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Carbon, Forests and People

Towards the integrated management of carbon sequestration, the environment and sustainable livelihoods

UNEP

IUCN
The World Conservation Union

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Carbon, Forests and People

Towards the integrated management of carbon sequestration, the environment and sustainable livelihoods

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IUCN – The World Conservation Union
2002

IUCN's Forest Conservation Programme

IUCN's Forest Conservation Programme coordinates and supports the activities of the IUCN Secretariat and members working with forest ecosystems. The goal of forest conservation is achieved through promoting protection, restoration and sustainable use of forest resources, so that forests provide the full potential range of goods and services.

The programme makes contributions to policy at various levels and uses field projects to derive lessons to feed into the policy debate. The principles of *Caring for the Earth*, published jointly by IUCN, WWF and UNEP in 1991, are applied to these projects, which combine the needs of conservation with those of local communities. One major activity is to develop coherent and informed policies on forest conservation in order to advocate the translation of policies into effective actions. IUCN frequently advises major development institutions on forest issues, to ensure that conservation priorities are adequately addressed in their projects and programmes.

Contents

Boxes

Figures

Tables

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Preface

Mitigating the impact of climate change presents governments and communities throughout the world with one of the main environmental challenges of our times. Most scientists agree that the planet is warming at a faster rate than at any other time in the last 10,000 years, and that this warming is caused by increasing amounts of carbon dioxide and other greenhouse gases in the Earth's atmosphere. The impact of global warming on people and nature is likely to be severe, particularly in developing countries, unless concerted action is taken to reduce greenhouse gas emissions. IUCN – The World Conservation Union, the United Nations Environment Programme (UNEP), the Institute for European Environmental Policy (IEEP) and the Swiss Organisation for Development and Cooperation (Intercooperation) welcome the adoption of the Marrakech Accords to the United Nations Framework Convention on Climate Change in 2001 as a step towards combating climate change.

Stabilising the level of greenhouse gas emissions in the Earth's atmosphere requires a sustained commitment by all governments. Significantly reducing emissions from energy-consuming sectors remains the most important undertaking for both governments and the private sector. Nevertheless, forestry and other land-use activities undertaken by governments, the private sector and communities can also make a contribution through carbon sequestration and reduction of greenhouse gases. Managing forests and other lands to retain carbon can have significant socio-economic and biodiversity-related effects. It is important to integrate carbon sequestration objectives with the goals of improving livelihoods and maintaining environmental services.

This publication provides an overview of the opportunities and challenges for carbon sequestration activities in the forestry and agricultural sectors of both industrialised and developing countries. It outlines a set of strategies and approaches seeking to ensure that forest and other land-use climate change mitigation measures deliver sustainable development benefits in an equitable and cost-effective manner.

We hope that this paper will be helpful to governments, indigenous peoples, community-based organisations, United Nations partners, private companies, non-governmental organisations, and other stakeholders involved in land-use change and forestry-based activities for the purposes of climate change mitigation. IUCN, UNEP, IEEP and Intercooperation look forward to working with all interested parties to further explore how climate change mitigation activities can be carried out in an environmentally sound and socially equitable manner.

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Executive summary

In the years ahead, the Kyoto Protocol will offer opportunities for improving environmental and social conditions in many landscapes throughout the world. It will also pose challenges; planned activities under the Protocol must be implemented carefully to avoid potential negative impacts. This publication reviews the environmental and social impacts of forestry and land-use activities for the purposes of carbon sequestration, and describes approaches to address these impacts within the context of sustainable development.

Industrialised countries, as outlined in the Protocol, may partly offset their domestic carbon dioxide (CO_2) emissions through afforestation, reforestation, revegetation, cropland and grazing land management projects and activities. Developing countries, on the other hand, are only eligible to implement afforestation and reforestation projects.

If land-use activities under the Kyoto Protocol are to make a positive contribution to sustainable development, it is critical that they provide broad socio-economic benefits to all communities, both local and indigenous, as well as ensure that traditional access and use rights are respected and maintain or enhance ecosystem integrity. One of the best opportunities for delivering environmental and social benefits in both industrialised and developing nations is through active regeneration of native tree species on land that was historically forested.

In industrialised countries, environmentally sound carbon sequestration activities in existing forests can be facilitated by encouraging longer rotations, practising selective harvesting and reduced impact logging, and by utilising other ecologically sensitive forest management practices. Restoring or setting aside degraded landscapes and implementing conservation tilling and erosion control practices on cropland and grazing land can also benefit the environment. Some of these practices, however, may require social trade-offs, such as reduced employment and income, in rural areas.

Carbon sequestration practices should not include the inappropriate use of alien invasive species for reforestation or the conversion of native grasslands and wetlands to industrial-scale carbon plantations. Both of these practices will have a negative impact on ecosystem integrity, will degrade ecosystem goods and services, and will contribute to a loss in local or even global biodiversity. There are other practices that aim at maximising carbon sequestration but risk forest degradation and diminished environmental quality. They include the manipulation of natural or established fire regimes, excessive application of fertilisers and pesticides, thinning to reduce the number of forest species, and other intensive land-management practices based on the simplification of forest structure. While the Kyoto Protocol and the Marrakech Accords refer to the importance of ensuring that carbon sequestration activities contribute to the objectives of the Convention on Biological Diversity (CBD), they do not explicitly exclude these practices.

Carbon sequestration can be carried out on a project basis and traded through market mechanisms established by the Kyoto Protocol. Project-based trading requires several technical considerations, including a project baseline and determining whether a project does in fact bring an increase in greenhouse gas benefits (known as additionality). Projects must also account for project leakage (the unanticipated decrease or increase in greenhouse gas benefits outside the project's boundary) and the durability of emission reductions. Ensuring that these factors have been considered helps determine whether a project will result in measurable and long-term emission reduction. The environmental and social context of forest and land-use carbon sequestration projects are key in determining the long-term success of such projects.

The global market for carbon credits from forest and land-use projects in developing countries is likely to be limited in future years, although the market does provide opportunities for implementing projects that restore forests and reintegrate trees into the landscape. Additional income from carbon credits can make forest landscape restoration and agro-forestry projects financially attractive but current patterns of foreign direct investment and transaction costs may encourage a market emphasis on large-scale single species plantations.

There is a perception that including environmental and social considerations in carbon sequestration activities will raise transaction costs. While this

might be true in some cases, fully addressing these issues in project design and implementation can minimise risks. It is also in the interest of project developers, buyers and sellers to consider the environmental and social impacts of projects, since projects that cause social conflict or environmental degradation may have less durability and, therefore, a lower market value.

Environmentally sound and socially equitable climate change mitigation projects in the forestry and land-use sectors will require a strong enabling context at the national and international level. This includes effective institutions, proactive environmental policies and regulations and clear legal frameworks. Successful carbon sequestration projects and activities can be encouraged by integrating them into existing land-use planning, environment, development, and financial policy processes. Tools and approaches such as impact assessments and safeguards are available to ensure that environmental and social issues are integrated efficiently and fairly into project planning, implementation and evaluation.

This is a pivotal time for the international community to address global warming through carbon sequestration activities. The emergence of markets for carbon credits creates new opportunities to generate value from ecosystem services. We should aspire to learn from the mistakes of the past to avoid perpetuating a purely sectoral approach to carbon sequestration. Market participants, from buyers and sellers to project developers, financial institutions and communities, can take steps to deliver environmentally sound and socially beneficial outcomes of climate change mitigation projects motivated by the Kyoto Protocol.

Introduction

In 2001, governments throughout the world made a broad political commitment to address climate change. The Marrakech Accords to the United Nations Framework Convention on Climate Change (UNFCCC) were adopted after several years of extensive negotiation. Through these accords, governments agreed on a set of rules for implementing commitments under the Kyoto Protocol to reduce greenhouse gas emissions over the subsequent decade.

A number of forestry and land-use initiatives were included in the Kyoto Protocol as a result of the Marrakech Accords. They were recommended as ways to facilitate carbon sequestration in the face of climate change, and include afforestation, reforestation and deforestation, as well as revegetation and management of forest, cropland and grazing land. A group of 39 industrialised countries, called Annex I Parties, can use these activities to partly offset their emissions during the first commitment period of the Kyoto Protocol from 2008 to 2012.[1] Activities can also be implemented jointly on a project basis among industrialised countries; the resulting emission reduction credits can subsequently be traded among those countries.

Afforestation and reforestation projects are allowed in developing countries, although these countries have no commitment to reduce emissions. Carbon credits from such projects can be traded with industrialised countries under the Clean Development Mechanism (CDM). The number of these projects is limited by the Marrakech Accords. Detailed rules for afforestation and reforestation projects under the CDM, including specifications on baselines, additionality, leakage and socio-economic and environmental impacts, will be adopted in late 2003.[2]

Since the adoption of the Kyoto Protocol in 1997, the environmental and social implications of using forestry and land-use activities to mitigate climate change have been widely discussed. Some argue that valuing carbon sequestration over other ecosystem services will have a negative effect on the environment and people's livelihoods. Others, however, feel that establishing a market for carbon will create new incentives for improved environmental management and biodiversity conservation.

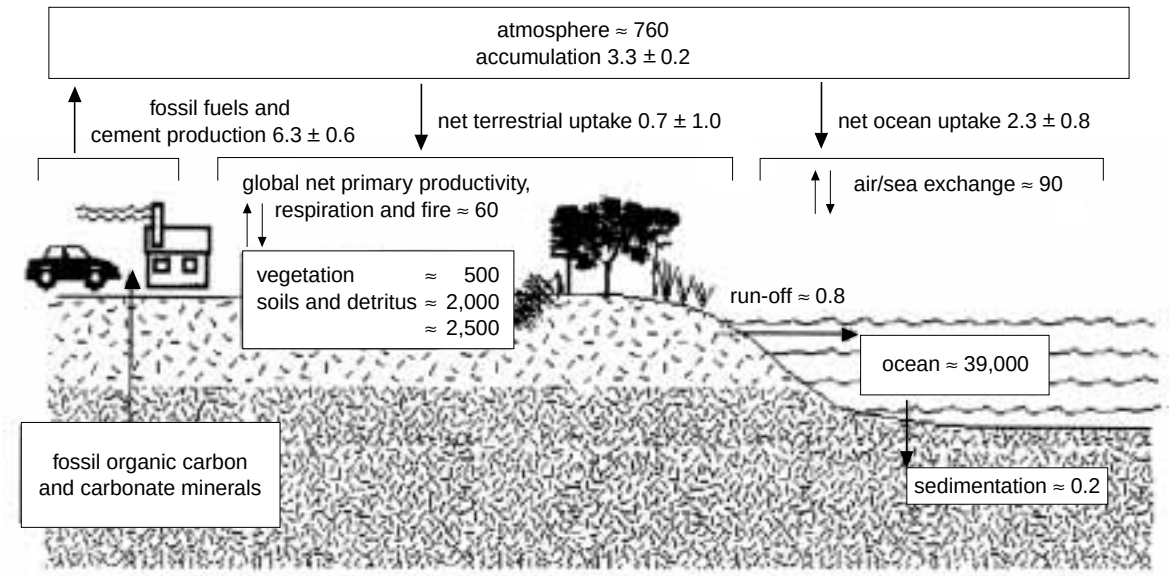
Parties to the UNFCCC are guided by the principle that forestry and land-use activities should contribute to biodiversity conservation and the sustainable use of natural resources.[3] They are also requested to abide by commitments under the Convention on Biological Diversity (CBD) and other relevant international environmental agreements related to sustainable forest management and agriculture.[4] They are further expected to minimise environmental degradation resulting from forestry and land-use activities through the use of strategies such as impact assessments.[5] Many international organisations, including IUCN – The World Conservation Union and the United Nations Environment Programme (UNEP), have highlighted the need for forestry and land-use activities administered under the Kyoto Protocol to be environmentally sound and socially equitable.[6]

Figure 1. Two Kayapo Indians on a trail bordered by medicinal plants in tropical rainforest, Amazonia National Park, Parà, Brazil. Mauri Rautkari, photographer, WWF-Canon.

