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GREEN economy

Forests

Investing in natural capital

Acknowledgements

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ABS	Access and benefit-sharing
AIDS	Acquired immune deficiency syndrome
AIJ	Activities implemented jointly
BAU	Business-as-usual
BNDES	Brazilian National Development Bank
BOD	Biological oxygen demand
CDM	Clean Development Mechanism
CI	Confidence interval
CO_2	Carbon dioxide
CPET	Central Point of Expertise on Timber
EMBRAPA	Brazilian Government Agricultural Research Agency
ESC	Environmental Services Certificate
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FLEG	Forest Law Enforcement and Governance
FLEGT	Forest Law Enforcement Governance and Trade
FONAFIFO	Costa Rica's National Forestry Financing Fund
FSC	Forest Stewardship Council
G2	Green Scenario 2
G8	Group of Eight
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse gas
GIS	Geographic Information Systems
GPGs	Global public goods
HIV	Human immunodeficiency virus
ICRAF	International Center for Research in Agroforestry
IEA	International Energy Agency
IFC	International Finance Corporation
IIED	International Institute for Environment and Development
ILO	International Labour Organization
IOE	International Organisation of Employers
IRR	Internal rate of return
ITTO	International Tropical Timber Organization
ITUC	International Trade Union Confederation
IUCN	International Union for Conservation of Nature
LDCs	Least Developed Countries
LPG	Liquefied petroleum gas
NGO	Non-governmental organisation
NPA	Natural Protected Areas
NPV	Net Present Value
NWFPs	Non-wood forest products
OECD	Organisation for Economic Co-operation and Development
PEFC	Programme for the Endorsement of Forest Certification
PES	Payment for Ecosystem Services
PFE	Permanent Forest Estate
REDD	Reducing Emissions from Deforestation and Forest Degradation
RIL	Reduced impact logging
RUPES	Rewarding the Upland Poor in Asia for Environmental Services
SFM	Sustainable forestry management
SIEF	Solomon Islands Eco-Forestry
SSA	Sub-Saharan Africa
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
VETE	Village Eco-Timber Enterprises (Solomon Islands)
VPAs	Voluntary Partnership Agreements
WRM	World Rainforest Movement

Key messages

1. Forests are a foundation of the green economy, sustaining a wide range of sectors and livelihoods. Forest goods and services support the economic livelihoods of over 1 billion people, most of whom are in developing countries and are poor. While timber, paper and fibre products yield only a small fraction of global GDP, public goods derived from forest ecosystems have substantial economic value estimated in the trillions of dollars. Forests sustain more than 50 per cent of terrestrial species, they regulate global climate through carbon storage and protect watersheds. The products of forest industries are valuable, not least because they are renewable, recyclable and biodegradable. Thus, forests are a fundamental part of the earth's ecological infrastructure and forest goods and services are important components of a green economy.

2. Short-term liquidation of forest assets for limited private gains threatens this foundation and needs to be halted. Deforestation, although showing signs of decline, is still alarmingly high at 13 million hectares per year. Although net forest area loss amounts to five million hectares per year, this is a result of new plantations that provide fewer ecosystem services than natural forests. High rates of deforestation and forest degradation are driven by demand for wood products and pressure from other land uses, in particular cash crops and cattle ranching. This "frontier" approach to natural resources – as opposed to an investment approach – means that valuable forest ecosystem services and economic opportunities are being lost. Stopping deforestation can therefore be a good investment: one study has estimated that, on average, the global climate regulation benefits of reducing deforestation by 50 per cent exceed the costs by a factor of three.

3. International and national negotiations of a REDD+ regime may be the best opportunity to protect forests and ensure their contribution to a green economy. To date, there has been no clear and stable global regime to attract investment in public goods that derive from forests and to assure their equitable and sustainable production. Such a regime promises to tip the finance and governance balance in favour of longer-term sustainable forest management (SFM)[1] – which would be a real breakthrough where the viability of SFM has been elusive in many countries. Management for forest public goods would then open up the prospect of new types of forest-related jobs, livelihoods and revenues – where local people can be guardians of forests and forest ecosystem services. It will require REDD+ standards as well as effective systems for local control of forests, and transfer of revenue, to ensure these livelihood benefits are realised.

1. Sustainable forest management may be defined as "the stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfil, now and in the future, relevant ecological, economic and social functions, at local, national, and global levels, and that does not cause damage to other ecosystems" (FAO 2005b).

4. Tried and tested economic mechanisms and markets exist which can be replicated and scaled up. There are enough existing glimpses of green-economy forestry to warrant more serious policy attention, including certified timber schemes, certification for rainforest products, payments for ecosystem services, benefit-sharing schemes and community based partnerships. They need to be catalogued, assessed for the ecosystem services they offer, promoted widely and scaled up. We contribute to that process in this chapter.

5. Investments in natural forests and plantations can deliver economic benefits. Modelling for the Green Economy Report (GER) suggests that an investment of just US$ 40 billion per year over 2010 to 2050 in reforestation and paying landholders to conserve forests could raise value added in the forest industry by 20 per cent, compared to business-as-usual (BAU). In addition, it could increase carbon stored in forests by 28 per cent, compared with BAU. Provided investments are also made in sustainable productivity-enhancing improvements in agriculture (see Agriculture chapter), this expansion in forest plantations need not threaten food production. However, tree planting would have to be carefully targeted to ensure that it does not displace poor farmers, who have ill-defined tenure; tree planting should also provide another livelihood option in rural areas.

6. Legal and governance changes are needed to tip the balance towards sustainable forestry, which is not yet at scale, and away from unsustainable practice, which is entrenched in both the forest sector and competing sectors. Well-managed forests are the cornerstone of ecological infrastructure; as such, they need to be recognised as an "asset class" to be optimised for its returns. These returns are largely public goods and services, such as carbon storage, biodiversity and water conservation and need to be better reflected in national accounting systems. Private forest goods can also have significant economic and social benefits if sustainably produced. Yet, expansion of SFM and green investment face competition from unsustainable and illegally-sourced wood and fibre products, as well as policy biases towards competing land uses such as pasture, agriculture and mining. Both carrots (support for skills training, independent verification of SFM and preferential government procurement) and sticks (tightening up laws and enforcement against illegal logging and marketing) are needed. Also necessary is a revision of policies favouring other sectors, which can erode forest benefits, notably the costs and benefits of agricultural subsidies.

1 Introduction

This chapter makes a case for greening the forest sector. It does so by assessing the gap between BAU in the forest sector and the role of the sector in a green economy. To support that assessment, the chapter reviews the current range of green investments in forests and how they are likely to affect both the timber industry and ecosystem services on which the livelihoods of the poorest depend.

This section includes a description of the forest sector's current state and a vision for forests in a green economy. Section 2 presents the challenges and opportunities facing the sector. Section 3 identifies a number of green investments in forests of different types. It reviews the state of knowledge on their magnitude, private and social rate of return, and economic, social and environmental impacts. Section 4 presents the results of modelling the impacts of directing 0.035 per cent of global GDP to two particular green investments: a public-sector investment that pays landholders to conserve forests; and a private-sector investment in reforestation. Section 5 gives an overview of the enabling conditions for green investments in forests to be effective. Section 6 concludes the chapter.

Box 1: Economic importance of the forest industry in sub-Saharan Africa (SSA)

While a figure of 6 per cent contribution to GDP is often quoted for the entire SSA, such a figure masks the disparities between tropical and non-tropical countries. For example, forests play a major role in the economies of Cameroon, the Central African Republic, Congo, the Democratic Republic of the Congo, Equatorial Guinea and Gabon, and in the livelihoods of local people. The forest sector contributes, on average, between 5 and 13 per cent of the gross domestic product (GDP) of these countries. Up to 60 per cent of export earnings for Gabon are from timber products, while for the Central African Republic it is about 50 per cent. Gabon is the biggest exporter of industrial roundwood, exporting nearly 97 per cent of its total production. Export of medicinal plants is a significant foreign-exchange earner for Cameroon, amounting to around US$ 2.9 million a year.

Source: Gumbo (2010)

1.1 Current state of the forest sector

In 2006, the forest industry (defined as roundwood production, wood processing, and pulp and paper) contributed approximately US$ 468 billion or 1 per cent of global gross value added, of which pulp and paper represented about 40 per cent (FAO 2009). Although this was an increase in absolute terms from 1990, the share of the forest sector declined due to the much faster growth of other sectors (FAO 2009). Nevertheless, the forest industry is extremely important for some developing countries (Box 1). Not captured in these figures on GDP share are the contributions made by forest ecosystem services to human wellbeing and the role of forests in sustaining livelihoods. With a broader concept of GDP, such as the GDP of the poor, which captures the reliance of rural populations on nature, the contribution of the forest sector is greatly increased (TEEB 2009).

Besides wood products and paper, the world's forests also produce a large amount of the energy used in developing countries, particularly among low-income households. About half of the total roundwood removed from forests worldwide is used for energy, including traditional heating and cooking and for heat and power production in industrial operations (FAO 2009). More than 2 billion people depend on wood energy for cooking, heating and food preservation (UNDP 2000). Figures on biomass energy (wood plus crop residues and animal dung) from Openshaw (2010) give an indication of the economic and social importance of the energy derived from wood. According to the International Energy Agency (IEA) (2007), for the world as a whole, biomass energy accounted for an estimated 10 per cent of primary energy in 2005 (47.9 ExaJoule (EJ), of which 39.8 EJ were in Least Developed Countries (LDCs). But in many developing countries it dominates, with over 50 per cent of total energy use. Although much of it is used by the subsistence sector, in many countries biomass energy is the most important traded fuel, both in terms of employment and value. In sub-Saharan Africa, biomass fuels account for as much as 80 per cent of energy consumption.

Forests are also home to important non-wood forest products (NWFPs) that make a significant contribution to local economies and livelihoods; in some cases NWFPs are important exports. The main product categories are food from plant products, raw material for medicine and aromatic products and exudates such as tannin extract and raw lacquer (FAO 2009). It has been estimated that in 2005 the value of NWFPs extracted from forests worldwide amounted to US$ 18.5 billion, but this was

Service	Estimates of value (US$/ha)	Source
Genetic material	< 0.2 – 20.6	Simpson et al. (1996) Lower estimate: California Higher estimate: Western Ecuador
	0 – 9,175	Rausser and Small (2000)
	1.23	Costello and Ward (2006) mean estimate for most biodiverse region
Watershed services (e.g. flow regulation, flood protection, water purification)	200 – >1,000 (several services combined in tropical areas) 0 – 50 single service	Mullan and Kontoleon (2008)*
Climate regulation	650 – 3,500	IIED (2003)*
	360 – 2,200 (tropical forests)	Pearce (2001)*
	10 – >400 (temperate forests)	Mullan and Kontoleon (2008)*
Recreation/tourism	<1 – >2,000	Mullan and Kontoleon (2008)*
Cultural services – existence values	0.03 – 259 (tropical forests)	Mullan and Kontoleon (2008)*
	12 – 116,182 (temperate forests)	Mullan and Kontoleon (2008)*

* Lowest and highest estimates from a review of valuation studies

Table 1: Estimates of the value of forest ecosystem services

believed to cover only a fraction of the total value because of incomplete coverage of the statistics (FAO 2010). Numerous studies have shown the importance of the subsistence use of NWFPs for people's livelihoods. In a review of 54 case studies, over half of which were from Eastern and Southern Africa, Vedeld et al. (2004) estimated that the average annual forest environmental income amounted to 22 per cent of household income. While a large part of this was from fuelwood, wild foods and fodder for animals were also important.

Forests, which sustain more than 50 per cent of terrestrial species (Shvidenko et al. 2005), play a vital role in protecting watersheds and regulating climate (ecosystem services) and they have great cultural and symbolic significance. Valuation studies of these services conducted in many different countries have shown a wide variation in results, reflecting the importance of location, the methodologies and assumptions about biophysical linkages, e.g. between forest cover and watershed services (Table 1). Studies that concentrate on the value of the climate-regulation services of forests associated with reducing deforestation also produce substantial estimates (Box 2).

Scaling up from such wide-ranging values is challenging, and estimations of values at a national or global scale have produced huge ranges. While there is still a high degree of uncertainty about the value of forest ecosystem services at a global level, even conservative estimates tend to be high, measured in trillions of US dollars, This indicates the importance of taking these services into account in decision-making on land and resource use.

Forests also provide significant employment, with the contribution of the formal sector greatly outweighed by that of the informal sector. About 10 million people are employed in forest establishment, management and use worldwide (FAO 2010). Adding employment in primary processing, pulp and paper and the furniture industry brings the figure to about 18 million people (Nair and Rutt 2009). Despite growing informality and mechanisation, forestry is still a highly significant sector, with roughly 0.4 per cent of the global workforce (FAO

Box 2: The value of forest ecosystem services: climate regulation

Hope and Castilla-Rubio (2008), contributing to the Eliasch Review (2008) estimated that the net present value of benefits in terms of reduced climate-change damage associated with reducing deforestation and hence emissions by 50 per cent each year from 2010 to 2100 would be US$ 5.3 trillion (mean) with a 90 per cent confidence interval (CI) of US$ 0.6 to US$ 17 trillion. Reducing deforestation by 90 per cent from 2010 was estimated to yield benefits of US$ 10 trillion (90 per cent CI of US$ 1 trillion to US$ 30 trillion). The mean benefits from reducing deforestation in both scenarios were found to greatly exceed the mean costs by a factor of approximately three (3.12 for a 50 per cent reduction and 2.86 for a 90 per cent reduction). In both cases there is a possibility that net benefits could be negative but the probability is very low.

Scope	Estimate	Source
Formal employment in forestry, wood processing and pulp and paper	14 million	FAO (2009)
Formal employment in furniture industry	4 million	Nair and Rutt (2009)
Informal small forest enterprises	30–140 million	UNEP/ILO/IOE/ITUC (2008), citing Poschen (2003) and Kozak (2007) for lower and higher estimate, respectively
Indigenous people dependent on forests	60 million	World Bank (2004)
People dependent on agroforestry	500 million–1.2 billion	UNEP/ILO/IOE/ITUC (2008)
	71–558 million	Zomer et al. (2009). For agricultural land with 10% tree cover up to 50%
Total	119 million–1.42 billion	Lower bound assumes overlap between indigenous people dependence and agroforestry

Table 2: Forest-dependent employment and livelihoods

2009). Outside of the formal sector there is greater uncertainty about the number of people dependent on forests for employment and livelihoods, as shown in Table 2. As a result, the estimate for the total number of people dependent on forests ranges from 119 million to 1.42 billion. But even conservative estimates of people engaged in informal forest enterprises, indigenous people dependent on forests and people dependent on agroforestry, greatly exceed employment in the formal forest sector.

