Forest Perspectives 4

# Do Trees Grow on Money?

## The implications of deforestation research for policies to promote REDD

Markku Kanninen
Daniel Murdiyarso
Frances Seymour
Arild Angelsen
Sven Wunder
Laura German

The Center for International Forestry Research (CIFOR)

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Cover by Leon Budi Prasetyo – Thousands of hectares of peatland forests are cleared and burnt to develop rubber tree monoculture plantations, Danau Sentarum National Park, West Kalimantan, Indonesia
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Jl. CIFOR, Situ Gede, Bogor Barat 16115, Indonesia
Tel.: +62 (251) 622622; Fax: +62 (251) 622100
E-mail: cifor@cgiar.org
Web site: http://www.cifor.cgiar.org

# Contents

# Preface

Forests are now receiving a level of international attention not seen since the 1992 Rio Earth Summit. The Stern Report (2006) and its sobering forecast of the economic costs associated with climate change was compelling in reminding policy makers of the important linkages between forests and climate: one-fifth of total annual carbon emissions now come from land-use change, most of which involves tropical deforestation. Every year some 13 million hectares of forest is lost, and deforestation now adds more carbon to the atmosphere than comes from the fossil fuel-intensive global transport sector. The world can no longer afford to ignore the role of deforestation in global warming.

The next three to four years will see considerable debate over the inclusion of reduced emissions from deforestation and forest degradation (REDD), in both national policy frameworks and a post-Kyoto climate protection regime. The design and implementation of REDD strategies must be informed by high quality, independent research if they are to succeed. Research is vital to ensure that the inclusion of forests in a future climate protection regime is efficient, effective, and reflects the interests of forest-dependent people in developing countries.

CIFOR has a strong legacy of conducting research on the underlying causes of deforestation, and its current research portfolio includes significant work on topics related to both

climate adaptation and mitigation. Over the last decade, CIFOR and its partners have produced more than 50 publications on deforestation, its causes and consequences.

This paper has two objectives. First, it analyzes the past research on deforestation and summarizes the findings of that research, in terms of its relevance to the development of future REDD regimes. Second, it highlights areas where future research and methodological development are needed to support national and international processes on avoided deforestation and degradation.

A key message of the paper is that while REDD presents new opportunities to address long-standing threats to forests, success will require grappling with a number of profound market failures and governance failures. Understanding the underlying causes of current deforestation and degradation trends is the first step towards overcoming the challenges that surely lie ahead.

Frances Seymour
Director General, CIFOR

# Acknowledgements

This paper is the result of a collaborative endeavour involving two phases. It draws on the CIFOR submission made in response to the conclusions of the UNFCCC Conference of the Parties at its eleventh session - on agenda item 6 (FCCC/CP/2005/L.2) - regarding information "on issues relating to reducing emissions from deforestation in developing countries, focusing on relevant scientific, technical and methodological issues, and the exchange of relevant information and experiences, including policy approaches and positive incentives". The submission was then updated with support from the Government of Australia as an input to the High-Level Meeting on Climate and Forests held in Sydney in July 2007. The current paper includes additional analysis on the implications for REDD.

The report has benefitted from the inputs and insights of a large number of people, to whom we extend our gratitude. In particular we would like to thank Claudio Forner for his contributions and leadership during the first phase of the writing process. We are also very grateful to the reviewers, David Kaimowitz, Pekka E. Kauppi, Rodel Lasco and Bernhard Schlamadinger, for their comments, critiques and suggestions regarding the manuscript.

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# Summary

Global and national policy arenas focused on climate change have identified deforestation and forest degradation as important sources of greenhouse gas emissions. Carbon emissions from land-use change are estimated to account for one-fifth of current global carbon emissions, and maintaining existing forests has been promoted as one of the least expensive climate change mitigation options. As a result, "Reduced Emissions from Deforestation and forest Degradation" (REDD) in developing countries has emerged as a likely component of the global climate protection regime, to be negotiated to replace the Kyoto Protocol, which comes to an end in 2012.

The purpose of this paper is to summarize what is known about the direct and underlying causes of deforestation and forest degradation, and the policy options available to reduce the resulting carbon emissions. The analysis suggests that the design and implementation of REDD policies will be neither simple nor straightforward, given the complexity of the social, economic, environmental and political dimensions of deforestation. Many of the underlying causes of deforestation are generated outside the forestry sector, and alternative land uses tend to be more profitable than conserving forests. REDD policies will have to deal with the fact that institutions for aligning the behaviour of individual economic actors with the public interest are generally weak,

and that there are constituencies with different interests within and between countries.

An appropriate policy framework for REDD can help to prioritize areas with high deforestation risk and high carbon content, while ensuring the sustained wellbeing of forest-dependent communities. A well designed framework should target the development of critical human capacity, and include efforts to overcome the institutional barriers to achieving these goals. Policy frameworks should make explicit, so as to manage, the trade-offs among efficiency, effectiveness and fairness.

Our analysis suggests that policies will need to be crafted to address diverse local situations. Policy change will need to include economic, regulatory and governance reforms, including the removal of perverse subsidies that provide incentives for clearing forests, reform of forest industry policies that allow unsustainable extraction, devolution of resource rights and management responsibilities to local forest users, and recognition of forest-based environmental services (in addition to carbon storage). All of these elements are likely to be important building blocks for conserving existing carbon stocks while safeguarding forest-based livelihoods.

The paper begins with a review of current knowledge and data on deforestation. It then summarizes issues and options related to measuring and monitoring forest-based carbon emissions, and the establishment of baselines. It provides an overview of findings based on long-term research on the direct and underlying causes of deforestation. These findings are then used as a basis for outlining REDD policy options, highlighting the governance challenges related to the observed trends. The paper concludes with a summary of the implications of the analysis for the design of national REDD strategies currently under discussion.

# 1 Introduction

Land use, land-use change and forestry (LULUCF) activities are a major source of carbon emissions and active contributors to global warming. The Intergovernmental Panel on Climate Change (IPCC) estimates that 1.6 billion tons of carbon is released annually due to land-use change, of which the major part is traced to tropical deforestation (Denman *et al*. 2007). This represents about one fifth of current global carbon emissions, which is more than what emanates from the fossil fuel-intensive global transport sector.

Deforestation avoidance was not accepted as an eligible Clean Development Mechanism (CDM) activity in the Marrakesh Accords, due to problems related to leakage[1], which could be significant and difficult to estimate accurately. Additionality and setting baselines were also seen as critical obstacles. Finally, the possibility that the scale of carbon credits from deforestation avoidance could be quite large also played a role in the decision to exclude avoided deforestation from CDM projects (Aukland *et al*. 2003; Forner *et al*. 2006; de Jong *et al*. 2007; Skutsch *et al*. 2007).

[1] Following the Marrakesh Accords, leakage in a CDM project is defined as the net change of anthropogenic emissions by sources of greenhouse gases, which occurs outside the project boundary, and which is measurable and attributable to the CDM project activity (UNFCCC 2003).

In response to calls from a number of parties to revisit deforestation in the climate change agenda, the Eleventh Session of the Conference of the Parties (COP11) to the United Nations Framework Convention on Climate Change (UNFCCC), in December 2005, launched a two-year process for considering a policy for reduced emissions from deforestation in developing countries. This process has focused on the documentation and exchange of relevant scientific, technical and methodological considerations and experiences, including policy approaches and positive incentives. The proposal for a post-2012 international agreement that includes avoided deforestation in non Annex-I countries is now undergoing public scrutiny.

Deforestation results from various causes, most of which originate outside the forest sector. Understanding these causes is crucial to identifying appropriate incentives to curb deforestation, while at the same time benefiting people whose livelihoods depend on forests. Forests provide a number of valuable goods and services to society. However, high returns from alternative land uses and lack of remuneration for forest ecosystem services sets the protection of forest ecosystems at a disadvantage and provides incentives for deforestation.

Understanding the drivers of deforestation and forest degradation has assumed renewed importance as the attention of policy makers and the general public has been refocused on forests due to their newly-appreciated role in climate change mitigation and adaptation. The Stern Review (2006), a report published by the Government of the United Kingdom analyzing the economics of climate change, emphasizes the prevention of further deforestation as one of four “key elements” of future international climate frameworks. The argument for inclusion of forests in a future climate agreement is twofold: forests are the largest emitter not included in the current Kyoto agreement, and the costs of reduced emissions compare favorably with most other sectors.

The attention of policy makers and the public has been attracted by the possibility of significant international transfers of funds under a post-Kyoto agreement to finance REDD. Estimates of the potential global value of REDD

payments vary depending on the underlying assumptions. Assuming a conservative carbon value of $10 per ton of carbon dioxide ($CO_{2e}$), estimates include a net present value of $150 billion (Chomitz *et al*. 2007) and annual revenue of $2.3-12 billion (Ebeling 2006; El Lakany *et al*. 2007). But with more positive assumptions about the carbon price ($10-20/t $CO_{2e}$) and deforestation reductions (20-50 per cent), estimates for annual REDD revenues are at $7-23 billion (El Lakany *et al*. 2007).

The key question then becomes: can finance of such magnitude catalyze forest protection in the interest of climate protection? In other words, can trees grow on money? The purpose of this paper is to provide a partial answer to that question.

The paper provides a brief overview of current knowledge and data on deforestation rates, research results on the causes of deforestation and forest degradation, and relevant policy options. It highlights issues of particular relevance to new discussions on reduced emissions from deforestation and forest degradation (REDD) in developing countries at different stages of forest transition. While examples are drawn from across tropical countries, experience from Indonesia, host of UNFCCC COP13, is given special attention. The paper then frames economic, regulatory, and governance reform options supportive of REDD. The paper concludes with a discussion of the implications for future deliberations around new policies for implementing REDD.

# 2 What do we know about deforestation?

## 2.1 A brief look at current rates

Deforestation is a significant feature of global environmental change. High rates of tropical deforestation have severe consequences for climate change, loss of biodiversity, flooding, siltation and soil degradation. Further, deforestation poses threats to the livelihoods and cultural integrity of forest-dependent people and the supply of timber and non-timber forest products for future generations.