Under the CBD, the Parties to the UNFCCC and the Kyoto Protocol are urged to ensure that future activities, including those targeted to carbon sequestration, are consistent with and in support of the conservation and sustainable use of biological diversity.[7] The CBD also encourages governments to explore ways by which incentive measures promoted through the Kyoto Protocol can support the objectives of the CBD.[8]

This publication reviews the environmental and social impacts of forestry and land-use activities relating to increased carbon sequestration and describes approaches to address these impacts. Section 1 assesses the potential impacts of these activities. Section 2 considers the opportunities and challenges for forest projects. Section 3 elaborates on strategies, methods and approaches available to address the synergies and trade-offs that may arise between climate change, environment and livelihood objectives. By drawing on the expertise and experience of IUCN, UNEP, IIEP, and Intercooperation, this paper seeks to show how the international community can avoid the mistakes of the past and encourage governments, private companies, NGOs, and local groups to design and implement forestry and land-use activities and projects that are environmentally sound and socially equitable. The conclusion, in Section 4, provides guidance about an enabling framework to achieve these results.

Figure 2. Carbon sinks and the carbon cycle



The global carbon cycle, showing the carbon stocks in reservoirs (in Gt C=10^{15}) and carbon flows (in Gt C yr^{-1}) relevant to the anthropogenic perturbation as annual averages, 1989-1998 (Schimel et al. 1996; Watson et al. 2000). Terrestrial ecosystems play an important role in the global carbon cycle. Around one-third of global anthropogenic carbon emissions in the past 150 years resulted from land-use change, namely forest clearing in the tropics and elsewhere. On an annual global basis, land-use change results in emissions of 1.6 ± 0.8 gigatonnes of carbon (Gt C). This accounts for around 25 per cent of emissions from fuel combustion and cement production. These and other findings were assessed by the UNEP/World Meteorological Organisation (WMO) Intergovernmental Panel on Climate Change (IPCC). Its Special Report, published in 2000, concluded that land use, land-use change, and forestry can contribute to the reduction of greenhouse gas emissions by avoiding deforestation and increasing carbon uptake through afforestation, reforestation and improved management of forests, crops and grasslands.

Section 1.
Environmental and social impacts

Section 1 reviews the environmental and social impacts of eligible forestry and land-use activities that can be employed to sequester carbon. These include afforestation, reforestation, deforestation, revegetation, and management of crop land and grazing land. Under the Kyoto Protocol, afforestation, reforestation and deforestation activities must be accounted for by industrialised country Parties on a national scale. Industrialised countries also have the option to account for revegetation, forest, crop and grazing land management. For operational purposes, Parties agreed on the definition of a forest and set a range for minimum land area, tree crown cover and tree height. Industrialised countries can adopt any definition of forest within these parameters, as long as it is consistently applied at a national level and is consistent with past use.[9] Each industrialized country is restricted to a specific number of carbon credits derived from forest management. Developing countries are only eligible to practice afforestation and reforestation activities under the Kyoto Protocol. While definitions exist for the use of forestry and land-use activities in industrialised countries, parties to the UNFCCC still need to develop definitions for afforestation and reforestation for use in developing countries.[10]

Afforestation and reforestation

Both afforestation and reforestation are defined by the UNFCCC as direct human-induced conversion of non-forested land back to forested land through planting, seeding, and/or the human-induced promotion of natural seed sources (see FCCC/CP/2001/13/Add.1, page 58). Afforestation can take place on land that has not been covered by forest for at least 50 years. Reforestation can occur on land that was historically forested but which as of December 31, 1989 was subject to another land use. An area of grazing land converted from forest 30 years ago would be reforested; 20 years from now forest planted on that land would fulfil the requirements of afforestation.

Both afforestation and reforestation can take place on naturally non-forested land, such as grasslands or peat land. Converting non-forested land to forests will have a range of effects on ecosystem services and species richness, depending on site conditions and methods and species used. Restoration of historically forested degraded lands, preferably using ecosystem-compatible native species, and employing ecologically sensitive techniques for ground preparation, planting, and management can help to optimise environmental benefits such as watershed protection and control of erosion and salinisation. It can also provide more livelihood options by generating additional income for local people (Box 1). Using tree plantations to reclaim severely degraded land can offer substantial benefits. Planting exotic trees as nurse crops can be a vital first step in the rehabilitation of natural forests.

Box 1 Krkonose and Sumava National Parks, Czech Republic

Acid rain from mining and industrial activities in the Czech Republic and former East Germany has led in the past 50 years to a significant death rate of trees in Krkonose National Park, Czech Republic (38,000 ha). Sumava National Park, also in the Czech Republic and the largest national park in Europe (55,000 ha), was severely damaged by inappropriate forest management 100 years ago. Starting in the mid-1990s, the Forests Absorbing Carbon Dioxide Emissions (FACE) Foundation has funded forest rehabilitation and reforestation activities in both areas. About 7,000 ha have been completely reforested and another 7,000 ha of forest gaps have been replanted, with an emphasis on mixed species. The parks will benefit ecologically from the recreation of a natural and stable forest. The work, involving more than 200 labourers and farmers, will likely increase recreation and tourism value in these areas. These restoration activities have a lifetime of 99 years and are expected to sequester some two million tonnes of carbon from the atmosphere (FACE Foundation 2000; IPCC 2000).

If ecological, climate, historical, cultural and site conditions are not considered when developing carbon sequestration strategies, afforestation and reforestation may have negative impacts on the environment, local communities and indigenous communities. Examples of how not to proceed include using species that are invasive, promoting industrial-scale, intensively managed monocultures, employing inappropriate management techniques on sensitive sites such as slopes or mountain catchments, and ignoring sacred cultural sites. Species for climate change mitigation activities and projects must be chosen carefully, as many of the characteristics of a good plantation tree (e.g. fast growing, wind-pollinated, high seed production) could make it an invasive species (Strahm and Rietbergen 1999; Binggeli 2001). Some invasive tree species consume large amounts of water; this lowers the water table, reduces water flow, and increases soil erosion.[11] Large-scale afforestation and reforestation activities within intact non-forest biomes (such as native grasslands, wetlands, or peatlands) will probably have a negative effect on ecosystem services and threaten endemic or endangered biodiversity.

The social implications of afforestation and reforestation activities will tend to be more prominent in developing countries. One of the main concerns is that land-use change, as may be required for development, will become too constrained if large tracts of land are locked up in contracts for carbon sequestration. In addition, for many communities the previous form of land use (e.g. cattle ranching) might provide more income. These issues are discussed in more detail in Section 2.

Figure 3. Mixed forest along the Golden Trail in Sumava National Park, Czech Republic. Michèle Dépraz, photographer, WWF-Canon.

Forest landscape restoration and agro-forestry are promising approaches to afforestation and reforestation that benefit many users. Forest landscape restoration can generate considerable environmental and socio-economic benefits. It is a framework that builds on a number of existing rural development, conservation and natural resource management principles and approaches. It helps restore many of the goods and services that enhance ecological integrity and provide tangible benefits to local people living in degraded or deforested landscapes. It differs from more conventional approaches, which tend to be limited to increasing tree cover, usually for a limited range of goods and services. Forest landscape restoration employs many technical approaches, including natural regeneration, tree planting and agro-forestry. In many settings, wood-lots, scrub, forest fragments and other natural vegetation can be restored to perform the main functions of a forest, on which households and communities rely for their livelihoods.

Agro-forestry is a system of mixing agricultural or horticultural crops and/or livestock with woody perennials. Integrating trees on farms into the wider agricultural landscape can improve the balance between food production, poverty alleviation and environmental management. Agro-forestry is practised in temperate as well as tropical regions, in arrangements varying from simple (e.g. scattered trees in and live fences around farmland) to complex (e.g. multistorey home gardens). It includes silvo-pastoral systems, urban agro-forestry and crop-fallow rotations. Agro-forestry is attractive to small-scale farmers, who can benefit from the income, products (fruits, vegetables, fodder, medicines, oils, nuts, fibres, fuel-wood and timber) and services (recycling of nutrients and soil protection) that it provides.[12] The Western Kenya Integrated Ecosystem Management project, implemented by the International Centre for Research in Agro-forestry (ICRAF), was designed to benefit small-scale farmers and will increase carbon storage in fallow vegetation and soils in combination with reduced tillage (ICRAF and UNEP 2000).

Deforestation

Converting forests to non-forests will typically decrease ecosystem function relating to water and nutrient retention, maintenance of micro-climatic

conditions, soil stability, forest product utilisation and plant and animal species richness. This is particularly true for marginal lands and sensitive systems such as upland catchments, montane slopes and mangroves. Converting forests to non-forests also produces greenhouse gas emissions.

In the context of the Kyoto Protocol, deforestation includes activities that started on or after 1 January 1990 and which will result in a debit to the national carbon account of an industrialised country. This is anticipated to create an indirect incentive for governments to regulate conversion of their forests to other land uses.

Most industrialised countries, however, have experienced a net increase in forested areas over the last two decades (FAO 2001). Declines in agricultural land-use and increases in reforestation subsidies have often caused a net increase in forested areas.

The Kyoto Protocol has no provisions to account for decline in forest quality, and so it may not be fully reflected in an industrialised country's carbon accounting framework. The Intergovernmental Panel on Climate Change (IPCC) is now developing definitions and a methodology for reporting on emissions from forest degradation. Governments will consider adopting these options in 2003.

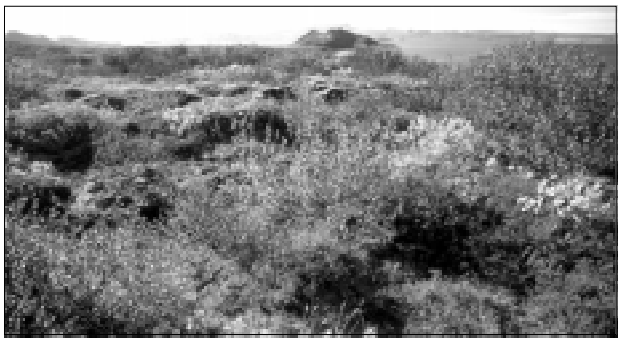


Figure 4. Original shrub landscape in southwestern Iceland. Peter Prokosch, photographer, WWF-Canon.

Box 2 Revegetation in Iceland

Unsustainable land use, combined with climate variation, has resulted in a loss of 95 per cent of woodlands and 50 per cent of vegetative cover since human settlement began in Iceland 1,100 years ago. Deserts now cover about 40,000 sq. km (about 40 per cent) of the country. Soil erosion and degraded vegetation is Iceland's most severe environmental problem; a further 10,000-15,000 sq. km of disturbed areas are characterised by reduced plant production and species richness (Arnalds 2002).