There are regional variations, however. The employment role of the sector has been declining, particularly in Europe, East Asia and North America, most probably because of gains in labour productivity (FAO 2010). The only countries in Europe that have increasing employment in the forest industry sector are Poland, Romania and the Russian Federation. Latin America and the Caribbean and the developing Asia-Pacific region are the two regions where the forest industry sector has been expanding on all fronts over the last decade. This has been driven by various factors, including the abundance of low-cost, skilled labour, relatively abundant forest resources, a high rate of economic growth, specific polices to encourage development and investment in the sector and a general improvement of the investment climate (Lebedys 2007).

The production and trade of fuelwood is also important for employment. Openshaw (2010), while noting that there are no definite estimates, suggests that nearly 30 million people worldwide may be involved in the commercial production, transport and trade of biomass- energy products, generating around US$ 20 billion annually. More specifically, a survey in Malawi in 1996/7 found that 56,000 people were involved in tree growing, fuelwood and charcoal production, transport and roadside and urban trading in the country's four principal towns. This was many times greater than the number employed in kerosene, liquefied petroleum gas (LPG) and electrical production, transport or transmission and trading for the household sector, estimated at 350 to 500 (Openshaw 2010 citing Openshaw 1997a and b). A repeat survey carried out in 2008 found that employment in growing, production, transport and trade of biomass energy had increased significantly to 133,000 (BEST 2009).

1.2 Scope of the forest sector

The forest sector can be considered in various ways: from merely forest management and primary production, to the whole supply chain of forest products and to the provision of ecosystem services. The focus of this chapter is on forests and the production and management of forest ecosystem services, including carbon management/climate regulation, water-quality management, energy provision and ecotourism. While issues of resource and energy efficiency and clean production are important in the manufacture of secondary wood-based and fibre-based products, they also apply to a number of other industrial sectors, and are therefore covered in the Industry and Energy chapters of this report.

The management of forest ecosystem services is unique to the forest sector (albeit influenced by other sectors) and we therefore give it priority here. The focus on forest ecosystem services also has the effect of widening the range of products and services that can be considered part of the downstream forest sector.

Confining the scope of the chapter to the production of forest ecosystem services simplifies matters but still leaves open the question of what types of forest to consider. FAO's official definition of forests covers a broad spectrum from pristine natural forests undisturbed by human intervention, often known as primary forests, to intensive high-yield plantations, as shown in Figure 1. In between, are natural forests with varying degrees of human modification, and various types of planted forests. We are interested in all of these forest types, in the

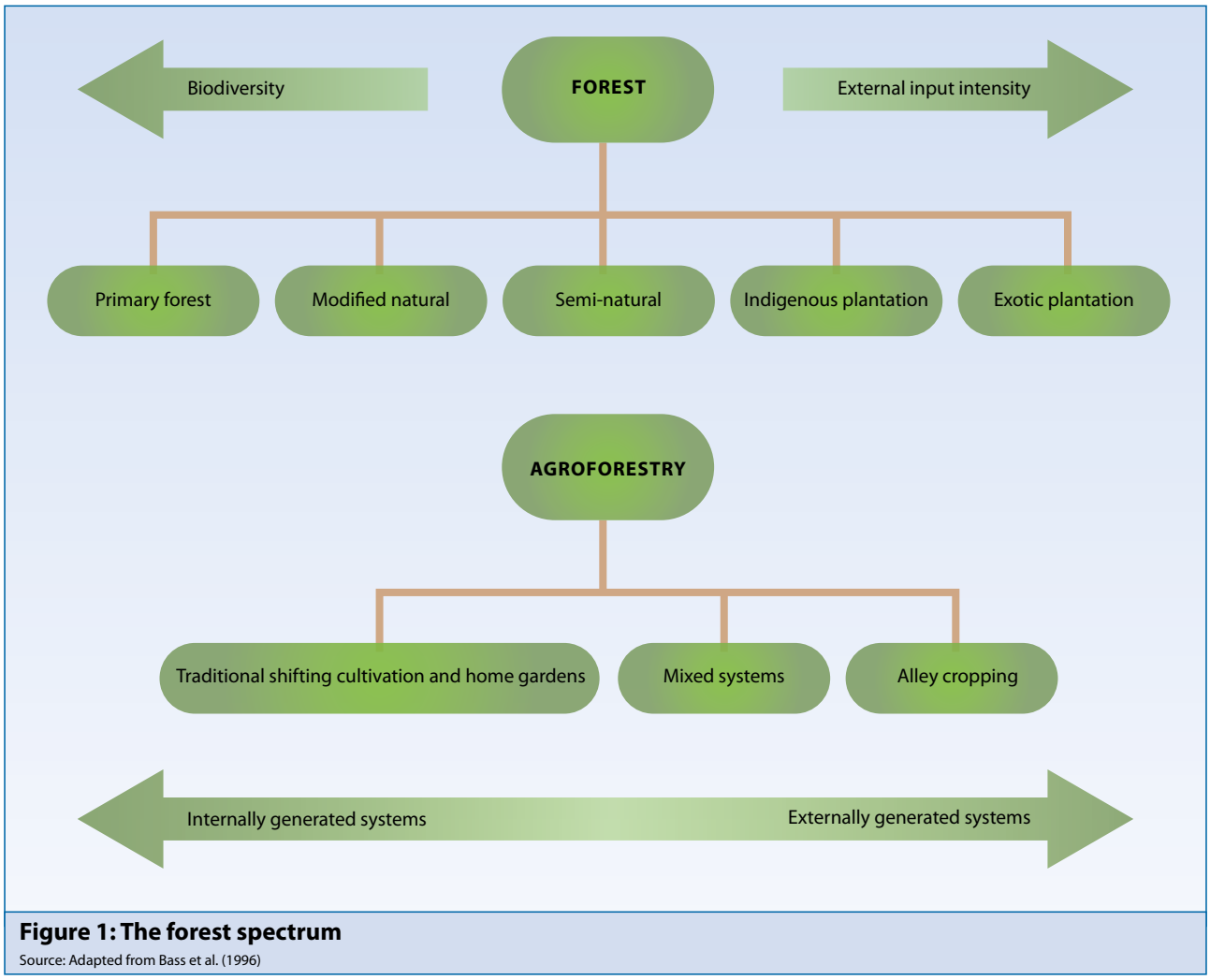

Figure 1: The forest spectrum
Source: Adapted from Bass et al. (1996)

extent to which each of these are managed for a range of ecosystem services, and the balance between them. Not covered by FAO's definition are various agroforestry systems, including admixtures of tree, crop and livestock regimes at the field or landscape level, under the management of the farmer. We include them in this chapter because they often provide many, if not all, forest ecosystem services and are important for livelihoods.

1.3 Vision for the forest sector in a green economy

Greening the forestry sector implies managing it and investing in it as an asset class that produces a wide range of benefits to society. The wider economic roles of forests in a green economy include: as factories of production (producing private goods from timber to food), as ecological infrastructure (producing public goods from climatic regulation to water-resource protection) and as providers of innovation and insurance services (forest biodiversity being key to both).

The greening of the forest sector will be driven by societal demands for ecosystem services spread across several sectors, encompassing the traditional industries of wood processing and paper manufacture as well as tourism, energy, water management, carbon trading and new forest-based products. Forestry in a green economy will also meet critical livelihood needs of local communities by providing a stream of fuelwood, construction materials, food sources and medicinal plants. Effective local control and management of forests need to be improved but governments, through access and benefit-sharing (ABS), and new markets, such as ecosystem services, will ensure there are greater economic incentives to do so. These incentives would emerge from a robust and fair international system that ensures forest-related public goods, notably carbon storage and biodiversity conservation, are transferred between nations. Forests would also attract interest from financial institutions opening up forests as a new economic asset.

With greater understanding and recognition of the public goods generated by forests, and the increasing financial rewards for producing them, it becomes critical for forest managers and governments to account more effectively and transparently for forest stocks and flows. This entails being able to measure and value the forest sector's contribution to societal wellbeing in

more sophisticated ways and capturing the full range of marketed and non-marketed goods and services, including the significant contribution they make to the livelihoods of the poor and marginalised.

1.4 Indicators

In order to assess how far the forest sector is shifting towards a green economy, it will be important to keep track of indicators that measure the following: 1) the changing proportion of consumption made up by forest goods and services, and particularly the rate of substitution of carbon-intensive products with forest products; 2) changing markets for forest ecosystem services; 3) investments in sustainable forest enterprise and production, especially those which aim at several ecosystem services and include sustainability conditions; 4) the changing ownership of forest land and forest enterprise, notably the inclusion of local forest stakeholder groups; 5) forest governance improvements; and 6) the sustainability of forest management, from stand to landscape to national levels, in environmental, social and economic terms.

2 Challenges and opportunities

2.1 Challenges

The major challenges facing the forest sector include the loss of forest, competing land uses, market, policy and governance failures. These challenges are connected. Competing land uses, especially from agriculture, are immediate causes of forest loss. These competing land uses are, in turn, driven by market, policy and governance failures.

Trends in forest cover and deforestation

There are clear signs that forests are not being sustainably managed. Table 3 shows that the world's forested area is declining both in absolute terms (deforestation) and in net terms (taking account of forest planting and natural expansion), although at a slower rate than in previous decades. Changes in total forest area at the global level, however, mask regional variations. Forest cover stabilised in North and Central America and expanded in Europe and Asia, in the latter case mainly owing to large-scale afforestation in China, which offset continued deforestation in Southeast Asia. Africa and South America underwent the largest net loss of forests in this period (2000-2010) and Oceania also experienced net loss (FAO 2010).

In its latest Forest Resource Assessment, FAO (2010) revised upwards its deforestation estimate for the 1990s. In the Forest Resource Assessment 2005 (FAO 2005a), deforestation in the 1990s was estimated at 13 million hectares per year.

Trends for different types of forests are also important. Of most concern is the decline in primary forests, 40 million hectares of which have been lost or modified since 2000. In contrast, planted forests are expanding more rapidly, with a 50 per cent increase in the growth rate over the previous decade, and now account for 7 per cent of the total forest area worldwide (FAO 2010). This expansion – explained by the forest transition theory – is expected to continue (see Box 3). Carle and Holmgren (2008) predict that the area of planted forest in 2030 will reach between 302.7 million hectares and 345 million hectares, depending on assumptions about productivity increase. Three-quarters of all planted forests consist of native species, although introduced species are more common in a number of countries with large areas of planted forests across sub-Saharan Africa, Oceania and South America (FAO 2010).

Competing uses of land

Agricultural expansion, often combined with timber extraction and the expansion of infrastructure, which facilitates access, has been found to be the main proximate cause of deforestation in tropical areas over the last two decades (Geist and Lambin 2002; Chomitz et al. 2006). Increasing population, increasing income and shifts in tastes to more meat-based diets are forecast to increase the demand for food by 70 per cent (in value terms) by 2050 (Bruinsma 2009). To meet this demand, further clearing of forest will be required unless agricultural productivity can continue to rise significantly. Increasing demand for biofuels means they will compete with food crops for land, putting further pressure on forests. Climate change, where it has an adverse impact on agricultural yields, will add to the pressure for converting forests to agricultural land. It also affects forests directly through changes in their growth rate or in fire propensity.

Market, policy and governance failures

Underlying the loss of forest and competing land-uses are governance and market factors that render deforestation a rational (and often legal) course of action, irrespective of the environmental and social costs. Governance drivers include the lack of forest rights for local stakeholders, which discourage local investment in intact forests and which enable appropriation of land and/or forest resources by more powerful outsiders. These are compounded by market failure, as not all of the important ecosystem services provided by forests are captured in markets. Those taking decisions on the practices used in timber extraction and conversion of forests to other land uses do not factor in the adverse effect on the provision of ecosystem services (Pagiola et al. 2002). Because maintenance of these other ecosystem services is not usually rewarded, there is very little incentive for forest managers to take them into account (De Groot et al. 2010).

	1990	2010
World forest area (hectares)	4.17 billion	4.03 billion
World planted forest area (hectares)	178 million	264 million
	1990-2000	2000-2010
Annual net forest loss (hectares/year)	8.3 million	5.2 million
Annual deforestation (hectares/year)	16 million*	13 million
Annual increase in planted forest (hectares/year)	3.6 million	4.9 million

Table 3: Trends in forest cover and deforestation

Source: Compiled from data in FAO (2010)

* In its latest Forest Resource Assessment 2010 FAO revised upwards its deforestation estimate for the 1990s. In the Forest Resource Assessment 2005 (FAO 2005a), deforestation in the 1990s was estimated at 13 million hectares per year.

Box 3: Forest transition theory

Globally, the area devoted to planted forests is growing. Planted forests are estimated to produce 1.2 billion m^3 of industrial roundwood, which amounts to about two-thirds of all production (Carle and Holmgren 2008). Further shifts in production to planted forests are expected. Improvements in technology mean that more and more can be produced per hectare of land. For example, eucalyptus plantings in Brazil have reached productivity levels exceeding 50 m^3 per hectare (FAO 2009). In view of such improvements, FAO (2009) predicts that growth in production from planted forests will keep pace with growth in demand for industrial roundwood. This can be expected to reduce the pressure on primary forest, although much of the latter could be lost by the time the switch to planted forest has taken place.

This growth of planted forests is explained by the forest transition theory (Mather 1992) and the stages of forest development (Hyde 2005, which draws on von Thunen's rent model; see also Angelsen 2007 who combines the von Thunen and forest transition theories). The theory suggests that countries start with high forest cover and as they develop, the forest is converted to other land uses, agriculture in particular. The process accelerates as infrastructure improvements open up frontier forest areas and makes timber extraction and agriculture economically viable. Over time, as timber becomes scarce, and as the economy develops, providing off-farm employment opportunities, a series of adjustments are made. It becomes profitable to manage forests and plant new ones. The area of forest cover starts to increase again.

This process has been followed by many developed countries and some developing nations, including Costa Rica, which is in the later stages of this transition. Similarly, Vietnam saw its forest cover decline from 43 per cent in 1943 to 20 per cent in 1993 as a result of agricultural expansion and migration into forested areas. Since then, considerable efforts have been made to increase forest cover, an ambitious programme of reforestation. By 2009 forest cover had increased to 39 per cent of the land area (FCPF 2010). In Vietnam, while forest cover has increased as a result of reforestation programmes, the quality of natural forests continues to be more fragmented and degraded (FCPF 2010). This is where valuation is important, as it would show the economic consequences of letting the standard forest transition takes its course.

