25 Reversing Emissions from Land Use Change

Key Messages

Curbing deforestation is a highly cost-effective way of reducing greenhouse gas emissions and has the potential to offer significant reductions fairly quickly**.** It also helps preserve biodiversity and protect soil and water quality. Encouraging new forests, and enhancing the potential of soils to store carbon, offer further opportunities to reverse emissions from land use change.

Policies on deforestation should be shaped and led by the nation where the forests stand but there should be strong help from the international community, which benefits from their actions.

At a national level, establishing and enforcing clear property rights to forestland, and determining the rights and responsibilities of landowners, communities and loggers, is key to effective forest management. This should involve local communities, and take account of their interests and social structures, work with development goals and reinforce the process of protecting the forests.

Compensation from the international community should be provided and take account of the opportunity costs of alternative uses of the land, the costs of administering and enforcing protection, and managing the transition. Research carried out for this report indicates that the opportunity cost of forest protection in 8 countries responsible for 70 per cent of emissions from land use could be around $5 billion annually, initially, although over time marginal costs would rise.

Carbon markets could play an important role in providing such incentives in the longer term. But there are short-term risks of de-stabilising the crucial process of building strong carbon markets if deforestation is integrated without agreements that increase demand for emissions reductions, and an understanding of the scale of transfers likely to be involved.

Action to preserve the remaining areas of natural forest is urgent. Large-scale pilot schemes are required to explore effective approaches to combining national action and international support.

25.1 Introduction

The earth's vegetation and soils currently contain the equivalent of almost 7500 Gt CO_2[1], more carbon than that contained in all remaining oil stocks[2], and more than double the total amount of carbon currently accumulated in the atmosphere. The carbon presently locked up in forest ecosystems alone is greater than the amount of carbon in the atmosphere[3].

Plants and trees play a vital role in carbon sequestration. This is the natural process whereby living plants and trees remove carbon from the atmosphere through photosynthesis as they grow. Some of this is transferred to the soil through the roots and as leaves fall. But when soils are disturbed through ploughing or trees are cut down, the stored carbon oxidizes and escapes back into the atmosphere as CO_2.

Emissions from deforestation are very significant globally. Independent estimates of the annual emissions from deforestation more than 18% of global greenhouse gas emissions[4],

[1] Prentice et al (2001)
[2] UNDP (2001) estimates this at 2400 Gt CO_2. Includes both conventional unconventional oil, known reserves and as yet undiscovered resources.
[3] Prentice et al (2001) gives ~4500 GtCO2 in forest ecosystems, compared with ~3000 GtCO2, the level with atmospheric concentration levels of 380ppm.
[4] Although all estimates suggest that land use emissions are significant, estimates of the scale of land use emissions vary. The WRI estimates used in this report estimate that emissions from deforestation are about 8 GtCO2 per year (see fig 25.1). This is within the range of the Third Assessment Report of IPCC which estimates emissions from land

greater than produced by the whole of the global transport sector[5]. These emissions could potentially be cut significantly fairly quickly – no new technology has to be developed – although considerable challenges have to be addressed, as discussed below.

While planting new trees is an excellent long-term policy, trees take decades to absorb the equivalent amount of carbon to that which is instantaneously released into the atmosphere when mature trees are cut down and burnt. Depending on the species, a tree may take 100 years to reach maturity, and much more land would have to be allocated for new forests to obtain the same amount of carbon absorption as would be released from burning an existing forest of mature trees. The biodiversity and other co-benefits of new forests are also likely to be much lower than those for natural forests. For these reasons, international support for action to protect existing forests should be kept distinct from the creation of new forest, through the latter is also important.

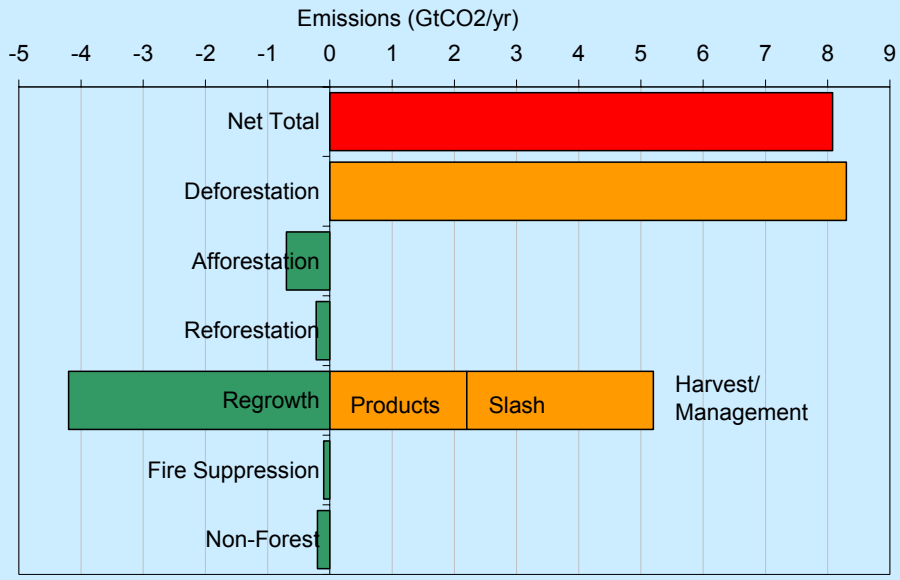
This chapter sets out the drivers of the release of emissions through deforestation, and how these can be reduced. It briefly addresses how atmospheric carbon can also be absorbed through changing agricultural methods, such as moving from deep ploughing to conservation tillage, and generally planting more trees and plants. It then discusses the international framework that can best support national programmes of action, the challenges that need to be overcome, and pilot schemes to start the process of taking action now and allow learning by doing.