The Soil Conservation Service (SCS) has combated soil erosion and land degradation since 1907 through a variety of measures, including protection of land from grazing, seeding of grasses, and fertilisation. Restoring land quality and preventing further damage is a significant task in a nation of only 280,000 people. Additional incentives are needed to further this work.

Iceland may have lost at least 1.6 billion tonnes in organic matter CO_2 equivalents (460 million tonnes C) through land degradation and desertification in past years. This is 500 times greater than its current annual emissions of greenhouse gases. In 1995 the Icelandic government decided to link commitments under the Kyoto Protocol with the urgent need to restore land-based carbon resources. From 1997 to 2000, the country increased government funding for soil conservation, revegetation and re/afforestation efforts by more than 30 per cent. Carbon sequestration is now one of the country's main tools for meeting Kyoto Protocol commitments through Iceland's National Climate Change Action Program (2002). Restoration of soil fertility and biodiversity provide additional benefits.

Approximately 50 sq. km of denuded land was revegetated in Iceland in 2000, resulting in an annual carbon sequestration increase of 15,500 tonnes. In addition, land condition is improving and carbon sequestration is increasing in large degraded areas through better grazing management and protection of land from grazing. A large number of land users in Iceland currently participate in revegetation work, especially through a cooperative program called Farmers Heal the Land. There are many volunteers in soil conservation and reclamation forestry work.

Revegetation

Under the Kyoto Protocol revegetation for carbon sequestration is restricted to industrialised countries. It will most likely be used in regions with large areas of eroded or unused land, and in areas where pastoral grazing has been restricted on marginal agricultural land. As with afforestation and reforestation, re-establishing non-forest vegetation will affect ecosystem functions, biodiversity and socio-economic aspects (such as income) depending on the site, methods and species used (Box 2).

Restoring degraded non-forested lands, such as overgrazed native grasslands or cultivated wetlands, can enhance overall productivity, water quality and biodiversity and can reduce adverse effects such as wind and soil erosion or flooding. Revegetation can also help restore severely degraded land on the fringe of urban environments or in heavily mined areas. These lands require additional technical inputs, and extra costs are usually involved; however, additional income from the sale of carbon credits may make it worthwhile to restore land that would otherwise remain abandoned. Revegetation programmes for purposes other than carbon sequestration already exist, and may provide valuable lessons. The Conservation Reserve Program in the United States pays out about US$1.6 billion per year in incentives for farmers to replace marginal cropland with protective vegetative cover. This involved about 33 million acres in 1997.[13]

The use of aggressive colonising species, including high-productivity grasses, may have a negative effect, eliminating remnant native or endemic species or arresting natural successional processes. This may prevent further site recovery that would facilitate natural and diverse vegetation association. Fertilisation of grasslands is one of the major causes of biodiversity decline in ecosystems.

Forest management

Harvesting and regeneration

Harvesting involves the logging of a forest stand, and includes pre-commercial and commercial thinning either through selection-, group- or clear-felling. Typically, when native old-growth forests are harvested and replaced with intensively managed forests or plantations, there is an associated decline in the range of forest habitats, species richness and ecological function (i.e. nutrient cycling). The frequency and intensity of harvesting also affects the integrity, diversity and resilience of a forest area. Management practices, such as increasing rotation lengths, temporarily retaining mature trees (for coverage, seeding and habitat after the main harvest), and minimising site disturbance through reduced-impact logging, can be adjusted to address such concerns. Many of these are conventional forestry practices known to improve good forest stewardship and, at the same time, increase carbon stocks. Although short rotation harvesting systems generally result in higher net productivity of stands, they also tend to reduce overall carbon stocks through facilitating higher mineralisation rates.

Forest regeneration tends to take place soon after harvest and can be facilitated through natural or human assistance.[14] Regeneration practices will be determined by the conditions at the site. Paying attention to factors such as site preparation, species selection, planting density and, where appropriate, the retention of mature trees, coarse woody debris and open glades can all help to increase environmental benefits. Although monoculture stands tend to have much lower biodiversity value than natural forest during the early years of forest regeneration, this can subsequently be increased through thinning techniques that maintain or enhance a rich plantation understorey.

Fire management

Fires burn four to six million hectares (ha) of forest globally each year. In particularly dry years, such as 1997 and 1998, this figure can rise as high as 14 million ha. The manipulation of fire regimes, either natural or anthropogenic, can minimise burning of forest biomass, ultimately reducing greenhouse gas production.

Caution must be exercised, however; well-intentioned but poorly understood fire management strategies can produce devastating forest fires, increasing carbon loss and causing negative environmental and social impacts. In many temperate, boreal and tropical dry forest types, fire is a natural and integral part of ecosystem function. Near-complete exclusion of fire from such forests, as

practised in the United States for many years, can disrupt natural ecosystem regeneration, leading to a large build-up of fuel that can cause catastrophic fires under extreme weather conditions.

Restoring historical fire regimes can, under some circumstances, make an important contribution to sustainable forest management. Risks do exist, however, when the management context has changed. Different stand densities, rotation lengths or species composition in managed forests can mean that a particular fire regime is no longer suitable. Changing fire management practices can also invoke opposition from the local population because of the hazard fire poses to life and property. The risk of the accidental spread of fire is probably the most important obstacle to the more widespread application of pro-active fire management techniques such as prescribed burning (IPCC 2000).

Fertilisation and pest management

Extreme care should be exercised when adding nutrients to increase forest growth rates and hasten the accumulation of woody biomass important to carbon sequestration. Fertiliser run-off can cause eutrophication of freshwater systems, which results in significant local biodiversity loss and impaired ecosystem function. This in turn has a direct effect on rural livelihoods. Fertilisers also contribute to greenhouse gas emissions through production of nitrogen oxide emissions and decreased methane oxidation. Decision-makers will need to weigh the negative impacts of applying fertilisers on an area of land against the potential for carbon sequestration through increases in forest biomass.

Controlling pest populations through toxic chemicals, for the purpose of retaining biomass for carbon sequestration, can also result in many negative environmental effects. Standard applications of pesticides may pollute air, soil and groundwater and affect non-target species such as the predators of target organisms.

High costs, concerns about environmental impacts and uncertainties about effectiveness are the main reasons why both forest fertilisation and pesticide application should be limited. The existence of a market for carbon credits is unlikely to reduce the concern about these activities.

Cropland management

Agricultural intensification

Biodiversity loss is most likely to occur where carbon sequestration strategies replicate agricultural intensification. For example, the use of nitrogen-based fertilisers for agricultural intensification creates changes in soil properties that favour the dominance of a few species over many others. The use of genetically modified crops for agricultural intensification can produce unknown ecological effects. Alternatively, improved water management, integrated pest management (including low-intensity and selective use of pesticides, judicious use of organic and inorganic amendments, use of crop rotations and other measures) are more likely to increase the efficiency of agricultural inputs and limit negative biodiversity impacts.

It has been argued that agricultural intensification can benefit biodiversity in some settings by reducing the demand for agricultural land elsewhere. Others point out, however, that the associated biodiversity benefit from agricultural intensification practices is very difficult to determine given the array of factors that drive land use and change in land use. Strategies to increase biomass through agricultural intensification need to be planned and executed with great attention to local conditions and should be targeted to appropriate areas. Organic farming and other agricultural systems that support biodiversity may provide direction (European Conservation Agricultural Federation 1999).

Figure 5. Forest set alight by farmer burning his land in preparation for planting, Roraima, Brazil. Nigel Dickinson, photographer, WWF-Canon.

Conservation tilling

Conservation tilling encompasses a range of techniques, such as no-till, ridge-till and mulch-till, all of which are intended to reduce soil loss and increase the organic content of soil. These techniques often improve environmental quality by enhancing water and nutrient retention in the soil, reducing erosion and improving soil fertility through increased soil organic content. This can promote increased biomass accumulation and, subsequently, carbon sequestration.

No-till systems are widely used in North America and are expanding in Australia. The system is most applicable in areas with large-scale farming operations because of the size and cost of machinery involved. Surveys suggest that much of Europe's farmed area would be suitable for no-till agriculture (Tebrugge and Bohrnsen 1997; Claupein and Pekrun 1998). One challenge is that farmers want to plough in order to break certain disease cycles and correct water imbalances; ploughing leads to an immediate release of soil carbon that may take years to rebuild.

Conservation and no-till systems must be accompanied by more intensive weed control to compensate for the lack of ploughing. Greater use of broad-spectrum herbicides can achieve this, but they should be carefully chosen (see section on pest management).

Erosion control

Terracing, use of "shelter belts" and other measures that reduce wind and water erosion benefit the land's long-term productivity. This creates increased opportunities for carbon sequestration. The re-establishment of vegetation to control erosion, such as buffer strips along streams and rivers and shelter belts on farmland, can enhance productivity and biodiversity in arable areas.

Figure 6. Intensive agriculture along the Gulf of California, Mexico, is causing serious soil erosion in some areas. Edward Parker, photographer, WWF-Canon.

Set-asides

Another component of cropland management is the setting aside of marginal or degraded land. Taking cropland out of production and allowing it to revert to grassland, in addition to increasing carbon storage, is likely to enhance species richness, increase wildlife habitat, reduce erosion and improve water quality (if the reversion is long term). Setting land aside is most likely to be carried out in countries with declining areas of agricultural land.

Grazing land management

Re-establishing natural vegetation cover on overgrazed range-land used for livestock production is likely to improve its environmental quality. The socio-economic implications of this action will vary from case to case. In some areas, reversion of arable or degraded land to permanent grassland may be possible through establishment of protected areas and long-term set-asides of land, which may involve a loss of farming employment.

Establishing rapidly growing perennials and annuals, increasing the frequency of fires, introducing cover crops and applying organic manure to increase vegetation growth and recovery of soils can all restore the productivity of degraded land and yield environmental benefits. These actions can also generate socio-economic benefits through increased income from additional yields. Carefully managing range-land and livestock numbers and rotating grazing can further minimise the risk of overgrazing. Such measures can facilitate carbon uptake through the growth of new vegetation. Conversely, biodiversity losses will occur if relatively natural pasture and vegetation are converted to more intensively managed land and high-yielding modern species replace native plants.

Key points: Section 1

1. Planting trees on formerly forested land can enhance biodiversity and environmental services, especially when native species are used. Socio-economic impacts must be evaluated case by case.

2. Using alien invasive species for forest establishment can, under some circumstances, adversely affect environmental services and create negative side effects.

3. If severe land degradation hampers regeneration of native species, the establishment of exotic species as a nurse crop may be justified.

4. Planting trees on intact non-forest ecosystems is likely to lead to the loss of native flora and fauna and associated ecosystem services.

5. Environmentally sound harvesting practices support carbon stocks, but artificially suppressing fires, application of fertilisers and pesticides may diminish environmental quality.

6. Restoring and setting aside degraded land and employing conservation tilling and erosion control measures can rebuild ecological functions, while intensifying land management practices can have a negative effect on environmental services.

Section 2.
Project-based activities

An international market for greenhouse gas emissions has emerged in recent years. The market has evolved in concert with a number of project-based programmes to address climate change in a cost-effective manner. The Kyoto Protocol creates three market mechanisms for industrialised countries to use to reach their emission reduction commitments:

- trading of emission allowances between industrialised nations;
- joint implementation (transferring emission allowances from projects between industrialised nations); and
- the Clean Development Mechanism (CDM), a market-based mechanism for cooperation between Annex I (industrialised country) and non-Annex I (developing country) parties.

