



Providing Public Goods through Forestry: An Enabling Environment

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Executive Summary

Forests are a multi-functional resource producing a number of public goods. Climate stabilisation, watershed protection and biodiversity conservation are three that are ascending both research and government agendas. Historically, neither the benefits nor the costs of forest public goods have been adequately reflected in markets or in forest management. Lacking incentives to sustainably manage forested areas, deforestation, degradation and unsustainable land management practices result.

As the global public goods provided by forests become better appreciated, the need for multi-lateral cooperation and modernisation of forestry policy to incentivise this provision is being recognised. Governments have been provided with both the rationale and justification for public expenditure to address this market failure. The joint nature of many public goods and the social and environmental co-benefits resulting from forest conservation or creation means that forests represent the most cost-efficient option for providing climate stabilisation, watershed protection and biodiversity conservation. The effectiveness of forests in their provision, however, is context-specific and further investigation of the possible trade-offs between public goods under different forest management regimes is required.

Historically driven by commercial objectives, forest policy has neglected public good provision. The trends towards privatisation of forests has been motivated by state efficiency gains and while the decentralisation of forest management theoretically leads to better management of environmental resources in practice the benefits of decentralisation are reliant upon strong institutional capacity. More recently, sustainability in forest management has been driving forest policy objectives. With more socially-oriented goals, sustainable forest management has been more effective at providing climate stabilisation, watershed protection and biodiversity conservation.

Recognising the role of the state in public good provision from forestry, policy-makers have a number of instruments and supporting tools at their disposal. Moving away from command-and-control style regulation, forestry is following a broader policy trend towards more market-based instruments such as payments for ecosystem services. With greater efficiency gains and equitable sharing of cost burdens, market-based instruments are favoured over more expensive regulatory instruments or weaker informational, planning or reform instruments. Policy tools to support public good provision also exist; programmes of the Global Environment Facility and the establishment of forest trust funds are notable for the financing they provide.

In light of the diverse stakeholders and values associated with forests, a mixture of policy instruments and tools are employed to reach policy objectives. The hybrid approach allows the maximisation of the benefits of the various policy instruments and tools, leading to higher efficiency. Market-based instruments, although largely administered by the private sector, must be underpinned by a strong legal and regulatory framework.

The policy mix must also identify cross-sectoral synergies, particularly at the global level where conventions such as the United Nations Framework Convention on Climate Change and the Convention on Biodiversity provide strong support for forest conservation. Cross-sectoral conflicts must also be taken into account and ameliorated where possible. In particular, macro-economic, fiscal, trade, agricultural and land tenure policies have the potential to oppose forest policies and

strategic policy planning is required to remove perverse incentives and reduce the relative opportunity costs of forestry.

A promising mechanism to incentivise and finance public good provision from forestry are carbon markets. Arising from the carbon sequestration and storage properties of forest ecosystems, a number of forestry activities have been identified that play a role in climate change mitigation. Afforestation and reforestation projects and reduced emissions from deforestation dominate the discourse. Despite the potential carbon savings, the current global climate change policy architecture has strict eligibility rules for forestry projects. This stems from a number of technical, political and social barriers faced in project design and implementation. These restrictions have largely limited forestry carbon activities to non-compliance carbon markets.

In light of the substantial potential of forestry activities to contribute to the climate change mitigation effort, considerable private sector and public funding is being committed to pilot forestry carbon projects. Environmental NGO involvement has also been stimulated by the prospect of watershed protection and biodiversity conservation as by-products of carbon financing activities. Ongoing negotiations at national and international levels may resolve technical and political barriers and a better understanding of socio-economic impacts of projects could make carbon forestry a feasible future policy option to ensure the provision of a number of public goods.

Irrespective of the mechanisms by which public good provision is promoted, the effectiveness of the policy is dependent on a number of factors. Clearly defined property rights, strong public and private institutions, full sectoral integration, steady financing and adequate stakeholder participation are imperative for policy to be effective.

In order to catalyse public good provision through forests, short term objectives should focus on creating an enabling policy environment. In the medium term, the focus should be on strategic policy planning that builds on synergies and reduces conflicts between goods, sectors and both spatial and temporal scales. It will also require stakeholder participation to overcome typical top-down policy formation. In the long term, the objective is a policy mix that counteracts market failures and safeguards the provision of public goods from forestry.

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Public Good Provision through Forestry

1. Introduction

This paper was commissioned for a joint UNDP/FAO/UNEP-Risoe Centre/Bale Eco-Region Sustainable Management Programme workshop in Addis Ababa in April 2009 entitled *Bio-Carbon in Africa: Harnessing Carbon Finance to Promote Forestry & Bio-Energy*. The workshop was borne out of a desire to catalyse carbon forestry in Africa, acknowledging that to do so will require the broader consideration of an enabling forestry policy environment. Designed to inform land managers of the policies and policy instruments that can be used to promote public good provision through forestry activities, and the factors or pre-conditions required for their implementation success, the paper aims to be accessible to those without forestry background. Drawing on insights from international forestry management, in both developed and developing countries, global efforts are reviewed in an attempt to catalyse global efforts to provide public goods from forestry.

Section 1 first reviews what is meant by public goods from forestry. The report focuses on climate stabilisation, watershed protection and biodiversity conservation, and not on the more 'traditional' uses of forestry such as timber and non-timber forest products. Section 2 outlines the policies, policy instruments and tools available to promote public good provision from forests, their strengths, weaknesses and suitability. Section 3 specifically identifies the theoretical and practical role that carbon financing can play in catalysing the provision of public goods from forests. Section 4 considers the factors and pre-conditions that will provide an enabling environment for successful provision of public goods from forestry, forest carbon in particular. Section 5 summarises the report findings and provides short, medium and long term objectives for public good provision through forestry.

1.1. Public Goods from Forestry

Globally, forests cover 3,952 million hectares, or 30% of the world's land area (FAO, 2006a). The demands that society place on this forest resource base are numerous and growing. The primary drivers of decline; settlement expansion, infrastructure expansion and unsustainable logging, result in losses of 13 million hectares of forest annually (FAO, 2006a; Houghton, 2005). This loss threatens not only long-term wood production, but also the multitude of benefits related to other social demands and ecosystem services.

Of the variety of benefits¹ provided by forests, some can be considered public and others private. Private goods are those that are rivalled: if used by one individual or firm they are not available to others, and excludable: ownership rights prevent others from deriving benefits, and so tend to be normal market goods with market prices. Traditional major forest products such as timber, pulpwood, and fuelwood are all examples of private goods from forests.

In contrast, public goods are non-rival: use by one person does not decrease the amount available for others, and they are non-excludable: no-one can be prevented from deriving benefits. Clean air and climate regulation, watershed protection, aesthetic beauty and recreation, soil nutrient cycling and soil conservation, biodiversity and nature conservation are all examples of public goods provided by forests.

¹ Forest products, forest benefits, forest goods and forest services are terms used widely and interchangeably. This report uses the term 'goods' loosely to encompass both goods and services where goods are tangible and transportable materials (these materials can be raw, e.g. logs for sawmills, intermediate e.g. timber for houses, and consumer e.g. firewood sold in markets); and services are non-transportable and often consumed on-site.

In reality, the distinction between public and private goods and services is not this defined (see table 1). For example, recreational forests may be a public product when visitor numbers are low, but may take on private characteristics if there is an entrance fee (excludable but non-rival), or when visitor numbers become high (non-excludable but rival).

Table 1. Characteristics of Public/Private Forest Products		
	Rival	Non-Rival
Excludable	<p>Private Goods</p> <ul style="list-style-type: none"> - Timber, nuts, berries, fruits, rubber, bush meat - Private forest land 	<p>'Toll Goods'</p> <ul style="list-style-type: none"> - Protected forest areas: access is regulated (e.g. entry charge) - Patents on the properties of forest species and knowledge
Non-Excludable	<p>'Open Access Goods'</p> <ul style="list-style-type: none"> - Local forest commons with unregulated access - Protected forest with unregulated access 	<p>Public Goods</p> <ul style="list-style-type: none"> - Biological diversity - Carbon Sequestration & Climate regulation - Pollination - Soil Conservation - Watershed Management - Local cultural and spiritual values - Protected forest with free access

Source: Adapted from Humphreys, 2006

Public goods offer positive utility to users but market failure², either because they are under-represented or absent in markets, means there is no way for consumers and suppliers to express their willingness to pay or produce them. There is also no price to be paid by those who degrade underlying functions that provide these public goods, which can quickly become public 'bads': climate change, soil erosion and biodiversity loss are all examples.

This report focuses on three principal, and topical, public goods from forests; climate stabilisation, watershed protection and biodiversity conservation (see table 2). The link between forests and these public goods have been subject to considerable research (e.g. O'Brien, 2000; Calder *et al.*, 2004), whereas the link between forest and other public goods such as open access recreation, pharmaceuticals and pollination have received less attention.

1.1.1. Climate Stabilisation

The changing climate is now widely accepted as human-induced and the two primary anthropogenic greenhouse gas³ (GHG) sources are fossil fuel combustion and net emissions from land use change (Canadell *et al.*, 2007; Houghton, 2007). Without mitigation efforts, the costs of climate stabilisation will be substantial (Stern, 2006). Forests have the potential to play a major role in this mitigation effort as they are both a source of emissions and a natural sink for carbon. The role that forests play in climate regulation, assuming a stable climate has positive net benefits, is non-rival and non-exclusive and therefore a pure public good (Bruce *et al.*, 1996; Sandler & Sargent, 1995).

² Market failures include: negative externalities, where costs are paid by society rather than producers of environmental bads; free-riding, where private costs of protecting the environment are higher than individual benefit and individuals will benefit from the action of others by doing nothing; and tragedy of the commons, where each individual has incentive to exploit common resource as much as possible.

³ There are six recognised greenhouse gases; carbon dioxide (CO₂), methane, nitrous oxide, sulphur hexafluoride, hydrofluorocarbons and perfluorocarbons. For ease of reporting and so that they are fungible, these gases are commonly described in terms of their carbon dioxide equivalence (CO₂e): a metric measure that standardises their emissions based on their global warming potential.

Table 2. Principal Public Goods provided by forests

Public Good	Description	Beneficiaries
Climate Stabilisation: carbon sequestration & emission reductions	Forests both sequester carbon (the uptake of CO ₂) and store carbon in their biomass. Since carbon is a known contributor to climate change these properties of forests help to stabilise the global climate	Climate regulation is a global public good, but forests also help to regulate local climate*
Watershed Protection	Forests impact on the quality and quantity of water flowing from topographic areas, reducing soil erosion and purifying water are two very important examples of positive impacts of forests on watershed areas	Watersheds are not defined by political or economic boundaries, but the impacts are dependent on the watershed size; thus beneficiaries are primarily local or national
Biodiversity Conservation	Forests are largely bio-diverse, contributing to the maintenance of the global gene pool necessary for resilient and adaptable species and ecosystems. Biodiversity also holds high non-use value from aesthetic, heritage and existence value.	Benefits are likely to be felt globally, but are more tangible at smaller scales

* Forest canopy cover affects micro-climates by increasing temperature and water infiltration

All forest management practices affect carbon release into the atmosphere as the quantity of tree biomass changes, and soil and litter are disturbed (Sajwaj *et al.*, 2008). The plantation of forests, the improved management of natural and managed forests, and the conservation of forested areas could make significant carbon savings (Nabuurs *et al.*, 2007). With annual forest losses estimated to be responsible for 20% of global carbon dioxide (CO₂) emissions (VCS, 2007; FAO 2006a; Stern, 2006), avoiding deforestation represents 50% of greenhouse gas emission abatement potential (IPCC, 2007).

1.1.2. Watershed Protection

Watersheds are the topographic areas within which water reaching the land surface drains to a specific water-body (Omernik & Bailey, 1997). There are a range of watershed services that humans are dependent upon for example, purified water for domestic and commercial use, abstraction for agriculture and irrigation, hydro-electric power generation, wildlife and recreational uses (Willis, 2002).

The quality and quantity of the water sustaining these social and ecological functions is highly dependent on characteristics of this upstream watershed area. There are links between forests and the quality of water from watersheds, a sporadic link between forests and water quantity, and a variable link between forests and constancy of flow (Jackson *et al.*, 2005). Forests within watershed areas reduce wind and maintain soil organic matter, both of which decrease soil erosion from surface run-off, increase water quality through capture of pollutants, and reduce nutrient, pesticide and erosion runoff from crop production. However, the scale and form of the effects of forests on watersheds are largely dependent on the species composition, soil type, climate, and – in particular – the land use regimes in place.

1.1.3. Biodiversity Conservation

Ongoing ecosystem degradation is causing losses in ecosystem, species and genetic diversity. These losses to the global gene pool lower the global potential to improve material, food and medicine production, increase vulnerability to environmental, economic and social change (Mayers & Bass, 1999), and decrease the amenity value of forests.

Tropical forests contain 50-90% of the world's species (WRI, 1992), largely resulting from the complex structure of the forest vegetation (Sajwaj *et al.*, 2008). Disturbances in the forest that alter habitat niches will therefore reduce biodiversity. The conservation of forested areas, plantation of non-forested areas and better management of other forestry types can increase or maintain 'collateral' biodiversity (Koziell, 2002).

1.2. Effectiveness and Efficiency of Public Goods from Forestry

The public goods focused on in this report are not necessarily uniquely provided by forests. When land uses change, opportunity costs, the value of the next best alternative, will be incurred. This is the case when land is kept forested (Grieg-Gran, 2008; Balmford & Whitten, 2003), or land is planted with forests (Benitez *et al.*, 2003). Competing land uses, such as extensive cattle ranching and large-scale soybean production in South America or large-scale oil palm and wood product plantations in Asia, are two examples where the opportunity costs of alternative land uses are particularly high. In contrast, deforestation on the African continent tends to be driven by small-scale staple crops and fuelwood collection, but the competition for land for settlements and infrastructure are just as critical to address.

Where other mechanisms to provide public goods exist, they should be acknowledged and assessed for effectiveness and efficiency of provision. It will then fall to policy-makers to decide if the co-benefits or multi-good characteristic of forests are sufficient to justify the cost of provision of public goods through forests.