The term "deforestation" is used quite variably, so it is important to have a precise definition. The Food and Agriculture Organisation of the United Nations (FAO) uses two different parameters in defining deforestation. First, based on land use, deforestation is defined as the conversion of forest land to another land use. Second, according to crown cover, deforestation is defined as the long term reduction of this parameter below a 10 per cent threshold. Both of these definitions can present problems for assessing deforestation on the ground - while the first requires a clear and unambiguous definition for forest[2], the second implies an arbitrary threshold.

[2] Forest is defined as: Land of more than 0.5 hectares with trees higher than 5 metres and a canopy cover of more than 10 per cent, or trees able to reach these thresholds *in situ*. It does not include land that is predominantly under agricultural or urban land use (Penman *et al.* 2003).

The Kyoto Protocol also includes a definition for deforestation, which applies to Articles 3.3, 3.4 and 12.[3] It follows a usage approach, together with a definition for forest that is determined through three parameters: tree height, canopy cover and minimum area. Parties have some flexibility to set these parameters (Penman *et al*. 2003).

Methods based on different spatial resolution, sample size and time scale may lead to considerable differences in current estimations of deforestation. Despite the arbitrariness regarding the choice of method, whenever rates of deforestation are estimated using consistent methods applied to all regions and time periods, the problem is considerably reduced.

The most widely used global-comparative estimate of deforestation is the global Forest Resources Assessment or FRA (FAO 2005). The FAO's FRA estimates that the current global area of forests is less than 4 billion hectares (about 30 per cent of the land area), with a quite uneven distribution across regions, as illustrated in Table 1.

The FAO's FRA also affirms that deforestation is continuing at alarming rates. The latest figures show that 13 million hectares are lost annually, amounting to a net loss of 7.3 million hectares per year for the period 2000-2005. It should be noted however, that this figure implies a decrease of about 17 per cent from the period 1990-2000, when the average net loss to deforestation was 8.9 million hectares per year. It should also be noted that the three large scale decennial FRA assessments (1980, 1990, 2000) have used different methods, which make comparisons over time, especially at the national scale, highly problematic.

The regions associated with the highest overall areas of deforestation are South America, with 4.3 million hectares per year, followed by Africa with 4 million hectares per year (Table 2). In the period 2000-2005, Brazil alone lost more than 3.1 million hectares of forest, mostly for pasture conversion, and the Amazon Basin remains a major hotspot of tropical

[3] In the context of the Kyoto Protocol, as stipulated by the Marrakesh Accords, cf. paragraph 1 of the Annex to draft decision -/CMP.1 (Land use, land-use change and forestry) contained in document FCCC/CP/2001/13/Add.1, p. 58 (UNFCCC 2001).

**Table 1: Data on global forest and total percentage cover by sub-region**
(Source: FAO, FRA 2005)

| Region/ Sub-region | Forest Area (1 000 ha) | % of Land Area |
|---|---|---|
| Eastern and Southern Africa | 226 534 | 27.8 |
| Northern Africa | 131 048 | 8.6 |
| Western and Central Africa | 227 829 | 44.1 |
| **Total Africa** | **635 412** | **21.4** |
| East Asia | 244 862 | 21.3 |
| South and Southeast Asia | 283 127 | 33.4 |
| Western and Central Asia | 43 588 | 4.0 |
| **Total Asia** | **571 577** | **18.5** |
| **Total Europe** | **1 001 394** | **44.3** |
| Caribbean | 5 974 | 26.1 |
| Central America | 22 411 | 43.9 |
| North America | 677 464 | 32.7 |
| **Total North and Central America** | **705 849** | **32.9** |
| **Total Oceania** | **206 254** | **24.3** |
| **Total South America** | **831 540** | **47.7** |
| **World** | **3 952 025** | **30.3** |

**Table 2: Differences in deforestation rates across regions** (FAO, FRA 2005)

| Region/Sub-region | 1990-2000 | | 2000-2005 | |
|---|---|---|---|---|
| | 1 000 ha | % | 1 000 ha | % |
| Eastern and Southern Africa | -1 731 | -0.71 | -1 702 | -0.74 |
| Northern Africa | -1 013 | -0.72 | -982 | -0.73 |
| Western and Central Africa | -1 631 | -0.56 | -1 356 | -0.48 |
| **Total Africa** | **-4 375** | **-0.64** | **-4 040** | **-0.62** |
| East Asia | 1 751 | 0.81 | 3 840 | 1.65 |
| South and Southeast Asia | -2 578 | -0.83 | -2 851 | -0.98 |
| Western and Central Asia | 34 | 0.08 | 14 | 0.03 |
| **Total Asia** | **-792** | **-0.14** | **1 003** | **0.18** |
| **Total Europe** | **877** | **0.09** | **661** | **0.07** |
| Caribbean | 36 | 0.65 | 54 | 0.92 |
| Central America | -380 | -1.47 | -285 | -1.23 |
| North America | 17 | n.s. | -101 | -0.01 |
| **Total North and Central America** | **-328** | **-0.05** | **-333** | **-0.05** |
| **Total Oceania** | **-448** | **-0.21** | **-356** | **-0.17** |
| **Total South America** | **-3 802** | **-0.44** | **-4 251** | **-0.50** |
| **World** | **-8 868** | **-0.22** | **-7 317** | **-0.18** |

Note: Percentages represent the proportion of remaining forest area lost and gained each year during the respective period.

deforestation. Existing data do not support the claim that the African Sahel is a desertification hotspot (Lepers *et al*. 2005).

In terms of annual percentage rates of deforestation (i.e., the forest loss of a particular region in proportion to its remaining forest area), Central America and Southeast Asia have the highest deforestation rates. Asia currently has the greatest concentration of areas of rapid land-cover changes, and in particular dryland degradation. The average deforestation rate in South and Southeast Asia was about one per cent, with Indonesia having a net annual loss of two per cent over the period 2000-2005. At the same time, there is substantial reforestation taking place in some Asian countries. India and Bangladesh have stabilized their forest cover, while China had an amazing annual increase of 4.1 million hectares (2.2 per cent per year), which is twice the annual increase of the 1990s.

In addition to the FAO FRA, there are other studies estimating rates of tropical deforestation. For example, the Tropical Ecosystem Environment Observation by Satellite (TREES) project uses high resolution sample data to estimate forest loss in humid tropical forests. There is rough agreement between these two sources on the magnitude of gross deforestation on two continents during the 1990s: about 4.4 million hectares a year in Latin America and 2.8 million in Asia. However, the greatest disagreements concern the dry forests and savannas of Africa (Chomitz *et al*. 2007: Table 3).

Differences in reported rates of deforestation are due to the differences in definition and methods used. For instance, when based on Landsat imageries, the rate of deforestation in Indonesia in the late 1990s was 1.7 million hectares per year (Holmes 2000). A later estimate compiled by FAO, based on country reporting, was 1.9 million hectares per year (FAO 2007 in Stibig *et al*. 2007).

Both Mathews (2001) and Lepers *at al*. (2005) provide an analysis of the definitions and methods used in different assessments of forest cover and deforestation data from recent decades. Both recognise the weaknesses of our current forest cover knowledge and emphasize the urgent need for establishing standardized, globally agreed definitions and

**Table 3: Estimated annual deforestation 1990–97 (millions of hectares)**
(Sources: Archard *et al.* 2002; Chomitz *et al*. 2007)

| | Humid forests | | | | Dry forests | |
|---|---|---|---|---|---|---|
| Type of forest change | Latin America and Caribbean except Brazil | Brazilian Amazon | Africa | Asia | Latin America and Caribbean | Africa |
| Deforestation | 1.08 ± 0.55 | 1.43 ± 0.88 | 0.85 ± 0.30 | 2.84 ± 0.90 | 1.9 ± 1.1 | 1.5 ± 0.6 |
| Degradation | 0.61 ± 0.46 | 0.22 ± 0.21 | 0.39 ± 0.19 | 1.07 ± 0.44 | n.s | n.s. |
| Regrowth | 0.20 ± 0.11 | 0.08 ± 0.11 | 0.14 ± 0.11 | 0.53 ± 0.25 | n.s. | 0.07 ± 0.05 |

methods for collecting baseline information on forest cover and forest cover change. In an ideal situation, a commonly agreed, comprehensive monitoring system should produce forest cover data and indicators more frequently than once a decade, accommodating the recurrent need for timely information in a rapidly advancing REDD process. These efforts might be harmonized through a global partnership of various actors, providing data and analyses needed for post-2012 climate regime and REDD initiatives.

Various methods are available and appropriate to analyze satellite data for measuring changes in forest cover. These methods range from visual photo interpretation to sophisticated digital analysis, and from wall-to-wall mapping to hot-spot analysis and statistical sampling. A variety of methods can be applied depending on national capabilities, deforestation patterns, and characteristics of forests. While sophisticated new methods may be used in the future, a major challenge will be to accurately measure past deforestation for national baselines (see below).

Another key constraint in implementing national REDD systems relates to the cost of, and access to, the high resolution data necessary to effectively monitor changes in forest cover. Few developing countries have operational systems in place for monitoring deforestation at national scales. Brazil and India are examples of two countries that do, although their systems are not yet based on high resolution data. These countries have receiving stations to acquire remote sensing satellite imagery (Landsat or Terra data) and/or national satellites (IRS or CBERS, respectively). Other countries have carried out forest assessments using remote sensing products, including Peru, Bolivia and Indonesia (DeFries *et al*. 2007).

Forest degradation should not be considered as deforestation. There are many definitions of forest degradation relating to canopy cover, ecological function, carbon stocks, and other attributes of forests (Penman *et al*. 2003). In the context of REDD schemes, forest degradation can be defined as a partial loss of biomass due to logging or other causes of biomass removal. Though carbon emissions may not be as sizeable per unit area as the complete removal of forest through deforestation, and vegetation regrowth in some cases may make that loss only temporary, forest degradation occurs over large areas and can contribute significantly to overall emissions from forest loss (Asner *et al*. 2005). Monitoring degradation is more technically challenging than monitoring deforestation and the methods to identify forest degradation using remote sensing require high resolution data (DeFries *et*. *al*. 2007).