Features of project-based trading

Project-based trading of greenhouse gas emissions through the Kyoto Protocol requires several technical considerations, including setting a project baseline (against which changes in carbon stocks occurring in a project can be measured), determining additionality, and accounting for project leakage and the durability of emission reductions. Adequately addressing these issues will determine whether a project results in measurable, long-term emission reductions that can be traded under joint implementation and the Clean Development Mechanism. Forestry and land-use projects can only deliver such results if environmental and social impacts are considered.

Establishing a baseline for forest and land-use projects requires knowledge of the conventional land use in the area, the local socio-economic situation, and broader (national, regional or even global) trends that may affect the project. In the case of forestry projects, a baseline is established by making projections based on past trends and current conditions in order to estimate the net amount of carbon that would have been sequestered on the land in absence of any project. Once the baseline is determined, the greenhouse gas benefits of the project must be substantiated as being greater than what would otherwise have occurred (this is referred to as additionality).

Leakage is the unanticipated decrease or increase in greenhouse gas benefits outside the project's boundary that occur as a result of the project activities. If, for example, farmers are displaced from an area of forest for the purposes of carbon sequestration, but then move to an adjacent area and convert it to agricultural land, greenhouse gas emissions will increase despite the attempt to minimise them. Conversely, a project could introduce a new land management approach, such as forest landscape restoration or agro-forestry (see below), which is unlikely to compete with existing land uses and will additionally offer carbon, environmental and socio-economic benefits. Projects implemented on land required for subsistence or cash-crop farming by a growing population are likely to experience leakage.

Once a climate change mitigation project is implemented, the project participants or a third party must monitor the emission reductions inside the project area, as well as account for any emissions that occur outside the project boundary and which are measurable and attributable to the project activity. The term “permanence” refers to the requirement under the Kyoto Protocol that the emission reductions resulting from a project last over time. Some risk factors affecting the permanence of emission reductions are specific to forestry and land-use projects. These include natural risks, such as storms and other adverse weather events, pests, disease, fire and climate change. Risk also exists from human-induced fire or encroachment, uncertain land tenure or property rights and changes in the price and opportunity cost of land.

Joint implementation

Industrialised countries can undertake forestry and land-use activities on a joint project basis as outlined in the Kyoto Protocol. Carbon credits generated from these projects can be traded from one industrialised country to another and used by a recipient country to partly offset its domestic emissions.

Among the forestry and land-use activities available for carbon sequestration, forest and cropland management present the most opportunities for

project-based trading among industrialised countries.[15] Canada, Russia and Japan possess large tracks of managed forest and many other countries have initiated national forestation programmes in recent decades. A country-wide programme to afforest eroded and degraded land with native species has existed in Iceland since the 1990s.[16] Many European countries have also afforested farmland with financial support from the European Union. All of these countries maintain large tracks of standing forest that are still growing and are, therefore, increasing their carbon stocks. This creates a number of possibilities for carbon offset forest management projects in industrialised (Annex I) countries. Because of the large potential for carbon offsets through forest management in Annex I countries, UNFCCC Parties agreed to limit the amount that these activities can contribute to meeting emission reduction commitments. Individual limits for forest management were negotiated for each industrialised country.[17]

The Clean Development Mechanism

The Clean Development Mechanism (CDM) was created to assist Annex I Parties in complying with the emission limitations and reduction commitments outlined in the Kyoto Protocol. At present, developing countries have no obligation to limit or reduce their greenhouse gas emissions. But they are still able, on a voluntary basis, to contribute to global emission reductions by hosting projects under the CDM. The CDM has two key goals as outlined in the Kyoto Protocol, which are as follows:

1. to reduce greenhouse gas emissions; and
2. to assist developing countries that host projects to achieve sustainable development.

In addition to afforestation and reforestation projects, initiatives in the energy, transport and other sectors are included in the CDM. Deforestation, forest, crop and grassland management projects are excluded, although there is an option to include them in a subsequent commitment period (beyond the year 2012).[18]

A framework has been established for approving climate change mitigation projects, including accounting for and certifying the carbon credits generated by projects under the CDM. An executive board supervises the CDM and approves its projects. Operational entities, accredited by the executive board, review project proposals and verify and certify emission reductions from projects. The executive board issues emission reduction credits that can be traded on the open market. A fund to help cover the costs of adaptation in countries severely affected by climate change has been established; two per cent of the emission reduction credits awarded to a CDM project will be allocated to it. The fund may provide support for land-use activities that are not presently eligible under the CDM (such as forest conservation) and may assist countries in addressing the adverse effects of climate change. An overview of CDM operations is available in Aukland et al. (2002).

Governments still need to agree upon definitions and methods for afforestation and reforestation projects. Methods include rules for setting baselines and verifying additionality as well as dealing with project leakage, non-permanence, uncertainties and accounting for socio-economic and environmental impacts (including impacts on biodiversity and natural ecosystems). Governments are expected to make decisions on these issues at the ninth Conference of the Parties in 2003.[19]

Factors influencing projects

As industrialised countries develop domestic policies to comply with the Kyoto Protocol, there will be a growing demand for emission reduction credits. Many factors will influence the size and stability of the global carbon credits market, however; some of them are outlined below.

Limited CDM forestry market

The U.S. decision not to participate in the Kyoto Protocol will likely mean a reduced demand for project credits, particularly from the CDM. The decision by governments in the Marrakech Accords to limit the size of the CDM forestry portfolio during the first commitment period of the Kyoto Protocol (2008–2012) will also affect the market. The carbon credits from afforestation and reforestation projects under the CDM that can be generated annually by an industrialised country cannot exceed one per cent of that country's base year emissions as of 1990. This means that the total global market potential for afforestation and reforestation project credits is limited to a maximum of

approximately 33 million tonnes of carbon (MtC) per year, or 165 MtC over the five-year commitment period.

Recent studies have outlined scenarios for industrialised country participation in the CDM (excluding the U.S). Jotzo and Michaelowa (2001) projected that industrialised countries with economies in transition would not participate in the CDM market, focusing instead on trading their emission allowances with other industrialised countries. If the remaining industrialised countries fully exploit their credits, the total amount of tradable credits from afforestation and reforestation projects under the CDM would be about 18.3 MtC per year globally. Kemfert (2001) estimated that the trading of emission allowances between economies in transition and other industrialised countries would dominate the global market because of the large number of such allowances and the low prices at which they are expected to trade. Under this scenario, carbon credits from CDM projects would not be traded.

Supply of carbon

The market for carbon credits will also be influenced by the amount of carbon sequestration that can be physically achieved by terrestrial ecosystems from the current period to 2012. Estimates range widely about the amount of land available for afforestation and reforestation projects and the amount of carbon that can be sequestered on that land. According to the IPCC (2000), agro-forestry in tropical regions has the potential to sequester two to five tonnes of carbon per hectare per year (t C ha^{-1} yr^{-1}), while the rehabilitation and restoration of degraded forest land can sequester 0.25 to 0.9 t C ha^{-1} yr^{-1}. Industrial plantations can take up an average of 3 to 6 t C ha^{-1} yr^{-1} to a maximum of between 12 and 15 t C ha^{-1}. This means an annual carbon uptake rate of 4–8 t C ha^{-1} in tropical regions.[20]

During the 1990s, 0.9 million ha of forest plantations were established on non-forested land every year on average in the tropics (FAO 2001). In the same period, an additional one million ha per year were converted from natural forest to plantations through reforestation. Using the aggregate rate above, average afforestation rates in the tropics generate between 3.6 and 7.2 million tonnes of carbon per year (MtC yr^{-1}). Reforestation, using conventional rates for tropical plantations, would amount to another 4-8 million tonnes of carbon per year. The total carbon generated by afforestation and reforestation would therefore amount to between 7.6 and 15.2 MtC per year. In other words, carbon sequestration from current conventional plantation projects range below Jotzo and Michaelowa's mid-range projection of 18.3 MtC per year for CDM carbon credits. CDM reforestation and afforestation plantation projects will thus have to be added to the average plantation establishment rate in the tropics in order to increase carbon sequestration. It is unlikely that such large tracts of land will be available for new projects. Project developers will have to focus on alternatives to plantations, i.e. agro-forestry or forest landscape restoration, to gain credits for afforestation and reforestation projects under the CDM (see below).

Price

Another factor influencing the carbon credit market is price. Estimates of the market price of a tonne of carbon range from US$3 to $57 (Jotzo and Michaelowa 2001; Kemfert 2001; Den Elzen and de Moor 2001b; Buchner et al. 2001; Eyckmans et al. 2001; Jakeman et al. 2001; Boehringer 2001). The market price is considered to depend heavily on the demand for carbon credits and the transaction costs of CDM projects. If large numbers of excess emission allowances (referred to as “hot air”) that certain countries possess under the Kyoto Protocol are sold, then the price will tend to be depressed. Cost estimates for forest projects in the tropics typically range from US$2 to $25 per tonne of carbon, with afforestation and reforestation projects ranging between US$5 and $15. These estimates, however, often do not include the opportunity cost of land, infrastructure, monitoring and data collection, maintenance and other project costs.

Kauppi et al. (2001) estimated the cost of a tonne of carbon for forestry and land-use activities in industrialised countries to be about US$7.5. Missfeldt and Haites (2001) projected the price to be double that figure (US$15). Van der Linden (1999) reviewed 280 potential energy projects in developing countries and concluded that an equivalent of 200 MtC could be reduced per year at a cost of US$10 per tonne of carbon. Domestic abatement costs in the energy and transport sectors of industrialised countries range widely, from US$10 to $200 per tonne. Afforestation and reforestation CDM

projects will have to compete with a variety of low-cost CDM projects in the energy and transport sector. But forest CDM projects may be cost-competitive when compared to domestic abatement activities in industrialised countries. Assumptions that forest projects could be realised for less then US$2 per tonne of carbon (see Jotzo and Michaelowa 2001) seem unrealistically low. All estimates, however, are likely to change over time as the market evolves and the rules for trading become known.

These price factors will likely constrain the amount of afforestation and reforestation project credits traded in the emission market. Nevertheless, private investment in climate change mitigation projects is likely to be substantial, opening up new opportunities for the forest sector. Additional funding is also expected from governments in the form of official development assistance to catalyse and finance projects.

Opportunities for projects

There are many opportunities for afforestation and reforestation projects to contribute to sustainable development in developing countries. The most effective activities will be those that enhance the productivity and resilience of existing land-use practices and provide additional income generation activities for the rural poor. Box 3 describes the Guaraqueçaba Climate Action Project, a public-private-NGO partnership formed to take advantage of the CDM's potential financial opportunities.

Box 3 The Guaraqueçaba Climate Action Projects in Brazil

After centuries of extensive human use, the Atlantic Forest in Brazil has been reduced to less than ten per cent of its original range and is threatened by continued deforestation and degradation. The Guaraqueçaba Climate Action Projects seek to restore and protect approximately 21,000 ha of partially degraded and deforested tropical forest within the Guaraqueçaba Environmental Protection Area, the largest contiguous remnant of Atlantic Forest and one of the highest priorities for conservation in the world. With investments from American Electric Power Corporation, General Motors and Chevron-Texaco, the projects are a collaborative effort between these investors, The Nature Conservancy and the *Sociedade de Pesquisa em Vida Selvagem e Educação Ambiental*, a Brazilian conservation organisation. The projects will assist natural forest regeneration and restoration on pastures and degraded forests in Guaraqueçaba and will protect standing forest that is under threat of deforestation. Asian water buffalo ranching is the main threat to Guaraqueçaba; to address the problem, the projects will remove water buffalo from areas that have been converted to pasture, restore forests in degraded areas and prevent further deforestation. With a total investment of US$18.4 million, the projects are expected to sequester and reduce or avoid emissions equivalent to approximately 8.4 million metric tonnes of CO_2 over the next 40 years.