1.2.1. Alternative Mechanisms of Climate Stabilisation

With many diffuse sources of GHGs, there are many alternative mechanisms by which to mitigate climate change (see Lal, 2008). These broadly include the reduction of direct and indirect fossil fuel use, and the reduction of other GHG emissions.

Sectoral studies have suggested that climate change mitigation through forestry could be cost-effective compared to alternative mitigation strategies (Parpia, 2009; Bellassen *et al.*, 2008) and can make up a significant proportion of the total mitigation efforts (see section 3.6; IPCC, 2007; Sohngen & Mendelsohn, 2003; McCarl & Schneider, 2001). It is tropical forests that constitute the bulk of this potential; cooling the climate through evapo-transpiration, cloud feedbacks and slowing the build up of CO₂ in the air. However, in boreal or temperate forests, climate mitigation impacts are less clear and bio-physical changes have the potential to alter regional climate in a conflicting way to carbon sequestration (Bonan, 2008).

Despite their potential, forests do not play a prominent role in the global climate change architecture. Laurance (2007) gives three primary reasons for this: it was thought by some that wealthy nations would buy their way out of international obligations rather than making substantial and permanent reductions; forest conservation was considered a risky strategy, with many underlying drivers likely to cause leakage⁴; and because of national-sovereignty issues and potential limitations for future national development options as a result of project commitments (this was mostly led by Brazil which contains 40% of the world's remaining tropical forest) (see section 3.5 for elaboration of the barriers to forestry carbon activities).

Among natural resource scientists, there has also been growing discourse on the danger that the valuation of forests for carbon will be at the expense of other forest goods and services. Carbon

⁴ Leakage refers to the transfer of an emission generating activity from within a project boundary to an alternative area that is not inventoried by the project, therefore resulting in no actual net emission reductions.

plantations, in particular, may be detrimental to biodiversity if stands are fast-growing and consist of exotic species rather than native species (Nelson *et al.*, 2008). The stress on the soil, the hydrological cycle and the stability of the resource must be considered and the knowledge for the management of plantations whose sole purpose is carbon fixation requires more research.

The rate at which the global climate is changing means that the costs of inaction are high. No sector should be ignored in the mitigation effort. More research into the deficiencies, socio-economic impacts, limitations, adverse effects and trade-offs of ecosystem services are crucial. Forestry can contribute effectively towards the global mitigation effort: abatement through forestry was recently estimated to reduce the costs of halving global carbon emissions from 1990 levels by up to 50% in 2030 and 40% in 2050 (OCC, 2008). It also brings a number of ancillary environmental (Salafsky & Wollenberg, 2000) and social benefits (Davis, 2000). The cost-effectiveness and social appeal of forestry options over energy-based options presents policy makers with good incentives to use forests to provide climate stabilisation as a public good.

1.2.2. Alternative Mechanisms of Watershed Protection

Evaluating the impact of forests on watersheds is problematic without the counter-factual: what would the land have been used for in the absence of forest? This stems from the fact that forests can actually decrease water availability by reduction of run-off into rivers and so the amount percolating down into the water table (Willis, 2002). Forests may either reduce or improve water quality depending on management practices chosen. Timber harvesting, for example, has been shown to worsen soil compaction and erosion in the short term, but benefit soil moisture and surface run-off in the longer term (Sajwaj *et al.*, 2008). Afforestation of grasslands can lead to salinisation that threatens water supply (Jackson *et al.*, 2005) and can reduce stream flow (Farley *et al.*, 2005). Irrigation of plantation efforts may also salinise land, reducing water quality for urban and rural uses and damaging infrastructure, fertiliser use can lead to eutrophication of waterways, impacting aquatic biodiversity (Cowie *et al.*, 2007), and increased nitrous oxide emissions in fertiliser production (Crutzen *et al.*, 2007). These potential adverse effects are dependent on local site factors such as site history, soil texture and the availability of the ground water. As a result, a limitation of using forests for watershed protection will be lack of predictive power and requirements for site- and context-specific assessments.

In areas where adverse effects are limited, the use of forests is likely to be a more cost-effective option than alternatives. Water management has historically focused on human population demands as opposed to the long-term health of the water supply. Management mechanisms to maintain water quality have focussed on water treatment and filtration measures and less so on other forms of perennial vegetation cover to prevent soil erosion. The New York Catskills case popularised watershed management and the move from treatment in urban areas to consideration of the upstream watershed. By protecting the upstream watershed, including buying sensitive land areas, New York City avoided spending billions of dollars on water purification and treatment (Browner, 1996; see box 1).

Box 1. New York's Catskills Watershed Protection Program

Nine million New York residents rely on reservoirs in the Catskill and Delaware watersheds covering 1,900 square miles, and supporting a population of 77,000 and almost 350 dairy farms. Potential for microbial contamination of water became a concern in the early 1990s and the Surface Water Treatment Rule under the federal Safe Drinking Water Act were put in place by the Environmental Protection Agency (US EPA), requiring costly filtration of water. This proved a problem for New York where water treatment plants and runoff from urban sources were principal pollution sources. In 1993, the EPA waived the filtration requirements stipulated by law, on the condition that New York City maintained and protected the Catskill/Delaware's drinking water quality. Saving the City billions on dollars on a filtration plant for Catskill/Delaware water supplies, the deal between the EPA, New York City, New York State, watershed communities and environmental groups was a landmark agreement for payments for environmental services. The cost to the downstream user, New York City, of the protection of the watershed, is much less than the cost of the alternative, the filtration plant, and benefits accrued to numerous groups in society.

Source: Browner, 1996

1.2.3. Alternative Mechanisms of Biodiversity Conservation

The conservation of biodiversity can be achieved by a number of means for example; the management of threats to natural ecosystems, increased diversity of production species in managed systems, planting forests and vegetation on degraded land, and reduced soil disturbance and enhanced soil organic matter, for example. Fences and fines, a long-standing conservation tool, alongside captive breeding programmes, zoos, and gene banks also feature in the biodiversity conservation toolkit.

A number of biodiversity conventions exist (see section 2.5) and many countries have national biodiversity plans. With many of these focused on preserving the niche diversity of habitats, forests will inherently play a role. This is especially so in the topics where forests contain over half of global biodiversity (WRI, 1992).

The preservation of primary forest is likely to have more positive impact on biodiversity conservation than the creation of forest plantations, which are rarely composed of slow-growing native species. Forest conservation is not known to have adverse effects on biodiversity and so represents an effective option of provision. Forest plantations have species-specific effects, reportedly enabling exotic species invasions (Sajwaj *et al.*, 2008) and reducing biodiversity; although animal kingdoms fare differently and birds and insects may be less affected than mammals (Azevedo-Ramos *et al.*, 2006). Plantations are limited in their effectiveness, but in light of growing costs of alternative conservation measures forests may well be the most cost-effective means of forest biodiversity conservation⁵.

1.3. Trade-offs between Public Goods

Largely, the interactions between the public goods analysed in this report are positive: planting native species to protect watershed function will concurrently sequester carbon and provide habitats for biodiversity, for example. These synergies and co-production can improve economic efficiency and decrease the burden on the state if managed appropriately. It is possible however, that protection or creation of forests in order to produce a single public good can lead to detrimental effects on the provision of other public goods.

The most topical example of this is the relationship between forests managed for carbon and biodiversity (Jackson *et al.*, 2008; Nelson *et al.*, 2008; Jackson *et al.*, 2005). Jackson *et al.* (2005)

⁵ It must be acknowledged that a significant amount of biodiversity exists outside of forests and therefore preservation of forest biodiversity must be complemented by biodiversity conservation in other habitats.

report that afforestation of grasslands, scrublands and croplands for carbon sequestration can cause water and nutrient depletion, leading to increases in both soil salinity and acidity. As trees have larger water demands than crops or pastures, stream flows from the watershed can be reduced by 38%, and high nutrient demands from trees can alter the soil chemistry affecting fertility and sustainability.

These trade-offs exist but are largely understudied. Only recently has more focused and in-depth research into the tradeoffs between ecosystem services, the ecological processes that underpin ecosystem services and the well-being measures used to value these services been called for. Before public good provision is fully integrated into forest policy, it will be important to identify these trade-offs and, where they arise, value judgements must be made at both spatial and temporal scales. Spatially, which good provides greater welfare benefits and which stakeholder's values are most important? Temporally, will the value of goods change in the future relative to one another? These costs and benefits at all scales must factor in decision-making; research will make these resource management decisions more transparent.

2. Forestry Policy and Public Good Provision

2.1. Forest Policy Architecture

Although general consensus on what policy is exactly is elusive, policy can be thought of as a course of action adopted by a government or organisation. Worrell states that *"a forest policy specifies certain principles regarding the use of a society's forest resources which it is felt will contribute to the achievement of some of the objectives of that society"* (Worrell, 1970).

With numerous stakeholders interested in various forms of forest utilisation, forestry policy must incorporate diverse needs and aspirations (table 3). Policy must resolve and regulate conflict between stakeholders with regards to values, interests, goals and the distribution of benefits and costs.

The framework of forest policy formulation and development is complex. Historical factors, institutional circumstances, other policies and social demands will all influence the policy formation process. In particular, there is substantial influence on forests from policies that impact on demand for private forest goods and services, and land for settlement and agriculture (Mayers & Bass, 1999; see section 2.5 and 2.6 for cross-sectoral discussion). In a globalised world, these demands are not solely dictated by local or national needs. The global public good nature of many products from forests means that integrated forest governance is required at all spatial and temporal scales.

At a national level, forestry sector policy comprises national forest policies, forestry acts, logging codes of practice, forest development guidelines, environmental plans and sustainable public procurement policies. National objectives are often guided by global-level forest discourse such as that deliberated at the United Nations Conference on Environment and Development (UNCED), the Intergovernmental Panel on Forests (IPF), the Intergovernmental Forum on Forests (IFF), the United Nations Forum on Forests (UNFF), the Committee on Forestry (COFO) of the UN Food and Agriculture Organisation (FAO) and the International Tropical Timber Organisation (ITTO). The United Nations Millennium Development Goals⁶ are a good example where international summits can have

⁶ Decided at the Millennium Summit in 2000 there are eight Millennium Development Goals; reducing extreme poverty, universal primary education, gender equality and empowerment of women, reduction of child mortality, improvement of maternal health, combating disease epidemics, ensuring environmental sustainability and developing a global partnership for development, that UN member states are working towards meeting in 2015.

pervasive influence and maintain prominence over a number of sectors and policy decisions. Furthermore, there are a number of regional and sub-regional processes and economic organisations that can shape policy directions for example, the Common Market for Eastern and Southern Africa (COMESA), East African Community (EAC), Economic Community of Central African States (ECCAS), Southern African Development Community (SADC), to name a few in the east and south of the African continent aiming to reduce barriers to trade and improve economic integration.

Although forest policy is variable between nations, a few common policy directions have emerged. This includes privatisation of the forest sector, decentralisation of forest governance and, most recently, sustainable forest management.

Table 3. Stakeholders in Forest Policy

Forest Owners	Private non-industrial
	Private industrial
	Public (e.g. state, municipal† and communal forests)
	Other (e.g. cooperative, indigenous people owned forest)
Forest Industries	Woodworking
	Pulp and paper
	Business customers
Forestry Employees	Forest workers and forest industry workers
	Civil servants
	Contractors (e.g. in logging, transportation)
Specific-Interest Groups	Environmental organisations
	Hunting organisations
	Recreation and tourism organisations
	Other (e.g. NTFP, grazing, ethnic groups)
General Interest & State Organisations	Political parties
	General State administration
	Forest administration
	Research institutes and universities
	Financial organisations
	Media
	Informal citizen groups
	General population

† State forests are usually committed to the promotion of public welfare and interests, whereas municipal forests often are related to recreational or protection needs.

2.1.1. Privatisation of Forests

Privatisation is the transfer of ownership or management of forests and their goods and services away from the public sector and into the hands of the private sector. The rationale for such transfer is that privatisation eases the pressure on limited government finances and improves resource inefficiency through private sector management skills and investment (FAO, 2000b). Since the 1970s, government policy in a number of sectors has moved towards privatisation and forestry is no exception. The reduction in government legal ownership and control of forests continues globally and in the 2002-2008 period, many countries have recognised forest land access and ownership for local people (Sunderlin *et al.*, 2008).

A concern in the privatisation of forest is the resultant loss of public control over vital national resources and a greater risk of forest degradation (Mayers & Bass, 1999). However, nothing prevents governments from retaining sufficient influence to ensure sustainable management. Since state-owned forests are largely committed to the promotion of public welfare and interests, forest privatisation should theoretically only occur where state forests do not produce non-financial (social

and environmental) benefits, or where the regulatory framework can ensure their continued provision even under the private sector.

The provision of climate regulation, watershed protection and biodiversity conservation through privatisation is varied. In more mature markets the competition provided by privatisation can make improved management practices economically attractive in efforts to differentiate products (Clarke, 2000). However, in many developing countries, privatisation has been known to magnify the effects of market failures (Sizer *et al.*, 1999). There is also a lack of sustainability: with the private sector generally motivated by shorter time horizons and there is a reliance on corporate social responsibility and codes of practice to motivate environmentally-sustainable behaviours.

2.1.2. Decentralisation of Forest Governance

Decentralisation is the process by which authority is delegated from the central administration to local administrative level. Environment groups have widely supported decentralisation of decision-making in resource management and theoretical justification for the transfer of responsibilities includes: remediation of lack of stakeholder participation, efficiency improvements, accountability, and transparency in forest management (Mayers & Bass, 1999).

In reality, experiences with decentralisation vary. South Asia, where long-term user and ownership rights, as well as control over the benefits accruing from forests, have been completely transferred is an example of where decentralisation has worked. In contrast, Sub-Saharan Africa has seen much failure in decentralisation programmes. Mayers and Bass (1999) attribute this unsuccessful decentralisation to: transferring problems and inflating bureaucracies, participatory burdens, inappropriate decentralisation models, weak state consultation and coordination skills, lack of accountability of local institutions, lack of representation, increase in local inequity, no environmental guarantees, inadequate funding and a reluctance to relinquish control.

In theory, decentralisation should enhance the provision of public goods from forests. In practice, it is highly dependent on the institutional and political context of a nation as opposed to its ecological characteristics (see section 4.1 for a discussion of the enabling environment for provision).