There are other market adjustments in response to increasing scarcity of wood, in particular, increasing use of wood-processing residues and recovered paper and wood products. While global demand for wood and fibre is expected to almost double by 2030, global production of industrial roundwood is projected to increase by a more modest 40 per cent (FAO 2009).

Thus, taking this longer-term perspective, the concern about forests is not so much about the ability to provide the world's increasing demand for timber and fibre but about the ability to continue providing livelihoods for forest-dependent people outside of the formal economy and to continue providing non-marketed ecosystem services. The latter are currently unpriced and therefore largely ignored in management decisions to date. This raises the question of how to change the shape of this forest transition (Angelsen 2007). Is it an inevitable pattern of development or can a combination of policies ensure the retention of greater areas of primary forest cover? Neither the forest transition theory nor the land-rent model distinguish between forest cover of different types – i.e. primary forest and secondary forest, degraded forest and planted forest. The provisioning services, such as timber and fibre, of forest may be maintained through market adjustments, but other valuable ecosystem services could be lost.

Governments have sought to secure these other ecosystem services of forests through designation of protected areas, restricting extraction of timber, or access or through regulations on timber harvesting and forest management. But these can be difficult to enforce, particularly when development through forest clearing is the norm. At the same time, these market failures can be exacerbated by policy failures or intervention failures, which increase the private benefits of conversion through tax incentives and subsidies. The impact of subsidies for cattle ranching on deforestation in the Brazilian Amazon in the 1980s and 1990s has been well documented (Browder 1988; Binswanger 1991). Similarly, in Cameroon, incentives for plantation agriculture led to natural forests being cleared for commercial agriculture (Balmford et al. 2002).

2.2 Opportunities

Together with the challenges facing the forest sector, there are also opportunities for greening the sector. They include the establishment of sustainable forest management (SFM) criteria and indicators, the growth of protected areas, the concept of reducing emissions from deforestation and forest degradation (REDD+) and the growing acceptance of payments for ecosystem services (PES).

Sustainable forest management (SFM)

Although there is no consistent, routine and comprehensive assessment of forest management globally, considerable effort has gone into developing SFM criteria and indicators to describe comprehensively the elements of good practice. They cover the economic, social/cultural, environmental and institutional dimensions of SFM, based on scientific and technical knowledge of forest systems. Regional criteria include those of the International Tropical Timber Organization (ITTO), which apply to all its member countries. Recent initiatives led by civil society groups and some forest companies and industry associations have developed voluntary SFM codes of practice and management guidelines. Certification schemes provide an independent assessment of adherence to the standards and statistics on them provide an indication of the extent of best practice, although lack of certification does not necessarily imply bad practice.

Currently over 5 per cent of the world's production forests are certified under the Forest Stewardship Council (FSC) standard, at 133 millions hectares certified in 79 countries, including 77.6 millions hectares of natural forests, 12.5 millions of hectares of plantations and 43.3 millions of hectares of mixed natural/plantation landscapes (FSC 2010 data as of 15/04/10). Over 80 per cent of FSC-certified forests are boreal and temperate. Tropical and subtropical forests account for 13 per cent of the total FSC-certified area, with 16.8 million hectares (FSC 2010).

The other major international forest certification scheme is the Programme for the Endorsement of Forest Certification (PEFC). Some 232 million hectares of forest are certified to PEFC's Sustainability Benchmark, nearly twice the area of FSC certification, although some forests are certified by the PEFC and FSC. Almost all the PEFC endorsed certified forests are in OECD countries, just under half in Canada with most of the rest in USA, Scandinavia and Brazil in the tropics (PEFC 2010). However, China is developing a national scheme and is expected to join the PEFC in 2011 (PEFC 2011).

In 2005, ITTO (2006) found that only 7 per cent of its member countries' production forests (25 million hectares) were being sustainably managed. Whilst every ITTO producer-country's policies promoted sustainable management of forests in 2005, management plans existed for only 27 per cent of the 353 million hectares of production forests, and just 3 per cent were certified (Table 4). Despite the low level of sustainable management, however, this is a huge improvement on the mere 1 million hectares of all tropical forests that ITTO had assessed as sustainable in 1988. Furthermore, ITTO noted that some countries have made notable improvements, including Bolivia, Brazil, the Republic of Congo, Gabon, Ghana, Malaysia and Peru. There is

	Africa	Asia and the Pacific	LA and the Caribbean	Total
Total closed natural forest (FAO 2001, '000 hectares)	208,581	226,984	788,008	1,223,573
Total area under permanent forest estate (PFE)	110,557	206,705	541,580	858,842
Percentage	53%	91%	69%	70%
Production PFE	71,286	135,726	190,331	397,343
	64%	66%	35%	46%
Natural production forests				
Total area	70,461	97,377	184,727	352,565
With management plans	10,016	55,060	31,174	96,250
Certified	1,480	4,914	4,150	10,544
Sustainably managed	4,303	14,397	6,468	25,168
Percentage sustainably managed	6%	15%	4%	7%
Planted production forests				
Total area	825	38,349	5,604	44,778
With management plans	488	11,456	2,371	14,315
Certified	-	184	1,589	1,773
Protection PFE	39,271	70,979	351,249	461,499
	36%	34%	65%	54%
With management plans	1,216	8,247	8,374	17,837
Sustainably managed	1,728	5,147	4,343	11,218
Percentage of PFE that is sustainably managed (excludes planted areas)	5%	12%	2%	4%

Table 4: Management status in tropical permanent forest estate (PFE) (2005, '000 hectares)*

Source: ITTO (2006). Includes forests in the tropical PFEs of all ITTO producer member countries except India

* Permanent forest estate (PFE) refers to "certain categories of land, whether public or private, that are to be kept under permanent forest cover to secure their optimal contribution to national development" (ITTO 2006). Closed natural forests are defined by FAO (2001) as forests "where trees in the various storeys and the undergrowth cover a high proportion (>40 per cent) of the ground and do not have a continuous grass layer".

still considerable room for improvement, in view of ITTO's conclusion that resources for enforcement and management are woefully and chronically inadequate, trained staff, vehicles and equipment are all in short supply, while systems for monitoring and reporting forest management are often limited or lacking.

In OECD countries, it is likely that there is a greater extent of sustainable management. The European Union estimates that 80 per cent of its forested area is under a management plan and 90 per cent of that area is managed sustainably: a large proportion of the area is managed by small private owners who have held the forest for generations. A majority of Canadian and many US production forests are certified. Although there are good examples of forest management in Russia, over-logging has occurred, especially in the Russian Far East, near the border with China (Sun et al. 2008).

It is also possible that a large proportion of small-scale informal forest enterprises (family forests, indigenous forests), which are beyond the scope of assessments like that of ITTO, are sustainably managed. This can be judged by the longevity of the forest resources, passed from generation to generation, and evident production of multiple goods and services. However, there is little information to go on, apart from the minority of forests that are certified.

Growth of protected areas

One apparently positive trend from the environmental perspective is that the area of protected forests is increasing. About 13.5 per cent of the world's forests are protected according to IUCN categories I-VI and 7.7 per cent (about 300 million hectares) for categories I-IV, involving more restrictions on land use (Schmitt et al. 2009). The area of protected forests has increased by 94 million hectares since 1990, of which two-thirds has been since 2000 (FAO 2010).

In Latin America designation of protected forests has been one of the most used strategies for the sustainable management of forests. It is estimated that there are 100 million hectares under IUCN categories I, II and III (which are the most restrictive) in Latin America and the Caribbean (Robalino et al. 2010). Growth in protected areas has been particularly rapid since the 1980s. In sub-Saharan Africa, 32.5 million hectares of forests and

Box 4: The national PES scheme in Costa Rica

The Costa Rican Payments for Ecosystem Services programme (PSA, in Spanish) was created in 1996, through the Forestry Law 7575, which recognises the provision of ecosystem services from forests. Based on the beneficiary pays principle, it suggests that forest owners should be compensated for the following services:

- Mitigation of greenhouse gases (GHG) (reduction, sinking, fixing and storing carbon);
- Protection of water for rural, urban or hydroelectric use;
- Protection of biodiversity for conservation, scientific and pharmaceutical use; and
- Landscape beauty for tourism.

Forest owners are currently paid for several land-management practices, and all except agroforestry are paid per hectare over five years: forest conservation (US$ 320), offering higher payments in hydrologically-sensitive areas (US$ 400), areas identified as "conservation gaps" (US$ 375), reforestation (US$ 980), forest management (active before 2003 and again in 2010, receiving US$ 250); forest regeneration, which could be in areas that meet the additionality criteria (US$ 320), or not (US$ 205); and agroforestry (US$ 1.3 per tree, paid over three years).

In order to finance this program, FONAFIFO (Fondo Nacional de Financiamiento Forestal or National Forestry Financing Fund) receives funds from different funding sources: public funds in the national budget, donations, credits conceded by international organisms, private funds, own generated funds and timber and fuel taxes. Also, in 2001 FONAFIFO created the Environment Services Certificate (ESC), which is a financial instrument where FONAFIFO receives funds from companies and institutions interested in compensating forest owners for preserving forests.

Between 1997 and 2008 FONAFIFO distributed US$ 206 million, an average of US$ 17.2 million per year (Porras, 2010). The majority of funds were for forest protection (73 per cent), covering 460,000 hectares of forest, and almost 6,600 contracts were signed across the country.

Source: Robalino et al. (2010)

woodland, corresponding to 5 per cent of the total forest area, are formally protected (IUCN categories I-VI) and as much as 8 per cent, if forestry reserves are included (Gumbo 2010).

It should be noted, however, that although there has been a marked expansion in protected areas, there is no guarantee that they will be well-enforced. This is evidenced by the continuing loss of forests and other natural ecosystems within protected areas. Effectively enforcing the land and resource-use restrictions in protected areas is challenging and many are being encroached on, particularly in densely populated countries (Chape et al. 2005). Unsustainable land uses within protected areas are another cause (Cropper et al. 2001). Strassburg and Creed (2009), in a study of 133 countries in Latin America, Africa, the Middle-East, Asia and Eastern Europe, estimate that only one-third of the protected forest area is effectively legally protected, corresponding to 6 per cent of the total forested area in these countries. Of the five regions examined, Latin America has both the highest proportion of legally protected forests (24 per cent) and effective legal protection (9 per cent).

Payments for ecosystem services (PES) and REDD+

New, incentive-based approaches to conserving forests have emerged over the last 10 to 15 years.[2] The most high-profile of such initiatives are PES, which pay forest landowners for providing watershed protection, carbon storage, recreation, biodiversity, etc. These range from local-level schemes, such as the local government in the town of Pimampiro in Ecuador, which makes payments ranging from US$ 6-$12 per hectare per year to a small group of farmers (19 in 2005), to conserve forest and natural grassland in the area surrounding the town's water source (Wunder and Albán 2008; Echavarría et al. 2004), to national schemes such as in Costa Rica, where farmers are paid US$ 64 per hectare per year in five year contracts (to protect biodiverse forests (see Box 4) and global schemes e.g. a range of voluntary carbon offset schemes for planting or conserving trees to fix CO_2 and store it. Some environmental payments schemes also factor in social needs, attempting to persuade poor and marginalised groups to become engaged in providing the service, for example the schemes developed under the RUPES programme in Asia (Rewarding the Upland Poor in Asia for Environmental Services they Provide).

One of the most long-standing global payment schemes is the Noel Kempff Mercado Climate Action project in Bolivia, which was developed as a pilot project in 1997 under the Activities Implemented Jointly (AIJ) programme of the UNFCCC. A consortium of international and local NGOs, some US energy companies and the Bolivian Government bought out local timber concession holders and implemented a community development programme in order to extend the Noel Kempff Mercado Park. Through avoided deforestation the project was expected to avoid emissions of up to 3.6 million tonnes of carbon over 30 years (May et al. 2004).

While PES is primarily associated with developing countries, there are some well-known examples in industrialised countries. The New York City water utility – faced with the need to improve water quality – provides incentives to farmers and owners of forest land in the catchment areas to conserve the forest and adopt agricultural environmental management measures. This proved far less costly than building water-filtration systems (Landell-Mills and Porras 2002). In north-east France, the mineral-water producer, Vittel, paid local landowners to conserve the watershed (Perrot-Maître 2006).

Until recently, the main driver of investment in PES schemes involving forest conservation was the need to protect watersheds. The rules of the Clean Development Mechanism (CDM) limited eligible forest carbon activities to afforestation and reforestation. This meant that carbon projects based on forest conservation were confined to the voluntary carbon market. But as the contribution of deforestation and forest degradation to GHG emissions has become recognised, this approach to mitigation has moved up the agenda in international climate negotiations, first as REDD (reducing emissions from deforestation and degradation) and more recently as REDD+, which adds conservation, sustainable management of forests and enhancement of forest carbon stocks to the list of eligible activities.[3] REDD+ has been likened to a multi-layer PES scheme, with transfers of finance between industrialised countries and developing countries in exchange for emission reductions associated with improvements in forest protection and management, and further transfers from the national level to forest landowners and communities (Angelsen and Wertz-Kanounnikoff 2008). Although PES will not be the only strategy used by governments to achieve forest-based emission reductions, it is likely to be important.

Unlike the project-based approach of international PES to date, REDD+ is likely to involve more national-level approaches, with finance being supplied by developed countries individually or as a bloc against the performance of national-level commitments to reduce deforestation and emissions. This is exemplified by Norway's contribution

2. PES has also been used to promote reforestation and agroforestry.

3. These are defined by Angelsen (2009). Angelsen also notes that REDD+ means different things to different people. The + sign captures the second part of UNFCCC Decision 2/CP.13–11 "policy approaches and positive incentives on issues relating to reducing emissions from deforestation and forest degradation in developing countries; and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries". Addition of a further + to give REDD++ is being promoted by ICRAF to include agroforestry.

to the Amazon Fund in Brazil, which is conditional on the achievement of deforestation-reduction targets[4]. In 2010 Norway announced a grant of US$ 1 billion to Indonesia in return for agreed measures to tackle deforestation and degradation. Indonesia, under the terms of the agreement, has accordingly announced a 2-year moratorium on new permits to clear natural forests and peatlands (Richardson 2010). The sums of money being estimated for full implementation of REDD+ amount to tens of billions of US$ worldwide. Already, the financial support committed for preparation activities and bilateral programmes greatly exceed what has been provided so far in PES, providing grounds for optimism that this new mechanism can capture and transfer important new resources for ecosystem services provided by forests.