To minimise the chance of unanticipated decreases or increases in greenhouse gas benefits outside the project's boundary (leakage), several sustainable development activities have been implemented. These include a rotational pasture management programme that helps ranchers outside the project area raise water buffalo more intensively on smaller grazing areas, allowing former pastures to return to forest while increasing milk and beef production. Sustainable development activities will vary according to the interests and needs of each community and will include ecotourism, organic agriculture, ornamental and medicinal plant production and craft manufacturing for the growing tourism industry. The projects will track the effectiveness of these activities and mitigate any leakage that occurs. Direct economic opportunities for community members include jobs as park wardens and in other project activities such as reforestation, carbon monitoring, infrastructure development and maintenance. In addition to climate change mitigation, the project will provide numerous important environmental services, including biodiversity protection, soil and water conservation, watershed protection, riverbank restoration, and environmental restoration with native species (The Nature Conservancy 2002).

Market for CDM forestry credits

Forests provide a number of assets that are valuable to people, particularly the rural poor. These assets include food security, browse and fodder, fuel-wood, non-timber forest products (NTFPs), building products and industrial round-wood, all of which provide the basis for livelihoods. Forests also provide services such as water retention and soil protection.

In the past 15 years, the world has lost 200 million ha of forest. In many developing countries, a large percentage of original forest cover has been cleared, fragmented or otherwise degraded. Forest restoration is a priority for both environmental and socio-economic reasons for these countries but is rarely financially attractive in the short to medium term. The market for CDM forestry credits could increase the financial viability of these efforts, although it is unlikely to completely cover the cost of stand afforestation and reforestation projects.

Reforestation

Planting trees to restore or rehabilitate degraded forest-land will generally increase carbon sequestration. Ensuring that a forested landscape possesses the necessary goods and services to fulfil biodiversity and sustainable livelihood objectives, as with the forest landscape restoration approach, can help to address project leakage and increase the durability of the project's emission reductions. The forest landscape restoration approach incorporates a broad range of activities, including establishing wood-lots on communal lands, reforesting marginal areas (including riverine areas), steep slopes and forest fragments with native species, rehabilitating degraded areas through tree planting or assisted natural regeneration and incorporating trees into existing farming systems. Box 4 describes "ngitili", an indigenous natural resource management system in Tanzania, and an example of a traditional management system that incorporates the basic principles of forest landscape restoration.

Box 4 The Shinyanga landscape in Tanzania

The Shinyanga landscape is changing. The Sukuma, an agro-pastoral people living in the Shinyanga and Mwanza regions of central Tanzania, are restoring formerly cleared or degraded forests. They are using "ngitili", an indigenous natural resource management system based on individual- and community-owned pieces of land regulated by customary and, now, village law. The system involves conserving fallow areas and range-land to restore vegetation (in particular, perennial grasses and important browse species) through controlled livestock grazing. Ngitili was developed in response to several problems: acute fodder shortages caused by long and frequent droughts; diminished grazing land due to increased cropping; rapidly declining land productivity; and labour shortages for herding. The objectives of ngitili have in recent years been expanded to integrate other wood products and services required by communities while retaining the original objective of providing fodder for the dry season.

A survey of 172 of the 800 villages of the region found that about 70,000 ha of important woodland have been restored through ngitili, equivalent to over 300,000 ha in the whole region. The system has increased the availability of fodder and wood products and facilitated environmental conservation at the local level. Farmers using the ngitili system are able to collect fodder, fuel-wood, poles and other wood products on their farms instead of spending time obtaining them from distant forests. Species diversity has increased dramatically; one farmer using the ngitili system had over 20 different woody species on his land, which provided a multitude of goods and services. Ngitili has contributed to soil conservation and reduced soil erosion, thus benefiting agriculture and livestock production.

Forest and woodland restoration activities are not just the responsibility of governments. The use of the ngitili system demonstrates that rural farmers and villages can, and will, restore very significant areas provided the incentives are right. In this case, the need for dry-season forage for livestock, combined with an increasing need for timber and NTFPs, were the main incentives. The individual area restored may not be large but the number of people who own it — either individually or jointly — is great, and spread widely over the region.

Agro-forestry

Agro-forestry complements a forest landscape restoration approach and is an alternative to slash-and-burn agriculture. By integrating trees into the existing agricultural landscape, agro-forestry can provide subsistence, firewood and cash-crop production without requiring more forest to be cleared (Box 5). Agro-forestry can also fulfil the additionality requirement by providing verifiable carbon credits beyond those achieved with the original land use. Agro-forestry is unlikely to result in project leakage because it puts an emphasis on diversifying and sustaining the household incomes of people living on the land, rather than displacing them. For the same reason, such projects are also more likely to encourage carbon credits that are durable over time. Agro-forestry is a complementary land use; it does not necessarily replace or compete with other agricultural land-use practices. It is estimated to have the greatest potential for carbon sequestration in developing countries (IPCC 2000). The reaction to agro-forestry has been mixed in past years because of questions about ownership rights over trees and use of private land. More sophisticated and site-specific forms of agro-forestry are now in place, providing new incentives that may overcome this resistance.

Figure 7. Restored trees on farmland in the Shinyanga region, Tanzania. Obadia Mugassa, photographer.

Box 5 Carbon sequestration in Mexico

In the *Scolel Té* project in Chiapas, Mexico's poorest state, forestry activities are planned and implemented by groups and communities of small farmers affiliated with local organisations (De Jong et al. 1997; DTZ Pieda Consulting 2000). Companies, individuals or institutions wishing to offset greenhouse gas emissions can purchase carbon credits from the *Fondo BioClimático*, a local trust fund. Based on the expected carbon sequestration from the project, the fund provides Mexican farmers with financial and technical assistance to implement farm- or community-scale forestry and agro-forestry. The system favours small-scale farmers and allows them a greater degree of self-sustainability. Local promoters help farmers draw up working plans (known as *Planes Vivos*) for forestry or agro-forestry systems that reflect their specific needs, priorities and capabilities. These *Planes Vivos* are assessed for technical feasibility, social and environmental impacts and carbon sequestration potential.

The trust fund considers at least five farm forestry systems to be technically, socially and economically viable for facilitating carbon sequestration: live fences; coffee with shade trees; plantations; tree enriched fallow areas; and taungya, a means of re-establishing forest cover through initial intercropping of forestry and agricultural crops. An evaluation by *Société Générale de Surveillance*, an independent verification and certification body, has shown that the project promotes significant carbon sequestration, provides secure commercial and subsistence outputs, encourages capacity building, facilitates the application of sustainable agricultural production systems and benefits biodiversity.

Community-based forest management projects that utilise local and traditional knowledge can greatly benefit CDM projects and communities. The use of traditional knowledge enhances the ability of local communities to change and improves their resilience to adverse conditions. Communities can also benefit from innovative projects by learning new skills through training and learning by doing. The participatory approach has particularly contributed to this project's success.

Box 5 described how agro-forestry is being used in Mexico to encourage carbon sequestration. Projects in Nigeria, Cape Verde and Ghana, included in the best practices databank developed by UNEP and in the World Agroforestry Centre (ICRAF), also demonstrate how agro-forestry can be used to control land degradation and reduce poverty.

Figure 8. Mangrove reforestation, Philippines. Jürgen Freund, photographer, WWF-Canon.

Forest landscape restoration and agro-forestry can also help reduce vulnerability to climate-related disasters and climate change (Girot et al. 2001; Abramovitz 2001). Deforestation and forest degradation have eliminated forest cover from steep and unstable terrain, setting the stage for disasters that are more frequent and severe. Many countries have recently experienced hurricanes, floods, mudflows and landslides that have set them back years in development terms.

Future projections of climate change suggest that higher temperatures with more droughts, fires, intense tropical storms and precipitation events will occur over the next century. Rebuilding forest cover can stabilise the landscape and provide a buffer against these threats. By providing social, economic and environmental benefits to land users, forest landscape restoration and agro-forestry can help households and communities become more adaptive.[21] Box 6 illustrates an example of ecosystem restoration helping to reduce vulnerability to climate-related disasters and climate change.

Box 6 Red Cross mangrove restoration project in Vietnam

In Vietnam, tropical cyclones have caused a considerable loss of livelihood resources, particularly in coastal communities. Although managing coastal resources has great social and economic importance, the country has a limited ability to protect coastal areas against weather hazards. In future decades, climate change may increase the risk of tropical storms as well as their frequency and severity. The relative uncertainty surrounding anticipated climate change impact, however, makes it difficult for decision-makers to justify increased costs for protection. Under such circumstances, it is important to adopt precautionary adaptation approaches that minimize future risk and reduce existing vulnerability.

Mangrove ecosystem rehabilitation along much of Vietnam's coastline represents such an approach. Mangrove wetlands provide enhanced physical protection from storms and are a reservoir for carbon sequestration; they also provide a resource base for local livelihoods and income generation. Since 1994, the Vietnam National Chapter of the Red Cross has worked with local communities to plant and protect mangrove forests in northern Vietnam. Nearly 12,000 hectares of mangroves have been planted. The benefits have been staggering; although planting and protecting the mangroves cost approximately US$1.1 million, it saved US$7.3 million per year in dike maintenance. During the devastating typhoon Wukong in 2000, project areas remained unharmed while neighbouring provinces suffered huge losses in lives, property and livelihoods. The Vietnam Red Cross estimates that some 7,750 families have benefited from mangrove rehabilitation. Family members can now earn additional income from selling crabs, shrimp and mollusks and increase the protein in their diets (International Federation of Red Cross and Red Crescent Societies 2001).

Challenges for projects

Although the CDM provides opportunities for carbon sequestration and enhancement of livelihoods, it also presents many risks and challenges. Afforestation and reforestation projects are often presented as solutions to climate change mitigation and sustainable development problems. Many complex ecological, socio-economic and political institutional processes challenge this assumption, however, and need to be evaluated in order to understand the specificity of the relationship between livelihoods and forest activities.

Experience suggests that the success of conventional forestry projects in the tropics is largely determined by how thoroughly social factors have been considered in project planning and implementation (Borrini-Feyerabend 1996, Borrini-Feyerabend and Buchan 1997). There are many examples of tree-planting projects on land that is considered degraded but is in fact utilised in one way or another by local people. These projects have caused serious land-use conflicts and pitted project investors and government authorities against local communities.[22] Lack of clear land tenure and resource ownership is a common source of conflict.

In some situations, policies preclude the participation of local people in the management of natural resources. The reforestation project in Uganda described in Box 7 demonstrates the consequences of ignoring the interests of local people.

Figure 9. Border of Mt. Elgon National Park, showing relic trees left on farmland. Edmund Barrow, photographer.

Box 7 Reforestation in Mount Elgon National Park, Uganda

Mount Elgon National Park in Uganda suffered from widespread encroachment by agriculture during the 1970s and 1980s, a period of political instability. After the political situation stabilised in the late 1980s, reforestation of encroached areas was recognised as a way to provide opportunities for carbon sequestration. The Uganda Wildlife Authority (UWA)-FACE Project, funded by a consortium of Dutch electricity companies, committed to planting 25,000 ha of the encroached areas with local forest tree species over 25 years starting in 1994.