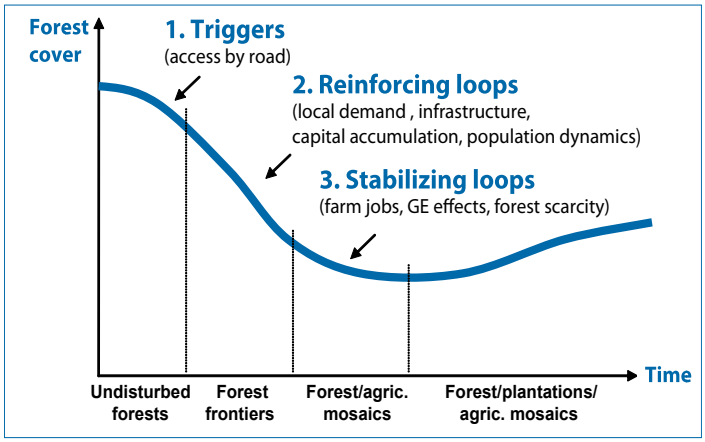
## 2.2 Forest transitions

"Forest transition" describes a long-run process in which economic development drives a pattern of forest loss followed by forest recovery (see Mather 1992; Rudel *et al*. 2005; Kauppi *et al*. 2006; Mather 2007). As shown in Figure 1, deforestation in early development phases is fuelled by the demand for agricultural products and related infrastructure development. At some stage, land clearance reaches a maximum and then declines, a phenomenon that is generally explained by two main factors. Firstly, in developed regions such as Europe or North America, better paid jobs have historically pulled people out of agricultural activities. Forest often grows back on the abandoned agricultural lands. Secondly, forest regrowth is also motivated by a wealthier population that demands scarce forest products (especially in Asia) and forest services (in Europe and North America), thus driving an increase in forest cover mainly through natural regrowth and plantations.

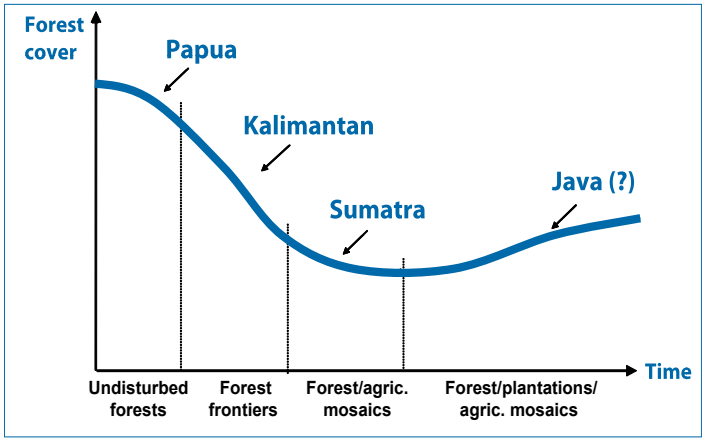
## 2.3 Implications for future REDD regimes

The implementation of policies to reduce emissions from deforestation requires effective deforestation measurement and monitoring systems that are reproducible, provide consistent results, meet standards for mapping accuracy, and can be implemented at the national level. The Costa

a)




b)




c)

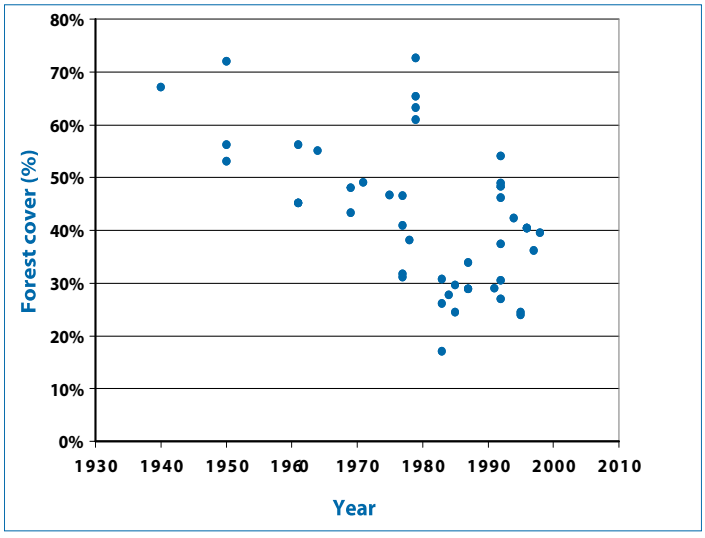



**Figure 1:**

a) **Forest transition indicating the dynamics of agriculture and forest rents over time, driven by demands of agricultural products and economic development** (Source: Angelsen 2007)

b) **Schematic presentation of forest transitions in different provinces of Indonesia**

c) **Changes in Costa Rica's forest cover 1940-1998 - each point represents a published value** (Source: Kleinn *et al.* 2002)

Rican example of Figure 1c (Kleinn *et al*. 2002) illustrates the challenges we will face in setting baselines in the context of an REDD regime, due to differences in definitions and uncertainties in forest cover estimates.

Remotely sensed data, supported by ground observations, are key to effective measurement and monitoring. Such methods should also be cost effective to attract the wide participation of countries harbouring significant amounts of forested area and corresponding carbon stores within the biomass. DeFries *et al*. (2007) list various issues and challenges related to estimating emissions from deforestation and degradation at the national level. These include:

- The need to establish guidelines and protocols to determine historical estimates/measurements and develop agreed baselines or base intervals (e.g. using model interpolations of scenarios such as "business as usual" or expected deforestation trends). Unlike the work on fossil fuel emissions, it is problematic to extrapolate GHG emissions from a given year because inter-annual variability is high. Rather, the base period should encompass at least 5 or 10 years in the recent past. The time period for determining the historical quantities and emissions trajectory needs to recognize the large inter-annual variability in deforestation rates, and be based on multiple rather than a single year's deforestation results.
- Estimates of the carbon stocks of forests undergoing deforestation, and the subsequent carbon dynamics, are uncertain for many developing countries, but default data and guidelines for carbon accounting already exist in the IPCC Good Practice Guidance report (Penman *et al*. 2003) and the IPCC Greenhouse Gas Inventory Guidelines (IPCC 2006). However, new technologies and approaches are needed for monitoring changes in carbon stocks, using a combination of satellite and airborne imagery that potentially reduce uncertainties in accounting for changes in GHG emissions from deforestation. International co-ordination is needed to further test and implement these technologies.

An effective REDD scheme will require monitoring methodologies and reporting systems to ensure comparable and consistent estimates of emissions from deforestation. A

comprehensive monitoring framework consists of technical, managerial and institutional elements (Penman *et al*. 2003). The management process refers to planning and documentation and quality assurance/quality control, as well as organization and staffing. The institutional element refers to institutional arrangements that are necessary to support a carbon instrument at the international, national and local level. Case studies of monitoring and reporting systems used in Costa Rica and Mexico suggest the need for capacity building efforts in order to ensure programme success (Karousakis 2007).

For a REDD program to produce credible carbon benefits, the baseline needs to demonstrate that the area was under threat of deforestation. Brown *et al*. (2006) propose a three-step method for setting the baseline in a REDD scheme: (1) Development of a historic land use change and deforestation estimate, including an analysis of historic baseline drivers and identification of major drivers. These drivers should be weighted according to their importance in the "time one" or calibration period; (2) Generation of a baseline projection for deforestation, including a projection of the future land-use change with projected rates of deforestation and carbon stock estimates; (3) A review and re-assessment of the baseline at agreed intervals (e.g., 10 years).

Although the scientific community and implementers of REDD schemes face considerable methodological challenges for estimating reduced GHG emissions from reduced deforestation at the national level, and for setting the baselines, the existing IPCC methods (Penman *et al*. 2003; IPCC 2006) provide a sound basis for developing national REDD strategies that are sufficiently robust and technically feasible to be operational at large scales.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# 3 The direct and underlying causes of deforestation and degradation

The design of effective REDD regimes requires a clear understanding of the causes of deforestation and degradation. Fortunately, a large body of research exists that illuminates those causes. The following section summarizes the key findings.

## 3.1 Definitions and distinctions

***Deforestation vs. degradation:***
As explained in the previous section, deforestation may be defined as a reduction of canopy cover below 10 per cent. As a result, significant degradation can take place before crossing the threshold to deforestation. A selective logging operation usually does not reduce canopy cover to that extent, leading to forest degradation rather than deforestation. Deforestation is normally a more drastic land-use change, often characterized by the clearing of trees and conversion to alternative land uses, predominantly agriculture. However, as described further below, forest degradation can often indirectly lead to deforestation through various pathways (e.g., logging operations providing easier access for farmers). Deforestation can also result from the clearance of land for open-pit mining, urban sprawl or other uses.

***Direct vs. underlying causes:***

The causes of deforestation and degradation can usefully be separated into two categories. The first involves factors that are directly linked to the act of clearing or degrading land, referred to as **direct or proximate causes**. The second category includes the background societal factors that drive these direct causes, which are referred to as **underlying causes** (Kaimowitz and Angelsen 1998). In addition, Kaimowitz and Angelsen (1998) introduce the term 'sources of deforestation' to refer to the agents or activities leading to deforestation (e.g. agricultural expansion by small scale farmers).

***Intra- vs extra-sectoral factors:***

Another distinction is between deforestation and degradation driven by causes originating within the forest sector itself (so-called **"intra-sectoral factors"**) and activities driven by causes originating from other sectors (**"extra-sectoral factors"**) (Contreras-Hermosilla 2000). Indeed, most causes do not operate within the forestry sector itself, but originate predominantly in relation to agriculture (for food, fibre or energy), or via infrastructure development, industrial fibre demands, etc. Activities outside the forest sector usually contribute much more to deforestation than does timber extraction.