25.2 Understanding deforestation

The drivers of deforestation are economic and challenging to reverse.

Action to prevent deforestation, as set out in Chapter 9, offers opportunities to reduce greenhouse gas emissions on a significant scale without much need for new technology except perhaps for monitoring. Action here can also bring significant national co-benefits in terms of local soil, water and climate protection, as well as opportunities for sustainable forest management and the protection of biodiversity and the livelihoods and rights of local communities.

Figure 25.1 Sources of emissions from global land use change 2000



Source: Reproduced from Baumert et al (2005)

use change within the range equivalent to 2.2 to 9.9 $GtCO_2$,, with a central estimate of 6.2 $GtCO_2$. A fuller discussion setting out the range of estimates can be found in Baumert KA et al. (2005).

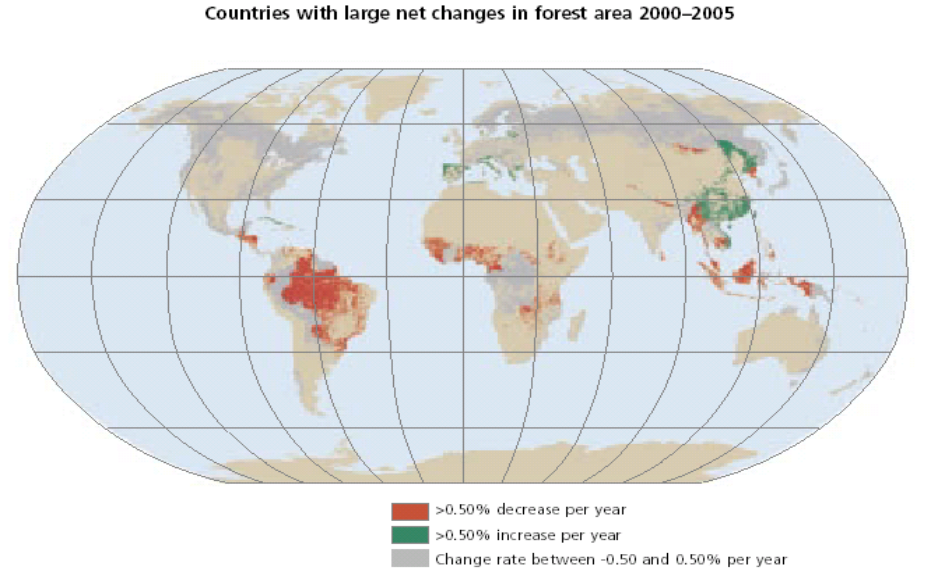
[5] CAIT, WRI. 2000 figures used.

As Figure 25.1 shows, deforestation is the main source of emissions from land use change. Harvesting leads to the release of CO_2 emissions, but growth absorbs CO_2. The difference between the two reflects the unsustainable exploitation of forest resources, such as timber from unsustainable logging[6]. Planting new trees[7] partially offsets emissions by absorbing CO_2.

The bulk of emissions from deforestation arise when the land is converted to agricultural production. Mature forests contain large stocks of carbon locked up within trees, vegetation and soils. Dense tropical forests have especially high carbon stocks per hectare. Conversion to agricultural land through slash and burn techniques releases most of this as CO_2. Burning is a cheaper way of clearing land, releases CO_2 and leaves behind ash that gives a short-lived fertiliser effect to the newly cleared land.

As shown in Figure 25.2, the areas of globally significant forest most vulnerable to deforestation are mainly concentrated in tropical countries. The forces driving demand for additional agricultural land vary globally. In Africa, the main clearers are small-scale subsistence farmers. In South America, the drivers are large farming enterprises producing beef and soya for export. In South East Asia, the driver is a mixture of the two, with oil palm, coffee and construction timber the main products.

Figure 25.2 Deforestation is currently concentrated mainly in tropical areas



Countries with largest annual net loss in forest area 2000-2005	Annual change (1 000 ha/year)
Brazil	-3 103
Indonesia	-1 871
Sudan	-589
Myanmar	-466
Zambia	-445

Source: FAO (2005a)

Logging, which is the process of harvesting large, valuable, mature trees mainly releases CO_2 from the cut trees and those damaged in gaining access to them. If logging is limited to valuable, single trees, forest recovery through re-growth can offset this over time. For these

[6] Although they are classified separately in this figure, unsustainable exploitation of a forest is similar to deforestation.
[7] Reforestation (re-establishing former forests) and afforestation (establishing new forests).

reasons, logging itself need not be a major driver of deforestation. Also if the timber is used for long-lived wooden products it actually conserves carbon during the product lifetime. Logging plays a greater role in specific cases such as Indonesia and elsewhere in South East Asia, where an unsustainable rate of logging is fuelled by the strong demand for timber from fast growing regional economies. The wider impact from logging is that building access roads, to bring in cutting equipment and take out the logs, makes forests more vulnerable to conversion to agricultural production. New logging access roads help to open up former closed regions and allow access to markets for agricultural products.

25.3 Changing economic incentives to reduce deforestation

Effective action to protect existing forests and encourage afforestation and reforestation requires changes to the structure of economic incentives that lead to unsustainable logging and to the conversion of forestland to agriculture.

In Chapter 9 we summarised the findings of research into the direct costs of reducing deforestation. These include net income from the sale of timber, the opportunity costs of agricultural production, the costs of administering and enforcing forest protection, and some transitional costs.