2.1.3. Sustainable Forest Management

The principle of sustainability – *‘development that meets the needs of the present without compromising the ability of future generations to meet their own needs’* (WCED, 1987) – has commanded significant and growing attention since the late 1980s. It encompasses fundamental social values and public goals: welfare, economic growth, justice and democracy, and sustainable forest management (SFM) is one of the highest-visibility issues on the international forest policy agenda.

The United Nations Forum on Forests (UNFF) was established in 2000 to promote the management, conservation and sustainable development of all types of forests. It is composed of all member states of the United Nations. In 2007, UNFF adopted the Non-Legally Binding Instrument on All Types of Forest (NLBI). It represents the first time member states have agreed to an international instrument for sustainable forest management. The four global forest objectives are: to reduce the loss of forest cover through SFM including protection, restoration, afforestation and reforestation and prevention of degradation; to enhance forest-based economic, social and environmental benefits; to increase the area of sustainably managed forests; and to reverse the decline in official development assistance from SFM and mobilise new financial resources.

Several tools have been developed for SFM including criteria and indicators that enable harmonisation of general forest sustainability principles against which a nation's use of forests can be judged and progress over time measured and monitored. The development of national forest programmes, model forests and certification schemes have further helped to operationalise the theory (Castañeda, 2000). Data on progress towards SFM, reported in the FAO global forest resources assessment (FAO, 2006a), indicates both positive and negative trends. In some areas, intensive plantation and growing conservation efforts have resulted in net biomass increase; forest area is increasing in China for example, but primary forest continues to be deforested and degraded in others such as Indonesia. Following sustainability principles will support the provision of the public goods highlighted in this report and continued UNFF activity will perpetuate their provision.

2.1.4. National Forestry Policies Supporting Public Good Provision

National forest programmes (NFPs) are a globally-adopted framework for forest policy, planning and implementing SFM at the country level. In accordance with a country's specific needs, priorities and context, they aim to achieve sustainable forest management (DFID, 2002a) and are based on a set of guiding principles to achieve country specific forest management.

Forest policies for different forest types (industrial plantations, non-industrial plantations, and natural forest management and conservation) can be generalised in terms of their impact on public good provision (table 4).

Forest Management	Management Objectives	Impact on Public Goods*		
		Climate Stabilisation	Watershed Protection	Biodiversity Conservation
Industrial Plantation	Primary management objectives are to optimise timber production and so profits	-	-	-
Non-industrial Plantation	Variable including; production of wood fuel; rehabilitation of degraded land; watershed protection and/or soil erosion control; employment generation; regional development; and other forest services	+	+/-	+
Natural Forest Management and Conservation	Degradation and deforestation delayed or reduced through complete forest protection, sustainable forest management, or by providing alternative economic returns including through non-timber forest products and tourism	+	+	+

* Provision is classified as positive (+), negative (-) or neutral (N)

Of the forms of forest management, non-industrial plantations and natural forest management and conservation are the two that will contribute most significantly to public good provision. The non-industrial plantations provide public goods as they tend to be established with government support. This support is required as non-commercial management objectives are often not commercially viable; the value of public goods provided cannot be realised by the private sector.

Wood fuel non-industrial plantations, for example, are common in South Asia. India, Pakistan and Bangladesh all have wood fuel production incorporated into forest plantation policies. This type of plantation carries co-benefits for watersheds and can conserve biodiversity by preventing the deforestation of primary forest areas. Of course, woodlots are more common in developing countries where communities are more reliant on wood fuel than in developed countries.

Non-industrial plantations for degraded land rehabilitation are found in North Africa, China and on the Indian sub-continent. Many of these plantations have the objective of stopping or reversing desertification and protecting soils and watersheds. The largest non-industrial plantation for watershed and soil protection is China’s Three-North Shelterbelt Development Project. Established in 1978, plantations now cover 35 million hectares. As discussed in section 1.2.2, well-managed forest plantations for water and soil protection purposes will only address desertification, soil erosion and watershed degradation under certain ecological conditions.

Inherently, the maintenance and conservation of natural forest will ensure ongoing public good provision. The management of forests for non-timber forest products has also been proposed as a tool to incentivise conservation of forests (Belcher, 2003), although the success of this approach is debated (FAO, 2000b).

2.2. Forest Policy Instruments

Policy instruments are the means to achieve the goals and targets of forestry policy. The typology of policy instrument can be classified in a number of ways: Sisak and Pulkrab (2002) define ethical, normative, economic and institutional tools for forest resource management, whereas Mayers and Bass (1999) define regulatory/judicial, economic/market, information, institutional and contracts/agreements. Despite divergence, the most important distinction made by analyses of policy instruments is that between the regulatory, so called ‘command-and-control’ (CAC) instruments, and market-based instruments (MBIs). With this distinction in mind, this report categorises policy instruments as normative or regulatory, economic or financial, informational, planning and institutional and reform instruments (table 5), but retains focus on CAC and MBIs in following sections.

Table 5. Typology of Policy Instruments	
Normative or Regulatory (command-and-control)	Laws, decrees, orders and administrative rules
Economic or Financial (market-based-instruments)	Subsidies (incentives, support): measures that reduce the costs of production or increase the prices of forest goods and services
	Disincentives: measures that increase costs or decrease prices of production
	Tax-concession: exemption from direct (income) or indirect (value added) taxes
Informational	Government use of information to induce certain actions (e.g. teaching forest owners of the benefits of certain actions, raising ethical awareness or commitment, funding and disseminating forest research and its results)
Planning	Forest planning at many levels: forest holding level (of the private forest owner), regional and landscape level planning. Particularly important in forestry due to long rotations (maturing time of trees)
Institutional or Reform	Significant changes in the basic institutions of forestry (e.g. shifts in forest ownership, organisational structures, financial or legislative frameworks).

2.2.1. Normative and Regulatory Instruments

Normative and regulatory instruments refer to traditional legislative command-and-control (CAC). This policy instrument has historically been used to correct market distortions by imposing enforceable limits on environmental degradation, including technology and performance-based

standards. Forestry policy has used these legally-binding regulatory instruments extensively, in national constitutions, forest laws and property rights frameworks.

A number of multi-lateral environmental agreements (MEAs) exist, some of which are legally-binding and so fall under this policy instrument. The United Nations Framework Convention on Climate Change (UNFCCC) and the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) are two examples of legally-binding MEAs that contribute to the provision of forest public goods. With MEAs rarely designed only with forests in mind, they encompass only certain environmental functions of forests. The UNFCCC focuses on forest carbon but not biodiversity within forests and CITES on endangered tree species but not the overall integrity of the forest. Nevertheless, MEAs are likely to play a greater role in public good provision from forests in the future, not least because of the increasingly global nature of goods.

At a national level, many official conservation policies centre on a representative system of protected areas. This spatial protection is variable in rivalry and excludability (parks fees or no park fees, successfully regulated or unregulated) and so in public good characteristics, but protected areas commonly include forested areas and, as a result, they provide climate stabilisation and biodiversity conservation benefits when managed effectively. Protected areas cover 12.2% of terrestrial land surface cover and contain 15.2% of the global terrestrial carbon stock. Forests within protected areas principally deliver climate stabilisation through avoided deforestation. Specifically designated for the conservation of biodiversity (Campbell *et al.*, 2008), their contribution to its conservation is high, although dependent on the protected area categorisation⁷. The impacts on watershed protection are unclear: no studies on water quality improvements as a result of protection have been identified.

The shortcomings of this regulatory style are that often the legal and institutional mechanisms established to pursue policy objectives are extremely costly or ineffective. It also fails to acknowledge the heterogeneity of forest users, and cost burdens are inequitable. Furthermore, once the regulation has been met, the incentive for the user to fund further technological innovation is absent. Because of this, environmental policy is moving away from these normative policy instruments.

2.2.2. Economic or Financial Instruments

Market-based instruments (MBIs) are becoming more prominent in environmental policy (Harrington & Morgenstern, 2004), encouraging environmentally-favourable behaviour through market signals rather than explicit directives (Stavins, 2001). In the forestry sector these economic and financial instruments can include: direct user charges and payments for environmental services (PES), taxes and subsidies, eco-labels, standards and voluntary measures⁸.

Direct user charges have commonly been used on environmental resources: charges for deforestation, sanction and penalty payments when forest management practices are against the law and natural forest entry fees, for example. PES schemes are another form of user charge and carbon, water, biodiversity and nature-based tourism are the four public goods that are presently being produced under PES schemes. PES work through the establishment of a price and market for the environmental good, either directly or indirectly, reflecting the true social costs and so correcting

⁷ There are six management categories for protected areas depending on the management objectives; I and II are restrictive on use; III and IV are variable, and V and VI explicitly recognise sustainable use.

⁸ MBIs can be grouped by a number of different characteristics such as price or rights-based, and direct or indirect imposition of prices. They are commonly divided into five main groups: pollution charges, tradable permits, market friction reductions, government subsidy reductions and voluntary agreements (see appendix 3 for definitions).

market distortions and reducing welfare losses overall. These voluntary schemes commoditise these goods that are 'bought' from a 'provider' who secures their supply. This is only possible where consumers' willingness-to-pay for the environmental service is sufficient to incentivise the maintenance of land-use practices providing those services (Wunder, 2005). As a policy instrument, PES is fast gaining ground as a more cost-effective mechanism for conservation (Simpson & Sedjo, 1996; Ferraro & Simpson, 2002). The Costa Rican government has been a first-mover on this and has provided public goods through this mechanism since 1996 (box 2).

Subsidies, payment or tax concessions have also been widely used in forestry: artificially low stumpage rates set by governments, afforestation grants, grants for investment in transport and road infrastructure, energy subsidies, preferential tax treatment of forestry investments, grants to promote investment and exports, bans on exports of certain types of forest product, and distorted tariff rates are all examples. These tax incentives and subsidies are criticised for encouraging investment by those interested in short-term tax relief and gains rather than technically-sound forestry practices (FAO, 2000b). Plantation incentive schemes are also criticised for creating economic distortions and perverse incentives. The artificial competitive advantage leads to inefficient allocation of resources across sectors and between countries, and leads to clearing of primary forest to be replaced by plantations. In short, forestry sector incentives can be simultaneously economically inefficient, environmentally damaging and socially inequitable (FAO, 2000b).

Box 2. Pagos de Servicios Ambientales: Payments for Environmental Services in Costa Rica

The environmental benefits of forest cover were recognised in the early 1990s in Costa Rica. In 1996, the Forestry Law created a financial mechanism, complete with an institutional and legal framework, that compensates private forest owners for the public goods that forests provide. The goal of this pioneering PES scheme is to protect primary forest, allow secondary forest to recover and promote reforestation on abandoned pasture and degraded land.

Specifically recognising watershed protection, scenic beauty, carbon sequestration and biodiversity conservation, the PES scheme pays forest owners who produce these ecosystem services through a National Forestry Financing Fund (FONAFIFO). Payment levels vary depending on the activity: reforestation commands US\$450 per hectare, forest preservation US\$200 per hectare and agro-forestry systems US\$0.75 per tree. These payments are made over a five-year period, after which contracts can be renegotiated, but the land remains committed for a full 20 years (15 in the case of reforestation).

The mechanism is financed by a nationwide fuel tax, international donations and money from the sale of environmental services to local and global stakeholders. In 1996, Costa Rica sold the first 200,000 tonnes of carbon emission reductions to Norway for US\$10 per tonne of carbon.

In recent years, deforestation in Costa Rica has virtually halted from 16,400 hectare per year in 1986-1997 to 3,300 hectares per year in 1997-2000. Payments have been provided to over 4,400 farmers and the PES scheme is generally deemed a success. This success is partly due to: the creation of minimum infrastructure and presence in all country regions, the creation of a fund to manage finances, the body of legislation supporting and protecting natural resources, tax establishment on fossil fuels to pay for these services, a national system to certify good forest management, and technical support for forest owners for reforestation, forest management and forest conservation. In summary, institutional capacity made this scheme viable: visible services, well organised beneficiaries, well structured land user communities, clear and secure property rights, and strong legal frameworks are pre-requisites for a PES scheme such as this.

Source: Rojas & Aylward, 2003; Rodriguez Zuniga, 2003; Pagiola et al., 2002

In developing countries, taxes and subsidies are not that prominent for small land owners that probably do not pay income tax anyway or who do not have access to subsidy schemes. The highest subsidies are found in developed countries where high levels of income, a strong tax base and

relatively effective government institutions mean that countries can afford to pay the private sector to meet public interest objectives.

Eco-labels and standards have been given more attention in the forestry sector of late. Eco-labels and standards require firms to provide information on the end-use product in order to differentiate their goods: Smart Wood in Bolivia and the Forestry Stewardship Council's (FSC) certification scheme are two widely-known examples. Incentives, such as increased market access or price premiums resulting from voluntarily-imposed standards, instigate changes in the supply chain of forestry private goods such as timber, and public goods are provided as a by-product of this more socially responsible and sustainable production. Gullison reports that measurable improvements in management practices have been made over 'hundreds of millions of hectares' that have been certified (Gullison, 2003). But changes are rarely made by low-standard operators where, arguably, they are needed most. Effective on a limited scale, and principally in developed countries where consumers can afford the luxury good, voluntary codes of conduct, certification and labelling have been identified by the G8 and participants at the XI World Forestry Congress as valuable alternatives to state regulation and intergovernmental regimes (Humphreys, 2006).

In contrast to CAC instruments, the flexibility of MBIs allow greater efficiency gains and are more cost-effective: goals are achieved through differentiated user adjustment and cost burdens are more equitable (Pezzy & Park 1998). Furthermore, MBIs such as taxes can generate additional government revenue for public expenditure, and they continually incentivise innovation so long as the polluter continues to pay (Harrington & Morgenstern, 2004).

There is still considerable debate whether price signals and environmental markets function efficiently in practice and economic approaches are criticised for their anthropocentric focus and inability to incorporate ethical obligations to other species (Sagoff, 2004; Simpson, 2007). This, combined with the lack of understanding of the whole range of social, ecological and economic consequences of MBIs, is currently restricting the expansion of MBIs in forestry.

2.2.3. Informational Instruments

Informational instruments, with the aim to foster communication between stakeholders and disseminate information, are often used alongside other policy instruments. Research, education and public relations between policy-makers, NGOs, rural populations and the private sector represent a move away from the traditional uni-directional flow of policy information.