Deforestation and degradation usually result from a combination of factors. The different causes of deforestation (direct and underlying, intra- and extra-sectoral) interact in complex and variable ways. For example, Sunderlin and Wunder (2000) illustrate how oil booms may affect deforestation in opposing ways under different market and policy settings. While wealth from oil can lead to forest protection due to the decline of agricultural competitiveness, this same wealth can have the opposite effect when it is used predominantly for road building, frontier expansion and transport subsidies. Variable macroeconomic policy responses can thus play a key role in determining differential impacts on forests. Box 1 provides another illustration of how direct and underlying causes can be driven by intra-sectoral and extra-sectoral factors.

**Box 1: The complexity of intra- and extra-sectoral factors**

As an example, consider a rise in urban income that increases the demand for meat, paper and construction materials. This consumer demand, in turn, increases the demand for pastures, pulp and timber. All three exert pressures for deforestation and degradation. The urban income boom acts as the "underlying cause", but it triggers one direct "extra-sectoral" cause (the expansion of cattle ranching) and two direct "intra-sectoral" causes (forest harvest for construction timber and pulpwood). Adding to this complexity, higher urban income can draw labour out of rural forested areas into the cities. This extra-sectoral factor, in turn, could counteract or even dominate the previous three effects by alleviating pressure on the forests, thus promoting forest regrowth.

From analysis of deforestation patterns in 152 countries, Geist and Lambin (2002) suggest three dominant sources of deforestation: agricultural expansion, wood extraction and infrastructure extension. These interact with five principal underlying factors: demographic, economic, technological, policy and cultural variables. Their study concludes that deforestation is best explained by a combination of proximate (direct) and underlying causes, described in further detail below.

## 3.2 Direct causes of deforestation and degradation

Following are the main direct causes of deforestation and degradation that have been described in the literature (related to the three main sources mentioned above):

***Agricultural expansion:***

Agricultural activities that result in the clearing and conversion of forestland include the establishment of permanent cropland, shifting cultivation and cattle ranching. The expansion of the agricultural frontier is usually the clearly dominant contributor to deforestation. Shifting cultivation can be less harmful than other agricultural activities, due to regrowth and secondary forest succession following this type of agricultural use - but only under very low rural population densities where long fallows can be maintained (Guariguata

and Ostertag 2001). The direct causes that stimulate the decision to convert forestland include:

- Favourable environmental conditions (e.g. forests in areas with good drainage and soil fertility are more likely to be converted into agriculture)
- High prices for agricultural outputs (more profitable production, and thus more clearing)
- Low wages (smaller costs of forest clearing, and thus more deforestation)
- Demographic changes (e.g. population growth and higher rural populations can foster further deforestation)

Kaimowitz and Angelsen (1998) conclude that agricultural expansion is the main source of deforestation, highlighting the Latin American cases of beef production in Central America and soybean production in Brazil. In Indonesia, conversion of forest to oil-palm plantations is a significant contributor. The high price of crude palm oil is driving the expansion of the area planted to oil-palm. In each of these cases, deforestation is driven much more by large scale industrial farms than by small scale agriculturalists. The additional rents available from timber generated by land clearing drive the expansion to take place on forested rather than degraded land. Over the past decade, the area planted to oil-palm in Indonesia has almost tripled, and in 2005, totalled 5.6 million hectares (BisInfocus 2006). Box 2 describes how various factors have combined to degrade and deforest peatlands in Southeast Asia.

**Box 2: Factors causing deforestation of peatlands in Southeast Asia**

Over the last decade, both legal and illegal logging have expanded towards less accessible peat and swamp forests - vulnerable ecosystems storing significant amounts of carbon in the form of below-ground organic materials. The establishment of large scale pulpwood and oil-palm plantations, to meet the rocketing demand for pulp in China (Wright 2004) and crude palm oil in Europe (Reinhardt *et al.* 2007), has driven rapid deforestation and forest degradation in peatlands. As a result, out of 27 million hectares of peatland in Southeast Asia, 12 million hectares have been deforested and degraded in the past 10 years (Hooijer *et al.* 2006). The direct causes have mainly consisted of fire-use for land clearing and drainage for plantation development.

***Wood extraction:***

Wood extraction is the principal intra-sectoral cause of forest degradation, and can also lead to deforestation, either directly or indirectly. Wood is extracted from forests for timber, pulpwood, fuelwood and charcoal. While logging practices usually degrade forests, selective logging need not trigger severe degradation or deforestation. A large literature on reduced impact logging (RIL) has developed prescriptions for silvicultural and harvesting techniques, as well as pre-harvest and post-harvest operations. Implementation of RIL and "beyond RIL" recommendations can minimize the damage to the residual stand and associated biodiversity and ecosystem services, as well as reduce the chances that logging will lead to conversion (Meijaard *et al*. 2005; Gustafson *et al*. 2007).

However, uncontrolled or under-regulated timber extraction, whether legal or illegal, often does lead to degradation and indirectly, to deforestation. Also, road construction associated with logging frequently leads to deforestation by facilitating immigration and conversion of forests to agriculture in areas where property rights are unclear or poorly enforced (Kaimowitz *et al*. 1998). Box 3 describes conditions under which logging roads facilitate deforestation.

**Box 3: Logging and deforestation**

Logging and deforestation are linked through road construction. Logging can facilitate deforestation by promoting immigration and land colonization when the following conditions coincide (Kaimowitz *et al.*1998):

- Road construction opens up new access to forestland
- Forest tenure and regulation of extractive activities are poorly enforced
- The forestlands possess some potential for agricultural conversion
- There is a large inflow of immigrants, due to demographic and poverty-related factors in the migrant-sending areas.

Poor logging practices - which leave behind large volumes of combustible waste - make forests vulnerable to escaped fires that have been set to clear land for commercial or subsistence agriculture, further degrading the forest

(Nepstad *et al*. 1999; Meijaard *et al*. 2005; Iskandar *et al*. 2006; Gustafson *et al*. 2007). Once a forest area has been degraded, it may be abandoned, leaving it vulnerable to "open access" exploitation (described below). Degraded forests may also be designated as eligible for conversion to other uses. In Indonesia, there is evidence that healthy forests have been irregularly designated as "degraded" in order to allow unscrupulous investors to obtain plantation development permits, reap a windfall profit from harvesting the timber, and then abandon the land without developing the plantation (Barr 1998; Smith and Scherr 2003).

Logging and pulpwood clear-cutting have been a major cause of deforestation in Southeast Asia, whereas unsustainable fuelwood extraction and charcoal production primarily occur in the drier forest of sub-Saharan Africa (Kaimowitz and Angelsen 1998). In Indonesia and elsewhere in Southeast Asia, illegal logging has emerged as a major force driving forest degradation (Tacconi 2007). Other "extra-sectoral" industrial activities, such as mining, may also use sizeable amounts of timber or charcoal, and may thereby contribute to high levels of forest degradation, through direct use and population expansion.

***Infrastructure extension:***

Finally, forests can also be cleared to construct roads, settlements, public services, pipelines, open-pit mines, hydro-electric dams, and other infrastructure. None of these sources tends to be a large factor in terms of the quantitative area of forestland cleared. But indirectly, road construction and improvement is by far the infrastructure development that contributes most to deforestation (Chomitz *et al*. 2007). This occurs not through the direct space roads occupy, but through their reduction of transport costs, which in turn, enable productive activities to take place in remote areas. Such activities often promote frontier expansion and forest destruction, as illustrated by cycles of timber harvesting, charcoal extraction and subsequent conversion to agriculture and pastures. Ecuador is one example where road building has been a prime driver of deforestation (Wunder 2000).

Direct causes of deforestation differ significantly across countries, following broader patterns of agricultural and infrastructure expansion, and commercial and domestic

demand for wood products, as illustrated by Geist and Lambin (2002) in Table 4.

**Table 4: Extent of leading drivers of deforestation for Asia, Africa and Latin America**

| | All cases (*n* = 152) | | Asia (*n* = 55) | | Africa (*n* = 19) | | Latin America (*n* = 78) | |
|---|---|---|---|---|---|---|---|---|
| | abs | rel (%) | abs | rel (%) | abs | rel (%) | rel (%) | abs |
| Agricultural expansion | 146 | 96 | 55 | 100 | 16 | 84 | 75 | 96 |
| Permanent cultivation | 73 | 48 | 24 | 44 | 10 | 53 | 39 | 50 |
| Subsistence agriculture | 61 | 40 | 20 | 36 | 10 | 53 | 31 | 40 |
| Cattle ranching | 70 | 46 | 3 | 6 | 3 | 16 | 64 | 82 |
| Shifting cultivation | 63 | 41 | 24 | 44 | 8 | 42 | 31 | 40 |
| Swidden agriculture | 46 | 30 | 24 | 44 | 7 | 37 | 15 | 19 |
| Colonization[a] | 61 | 40 | 23 | 42 | 4 | 21 | 34 | 44 |
| Infrastructure expansion | 110 | 72 | 36 | 66 | 9 | 47 | 65 | 83 |
| Transport extension | 97 | 64 | 26 | 47 | 9 | 47 | 62 | 80 |
| Roads | 93 | 61 | 25 | 46 | 9 | 47 | 59 | 76 |
| Settlement/market extension | 41 | 27 | 12 | 22 | 3 | 16 | 26 | 33 |
| Wood extraction | 102 | 67 | 49 | 89 | 13 | 68 | 40 | 51 |
| Commercial (for trade) | 79 | 52 | 43 | 78 | 5 | 26 | 31 | 40 |
| Fuel wood (for domestic uses) | 45 | 28 | 18 | 33 | 10 | 53 | 14 | 18 |
| Other factors[b] | 52 | 34 | 17 | 31 | 10 | 53 | 25 | 32 |

Note: Multiple counts possible; percentages relate to the total of all cases for each category; abs = absolute number; rel = relative percentage; cum = cumulative percentages. Relative percentages may not total 100 because of rounding.

[a] Including transmigration and resettlement.

[b] Predisposing environmental factors such as land characteristics and social or biophysical trigger events.

