbers that do not meet export grade standards. This improves housing in their villages. Cash income from timber sales has also been used to develop other areas such as water supply and sanitation, transport, schools, health and home gardens, which is helping to raise the health and nutrition of villagers.

The most important benefit of the eco-forestry programme is the re-emergence of the traditional communal approach of villagers working together. "Better understanding and good relationships between members in the communities is increasingly harmonious," according to Geoffrey Dennis, of the Solomon Islands Development Trust Eco-forestry Unit. "This makes people to be more responsible for their own lives. Ecoforestry projects have been successful in providing an alternative solution to large-scale foreign-owned logging operations in the Solomon Islands and more people are becoming aware of the benefits ecoforestry provides."

The success of the Solomon Islands ecoforestry programme highlights the distinct advantages of small/medium-scale village enterprises that directly benefit the people, their community and their land. In contrast with large-scale industrial enterprises, small-scale enterprises tended to produce benefits for a majority of the people involved. While the immediate economic benefits are not always great, over a period of three to four years, families and villages are seeing an incremental and continuous trickle of benefits. With good management, they realize they can provide themselves with consistent income improvement. A major benefit reported by all people involved in these small-scale enterprises is a sense of advantage over people who sold their logging rights. They are highly aware of the need to retain their basic resources and what the loss of those resources might mean having seen the outcomes in logged villages.

At the consumer end of the market, the Solomon Islands eco-timber is of excellent quality (ideal for furniture and joinery) and has reputable “chain of custody” credentials. In fact, The Woodage is the first accredited Australian timber merchant to supply timber certified according to the Forest Stewardship Council guidelines. Eco-forestry certified products guarantee the authenticity of the original source of the timber and ensures that the timber comes from well-managed forests that meet agreed global standards.

Example 7. Eco-organic holiday farms in protected areas of Italy[9]

In Italy, organic farmers in or near protected areas often supplement their income with ecotourism and environmental education activities. In the last ten years, 300 organic farms have been offering educational activities to school children or other groups. Three types of organic educational farms can be identified: open farms (where farmers offer on-farm tours to visitors, explaining the environmental rationale behind production activities); educational farms (visitors are involved in production and processing activities); school farms (green weeks are offered to engage visitors in educational activities, both on-farm and in neighbouring farms and education curricula cover agriculture, nature conservation and cultural issues). The national network of educational farms allows exchange of experience, common promotion, adherence to common basic requirements (a quality chart is signed by participating farmers) and development of common didactic tools (e.g. posters, leaflets)[10]. Two cases are presented below, describing the contribution of organic farm-related education and ecotourism to rural employment, maintenance of agricultural lands and threatened agricultural diversity and conservation of wildlife ecosystems.

Parco Rurale Alture di Polazzo. The Carso area is a peculiar calcareous mountain environment, surrounding the Trieste gulf and linking Italy to Slovenia. Historically, the area was devoted to pasture (cows and sheep). The Carso area was almost completely abandoned up to the 1970s because it was subjected to military use (the border to Yugoslavia, now Slovenia, is a few kilometres away). In the last 30 years, the area was further abandoned due to high economic competition of non-agricultural activities and management difficulties. Land abandonment allowed forest to occupy pasture areas, resulting in important losses of botanical species proper of pastures.

Now that military servitude has been removed, the area is gaining the interest of the tourism and agricultural sectors. For several decades, the Parco Rurale Alture di Polazzo was the only farm of the area. The farm is partially included in the Natural Reserve of Landa Carsica and there are several protected areas in the farm vicinity.

The farm of Parco Rurale manages 98 hectares of land, which include 18 km of hiking tracks. Walks inside the farm recall several historical memories, from the Venice Republic of the 1500s (that introduced sumac - *Rhus L.* - shrubs used for wool dying) to the first World War (pieces of weapons can be easily found).