2.2.4. Planning Instruments

There are several master-planning approaches that impact on forestry, including Tropical Forest Action Programmes (TFAPs), Forest Sector Master Plans (FSMPs), National Conservation Strategies (NCSs) and National Environmental Action Plans (NEAPs). These often arise from international institutions – NCSs are encouraged by the World Conservation Union (IUCN) for example, and NEAPs are driven by the World Bank. These are designed to encourage a systematic approach to forestry policy and management and drive forestry sector reforms. However, they have had limited impacts, often because they have been based on past and current trends rather than with due consideration of environmental and developmental conditions in the future (Mayers & Bass, 1999).

2.2.5. Institutional and Reform Instruments

Institutions are the organisations and institutes that are responsible for different functions in forestry: they include administrative, research and educational institutes. Reform is a re-think of the policy and institutional architecture (Mayers & Bass, 1999). Where forest policy is consistently failing

to meet objectives, or is maladaptive to the changing needs and values of society, reform of policy and institutions involved in forest management may be required.

Over the years, UK forestry sector objectives, for example, have shifted towards enhancing public good provision. This can be seen by following the justification of forestry expansion in the UK through the 20th Century. In 1919, it was for a strategic reserve of timber; in 1957, for rural regeneration and employment; in 1967, conservation and natural beauty and amenity were integrated; in 1980, timber import costs were to be saved; in 1987, agricultural surpluses were to be cut through forestry promotion; in 1991, multi-purpose sustainable management began to be pursued; and, in 1998, sustainable forestry was to be certified against government and civil society standards (Mayers & Bass, 1999). As management approaches become more holistic and shift from a single-good approach to a more ecosystem-based approach, sector reforms are likely to be necessary for more strategic policy.

2.3. Other Tools for Forest Public Good Provision

There are a number of other tools that fall outside of this policy instrument framework. Considering only those that impact upon the public good provision of forestry, these can include programmes of the Global Environment Facility (GEF), Conservation Easements, 'Green Accounting', and Forest Trust Funds.

2.3.1. The Global Environment Facility

The GEF is a multilateral mechanism partnering international institutions, NGOs and the private sector to address global environmental issues and support national sustainable development initiatives. Over the past 12 years, the GEF has allocated US\$4.5 billion, supplemented by US\$14.5 billion in co-financing, for 1,400 projects in 140 developing countries (GEF, 2004). Providing the funding for the incremental costs of policies yielding global environmental benefits, GEF has been identified as '*the only multilateral mechanism dedicated to global public goods financing*' (Humphreys, 2006).

Under CBD guidance the GEF is targeting forest ecosystems as a key to conservation, sustainable use, and equitable sharing of benefits from biodiversity. This represents a move away from the protected area focus of the first 10 years of GEF activities. In 2003, the GEF had committed US\$777.6 million for 150 projects in forest ecosystems and US\$2 billion in co-financing. Project approaches are variable and include: sustainable financing, community support and awareness, integrated management systems, supporting indigenous management and communal reserves and integrating biodiversity conservation in forestry and range management (GEF, 2004). The GEF therefore provides a source of financing for public good provision through forestry where governments do not have institutional or financial capacity to do so.

2.3.2. Conservation Easements

A conservation easement is a voluntary, but legally binding, agreement limiting land uses or preventing development on a piece of land now and in the future. The aim is to protect the property's ecological or open-space values. Land owners benefit from easements by the sale of land, with opportunity costs of forgone development factored in, or tax benefits, contingent on conservation values including wildlife habitat, open space, scenic beauty, and agriculture (see Diehl & Barrett, 1988). The land protected remains in private ownership and management, but the purchaser of the easement provides monitoring and enforcement of the restrictions on the land.

Typically, easement holders are land trusts managed by non-profit organisations or governments: the American Farmland Trust and The Nature Conservancy, for example, are both major easement

holders. Governments buy easements as part of land-use planning projects, for watershed protection, ecological significance, or to preserve land of historical significance from being developed. Under easements, both the current and future owner's rights to certain specified land uses are relinquished, thus the provision of public goods from these land areas can be ongoing.

Depending on the locality of the easement, the opportunity costs of government funding may be too high to justify the employment of conservation easements. The US Forest Legacy Programme, for example, conserves resource values of forest land with national significance and that are threatened with conversion to non-forest uses. It protects wildlife habitat, watershed functions and maintains recreational capacity of the lands in the programme. But at a cost of US\$27 million in 2000 to protect 45,038 hectares of land, easements can be expensive tools. The substantial cost of forest conservation through conservation easements is incurred not only by the easement purchaser, but also by the land-owner, especially when specific conservation practices are required. The permanency of the easement also requires strong legal frameworks for monitoring and enforcement for conservation easements to be a successful policy tool. In light of this, it is unlikely that conservation easements will be a prevalent forest policy instrument for public good provision in developing countries.

2.3.3. *'Green Accounting'*

Historically, the system of national accounting (SNA) that underpins gross domestic product (GDP) measurements has not accounted for loss of non-market goods and services – such as those provided by forests. Green accounting is the process by which the depletion of natural capital, including oil and forests, is incorporated in a similar way to the depreciation of man-made capital, and unsustainable over-exploitation of, say, fisheries and forests is deducted. Under the existing SNA, an increase in mineral exports increases GDP, but under green accounting the decline in the stock of natural resources would reduce the gain from the production and export of the mineral in question.

Developed by the UN under the Integrated System of Environmental and Economic Accounts in the 1980s, it was hoped that either 'satellite' accounts that ran alongside measures such as GDP would be developed or green accounting would replace SNA altogether (Krause, 2002). 'Green Accounting' enables comparisons of the cost of public good provision with market commodities and economic objects through quantifiable relationships. It therefore allows policymakers to incorporate social and environmental costs into decision-making. But a number of complexities exist, such as potential double-counting of the costs of capital investment and the potential negative knock-on economic effects of this form of accounting (see Krause, 2002). It also is limited in its applicability to goods with established markets and prices and so is still not a complete accounting system. As a result, 'Green Accounting' has largely fallen by the wayside in environmental policy.

2.3.4. *Forest Trust Funds*

Under a trust fund, an area of land is managed by one person or group ('trustees') for the identified goals or benefit of a second person or group ('beneficiaries'). The fund is financed by central government allocations, donor grants or local tax revenues, and capital disinvestment by the fund management institutions is restricted by the trust fund holder, often the government. Trust funds, and similar financial mechanisms⁹, are considered when government budget support, user-charges, resource rents and long-term donor assistance are not sufficient to secure a steady stream of funds to meet recurrent costs of forest management or maintenance of forest areas. The assets in a trust

⁹ Other financial mechanisms that serve a related function to trusts include; foundations, endowments, sinking funds, revolving funds, debt-for-nature swaps, social funds and local currency funds (for more detail see Mikitin, 1995).

fund are invested in financial markets so that they earn interest and grow in perpetuity. Trust funds have complex financial and administrative arrangements: GEF trust funds for biodiversity conservation are commonly designed in conjunction with investment in the creation or upgrading of conservation areas, systems or institutions for this reason (Mikitin, 1995).

The recent popularity of avoided deforestation has elicited finance and trust funds from a number of multi-lateral sources (see table 11, section 3.7). In 2008, the British and Norwegian governments announced a US\$211 million initiative to conserve rainforests in the Congo Basin in cooperation with the Commission for the Forests of Central Africa and the African Development Bank. Although not generating carbon credits, the fund aims to fund community-based conservation and deforestation monitoring and so will raise the profile of forests for climate change mitigation. In the future, trust funds could well prove a valuable source of funding to ensure public good provision of forests in countries where other demands on government finance are high. This is particularly the case in a number of developing countries. With more funds emerging, a co-ordinated system of multilateral funding will be imperative to ensure these funds are cost-effective and not overlapping in their objectives.

2.4. The Hybrid Approach: Bundling Policy Instruments

Desirable features of policy instruments and tools are focused on cost-efficiency, fairness and equity, incentives to innovate, and agreement with moral precepts (Field & Field, 2005). Table 6 identifies the advantages and disadvantages of the policy instruments and supporting tools discussed in 2.2 and 2.3 with cost-efficiency divided into administrative costs, monitoring and compliance costs, regulatory control and fiscal objectives.

As can be seen, policy instruments and tools available to forest policy-makers have variable characteristics. Selection of these instruments will therefore be dependent on the objective, target and resources available and it is common for a number of policy instruments to be used to achieve a single policy target. This hybrid approach to policy implementation is followed when policy is addressing a multi-aspect issue, as is the case with public goods from forestry. While the forestry policy mix is moving towards a more market-based approach in the search for economic efficiency and cost gains, regulatory CAC instruments will still be required. Public goods from forestry, as with most environmental goods, are not well defined with respect to rights and responsibilities, and so regulations stipulating definitions and allocations will be required to support these MBIs.

A further example of bundling is the drive, principally in developed countries, to promote a more environmentally-conscious population. Through informational instruments, consumer behaviours are changing, and this feeds into financial and economic instruments such as forest product standards and eco-labelling. A more environmentally-aware society then makes it easier for governments to meet legally-binding environmental targets or impose taxes to fund public good provision.

The diversity of public goods arising from forests, the number of peripheral policies that influence their provision and the various forms of market failure mean that a number of instruments are already being used to provide forestry public goods. Maximising the benefits of each instrument and giving firms greater flexibility in compliance, instrument bundling is the most cost-effective application of policy tools. It does, however, make the role of specific instruments in the successes or failure of policies difficult to disentangle. In the long-term, it will be necessary to try to disentangle these effects so as not to select policy instruments that undermine each other and lead to unnecessary administrative costs.

Table 6. Assessment of Policy Instruments and Supporting Tools

	Administrative Costs	Monitoring and Compliance	Control by Regulators	Fairness and Equity	Incentives for Innovation	Fiscal Policy Objectives	Agreement with moral pre-concepts
Policy Instruments							
Normative and Regulatory	High burden on public sector	Often complex and costly as managed at national level	High demands on public sector	Often ex-post adjustments required	Minimal	None	Dependent on policy in question
Economic or Financial	High, but with burden often transferred to private sector	Left to market and private sector, but high where not	High demand	Flexibility of compliance leads to more equitable cost sharing*	High incentives to reduce costs	Can generate finance to feed back into public expenditure	Some discontentment with 'commoditisation of nature'
Informational	Medium, costs include collation and dissemination	Low requirements for quality control	Not required	High as fosters bi-directional information flow	Not applicable	None	High as more inclusive
Planning	High for forestry sector of public sector	Not required	Not required	Not applicable	None	None	Not applicable
Institutional and Reform	High for public sector	Not required	Not required	Inherently should be an outcome of reform	None	Can reduce costs of policy conflicts	High where process is inclusive
Other tools							
GEF: Land Rehabilitation	Low for public sector	Responsibility transferred to project activities	Medium control to direct project activities	Dependent on project application process	Minimal	None	High as funds public goods
Conservation Easements	High for public sector	High costs for easement owners	Medium control to direct easement practices	Dependent on project application process	Medium incentive if conservation practices required	None	High as funds public goods
'Green Accounting'	High for public sector expertise	Medium	Not applicable	Promotes between generation equity	None unless accompanied by performance incentives	None	High as promotes inter-generational equity
Forest Trust Funds	High for trustees and if funded by government	Low	Medium control to direct funds	Not applicable		Invested funds leads to public sector finance (tax)	High as funds public goods

* equity of MBIs is dependent on the particular instrument chosen

2.5. Cross-Sectoral Policy Synergies

The influence of environmental policies outside of the forestry sector can impact greatly on forestry public good provision (table 7). At the international level, a number of MEAs, whose objectives are not specifically directed at forests, have had a significant influence on their public good provision. The Convention on Biodiversity (CBD), the United Nations Convention to Combat Desertification (UNCCD) and the United Nations Framework Convention on Climate Change (UNFCCC) are three that have significant importance in the provision of public goods from forestry – so much so that in 2001 a Joint Liaison Group was established to facilitate collaboration between the secretariats of these Conventions.

Table 7. International Environmental Agreements affecting public good provision through forests		
International treaties/conventions	Regional Agreements*	National/State Policy*
Climate Change		
United Nations Framework Convention on Climate Change	European Climate Change Programme, EU Emissions Trading Scheme, EU Renewable Energy target, EU Energy Crop Subsidy, Asia Pacific Partnership on Clean Development and Climate	UK Climate Change Programme, New South Wales Greenhouse Gas Abatement Scheme (Australia), National renewable energy targets (USA, Canada, Brazil, UK), National Programs for reforestation (Canada, New Zealand, Ireland)
Biodiversity		
Convention on Wetlands, Convention Concerning the Protection of World Cultural and Natural Heritage, Convention on International Trade in Endangered Species of Wild Fauna and Flora, World Conservation Strategy IUCN/UNEP/WWF, UN World Charter for Nature, Convention on Migratory Species, UN Convention on Biological Diversity, Cartagena Protocol on Biosafety	The Convention on the Conservation of European Wildlife and Natural Habitat, European Conservation Strategy, EC Biodiversity Strategy, Pan-European Biological and Landscape Diversity Strategy	National policies on conservation of biodiversity and protection of threatened species (Australia, New Zealand), Legislation controlling land clearing, National Biodiversity Action Plans (Parties to the CBD)
Desertification/Land Degradation		
Plan of Action to Combat Desertification, World Soils Policy UNEP, World Soil Charter FAO, United Nations Convention to Combat Desertification	European Landscape Convention	Soil conservation policies (Iceland, Australia, New Zealand), Farm income support/Rural adjustment program, Conversion of cropland to forest program (China), National Water Initiative (Australia), National Action Programmes (Parties to the UNCCD), Desertification prevention and control law (China)

Source: Adapted from Cowie et al., 2007

* At national levels there are numerous strategies hence these mentioned are just exemplary.

2.5.1. UN Framework Convention on Climate Change

International legally-binding climate change mitigation policy is governed by the Kyoto Protocol, regulated by the UNFCCC Secretariat. Under the Kyoto Protocol, commitments have been made by a number of developed (Annex I) countries to reduce emissions by, on average, 5.2% relative to 1990 levels before 2012 (UNFCCC, 1997). Developing countries (Non-Annex I) have no legal obligations to reduce GHG emissions; instead, they participate through hosting Clean Development

Mechanism (CDM) projects. The CDM allows industrialised countries to offset a portion of their emissions in developing countries by initiating carbon saving projects.