(Source: Geist and Lambin 2002)

## 3.3 Underlying causes of deforestation and degradation

Over the last decade, the strong effects of macroeconomic forces, weak governance, and other broader societal characteristics on deforestation and forest degradation have been amply documented (see for example, Chomitz *et al*. 2007). The main underlying causes of deforestation are described below.

***Macroeconomic factors:***

Actors responding to market forces will often clear land to accommodate higher demand for products that can be cultivated (or grazed) on converted forest land.

Economic growth may increase deforestation at early economic development stages, when forests are cleared for agricultural commodity production. In later stages of economic development, pressures on forests may decrease as agricultural production becomes more intensive, service sectors increase their share in the economy, and the demand for forest products and services rises, making timberland more valuable. See Box 4 for a list of macroeconomic factors that promote deforestation and degradation.

**Box 4: Macroeconomic factors that promote deforestation and degradation**

- Currency devaluations can make agricultural expansion more profitable
- Austerity adjustment packages can curtail the urban economy, driving people back to the agricultural frontier
- Trade policies can protect land-extensive and timber sectors from imported substitutes, increasing pressure on forests to meet local demand
- Fuel and transport subsidies can facilitate remote timber extraction or make land development more profitable

(See Kaimowitz and Angelsen (1998) and Wunder (2003))

As discussed earlier, the higher profitability of agriculture (agricultural rent) is the main economic factor underlying the conversion of forests to other uses (Wunder and Verbist 2003). Rising agricultural output prices and reduced input prices render agriculture more profitable, and lead to expanded areas under production. Other macroeconomic factors with significant potential to impact upon deforestation include external debt, foreign exchange-rate policy, and trade policies governing sectors linked to deforestation (mainly agriculture and cattle ranching) and forest degradation (mainly timber extraction). The net impacts of such policies on forests are however, highly variable. For example, a devaluation or currency depreciation will stimulate exports, and the deforestation impact depends on whether or not export crops are suitable for cultivation on cleared forest land.

Economic crisis can also stimulate deforestation. When Indonesia's economy collapsed in 1997, many people who had lost their jobs in the formal sector turned to the forest for

supplemental income. Their activities included the clearing of forest for cultivation, illegal logging on idle timber concessions, and the use of fire to facilitate access to fish and reptiles (Chokkalingam *et al*. 2006). However, the crisis also paused large scale infrastructure and land development projects which would have otherwise had a significant impact on rates of deforestation.

Policies supporting the expansion of forest product industries and related debt can be a significant force driving deforestation. Once production capacity is in place, both market and political factors exert pressures to maintain the supply of raw materials from natural forests if plantation-generated supplies are insufficient. In Indonesia for instance, the pulp industry obtained approximately 70 per cent of its fibre from natural forests in recent years (Spek 2006). Box 5 describes a lost opportunity to use debt policy to address this structural imbalance between supply and demand.

***Governance factors:***

Governance plays a major role in determining what happens to forests. Deforestation and degradation can result from the combined effect of forest tenure and institutions, which in turn, determine the set of incentives which lead to over-exploitation (Ostrom 1990).

With respect to tenure, deforestation and degradation can occur as a consequence of poorly defined property rights, including systems that reward deforestation with tenure establishment. Where property rights are ambiguous, overlapping or weak, incentives for investing in long term returns from natural resources are also weak. For example, when land designated as public forest is poorly regulated or "policed", these areas will be treated as "open access" resources and subject to predatory use (Agrawal and Ostrom 2001). When property rights are secured on paper and in practice, longer term investments in sustainable management are made possible.

Yet secure property rights, while critical, are often insufficient for ensuring sustainable forest management. Where property rights are held in common but local institutions specifying clear rights and responsibilities for forest management are absent, forest degradation can result (Ostrom 1990, 1999).

**Box 5: Corporate debt policy as an underlying cause of deforestation and degradation**

When the Indonesian Rupiah tumbled against the US dollar in 1997 and 1998, export-based wood processing companies were unable to service their debts to local and international financial institutions, especially banks. Many companies, including most of the country's major forest conglomerates, defaulted on their corporate debts and many were effectively bankrupt. To prevent the collapse of the banking system and the real sector as a result of the financial crisis, the Government of Indonesia, with support from the International Monetary Fund (IMF) and the World Bank, established the Indonesian Bank Restructuring Agency (IBRA) to oversee the recapitalization of the country's ailing banking sector. In this capacity, IBRA assumed control over almost all major wood-based companies and all banks owned by forestry conglomerates.

IBRA was a powerful agency equipped with the legal power to achieve maximum financial returns from assets under its management. In response to advocacy from the international donor community , the government committed to link IBRA's debt restructuring process and write-offs to a reduction in the processing capacity of the forest industry. Had that policy been implemented, many of Indonesia's pulp and paper companies and other forestry conglomerates would have had to reduce their milling capacity to a level that could be supported by a sustainable timber supply. At the time Indonesia entered into the financial crisis, the annual demand of wood-based industries was three times the sustainable and legal timber supply.

Unfortunately, the debt management policy followed by the Indonesian government, and supported by the IMF and the World Bank, favoured quickly releasing government control over industries considered to be "strategic", including most forestry and pulp and paper companies. Debts of these companies were often sold at about 20 per cent of their total book value, without the imposition of requirements to reduce their milling capacity. As a result, companies bailed out with public funds have been able to continue and, in some cases, even expand their unsustainable operations.

(Setiono 2007)

In some cases where it is not forest use, but alternative land uses (e.g., cattle ranching) that are seen in the long term as the most profitable land use, securing individual property rights serves to accelerate the conversion of forest to other uses (Wunder 2000; Kaimowitz 2002). This underscores that secure and predictable land rights, often seen as a pre-

condition for managing forests in a sustainable manner, can only be an effective tool for REDD if they are applied together with economic incentives which address the root causes of the inferior profitability of forest conservation.

Non-transparent decision making regarding the allocation or conversion of state forest resources, and associated rent-seeking behaviour, is a second significant factor that drives deforestation and degradation. Ambiguous or overlapping laws, regulations and jurisdictions across sectors, and confusion introduced by incomplete decentralization, all provide opportunities for entrepreneurs to exploit "grey areas" to circumvent forest protection policies. In Indonesia, Casson and Obidinski (2007) found that decentralization reforms initiated in 2000 led to a blurring of the distinction between legal and illegal logging. Newly empowered local officials, seeking additional revenue, legitimized what were previously illegal activities by issuing permits for small, poorly regulated timber concessions.

Similarly, national economic and political elites often use their positions of power to leverage economic control over forest resources and contribute to unsustainable exploitation (Barr 1998; Colchester *et al*. 2006; Milledge *et al*. 2007). Timber and wood-processing companies with close ties to government and military officials frequently are able to gain preferred access to valuable logging and plantation concessions and to capture a significant portion of the economic rents associated with these (Barr 2001). The widespread prevalence of corruption at all levels in many forest-producing countries often allows powerful political and corporate actors to behave with minimal levels of public accountability. Opportunities for such "elite capture" within and across national borders may be exacerbated under situations of conflict (Baker *et al*. 2003; UNSC 2002).

Also affecting the fate of forests, a third set of governance factors involves inappropriate forest law and weak law enforcement capacity. Forest laws often define some sustainable forest activities as illegal, while at the same time treating other unsustainable activities as legal. Colchester *et al*. (2006) found that forestry laws tend to render forest-based sources of income for the poor technically illegal, while laws outside the forestry sector that protect communities'

rights are often weak, ambiguous or ignored. At the same time, forestry laws have proven weak instruments for dealing with large scale forest crime. In Indonesia, attempts to pursue cases of illegal logging and burning against notorious individuals and companies have failed to result in successful prosecutions (Smith *et al*. 2007).

***Other factors:***

- **Cultural factors:** Local culture can directly affect the use given to land. For instance, sacred forest areas are often protected from land conversion and degradation. However, other cultural factors can exert pressure on forests. For example, a "cowboy culture" in Latin America goes along with high meat consumption, with most forest clearing aimed at pasture establishment.
- **Demographic factors:** Rising rural populations and migration to the agricultural frontier increase the labour force available for deforestation. An increasing population in urban and rural areas also raises demand for food and other land-demanding commodities, thus requiring more land to produce them. As population growth is often viewed as the main cause of deforestation, it is important to nuance this with the observation that most deforestation is from the conversion of forest to agricultural land - and much of this is from industrialized rather than smallholder agriculture.
- **Technological factors:** Technological improvements can affect deforestation rates. The adoption of land-extensive technologies, for example, can result in the expansion of agriculture at the expense of forests. Or, a new technology that results in more intensive agriculture can pull resources out of extensive agriculture at the forest frontier, and thereby reduce deforestation (Angelsen and Kaimowitz 2001; Angelsen 2007; Chomitz *et al*. 2007). Generally, the role of improved agricultural technologies in terms of deforestation is ambiguous, and depends on the relative strengths of two opposing forces. First, new technologies will be adopted if they increase profitability, and higher agricultural profitability makes forest conversion more attractive. Second, the increased supply of products (and demand for inputs like labour) will change prices in a way that dampens - and possibly reverses - the increase in profitability. Figure 2 shows some critical factors that determine the net impact.