The dry and bare Carsic land offers pasture to 20 cows (Pezzata Rossa breed), 96 sheep (Carsolina breed), 14 donkeys (including some Amiata breeds) and 15 beehives. All animals are reared together in order to optimize pasture use and keep weeds under control. In the past, different animal species grazed on the pasture in different times: cows, then sheep and lastly

[9] Information provided by Micheloni, Cristina, AIAB, 2003
[10] A list of participating farms and more information on the activities can be found at: www.aiab.it/sitonuovo/

horses and donkeys. The now contemporary grazing creates more synergy. Furthermore, the organic extensive husbandry adopted allows animals to live much longer than in conventional systems: according to official records, the oldest Italian cow (20 years old) lives there.

Besides lamb and beef meat production, vegetables are grown in the valley for local consumption. The farm offers accommodation in eight rooms and a camping site: 10 000 tourists visit the farm annually, as well as 2 000 students that receive on-farm education, by the farmer's family. Didactic activities include farming operations (e.g. vegetable growing, honey production, animal keeping), nature observations (e.g. trekking to natural reserves, bird-watching) and history education (particularly on the World War I which locally implied long-lasting fighting). The kind of “informed” tourism offered by the farm appeals people sensitive to nature conservation and this, in turn, allows profitable farm activities.

The farm’s positive contribution to the area biodiversity includes:

- maintaining pasture ecosystems and preserving them from reforestation;
- rebuilding the typical Carsic lakes for animal watering hence, creating “wetlands” that allowed the recovery of local botanical species and birds;
- improving soil biodiversity through organic cattle grazing thus, avoiding contamination from conventional veterinary drugs;
- increasing awareness on biodiversity through education of visitors.

Organic Bergamot in the vicinity of Aspromonte National Park. The Bergamotto farm is located in Amendolea di Condofuri (Reggio Calabria Province), on the coastal hills bordering the Aspromonte National Park. This area is rich in history, including ancient Greek vestiges, and tourism activities strongly compete with agriculture, which is on the decline. Agricultural lands are replaced by unmanaged woodlands.

In the area, the main cultivations are olive trees and arable crops on steep slopes and vegetables and citrus groves on the flat valley bottom. The particularity of the citrus groves is bergamot: worldwide, only 2 000 hectares of Bergamot exist, all around the Reggio Calabria Province. Bergamot (*Citrus aurantium var. bergamia*) is a citrus of unclear origin: it may have come from the Middle East or have resulted from a mutation of oranges or lemons. Bergamot used to be important for essential oils extraction that was utilized in perfume production. In the last 20 years, however, essential oils have been replaced by synthetic substances, causing the substitution of many hectares of bergamot by other citrus crops (oranges or tangerines).

On the Bergamotto organic farm of 24 ha, almost 4 ha are devoted to bergamot growing, half of which have been renewed recently thanks to European Union (EU) funding. Currently, the produce is sold to the conventional perfume sector but a local group of organic bergamot producers intends to set up a specific processing facility in order to give a higher value to their products.

The re-valorization of bergamot and natural oils enhanced the role of organic agriculture in maintaining an ancient and disappearing crop and its protected area environment. The creation of trekking paths for tourists preserved these areas from becoming dumping sites and sustainable tourism-related activities enhanced rural people motivation for landscape quality and typical rural architecture.

The Bergamotto is also an eco-organic holiday farm and the farmer is involved in tourism activities. Acting as a guide, the farmer offers a wide range of opportunities that sensitize visitors to the local natural and cultural patrimony. Activities include trekking in the Aspromonte Park with accommodation in typical rural houses (masserie), testing and preparation of typical local food and participation to local cultural events. The Bergamotto farm induced, through its activities, the creation of a network of collaborating holiday farms, bed-and-breakfast and artisans. This is actively counter-balancing the trend of land and village abandonment.

References

AIAB 2001. Towards a Sustainable Tourism in Rural Areas. Ecotourism Moldules. Associazione Italiana per l'Agricoltura Biologica (AIAB), Programme Leonardo da Vinci: Action Plan for the Implementation of a Professional Training Policy for the European Union, 1995-1999.