Research commissioned by the Review, suggests that the direct yields from land converted to farming, including proceeds from the sale of timber, are equivalent to less than $1 per tonne of CO_2 in many areas currently losing forest, and usually well below $5 per tonne.[8] The opportunity costs to national GDP would be somewhat higher, as these would include value added activities in country and export tariffs. Other modelling studies, using alternative methodologies, have suggested that, whilst there are significant opportunities to protect forests in some regions at low costs, the marginal abatement cost curve could rise from low values up to around $30 per tonne of CO_2 [9] were deforestation to be eliminated completely.

Although the direct costs could be low at first, there are major institutional and policy challenges that have to be overcome in achieving the transition away from economic activities leading to deforestation towards those consistent with forest conservation. This means that forest conservation and management projects, to be successful, need to be part of a much wider, integrated resource management programme. Many countries have national forest programmes in place that increasingly take a broad inter-sectoral approach to the management and conservation of forests. They espouse a participatory approach to policy formulation and planning, involving stakeholders at the local, sub-national and national levels. The more developed of these programmes are closely linked to higher level policy and planning frameworks, such as poverty reduction strategies, and provide a focus for directing development assistance. Such programmes can be amended so that, in a more targeted and effective way, they can tackle the main drivers to deforestation and unsustainable land use.

A recent World Bank study [10] of deforestation and related issues highlights two key public policy challenges that forested countries face.

The first is to determine who has rights over the forest and what these rights should be. The situation varies widely. In some countries, landowners clear forest legally. Elsewhere, forests owned by the government are illegally encroached upon by subsistence farmers, logging companies and agricultural businesses. Specific circumstances require policies tailored to particular local and national conditions. Over the last 20 years 26 tropical countries have experienced armed conflicts in forested areas, and in some cases timber sales have financed the fighting[11].

[8] Grieg-Gran (2006), calculation assumes CO_2 levels per hectare of tropical forest preserved is 500-750 t per hectare
[9] Sohngen (2006), Obersteiner (2006)
[10] At Loggerheads?: Agricultural Expansion, Poverty Reduction, and Environment in the Tropical Forests. Chapters 5 and 6 have comprehensive discussion of forest management policies. This section draws from the work of this report, and especially from the expertise of Ken Chomitz for which we are grateful.
[11] FAO 2005(b)

The second challenge concerns the social and economic decisions that national governments make about managing land use, including how to balance global and local environmental benefits with the opportunities for production of wood, food, fuel and fibres.

The World Bank study cites several examples of successful efforts to preserve forests and highlights some common themes. Reducing deforestation requires effective and capable institutions at the national, regional and local levels. Involvement of local communities is key to finding solutions that support local development goals.

Clarifying both property rights to forestland and the legal rights and responsibilities of landowners is a vital pre-requisite for effective policy and enforcement.

A lack of clear and enforceable property rights means that forests are often vulnerable to damage and destruction. Loggers can quickly exploit lack of clear ownership and their actions often open up the land for subsequent illegal conversion to farming. Historically there have been violent clashes between landless groups and large landowners, which stemmed from legal ambiguity, conflicting laws made both groups consider they had rightful claims to land and timber[12]. Clarity over boundaries and ownership, and the allocation of property rights regarded as just by local communities, will enhance the effectiveness of property rights in practice and strengthen the institutions required to support and enforce them.

Box 25.1 Local and community ownership of forests

Latin America and South Asia have increasingly involved local communities in the ownership and stewardship of forests, and communities have often opted for more sustainable long-term programmes as a result. Another example is the Joint Forest Management Program in India. This has both improved forest regeneration and had a positive impact on livelihoods. Similarly in Guatemala 13 community concessions, almost all certified by the Forest Stewardship Council, have managed to combine highly profitable mahogany enterprises with deforestation rates lower than in protected or outside areas[13]. Other approaches have allowed local communities to benefit from timber revenues. This helps promote local support. In Cameroon, for example forest concessions were allocated through transparent auctions, with 50% of the royalties going to local communities[14].

Land use planning has a key role to play in determining what kinds of activities are appropriate in forest areas: a complete ban on all activities may be justified in some areas, while in others, logging may be allowed subject to specific rights and duties. Logging concessions can be granted with conditions such as permissible extraction levels and sustainability requirements. Brazil has recently granted such contracts to private companies. The concessions run for 40 years, operations are required to meet key criteria for sustainability. The revenues have been used to set up and run the Brazilian Forest Service, which manages the concessions. In the first year of operation deforestation fell by an estimated 31%.

There are many examples of perverse outcomes from poorly designed forestry policies, including policies that inadvertently create incentives for forests to be cleared illegally. For example, in one case, a tax on timber obtained from legally converting forestland, led to some farmers clearing the land by simply burning the forest[15]. More restrictive regimes for forest management have meant that in practice, it can be easier to get a permit for forest conversion than forest management.[16] This has led loggers to clear-cut and then abandon forest plots they would have been otherwise content to harvest selectively.

Rigorous enforcement of forest protection in one country without action to reduce demand for timber can displace logging to neighbouring countries. Following floods associated with deforestation in the upper reaches of the Yangtze River, China banned the logging of natural

[12] Alston, Libecap and Mueller (2000)
[13] World Bank (2006) However deforestation is still present at a reduced rate.
[14] World Bank (2006)
[15] Merry et al (2002)
[16] World Bank (2006)

forest in 1998 and has greatly increased its own forest cover. However, timber imports from the Russian Far East, South East Asia and Africa have risen strongly since the ban has been enforced[17].

There are further challenges in institutional capacity, governance, and weak law enforcement. It is difficult to turn round entrenched systems of vested interests, although some countries are making significant efforts to do so. Indonesia is trying hard to improve governance, including tenure reform for judges and stricter law enforcement. Efforts to stem the trade in illegal merbau logs between Papau Province and China in 2005 resulted in an 83% drop in Chinese imports of this species[18].