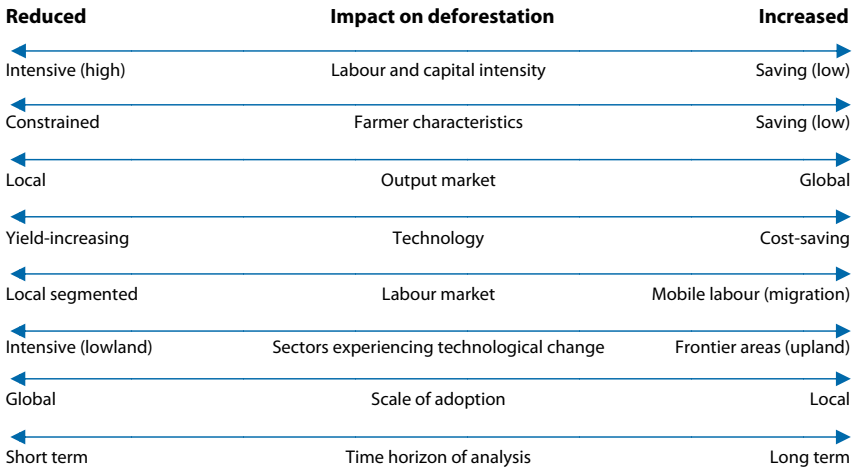


**Figure 2. Links between agricultural technologies and deforestation** (Angelsen and Kaimowitz 2001)

## 3.4 Implications for future REDD regimes

The summary of the research on the causes of deforestation and degradation reveals that behind the simple acts of forest use and conversion lies an intricate set of social, economic and political realities. Further, the multi-dimensional causal factors can differ significantly across countries and over time, making it hard to generalize. For the design and implementation of REDD schemes, such complexity and diversity means that there will be no "one size fits all" approach for different countries at different stages of development. The research also reveals that the net effect on forests of various underlying causes - macroeconomic factors such as exchange rate movements, and governance factors such as decentralization - will be difficult to predict. As a result, there will be an inherent uncertainty in the ability of REDD policies to result in a given level of increased forest protection.

While incentives for policy reforms for reduced deforestation are vital, the discussion also suggests that quantifying the deforestation impacts is very challenging. An implication is that any rewards in the form of carbon credits should be linked to reductions at the national (or sub-national) deforestation level as compared to a given baseline, rather than to the implementation of specific policies.

The research suggests that one set of underlying causes of deforestation and degradation reflect broader changes in economic and social conditions - such as commodity prices, agricultural technologies, and demographic trends - that are not amenable to direct policy interventions in the interest of forest protection. Analysis of the effects of such conditions can mainly serve to predict pressures on forests, and prompt the application of safeguards to counteract them.

A second set of direct and indirect causes of deforestation and degradation reflect the preferences of societies and their governments for achieving economic growth and poverty reduction. In many cases, converting forests to alternative uses is a key step for developing countries in increasing national welfare. Specific measures particularly include agricultural expansion, but also settlement schemes, investment in forest industry, rural infrastructure development, and the development of biofuels. For REDD schemes to be successful, they will need to provide a convincing economic alternative, and will have to be co-ordinated across multiple sectors.

A third set of direct and underlying causes of deforestation and degradation reflect the interests of political and economic elites, which until now, have been given higher priority by policy makers than the objective of forest protection. Such interests are privileged by the failure of authorities to secure the property rights of traditional forest users, provide adequate regulation of forest industry, reform and enforce forest law, and address non-transparent forest-related decision making. A key question is whether the prospect of a global REDD regime will provide incentives for accelerating progress on governance reforms to address those causes (Chomitz *et al*. 2007).

The attractiveness of governance reforms is severalfold. The magnitude in terms of reduced deforestation can sometimes be large scale, for example, by changing policies related to concessions and land use planning for logging, oil-palm and soybean production. Compared with reforms that involve millions of small scale farmers the transaction costs are low. Finally, such reforms may present less conflict with other policy objectives such as poverty reduction.

# 4 Policy options for reducing deforestation and degradation

The research summarized in Section 3 on the underlying causes of deforestation and degradation suggests policy options for addressing the trends described in Section 2.

A decade ago, Kaimowitz *et al*. (1998) undertook a thorough analysis of policies to abate deforestation. The paper proposed a normative distinction between "appropriate" and "inappropriate" deforestation. "Appropriate" deforestation derives from recognition that some forest clearance supports development objectives, such as when low-utility forests are converted to other land uses that provide higher and/or longer lasting benefits. "Inappropriate" deforestation occurs when forests are converted to less suitable land uses at the expense of important forest values. Deforestation is often inappropriate on lands with high biodiversity and lands with large numbers of forest dependent people, or in environmentally fragile areas where forest conversion results in negative "downstream" effects.

In practice, the distinction between appropriate and inappropriate deforestation is often ambiguous, as multiple stakeholder interests are affected by both deforestation and by attempts to curb it. Indeed, from the narrow perspective of climate protection, *any* deforestation or degradation is undesirable, because it releases greenhouse gases that lead to climate change. The introduction of a global REDD regime can be expected to alter the calculus of what forest

use is most appropriate in any particular place. Careful consideration of what is gained and lost from alternative land uses should be central to any policy decisions on where and how to implement REDD.

The Kaimowitz *et al*. (1998) analysis concluded that the following types of policies can influence deforestation rates:

- Regulating the prices and demand for tropical agricultural and forestry products
- Making production associated with deforestation more costly and risky
- Curbing land speculation
- Increasing the profitability of maintaining forests
- Increasing the opportunity costs of capital and labour used in forest clearing

The following section builds on and updates that analysis, taking into account a number of trends that have emerged over the last decade, including the surge in biofuel investment, international interest in controlling illegal logging, and experience with payments for environmental services (PES) schemes. A review of the literature on incentives and policy instruments to abate deforestation suggests a classification distinguishing economic and financial instruments, direct regulation, and governance and institutional strengthening.

## 4.1 Economic and financial instruments

A root cause of forest clearing, as explained in Section 3, is that alternative land uses tend to be more profitable to individual land users than conserving forests. Economic and financial instruments can be used to reverse the relative returns and benefits to the land-use decision makers from forest conservation. From an economic perspective, such instruments internalize the negative environmental impacts associated with the loss of forests, or the positive externalities of forest protection. Related policies are of two types: firstly, those involving the elimination of subsidies and other price distorting policies that artificially raise the returns from logging, burning, conversion to agriculture, and forest colonization; and secondly, those concerning the creation of new market and finance mechanisms to create positive incentives for forest protection.

### *Eliminating subsidies that drive deforestation and degradation:*

The first set of policy options to reduce deforestation and degradation involves eliminating subsides that encourage activities associated with forest loss by making them less costly or risky. Kaimowitz *et al*. (1998) and Wunder (2003) identified the following list:

- Subsidies for agricultural inputs that encourage agricultural expansion
- Financial support for colonization and settlement schemes
- Technical and advisory support, tax credits and subsidies for activities on newly-cleared lands
- Import protection of land-extensive sectors (especially livestock)
- Road and transport subsidies
- Subsidies to logging and forest industries engaged in destructive exploitation

However, elimination of agricultural subsidies alone is not always sufficient to slow deforestation. In the cases of Brazil and Central America, deforestation was temporarily reduced but later boomed again, even after subsidies for cattle ranching were eliminated (see Box 6).

**Box 6: When removing subsidies is not enough**

Kaimowitz (2002) revisited the effect of renounced cattle credit subsidies and other policies on deforestation in the Amazon. After the removal of some subsidies for agricultural activities, deforestation declined between 1987 and 1991. However, it steadily rose again in the 1990s as logging became more intensive, and agriculture and cattle ranching proved to be profitable, even without subsidies. In some instances, securing land titles could facilitate farmers' access to credit to implement activities that increase deforestation. These findings suggest that policies to halt deforestation only work if the multiple and dynamic underlying causes of deforestation are understood and addressed.

A new pressure on forests through subsidized agricultural expansion has emerged in the form of **'biofuel' development**, including oil-palm, sugar cane and *jatropha*. Ironically, current policies promoting the production and use of biofuels

- as an environmentally friendly alternative to fossil fuels - may have the perverse effect of increasing GHG emissions by stimulating conversion of natural forests either directly or indirectly. Targets adopted by the European Union and other countries to promote biofuels - which are in effect subsidies - need to be reviewed in the context of REDD objectives.

For instance, a 10 per cent substitution of petrol and diesel fuel for biofuels in the United States and Europe, would require an estimated 43 per cent and 38 per cent of current cropland area respectively (Righelato and Spracklen 2007). If such targets are adopted and maintained, pressure will grow to expand biofuel production in the tropics. In some cases, new biofuel crops may be grown on degraded land, but in many other cases, biofuel development will increase overall cropland demand - the largest single cause of forest loss - and thus, likely result in higher levels of deforestation.

At the same time, across the vast majority of developing nations, vegetable oil consumption per capita rose considerably during the 1990s. For instance, in Indonesia and India consumption rose by 65 per cent and 94 per cent respectively (Murphy 2007). This rise is closely linked to increased household incomes having enabled people to improve their diet through a higher proportion of oils. Palm oil demand, whether for human consumption or conversion to biodiesel, continues to grow rapidly, and is already beginning to affect the prices of plant oils in general. A 'biodiesel effect' has been distorting palm oil markets with a major expansion of new projects in many countries (Murphy 2007). In 2004, the total land surface covered by palm oil cultivation globally was estimated at almost 8.99 million hectares. By 2007, this figure had increased to 10.92 million (Carter *et al*. 2007). Even in the absence of subsidized demand for biofuels, forests in many countries will likely continue to be threatened by oil-palm development, requiring other policy measures to ensure that resulting deforestation is "appropriate".

With regard to **wood extraction**, artificially low stumpage charges often need to be increased as part of more general concession policy reform. However, low fees are only one of a number of implicit and explicit subsidies enjoyed by timber companies and forest product industries.

Over the last 15 years, several Asian pulp and paper companies have easily obtained loans and guarantees for non-sustainable operations that convert natural forests into pulp and paper. As described in Box 5, many of these companies defaulted on their loans in the aftermath of the Asian financial crisis, effectively passing on the risk related to their activities to the international banking community and the public in affected countries (Barr 2001). Increased financial due diligence - to ensure that proposed expansion of processing capacity can be supplied with legally and sustainably-sourced wood - can illuminate, and perhaps reduce, such hidden subsidies in the future. However, Box 7 suggests that the risk assessment and due diligence practices of banks are not in themselves sufficient to deny finance to poorly performing or unsustainable pulp producers.