Under the current regulatory framework, forestry activities are governed by articles 3.3, 3.4 and 3.7 of the Kyoto Protocol. Annex I countries must include afforestation, reforestation and deforestation (occurring after 1990) in overall country emission calculations. Forestry management, cropland management, grazing land management and re-vegetation occurring after 1990 can be voluntarily included in calculations. Although included in accounting, land use, land use change and forestry (LULUCF) activities can only be used to meet Kyoto targets under many restrictions: forest management activities can only be used to offset a maximum of 33MtCO₂ per year; only the emissions and removals from crop management, grazing land management and re-vegetation can be accounted for to help meet emissions targets, and only afforestation and reforestation (AR) projects are eligible under the CDM. Furthermore, GHG removals through LULUCF are limited to 1% of base year emissions in each year of the commitment period, and cannot be banked to a subsequent commitment period. Although limited, the role of forests in climate change mitigation efforts has been recognised and compliance, and in particular future compliance, is likely to lead to the provision of considerable public goods through forestry (see Section 3 for a discussion of forestry carbon).

2.5.2. UN Convention on Biological Diversity

The CBD requires parties to implement measures to protect biodiversity at a national level. Measures to do so include a system of protected areas and strategic plans to reduce pressures from habitat loss, land use change and degradation, unsustainable water use, and to enhance resilience to climate change (Cowie *et al.*, 2007). The Convention therefore greatly supports the provision of public goods through forestry by taking a broad-scale ecosystem approach, of which forests form an integral component.

2.5.3. UN Convention to Combat Desertification

The UNCCD is focused on combating desertification. One driver of desertification is deforestation and, along with over-cultivation, overgrazing and poor irrigation practices, leads to soil erosion and salinisation that negatively impacts cropland, pastures and woodland (Cowie *et al.*, 2007). Parties to the Convention have national and regional action programmes that seek to address causes of land degradation. In so doing, the Convention supports both avoided deforestation and forestry plantations.

2.6. Cross-Sectoral Policy Conflicts

Since the contributions of forests to the economy are diverse – including food security, energy security, ecosystem services, and social wellbeing – the impact of a number of non-forest sector policies can oppose forest policies. Conflicts arise from macroeconomic policies, fiscal policies, trade barriers, agricultural policies, poverty alleviation and land tenure reform policies, all of which alter the economic motivation for the management and conservation of forests (de Montalembert; table 8).

Furthermore, trends in global population growth, economic development and globalisation are increasing the demand for wood products and so pressures on forests. With population set to increase from 6.4 billion in 2005 to 8.2 billion in 2020 and economic growth predicted to grow to US\$100 trillion in 2030 these ongoing and, often, intensifying factors of wood product demand will continue to impact on the sustainable management of forests and their ability to provide public goods.

Land Use and Land Tenure Policies	Policies that influence land use and tenure are of critical importance as the land resource base is the common denominator of all sectoral policies dealing with natural resources and rural development.
Macroeconomic Policies	Inefficient macroeconomic policies can lead to loss of native forest by reducing alternative job opportunities, encouraging land conversion and lowering the priority of national conservation of forests.
Industrial and Fiscal Policies	Designed to pull economies out of recession and alleviate international debt, short-term industrial and fiscal policies can increase demand for forest products, stimulate production, foster deforestation, overharvesting, and unsustainable use of resources.
Irrigation and Power Generation Policies	When under additional pressures of poverty and unemployment, priority is given to fast-yielding economic development through irrigation and power generation practices that come at the expense of forests.
Public Administration Policies	Especially for natural resource and public land policy, insufficient political attention in forestry results in weak forestry institutions that are unable to maintain dialogue with other land-use sectors.
Welfare and Poverty Alleviation Policies	Especially at the rural level, population management, crop and livestock, rural development and tourism and energy policies focus on short term gains and divert attention away from sustainable forest use.

Source: compiled using de Montalembert (date unknown)

The success of forestry policy will only be felt where forestry is an economically-viable and stable option with due consideration of longer term population and economic growth trends. Therefore, mechanisms that enable dialogue between all sectors is vital to create an enabling policy environment (see section 4). Not only must this dialogue involve all relevant national actors, but it must also include regional or neighbouring actors (the European Union, for example) and must also be mindful of broader international factors such as free trade agreements shifting both consumption and production patterns.

3. Forests and Climate Change Mitigation

3.1. Forests and Carbon

The Intergovernmental Panel on Climate Change (IPCC) identifies four means to sequester carbon or prevent the emissions of carbon through forest systems: by maintaining existing carbon pools, by expanding carbon sinks and pools through forest management, by creating new carbon sinks and pools through forest management, and by substituting renewable wood-based fuels for fossil fuels (IPCC, 2000). A number of forestry activities contribute to these means: conserving primary or secondary forests under threat of conversion improved forest management (e.g. reduced impact logging), production of bio-energy (e.g. sustainable fuelwood management), biomass energy plantations, establishment of forest plantations on previously deforested land (reforestation) or land not recently forested (afforestation), regeneration of secondary forest on previously deforested land, agro-forestry systems on agricultural land, and lengthening of primary or secondary forest rotation cycles. The numerous options by which forests can contribute to climate stabilisation illustrate their potential in the global climate change mitigation architecture.

3.2. Forestry Carbon Finance

An important development in the effort to combat climate change is the emergence of carbon markets where units of reduced GHG emissions are traded. This market-based instrument provides economic incentives to reduce harmful GHG emissions and, in 2007, carbon markets traded an estimated US\$64,035 million or 2,983 million tonnes of CO₂e (Capoor & Ambrosi, 2008). This carbon trading is either compliance-based, under the Kyoto Protocol (see section 2.5.1), or voluntary-based, driven by concerned consumers and businesses.

In the compliance market, the role of forests is limited, with only afforestation and reforestation (AR) eligible as CDM projects in the first commitment period (2008-2012). Of over 4,000 projects in the CDM pipeline in December 2008, only 27 are forestry-related and one of these AR CDM projects was registered (see box 3). In March 2009, two more CDM forestry projects were validated: The Moldova Soil Conservation Project and the Private Lands Affected by Shifting Sand Dunes in the Thar Desert in Rajasthan, India, taking a total of 1610 and 409 days from host country Letter of Approval to full project registration, respectively. Of the CDM pipeline, forestry projects equated to only 0.5% of expected certified emission reductions in 2012.

Box 3. Facilitating Reforestation for Guangxi Watershed Management in Pearl River Basin, China

One of the three registered AR projects under the CDM is in the Pearl River Basin, China. The project aims to explore and demonstrate methodological and technical approaches to credible carbon sequestration and hopes to enhance the livelihoods of people and the natural environment by reforesting in watershed areas. The plantations are to act like a 'virtual cash crop', with locals directing gaining from carbon credits and sale of harvested products. As well as climate stabilisation through carbon sequestration, the project activity will produce a number of public goods, including biodiversity enhancement and watershed protection.

Commencing in April 2006, the project has a fixed 30-year crediting period, generating 25,795 tons of CO₂e annually or 777,000 tons of CO₂e in total. Establishment costs are being met by local commercial bank loans, counterpart funds from local government, and participants themselves. Operating and maintenance costs are also covered by loans from commercial banks.

The additional environmental benefits of the project include: enhancing biodiversity and ecosystem integrity with forest corridors, reducing firewood pressure on natural forest, habitat provision, generating alternative income sources to reduce poaching and illegal logging, controlling soil erosion, regulating hydrological flows that alleviate drought and flooding risk, improving nutrient cycling within the soil, and improving watershed management that leads to downstream benefits.

Source: Project Design Document: Facilitating Reforestation for Guangxi Watershed Management in Pearl River Basin, China, 2006

Pre-dating the compliance market (Bayon *et al.*, 2007), voluntary carbon market (VCM) demand is driven by corporate social responsibility (Hamilton *et al.*, 2007) and individuals wishing to contribute to a 'solution' for climate change. In 2007, US\$265 million (or 42 MtCO₂e) were traded on the VCM (Capoor & Ambrosi, 2008) and this figure is growing. Not subject to as stringent reporting processes, lengthy protocols or established methodologies as the compliance market, VCM projects can be more attractive to investors. The VCM is more open to forestry projects and is currently the only source of carbon finance for avoided deforestation GHG emission reductions. In 2007, the VCM consisted of 18% forestry projects, a decrease on 37% in 2006 but still significantly more than the 1% under compliance markets (Hamilton *et al.*, 2007). In addition, the VCM allows a price premium to be obtained for projects that deliver not only climate stabilisation through reduced GHG emissions, but also other public goods such as biodiversity conservation or sustainable development.

Forestry activities that are eligible for carbon financing through the carbon markets can be broadly classified as those that avoid emissions and those that sequester carbon (see table 9). These carbon financing activities are varied in their contribution to the climate change mitigation efforts as well as to public good provision. The Fourth Assessment Report of the IPCC identifies reduced emissions from deforestation and degradation (REDD) as having the greatest short-term mitigation potential, but SFM, inclusive of soil carbon management, reduced impact logging (RIL) and improved forest management, as having the greatest long-term mitigation benefit. The IPCC also acknowledges bio-energy and agro-forestry as being an important part of a sustainable and ongoing climate change mitigation effort (Nabuurs *et al.*, 2007).

Table 9. Forestry Activities for Carbon Financing				
Activity	Definition	Contribution (+ / neutral / -)		
		Climate Stabilisation	Watershed Protection	Biodiversity Conservation
<i>Avoid Emissions</i>				
Reducing Deforestation	The direct human-induced conversion of forested land to non-forested land.	+	+	+
Reduced Impact Logging	RIL is carefully planned and controlled harvesting practices reducing impacts on forest stands and soils	+	+	+
Forest Management Project Activities	Increasing overall GHG removals and reducing GHG emissions by means of various management activities that depend on the characteristics of the project site and management goals. E.g. practices that reduce emissions from disturbances through insect and fire prevention or control, or enhance carbon storage by planting improved or different species of planting stock.	+	+	+
Bio-Energy Production	Displacing fossil fuel use, either through product substitution or through use of biomass from forests forms part of bio-energy production	+ / -	+ / -	+ / -
<i>Sequester Carbon</i>				
Afforestation	Direct human-induced conversion of land that has not been forested for a period of at least 50 years to forested land through planting, seeding and/or the human-induced promotion of natural seed sources	+	+ / -	+ / -
Reforestation	Direct human-induced conversion of non-forested land to forested land through planting, seeding and/or the human-induced promotion of natural seed sources, on land that was forested but that has been converted to non forested land	+	+ / -	+ / -
Agro-Forestry	Planting and maintaining tree species on agricultural land, activities include boundary planting, windbreak planting, hedgerow intercropping and home gardens	+	N	N

Source: definitions from IPCC, 2000

3.3. Emission-Avoiding Activities

Emission reductions through reductions in deforestation is a highly emotive issue and, while avoided deforestation has risen on the international climate policy agenda, reduced degradation and forest management activities have largely been ignored (Nepstad *et al.*, 1999, Asner *et al.*, 2005) and bio-energy has been a topic of controversy (for example, Crutzen *et al.*, 2007). These activities and their impacts on public good provision are outlined below.

3.3.1. Avoiding Deforestation and Degradation

Deforestation is the human-induced conversion of forest to non-forest land uses that typically results in large immediate reductions in forest carbon stock (Nabuurs *et al.*, 2007). Forest degradation is the reduction in forest biomass through non-sustainable harvest or land-use practices including selective logging, fire and other anthropogenic disturbances (Asner *et al.*, 2005). According to the IPCC Fourth Assessment Report, REDD is the forest mitigation option with the largest and most immediate carbon stock impact (Nabuurs *et al.*, 2007). A recent review for the UK government provides a comprehensive analysis of international financing to reduce forest loss, its associated impacts on climate change, and mechanisms to significantly reduce forest carbon emissions (OCC, 2008).

In addition to carbon savings, REDD activities also provide environmental benefits of biodiversity conservation and watershed protection. Furthermore, REDD preserves option value and non-use values¹⁰, and are thought to be able to contribute to poverty reduction in developing countries (Davies, 2000).

3.3.2. Forest Management and Reduced Impact Logging

Forest management activities increase stand-level forest carbon stocks through better harvest systems, the maintenance of forest cover, minimisation of soil erosion, and avoidance of high-emission activities such as slash-and-burn (Nabuurs *et al.*, 2007). RIL is one such mechanism, whereby logging is carefully planned and controlled harvesting practices that reduce impacts on forest stands and soils are employed (Schwab *et al.*, 2001). RIL includes planning of harvesting operations and regeneration, better planned extraction for subsequent cutting cycles and reduction of logging damage, logging restrictions, and post-harvest treatment (Sajwaj *et al.*, 2008).

Putz *et al.* (2008) report that improved forest management in the tropics, including appropriate harvest planning of log extraction paths and directional felling, can eliminate over 50% of collateral damage and therefore substantially conserve carbon stock. They estimate emission reductions through improved forest management as 10% of avoided deforestation potential¹¹, not least because improved forest management is only practiced in less than 5% of tropical forests (ITTO, 2005). RIL and better forest management have also been shown to lead to co-benefits, such as the safeguard of biodiversity and maintenance of forest functions (Lohuji & Martin, 2001).

3.3.3. Bio-Energy

Bio-energy contributes to climate stabilisation through the displacement of fossil fuel use, either through product substitution or bio-energy from biomass. Product substitution, such as sustainably-

¹⁰ Option value is held for goods and services that are not used at present but may be used in the future. Non-use values are those of continued provision even though there is no intention of use by the individual (this can be for bequest, existence or altruistic purposes).