Many frontier forests are remote and lack adequate communication facilities. This makes monitoring the forest difficult, and can cloak conflicts and resource grabs. However developments in remote sensing have started to improve real time monitoring for owners, the authorities and civil society.

Changing economic incentives and encouraging alternative economic activities are essential elements of sustainable forest management.

Competition for, and sometimes conflict over land use, reflects the many potential uses of the land, with changing values depending on the type of crop, world prices and other factors. Land-use planning forms part of the response but may have little impact in practice if land users face strong incentives for non-compliance. Planning that takes more account of the behaviour of those with claims on property, and which seeks popular support, may achieve greater success.

Poverty is often one of the key drivers for people who have little choice but to use forests unsustainably. It is important that the interests and livelihoods of those who would have gained income from converting forestland to agriculture are taken into account. Tackling the causes of poverty through an approach that offers local communities alternatives to deforestation is an important part of efforts to reinforce and sustain action. In the Philippines, conversion of lowland farms to labour intensive integrated rice production, tripled the employment of uplanders, and halved the rate of forest clearance by them[19]. Cameroon drew up a zoning plan on the basis of existing land use patterns, which is thought to have deterred conversion from forest to agriculture.

Many countries have set up protected areas, with the overall area increasing threefold over the past 30 years, while annual spending on protected areas in developing countries is estimated to have risen to $800m. The UN Global Environment Facility financed $3.6 billion of such projects during 1992-2002[20]. Potential areas are often chosen for biodiversity and national heritage value, and may not be at immediate risk of logging or conversion to agriculture. Experience has shown, that for Protected Areas to operate successfully, they need to be an integral part of a wider integrated natural resource management programmes, as otherwise the drivers that lead to deforestation cannot be addressed adequately.

However where people live in or close to forests, preserving the forest does not mean that it has to stay untouched. There are other ways of producing income from forests, and logging can also be carried out in a sustainable way. Estimates indicate that up to 5% of trees can be removed each year without risk to the forest[21]. Reduced impact logging, using known methods[22] can also reduce impacts to the soil from heavy logging machinery by 25% and preserve up to 50% of the carbon stored in the remaining vegetation.

Managing the tension between agricultural land use and forests.

[17] Chunquan et al (2004)
[18] Research in progress by CIFOR (Center for International Forestry Research)
[19] Shively and Pagiola (2004)
[20] World Bank (2006)
[21] C Kremen et al (2000)
[22] Priyadi, H et al (2006)

Fluctuations in the rate of deforestation have occasionally been observed in response to global commodity prices. In Madagascar for example, deforestation increased sharply in response to higher maize prices[23], and in Brazil, increases in world prices for beef, soya beans and pig iron in 1999 greatly increased the incentive for deforestation. They contributed to a 33% rise in the rate of deforestation over the following five years.[24].

Opportunity costs of action essentially reflect the different returns on land depending on its use. The NPV of income[25] ranges from $2 per hectare for pastoral use to over $1000 for soya and oil palm, with one off returns of $236 to $1035 from selling timber. A study undertaken for the Stern report[26] estimates that these returns in 8 countries, responsible for 70% of emissions from land use, are $5 billion a year including one -off timber sales. This level of financial incentive would offset lost agricultural income to producers, although it would not reflect the full value chain within the country. Nor would it reflect the possible response of existing timber markets to reduced supply, given the current margin between producers and final market value, Nethertheless, the high carbon density of each hectare of forest that would be preserved (up to the equivalent of 1000t CO_2) suggests that reducing deforestation offers a major opportunity to reduce emissions at relatively low cost. Assuming a carbon price of $35-50, a hectare containing 500t CO_2, would be worth $17500-25000 in terms of the carbon contained if it were kept as forest, a large difference compared with the opportunity costs at the low end of the range.

Box 25.2 Impact of avoided deforestation on availability of land for food production

The amount of potential agricultural production lost through better protecting forest, both within a country and globally, is likely in practice to be a small proportion of the existing farm output from converted former forest land. The level of output for any particular agricultural product is not fixed, and the additional output will in any case be small compared with total global agricultural output.

Completely eliminating deforestation in those countries covered in research carried out for the review would lead to an annual loss equal to 0.25% of land used globally for soybean production and 6% of land used for oil palm[27]. Depending on the elasticity of demand for products, this would be likely to have only a small impact upon commodity prices.

Much of the agricultural activity that currently takes place on converted forestland could be moved to other types of land, without a significant fall in productivity. For example, advancements in soil science have allowed farmers to grow soybeans and other crops in the infertile 'Cerrado' region of Brazil, a large area previously unusable by farmers. This has taken pressure off of the fertile Amazonian regions, whilst increasing overall agricultural production[28].

Direct incentives can create a value for maintaining forest and form a key part of national programmes to reduce greenhouse gas emissions.

As set out in Chapter 2 of this Review, market failures can be corrected by adjusting prices to include the value of the externalities that are not fully captured by behaviour. Incentives that reflect the full benefits of forests to society could reduce the attractiveness of the potential income from agriculture on converted land. But transparent and legitimate ownership is vital for the success of any scheme that seeks to use incentives to protect forests by changing behaviour.