AIAB 2003. Agritourismi Bioecologici. Associazione Italiana per l'Agricoltura Biologica, Italy. www.aiab.it/agriturismi/

Altieri, Miguel 1999. The Ecological Role of Biodiversity in Agro-ecosystems. Agriculture, Ecosystems and Environment no. 79.

Altieri, Miguel 2001. The Ecological Impacts of Agricultural Biotechnology. Action Bioscience. http://www.actionbioscience.org/

Allen-Wardell, *et al.*, 1998. The Potential Consequences of Pollinator eclines on the Conservation of Biodiversity and Stability of Food Crop Yields. Conservation Biology, 12 (1).

Benton, T.G., Vickery, J.A. & Wilson, J.D. 2003. Farmland Biodiversity: Is Habitat Heterogeneity the Key? *In*: Trends in Ecology and Evolution 18(4), 182-188.

Borrini-Feyerabend, G. (ed.) 1997. Beyond Fences: Seeking Social Sustainability in Conservation, IUCN. http://www.iucn.org/themes/spg/Files/beyond_fences/beyond_fences.html

Brown, Martha 1999. Buffer Strips Help Protect Watershed Health. The Cultivar. Volume 17, No. 1: Winter/Spring 1999. UC Center for Agroecology and Sustainable Food Systems. http://zzyx.ucsc.edu/casfs/index.html.

Bugg, Robert L and Trenham, Peter C. 2003. Agriculture Affects Amphibians *In*: Climate change, Landscape-scale Dynamics, Hydrology, Mineral Enrichment of Water. Sustainable Agriculture, vol. 15, no.2., summer 2003. http://www.sarep.ucdavis.edu/newsltr/v15n1/sa-6.html

Bugg, Robert L. and Picket, Charles H. (eds) 1998. Enhancing Biological Control: Habitat Management to Promote Natural Enemies of Agricultural Pests. University of California Press.

California Rice Commission 1997. Special Status Wildlife Species Use of Cultivated Lands in California's Central Valley. Californian Rice Commission. http://www.calrice.org/environment/special-status/index.html

Carpenter, Stephan, Caraco, Nina F., Correll, David L., Howarth, Robert W., Sharpley, Andrew and Smith, Val H. 1998. Nonpoint Pollution of Surface Waters with Phosphorus and Nitrogen. Issues in Ecology 3. Ecological Society of America. www.esa.org/issues.htm

Christina Vakali 1999. Possibilities and Limits of Reduced Primary Tillage in Organic Farming. http://www.iol.uni-bonn.de/english/projekte/Projekt%20CV_e.htm

CIFOR 2003. Certifying the Little Guys. POLEX:CIFOR's Forest Policy Expert Listserver. www.cifor.cgiar.org/

Costello, Michael 1999. Native Grass Species for Use as Perennial Cover Crops in San Joaquin Valley Vineyards. Final Report. Sustainable Agriculture Research and Education Program. http://www.sarep.ucdavis.edu/grants/Reports/Costello/costello97-07.htm

Damiani, Octavio 2001. Organic Agriculture in Costa Rica: the Case of Cacao and Banana Production in Talamanca. Office of Evaluation and Studies, International Fund for Agricultural Development (IFAD), Rome.

Department for Environment, Food and Rural Affairs (Defra) 2003. Agriculture and Biodiversity. http://www.defra.gov.uk/.

Dudley, Nigel and Sue Stolton 1998. Protected Areas for a New Millennium: the Implications of IUCN's Protected Area Categories for Forest Conservation. Joint WWF/IUCN Discussion Paper, January 1998.