4. Available at http://www.regjeringen.no/en/dep/md/Selected-topics/climate/the-government-of-norways-international-/norway-amazon-fund.html?id=593978

3 The case for investing in greening the forest sector

As indicated in the last section, there are promising developments such as certification of sustainable forest management, targets to increase protected areas and the growing momentum of PES and REDD+ schemes. But without a major change in the recognition given to the full suite of forest ecosystem services, in particular in climate negotiations, and in the absence of improvements in the agriculture sector, loss of primary forest is likely to continue. Protected areas will continue to expand but a large proportion will not be effectively enforced. The forest sector will meet the market demand for timber through planted forests and efficiency improvements in processing, but pressures on natural forests from other sectors, agriculture in particular, will continue, exacerbated by climate change. As a result, ecosystem services will continue to be lost.

Additional resources and policies are therefore needed to internalise the value of forest ecosystem services for forest landholders and ensure forests are worth more standing than cleared (Viana 2009). Investments targeted at increasing the profitability of sustainable harvesting techniques and making tree planting worthwhile can also make a contribution. This section reviews a range of investment options for greening the forest sector and identifies the economic, social, and environmental effects of these options.

3.1 Options for green investment in forests

Some broad categories of green private and public investments can be distinguished for the main forest types, including agroforestry, as shown in Table 5. Green investment can be targeted at reversing the loss of forest area by conserving existing areas of primary forest or promoting expansion of forests through regeneration and reforestation. Green investment can also be directed to improving management in existing forests and agroforestry systems to ensure they continue to provide a wide range of ecosystem services. Such investment can only be considered green if it ensured that the forests conserved, established or restored meet principles of sustainable forest management, and balance the needs of different stakeholders. For example, creating a protected area that displaces forest-dependent communities would not meet the principle of supporting relevant socio-economic functions. Moreover, creating a protected area does not guarantee enforcement. Similarly, extending the forest area through tree planting may be contentious if it uses a large amount of external inputs and directly or indirectly displaces local people from their land.

Some of the green investments listed in Table 5 are straightforward to quantify, although there will be considerable variation by location and species. Some of the public sector investments are not well-documented, in particular the amounts being spent on controlling illegal logging.

Because of the public-good nature of some forest ecosystem services, the private sector and holders of forested land are not always able to perceive a sufficient incentive to make green investments in forests, even

Forest type	Investment	
	Private*	Public**
Primary forest	Ecotourism development	Create new protected areas
	Private nature reserves	Improve enforcement of protected areas
	Pay landowners to protect watershed	Pay forest landholders to conserve forests
		Buy out logging concessions
Natural modified forest	Reduced impact logging and other forest management improvements	Incentives for improved forest management
	Certification to sustainable forest management standards	Support establishment of certification systems
		Control illegal logging
Planted forest	Reforestation and afforestation for production	Incentives for reforestation/ afforestation
	Improve management of planted forests	Incentives to improve management
		Reforestation to protect ecological functions
Agroforestry	Extend the area with agroforestry systems	Incentives to landholders
	Improve management of agroforestry systems	Incentives to improve management Technical assistance

* Private could also include investments made by communities

** Some of the public investments listed here may also be made by the private sector, often on a more limited scale.

Table 5: Green investment options for various forest types

if such investments often involve a positive rate of return for society as a whole. Investment by the public sector is therefore needed in some cases to provide forest ecosystem services directly, to provide financial incentives to the private sector to make green investment competitive and to prevent unsustainable forest management, i.e. by controlling illegal logging. The return on investment for the public sector is measured in terms of social and environmental benefits. Research carried out as part of TEEB on the costs and benefits of investing in ecological infrastructure indicates that the rate of return could be very high, with a benefit cost ratio of over 13 to 1 in the case of active restoration of eucalyptus woodlands and dry forest in Australia, and over 30 to 1 for restoration of Atlantic forest in Brazil (Neβhöver et al. 2009).

3.2 Investing in protected areas

The creation of protected areas to restrict access and certain land-use practices has been the dominant approach used by governments to secure ecosystem services by controlling deforestation and forest degradation. In some cases the investment in protected areas may be made by NGOs. A well-known example is the conservation concessions whereby conservation organisations lease forest lands that would otherwise have ended up as logging concessions. Such concessions, mostly led by Conservation International but involving other major NGOs and donors, have been established in a number of countries, including Guyana, China, Cambodia, Ecuador and Madagascar (Rice 2002). Private companies do sometimes operate protected forest areas, usually where there is a tourism interest or where the public sector is providing an incentive. In Brazil, for example, private landowners that set aside a protected area can receive a reduction in land tax (May et al. 2002).

The investment involved for the protected area authority, whether government, NGO or private sector, includes the administrative costs of demarcating and managing the area and keeping unauthorised users out. For the owners and users of the protected forest land it means forgoing timber royalties and giving up the net benefits from agriculture and other land uses that compete with forests. This latter cost has rarely been factored in, except where compensation schemes operate.

Balmford et al. (2002) estimated current expenditure on protected areas at US$ 6.5 billion per year, of which half was spent in the USA. A more recent estimate suggests this could range from US$ 6.5 to US$ 10 billion per year (Gutman and Davidson 2007). These estimates do not distinguish between forest ecosystems and other ecosystems in the protected areas. For example Mullan and Kontoleon (2008) cite an estimate by Bruner et al. (2003) of US$ 8 billion of total expenditure on protected areas, of which approximately 60 per cent covers forested land. This suggests a little under US$ 5 billion per year or US$ 16.7 per hectare (assuming IUCN categories I-IV) is being spent on protected forests.

Many protected areas do not receive adequate funds to ensure their effective management. Very little is spent on compensation to those local communities who lose access to land and resources when protected areas are created. Protected areas are a vital part of the management of forest ecosystem services, but they need to address concerns over ineffective enforcement and share benefits with local communities. Estimates made of the cost of effective enforcement of protected areas with compensation for local communities are two to three times the amount currently spent (Box 5). Increased investment is needed to ensure better integration of communities' interests and to improve effectiveness along with better buffer- zone management.

Investing in protected areas may bring economic benefits to the national economy in the long term. Some countries have been able to build up a lucrative nature-based tourism industry, which has brought in foreign exchange and generated employment. For example Costa Rica, where protected areas received more than 1 million visitors per year in the five years up to 2006, generated entrance-fee revenue of over US$ 5 million in 2005 and directly employed 500 people. Protected areas in Latin America receive large numbers of visitors and generate many associated jobs. For example, Mexican protected areas recorded 14 million visitors per year and 25,000 jobs (Robalino et al. 2010).

Box 5: Costs of effective enforcement of protected areas

The total annual cost of managing the existing network of protected areas effectively was estimated in 1999 to be around US$ 14 billion per year. This included increasing management costs (then estimated at US$ 6 billion) by over a third and introducing compensation payments to communities living in protected areas of some US$ 5 billion (James et al. 1999). A later estimate of US$ 20-28 billion (Balmford et al. 2002) added the cost of up-scaling protected areas to ensure protection of 15 per cent of land area in each region. Assuming that forests constitute 60 per cent of terrestrial protected areas, this would suggest a cost of US$ 12-17 billion per year for effective management of protected forests.

Nature-based tourism is also a major economic activity in sub-Saharan Africa and the number of tourist arrivals is growing faster than the global average (in 2004 at 14 per cent compared with 10 per cent worldwide). In the Great Lakes region, revenue from tourism based on gorilla viewing and other activities brings in about US$ 20 million annually (Gumbo 2010). But the tourism industry in Africa also has human and environmental costs, contributing to the displacement of communities, thus undermining rights and livelihoods (Gumbo 2010).

Admittedly, setting aside forests as protected areas has often been controversial because it is seen as preventing more productive activities such as timber harvesting and agriculture and as being damaging to livelihoods and to human rights, particularly where indigenous people are involved (Coad et al. 2008). Adverse social impacts of protected areas identified by these authors include: displacement of local communities, changes in traditional land tenure, denied or restricted access to resources, loss of employment, crop damage and livestock predation.

Cost-benefit studies have been conducted for protected forests in different regions. These examine costs and benefits at local, national and global levels but are not able to monetise all of the social costs identified above (Balmford et al. 2002; Coad et al. 2008). While there is some variation, a number of the studies conclude that global benefits and sometimes national scale benefits outweigh the overall costs including the tangible opportunity costs to local communities. For example, the protection of the Virunga and Bwindi afro-montane forests of Eastern and Central Africa – home of mountain gorillas – show positive benefits as opposed to costs, but most of them accrue to the international community (Hatfield and Malleret-King, 2004). Overall, gorilla tourism generates US$ 20.6 million per year in benefits, with 53 per cent accruing to the national level; 41 per cent to the international level, and only 6 per cent locally.

Another study (Ferraro 2002), one of six reviewed by Coad et al. (2008), examines the costs and benefits of the Ranomafana National Park in Madagascar, which was created in 1991. It finds that the opportunity costs to local communities amounted to US$ 3.37 million or US$ 39 per household per year, but were greatly exceeded by the global- and national-scale benefits. Earlier studies of the Mantadia National Park Madagascar (Kramer et al. 1995) and Mount Kenya National Park in Kenya (Emerton 1998) reached similar conclusions.

These studies indicate that, in theory, those gaining from the protected areas should be able to compensate local communities and still be better off. Historically, this compensation to communities has rarely happened. This highlights a challenge and an opportunity in a green forest sector for capturing the global benefits and creating redistribution mechanisms that are able to compensate local communities and improve their livelihoods.

As far as environmental effects are concerned, although the creation of a protected area does not guarantee environmental effectiveness and many are being encroached on, there are positive examples suggesting that this investment option merits further attention. Protected areas are considered critical for conserving residual tropical-forest biodiversity (Lee et al. 2007; Rodrigues et al. 2004). Studies in South-east Asia show that parks and reserves consistently recorded larger numbers of endemic bird species and higher population densities than surrounding human-modified areas (Lee et al. 2007).

Figueroa and Sánchez-Cordero (2008) evaluated the effectiveness of Mexican Natural Protected Areas (NPAs) for preventing deforestation. They constructed an effectiveness index, based on the protected areas' percentage of transformed areas, the rate and absolute extent of change in these areas, the comparison between rates of change observed inside the protected area and in an equivalent surrounding area, and between the NPA and the state(s) in which it is located. They found that over 54 per cent of NPAs were effective in preventing land-use or land-cover change.

3.3 Investing in PES

There are no precise statistics on the amount of money currently channelled into PES schemes, but Canby and Raditz (2005) estimate this as being hundreds of millions of US$. The majority of this money comes from governments directly or from international donor support. These funds cover two main types of cost: the payment to the landholder or forest concession holder, compensating for the opportunity cost of forgone land-use, along with the costs of any actions necessary for conservation such as fencing or employment of guards, and the transaction costs of designing, setting up and operating the payment scheme, including contract management, fund management, the transfer of funds and monitoring.

The evidence on the social and economic impacts of PES schemes is mixed, both in terms of the extent to which the poorest groups participate in the schemes and the extent of livelihood benefits for those who do (Engel et al. 2008; Porras et al. 2008). Evidence of impact on non-participants is particularly scanty, and largely confined to observations in Costa Rica where a high proportion of those receiving payments hire labour to carry out

conservation-related work (Ortiz Malavasi et al. 2003; Miranda et al. 2003).

The two national PES schemes involving forest conservation in Costa Rica and Mexico provide contrasting experiences in terms of the nature of participants, reflecting to some extent differences in land and forest-tenure regimes. In Costa Rica, where most land is held privately, small farmers have very little participation in the PES scheme in spite of efforts made to prioritise the poorest regions (Porras 2010). In Mexico, a high proportion of forest land is held as common property by local communities and even though criteria for selecting priority areas were primarily biophysical, the poorest groups were fairly well-represented. In 2003 and 2004, 72 per cent and 83 per cent respectively of the total paid out went to forests associated with marginalised population centres (Muñoz-Piña et al. 2008).

Local schemes such as at Pimampiro in Ecuador and Los Negros in Bolivia have achieved a fairly wide participation of local forest landowners, albeit over a small area, partly because they have been able to adapt to local circumstances (Porras et al. 2008). In Los Negros, for example, the majority of landowners did not have clear land title, but the scheme went ahead on the basis of local recognition of farmers' landholding (Robertson and Wunder 2005).

Analysis of the livelihood benefits of PES schemes in several Latin American countries has given varied results; in general they have been welcomed by participants. The cash payments, with some exceptions, appear to be relatively insignificant when compared with opportunity costs and household income (Porras et al. 2008). This has led some researchers to conclude that the payments function more as support, providing recognition of existing good practice, rather than constituting a real incentive for land-use change (Ortiz Malavasi et al. 2003; Kosoy et al. 2007).

Non-financial benefits, such as capacity building, strengthening of land and resource tenure are therefore often considered to be significant. For example, PES schemes have been found to strengthen resource management and social coordination capacities of the community institutions involved (Tacconi et al. 2009). Capacity building is commonly reported as a benefit from PES schemes (i.e. increasing agricultural productivity in Pimampiro, Ecuador (Echavarría et al. 2004); apicultural training in Bolivia measured at US$ 35 per participant (Asquith and Vargas 2007). However, for Tacconi et al. (2009) there is little evidence available about the long-term impact of capacity-building activities, for instance whether new knowledge and skills were applied in practice.

The evidence on the effectiveness of PES in reducing deforestation is also mixed, reflecting difficulties in establishing a clear counterfactual of what would have happened in the absence of the scheme and in predicting the location of deforestation (Cropper et al. 2001; Nelson and Hellerstein 1997). The national scheme in Costa Rica reflects reductions in national deforestation rates after the scheme started, but much of the research on this scheme throws doubt on a causal link between the two (Box 6). The same can be said for the Mexico

Box 6: Research on the impact of PES on deforestation in Costa Rica

In Costa Rica's Virilla watershed Miranda et al. (2003) asked PES participants about their motivations and found that many of them planned to retain their forests regardless of the scheme. But as forest clearance is prohibited by law, this may have influenced the responses of the landholders as they might not want to state openly that they would contemplate illegal activity. These responses only represent a snapshot in time. It is unclear how these motivations would change as macroeconomic and microeconomic conditions change. Another study examined the characteristics of land included in the PES scheme. In the isolated Peninsula of Osa, for example, it was found that land under protection contracts corresponds mainly to forest that may not be in direct danger of being converted because of its remoteness and difficult access (Sierra and Russman 2006).