¹¹ This calculation by Putz *et al.* (2008) is based on emission savings through improved timber harvesting practices in tropical forests; estimated at 0.16 giga tons of carbon annually, largely from the intensively logged forests of Asia, and total tropical deforestation emissions estimated at 1.5 giga tons of carbon annually (Gullison *et al.*, 2007).

harvested wood instead of concrete, steel, aluminium and plastic construction materials, decreases the energy intensity of production and stores carbon in resultant wood products. Fuel substitution, such as forest-derived biomass instead of coal, provides a more sustainable and less fossil fuel-intensive energy source. Bio-energy therefore has substantial potential to reduce net emissions (Murphy, 2004; Petersen & Solberg, 2002): intensively and sustainably managed forests can provide fibre, timber and energy whilst maintaining or increasing forest carbon stocks.

In developing countries, bio-energy from forests could be a particularly important mitigation strategy. In these countries, energy demands are set to grow and the direct combustion of biomass is already a common source of fuel in rural areas. Forestry bio-energy could provide residential and commercial cooking and hot water through wood or charcoal or even be used to generate grid-based power¹². As it largely does not require major behavioural or technological change, the use of bio-energy has been promoted for more than just climate change mitigation. It could prevent the development of fossil fuel-intensive economies in developing countries where bio-energy policies are in place to increase energy security and promote rural development (Parris, 2004); and in developed countries, bio-energy is often pursued to meet renewable energy targets.

The scale of the contribution to climate change mitigation from forestry bio-energy will be dependent on the mechanism chosen and the particular crop species. Carbon in wood products has variable life spans: days in the case of bio-fuels and years in the case of housing materials. Some studies have found that bio-energy projects may cause a decline in soil organic carbon; if fertiliser is applied, commercial bio-energy plantations can actually increase fossil fuel consumption. In general, the IPCC reports that the production of a sustained yield of timber, fibre or energy from forest can generate a large sustained mitigation benefit, with estimates ranging from 420 to 4,400 million tonnes of CO₂ annually – dependent on whether either gas or coal is replaced by biomass (Nabuurs *et al.*, 2008).

The impact of bio-energy from forests crops on watersheds and biodiversity is also highly dependent on crop species and local context (see Yamamoto *et al.*, 2001; Smeets & Faaij, 2007). Single-species rotations, as mentioned previously, may negatively affect biodiversity and watersheds, depending on site-specific conditions.

Furthermore, plantations for bio-energy have created significant debate in relation to competition for land and food. These problems have been exacerbated by high oil prices and government policies promoting renewable energy sources that have made bio-crops more lucrative than stable food crops.

3.4. Carbon Sequestering Activities

Carbon sequestration is the uptake of CO₂ from the atmosphere into plant tissue as forests grow and increase their biomass. The primary activities for carbon financing are afforestation, reforestation and agro-forestry. The definitions of these activities and their impacts on public good provision are outlined below.

3.4.1. Afforestation/Reforestation

AR is the direct human-induced conversion of non-forest to forest land through planting, seeding, and/or the human-induced promotion of natural seed sources (Nabuurs *et al.*, 2007). Forest stands

¹² Non-forest bio-energy includes provision of transport fuel through sugar cane ethanol or biodiesel, rural power for lighting and communications through bio-gas and can provide energy for household cooking and water heating through crop residue and dung combustion.

established on land that has not supported forests in the last 50 years are afforestation activities, whereas stand establishment on land that has supported forests in the past, but the original vegetation has been replaced, are reforestation activities.

Although climate regulation through carbon sequestration has not historically been the primary motivation of AR activities, the importance of projects as carbon sinks in the tropics has been shown by a number of authors (de Jong *et al.*, 2005; Kraenzel *et al.*, 2003). In contrast, boreal forests may be a positive climate force due to low albedo effects (Bonan, 2008). A result of increases in above- and below-ground living biomass, dead organic matter, and small increases in carbon pools, AR activities have the potential to sequester significant amounts of carbon: the Third Assessment Report of the IPCC reported that AR could potentially sequester 87 billion tonnes of carbon by 2050 globally (Watson *et al.*, 2000).

AR activities will also protect watersheds, so long as species are not water-thirsty, by reducing runoff, flooding and controlling ground water recharge (Nabuurs *et al.*, 2007).

The impact of AR activities on biodiversity conservation is largely dependent on the composition of the stand and management practices (Quine & Humphrey, 2005). Mono-culture plantations or those replacing species rich grasslands or shrub lands, are likely to result in a decline in biodiversity (Wagner *et al.*, 2006). However, plantations in areas of degraded land or mixed species plantations have significant potential to increase biodiversity, replacing native vegetation, acting as wildlife corridors and providing habitat for a multitude of species.

3.4.2. Agro-forestry

Agro-forestry refers to the growing of tree species on land areas broadly characterised as agricultural. Activities include boundary planting, windbreak planting, hedgerow intercropping and home gardens (Sajwaj *et al.*, 2008). It is an important carbon sequestration strategy due to carbon storage in plant species and in soils, but also due to avoided use of the land for agricultural purposes that is more carbon-intensive (due to fertiliser application and farmland maintenance costs). The amount of carbon sequestered through agro-forestry is therefore, dependent on existing edaphic and ecological factors as well as the counterfactual land-use.

In addition to carbon savings, little evidence of local extinctions and invasions of species risking biodiversity have been found when practising agro-forestry (Clavijo *et al.*, 2005) and watershed benefits include the reduction of overgrazing and soil degradation where land uses such as conventional livestock production have been disincentivised.

Agro-forestry also highlights the important benefits derived from trees outside the definitions of forests; defined by the FAO as a minimum area of 0.5 hectares with average canopy height of 5m and crown cover above 20% (FAO, 2000a). Trees outside of forests includes those on farms and along roads, for example, that both contribute to socio-economic well-being but do not factor in national forestry inventories. Providing fruit in plantations or in home-gardens, shade, and aesthetic benefits in urban areas as forest and woodland areas decline, trees outside of forests are likely to become more prominent in future reducing pressures on forest resources, increasing food supplies, providing income and conserving farmland soils (FAO, 2000a).

3.5. Barriers to Public Good Provision through Forestry Carbon Mechanisms

The reluctance to invest in forestry carbon activities arises from a number of interlinked technical, political and social issues in project design (see table 10). These uncertainties have led some to

believe that LULUCF has been adopted into the political agenda without fully understanding the scientific, technical and social challenges (Boyd, 2007). Scientific and technical concerns of measurement uncertainties, non-permanence, leakage and market flooding have all been extensively studied (Myers, 2007; Skutsch *et al.*, 2007; Schlamadinger *et al.*, 2005). In contrast, political concerns, focused on sovereignty and establishment of deforestation baselines, and social concerns, including community land tenure and resource rights, have been less studied though recognised as important (Roe *et al.*, 2007).

Table 10. Barriers to Forestry Carbon Activities

Barrier Classification	Barrier Explanation	Concern with regard to forestry activities	
Technical	Additionality	To generate emissions reductions, carbon savings must be proven to result from project activities; they would not have occurred in its absence if the project is additional (see IPCC, 2003).	Forestry projects on the whole, are more easily proved to be additional. This is especially so in developing countries where significant barriers (subsistence livelihoods driving deforestation, lack of financing, lack of technical assistance or marketing infrastructure) are faced.
	Leakage	Carbon projects must not merely shift emissions to another geographical area (Sohngen & Brown, 2004); leakage may result in fewer, or no, actual reductions being generated by the project activities.	Forestry projects, particularly avoided deforestation, are vulnerable to leakage unless the underlying drivers of deforestation are acknowledged (see Chomitz <i>et al.</i> , 2007; Tomich <i>et al.</i> , 2005), and local community needs are adequately addressed.
	Permanence	Project activities must generate emissions reductions that are persistent over time.	With forests subject to both natural and anthropogenic disturbances, such as fire, pests or land-use change decisions, there is a risk that emissions reductions may be short-lived. However, mechanism to deal with forestry project risk have been developed including; periodic, performance based payments (Sedjo & Marland, 2003) or reserve accounts and temporary crediting (Parpia, 2007).
	Market Flooding	If a significant volume of credits were added to the market there is concern that carbon prices will be depressed to such an extent that incentives to invest in clean-energy technologies will be reduced (Leach, 2008).	The development and continued management of forestry projects incur such substantial transaction costs the supply of credits to the market is unlikely to be a 'flood'. Other mechanisms to prevent market flooding include; higher emission reduction targets or, a price floor for carbon that maintains incentives for technological advancement.
Political Issues	Baseline Scenario	In order to set emission reduction targets business-as-usual scenarios and historical emissions must be considered. This raises issues of equity between countries, and impacts country participation in climate change mitigation activities.	The question of the baseline is particularly important for avoided deforestation. Without due consideration countries with historically high rates of deforestation will be rewarded more than those that have been active and successful in conserving forest areas (see Sedjo <i>et al.</i> , 2005; Fearnside, 2007).
	Sovereignty	In committing to certain land uses in perpetuity, a country is limited in future land use decisions, even if opportunity costs of various land uses change.	Since forestry activities require significant land areas, there are concerns regarding sovereignty that may impact on project contract and credit design.
	Institutional Capacity	Markets sit within institutional landscapes so political stability, the quality and transparency of the legal system, monitoring and enforcement standards and capabilities will have a direct impact on carbon projects.	Institutional uncertainty, together with characteristics of forestry carbon projects such as high upfront costs, delayed returns, and low rates of return (Neef & Henders, 2007), introduces high perceived risk and concerns over liability that need to be addressed through appropriate contract and credit design (see Davies, 2000).

Even if the technical and political issues can be addressed from the top down through methodologies and protocols, there are a wide range of socioeconomic considerations that make micro-level feasibility of forestry carbon projects highly dependent on local factors.

In the project design: local property rights, skills and education, market information, market contacts, communication infrastructure and access to financial resources all provide barriers to forestry activities. In particular, AR has high labour demand, sunk costs and illiquidity of the investment, as well as production and price risk and a long waiting period for financial return (Coomes, 2008; Nabuurs *et al.*, 2007). REDD is not as affected by the absence of front-loaded payments, but the costs to set up a project are still high and projects commonly rely on donor and NGO support at initial stages.

In project implementation: changing resource access, mechanisms for payments, alternative livelihoods, community needs and aspirations all provide barriers to forestry activities. Where projects greatly alter land uses, this can significantly alter livelihoods or fundamentally change the way local communities use land – those dependent on that land for their livelihoods must be provided with alternatives.

These barriers are not completely prohibitive and a number of well designed forestry projects are operating and delivering carbon emission reductions. A non-exhaustive search identified 48 forestry projects¹³ that have been, or are in the process of being, registered with CDM or voluntary standards, or follow proper verification procedures and carbon accounting methods (table 11). The identified projects were 71% reforestation projects, 11% SFM, and 9% REDD and afforestation. They are geographically concentrated in Central and South America (34%), closely followed by Asia (31%) and Africa (25%).

Table 11. Existing Forestry Projects		
Standard	Registered	Seeking Validation
Clean Development Mechanism (CDM)	1	19
Climate, Community and Biodiversity Alliance (CCB)	4	5
California Climate Action Registry (CCAR)	2	-
Voluntary Carbon Standard (VCS)	-	2
Plan Vivo	3	-
Leading Organisation		
World Bank Bio Carbon Fund	12 (inc. 4 with CDM potential)	
Conservation International (CI)	1	
Wildlife Conservation Society (WCS)	1	
Other Noteworthy Projects:		
Noel Kempff Climate Action Project, Bolivia		
<i>Note: Projects can fall under more than one standard</i>		

The emergence of standards has greatly improved the quality of VCM emission reductions, providing proper verification procedures and carbon accounting methods that build consumer confidence. Although not all standards accept forestry activities, others have wholly embraced forestry activities. These, such as the Voluntary Carbon Standard (VCS) and Plan Vivo, deal with the issue of permanence through temporary offset credits or carbon buffer zones that retain a portion

¹³ There are a number of other forestry projects in the planning and development stages; some in the VCS pipeline, and some registered under the Chicago Climate Exchange.

of the projects carbon credits in case of forest loss. Others, such as the Climate, Community, Biodiversity Alliance and Plan Vivo, are specifically designed to maximise co-benefits for biodiversity and other social benefits.

3.6. The Potential Supply of Forestry Emission Reductions

The future impact of forestry in the global climate change mitigation effort is not only dependent on addressing the technical, political and social barriers. The scale of the supply of forestry emission reductions is also dependent on the costs of forestry mitigation relative to the costs of other GHG emission reduction efforts.

Table 12: Annual emissions reduction potential of global forestry activities*

Region	Activity	Potential at costs ≤US\$100 /tCO ₂ (in MtCO ₂ /year in 2030)	Fraction in cost class: US\$ 1-20 /tCO ₂	Fraction in cost class: US\$20-50 /tCO ₂
USA	Afforestation	445	0.3	0.3
	Reduced Deforestation	10	0.2	0.3
	Forest Management	1,590	0.26	0.32
	TOTAL	2,045	0.26	0.31
Europe	Afforestation	115	0.31	0.24
	Reduced Deforestation	10	0.17	0.27
	Forest Management	170	0.3	0.19
	TOTAL	295	0.3	0.21
OECD Pacific	Afforestation	115	0.24	0.37
	Reduced Deforestation	30	0.48	0.25
	Forest Management	110	0.2	0.35
	TOTAL	255	0.25	0.34
Non-annex I East Asia	Afforestation	605	0.26	0.26
	Reduced Deforestation	110	0.35	0.29
	Forest Management	1,200	0.25	0.28
	TOTAL	1,915	0.26	0.27
Countries in transition	Afforestation	545	0.35	0.3
	Reduced Deforestation	85	0.37	0.22
	Forest Management	1,055	0.32	0.27
	TOTAL	1,685	0.33	0.28
Central and South America	Afforestation	750	0.39	0.33
	Reduced Deforestation	1,845	0.47	0.37
	Forest Management	550	0.43	0.35
	TOTAL	3,145	0.44	0.36
Africa	Afforestation	665	0.7	0.16
	Reduced Deforestation	1,160	0.7	0.19
	Forest Management	100	0.65	0.19
	TOTAL	1,925	0.7	0.18
Other Asia	Afforestation	745	0.39	0.31
	Reduced Deforestation	670	0.52	0.23
	Forest Management	960	0.54	0.19
	TOTAL	2,375	0.49	0.24
Middle East	Afforestation	60	0.5	0.26
	Reduced Deforestation	30	0.78	0.11
	Forest Management	45	0.5	0.25
	TOTAL	135	0.57	0.22
TOTAL	Afforestation	4,045	0.4	0.28
	Reduced Deforestation	3,950	0.54	0.28
	Forest Management	5,780	0.34	0.28
	TOTAL	13,755	0.42	0.28

* Exclusive of bio-energy with emissions reduction potential of 3140 MtCO₂/yr in 2030

Source: Chapter 9 Forestry, table 9.3 IPCC Fourth Assessment Report (Nabuurs et al., 2008).