Edge, Daniel 2000. Wildlife and Agricultural Ecosystems. Department of Fisheries and Wildlife, Oregon State University. http://oregonstate.edu/instruct/fw251/notebook/agriculture.html

El-Hage Scialabba, N., Grandi, C., Henatsch, C. 2003. Organic Agriculture and Genetic Resources for Food and Agriculture. *In:* Biodiversity and the Ecosystem Approach in Agriculture, Forestry and Fisheries. Proceedings of the satellite event held on the occasion of the 9th Regular Session of the Commission on Genetic Resources for Food and Agriculture, FAO, Rome 12-13 October 2002. http://www.fao.org/docrep/005/AC784E/AC784E00.htm

Environment Canada 2002. Nitrate Pollution: An Unseen threat to Amphibian Populations. http://www.on.ec.gc.ca/wildlife/factsheets/nitrate-e.html

Environment Canada 2003. Annual Report: http://www.ec.gc.ca/regeng.html

European Preparatory Conference 2002, Ecotourism in Mountain Areas: a Challenge to Sustainable Development. Salzburg, Austria, 12-15 September 2001. International Year of Ecotourism and the International Year of Mountains.

FAO 2002. Organic Agriculture, Environment and Food Security. El-Hage Scialabba Nadia and Hattam Caroline (eds.). Environment and Natural Resources Series 4. Food and Agriculture Organization of United Nations. http://www.fao.org/DOCREP/005/Y4137E/Y4137E00.htm

FAO/UNEP 1999. Proceedings from the International Technical Consultation: Protected Area Management and Sustainable Rural Development. Harare, Zimbabwe, 26-29 October1999.

Flint, Mary Louise 1998. Pests of the Garden and Small Farm: A Growers Guide to Using Less Pesticides 2nd edition. University of California Press.

Nature Conservancy, 1997. Talamanca Sweet Success. January-February 1997.

GEF, 2002. Biodiversity Conservation in Cocoa Agroforestry. www.gefweb.org/Documents/Medium-Sized_Project_Proposals/MSP_Proposals/COSTA_RICA_Cacao.pdf

GEF, 2002b. El-Salvador: Promotion of Biodiversity Conservation. Medium-Size Project Brief. www.gefweb.org/operport/msp/elsalva.doc

Gliessman, Stephan R. 1999. Agroecology: Ecological Processes in Sustainable Agriculture. Ann Arbor Press 1999.

Greenberg, R., 1994; Smithsonian Migratory Bird Center. *In*: Rice, R. and Ward, J., 1996.

Hilty Jodi *et al.* 2002. Wildlife Activity Along Creek Corridors. Department of Environmental Science, Policy and Management, University of California, Berkeley.

Ibanez, Carles 1999. Integrated Management in the Special Protected Area of the Ebro Delta: Implications of Rice Cultivation for Birds. Proceedings from the Conference on the Councils Directive on the Conservation of Wild Birds. 20 years with the EC Birds Directive. Elsinore Denmark 18-19 November 1999.

Ibarra-Nunez, 1990. *In*: Perfecto *et al.*, 1996

IFOAM 2002. IFOAM Basic Standards for Organic Production and Processing. http://www.ifoam.org/standard/norms/ibs.pdf

Imhoff, Daniell 2003. Farming With theWild: Enhancing Biodiversity on Farms and Ranches. Island Press. Covelo, Ca. USA.

International Network for Environmental Compliance and Enforcement (INECE) 2002. Conservation Easements: Proceedings from the 6th International Conference on Environmental Compliance and Enforcement: Inaugurating a millennium of implementation and enforcement of environmental law. San Jose, Costa Rica. April 14-19, 2002.

Iowa State University Forestry Extension (ISU) 2001. Buffer Strips for Riparian Zones. http://www.forestry.iastate.edu/ext/buffstrips.html

IUCN. 2002. Parks. Vol 12, no. 2, Local Communities and Protected Areas. Protected Area Programme of the World Conservation Union.

IUCN 1994. Guidelines for Protected Area Management Categories. www.wcpa.iucn.org/

Kegley, Susan; Neumeister, Lars and Martin, Timothy 1999. Disrupting the Balance. Pesticide Action Network of North America. http://www.panna.org/resources/documents/disrupting.pdf

Lacche, Federico, 2000. Guide to Eco-organic Holiday Farms: Agrotourism Enterprises Certified and Classified by the Italian Association of Organic Agriculture According to Environmental Quality Criteria. Guides of Nature and Health.