Analysis by Sanchez-Azofeifa et al. (2007) at a national level found that although the average deforestation rate dropped from 0.06 per cent per year in 1986-1997, to 0.03 per cent per year in the first phase of the PES programme 1997-2000, there was no significant difference in the rate of deforestation between areas in the national PSA scheme and areas that were not. They suggest that this could reflect lack of targeting of areas under deforestation pressure and also the impact of previous forest conservation policies, including a 1997 legal restriction on forest clearing. Similar results were found in a more recent study by Robalino et al. (2008) i.e., the efficiency of PES in reducing deforestation between 2000 and 2005 was also low. Less than 1 per cent of the parcels of land enrolled in the programme each year would have been deforested without payments.

national scheme (PSAH). The only major study so far of this scheme, (Muñoz-Piña et al. 2008) found that much of the land being put under payments was not at risk of being converted because of its low opportunity costs. In 2003, only 11 per cent of the participating hectares in the scheme were classified as having high or very high deforestation risk. This increased to 28 per cent in 2004 but fell again to 20 per cent in 2005.

A common thread in this research is the importance of targeting specific areas in improving the effectiveness of PES. Robalino et al. 2010, noting that in Costa Rica there was improvement in 2000-05 compared with the 1997-2000 period, argue that targeting areas affected by some deforestation pressure and including spatially-differentiated payments are two plausible next steps to improve the effectiveness of the scheme. This also points to the importance of developing monitoring and verification schemes and data collection (including the use of easily available GIS databases) that can help identify additional areas.

The PES experience also shows that while challenges have been faced in achieving environmental objectives and ensuring the participation of small-scale forest owners and marginalised groups, there has been considerable learning and adaptation to make improvements. In particular, ways have been found of including landowners without formal land title in PES schemes. The most important actions appear to be to introduce environmental and social criteria for targeting, actively promoting the PES option amongst groups that would not otherwise get involved and/or to reduce transaction costs. The involvement of intermediaries or facilitating organisations that have a community development mission is also important (Grieg-Gran 2008).

The main constraint on the expansion of PES schemes has been lack of funds to scale up from pilot projects. Even national-level schemes such that in Costa Rica have been constrained by lack of resources, with applications to enter the scheme greatly exceeding the funds available (Porras et al. 2008). If a REDD+ mechanism is negotiated, there will be a step change in the amount of funds available: the sums currently involved in the readiness phase are already significant.

However, if payment schemes are implemented at much larger scales and in locations where governance is weak, facilitators will have to guard against elite capture and more attention will have to be given to strengthening the land tenure of local communities (Bond et al. 2009). Attention to such safeguards will need to be a part of any investment in scaling up PES under REDD+.

3.4 Investing in improved forest management and certification

This investment approach recognises the importance of the production of timber, fibre, and energy in natural forests; if managed well, they need not conflict with the provision of other ecosystem services. Moreover, the ability to generate returns from forests through timber harvesting that are high enough to compete with other land uses is an important factor preventing total conversion.

Since the early 1990s, various sets of timber-harvesting guidelines on Reduced Impact Logging (RIL) have been produced in different regions of the world, designed to reduce the adverse environmental impacts associated with tree felling, yarding and hauling (Putz et al. 2008). Some of the requirements of RIL imply higher costs for logging companies, in the form of new equipment, safety gear, technically qualified supervisors, reductions in the area harvested and/or the need to use helicopter

Box 7: Research on the profitability of Reduced Impact Logging (RIL)

Studies of the costs and benefits of improved forest management produce conflicting results. Two studies in the Brazilian Amazon, in Tapajos National Forest (Bacha and Rodriguez 2007) and Paragominas (Barreto et al. 1998) have concluded that RIL can be highly profitable. But Putz et al. (2008) highlight other studies that have shown conventional logging to be more profitable (Healey et al. 2000) or have given mixed results (Applegate 2002). They conclude that it is not possible to draw general conclusions about the financial viability of RIL because of the wide range of forest conditions and practices that influence profitability in the tropics.

An earlier review of cost information in over 250 RIL studies (Killmann et al. 2002) concluded that RIL does cost more, but not as much as expected. Activities where RIL involved higher costs included planning, where the median difference (10 observations) was US$ 0.28 per m^3, and felling, where RIL was US$ 0.56 per m^3 higher than conventional logging or 48 per cent higher. It is possible that the experience gained with RIL techniques since this review was carried out has led to a reduction in costs and a greater chance of profitability, as reflected in the more recent studies from Brazil cited above.

or cable systems to log areas with steep slopes (Putz et al. 2008). Given the planning it entails, RIL should involve less wastage of saleable timber and there were high hopes when it was first promoted that it would be sufficiently financially attractive for logging companies to adopt it as part of their normal practice.

The evidence on its financial benefits is mixed though, reflecting the wide range of forest practices and conditions (see Box 7).

Reduced Impact Logging is just one aspect of SFM criteria and indicators used in national standards and in voluntary certification schemes which describe more comprehensively the elements of good practice. There are a number of cost-increasing requirements beyond RIL, which makes it unlikely that increased efficiency will be sufficient to offset these.

The experience from Africa and Gabon in particular has shown that meeting government SFM standards can be challenging (Box 8). SFM management plans are expensive and, as a result, there has been limited uptake.

Many schemes have emerged to certify forest management against SFM standards, as well as wood tracking systems to ascertain sustainable and/or legal wood sources. Independent inspectors assess a mix of forest management documentation and actual field practice. There are two international approaches with widespread support: FSC and PEFC. Both also offer chain-of-custody certification, tracing products from SMFs and verifying they are not contaminated by other (potentially unsustainable) products. The logistics can be challenging, especially for pulp, where many wood sources are mixed. It usually operates through an electronic system of tagging logs with bar-codes and tracking subsequent products.

Companies opting for certification not only have to meet the costs of any improvements needed to meet the standards, but also the direct costs or transaction costs of the certification application. For small forest areas these can be relatively significant (Bass et al. 2001). The direct costs of FSC certification have been estimated to range between US$ 0.06 and US$ 36 per hectare certified, depending on the size of forest area, as unit costs decline with scale (Potts et al. 2010). In certification, links to markets and the possibility of premiums or improved access to high value markets provide the incentive for investment .

An analysis of the impact of forest certification by Cashore et al. (2006) used case studies from 16 countries in four regions (sub-Saharan Africa, Asia-Pacific, Eastern Europe and Russia and Latin America). Positive social effects were consistently reported, including improved pay and conditions for workers, the development of community infrastructure and the provision of training. There was less consistency in these case studies and other recent literature on the market benefits of certification for the companies concerned, raising concerns about its financial sustainability in some areas (Box 9).

While a niche market may exist for some certified timber, many companies (especially in developing and transitional countries) produce for local and national markets. In these cases, tools such as FSC certification will not provide a significant impact on prices received (Cashore et al. 2006). Studies of certification in Africa, Eastern Europe and Latin America provide support for this finding. Nevertheless, in three tropical-forest countries in Asia and the Pacific, there is some evidence of positive market benefits from certification. In other cases, in South Africa and Finland, certification is found to be beneficial in maintaining existing market share (Box 9).

Box 9 provides examples of both positive and negative cost-benefit ratios related to the uptake of certification.

Certification has so far been taken up by forest operations of all sizes in developed countries, as well as by larger companies (often plantation companies) in developing nations. None of the ten largest certified forests are in the tropics and few certified forests are

Box 8: The high cost of SFM plans in Gabon

Rough calculations show that to invest in a 15,000 hectare concession (for locals) a sum of US$ 4,505,000 is needed, of which US$ 2,850,000 (63 per cent) will go towards the development of a management plan and the rest into various associated studies and impact assessments, the most costly being those of fauna. These figures do not include management training and other costs such as licenses. Sustainable forest management has complex requirements. To formulate a Sustainable forest management (SFM) plan for a concession, an inventory of forest resources is needed and funds are required for associated mapping, in-forest measurement and assessment, and development of the plan and a process for implementation. These actions alone entail heavy investments. In addition, the Forestry Code for Gabon calls for low-impact logging practices; workers' compounds must be established for at least 25 years, and associated agricultural sites must be taken into account and studied in advance.

Source: Gumbo (2010)

Box 9: Costs and benefits of certification for producers

In Uganda, there is no internal market for certified products and most exports are destined for other African countries that do not require certification (Gordon et al. 2006). Paschalis-Jakubowicz (2006) reported that although FSC certification increased costs for private producers, this was not reflected in the price of lumber in Polish markets. In Guatemala and Mexico, economic benefits of certification have generally not lived up to expectations, despite major government initiatives encouraging its use in communities and industry (Carrera Gambetta et al. 2006; Anta Fonseca 2006). In Guatemala, the direct and indirect costs of certification in the Maya Biosphere reserve have been estimated to range between US$ 0.10 and US$ 1.90 per certified hectare per year, US$ 8-107 per hectare harvested per year, and US$ 4.2-52.9 per m^3 of harvested round timber. This indicates considerable variation but suggests that for some forest owners the costs are very high. While premiums have been obtained, they are not high (in the case of certified mahogany, US$ 0.05-0.10 per board feet, equivalent to less than 10 per cent of the sales price), and it was found that prices for non-certified wood soon caught up (Carrera Gambetta et al. 2006).

Malaysia has benefited from an average premium of 37 per cent on sawn timbers (see Shahwahid et al. 2006). Muhtaman and Prasetyo (2006) found that Perum Perhutani in Indonesia received a 15 per cent price premium, and Wairiu (2006) reported an increase in price per cubic metre for Solomon Islands Eco-forestry (SIEF) timber marketed through Village Eco-Timber Enterprises (VETE) in the Solomon Islands.

A survey of the furniture industry in South Africa found that although FSC certification does not lead to price premiums, there are other benefits in maintaining existing markets and contributing to quality control (Morris and Dunne 2003) cited in Blackman and Rivera 2010).

In Finland, a survey of perceptions of certified and non-certified wood products companies found that certification was not considered to improve financial performance or to result in premiums but was important for signalling environmental responsibility and maintaining market share (Owari et al. 2006 cited in Blackman and Rivera 2010).

community-run (FSC 2010). This reflects challenges in interpreting and meeting social standards locally, addressing insecure rights and assets of tropical forest land-holders and managers, and poor access to capital, skills and markets (Bass 2010).

However, there are some important exceptions that suggest these challenges could be overcome. Mexico contains more than 700,000 hectares of community-managed FSC-certified natural forest, spanning 33 communities with stands ranging from 56 hectares to 252,000 hectares. Most of these (26 out of 33) cover less than 20,000 hectares (Robalino et al. 2010). The Mpingo Conservation Project in Tanzania was awarded an FSC group certification for its community forests in 2009 and Kikole village, one of the project's constituent rural communities, sold the world's first harvest of FSC-certified African blackwood in January 2010 (FSC 2009).

In terms of the environmental impacts of certification, there is a general perception that certification has been taken up by forest enterprises that were already practising good forest- management. Some support to this perception is given by the geographic pattern of the uptake of certification, which is heavily concentrated (80 per cent in the case of FSC) in temperate and boreal areas (FSC 2010). The evidence on the impact of forest certification on biodiversity has been reviewed by van Kuijk et al. (2009) who concluded that while there is no conclusive quantitative evidence about the effects, the good forest-management practices associated with certification are beneficial for biodiversity. These include reduced impact logging, riparian buffer zones, green tree retention in clearcuts, protected areas within forest management units and biodiversity corridors. The review also showed that many species and ecosystems are negatively affected by any form of logging, highlighting the need for a mix of conservation areas and production areas of forest.

A more recent review and expert survey (Zagt et al. 2010) draws a heavily qualified conclusion that certification has helped reduce biodiversity loss in the tropics. The caveats to this conclusion relate to the limited area of certified natural forest in the tropics and the range of extra-sectoral threats to tropical forests which certification can do little to address.

In short, while there are some positive examples of premiums being received by developing country producers, and good evidence of positive social impacts, the slow pace of expansion of forest certification in

tropical and sub-tropical areas suggests that more proactive support is needed for scaling up. The evidence on environmental impact shows that there is potential, but that investment in certification needs to be accompanied by other measures aimed at protecting high conservation-value forest, controlling illegal logging and policies directed at other sectors.

3.5 Investing in planted forests

Investment in planted forest can take a number of forms. It can be for productive purposes and range from systems using native species to high-yield plantations. Alternatively, trees can be planted to promote ecological restoration and ecosystem services, as in the case of China (Box 10), although use of timber and fuelwood in such cases is often not precluded. A distinction is often made between reforestation and afforestation.[5]

Historically, governments have played a strong role in subsidising plantations, often providing as much as 75 per cent of total costs (Canby and Raditz 2005). This has been particularly significant in low- and middle-income countries, where governments have justified large subsidies in order to increase domestic timber supplies, supply industry with low-cost wood, and even to relieve pressure on natural forests (Canby and Raditz 2005). Global subsidies for plantations between 1994 and 1998 totalled US$ 35 billion, of which US$ 30 billion went to non-OECD countries (van Beers and de Moor 2001; Canby and Raditz 2005).

In Brazil, for many years, industrial forest plantations were promoted for production purposes (fibre for pulp and charcoal) through national government financial incentives (Viana et al. 2002). But several programmes now promote reforestation for ecosystem services. For example, in Piraçicaba in Sao Paulo state, the local authorities in charge of water supply provide assistance to farmers in the form of seedlings and technical assistance to restore riparian forests (Porras et al. 2008). A number of countries have invested in mangrove restoration in order to improve sea defences.

The cost of planting forests and the rate of return on investment varies according to the species, location, and whether planting is for productive or protective purposes. Differences in assumptions about the inclusion of opportunity costs of the land or the land price also lead to variations in reported costs (van Kooten and Sohngen 2007). Table 6 gives an indication of the variation in costs. Taking the range of costs in Table 6 and an annual increase of 5 million hectares, the current level of investment in extending the forest area could range from US$ 1.25 billion to over US$ 40 billion per year.