Since that time 7,500 ha of the park have been planted. Although UWA legislation and policy recognise that local people living around the park depend heavily on the area for basic needs such as firewood, grass for livestock, food, medicines and building materials, this fact was not adequately addressed during the project's initial phase. The lack of real involvement in reforestation activities by the local people gave rise to a number of serious problems. For example, widespread dissatisfaction with the reforestation programme led to the destruction of a large number of nursery seedlings in UWA-Face nurseries and of areas of planted seedlings. In one parish, where a pilot collaborative management agreement had been negotiated, UWA-Face staff involved in the reforestation programme prevented people who were legally entitled to collect park resources from doing so. The design and management of the project have since been changed, based on the hard lessons learned in the first phase of the project (Hinchley 2001; Barrow 2002). The project area is going to be awarded a certificate of compliance with the principles of the Forest Stewardship Council for sustainable forest management.

Box 8 describes how local interests and traditional land rights can easily be overlooked when outside commercial interests dominate project design and the decision-making process. Such projects are likely to result in leakage and any emission reductions generated are unlikely to be durable over time. If a project is perceived as being an impediment to local livelihoods, it may create an incentive for illegal clearing or harvesting.

Private forestry companies will play a strong role in the CDM. They will tend to invest in countries where they already have operations and will select projects that are already approved. These projects will be driven by financial considerations and adapted for the purpose of generating carbon sequestration credits. Little effort will be made to design entirely new projects, given the small amount of time between now and 2008, the start of the first Kyoto Protocol commitment period.

Box 8 Carbon sequestration in Uganda

Two Norwegian companies currently lease several thousand ha of government-controlled forest reserves from the national authorities in Tanzania, Uganda and Malawi. They pay nominal rents to establish plantations of fast-growing trees like eucalyptus and pine.[23] The plantations are expected to produce timber and, if ongoing climate change negotiations allow, they will also generate carbon credits that could be sold. If carbon trading becomes possible, the companies would have the potential to earn up to US$27 million from the sale of carbon credits (based on 350–500 tonnes of CO_2 per ha at US$13.5 per tonne). The host countries, meanwhile, will only be able to earn US$570,000 a year from land rents (Eraker 2000; Centre for Science and Environment 2000).

One of Norway's concessions is located at Bukaleba Forestry Reserve beside Lake Victoria in the Iganga District of Uganda. When the reforestation project began, as many as 8,000 farmers and fishers lived in the reserve. There is a high population density, few opportunities for work outside of agriculture, and a high demand for land. The Norwegian company made it clear to forest authorities early on that they considered people living and farming inside the reserve as illegal intruders. This created serious conflicts between forest authorities and locals. Attempts were made to evict the locals through destroying their crops and tearing down their houses.

Tree seedlings in the Bukaleba Forestry Reserve were planted according to a system that permits farmers to grow agricultural crops between rows of trees for a few years (until the trees shade out the crops). Farmers are charged an annual rent for use of the land. Since the farmers know that they will be unable to cultivate their crops once the trees grow to a certain height, they actively suppress tree growth through constant pruning and uprooting of seedlings. Farmers are further frustrated by having to pay rent on land they previously cultivated free of charge and by losing access to that land as the trees grow. Moreover, they appear to be paying for the bulk of the plantation investment cost through their rents and crop weeding, which benefits the trees.

The project's costs and benefits appear to be heavily weighted in favour of the forest company. The company's potential gains in carbon credits (or timber sales, in the event that carbon trading is not allowed) are substantial compared with the relatively modest land rents and plantation establishment costs. Revenue from farmers' payments for plot rental, along with the unpaid weeding done by farmers, reduces establishment costs significantly. By contrast, Uganda's potential benefits are modest annual rents for the land, NTFPs for local communities, and the environmental benefits of restoring degraded forest. Significant socio-economic costs are borne by the 8,000 local people displaced by the project, a factor given insufficient consideration when negotiating the project. None of the commercial benefits normally associated with plantation timber projects, such as provision of industrial raw material, timber for housing development, import substitution, and jobs, will accrue to the local economy if the timber is used for carbon credits rather than being harvested. In addition, if carbon credits are sold, Uganda forfeits the option of using the land for other purposes in the future.

The market for carbon credits could end up encouraging large-scale conventional forestry schemes, with a focus on simple forest types (notably single species plantations) on land with good growth rates and the use of exotic or genetically modified species to improve those rates. Projects will tend to take place on unpopulated lands where fewer "people" conflicts will arise. Projects with a livelihood component, or which are designed to deliver community benefits, are more complex, and therefore initially more costly, to design and implement. CDM projects have significant transaction costs and require considerable information, negotiation, design and monitoring. Since profit margins under the CDM will therefore be slim, project investors will tend to favour larger operations that can benefit from economies of scale. Box 9 discusses the use of plantation projects in developing countries.

Projects that focus on large-scale conventional forestry schemes can be effective at storing carbon, but will conflict with sustainable development efforts. They are unlikely to strengthen local institutions, generate income for forest-dependent communities or enhance forest biodiversity. Careful review is necessary to determine who benefits from projects and how those benefits are distributed. CDM projects will not necessarily ensure social, economic or environmental improvements.

Figure 10. Agro-forestry in the Atlas Mountains, Morocco. John Newby, photographer, WWF-Canon.

Box 9 Plantations in developing countries

In the 1960s, many plantations were established in developing countries using donor funds. The goal was to supply raw materials for nascent wood industries and generate local employment. Many of these projects failed in their objectives due to poor management of government-owned plantations and lack of private sector interest in investing in remote processing facilities, among other reasons (Westoby 1987). Wood-fuel plantations near urban areas, established with donor funds to address the so-called "wood-fuel crisis" of the 1970s and 1980s, were similarly unsuccessful; energy derived from the wood cost 3–18 times more per calorie than that provided by imported fuels (Leach and Mearns 1988).

The availability of land and labour in developing countries is often overstated by outside observers who fail to understand the importance of "waste" lands to local livelihoods. These lands are often held in common and form a key element of the livelihoods of the landless and the poorest rural inhabitants. On the most degraded land, where afforestation and reforestation efforts would have positive impacts, benefits will be slow to materialise and investor interest will be limited. Conversely, carbon sequestration will be more attractive where higher growth rates can be attained, i.e. on land that is still productive. Such land is frequently in constant use for local subsistence and income-generating activities, however, which would be displaced under many proposals.

Key points: Section 2

1. The ability of forestry and land-use projects to deliver real, measurable and long-term emission reductions can be greatly enhanced if environmental and social conditions are thoroughly considered.

2. Policy choices, the supply of carbon credits and price will constrain the global market for forestry and land-use project credits over the next decade.

3. Restoring degraded forest land and introducing agro-forestry regimes on a project basis are two methods of contributing to sustainable development in developing countries under the CDM.

4. The market for carbon credits is likely to emphasise conventional forestry schemes, paying little attention to social issues.

Section 3.
The way forward

National implementation

In both industrialised and developing countries, legislative and administrative adjustments will be needed to successfully implement forestry and land-use activities for the purpose of climate change mitigation. These adjustments can help ensure that forestry and land-use projects are designed to be environmentally sound and socially equitable.

Carbon measuring and accounting regimes

Many industrialised countries do not possess the infrastructure to regularly account for changes in carbon stocks resulting from forestry and land-use activities at a national level. While most countries have at least part of the required infrastructure, and many have started to establish data bases on carbon flows resulting from various land uses, they will need to invest substantially to set up and maintain carbon inventory mechanisms at a national scale.

For countries seeking to host projects, it is important to develop such national inventories because doing so will allow them to evaluate the technical potential and feasibility of proposed projects. While there is no specific requirement for developing countries to maintain a national emissions inventory, the ability to cross-reference project and national data will likely improve project quality.

Institutional capacity and national programmes

National implementation of climate change mitigation projects, in both industrialised and developing countries, can be facilitated by establishing a government authority responsible for these types of forestry and land-use activities. This authority will need to work with the agencies responsible for agriculture, forestry, environment, national planning and finance in order to coordinate different initiatives.

Regulatory measures, along with tax breaks to provide incentives for the private sector to engage in forestry and land-use activities, are extremely important. Governments can make more effective use of the carbon market by emphasising activities that will mesh with existing environmental and socio-economic objectives. These could include, for example, the creation of sustainable rural employment, protection and improvement of environmental services including biodiversity and improvement of economic returns for farmers and foresters. Such activities may be part of existing national land-use, forestry and agricultural programmes and policies.

Governments can draw upon a number of existing initiatives to facilitate forestry and land-use activities that contribute to climate change mitigation. For example, governments can integrate new projects with national sustainable development programmes created under the Agenda 21 process. As well, nearly all of the governments that are UNFCCC Parties are also Party to the CBD and have prepared National Biodiversity Action Plans. Several principles of the ecosystem approach endorsed by the CBD could be readily applied to forestry and land-use activities and projects. The CBD-expanded work programme on forest biological diversity and the principles for mitigating the impact of invasive alien species provide additional guidance. The Global Invasive Species Programme — a partnership of governments, intergovernmental organisations, NGOs, academic institutions and

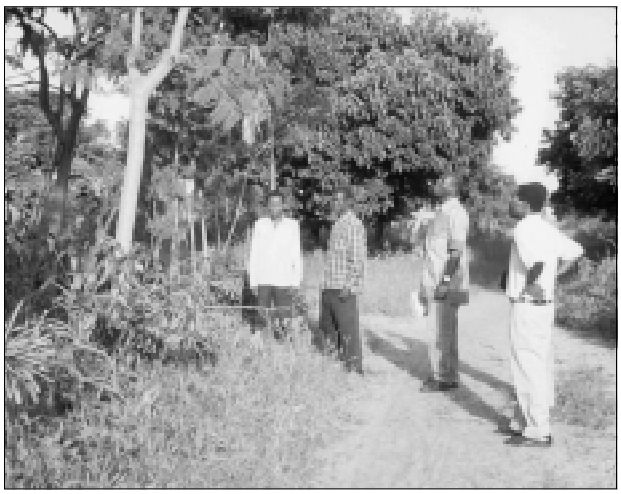


Figure 11. Restored woodland or ngitili in Shinyanga Region, Tanzania. Obadia Mugassa, photographer .

the private sector that supports CBD Parties and other governments — has produced numerous tools and documents that could be useful.

Environmental and social safeguards can be drawn from many sources and applied to carbon sequestration programmes. In the countries of the European Union, for example, regulations such as the European Union Habitats Directive provide regionally relevant standards that may be applied to carbon sequestration. On a wider regional scale, the Pan-European Criteria and Indicators for Sustainable Forest Management and the Pan-European Operational Level Guidelines for Sustainable Forest Management may also provide the basis for the development of environmentally sound carbon sequestration. Reforms to the Common Agricultural Policy, currently under review, might also be helpful. The International Labour Organisation has also completed extensive work on the social aspects of forest management.[24]

National legislation may need to be reviewed in countries that encourage the harvest of forest resources as part of the international timber trade. Legislation might need strengthening so that carbon sequestration measures do not overwhelm existing safeguards for sustainable forest management. Safeguard policies for sustainable forest management could also be applied as appropriate through certification, such as that of the Forest Stewardship Council. Safeguard policies include a wide variety of technical, social and environmental parameters. Industrialised countries are currently required to report to the UNFCCC on the legislative arrangement and administrative procedures in place to ensure that forestry and land-use activities contribute to the conservation of biodiversity and the sustainable use of natural resources.