[23] Moser, Barrerr and Minton (2005), Minten and Meral (2005)
[24] Data from INPE (www.obt.inpe.br/prodes)
[25] These figures are calculated from income over 30 years, using a discount rate of 10%, except for Indonesia which uses 20%.
[26] Grieg-Gran, (2006),
[27] Calculations using Grieg-Gran (2006) and FAO Stat- available at http://faostat.fao.org
[28] The former Brazil Minister of Agriculture **H.E. Alysson Paolinelli** and former Technical Director of EMBRAPA Cerrado Research Center **Mr. Edson Lobato**, both of Brazil; and Washington Representative of the IRI Research Institute, **Dr. A. Colin McClung** of the United States were awarded the 2006 World Food Prize for their work in this area. http://www.worldfoodprize.org/press_room/2006/June/2006Laureates.html

Several countries have successfully included incentive payments as part of their programmes to protect forests. In Costa Rica landowners can receive up to $45 a hectare per year if they if volunteer to maintain forests in the interests of carbon sequestration, biodiversity, hydrological protection and scenic beauty. Combined with other measures this has increased forest cover from 21% in 1977 to 51% in 2005, reducing rural poverty by benefiting 7000 families. Mexico has used similar payments involving payments of up to $28 a hectare a year to preserve forests, in a programme motivated by water scarcity and the need to raise water quality.

25.4 Project-based approaches to increasing carbon storage in land use

Protecting existing forest is the key to maintaining the large stocks of carbon contained in forests that are currently at risk. Action to protect these forests can be complemented by action to increase and store the uptake of atmospheric CO_2 in soils and trees. As with other types of mitigation, this can take place anywhere in the world, and produce the same benefits from reducing atmospheric carbon levels.

Planting new trees could be cost effective in many countries.

Forest cover can be increased in most areas of the world. Eight thousand years ago, 50% of the global land surface was covered by forest, compared with only 30% now. At modest carbon prices, there are potentially large areas of land in many countries where new forests could be planted, should the enabling environment be conducive. The costs of planting new forests depend on the value of an alternative land use and may be offset in the medium term by revenues from sustainable forest use. Reforestation (re-establishing former forests) and afforestation (establishing new forests) in marginal agricultural land and on abandoned land offer significant local benefits by reducing vulnerability to soil erosion and desertification

Table 25.1 Countries with largest recent net gains in forest area

Countries with largest annual net gain in forest area 2000-2005	Annual change (1 000 ha/year)
China	4 058
Spain	296
Vietnam	241
United States	159
Italy	106
Source: FAO (2005a)	

Some countries already have programmes to encourage farmers to convert land and plant trees. For example China, as shown in Figure 25.2 and Table 25.1, in area terms has added forests at a rate equal to nearly half of global deforestation over the past 5 years. Measures include a programme that offers seedlings, cash and grain to farmers who retire marginal or steep, erosion-prone farmland and replant it with grass, fruit bearing trees or trees for timber. Under this plan 7m hectares of farmland was converted in the first 5 years. Vietnam is aiming to establish 3 million hectares of production forest, mainly via plantations, and 2 million hectares of protection forests by 2010. The programme has a strong focus on smallholder reforestation and allocation of forestland to private households, organizations and individuals. More than 1.4 million hectares have been allocated to 500000 families for periods up to 50 years.

An international framework for incentives for reforestation and afforestation is already in place for Parties to the Kyoto Protocol, see Box 25.3.

Box 25.3 Land use change in the Kyoto Protocol

Article 3, paragraph 3 of the Kyoto Protocol requires developed countries to account for afforestation, reforestation minus deforestation, since 1990 in meeting their commitments for the first commitment period. In other words they must take account of forestry activities that increase or decrease forest carbon stocks (or cause other greenhouse gas emissions) since the base year of the Protocol.

The Marrakesh Accords established that afforestation and reforestation would be eligible as project based activities for the CDM. By October 2006 no afforestation or reforestation projects had been registered by the CDM Executive Board, although one reforestation project was requesting registration and two reforestation projects were under consideration. Three afforestation and reforestation methodologies had been approved. Under Joint Implementation (JI), there was one afforestation project at the validation stage, to be hosted in Romania.

The agreement on forest activities has been criticised for its relative complexity, though this was regarded as necessary to reach agreement as the negotiations evolved over time. It is likely to be possible to simplify the inclusion of forestry in future.

Changing agricultural practice can store carbon in soils and biomass.

As discussed in Chapter 9, cost effective carbon sequestration from agricultural land use change practices could amount to 1Gt of CO_2 in 2020. When soils are exposed to microbial activity, CO_2 emissions are released. These emissions can be reduced by disturbing the soil less, for example by using conservation tillage techniques and turning land into permanent set-aside.

Carbon emissions can also be reduced by improving the fertility of the soil because this increases the ability of the soil to sequester carbon, for example by using techniques known as conservation tillage, and by setting aside land to return to grassland. Techniques include planting particular crops and trees together to improve soil nutrient levels (agroforestry), erosion control, restoration, crop residue management and crop rotation.

Market based instruments can be used alongside agricultural extension activity to encourage biological carbon sequestration. The Chicago Climate Exchange[29] (CCX) allows participants (companies who have taken on voluntary commitments to reduce emissions) to purchase Carbon Financial Instruments from eligible projects. These eligible projects include reforestation, afforestation and soil carbon offsets. Soil carbon offsets are created through the use of conservation tillage and grass planting. There is a minimum four-year commitment to continuous no-till on enrolled areas. The projects must be enrolled through an intermediary registered with the CCX that serves an administrative and trading representative on behalf of multiple individual participants, known as an "Offset Aggregator". The first sale of an exchange of verified CO_2 offsets generated from agricultural soil sequestration took place in April 2005. By June 2006, approximately 350,000 acres of conservation tillage and grass plantings had been enrolled in Kansas, Nebraska, Iowa and Missouri.