The rate of return on private investment in planted forest for productive purposes can be very high. Estimates made by Cubbage et al. (2009) of the financial viability of industrial plantations based on exotic species indicate that excluding land costs, returns for exotic plantations in almost all of South America – Brazil, Argentina, Uruguay, Chile, Colombia, Venezuela, and Paraguay – could be substantial, with an internal rate of return (IRR) of 15 per cent or more. Yet the record of public incentives in plantations has been poor, with the wrong choice of sites, poor genetic material, poor maintenance and location too far from markets (Bull et al. 2006; Cossalter and Pye Smith 2003). Changes in local and global markets are also a major factor affecting rate of return. The depressed timber prices on world markets at the end of the 1990s and the early years of the last decade led to smallholder plantations in the Philippines becoming unprofitable (Bertomeu 2003).

The social impacts of reforestation can be very controversial, particularly where it involves large-scale plantations run by private companies because

5. Afforestation refers to planting of trees on land that has not had forest cover for many years (for more than 50 years under the rules of the Clean Development Mechanism) and that is therefore not considered forest land. Reforestation refers to planting of trees on land that has had forest cover removed recently (e.g. within the last 50 years) and that therefore can be considered as forest land.

Box 10: Afforestation in China: The Sloping Land Conversion Programme

The Sloping Land Conversion programme (or Grain for Green programme) started in 1999 with a goal to convert around 14.7 million hectares of erosion-prone farmland to forest within critical areas of the watershed of the Yangtze River and Yellow River in China by 2010 (Bennett 2008). This includes 4.4 million hectares of farmland on slopes greater than 25 degrees (Ibid.). There was also a goal to afforest a similar area of wasteland (Ibid.). Total investment has been US$ 4.3 million per year (Porras et al. 2008). By the end of 2003, 7.2 million hectares of cropland had been converted and 4.92 million hectares of barren or wasteland had been afforested (Xu et al. 2004). By the end of 2006, the area of cropland converted had reached 9 million ha (Chen et al. 2009). This was a considerable increase over previous trends for conversion of cropland to forests, estimated at just 1.2 million ha from the late 1980s to 2000 (Bennett 2008).

Activity	Location	Cost/ha	Reference
Restoring eucalyptus woodlands	S.E Australia	€ 285–(passive i.e. natural regeneration) –€ 970 (active i.e. replanting)	Dorrough and Moxham (2005) *in* Neßhöver et al. (2009)
Restoration of degraded stands	Atlantic forest, Brazil	€ 2,600	Instituto Terra (2007)
Replanting of mangroves	Thailand	US$ 8,240 plus US$ 118/ha per year for maintenance	Sathirathai and Barbier (2001)
Reforestation for carbon sequestration and wood	Costa Rica	US$ 1,633	Based on payment in national PES scheme of US$ 980/ha (Robalino et al. 2010) which covers 60% of costs (Miranda et al. 2004)
Reforestation for carbon sequestration and wood	Ecuador	US$ 1,500	Wunder and Albán (2008)
Afforestation	India various regions	US$ 413 (2001 prices). Mean of 25 estimates from 21 studies ranging from US$ 12 to US$ 755	Balooni (2003)
Industrial forest plantation	Sabah, Malaysia (Acacia mangium)	US$ 921–1,052 (2001 prices)	Chan and Chiang (2004)
Industrial forest plantations	Average for Southern hemisphere, USA and China – main species	US$ 957	Cubbage et al. (2009) excludes land costs, and uses 8% discount rate.
	Uruguay (Eucalyptus globules)	US$ 500	
	US (Douglas fir)	US$ 1,300	
	Colombia (Pinus tecunumani and Eucalyptus)	US$ 1,800	

Table 6: Costs of reforestation and afforestation

of concerns about land grabs, withdrawal of access to local communities to common-property forest resources and replacement of perceived degraded or low-value common property forest, or land important for food production, by forest plantations (WRM 2008a). Other reviews acknowledge these issues but point out that in some areas plantations can provide benefits to the local poor. Garforth, Landell-Mills and Mayers (2005) highlighted the employment generated by the plantation sector in South Africa, directly and indirectly in small-scale processing and retailing and supporting industries, estimating that about 7 per cent of the population depend on the sector. Bull et al. (2005) pointed to extensive outgrower schemes and social programmes of HIV AIDs, education and job training as benefits from plantations in the Southern Hemisphere. But Garforth et al. (2005) stressed that significant investment in local bargaining power is needed for outgrower schemes to offer routes out of poverty.

Small-scale reforestation on the part of communities or small farmers has been less controversial because it is often an important livelihood option introduced with a poverty- reduction aim. Farmers in India have become important suppliers of wood as a result of such programmes (Saigal 2005). A number of reforestation schemes have been targeted at the provision of ecosystem services, notably carbon sequestration. While some case studies have been generally positive, e.g. Miranda et al. 2004, on Costa Rica and Wunder and Albán (2008) on PROFAFOR in Ecuador, concerns have been raised about the long time scales involved for benefits to accrue to farmers and the need for capacity building. The Sloping Land Conversion Programme in China was welcomed by farmers in its early years because the compensation offered outweighed the loss of agricultural return (Xu et al. 2004). However, surveys in five provinces found that there were shortfalls for a significant proportion of farmers from 7 per cent to 77 per cent (Uchida et al. 2005; Xu et al. 2004).

The environmental impacts of reforestation and afforestation vary considerably. Plantations can be contentious owing to their more intensive use of water and chemicals, as well as introduction of exotic and genetically modified tree species. There has been much criticism of monoculture plantations of exotic species (WRM 2008b). Recognising plantations' high potential to produce wood, potentially taking pressure off natural forests, their sustainability is often conferred at the landscape level rather than within the plantation – siting plantations on less biologically and culturally important land within a land-use mosaic, so that the landscape as a whole provides the range of goods and services required.

Even where tree planting is for protective purposes rather than production, much depends on the way programmes are carried out. The mangrove-planting programme in Vietnam has been widely hailed for its environmental benefits. It involved an investment of US$ 1.1 million in planting (carried out by volunteers) and protecting 12,000 hectares of mangroves but

Type of agroforestry system	Location	Rate of return/comparison with conventional farming	Reference
Silvo-pastoral	Central and South America	4–14%	Pagiola et al. (2007)
	Peruvian Amazon	Lower return than shifting agriculture with short time horizon but higher return over a longer period	Mourato and Smith (2002)
Three strata: 1) fruit trees, 2) banana, papaya, lemon 3) spices	Northern Bangladesh	Agroforestry is more profitable than conventional farming with or without the inclusion of family labour costs and less risky	Rahman et al. (2007)
Mixed agroforestry, timber, horticulture, agriculture – timber harvested after 15 years	Chittagong Hill Tracts, Southern Bangladesh	Agroforestry gives lower annual return per land unit than shifting cultivation in year 1, 5, 9 and 13 and higher in other years. Agroforestry has a higher NPV over 15 years at 10% discount rate	Hossaiin et al. (2006)
Contour hedgerows	Eastern Visayas, Philippines	Through soil conservation and improved yields increases agricultural profits by average US$ 53/household or 6% of total income but outweighed by opportunity costs of land and labour. Excludes on-farm benefits such as fuelwood and fodder as well as long run and external benefits	Pattanayak and Mercer (1998)
Fertiliser tree fallows	Zambia	Over 5 years at 30% discount rate, agroforestry is more profitable than continuous maize with no mineral fertilisers	Ajayi et al. (2006)
Rotational woodlots	Tanzania	Agroforestry has an NPV of US$ 388/ha, six times that of conventional maize	Franzel 2004 cited in Ajayi et al. (2006)

Table 7: Rate of return of agroforestry compared with conventional farming

saved US$ 7.3 million per year on dyke maintenance (Neßhöver et al. 2009). In contrast, mangrove restoration in the Philippines produced poor results because trees were planted in the wrong places leading to low survival rates (Neßhöver et al. 2009).

Similarly, the Sloping Land Conversion Programme in China, although effective in bringing about tree planting on large areas of land, has problems of low survival rates and lack of technical support (Bennett 2008). The suitability of this approach for drier regions of China has also been questioned, for example by Zhang et al. (2008), who estimated that in the sub-alpine region of south-western China, afforestation would reduce water yield by 9.6 - 24.3 per cent, depending on the type of species and the climatic conditions. Another study (Sun et al. 2006) which applied a simplified hydrological model across the diverse regions of China, estimated higher annual water yield reductions from afforestation from 50 per cent in the semi-arid Loess Plateau region in the north to 30 per cent in the tropical south.

To conclude, private investment in reforestation has a place in a green forest sector to ensure sufficient supplies of wood. But it needs to take place within management of the landscape and should not replace natural forests, nor land that is important for subsistence food production. The economies of scale of planted forests, particularly high-yield, fast-growing, single-species plantations are such that market forces will drive expansion. But incentives are often given in forms that lead to their replacing natural forests. The CDM also was restricted to reforestation and afforestation, putting natural forest management at a further disadvantage in developing countries. As stressed by Bull et al. (2005) incentives to plantations should be directed instead at promoting forest ecosystem services and social development. Governance conditions are also required that will tilt the balance away from those planted forests that do not support many ecosystem services towards those that do. It is important that certification schemes continue to provide criteria for planted forests, including high-yield plantations, to encourage best practice while not putting sustainable timber harvesting from natural forest at a disadvantage.

3.6 Investing in agroforestry

Agroforestry encompasses a wide range of practices as demonstrated by a definition given in a recent assessment (Zomer et al. 2009): "Agroforestry systems range from subsistence livestock silvo-pastoral systems to home gardens, on-farm timber production, tree crops of all types integrated with other crops, and biomass plantations within a wide diversity of biophysical conditions and socioecological characteristics. The term has come to include the role of trees in landscape level interactions, such as nutrient flows from forest to farm, or community reliance on fuel, timber, or biomass available within the agricultural landscape."

Zomer et al. (2009) estimate that as much as 1 billion hectares of agricultural land could currently be considered as agroforestry if a threshold of 10 per cent tree cover is taken. With a higher threshold of 30 per cent tree cover, the area of agroforestry would be considerably lower at 375 million hectares, but still

significant. They conclude that trees are an integral part of the agricultural landscape in all regions except North Africa and West Asia. Agroforestry is relatively important in Central America, South America and South-east Asia, where there are many long-standing management traditions as well as new scientific forms of agroforestry, but agroforestry is also practiced on large proportion of Africa's land area.

As with reforestation, the costs and rates of return of agroforestry systems vary considerably depending on location, species and management type. FAO (2005b) cites a review by Current and Scherr (1995) of agroforestry practices in Central America and the Caribbean which found that in 2/3 of the cases, Net Present Value (NPV) and returns to labour were higher than for the main alternative practices. Some more recent studies in different locations that have compared the profitability of agroforestry systems with conventional farming systems are shown in Table 7. They are generally consistent with the conclusions in Current and Scherr (1995) but show the importance for the results of time horizons, discount rates and the range of benefits included. A common conclusion of the studies that find in favour of the profitability of agroforestry is that it requires considerably higher investment in the early years. This constitutes a major obstacle to its adoption.

The Food and Agriculture Organization of the United Nations' review of the benefits of agroforestry (FAO 2005b) cited a number of positive impacts for farmers, an additional source of cash income, provision of products such as fodder for livestock, fuelwood and fertiliser in the form of nitrogen-fixing trees, that the farmer would otherwise have to buy, decreased risk because of the wider range of products on the farm, and the ability to earn income throughout the year and accrue benefits at different times, over the short, medium and long term.

Research on the payments for agroforestry scheme introduced in Costa Rica in 2004 as an additional eligible activity in the national PES scheme, provides some evidence on the social impact of providing incentives for agroforestry (Cole 2010). A high proportion (78 per cent) of the farmers interviewed reported an increase in income. This was not from sale of harvested timber but from money left over after planting and maintenance costs were covered. This was particularly important in indigenous communities because of their strong dependence on subsistence farming and little other opportunity for outside income. However, farmers commonly viewed the plantings as a savings account for future generations and saw little short-term benefit. While the payments were concluded to be effective in overcoming initial economic and technical obstacles, the need for ongoing capacity building and support from strong local organisations was highlighted.

A number of projects and programmes have promoted the wider adoption of agroforestry on the basis of its significant on-site and off-site environmental benefits. The Alternatives to Slash and Burn programme showed that tree-based farming systems, whether mixed or monocultural, had significant carbon storage benefits, in part due to its limited soil cultivation and consequent oxidation of soils, in part due to making use of many vertical layers of vegetation. It has been estimated that in Sumatra, Indonesia,

Box 11: Evidence on the impact of incentives for silvo-pastoral practices

Around US$ 4.5 million was invested in payments to farmers in Central America and Colombia to fund a transition to greater use of silvo-pastoral practices in cattle ranching. The payments to farmers were based on a scoring system for environmental services.

Research on the implementation of this scheme in Quindío, Colombia (Rios and Pagiola 2009) shows a significant difference between participants and the control group after four years of payments. Only 13 per cent of the land area in the control group experienced any change in land use and the effect of this change was to increase the environmental service score by 7per cent. In contrast, changes in land-use practices extended to 44 per cent of the area occupied by participants in the payment scheme and the environmental service score increased by 49 per cent. Similar conclusions based on casual observation of neighbouring areas are drawn for the silvopastoral scheme in Matiguás-Rio Blanco, Nicaragua (Rios and Pagiola 2009).

Although water-related services were not a focus of the payment scheme, some positive impacts were also found. The silvo-pastoral scheme in Quindío, Colombia monitored water quality upstream and found a rapid drop in turbidity, biological oxygen demand (BOD) and coliforms after measures had been taken to reforest riverbanks and protect them from livestock entry (Pagiola et al. 2007).

rubber agroforestry systems store about 116 tonnes of carbon per hectare, 45 per cent of the amount stored by undisturbed natural forests (254 t/C per ha), whereas continuous cultivation of cassava stores only 39 tonnes of carbon per hectare (Tomich et al. 2001). The Food and Agriculture Organization of the United Nations (2005b) cites evidence of various types of environmental benefits from agroforestry. In Sumatra (Murniati et al. 2001) showed that households with diversified agroforestry systems depend less on gathering forest products from protected areas than farmers cultivating wetland rice. In the USA, trees planted as wind breaks have been estimated to increase crop yield significantly, for example, by 23 per cent for winter wheat (Kort 1988). More recently, the GEF-funded Silvopastoral project in Colombia, Costa Rica and Nicaragua, which targeted areas of degraded pasture, provides some rigorous evidence of the environmental benefits of creating incentives for agroforestry (Box 11).

In general, agroforestry has potential to be both beneficial to farmers and to provide offsite-benefits in the form of carbon sequestration, reduced sedimentation in surface water, and maintenance of a wider basis of biodiversity than agriculture. But the economic evidence shows that farmers need both financial assistance and technical assistance in making the transition to modern forms of agroforestry. Investment in incentive schemes combined with longer-term technical support can be effective in promoting its expansion.