Consultation is a key step in securing public acceptance of forestry and land-use activities. Most industrialised country governments have well-developed procedures for stakeholder consultation in the design of national regulations, policies and strategies. These governments can apply such procedures before launching any national plans for carbon sequestration. Stakeholder consultation processes can help mobilise different social groups and provide venues for them to express their opinions, interests and concerns.

Some developing countries, such as Costa Rica and Colombia, have already moved to develop programme approaches to climate change mitigation projects. A national approach has the distinct advantage of clarifying in a strategic sense how a country wishes to benefit from project activities. Such an approach can serve as the basis for developing a list of potential projects or even a portfolio of projects that could be readily approved if investors were willing to finance them. Countries can also create mechanisms for providing support through the planning and financing of projects. Some developing countries have fulfilled at least part of this capacity by participating in the World Bank National Joint Implementation and Clean Development Mechanism Strategy Studies.[25] Host countries can also put in place procedures for registering, monitoring and verifying projects. These national strategies can help government authorities evaluate whether projects conform to the principle that forestry and land-use activities should contribute to the conservation of biodiversity and sustainable use of natural resources.

Establishing the legal title to carbon

In any forestry and land-use activity implemented with the intent of carbon sequestration it is vital to know who owns the carbon. Where a single individual or company owns land, crops and trees, legal title can be determined fairly easily. On land where rights are unclear or disputed, however, or where certain groups, such as indigenous peoples, have customary or statutory rights, there may be legal complexities to resolve. National laws regarding property ownership may need to be reviewed and amended to address the emerging carbon market. Clarifying issues such as land tenure and access to and control of resources will be especially important in determining the success of activities and projects with social components.

Project implementation

For both Joint Implementation and the Clean Development Mechanism, project developers can incorporate forestry and land-use activities that are environmentally sound and socially equitable.[26] Socio-economic and environmental impacts can vary from region to region and place to place; they therefore need to be analysed on a project-by-project basis. There are three approaches[27] to considering these issues in projects:

- the impact assessment approach;
- the process-oriented approach; and
- the preventive approach.

These three approaches are not exclusive but are complementary to each other. Different approaches may be needed at various stages of a project.

In terms of social considerations, it is important to emphasise that local stakeholders are often not a homogeneous group. The life and perceptions of a landless subsistence farmer, settled agriculturist, indigenous person, livestock rancher, charcoal-maker, micro-entrepreneur and local trader can be substantially different. There is a high risk of trade-offs in carbon sequestration projects that promote climate change mitigation over other objectives where a specific local stakeholder or a group of stakeholders is a clear beneficiary, while others are disadvantaged. Project participants and evaluators should therefore include social heterogeneity in their project analysis and review. Project participants should also identify strategies that can minimise social hardship and/or social conflicts between local stakeholders.

The impact assessment approach

This approach aims to evaluate or estimate social and environmental impacts throughout the life of a project. Impact assessments identify the project's trade-offs between carbon sequestration, human livelihoods and the environment. Although impact assessment processes vary, they share common features:

- screening to determine the need for, and the appropriate level of, assessment;
- preliminary assessment to rapidly determine the project's key impacts, their magnitude and significance, and their importance to decision-making;
- gathering information to define the focus of the assessment;
- detailed assessment of project impacts, their magnitude and significance, and measures to mitigate adverse impacts and maximise positive impacts;
- review to determine if the assessment contains enough information to guide decision-makers;
- monitoring of impacts and implementation of prescribed mitigation measures; and
- in some cases, audits to review the process.

The process-oriented approach

The process-oriented approach deals with social and environmental issues during a project's planning, implementation and evaluation phases. The process-oriented approach proposes five steps to identify and address socio-economic considerations associated with forestry mitigation projects.

1. Setting the framework

This first step should identify the system or framework in which the project is developed and will operate. Components of the framework include technical measures (e.g. reforestation or agro-forestry practices), policies (national, regional and local policies, legal landscape, participation mechanisms), as well as economic and financial conditions (e.g. economic activities, distribution of income).

2. Defining social groups

Projects affect social groups in a variety of ways. Identifying the different social groups that may be involved in or affected by a project is an important step in the process-oriented approach (examples of variables by which to group social groups are listed in Table 1).

Table 1. Variables defining social groups

Variables	Affected groups
Income	• poor, subsistence farmers • poor, basic livelihood secured, limited income • the middle class • the elite class
Land tenure	• owners • renters • settlers • concessionaires
Economic activities	• producers • consumers • traders
Forestry and land use	• public land-owners (governments) • private land-owners • concessionaires • local users • indigenous people • non-government organisations • multi-lateral agencies

Source: Robledo and Blaser 2001

3. Understanding the links between social groups

Once the different social groups relating to a carbon sequestration project have been identified, the next step is to determine how they are linked. This will lead to a better understanding of how each group will be affected by project implementation. There are four elements to consider: potential benefits, potential risks, potential conflicts and impacts on the market (Table 2).[28] Risk is a particularly important element for social groups that live close to the minimum subsistence level.

Different social groups' acceptance of a project's benefits and risks will be important in determining whether a project succeeds. In many cases, risk may need to be managed and project participants will need to be prepared to incorporate actions that reduce risks for those social groups affected.

4. Including local social groups in project processes

Social processes are dynamic; social groups and their interests might change over time. A thorough understanding of the social processes at work can help project developers anticipate changes and reduce risks during the course of a project. One recommended method of ensuring social acceptance of project activities is to allow affected social groups to participate in three main project processes: decision-making (planning), implementation and monitoring.

Social equity involves the distribution of costs and benefits across social groups as well as their enhanced participation in project processes. Finding ways to increase equity will be an important component of afforestation and reforestation projects. Key steps in deciding how to address social equity include the following:

- determining and communicating project boundaries;
- devising strategies to minimise negative impacts on people's lives;
- involving people as much as possible in the project process; and
- identifying compensation measures for those adversely affected by implementation of a project. This can include employment opportunities created by the project and cash payments.

5. Assessing the social components of sustainability

Social groups should be analysed to assess their understanding of a project's goals and objectives, their preferences and their understanding of the necessity for and the opportunity presented by the project. This can be facilitated through workshops, training and other initiatives. Analysis can also form the basis of continued monitoring of a project's social and environmental factors during implementation. In the context of the Clean Development Mechanism, such a process-oriented approach enables monitoring and evaluation of the social component of forestry projects, as articulated in Article 12 of the Kyoto Protocol.

Table 2. Key questions to define links between sociabgps

Potential benefits	Which benefits or costs will affect each social group from implementation of the proposed technical measures?
Potential risks	Based on the characteristics of each social group, what risk is there that the goal and objectives of the technical measures will not be met?
Potential conflicts	What potential conflicts are likely to arise in the implementation of technical measures?
Potential impacts on the market	What effects will there be on market exchanges from implementation of the technical measures?

The preventative approach

The preventive approach focuses on social groups and natural environments that are likely to be negatively affected by changes caused by the project. Safeguard policies, as employed by the World Bank, are intended to protect vulnerable social sectors and natural environments in countries with weak social and environmental policies and institutions. Safeguards for forestry projects address participatory planning, ecological zoning, demarcation and land titles, and incorporation of indigenous people's territories in project design.

Although safeguard policies have improved considerably since being introduced, more than 20 years ago, they still have serious shortcomings. They are heavily front-loaded, with little emphasis on implementation and supervision. They can result in high political and economic transaction costs, project preparation delays and significant expense. Most problems arise in projects that address distribution of forest resources, often an aspect of the creation and demarcation of indigenous people's territories or protected areas. Even though safeguards have included vulnerable communities and individuals in project design, they have not always triggered broader consultations with key stakeholders.

Despite these problems, this approach may have merit in the context of afforestation and reforestation projects under the CDM. In combination with a process-oriented approach, some basic safeguards can be developed that identify vulnerable social groups and natural environments and indicate which measures affect them.

Figure 12. Non-timber forest products being collected from restored woodlands (ngitili) in Shinyanga Region, Tanzania. Edmund Barrow, photographer.

Key points: Section 3

1. Forestry and land-use projects require an enabling framework and conditions, including institutions, regulations and legislation.

2. Forestry and land-use projects should be integrated as much as possible into existing environment, biodiversity, development and financial programmes.

3. Impact assessment and safeguards can help to screen out inappropriate projects.

4. Integrating environmental and social issues into planning, implementation and evaluation can ensure that projects contribute to sustainable development and reduce the risk of intended carbon benefits not materialising.

Section 4.
Recommendations

Reducing greenhouse gas emissions is vitally important. The primary means of achieving this is by limiting emissions in the energy-consuming sectors. Forestry and land-use activities are additional measures. Industrialised countries can partly offset their emissions through various forestry, agricultural and land-management activities, which include afforestation and reforestation projects in developing countries. Carbon considerations will have to be increasingly integrated into the management objectives of forests and other lands. This will have implications for governments, indigenous peoples, NGOs, international organisations, local communities, and members of the business community, from project developers to buyers and sellers, financial institutions and auditors. The following recommendations are put forward in order to increase the prospects of implementing environmentally sound and socially equitable carbon sequestration activities and projects.

Governments

Governments that have ratified the Kyoto Protocol need to move quickly to establish rules for carbon sequestration activities and for emission trading. They can help establish the carbon market in a way that is favourable to the environment by setting up an appropriate regulatory framework. A strong enabling context at the national and international level will be required to ensure environmentally sound and socially equitable climate change mitigation projects in the forestry and land-use sectors. Government agencies should review policies, legislation and programmes related to forestry, biodiversity, land use, and agriculture and integrate carbon sequestration with them. Scientific advice on integrating biodiversity issues into the UNFCCC and the Kyoto Protocol, currently being prepared by the CBD, should be considered. Capacity building and financial support for developing countries will also be required. Extension services, information dissemination and investments can support the development of activities and projects in high-priority areas.

Social and environmental safeguards, including measures for alien invasive species, can ensure that the new interest in carbon sequestration does not overwhelm existing priorities for environmental management, income generation and poverty alleviation. Stakeholder consultations should be carried out to gather information and promote public acceptance of new policy initiatives. A framework for monitoring and evaluating the environmental and socio-economic effects of carbon sequestration projects is another valuable public policy tool for ensuring that forestry and land-use activities and projects are environmentally sound and socially equitable.

Figure 13. Forestry and land-use activities can help to achieve reductions in greenhouse gas emissions while providing opportunities to improve both environmental and social conditions. Dagmar Timmer, IUCN, photographer.

Buyers and sellers

Buyers of carbon credits are likely to include large oil and gas companies, electric utilities and industrial firms that produce large amounts of greenhouse gases and face emission limits. Many of these firms have moved early into the greenhouse gas market. Some of them have policies related to environmental stewardship and social responsibility. Buyers can adopt minimum environmental and social standards for the emission allowances and project credits they purchase.

Sellers of carbon credits include forest companies, farmers and other private and public land-owners whose land sequesters greenhouse gas emissions. Sellers are motivated by the opportunity to generate revenue from the sale of emission reductions. Prospective sellers should review their current activities and projects and identify marketing opportunities for carbon sequestration. The market for carbon can provide additional revenue, and help tip the scales toward environmentally sound activities and projects that are only marginally feasible financially. Sellers, as well as buyers, should have a strong interest in the related effects of projects, since projects that cause social conflict or degrade the environment may be less durable, and therefore of less value.