Measures to enhance natural soil fertility and carbon sequestration potential can also have spin-off benefits in the form of reduced need for man-made fertilisers, reducing the need to deforest land, improved water quality and reduced power and fuel requirements to till land[30]. The Nhambita project in Mozambique, described in Box 25.4 provides an example of how these measures formed the basis of a carbon-offsetting project and also helped to reduce poverty.

29 Source: www.chichagoclimateexchange.com
30 International Soil Tillage Research Organization (ISTRO)

Box 25.4 Sustainable agriculture and forestry project in Nhambita, Mozambique

The Nhambita Community project in Mozambique provides an example of the potential for a beneficial relationship between emissions reductions and poverty reduction. The natural habitat of the Gorongosa National Park was deforested and degraded during the country's 16 year civil war. The aim of the Nhambita project is to regenerate the environment, reduce CO_2 emissions and reduce poverty by incentivising local people to adopt sustainable agricultural and forestry practices. The following activities help to achieve these aims:-

- Agro-forestry is the practice of planting special types of trees and crops, such as the pigeon pea nitrogen fixing crop, to improve the fertility of the soil. This increases crop yields, reduces the need to use synthetic fertilisers that produce GHGs, and enhances the natural carbon absorption of the soil. It also saves emissions because by improving the soil fertility, the land can be farmed for longer and there will be no need to deforest other land to convert it to agriculture.
- Afforestation and planting other crops reduces GHG emissions as the biomass grows and sequesters carbon. Local people are paid to plant trees and crops appropriate to the local habitat and maintain the land. The Nhambita Community project has planted 150,000 trees over the last three years. The sustainable harvest of crops and trees provides a supply of fuel wood and other forest products.
- Forest fire fighting limits damage to crops and forest land. The Nhambita community has purchased mechanised fire fighting equipments and earns money for responding to forest fires.

To date there has been limited success in accrediting small-scale sustainable agriculture and forestry initiatives as CDM projects because the transaction costs are too great. The Nhambita community undertakes the sustainable practices described above under contract with Envirotrade, an organisation that brokers the carbon. The carbon credits from this project are independently verified, then purchased by organisations such as the Carbon Neutral Company on behalf of people who want to offset their emissions on a voluntary basis. The sustainable practices adopted by people in Nhambita are estimated to save 90 t CO_2 per hectare.

Source: Girling (2005) and Envirotrade[31].

25.5 International support for avoided deforestation

Existing international frameworks and processes relevant to deforestation include the United Nations Forum on Forests (UNFF), the International Timber Trade Organisation (ITTO) and initiatives on forest law enforcement, governance and trade (FLEG and FLEGT). There are also forest certification schemes that can be linked to procurement programmes and bilateral and multilateral initiatives.

However there are currently only limited international frameworks that focus upon reduced emissions from deforestation. Action to protect forest incurs costs, requires commitment of resources, and has to compete with other priorities. The pressure for deforestation is greatest in a small number of developing countries, but all countries gain from preserving forests that provide global public goods.

Emissions from deforestation are within the Kyoto Protocol for Annex I countries, but non Annex I countries are where the vast majority of emissions take place. The Marrakesh accords rejected the inclusion of deforestation within CDM projects during the first commitment period, primarily because of concern about the risk that protecting forest in one project area would simply displace deforestation which would just take place elsewhere.

[31] www.envirotrade.co.uk

The scale of the problem is daunting. Without prompt action emissions from deforestation between 2008 and 2012 are expected to total 40Gt CO_2, which alone will raise atmospheric levels of CO_2 by ~2ppm, greater than the cumulative total of aviation emissions from the invention of the flying machine until at least 2025[32].

Taking action to protect forests is therefore too important to wait until the next commitment period. This means that pilot schemes outside the Kyoto Protocol are necessary. These need not be limited in scope - the more ambitious the reductions, the greater the benefit.

Currently, there are a number of schemes involving governments, companies, NGOs and individuals seeking to protect areas of rainforest. Examples include

- ***Debt forgiveness in return for forest protection***

Debt-for-nature swaps are designed to free up resources in debtor countries for conservation activities. The US Government has forgiven debt in exchange for forest protection in 10 countries under the 1998 Tropical Forest Conservation Act. A debt swap involves purchasing foreign debt at a discount and converting the debt into local currency to establish a Tropical Forest Fund, The fund then makes grants to local NGOs engaged in a variety of forest conservation activities. These include research on the protection and sustainable use of local plants and animals, development of sound forest management systems, training of local organizations in forest conservation management, and establishment and maintenance of protected areas. Signed agreements will generate over $100m over the next 10-25 years.

- ***Using insurance markets to protect forest***

Rather than increase premiums, insurance companies can reduce the cost of premiums payouts by improving forest management practice and selection of risk. This needs to be done in parallel with the realignment of forest insurers risk profile. For example the forestry insurance company, ForestRe proposes to use insurance premium criteria to reinforce the benefits from adopting a sustainable forest management system. As such, management is likely to reduce their risks of catastrophic loss, and their premiums will be reduced. It is also exploring linkages to ensure that sound environmental management (including reforestation and watershed management) is required to gain cover for large infrastructure projects, such as refurbishment of the Panama Canal.

- ***International Finance to back national action***

National action can be strengthened by the assistance of NGOs and International agencies. For example, the Amazon Regional Protected Area scheme, a collaboration between the Brazilian Government, the Global Environment Facility, the World Bank and the WWF has set up a project to create 18 million ha of Conservation Units. It includes areas where the forest is fully protected, and areas where sustainable exploitation is possible. Rights of indigenous people are respected and there is biodiversity monitoring and funding for protection of parks and reserves. Another example is the multi-stakeholder partnership proposed by the World Bank, which is designed to bring together developing countries, industrialized countries, international financial institutions, NGOs, and the private sector. This partnership would implement and evaluate, on a prototype basis, incentive payments designed to reduce net deforestation rates in developing countries. The proposed partnership would integrate existing policies and programs for forest protection and management.□

These initiatives offer the opportunity to learn what action is most effective, but they are not sufficient to ensure that forests are protected on a large scale.