4 Modelling green investment in forests

In this section we examine the impacts at a global level of increasing investment in two of the options discussed in the previous section: private investment in reforestation and public investment in payments to avoid deforestation. This is because both are highly likely to play a role in climate-change mitigation and will form part of a post-2012 international climate agreement.

4.1 The green investment scenario

Under the global model developed for the Green Economy Report by the Millennium Institute, the green investment scenario (G2) allocates 0.034 per cent of global GDP to reforestation and incentives for avoiding deforestation/forest protection between 2011 and 2050.[6] This equates to US$ 40 billion (in constant 2010 US dollar prices) per year on average, with 54 per cent or US$ 22 billion directed to reforestation and 46 per cent or US$ 18 billion per year to avoided deforestation.

This is similar in order of magnitude to estimates made in the 1990s of the amount of investment needed for sustainable forest management in production forests of US$ 33 billion per year (Tomaselli 2006) and estimates made in recent years for the cost of avoiding deforestation, which range from US$ 5 billion to US$ 15 billion per year (Stern 2007; Grieg-Gran 2006) to US$ 17-28 billion (Kindermann et al. 2008). The amount indicated for avoiding deforestation also compares well with the estimate of US$ 12-17 billion per year made in Section 3.2 of the investment needed for effective management of protected forests (based on Balmford et al. 2002).

4.2 The baseline scenario: business-as-usual

In the model, the baseline scenario or business-as-usual (BAU) for the forest sector replicates the historical trend from 1970 and assumes no fundamental changes in policy or external conditions going forward to 2050. Under business-as-usual, the projection is for a steady decrease in forest cover from 3.9 billion hectares in 2010 to 3.7 billion hectares by 2050. As a result, carbon storage in forests will decline from 523 Gt in 2009 to 431 Gt in 2050. The contribution of the forest sector to global GDP and employment is projected to grow at 0.3 per cent per year between 2010 and 2050 to reach US$ 0.9 trillion and 25 million jobs by 2050. This is in line with growth rates in the sector between 1990 and 2006 (FAO 2009).

4.3 Investing to reduce deforestation

The cost of avoiding deforestation is assumed to start at US$ 1,800 per hectare, increasing to US$ 2,240 per hectare by 2050. This is based on the global average value added per hectare of crop production plus the value added of forest products per hectare (measured in constant 2010 US$ prices), which is taken to represent the opportunity cost if forests are conserved with no extraction of forest products or clearing. This approach to estimating opportunity cost is somewhat different from that taken in a number of studies on this topic (e.g. Grieg-Gran 2006; Börner et al. 2010), which add together the present value of agricultural revenues net of cost discounted over several years and the stumpage fees for timber, but the result is within the range of most such estimates.[7] It can be considered a generous estimate of the opportunity cost as in many locations the returns to converting forests to smallholder agriculture, subsistence and cash crops and to cattle ranching are considerably lower than US$ 1,800 per hectare. This figure is more representative of higher-value land uses such as oil palm (see Grieg-Gran 2006; Chomitz et al. 2006; Börner et al. 2010).

Nevertheless, the cost of designing and administering a payment scheme, the so-called transaction costs, can be considerable, particularly in developing countries and in remote forest areas. While existing national-level PES schemes in Costa Rica and Mexico have administration costs of well below 10 per cent of the overall amount spent (Wunder et al. 2008), analysis of the Bolsa Floresta scheme in Amazonas state in Brazil indicates a much higher proportion, around 40 per cent (Viana et al. 2009). The cost figure used in this model is high enough to incorporate some provision for transaction costs.

6. The 0.034 per cent of GDP for forest-related investments is part of an integrated green investment scenario, G2, in which a total of 2 per cent of global GDP is allocated to a green transformation of a range of key sectors. The results of this scenario, in which the 2 per cent is additional to current GDP, is generally compared to a corresponding scenario in which an additional 2 per cent of global GDP is allocated following existing business-as-usual trends, BAU2. In the case of the forestry sector, there is no significant difference between the BAU2 scenario and the BAU scenario, which also projects a business-as-usual path but without additional investments (see the Modelling chapter for more explanation of the scenarios). Hence the green investment scenario (G2) can be compared to the BAU which also represents the model's projections of future trends on a business as usual path.

7. It is equivalent to the cost of purchasing the land or the cost of making annual payments (as in PES schemes) to compensate for forgone annual returns to land over an appropriate time period (30-50 years) discounted at an appropriate rate.

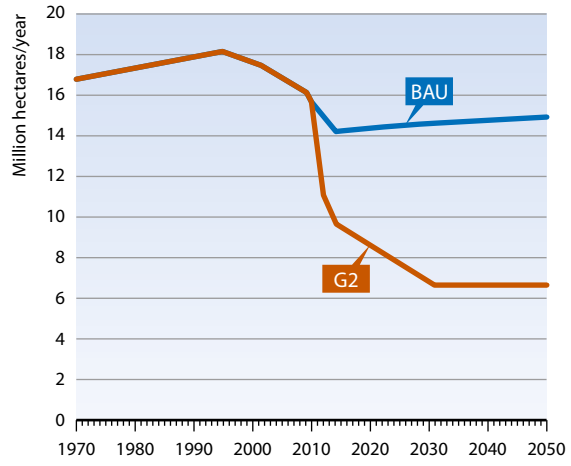

Figure 2: Deforestation reduction under the green investment scenario (G2)

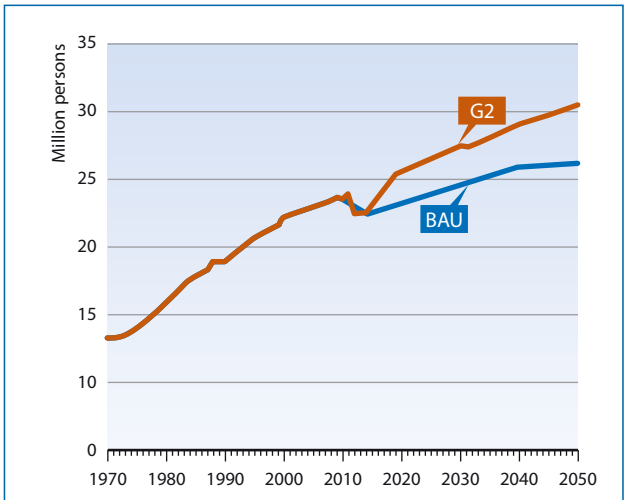

Figure 3: Employment under the green investment scenario (G2) and business-as-usual (BAU)

The investment would enable payments to be made to forest landholders over a steadily expanding area, with the yearly increase reaching 6.76 million hectares by 2030 and then decreasing to 6.66 million hectares by 2050, in effect reducing the annual rate of deforestation by just over 50 per cent, as shown in Figure 2. This is consistent with other studies, which have predominantly estimated the cost of reducing deforestation by 50 per cent (Stern 2007; Eliasch 2008; Kindermann et al. 2008).

4.4 Investing in planted forest

The cost of planting forests is assumed to be US$ 1,630 per hectare based on the costs of reforestation in Costa Rica's national PES scheme, which pays farmers US$ 980 per hectare (Robalino et al. 2010) to cover 60 per cent of the costs of establishment (Miranda et al. 2004). As shown in Table 6, this is within the range of costs estimated for production planted forests, which is the type of reforestation under consideration here.

Key forest-sector indicators in 2050	BAU	Green investment scenario (G2)
Natural forest area	3.36 billion ha	3.64 billion ha
Deforestation rate ha/ year	14.9 million ha	6.66 million ha
Planted forest area	347 million ha	850 million ha
Total forest area	3.71 billion ha	4.49 billion ha
Carbon storage in forests	431 billion tonnes	502 billion tonnes
Gross value added	US$ 0.9 trillion	US$ 1.4 trillion
Employment	25 million	30 million

Table 8: Forests in 2050 under the green investment scenario and business-as-usual (BAU)*

* See footnote 6.

The modelling examines the full cost to a landowner of establishing a planted forest rather than the incentive payment that might make such a land use competitive. On average, the investment allocated will cover the cost of reforesting an additional 9.6 million hectares per year or 386 million hectares over the 40-year period.

4.5 Impacts of investment in reducing deforestation and in planted forest

The economic and environmental impacts of the green investment scenario are shown in Table 8. In the short term the reduction in deforestation leads to a decrease in the value added of the forest sector (wood, wood processing and pulp and paper) so that it is 1.7 per cent below the baseline in 2013. Similarly, employment is 2 per cent below the baseline level in 2013. However, this does not take account of the economic impacts on other sectors such as tourism, which may benefit from the reduction in deforestation and also the economic value of the reductions in carbon emissions. In the longer term, as the area of planted forest increases, value added in the conventional forest-based industries rises to US$ 10.4 trillion, some 19 per cent above BAU. The increase is accompanied by growth in employment from 25 million to 30 million worldwide, or 20 per cent above business-as-usual (Figure 3).

The main environmental impact is on the area of natural forest, which in 2050 is 8 per cent more extensive in the green investment scenario than under BAU, and on the total area of forest (natural and planted) which in the green investment scenario is 21 per cent more extensive in 2050 than under BAU and 14 per cent higher than the current forest area. This has positive implications for biodiversity and carbon storage and results in reduced greenhouse gas emissions. The increase in the forest

area is made possible by the investments in improved agricultural productivity (see the Agriculture chapter). This means that demand for agricultural production can be met from a smaller area of land, freeing up land for reforestation or afforestation. It also means that there is less pressure on natural forest.

These projections indicate the potential of increasing green investment in the forest sector. But much depends on how the investment is made and in what policy and institutional context. As discussed above, reforestation programmes do not always work financially, socially or environmentally, and the small amount of investment in avoiding deforestation so far, mainly in the national PES schemes in Costa Rica and Mexico, has struggled to demonstrate cost-effectiveness. Large investment programmes on the scale modelled here will be more challenging although they can draw lessons from the existing experience. Global aggregate projections of this nature cannot, owing to limitations of their design, capture the differences in response between tropical countries and non-tropical countries, or between countries with high forest cover and low forest cover, or between high income and low income countries. They do, however, indicate what can be achieved at a global level in the appropriate policy and institutional conditions.

5 Enabling conditions

Increased investment needs to be catalysed and backed up by improvements in forest governance, institutions and policy (UNFF 2009). Enabling conditions are needed to motivate the private sector and forest communities to make investments in sustainable forest management and downstream activities, and to support public-sector investments and ensure they realise value.

This section discusses important enabling conditions, including: forest governance and policy reform, actions to tackle bad practice in forestry and extra-sectoral drivers of forest loss, and information technology to characterise forest assets.

5.1 Forest governance and policy reform

An overarching requirement is to ensure that good forest governance is in place at the national level based on specific, country-led analysis of the economic, social and institutional drivers of forest loss. This good governance includes a vision for the future of a country's forests, and of forest-based economies, which addresses the sustainable and equitable provision of all forest ecosystem services. It also includes a policy framework that balances global and national public goods with private goods and community requirements, captures the value of forest ecosystem services in private and public decision-making, and creates clear incentives for good practice and disincentives for bad practice. In addition, it includes transparent, secure and fair rights to forest resources and allocation mechanisms especially for forest-dependent groups such as indigenous peoples. The fundamentals of good governance in a country (rule of law, freedom of association, respect for property rights, accountable legislature, etc.) will be critical.

At an operational level, good forest governance includes forest management principles, and a related hierarchy of criteria, indicators and standards that support progress from mere legality to SFM. It also includes participation of forest stakeholders – with special support to poor communities and indigenous peoples. Furthermore, it includes transparent and accessible databases and accountability mechanisms that record forest use by stakeholders and are linked to incentives and sanctions. Subsidies, fiscal instruments and other means to get the price right for given forest ecosystem services should also be covered, ensuring that externalities are reflected in payments for services. Finally, good forest governance should include a capacity-developing, step-wise approach, helping stakeholders to continually improve forest management.

5.2 Tackling illegal logging

Illegal logging is a serious problem. The international trade in illegally sourced wood products was estimated to be worth US$ 8.5 billion in 2008. Sustainably produced wood products will not be able to compete if large volumes are produced illegally or unsustainably, with low production costs, unreported taxes and royalties and unfair prices below market price. Because there are even larger volumes of illegal wood products that do not enter international trade and are consumed within the producing country, the actions that the governments of producing countries take to tackle illegal logging are likely to have leverage effects. However, the governments of countries that import wood products and the financial institutions that back forestry and manufacturing of wood products can also play an important role.

The 1998 G8 meeting was catalytic in drawing attention to illegal logging and setting in motion a significant international policy process – one that is increasingly influential and has recently reduced illegality, although has not yet stopped it. Subsequent intergovernmental agreements, in particular the Forest Law Enforcement and Governance (FLEG) processes coordinated by the World Bank, have helped to raise awareness of the issue and have resulted in agreements that "all countries that export and import forest products have a shared responsibility to undertake actions to eliminate the illegal harvesting of forest resources and associated trade".[8]

The initiatives involve governments of importer countries increasingly excluding illegal products from their markets: by setting up border mechanisms to prohibit imports; by using public procurement policy to create protected markets for legal products; by using their own legal systems more aggressively to target companies involved in importing illegal goods; and by offering information and encouragement to importing, processing and retailing companies to control their supply chains. The USA became the first country to ban the import and sale of illegally harvested wood, and to require declaration of species and country of

8. Europe and North Asia FLEG Ministerial conference, 2005 St. Petersburg Declaration. Available at http://194.84.38.65/files/specialprojects/enafleg/25dec_eng.pdf

origin, extending the Lacey Act to wood products. The European Union has established a licensing system based around Voluntary Partnership Agreements (VPAs), which are negotiated with cooperating exporter countries (Box 12) under the Forest Law Enforcement, Governance and Trade (FLEGT) Action Plan.

The success of these tools will depend upon how extensive the uptake is and how well they close off the opportunities for circumvention by e.g. trade through third countries. This is highlighted in a recent study of illegal logging trends up to 2008 (Lawson and MacFaul 2010), which notes that there has been a reduction in illegal logging and in trade of illegally sourced wood products – although importing country measures had played a relatively small role in this. While FLEGT and the Lacey Act can be expected to have an impact in the future, the main challenge is the arrival of illegally-sourced wood via third party processing countries, notably China. The authors note that governments in processing countries are not taking adequate action to address illegal logging (Lawson and MacFaul 2010).