Project developers and implementers

Project developers and implementers are a diverse group that includes forestry companies, private land-owners, NGOs, and project consultants, among others. They are focused on the supply side of the carbon market, and undertake steps to design, develop, quantify, and monitor projects and activities that may lead to emission reduction credits. Several have already developed rigorous standards regarding environmental quality and community involvement in project design and implementation. Governments and operational entities should encourage project developers and implementers (under the CDM) to demonstrate that they have considered social and environmental issues in their project design. This means that projects would not adversely affect biodiversity conservation, sustainable use of natural resources or the livelihoods of communities.

Section 3 describes several approaches to the integration and monitoring of the environmental and socio-economic impacts of climate change mitigation projects. Other participatory approaches, such as IUCN's *Beyond Fences* resource manual (Borrini-Feyerabend and Brown 1997), have been designed to help project developers and other professionals involved in environmental initiatives identify social concerns and assess options for action and implementation.

Financial institutions

Banks and insurance companies can assist with financing and risk management of climate change mitigation projects. They provide many products and services that can facilitate the development of the market. Several financial institutions are preparing to create carbon investment funds that would help to diversify the risk associated with investments in emission reduction projects. Financial institutions can establish criteria for these funds that will facilitate the promotion and trade of environmentally sound and socially equitable projects. Investment funds can encourage bundling of small-scale afforestation and reforestation projects. Institutions can also provide financial back-up for projects that are more expensive, such as those with strong environmental and social components.

Operational entities and auditors

Accounting and certification firms provide validation and verification that emission reductions are real and meet a minimum quality standard. Under the CDM, these firms can be designated as operational entities. So far, they have focused on ensuring the accuracy of data used to calculate baselines and emissions. These firms could also develop rigorous validation and verification criteria for the environmental and social aspects of projects. Criteria could take the form of a checklist of indicators to be reviewed, such as local participation in the project, socio-economic and environmental assessment, and benefit-sharing arrangements. The World Bank and other potential CDM operational entities have well-developed environmental and social safeguard policies upon which to base such criteria.

Conclusions

Governments, buyers and sellers, project developers, financial institutions, and operational authorities are likely to have different perspectives on the use of forestry and land-use projects to offset greenhouse gas emissions. All of them, however, are familiar with the negative effects of short-sighted policies and practices, and with the mistakes made in the past relating to climate change mitigation. At the same time, all of them recognise the opportunity offered by the new carbon market and the chance to leverage new sources of value from ecological services. Each of these groups, therefore, has a part in establishing a carbon market that delivers environmentally sound and socially beneficial outcomes. IUCN, UNEP and the other institutions involved in the preparation of this publication look forward to working with them to put such a market in place.

Endnotes

1. The 39 Annex I Parties are: Australia, Austria, Belgium, Bulgaria, Canada, Croatia, Czech Republic, Denmark, European Economic Community, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Lichtenstein, Lithuania, Luxembourg, Monaco, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, United Kingdom and USA.

2. FCCC/CP/2001/13/Add.1 decision 11/COP-7.

3. Decision 11 / CP 7. Land use, land-use change and forestry (extract from: FCCC/CP/2001/13/Add.1).

4. Article 4.1(f) of the UNFCCC.

5. Article 4.1(f) of the UNFCCC.

6. IUCN Resolution 2.94: Climate change mitigation and land use, Second World Conservation Congress (IUCN – The World Conservation Union, 2000) and UNEP, Report of the Executive Director to the Global Ministerial Environment Forum (UNEP/GC.21/INF/13), 2001.

7. Decision UNEP/CBD/COP/V/4.

8. Decision UNEP/CBD/COP/V/15.

9. See Part VII.4 of the Annex to Decision 5/CP.6, The Bonn Agreements on the implementation of the Buenos Aires Plan of Action, FCCC/CP/2001/5.

10. FCCC/CP/2001/13/Add.1 decision 11/CP7.

11. Invasive species are the second most common cause of biodiversity loss world-wide (after habitat conversion) and the main cause on islands.

12. For further information see ICRAF website: http://www.worldagroforestrycentre.org.

13. Analysis of farmer responsiveness to these incentives may provide useful insights into setting baselines and achieving permanence in sequestration projects (Chomitz 1999). More information may be found at http://www.fsa.usda.gov/dafp/cepd/12logocv.htm.

14. Human-assisted natural regeneration means establishment of a forest stand from natural processes such as seeding or sprouting, after activities such as selection cutting, seed-tree harvest, soil preparation, or restricting the size of clear-fells to encourage natural regeneration from surrounding trees.

15. Gurney and Neff 2000.

16. Sigurdsson and Snorrason 2000.

17. Appendix FCCC/CP/2001/13/Add.1 decision 11/CP7).

18. Par. 15, Annex to Draft CMP decision on LULUCF, FCCC/CP/2001/13/Add.1.

19. FCCC/CP/2001/13/Add.1 decision 11/CP7. I.

20. Noble pers. comm.

21. Government of India, UNEP and CGIAR workshop on Adaptation to Climate Change and Agricultural Productivity, Session 2.3: Linking adaptation and mitigation in agriculture and forestry as a cost-effective option. http://www.unep.org/dpdl/IndiaWorkshop.

22. Caucus of Indigenous Peoples and Local Communities 2001. Spanish version available at http://www.wrm.org.uy.

23. In Tanzania, Norwegian foresters leased or tried to lease over 50,000 hectares at an annual rent of US$1.9 per ha.

24. Poschen 2000.

25. For more information, please visit www.worldbank.org/climate.

26. The proposal presented here is based on the concepts developed by Robledo and Blaser (2001) presented during the meeting of the action COST E21 in Budapest, Hungary in April 2001.

27. Based on Robledo and Blaser 2001.

28. We distinguish here between two kinds of risks: risks of negative impacts due to the project, and risks from local elements (corruption, social conflicts, etc.) that could affect project implementation.

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Glossary

Additionality	a substantiated estimate of greenhouse gas benefits from a project activity that would not have otherwise occurred in the project area
Afforestation	direct human-induced conversion of non-forested land to forested land. In the context of the Kyoto Protocol to the UNFCCC, afforestation can take place on land not covered by forest for a period of at least 50 years
Agricultural intensification	practices intended to produce higher crop yields without increasing cultivated land area
Agro-forestry	a land use system in which woody perennials are grown for wood production with agricultural crops, with or without animal production
Alien species	a species introduced and occurring in locations beyond its known historical range. This includes introductions from other continents, bioregions, and those not native to the local geographic region
Annex I Parties	a group of 39 industrialised countries as defined under the UNFCCC
Carbon credits	greenhouse gas emission reductions or removals generated by a project activity that can be bought or sold through the Clean Development Mechanism or joint implementation
Carbon sequestration	the uptake and storage of carbon in terrestrial ecosystems, particularly through forests, agricultural soils and wetlands
Clean Development Mechanism	a mechanism established by the Kyoto Protocol to facilitate cooperation between Annex I (industrialised country) Parties and non-Annex I (developing country) Parties to reduce greenhouse gas emissions and assist developing countries in achieving sustainable development
Conservation tillage	tillage practices (including no-till, mulch till and ridge till) that leave beneficial plant materials (leaves, stalks, etc.) from previous crops on the soil surface, thus maintaining or enhancing soil carbon stocks
Ecological integrity	maintaining the diversity and quality of ecosystems and enhancing their capacity to adapt to change and provide for the needs of future generations
Group felling	a silvicultural system that removes mature timber in small groups at relatively short intervals, repeated indefinitely, where the continual establishment of regeneration is encouraged and an uneven-aged stand is maintained
Invasive species	plants that readily compete with native species, aggressively expanding into natural communities where their abundance disturbs the natural balance of ecosystem structure, evolution and function
Leakage	the unanticipated decrease or increase in greenhouse gas benefits outside a carbon sequestration project's boundary
Mineralisation	the conversion of an element from an organic form to an inorganic state as a result of microbial decomposition

Mulch till	conservation tillage system where the soil is disturbed prior to planting
Native species	a species that, other than as a result of an introduction, historically occurred or currently occurs in an ecosystem
Ngitili	a traditional natural resource management system of the Sukuma people of the Shinyanga region in Tanzania that involves the conservation of fallow areas and rangeland to restore vegetation, in particular perennial grasses and important browse species, through controlled livestock grazing
No till	conservation tillage system where soil is left undisturbed from harvest to planting except for nutrient injection
Reforestation	direct human-induced conversion of non-forested land back to forested land. In the context of the Kyoto Protocol to the UNFCCC, reforestation can take place on land that was historically forested but as of December 31, 1989 was subject to another land-use
Revegetation	re-establishment of non-forest vegetation and restoration of degraded non-forested lands, such as overgrazed native grasslands or cultivated wetlands
Ridge till	conservation tillage system where soil is left undisturbed from harvest to planting except for nutrient injections. Planting is completed in a seedbed prepared on ridges and residue is left on the soil surface between ridges
Selection felling	a silvicultural system that removes mature timber either as single scattered individuals or in small groups at relatively short intervals, repeated indefinitely, where the continual establishment of regeneration is encouraged and an uneven-aged stand is maintained
Shelterwood silvicultural system	a silvicultural system in which trees are removed in a series of cuts designed to achieve a new even-aged stand under the shelter of remaining trees
Shelter belt	A windbreak hedge taking the shape of a wooded strip that diverts wind currents moving across the ground, reducing wind chill and enhancing the growth of crops, plants and trees within the sheltered area
Silvo-pastoral systems	the combined use of forestland or woodland for both wood production and animal production
Taungya	a means of re-establishing forest cover through initial intercropping of forestry and agricultural crops.

List of acronyms

CBD	Convention on Biological Diversity
CDM	Clean Development Mechanism
DFAIT	Department of Foreign Affairs and International Trade
FACE	Forests Absorbing Carbon Dioxide Emissions Foundation
ICRAF	International Agroforestry Centre
Intercooperation	Swiss Organisation for Development and Cooperation
IEEP	Institute for European Environmental Policy
IPCC	Intergovernmental Panel on Climate Change
IUCN	The World Conservation Union
MtC	million tonnes of carbon
NTFP	non-timber forest product
SCS	Soil Conservation Society
SDC	Swiss Agency for Development and Cooperation
t C ha^{-1} yr^{-1}	tonnes of carbon per hectare per year
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UWA	Uganda Wildlife Authority
WMO	World Meteorological Organisation

IUCN – The World Conservation Union

Founded in 1948, The World Conservation Union brings together States, government agencies and a diverse range of non-governmental organisations in a unique world partnership: nearly 980 members in all, spread across some 140 countries.

As a Union, IUCN seeks to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable.

The World Conservation Union builds on the strengths of its members, networks and partners to enhance their capacity and to support global alliances to safeguard natural resources at local, regional and global levels.

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IUCN supports a people-centred approach to conservation that ensures that biological resources are positively employed to help secure sustainable and desirable livelihoods. The IUCN Forest Conservation Programme publishes the series “Livelihoods and Landscapes” in order to explore the complex linkages between human livelihoods and forest conservation, and analyse their implications for a wide range of policies. The aim of the series is to encourage and assist societies to attain an appropriate balance between economic growth, social equity and environmental sustainability.

The IUCN Forest Conservation Programme also publishes another series, “Managing Forest Ecosystems,” that explores key forest-related research questions and highlights opportunities for technical innovation.

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IEEP
inter cooperation Natural Resource Management Rural Economy Local Governance and Civil Society
UNEP