Lawler, Virginia 2003. Can Ecoforestry Replace Logging? http://www.pacificislands.cc/pm82003/pmdefault.php?urlarticleid=0014

Landis, Douglas A.Wratten, S.D. and Gurr, G.M. 2000. Habitat Management to Conserve Natural Enemies of Arthropod Pests in Agriculture. Annual Review of Entomology. 45:175-201.

Le Coeur D., Baudry J., Burel F. and Thenail C. 2002. Why and How we Should Study Field Boundary Biodiversity in an Agricultural Landscape Context. Agriculture Ecosystems and the Environment 89: 23-40.

LLAF, 1996. Linking Land and Future Farmers. Growing Food on Someone Else's Land: a Resource Guide for Landowners and Landseekers.

Mader, Paul *et al.* 2002. Soil Fertility and Biodiversity in Organic Farming. *In:* Science. 296: 1694-1697.

Mallet, Patrick 2001. Conservation Principles for Coffee Production. In collaboration with Conservation International, Consumer's Choice Council, Rainforest Alliance, Smithonian Migratory Bird Center, with funding from the Summit Foundation. Falls Brook Centre, 25 May, 2001.

Magdoff, Fred and Van Es, Harold 2000. Building Soils for Better Crops Second Edition. Sustainable Agriculture Network. Sustainable Agriculture Publications. Berlington, VT, USA.

McNeely, Jeffrey A. and Scheer, Sara J. 2001. Reconciling Agriculture and Biodiversity: Policy and Research Challenges of 'Ecoagriculture'. World Summit on Sustainable Development 2002. UNDP\IIED. http://www.undp.org/equatorinitiative/pdf/ecoagriculture.pdf

McNeely, Jeffrey and Scherr, Sara 2003. Ecoagriculture: Strategies to Feed the World and Save Wild Biodiversity. Future Harvest and World Conservation Union (IUCN). Island Press.

Mississippi Fish and Wildlife Foundation 2003. Food Plots in Mississippi: Supplementing the Nutritional Needs of Wildlife.

Naiman, Robert *et al.* 1993. The Role of Riparian Corridors in Maintaining Regional Biodiversity. Ecological Applications 3 (2).

Naspetti, S., Segale, A. and Zanoli, R., 1999. The National Holiday Farm Demand: Results of a Practical Survey. *In*: Evaluation of the Territory, no. 11-1999, Edagricole, Bologna.

Parrish, J., Reitsma, R., Greenberg, R. 1999. Cacao as Crop and Conservation Tool: Lessons from the Talamanca Region of Costa Rica.

Perfecto, Ivette, *et al.* 1996. Arthropod Biodiversity Loss and the Transformation of a Tropical Agroecosystem. Biodiversity and Conservation 6:935 – 945.

PARC 1999. Protected Area Resource Conservation Project (PARC) of the Government of Vietnam/ UNDP Vietnam. http://www.undp.org.vn/projects/vie95g31/index.htm

Rainforest Alliance 2000. Models of Sustainable Development: Coffee Farmers in El Salvador Conserve Biodiversity. www.rainforest-alliance.org

Reitsma, R., Parrish J.D., McLarney, W. 2001. The role of Cacao Plantations in Maintaining Forest Avian Diversity in Southeastern Costa Rica. *In:* Agroforestry Systems 53:185-193. Kluwer Academic Publishers, Netherlands.

Rice, Robert A. and Justin R. Ward 1996. Coffee, Conservation and Commerce in the Western Hemisphere: How Individuals and Institutions Can Promote Ecologically Sound Farming and Forest Management in Northern Latin America. Smithsonian Migratory Bird Centre. Natural Resources Defence Council. Washington DC.

Scherr, Sara J. 2002. Ecoagriculture Partners. IUCN and Future Harvest Leaflet. Sscherr@futureharvest.org

Scottish Executive 2003. Action for Scotland's Biodiversity: Boundary Features and Hedgerows. http://www.scotland.gov.uk/library3/environment/afsb-09.asp

Settle, William 2003. Ecosystem Management in griculture: Principles and Application of the Ecosystem Approach. *In*: Biodiversity and the Ecosystem Approach in Agriculture, Forestry and Fisheries. Proceedings of the satellite event held on the occasion of the 9th Regular Session of the Commission on Genetic Resources for Food and Agriculture. FAO, Rome 12-13 October 2002.