Further and more widespread improvement requires a transformation of forest governance in producing countries with wider stakeholder participation in the allocation of forest resources, and the determination of laws so that there is greater legitimacy for laws relating to forests and timber harvesting (as emphasised in 5.1). Both carrots (support for skills training in SFM, independent verification of SFM, and preferential government procurement for SFM) and sticks (tightening up laws and enforcement against illegal logging and marketing) are needed. The measures taken by consuming countries may help to promote this broader governance improvement, as the process of negotiating the VPAs has involved the inclusion of partner-country civil society in the negotiations (Brack 2010).

5.3 Mobilising green investment

Investment in forests can target conserving existing areas of primary forest, promote expansion of forests through regeneration and reforestation, improve forest management in existing forests of different types, and increase the number of agroforestry systems. Each of these will have different attractions for specific investors, e.g. agroforestry for agricultural investors aiming for long-term resilience in food and other markets. There is increasing evidence that private investments that seek long-term growth and security are attracted to well-managed forestry (such as pension funds, as well as specialist vehicles such as forest bonds). More recently, social stock exchanges and partnerships with corporations and government have revealed significant scope for social investments in locally-controlled forestry.

Because of the public-good nature of some forest ecosystem services, however, businesses and forest landholders usually do not perceive a sufficient incentive to make green investments in forests. Where such investments indicate a positive rate of return for society as a whole, investment by the public sector can be warranted: to provide forest ecosystem services directly; to provide financial incentives to the private sector to make green investment competitive; and/or to prevent unsustainable forest management. Central to this will be a hard-headed examination of national competitiveness in sustainable forest management, and effective regimes supporting financial rewards for producing forest ecosystem services, and notably Global Public Goods (GPGs).

A major incentive measure is public wood procurement, which has had a significant impact in a few importing countries and can have a knock-on effect on private procurement policy. Six EU countries including the UK (Box 13) have established procurement policies. These public procurement systems are driven by the power of public spending in the EU (which accounts for 16-18 per cent of GDP). They differ in some aspects, e.g.: whether they separate out legal and sustainable categories; whether they include social norms; and how they verify

Box 12: The EU licensing system for legal wood products

The EU's licensing system is based on VPAs with producing countries. These VPAs put in place a licensing system in each country, to identify legal products and license them for import to the EU. Unlicensed, and therefore possibly illegal, products will be denied entry to the EU. The agreements include: capacity-building assistance to set up the licensing scheme, improved enforcement and, if necessary, reform laws; and provisions for independent scrutiny of the validity of the issue of the licenses, as well as verifying legal behaviour through the chain of custody of the timber. The VPAs' impact is as yet unknown: the first two agreements with Ghana and Republic of Congo were signed too recently (September 2008 and March 2009, respectively) for any impact to be discernible. As developing a licensing system is estimated to take two years, the first FLEGT-licensed timber will not enter the market until late 2010. Negotiations are also underway with Cameroon, Central African Republic, Malaysia, Indonesia and Liberia (Brack 2010).

Box 13: Wood procurement policy in the UK

The UK central government's wood procurement policy started with a requirement to source only legally-produced forest products (compulsory for all government contracts). A requirement for sustainable forestry was originally optional, but became mandatory from 2009, albeit with a six-year exemption for FLEGT countries (CPET 2010).

The UK policy recognises FSC and PEFC , and includes an independent Central Point of Expertise on Timber (CPET) to advise specifiers, contractors, etc.[9]

non-certified imports. Public procurement policies for timber also exist for Japan and New Zealand, as well as some local authorities in the EU and USA. There is clearly room for improvement but a good start has been made.

Another incentive is in the hands of key investors, such as the IFC and major private banks, which operate coherent controls and have specific policies for sustainable forest investment. Most of them have already stopped investing in unsustainable forestry and forest industry, and require certification associated with all forest investment (HSBC 2008). Some financial institutions have followed the lead of NGOs such as Tropical Forest Trust, Rainforest Alliance and Woodmark in promoting a step-wise approach to improving practice that culminates in full certification. A stepwise approach presents less of a challenge – and possibly more of an attractive business proposition – than the big stretch that is often required to move straight to full SFM certification. HSBC for example, is allowing five years to progress to certification (HSBC 2008).

5.4 Levelling the playing field: Fiscal policy reform and economic instruments

Forests are not so much a sector as a resource, which other sectors and livelihood systems use, e.g. the energy sector (low-cost wood can move in and out of energy markets) and the agriculture sector (forests can be a continuing source of food and an asset to be liquidated for farming). Policy measures which favour competing activities for forest land and demand for the products derived from these activities can undermine efforts to conserve and sustainably manage forests. Mining and infrastructure projects, often prioritised for their contribution to government revenue, can have destructive direct impact on forests and indirect impacts through opening up remote areas. Government regulation of such projects and the due diligence procedures of financial institutions that back these projects provide important levers for good practice in siting, construction and operation to mitigate impacts on biodiversity.

Some governments and financial institutions are actively promoting biodiversity offsets to ensure that areas of rich biodiversity such as tropical forest that are unavoidably lost through capital development projects are offset through conservation actions to restore forest elsewhere or reduce risks. Engaging with a wide range of stakeholders is also critical, asking the question: which supply or demand factors (including particular specific goods and services) are tipping markets and governance regimes towards environmentally-sound, fairer, and more competitive outcomes? Which factors are mutually supportive and could lead to leveraged outcomes if more widely applied? The ecosystem approach can be used as a common framework for assessing potential trade-offs and synergies between sectors and stakeholders.

The most significant driver in terms of forest area is agriculture. For much of the 1980s and 1990s, the subsidies given to agriculture resulted in farming being the biggest cause of deforestation, and often also of inequity between farmers, where subsidies tend to be captured by larger farmers. With the onset of structural adjustment programmes, subsidies for key agricultural inputs such as fertiliser were reduced or phased out altogether in many developing countries. However, agriculture remains the engine of development of most low-income countries and is the focus of national and international efforts to ensure food security, particularly in response to the recent food price spike. Thus, it is not surprising that agriculture remains favoured over forests, if by means other than input subsidies – in particular, through water allocation systems, artificially low irrigation charges and infrastructure expansion, and roads. Today, the drive for biofuels expansion, often with substantial government support, is a new source of unequal competition and pressure on natural forests.

It is unrealistic to expect support to agriculture to be removed altogether if development and food security objectives are to be met. Agroforestry is one means to increase synergies between the two sectors. Mechanisms such as REDD provide incentives for forest conservation but will be undermined if agriculture is still subsidised in ways that are not coordinated with forest policy. Ways

9. Available at http://www.cpet.org.uk/evidence-of-compliance/category-a-evidence/approved-schemes.

should be sought for them to be mutually reinforcing (See Box 14). The chapter on Agriculture sets out the types of investment in sustainable agriculture that can meet world food needs and support conservation of natural forests and expansion of forest area.

5.5 Improve information on forest assets

In determining the relative priority to give to the forest sector versus agriculture and other sectors and to the range of forest ecosystem services, governments need to have better information on forest stocks, flows and cost-benefit distribution. This should go beyond counting trees and measuring area to assessing the magnitude, value and quality of forest ecosystem services. To do this requires information technology that can handle complexity. Geo-referenced information is needed on forest resources and the ecosystem services they provide. The associated economic, social and environmental benefits of forest ecosystem services also need to be captured in monitoring and economic statistics and included in multi-criteria analysis as basis for decision-making. There is adequate experience to take this to scale, so that countries have an accurate assessment of the stocks and flows of ecosystem services and who benefits from them. This is also needed to access ecosystem services markets that demand verification, and to improve the case made in public expenditure reviews.

At present, there are considerable uncertainties in estimating the value of ecosystem services at the local, national and particularly at the global level, reflecting gaps in information on biophysical linkages and how they depend upon both the type of forest and its management, and the site-specific nature of much of the research done to date. Publicly supported research on ecosystem services is needed to reduce the gaps in information and to document more fully the contribution made by the forest sector to the economy, livelihoods and social development in different downstream sectors. Improved knowledge of ecosystem services is essential for ensuring the full value of forests is acknowledged in wider development decisions. The link between forests and water supply particularly requires better information.

5.6 Making REDD+ a catalyst for greening the forest sector

There is no clear and stable global regime to attract investment in Global Public Goods (GPGs), and to assure their production in ways that are effective, efficient and equitable. Yet such a regime is essential to tip the finance and governance balance in favour of longer-term, sustainable forest management. Management for GPGs, as opposed to wood production alone, also opens up the prospect of new types of forest-related employment, livelihoods and revenues, including management partnerships with local communities. However, standards that support the co-production of local benefits with global benefits will be needed, as well as effective systems for local control of forests, to ensure livelihood benefits are realised and an equitable distribution of costs and benefits.

Payments for the climate regulation services of forests through the CDM and REDD+ mechanisms offer perhaps the greatest opportunity for countries and landholders to capture the value of their forest ecosystem services. The experience with PES provides valuable lessons for developing effective and equitable REDD+ mechanisms. Considerable work needs to be done, however, to resolve the issue of additionality[10], that is to ensure that payments are targeted at forest conservation and enhancement activities which would not otherwise take place. This has proved challenging for existing PES schemes.

Box 14: The effect of financial support to livestock in Brazil

A study of the livestock sector in Brazil highlights the challenges for policy coordination with forestry. Financial support from the Brazilian National Development Bank (BNDES) has played a significant role in the expansion of the livestock sector. The major part of this support has been targeted at purchase of stock, with less than 6 per cent of the funds being used to promote improvement of pastures. However, studies made by EMBRAPA, the Brazilian government agricultural research agency indicate that, with improvements in livestock, feed and management, it would be possible to increase the number of livestock by 42 per cent, while reducing the area of pasture by 35 per cent from its 2006 level. As the area of pasture in the Brazilian Amazon increased by 44 per cent between 1985 and 2006, driving much of the deforestation there, this has important implications for REDD: redirecting government support to improve pastures could reinforce efforts to control deforestation and restore forest cover.

Source: Smeraldi and May (2009)

10. Additionality is aimed at improving efficiency.

However, this appears to discriminate against countries and forest landholders who have already conserved forests or taken early action. Determining the counterfactual or reference level of forest-related emissions – from forests that would otherwise not be conserved – is also challenging, as this is not necessarily the same as the formal development plans laid out by the country concerned; neither is it necessarily determined by whether forest conversion is permitted by national law. While there is scope for technical improvements in assessing deforestation and degradation and measuring forest carbon, determining reference emission levels into the future requires political negotiation (Bond et al. 2009).

The methodological guidance that came out of the Copenhagen COP was for reference emission levels in REDD+ to be based on historical rates adjusted for national circumstances (UNFCCC 2010). Reaching agreement on how these adjustments will be made will require both better understanding on the part of forest countries of how different rules on adjustment will affect them, and a pragmatic approach that recognises existing efforts to conserve forests and improve forest management.

Safeguards are also needed to protect the rights of forest-dependent people, particularly when these rights derive from traditional systems, rather than formal legal systems and to ensure that those who bear the costs of REDD+ schemes, in terms of land and resource restrictions, receive an appropriate share of the benefits. Specific models need to be developed for small-scale producers and local communities. As with protected areas, long-term effectiveness and efficiency of REDD+ schemes may often depend critically on ensuring these benefits for local stakeholders. Some projects in the voluntary carbon market, or as part of readiness activities and project design standards such as those of the Climate Community and Biodiversity Alliance, are showing how these equity issues can be addressed at the project level. At the national and international level, the payment against performance approach being promoted in some bilateral deals could employ a broader concept of performance – one that incorporates not only emission reductions, but also considerations of equity and local co-benefits.

6 Conclusions

Understanding and accounting for the full range of services provided by forests is the most important task for the sector in a green economy. The active protection of tropical forests, for example, is now widely perceived as a crucial ecosystem management priority and a cost-effective way to reduce global carbon emissions. While the loss of forest carbon can be offset by planting trees, and some growing timber demand can be met by plantations, the loss of primary forest is often irreversible. Competing demand for forest land, especially from agriculture, is likely to continue driving deforestation. Policy measures beyond the forest sector, such as agricultural subsidies, are therefore at least as important as policies within the forest sector and innovative policies that exploit synergies between the two sectors will be especially valuable.

There are reasons for optimism, but greening the forest sector requires a sustained effort. Various standards and certification schemes have provided a sound basis for practising sustainable forest management, but their widespread uptake requires a strong mandate and consistent policies and markets. Protected areas, although controversial from the beginning, remain an important option for preventing the permanent loss of critical ecosystems and biodiversity. Their effective and equitable enforcement remains a challenge. The emerging PES and REDD+ schemes are ambitious and innovative avenues for funding the greening of the forest sector. Their interface with existing standards, certification schemes and networks of protected areas, however, needs to be monitored to ensure they build on or learn from earlier experiences.

Investment in greening the forest sector should consider sustainable forest management, PES and REDD+, planted forest, agroforestry, and indeed protected areas, although the modelling exercise – for illustrative purposes – focused only on reducing deforestation and increasing the area of planted forest. Investing in greening the sector may involve short-term sacrifices in terms of income and jobs, as the forest stock in general requires time to grow or recover. This is why compensation schemes – whether national or international – are essential for communities.

Countries face a choice, whether to allow the prevailing forest transition to take its course or to change their forest economy to sustain a mix of forest goods and services that adds value and confers long-term resilience. Forests have tended to be associated with benefiting only the early phases of the development transition, where their intentional liquidation produces other forms of capital. Yet Sweden, Finland, Canada and other countries demonstrate how forests can play a sustained role in high-income countries, too. Maintaining forests in such countries has not inhibited wealth creation or labour markets; rather, there are significant forward linkages to many economic sectors with real opportunities for investment and related growth in wealth and jobs. These sectors could in turn, benefit from the renewable, recyclable, and biodegradable inputs that forests can provide. There are also highly significant public benefits in terms of biodiversity, health and recreation that are provided at relatively low cost.

The prospect of payments for ecosystem services such as carbon and biodiversity extends this practical proposition to those countries – notably low and middle-income – that are bold enough to make policy choices in favour of investing in the ecological infrastructure of forests, but that do not yet have the resources to invest in a modern forest industry. Protecting forests to maintain biodiversity and reduce carbon emissions do not require intensive management inputs, although they do require scrutiny and protection, and stable financial mechanisms. The alternative, a steady stripping of forest assets where the wider costs are unsupportable and the benefits are often uncertain, is no longer tenable.

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