These costs of forestry activities are largely dependent on the opportunity costs of other land uses (i.e. the minimum income that land owners derive from the alternative land use) and the costs of project implementation. The costs of REDD, for example, will primarily vary according to the underlying drivers of the forest losses which dictate the opportunity costs of the forest land. In contrast, AR has additional demands of land purchase, plantation site preparation and labour costs. In general, studies on the market potential for forestry have provided very broad estimates, with highly varying assumptions in accounting, forestry activity eligibility, influencing policies and market penetration rates (for example, Strengers *et al.*, 2008; Sathaye *et al.*, 2006; Richards & Stokes, 2004; also see Appendix 4 for supply estimates by model approach). The Fourth Assessment Report of the IPCC summarises global forestry sector models that predict what forestry supply will be under particular carbon prices (table 12).

These estimates show that potential is not evenly geographically distributed, with forestry potential concentrated where costs are lowest. Parpia (2009) finds that South and Central America have the largest potential by volume (largely due to Brazil) and Asia the second-highest potential. Sohngen and Sedjo (2006), focussing on REDD, find that the largest potential is found in Southeast Asia followed by both South America and Africa, with the lowest potential in Central America. They also estimate that a carbon price of US\$27.2 per tonne of CO₂ may nearly eliminate global deforestation.

3.7. Forestry Carbon Finance in Africa

On neither the compliance market, through CDM projects, nor in the VCM, does Africa feature prominently. Under the CDM, Sub-Saharan Africa has contributed only 10 million tonnes of CO₂e (Capoor & Ambrosi, 2008). On the VCM, despite project attractions of emotional appeal and societal benefits, African market share declined from 6% in 2006 to 2% in 2007 (Hamilton *et al.*, 2008).

In the period 2000-2005, 48% of the average annual total anthropogenic carbon emissions in Africa were from land use change (Canadell *et al.*, 2008). Rates of deforestation in Africa were higher than those in tropical Asia and nearly as high as those in Latin America over this same period (FAO, 2006a). Africa is, therefore, not lacking in physical potential for forestry carbon projects. The lack of investment is likely to reflect lengthy project development times found across Africa as a result of technical and institutional barriers (Ruhweza & Waage, 2007) as well as institutional uncertainty and lack of forest project experience.

3.8. The Future of Public Good Provision through Forestry Carbon Finance

Although the barriers to forestry carbon projects are many, they can be overcome. In theory, if projects are designed with due diligence to socio-economic impacts and with mechanisms to maintain technological innovation incentives in other sectors, forest carbon has the potential to provide a number of environmental, social and economic benefits.

Reflective of this, at the 11th Conference of the Parties of the UNFCCC in 2005, a Coalition for Rainforest Nations formalised their growing interest in REDD activities. This interest prompted reactions from the European Union, the Group of Eight Developed Nations (G8), the Asia Pacific Economic Co-operation Group, and the UNFCCC in Bali, leading to commitments to review the scope of forestry in existing compliance carbon markets. The future of REDD looks bright and a number of national and multi-national initiatives investing significant funds to explore project feasibility and to fund project start-ups (table 13). A decision for the future inclusion of REDD in compliance markets should be delivered in Copenhagen late 2009.

Initiative	Estimated funding (US\$ million)	Period
International Forest Carbon Initiative (Australia)	135	Uncertain
Climate and Forest Initiative (Norway)	2,250	2008-2012
Forest Carbon Partnership Facility (World Bank)	300	2008-2018
UN-REDD Programme	35	2008-2012
Amazon Fund	1,000	2008-2015
Congo Basin Forest Fund	200	Uncertain

Source: UNFCCC (2008)

4. An Enabling Environment for Forestry Public Good Provision

4.1. Elements of an Enabling Environment for Forest Policy

Forestry are notoriously difficult to govern. Brown *et al.*, (2002) identify three primary characteristics that make them especially so with regard to public goods from forestry:

- *The nature of the resource*: forests offer multiple benefits that are not necessarily compatible and accrue to many different users. To some, they provide a repository of value but they are easily liquidated to realise alternative values;
- *The nature of the rights*: forests have competing *de facto* and *de jure* claims as well as unclear or insecure rights of access to forest resources;
- *The value of forest resources*: forests have both non-market and market benefits and are enjoyed at local, national and global levels. Although the non-market goods are often global goods, they are managed by sovereign territories and are largely uncompensated, causing disequilibrium between their costs and benefits. Furthermore, with high market values, forest management engages powerful stakeholders increasing pressure to centralise control and manage forests less democratically and transparently, leaning to industrial rather than societal interests.

As a result of these characteristics an enabling environment for implementation of any forest policy is necessary for it to be effective. It must be designed with many economic, cultural, social, legal and political factors in mind and these factors are numerous and diverge between nations and regions, and between developed and developing countries.

Broadly, an enabling environment that can encompass these characteristics and factors requires: defined property rights, strong public and private sector institutions, greater sectoral integration, understanding of the political economy, a steady stream of financing, better information and awareness, and full stakeholder participation.

4.1.1. The Role of Defined Property Rights

Tenure is one of the most complex subjects in forest resource management and underpins any land use policy. Clearly defined tenure identifies the rights over non-timber forest products, the trees, forests and the land on which forests grow.

On a global scale, the majority of forests are under public ownership (FAO, 2006a). In addition, in industrialised countries close to 90% of forests are under formal or informal management plans (FAO, 2000a) and state ownership tends to be successful. In contrast, developing countries have an

estimated 6% of forest under formal management plans and, in most tropical developing countries, the public ownership of forests has been regarded as a failure.

For both private and public investment in forestry a clearly-defined system of rights and tenure will be required. At a local level this ensures accountability and control and increases incentives to comply with policy. Rights must extend to protection from competing land users and uses, including those that are illegal. This means that property rights must be supported by institutional capacity and legal frameworks and thus have other political and institutional prerequisites.

4.1.2. The Role of Strong Institutions

Both private and public sector institutions have the potential to make or break forest policy. High-quality institutions lead to good governance, which in turn allows law enforcement, decision-making to be transparent, information to be disseminated and for individuals and institutions to be accountable (Irwin & Ranganathan, 2007; DFID, 2002b). This also leads to reduction or elimination of corruption in the private sector and government.

The need for good governance is illustrated in conflict areas. Conflicts arise between resident communities and refugees, between different forest dependent groups, and between local people and powerful external actors, largely arising due to insecure property rights and/or profit driven timber, mineral or petroleum extraction (IUCN, 2008). Where war can protect forests by discouraging some destructive investments, it can also prove a destructive force; providing fuel-wood and construction materials for rebel forces for example. Furthermore, post-war governments commonly offer timber revenues or agricultural land to appease insurgents and forest use increases when people return to abandoned forest dwellings. Where governments are weak, they are often unable to regain control of these forested areas.

For forests, and particularly for public goods, management requires robust institutions to enable the coordination and cooperation of institutions and stakeholders at local, national and global scales (Ostrom & Ahn, 2003). Building institutional capacity can be expensive: capacity for REDD project has been estimated at US\$4 billion over five years for 40 forest nations (OCC, 2008). The shift towards more widespread use of MBIs in forestry policy for example, will necessitate an appropriate shift in institutional structure to manage and maximise the potential benefits of these instruments. There are several examples where large investments in building technical and institutional capacity have dramatically improved forestry practices (Dourojeanni, 1999) and if the costs of this capacity building can be supported by NGO, civil society or the private sector, the resultant high-quality institutions will ensure more strategic policy-making that considers the wider policy landscape.

4.1.3. The Role of Broader Sectoral Integration

As identified in section 2.5 and 2.6, a number of policies have cross-sectoral influence, both synergistic and conflicting in nature. Where policies work together governments and donors must take advantage of this to improve economic efficiency through better use of human and financial resources, data sharing and reduced reporting burdens. Where policies work in competition, governments must limit disadvantages by full inter-sectoral integration and strategic policy planning. Within the forestry sector, better cooperation is being addressed in broader strategic frameworks such as National Environmental Action Plans (see section 2.2.4), but it is the between-sector integration that is lacking, especially in developing countries where lack of political commitment or shortage of financial resources can sideline forestry. It is also in these countries

that population and economic growth are also creating most pressures and increasing demand on a diminishing resource base.

In order to integrate, forestry policy must acknowledge and be in accordance with other national policy goals. The most difficult reconciliation is between forestry policies and economic forces that exacerbate economic pressures on forests. Reform in many areas, such as tax breaks and agricultural subsidies that encourage deforestation, will help realign incentives. Forestry in the CDM, for example, will not be a solution where it is not compatible with the development objectives of developing countries, and is unlikely to be successful where the underlying causes of unsustainable land-uses are ignored: *“the impact of negative policy and institutional arrangements may overwhelm positive incentives provided by CDM funds”* (Smith *et al.*, 2000). If these cross-sectoral linkages are not addressed, particularly those conflicting with national goals, both political support and sufficient financing for forest policy are likely to be lacking.

4.1.4. The Role of the Political Economy

Policy and legal reforms in forestry often come up against opposition from powerful economic and political interest groups, such as the paper, pulp and packaging industry. The political economy will factor heavily in policy and decision making, with interest groups negatively affected by reforms undermining their design, legislature and implementation depending on the structure, strength and response of affected parties (FAO, 2005).

In forestry, where a number of goods are public goods, political power-holders find it challenging to retain power through promoting these less-tangible forest benefits, especially as the long-term sustainable forest goals are often beyond the tenure of politicians. Where this is the case, forestry policy may well follow the value judgements made by those in power – high-level officials in forest and forest-related offices, industrialists and large-scale farmers – as opposed those politically disempowered, such as subsistence farmers, indigenous communities or the landless.

Understanding these power structures and the responses of relevant stakeholders, as well as gaining support from all involved stakeholders, will ameliorate the effects of the political economy. Obtaining such political will and widespread policy support may also aid in the elimination of perverse fiscal or monetary incentives, such as agricultural subsidies, that negatively impact the forestry sector.

4.1.5. The Role of Steady Financing

Insufficient funds to implement, monitor and enforce policy will lead to policy failure no matter how good it may be in theory. Although NGOs and the private sector are highly involved in forest policy, for example through MBIs, the scale of public goods provided by forestry does justify financing from the public sector. Developed countries generally have sufficient resources to fund new policy and policy changes, but this is not always the case in developing countries where public finance is demanded in many needed sectors.

In developing countries in particular, a steady stream of financing is crucial for sustainable forestry and forest conservation to be financially competitive with alternative land uses (Tacconi *et al.*, 2003). Carbon funds, for example, could be used to provide a stream of finance to improve government institutions and capacity, increase enforcement of environmental laws, provide direct payments to landowners who limit forest loss, and monitoring of landowners (Laurance, 2007). The greater awareness of REDD has prompted many such funds already and if the social values and

externalities of land use practices are internalised and society made more aware of the public goods arising from forestry activities, more funding is likely to follow.

4.1.6. The Role of Information and Awareness Building

The role of information in policy is threefold: to inform policy design, to engender political will, and to engender societal motivation to adhere to policy. Data and research about forest resources and drivers of their decline is necessary for governments to identify policy priorities and to take appropriate policy action. Ongoing accurate and up-to-date information will then be essential for prevention, detection, monitoring, reporting, investigation and suppression of illegal activities (FAO, 2005). The influence of research on policy is then enhanced by: scientific organisations making targeted efforts to be part of policy preparation processes; research focused on policy needs; research that helps define or refine existing policy narratives; and when scientists consistently highlight key issues and provide analysis to support their policy advice (Spilsbury & Bose, 2005).

The second role of information is to raise political support for forestry public goods. Greater political will leads to investments in SFM and forest conservation. Achieving this through sound environmental economic assessments that include not only financial but the full range of social and economic benefits is essential for this. The incorporation of this research into better cost-benefit analysis and economic valuation into policy design will also make decisions more transparent.

Finally, raising awareness of the public goods provided by forests engenders societal motivation to adhere to the rules of policies. In developed countries, the link between the environmental resource system and consumer goods is weak and education to strengthen this link is required. In developing countries, by contrast, there is still a strong link to the environmental resource system, especially where subsistence agriculture persists and societal will to preserve resources is driven less by market failure and more by lack of public good infrastructure and traditional household practices. The acknowledgment of these different societal conditions will be important and local stakeholder knowledge, in particular, will be important to feed into forest policy from the bottom up.

4.1.7. The Role of Stakeholder Participation

Informal institutions, or societal inputs, are important for effective policy: the success of law and regulation relies on “voluntary compliance” that draws on society’s traditions, norms and beliefs (Slemrod, 1998). In the forestry sector, this translates into better involvement and consultation of stakeholders in policy design. Policy needs to reflect the numerous values of forests and the powers of those holding these values. Strengthening the views of those historically marginalised from the decision-making process is important, especially where trade-offs have to be made. Decentralised planning often does this, facilitating involvement of local stakeholders and devolving decision-making authority over forest resources from governmental authorities to community-based organisations (Saxena, 1997).

The Intergovernmental Panel on Forests recognise that government failure to recognise and respect indigenous and forest peoples rights to their territories, forest and resources is exacerbating deforestation and degradation (IGPF, 1997). So far, the design of climate mitigation activities, the CDM in particular, has been top-down, biasing global needs over local ones. Local land tenure regimes, land use customs and laws, and cultural characteristics will affect possibilities of forest carbon activities in forests and must be addressed in future conventions. Although this multi-stakeholder participation may slow down the policy process, it is beneficial in the long run since it

promotes transparency, reduces corruption potential, ensures greater equity and reduces the influence of privileged groups (FAO, 2006b).

4.2. Catalysing Forestry Carbon Activities

Beyond an enabling environment for policy implantation discussed in section 4.1 the better inclusion of forestry will require substantial reform of climate change mitigation architecture and adaptive management to ongoing research in a relatively new sector. Reform must occur at all levels; in the global post-2012 Kyoto Protocol, in US markets and in the EU emissions trading scheme, and must be flexible enough to adopt research findings that resolve technical and methodological issues associated with forestry carbon projects (see table 10, section 3.5) and to reconcile differences of opinion in the discourse.