Smeding, F.W., Joenje W. 2000. Farm-Nature Plan: Landscape Ecology Based Farm Planning. Landscape and Urban Planning 46:109-115.

Soil Association 2000. The Biodiversity Benefits of Organic Farming. Soil Association/WWF – UK. http://www.soilassociation.org/web/sa/saweb.nsf/9f788a2d1160a9e580256a71002a3d2b/67bff1084a5b1d0880256ae50039d8cb/$FILE/Biodiversity%20Report.pdf

Solis Rivera V., Madrigal Cordero P., Ayales Cruz, I. and Fonseva Borràs M. 2002. The Mesoamerican Biological Corridor and Local Participation. *In*: Parks, Vol 12, no. 2, IUCN.

Stolton, Sue (ed). 1999. The Relationship Between Nature Conservation, Biodiversity and Organic Agriculture. IFOAM/ IUCN. http://www.iucn-ero.nl/whatsnew_files/pdf/ifoam.PDF

Stolton, Sue 2002. Organic Agriculture and Biodiversity. IFOAM Dossier 2. http://www.ifoam.org/dossier/biodiversity.pdf

Stolton, Sue and Geier, Bernward 2002. The Relationship Bewteen Biodiversity and Organic Agriculture: Defining Appropriate Policies and Approaches for Sustainable Development. *In*: High Level Pan-European Conference on Agriculture and Biodiversity: Towards Integrating Biological and Landscape Diversity for Sustainable Agriculture in Europe, Strasbourg, 4 March 2002. STRA-CO/AGRI (2001)3. UNEP, Council of Europe, Government of France. www.strategy\agriculture\conference\docs\agri03e.01

Sustainable Agriculture Network 2001. Managing Cover Crops Profitably. Sustainable Agriculture Network. Sustainable Agriculture Publications. Burlington, VT ,USA

Tugel, A., A. Lewandowski, D. Happe-vonArb (eds.) 2000. Soil Biology Primer. Revised edition. Ankeny, Iowa: Soil and Water Conservation Society.

United States Department of Agriculture 2002. Wildlife Services: The Facts About Wildlife Damage Management. USDA Animal and Plant Health Inspection Services. http://aphisweb.aphis.usda.gov/ws/introreports/factsaboutWDM.pdf

US EPA 1997. Environmental Protection Agency Special Report on Endocrine Disruption. http://www.epa.gov/ORD/WebPubs/endocrine/factsheet.pdf

US Geological Survey (USGS) 1998. Agricultural Non-point Pollutant Loading Patterns in Upper Mississippi River Watersheds: http://www.umesc.usgs.gov/reports_publications/psrs/psr_1998_12.html

Vandermeer, J. 1989. The Ecology of Intercropping. Cambridge University Press, Cambridge, England.

WHO/FAO 2001. Codex Alimentarius guidelines for Organically Produced Foods. GL 32-1999, Rev. 1 – 2001. http://www.fao.org/DOCREP/005/Y2772E/Y2772E00.HTM

Wild Farm Alliance (WFA) 2003. Briefing Papers: Agricultural Cropping Patterns: Integrating Wild Margins. www.wildfarmalliance.org

Wood, Stanley Sebastian, Kate and Scherr, Sara J. 2000. Pilot Analysis of Global Ecosystems: Agro-ecosystems. International Food and Policy Research Institute and the Worlds Resources Institute. http://www.wri.org/wri/wr2000/agroecosystems_page.html

WEHAB 2002. A Framework for Action on Biodiversity and Ecosystem Management. The WEHAB Working Group, August 2002.

WWF 1999. Beneficial Bugs at Risk From Pesticides. http://www.wwf.ca/satellite/prip/resources/bugs-at-risk.pdf

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