**Box 7: Underestimating the financial risks of forest investments**

A 2006 CIFOR study on global pulp mill finance found that banks and other investment institutions often underestimate the financial risks associated with pulp mill investment projects. In particular, financial institutions routinely fail to adequately evaluate the sustainability of fibre supply for new pulp mills and capacity expansion projects. Most banks have little in-house forestry expertise, and many tend to rely on multilateral financial institutions – such as the World Bank's International Finance Corporation – to assess the risks associated with a project's forestry operations.

Financial institutions generally take a portfolio approach to risk management, with sector and country allocations taking precedence over the analysis of individual loans. In addition, risk assessment is typically based on credit risk ratings given by rating agencies. Due to disintermediation and competitive pressures, lenders and investors often do not have access to unambiguous and relevant data that would allow them to make a more detailed credit assessment of a particular company.

(Spek 2006)

***Creating new incentives for forest protection:***

Market failure is a major reason why deforestation and forest degradation are too high: forests provide not-yet remunerated but tangible goods and services well beyond the ones appropriated by "land-users" in the proper sense of the term, causing protection of natural forests to be undervalued from society's perspective compared to conversion to other land uses. Economic and financial incentives are instruments to alter the decisions of individual land users through price signals

and by compensating providers for foregone profits from not converting or degrading the forest. Examples include the following:

- **Forest-friendly subsidies** include lower tax rates on lands where forests are conserved.
- **Certification schemes** depend on consumer preferences to provide increased market share and/or a price premium for forest products produced in ways that minimize deforestation and degradation.
- **Public and private investment flows** can be targeted to beneficial activities, or denied to those deemed detrimental to forest protection. For example, public agencies could make financial resources available to land holders through microfinance schemes to support activities that do not clear forest, such as the commercialization of non-timber forest products. On the other hand, public and private investment flows could be denied to forest industries that cannot demonstrate compliance with social, environmental and legality safeguard standards, with respect to their wood supply, or to activities that require large scale forest clearing.
- **Transfer payment schemes** provide a specific, conditional compensation for either undertaking (e.g. reforestation or forest regeneration) or not undertaking (e.g. forest clearing or logging) a specific action. Financial resources are usually channelled through funds which are allocated to forest actors according to specific criteria. Examples include Payment for Environmental Services (PES) schemes (see Box 8) and debt-for-nature swaps. PES case studies from Costa Rica and Mexico (Karousakis 2007) illustrate that it is possible to compensate land users directly for the environmental services they provide. Compensation schemes may also be designed for non-monetary benefits, such as more secure land tenure or access to public services.

## 4.2 Direct regulation

Application of the economic and financial instruments described above usually depends on forest actors having secure tenure to forest land and the ability to control what happens to forest resources. In many forested areas, such conditions do not apply, and forest ownership and access is

**Box 8: Payments for environmental services**

Payments for environmental services (PES) are part of a new conservation paradigm that explicitly recognizes the need to bridge the interests of landowners and other beneficiaries through compensation payments. PES schemes can be defined as a voluntary, conditional transaction with at least one seller, one buyer, and a well defined environmental service. Conditionality - the 'business-like principle' that means payment is made only if the service is actually delivered - is the most innovative feature of PES.

Payments to landowners to curb deforestation in the interest of reducing carbon emissions are an example of PES. Four environmental services from REDD are likely to be targeted by PES: carbon sequestration and storage, biodiversity conservation, watershed protection, and landscape beauty.

The design of PES schemes must take into account the establishment of clear baselines, calculation of the opportunity costs faced by the "seller" of ecosystem services, and the need to tailor payment mechanisms to institutional capacities. In addition, PES should be targeted to agents that can effectively control land use, and whose decisions may be influenced on the margins by transfer payments.

Most PES schemes are currently found in developed countries, and the majority of these are State-run, rather than private sector schemes. In developing countries, development of PES programs has been constrained by a lack of willingness-to-pay on the demand side, and a lack of implementation capacity on the supply side.

(Wunder 2007)

contested. In such cases, direct regulation of forest use may be one of the few available options.

Direct regulation is usually referred to as "command and control", and relates to the establishment and enforcement of laws and regulations steering the behaviour of forest actors. Direct regulation is the most common form of environmental policy and land-use planning. It can directly address forest conversion and degradation by making such action illegal, for example, through the establishment of national parks, logging and burning bans, and land-use zoning.

Direct regulation provides opportunities for "stroke of the pen" decisions that can have a significant impact on the

trajectory of forest protection or loss. The planning and design of transportation infrastructure is especially important given the strong link between road construction and land clearance. According to Chomitz *et al*. (2007), "providing road access is the most effective determinant of deforestation that is under policy control". And as suggested in previous sections, there is significant room for improvement in the regulation of forest industry in terms of enforcement of the terms of logging concessions, and ensuring that wood-processing industries source their wood fibre from legal and sustainable supplies.

Protected areas such as national parks now cover about one seventh of the world's forest, and the number of them has grown rapidly over the past two decades. Their effectiveness varies from ineffective "paper parks" to effective "conservation tools", as reviewed by Chomitz *et al*. (2007). But in general, deforestation in protected areas tends to be significantly lower than outside of those areas (Bruner *et al*. 2001). Brazil, Costa Rica, Madagascar and Uganda provide examples of countries where national parks have significantly lowered deforestation. The effectiveness of protected areas is often reduced by gross under-financing of operational costs. REDD schemes could contribute to the creation of new protected areas. In some cases, REDD transfers could also contribute to the costs of already existing protected areas, given that an improvement of carbon-stock protection vis-à-vis a pre-established baseline is likely.

***Avoiding unintended negative consequences of regulation:***

Inappropriate regulation can inadvertently inhibit activities that could serve to reduce deforestation and degradation. For example, in many countries, regulations covering the extraction, transport and sale of non-timber forest products are inappropriately modelled on regulations developed for timber, imposing overwhelming costs on small scale producers (Belcher and Schreckenberg 2007). And yet the commercialization of non-timber forest products can sometimes also help to prevent conversion of forests to other uses (Kusters *et al*. 2007). As with the perverse subsidies described above under economic and financial instruments, a first step in controlling deforestation and degradation should be to remove perverse regulations.

Recently, an incremental move away from command-and-control measures has been observed, due to an increased recognition that limited government presence or corruption and favouritism in forest-frontier areas often inhibits effective enforcement. Indeed, overly complex regulation is often cited as increasing the opportunities for corruption. The effectiveness of direct regulation strongly depends on the clarity and appropriateness of existing law, and the ability of a government or other stakeholders, such as local communities, to report offenses, enforce laws and penalize non-compliance (Gregersen *et al*. 2005; Colchester *et al*. 2006).

In equity terms, there is a danger that enforcement of existing forest laws can have the effect of criminalizing small scale forest users, while ignoring some of the most important actors causing deforestation. In case studies in five countries, Colchester *et al*. (2006) found that forest law enforcement tended to be systematically biased *against* small forest users, targeting the rural poor in crackdowns while allowing more powerful businessmen behind forest crime to go free. One way to address this inequity is to mobilize law enforcement tools that are more naturally targeted at the criminals that drive large scale illegal activities. Such tools include the pursuit of prosecutions relating to money laundering and corruption activities in illegal logging cases (Setiono and Husein 2005).

***International constraints on regulation:***

National level policy options to address excessive forest exploitation are constrained by international trade and investment agreements. For example, the primacy accorded to trade rules has precluded regulatory approaches to combat international trade in illegal timber products in consumer countries. As a result, the European Union's Forest Law Enforcement, Governance and Trade (FLEGT) Action Plan is limited to voluntary bilateral licensing schemes to avoid transgressing World Trade Organization rules. According to Humphreys (2006), the global embrace of 'neoliberalism' is a key explanation for the international community's failure to create an effective regime to address the challenges of deforestation and degradation, despite years of discussion in the United Nations Forum on Forests and the forums that preceded it.

## 4.3 Strengthening governance mechanisms and institutional capacity

Strong governance mechanisms and institutional capacity are necessary to underpin the effective design and implementation of both economic and financial instruments and direct regulation. Three areas are particularly important for addressing the causes of deforestation and degradation: tenure and property rights, procedural integrity of decision making, and capable institutions.

***Tenure and property rights:***

As described in section 3, land tenure regimes and property rights can have strong implications for the way land is used. In many tropical countries, property rights to land depend on formal definitions of "use" associated with open land, supporting the clearing of forests to consolidate private land tenure through "active use" and to avoid expropriation. This mechanism of "homesteading through deforestation" can exist both informally (e.g. neighbours or external squatters more readily accept the claim of a land plot being 'worked') and at the policy level, by allocating secure land tenure and land titles only to those who incrementally deforest. A first step to controlling deforestation is to eliminate property regimes that require forest clearing for establishing and securing property rights, thus effectively delinking secure land rights from deforestation.

Well defined property rights are also essential to provide private actors with the incentives to undertake investments in the most beneficial long term use of forest resources. To the extent that forest conservation actually constitutes the privately most beneficial land use, securing property rights can lead to more sustainable management. In cases where the opportunity costs for forest conversion are high, conditional tenure could be used as a form of "in-kind" payment for environmental services, making tenure security conditional upon sustainable forest management. This strategy is currently being tested in RUPES sites (Rewarding Upland Poor for Environmental Services) in Southeast Asia (www.worldagroforestrycentre.org/Sea/).

Another innovation, exemplified by extractive reserves in Brazil, is the establishment of local common property regimes with regulations for sustainable forest management to avoid

conversion and combat land speculation. Yet another example, is the promotion of networks of private forest reserves, recently mushrooming in Latin America, which serve as a collective support channel for income enhancements and to secure property against invasions. Such innovative strategies must however, go hand-in-hand with the monitoring of forest condition.

***Procedural integrity of decision making:***

As suggested in previous sections, forest sector governance has been characterized by the top-down, non-transparent allocation of public resources, often at the expense of the public interest in avoiding deforestation and degradation. Improving the procedural integrity of forest-related decision making can help to ensure that a broader range of stakeholder interests are taken into account.