Carbon markets could play an important part in providing incentives

Bringing deforestation into the broader multilateral mitigation framework would potentially allow trading of credits earned through preserving forests. The proposal by Papua New

[32] Calculation using IPPC data and IEA data and forecasts

Guinea with other rainforest nations identifies a possible approach to integrating action to protect forests (see box 25.5)

In the long term, the main advantage of inclusion in a system of deep and liquid global markets for carbon is that this would support large-scale action. However any integration with the carbon market should be managed carefully since bringing in a substantial tranche of new emission reductions, particularly if they are cheap to generate, could destabilise the carbon market. They could for example, represent a substantial disincentive on action to reduce emissions from long-lived energy and transport infrastructure unless national targets in participating countries were substantially increased.

Integration for the first commitment period in the Kyoto Protocol is in any case not possible under the existing agreement because the rules are already set. They do not include any provision in the CDM for reduced emissions from avoided deforestation. Beyond the first commitment period the level of commitments can be adjusted to accommodate the new reduction potential. In the longer term there are reasons to believe that the marginal costs of reducing deforestation will rise and that the technical challenges to include avoided deforestation in carbon markets can be overcome. Early crediting for the second commitment period could be a feature of pilot schemes discussed below.

Box 25.5 Compensated Reductions – Proposal by Papua New Guinea and Costa Rica

In the run up to the COP11 meeting in Montreal, Papua New Guinea (PNG) and Costa Rica, on behalf the Coalition of Rainforest Nations[33], led a move to reconsider approaches to "stimulate action to reduce emissions from deforestation". Their key proposal (commonly known as the PNG proposal) was to develop a mechanism to enable carbon saved through reduced deforestation in developing countries to be traded internationally.

Specifically, a country establishes a national baseline rate of deforestation (converted into carbon emissions) and negotiates a voluntary commitment (over a fixed commitment period) for reducing emissions below the baseline. Any reductions that are achieved below the baseline could then be sold under Kyoto or other carbon markets. No trading would be allowed if emissions were above the baseline in a commitment period.

The proposal has focused attention on how deforestation might be included, either as part of future commitments under the Protocol or under the Climate Change Convention itself. The proposal is now being reviewed by the UNFCCC's Subsidiary Body for Scientific and Technological Advice (SBSTA) to report back for COP13 in late 2007.

Challenges to integrating deforestation into carbon markets.

Looking beyond initiatives and project-based approaches in the longer term, there are good reasons to integrate action to reduce deforestation within carbon markets. This is challenging for a number of reasons.

- ***Carbon measurement***

Estimating carbon emissions to a uniform standard from forest preservation activities is more difficult than for energy-related projects. This is because the carbon content of forests varies significantly depending on the density, age and type of trees, and the soils. Detection of forest degradation, as opposed to actual deforestation, is particularly challenging. However, standard inventory methods have been developed by the IPCC and a combination of ground based and remote sensing methods is likely to be feasible. Brazil already uses advanced remote sensing methods, which are increasing in effectiveness while falling in cost. Such remote monitoring can also be used to monitor compliance.

[33] Submission by the governments of Bolivia, Costa Rica, Nicaragua, and Papua New Guinea, supported by the Central African Republic, the Dominican Republic and the Solomon Islands. The Coalition currently consists of Bolivia, Central African Republic, Chile, DR Congo, Congo, Costa Rica, Fiji, Guatemala, Nicaragua, Panama, Papua New Guinea, Solomon Islands and Vanuatu

- ***Natural/accidental deforestation***

Forests can be reduced through natural or accidental causes, such as fires or disease, causing unplanned fluctuations in emissions. Whilst inclusion with carbon markets would incentivise action to reduce the risks, the potential scale of events mean that that the markets would need to allow for this in some way. One approach would be to extend the period over which compliance was assessed, so as to average out fluctuations. The Chicago Climate Exchange[34] dealt with this for their Forestry Carbon Emissions Offsets by creating a carbon reserve pool of 20% of emissions to allow for catastrophic loss, released at the end of the programme. Losses could also be counted against future credits against the baseline or reference level. The way in which this issue is handled will affect credibility and could influence the price at which units are traded.

- ***Ensuring climate benefits***

A key challenge is to ensure that emissions reductions are additional. The nature of the drivers of reforestation implies a substantial risk that, if small areas are protected, leakage to other areas could take place and overall emissions would not be reduced. The only way this can be overcome is to have projects over a large enough area to reduce this risk and induce a genuine change to behaviour of the people involved. This means a strategy for action will probably have to be adopted at a country level rather than relying only on local projects, and national baselines are a feature of the current proposed approaches from the Papua New Guinea and the Coalition of Rainforest Nations. The greater the international coverage, the lower the potential for leakage between countries.

- ***Agreeing an equitable basis for participation and incentives***

Setting baselines that are regarded as fair will be an important part of any future agreement to extend climate change agreements to include incentives to reduce deforestation, whether by emissions trading, a fund-based scheme or some other approach.

Determining the baseline of emissions from deforestation beyond which tradable credits would be earned will not be easy. Getting the level right may involve assessment of the historical trend and is a technical challenge given variability in deforestation rates year by year and lack of historical data in some countries. Setting a baseline incorrectly could lead to distortion in the level of effort.