The largest of the carbon market mechanisms, reform of the CDM will be a priority to catalyse the provision of climate stabilisation through forestry. A number of studies have suggested possible architectures to better incorporate forestry activities (Schlamadinger *et al.*, 2005; Trines *et al.*, 2006). Santilli *et al.* (2005), for example, propose that non-Annex I countries might, on a voluntary basis, elect to reduce their national emissions from deforestation. The emission reductions could then be credited and sold to governments or international carbon investors at the end of a commitment period, contingent upon agreement to stabilize – or further reduce – deforestation rates in the subsequent commitment periods. This national approach to LULUCF would ameliorate a number of technical and political issues associated with forestry activities, but would need to go hand-in-hand with policy and institutional reforms that address underlying drivers of land use change. Smith *et al.* (2000) go as far as to say that CDM reform might limit forestry projects by particular preconditions such as favourable policies and institutions in order to prevent perverse outcomes and reduced leakage of emission reductions. CDM funds could then be recycled into initiating policy and institutional reforms in order to meet these pre-conditions in non-annex I countries.

On the VCM, the growing public scrutiny of environmental performance, and the natural appeal of forest creation and conservation is already encouraging forestry credit-generating activities. A number of conservation organisations are optimistic that carbon financing can contribute significantly to biodiversity conservation and poverty alleviation goals and have involved themselves in REDD projects. In June 2008 the Macquarie Group, an Australian financial services provider, and Fauna and Flora International, a conservation organisation, announced a three-year project to support REDD projects in South East Asia, South America and Africa. In the same month the Makira Carbon Company, established by the Wildlife Conservation Society, and the Madagascan Government agreed to sell 9 million tonnes of carbon to fund rainforest conservation.

The interest of these NGOs is likely to stem from deficiencies in adequate resources for conservation. Forestry carbon may well provide conservation activities with a source of sustainable financing. Protected areas could benefit greatly from additional financing, with protected status and (usually) defined property rights supporting the legal commitment to permanence of the forestry carbon activity. In eastern Uganda, the Mount Elgon Reforestation Project (a partnership between the government of Uganda, the Forests Absorbing Carbon Emissions (FACE) Foundation and IUCN) is using finance from carbon sequestration to fund reforestation for ecological restoration (FACE, 1998). REDD too may be a feasible option where additionality of project activities above current levels of protection can be proven in protected areas. A recent study by Campbell *et al.* (2008) reports that 15.2% of global terrestrial carbon stock, or over 312 gigatonnes of carbon, are found in protected areas that cover 12.2% of the land surface.

By increasing the capacity of NGOs to design, implement and monitor VCM forestry projects this trend can be accelerated particularly in tropical forests and areas of high biodiversity where NGO activities are concentrated. Therefore, while forestry is limited under CDM, at least until 2012, it is likely to increase its market share on the VCM. The emergence of LULUCF methodologies from the VCS, the most widely used and recognised of the standards (Capoor & Ambrosi, 2008), will further encourage investment, particularly in REDD activities, irrespective of inclusion on compliance markets by increasing the value of the emissions reductions generated.

In contrast to the rising profile of REDD, AR projects and other forestry carbon finance activities have received less attention at the global level and the micro-level feasibility of AR projects is still under debate (Minang *et al.*, 2007; Pfaff *et al.*, 2007; Locatelli & Pedroni, 2006; Gundimeda, 2004). Despite this a number of national and regional level policies have emerged that incorporate forestry and land-management practices into climate change mitigation efforts.

In the United States, the Chicago Climate Exchange (CCX) trades forestry credits and the California Climate Action Registry and Regional Greenhouse Gas Initiative are both registries that provide for LULUCF projects. In addition, although the Lieberman-Warner Bill, proposing a US CO₂ market allowing corporations to offset 30% of their emissions through forestry and land-management activities, did not pass through Congress, it does indicate a move towards forestry-related activities. A scheme exists in Australia (the New South Wales Greenhouse Gas Abatement Scheme) that allows forestry activities. Furthermore, developed country governments have begun to develop regional partnerships with highly forested countries: Australia has pledged A\$10 million to protect Indonesian rainforest, the Department for International Development of the UK government has created a £50 million fund to protect forest in the Congo Basin, and the US signed an agreement with Brazilian and Indonesian government officials in late 2008.

The European Union Emissions Trading Scheme has thus far banned forestry credits entirely. This may be a factor in the slow growth of the forestry carbon sector, eliminating a major source of demand. The rules for 2013-2020 are likely to also restrict forestry activities, even though a number of NGOs and research institutions have been lobbying for its inclusion. Instead, the EU has tended towards the establishment of a forestry fund from auctioning revenues in the emissions trading scheme that rewards developing countries for reducing deforestation rates.

The support for forestry carbon activities in these national and regional level climate policies could be a key factor for sector growth but requires the reconciliation of two main views in the forestry carbon discourse. Opinions are broadly divided into those who support the wider inclusion of forestry in the climate change mitigation architecture, and those that criticise the development of forestry carbon projects. The former believe that forestry represents cost-effective emissions reductions that can compensate forest owners and managers for public good provision. The latter believe 'carbon farming' will come at the expense of social concerns, mitigation efforts in other sectors or at the expense of other ecosystem services. This paper takes the former view: current barriers facing forestry carbon activities are not irresolvable and the substantial potential carbon savings and multitude of co-benefits that arise from forest ecosystems should be sufficient to justify better integration into national, regional and international mitigation efforts.

5. Conclusion

Forest policy is a constantly changing landscape, with a long and growing list of local, national and global goods that must be incorporated into its design. The contemporary focus on ecological and cultural functions of forests, and the popularity of the 'sustainability' concept, has challenged the traditional objectives of forest policy. The recognition of the public goods that forests provide – particularly climate stabilisation, watershed protection and biodiversity protection – should rationalised government intervention and public expenditure to ensure their sustained provision. To achieve this objective efficiently, a hybrid approach that utilises a number of policy instruments must be employed. Market-based instruments, underpinned by regulation, reduce the cost burden on the state but their effectiveness is dependent on a supportive policy environment.

In the short term, the focus should be on creating an enabling environment for public good provision. Clearly-defined property rights and strong institutions are pre-requisites and capacity building in many forest nations is likely to require steady financing from policy-supporting tools such as the GEF, trust funds, NGOs and donors. In the medium term, the focus should be on strategic policy planning that addresses complexities between goods and builds on cross-sectoral synergies and reduces cross-sectoral conflicts. It will also require stakeholder participation to overcome top-down policy formation. If all of this can be achieved, the long-term objective will be efficient, effective and equitable forest policy that fully acknowledges the public goods provided by forests and safeguards their provision.

Table 14. Linking Forest Policy, Instruments and Enabling Factors

	Property Rights	Institutions	Sectoral Integration	Political Economy	Steady Financing	Information and Awareness	Stakeholder Participation
<i>Broad Policies</i>							
Privatisation of forests	Clearly defined	Strong private sector	Required for better land use planning	Danger of over influence of commercial industry	Not required from state	Not required	Not required
Decentralisation of forest governance	Not required	Strong private sector	Required to deal with conflicting policies	Danger of local power capture	Financial demands of coordination	Not required	Not required
Sustainable Forest Management	Clearly defined	Strong management institutions (public or private)	Required to deal with conflicting policies	Limited influence	Required where non-market benefits are not realised	Required to raise political will and public support	Required to manage multiple user needs
<i>Policy Instruments</i>							
Normative and Regulatory	Not necessary but beneficial to motivate compliance	Strong state at national and regional level	Necessary to avoid conflicts, perverse incentives and inefficient policies	Danger of high influence from powerful actors standing to gain/lose	Required for ongoing monitoring and enforcement	Not required	Important to meet all needs and to be effective
Economic or Financial	Clearly defined	Strong private sector	Important to reduce competing incentives	(dependent on tool)	Costs met by private sector	Required to motivate private sector and society	Important so as to address issues of equity
Informational	Not required	Strong research and unrestricted media	Not required	Danger of restrictions on information	Required for research and dissemination	Inherently necessary	Necessary to incorporate all views and values
Planning	Addressed in planning process	Required to carry out plan	Necessary for efficiency and effectiveness of plan	Danger of influence of outcomes	Required to implement plan	To build on experiences in other sectors, nations	Necessary to identify priority forest areas
Institutional and Reform	Not required	Inherently building on weaknesses	Inherently leads to better integration	Danger of capture of power	Required to instigate and maintain	To build on experiences in other sectors, nations	Necessary to identify synergies and conflicts to address
<i>Other tools</i>							
GEF financing	Not required	Adequate to access financing	Important but not necessary	Limited influence	Financing inherently available	To identify worthy ecosystems/protected areas	Required to appropriately direct funds
Conservation Easements	Clearly defined	Strong monitoring and compliance enforcement	Required to reduce perverse subsidies	Limited influence	Large financing burden on purchasers of easements	To identify appropriate high value areas	Identifying local land values
'Green Accounting'	Not required	Accurate reporting and honest institutions	Not required	Danger of inaccurate information	Not required	Detailed resource accounting necessary	Minimal
Forest Trust Funds	Not required	Strong legal frameworks and financial institutions	Coordination between funds within and between sectors	Danger of fund capture or mismanagement	Financing inherently available	Research to shape funding priorities	Required to appropriately direct funds

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Appendix 2: Acronyms

AR	afforestation/reforestation
CAC	command-and-control
CBD	Convention on Biodiversity
CDM	clean development mechanism
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
CO ₂	carbon dioxide
CO ₂ e	carbon dioxide equivalents
COMESA	Common Market for Eastern and Southern Africa
EAC	East African Community
ECCAS	Economic Community of Central African States
FAO	Food and Agriculture Organisation of the United Nations
FSC	Forest Stewardship Council
GDP	gross domestic product
GEF	Global Environment Facility
GHG	greenhouse gases
IPCC	Intergovernmental Panel on Climate Change
LULUCF	Land Use Land Use Change and Forestry
MA	Millennium Ecosystem Assessment
MEAs	Multi-lateral Environmental Agreements
MBIs	Market Based Incentives
NFPs	National Forest Programmes
NGOs	Non-governmental organisations
PES	payments for ecosystem services
REDD	reduced emissions from deforestation and degradation
RIL	reduced impact logging
SADC	Southern African Development Community
SFM	sustainable forest management
SNA	system of national accounting
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations Framework Convention on Climate Change
UNFF	United Nations Forum on Forests
US EPA	United States Environmental Protection Agency
VCM	Voluntary Carbon Market
VCS	Voluntary Carbon Standard

Appendix 3: Typology of Market-Based Instruments for Policy Planners

Table A3. Market Based Instrument Typology		
Pollution Charges	Effluent Charges	Charges in proportion to actual amount of pollution produced and released
	User charges	Fee levied on the user of an environmental resource, based on costs of treating emissions
	Product Charges	Mark up on the price of a polluting generating product
	Administrative charges	A service fee for implementing and monitoring regulation
	Betterment charge	Fee levied for private properties benefiting from public projects
	Insurance Premium Taxes	Financial cost imposed by the state, taxes come in many forms
	Sales Taxes	
	Tax differentiation	
	Performance bonds/Environmental guarantee	Ensuring funds are available for environmental clean up/compensation in event of environmental accidents
	Subsidies	Payment or tax concession to help firms reduce pollutant production (often offered as a proportion of abatement or for equipment and technology)
	Deposit-Refund Systems	Front-end payment for potential pollution with guarantee of charge return when pollution did not take place (consumer forced to account for the cost of improper disposal)
Non compliance fees	Fees for failing to observe standards	
Tradeable Permits	Credit Programs	Allowances defined relative to a business parameter such as energy consumption or generation (no absolute cap), improved performance relative to a base-line allows extra credits to be sold
	Cap-and-Trade Programs	Each installation receives allowances that must not be exceeded unless additional allowances have been brought
Market Friction Reductions	Liability Rules and Compensation	Works through creating a market for insurance and so incentivises better practice
	Eco-labelling/ISO standards	Firms are required to provide information on the end-use product, differentiates goods
	Education	To alter the behaviour of consumers through increased awareness
Reducing Government Subsidies	Reduction of 'soft loans', tax provisions, and under charging for public services that maintain environmentally harmful economic activities	
Voluntary Agreements	Achieving environmental quality through agreements not binding by law	

Source: Adapted from EEA, 2006 and Stavins, 2001

Appendix 4: Potential Emissions Reductions through Forestry Activities

Table A4 shows the range of estimates as aggregated by the IPCC in the Fourth Assessment Report through regional bottom up, global forest sector, and global multi-sectoral model approaches (Nabuurs *et al.*, 2008).

Major Region	Regional bottom-up estimates			Global forest sector models	Global integrated assessment models
	Mean	Low	High		
OECD	700	420	980	2,730	
Economies in transition	150	90	210	3,600	
Non-OECD	1,900	760	3,040	7,445	
Global	2750*	1,270	4,230	13,775	700

* Exclusive of bio-energy with emissions reduction potential of 3140 MtCO₂/yr in 2030
 Source: Chapter 9 Forestry, table 9.7 IPCC Fourth Assessment Report (Nabuurs *et al.*, 2008).

Regional bottom up models start from physical forestry potential, often incorporating a great deal of detail on ecological, institutional and social context. It is because of the variable assumptions made by these models in; the eligibility of forestry activities, the technical and institutional potential and the accounting methodologies applied, that comparisons between and scaling up from these bottom up analyses is complicated.

Global forestry sector models use predictions of the carbon price to predict what forestry supply will be in the future (see section 3.6 in the main report and table 12). Assessing forestry potential across countries these models allow the comparison of forestry mitigation with alternative mitigation efforts. However, these models don't always incorporate transaction costs or the local context and thus may sometimes inadequately represent market potential.

Global multi-sectoral models are also top-down models that represent dynamic feedbacks in the economy from other sectors, regions and ecological systems. These models are highly complex and allow forestry mitigation efforts to be examined within a portfolio of mitigation efforts from all sectors. However, few of these models have considered avoided deforestation.