As with the inclusion of any new sector, allocated limits would have to be re-examined to make sure they were appropriate, given the extended scope of the trading scheme and the limits and incentives adopted by new participants. Agreeing the terms under which countries can earn carbon credits will require consideration of the rate at which action can earn tradable credits. As discussed in Chapter 22, quota allocation must embody criteria of equity.

A particular challenge, when setting baselines, is how to treat countries that have already implemented policies to avoid deforestation such as China and Costa Rica. Focusing only on current deforestation would mean the countries currently removing forests most rapidly could benefit the most. Deforestation can occur at any time, and the potential returns from doing so, could rise if action elsewhere is successful. Potentially, as highlighted by Stiglitz[35], the combination of existing incentives in place to plant new forests, but no or insufficient incentives to preserve existing forests, could encourage perverse behaviour with forests being cut down, and then replanted. The result would be an increase in atmospheric carbon and a likely loss in biodiversity.

Under a global scheme, commitments by all countries to preserve natural forests and plant new forests could be rewarded appropriately. The design of a scheme should address the

[34] See www.chicagoclimatex.com
[35] Stiglitz (2006)

incentives so that the scheme is effective. Understanding and deciding upon the scale of transfers will be relevant to negotiations.

Finding agreement will need consideration by countries as to how to distribute available resources, and could prove challenging if a scheme were considered to channel excessive flows to a limited number of countries, or at the national level to particular interest groups within countries. This might happen it a situation where the price of carbon was far higher than the cost of avoided deforestation. The difference might be considered rents or pure profits. Discounting and taxing credits offer options to handle the creation of excess rents.

Early action can reduce emissions significantly and allow learning to understand how to successfully address challenges arising from large-scale action.

International support for action by countries to prevent deforestation should start as soon as possible. Action starting with a few countries could start to turn the tide, and allow learning from the experience gained. In this way implementation can be used to refine and strengthen action as more countries choose to participate.

Since the rules for the first commitment period are already set, and do not include provision to credit reduced emission from deforestation, and there are difficulties with an immediate integration of deforestation into global markets, there is a need for pilot schemes. These pilot schemes will have to be separate from carbon markets in the first commitment period under the Kyoto Protocol, although the possibility for early crediting for the second commitment period exists.

The important step is to establish pilots to gain practical experience. Pilot schemes could be based on funds with voluntary contributions from developed countries, businesses and NGOs, This approach could also be an alternative to access to carbon markets for the longer term. Fund-based and market-based approaches largely share the preconditions just identified so it is not be necessary to make a final decision at the pilot stage. Practical experience will be needed for integration into global carbon markets or maintaining separate schemes.

Longer-term alternatives to inclusion in the carbon markets, by maintaining a separate but complimentary approach, offer the possibility of being more closely targeted on reducing deforestation and the issues associated with it. These alternatives might deliver savings more cheaply, depending on the long-term carbon price and the level of incentive required. These include:

- ***Specialised funds***

The advantage of specialised funds is that they can be targeted and directed to where they can provide most benefit. The stand-alone nature of protecting forests – there are few direct tradeoffs with other forms of mitigation -make it suitable for focused funds. A fund could work at country level, offering tailored support that provides resources at the outset of a programme and incentives to encourage success. It could also allow countries to generate resources for successfully tackling poverty and the other underlying drivers. The proposal by Brazil, see Box 25.6 could be developed into a specialised fund.

Box 25.6 Brazilian proposal of voluntary scheme[36]

At the UNFCCC Workshop in Rome in August 2006 Brazil proposed a scheme to offer positive incentives to developing countries that voluntarily reduce the greenhouse gas emissions from deforestation.

This would be a voluntary arrangement in the context of UNFCCC, that does not generate future obligations, and would not count towards emissions reductions commitments of Annex I countries. There would be a reference emission rate based upon previous deforestation rates, which would be periodically updated. This would allow annual or periodical emissions from deforestation to be compared to the reference level with standard values of carbon per hectare. Countries could earn credit, or debits (deducted from future incentives), with incentives distributed, according to the ratio of emissions reductions achieved.

This scheme has several elements in common with the Rainforest Coalition proposal - with the crucial difference that funding will be outside carbon markets. The proposal is that developed countries voluntarily share the cost of the scheme.

Targeting funding could allocate resources to individual country programmes depending on the opportunity costs faced, and could sharpen incentives. This could be better than a simple fixed global rate, which, depending on the level, could cost more overall or reduce the overall amount of action.

An example of a specialised fund for forests is the BioCarbon Fund, created in 2004 as a private sector trust managed by the World Bank. So far, the Fund is committed to a diversified portfolio of 23 projects worth $54m. Examples of the types of projects financed include, restoring forest ecosystems by connecting forest fragments with corridors, agroforestry projects, planting trees and improved forest management to enhance carbon storage.

Establishing separate markets for forest credits

A particular form of funding that could also be explored in the pilot phrase could be delivered through markets for biodiversity credits or deforestation credits. These credits would operate in a similar way to carbon credits, with demand coming in from those who wanted to invest in forestry projects linked to corporate social responsibility or other goals.

The credits could recognise a wider range of benefits than just avoided emissions. They could, for example, be based on the area of forest protected rather than complex measurement of carbon saved. If the credits were non-fungible with carbon finance, emissions reductions need not be the denomination, and it would not be necessary to look for parity with the global carbon price.

[36] Presentation by Mr. Joao Paulo Ribeiro Capobianco to UNFCCC Workshop on Reducing Emissions from Deforestation in Developing Countries, Rome 30 Aug to 1 Sept 2006 “Positive incentives to reduce emissions from deforestation in developing countries: Views from Brazil”

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