**Access to information and transparency** of the decision-making that affects forests can help empower constituencies for the public interest. Assuming that individuals and policy makers make rational decisions, the availability of timely and reliable information enhances their capacity to bargain and make appropriate decisions. Transparency reduces the opportunities for corruption, and increases the ability of the public and public interest organizations to hold government agencies and private companies accountable for their performance in forest management. Information on forest status and trends, and proposed changes in status (such as conversion to agriculture) can make the adoption of rational land-use decisions, or civic action against politically-motivated acts carried out by elites, more likely. The enhanced disclosure of operational information by forest industries can inform both consumer and regulatory decision making (Barr 2001; Spek 2006).

New tools, based on remote sensing and public access to information, have improved the efficiency of mechanisms to control deforestation. For instance, Chomitz *et al*. (2007) report that the introduction of a system in Mato Grosso State in Brazil, which registers the location of large properties and uses remote sensing to track their compliance with land use regulations, did seemingly shift landholder behaviour in a direction consistent with reduced illegal deforestation.

**Inclusive participation in decision making** can improve both the design and implementation of forest policy. Forest-related decision making is important to the general public due to the financial revenues and broadly beneficial ecosystem services that are often at stake. However, communities located in and around forests have particularly high stakes in forest-related decision making, as their interests are likely to be most affected by changes in forest management, whether as victims of deforestation or as net beneficiaries. Further, their co-operation is critical to the implementation of many forest-related policies (Colfer *et al*. 1999; Purnomo *et al*. 2005; Colfer 2005).

***Capable institutions:***
The capacity of a government to design, implement and enforce policies is key to ensuring their effectiveness. Capacity can be nurtured at national, regional and local levels to ensure that each of these levels is allocated appropriate responsibilities and the resources to fulfil them.

Linking in to the above discussion on the importance of property rights, a recent wave of forest tenure reforms designed to strengthen local rights to forest resources (Wily 2004; see also www.rightsandresources.org), provides useful experience on which to build future institutional reform and strengthening efforts. Many reforms have been hindered by insufficient devolution, and corruption in the distribution of rights and royalties, excessive formal or informal claims to benefit streams by government agencies, and failure to ensure that tenure security is matched to organizational strengthening and minimum environmental standards (Ribot 2002; Oyono *et al*. 2006). Policies supporting true devolution of property rights, combined with support to local governance of the resource (e.g. clear rules on rights and responsibilities, monitoring systems and sanctions), and the right incentives, could go a long way in supporting more effective outcomes.

There is increasing evidence (Molnar *et al*. 2004; Mayers 2006; Chomitz *et al*. 2007) that community forestry enterprise, and small and medium-sized forest enterprises, represent a more promising route to sustainable forest management, and especially to poverty reduction benefits, compared to the industrial forestry sector. However historically, these stakeholders have been underserved by forestry agencies

with regard to supporting their role in sustainable forest management. For community and indigenous forest management initiatives to succeed, key elements of support would include:

- Legal protection of tenure and political rights
- Strengthening of intermediary institutions that provide business development or technical assistance to communities
- Certification models more appropriate for communities (based on a "criteria and indicators" approach)
- Development of community-company partnerships (El Lakany *et al*. 2007)

## 4.4 Implications for future REDD regimes

The analysis of policy options presented above suggests a number of implications for the design and implementation of national-level REDD strategies.

First, national REDD strategies should give early attention to eliminating current policies that either reduce the costs and risks of activities that drive deforestation and degradation, or impede activities that are supportive of sustainable forest management. High on the list should be removal of subsidies to activities that drive forest clearing, including those that make agriculture, ranching or biofuel development more profitable, and those that reduce the risks of investment in forest industry in the absence of sustainable wood supply. Regulations that have the effect of constraining small scale and community forest enterprise and creating opportunities for corruption, such as onerous permitting procedures for exploitation of non-timber forest products, should be reviewed and revised.

However, removal of perverse subsidies and regulations alone may not always be sufficient to reverse many of the forces driving deforestation and degradation. For example, demand for palm oil for human consumption will likely continue to rise, even in the absence of subsidies for biofuels. Where the opportunity costs of foregoing forest conversion to other uses are high, a combination of policy options involving positive incentives and direct regulation will be necessary, if deforestation is to be avoided. Where forest-related property

rights are clear and secure, direct private transfer payments such as PES schemes show promise for altering the behaviour of land owners. Elsewhere, REDD strategies may require early investment in the clarification of forest tenure.

Application of direct regulation in the context of REDD strategies will need to be applied with care to target the most significant opportunities for curbing "inappropriate" deforestation, and to avoid unintended negative consequences, especially for the rural poor. Increased law enforcement effort targeted at industrial scale forest crime, ensuring that the development of new roads does not open up access to vulnerable forests, and enhanced compliance with safeguards by commercial enterprises should be considered as high priorities.

The implementation of new incentive mechanisms and better-targeted regulatory approaches in support of REDD, in turn, will require the creation of new governance mechanisms and institutional capacity. Transfer payment schemes, for example, can only be effective at a large scale if an intermediary organization exists to allocate and channel funding in a transparent and efficient manner, and if monitoring mechanisms are in place to ensure performance on the part of the "seller" in return for payment. More effective targeting of industrial scale forest crime will not result in successful prosecutions without investment in strengthening the capacity of judicial system officials. And finally, a shift to small scale and community forestry will require new skills on the part of forestry agencies in order to provide the appropriate support services.

# 5 Implications for policies and further research to support REDD

Deforestation and forest degradation result from intricate relationships among social, economic, environmental and political factors. It is difficult to make generalizations about the causes of forest loss and degradation, and to propose generally appropriate responses. Accordingly, there is seldom a one-size-fits-all solution. Different regions feature different underlying and proximate deforestation causes, and different capacities to respond, thus calling for responses tailored to specific contexts.

At the same time, the challenge is also inherently simple: forest land is being cleared for alternative uses or degraded by individual, corporate or government actors who can get a higher return by being involved in such activities, compared to protecting the forest. Any strategy to reduce deforestation and degradation at any level of aggregation has to address this basic reality.

The proposed global REDD regimes and national REDD strategies currently under discussion propose to address this challenge by providing financial resources - in the form of "compensation" or "incentive" payments - to alter the cost-benefit calculus that currently leads to deforestation and degradation. What lessons can be drawn, from more than a decade of research, that are relevant to the REDD debate, and what further research is needed? The following section summarizes the challenges and opportunities related

to monitoring and baselines, policy options, and institutional and governance needs.

## 5.1 Forest carbon monitoring and baselines

The various estimates of forest cover and deforestation rates presented in Section 2.1 suggest that the forest monitoring efforts to date reflect a non-trivial degree of uncertainty. Data on forest degradation is even less reliable. For REDD regimes to function as envisioned, more robust definitions, systems and methods will be needed to monitor changes in forest carbon stocks. Collaboration between developed and developing countries is needed to generate and process reliable data, while strengthening the capacity of the personnel involved.

However, as described in Section 2, new technologies, combined with new incentives provided by REDD, show promise of being "good enough" to facilitate a move forward with the development of REDD regimes. Remotely sensed data supported by ground observations are a key to effective and cost efficient monitoring. Thus, the use of high resolution active or non-optical sensors is necessary to increase data quality and accuracy. However currently, only a few developing countries have the data and capability to retrieve, process and analyze it adequately. One of the first steps necessary is an assessment of national capacities for analyzing data on land cover change and carbon stocks in developing countries, along with the launching of efforts to improve upon this capacity. Further research is needed on quantifying forest carbon pools in the Tropics. Particular attention should be paid to the highest uncertainties and gaps, including those related to forest degradation and tropical peatlands.

Determination of appropriate REDD baselines will require grappling with a number of uncertainties. As described in Section 2.1, estimates of past deforestation rates in particular countries vary widely and are often contentious. In addition, extrapolating baselines from past rates of deforestation may need to be done with care, for three reasons.

First, as described in Section 2.2, the literature on "forest transitions" suggests that a country's deforestation rate is

unlikely to be linear over time. After an initial trigger and factors that accelerate forest conversion in early stages of national development, other factors that favour stabilization of forest cover begin to play a role.

Secondly, different countries and regions within countries are placed at very different points along the forest transition. Political negotiations at both global and national levels will have to determine what is "fair" in allocating REDD resources across jurisdictions with such different starting points, and at the same time, what is effective in terms of genuinely reducing forest loss. On the other hand, leaving each country to develop their own national baseline methodology is not an incentive-compatible proposal - each country will have a direct financial incentive to set deforestation baselines as high as possible, in order to qualify for larger REDD transfers. Hence, an internally agreed-upon baseline REDD methodology is necessary in order to make the system credible.

Thirdly, as described in Section 3, many drivers of deforestation will be difficult for national REDD programs to influence. Factors such as population growth, exchange rate movements, and international commodity prices, have low "targetability" for policies intended to influence forests. Methods used for REDD baselines will thus have to be able to accommodate an inherent degree of uncertainty relating to assumptions on future development (e.g. a government's ability to control deforestation rates and forest degradation).

Assuming that REDD schemes are implemented at a national scale, the highest priorities for further research on baseline methods include: (a) analysis and modelling of historical forest cover changes; (b) analysis of the extent to which such models are able to represent the future projection of biophysical and socioeconomic parameters in a given REDD scheme; and (c) analysis of the importance of the geographic scale of the assessment (e.g. national vs. sub-national) for national baselines.

## 5.2 Policy options

Among the policy options that have received the most attention in REDD discussions is the prospect of direct transfer payments to individual forest users, to foster changes in their

behaviour in favour of forest protection. Clearly, payments for environmental services (PES) arrangements offer some promise for altering deforestation decisions, whether for carbon storage alone or in combination with other forest-based ecosystem services.

However, as discussed in Section 4, PES schemes are likely to be viable only under certain conditions, which include the possibility of identifying at least one viable "seller". Moving forward with PES schemes or other economic incentive mechanisms in the absence of clarity over rights to land and resource use could be counterproductive, leading to conflict and the marginalization of less powerful claimants. Because large areas of forests in developing countries are either under de facto "open access" regimes, and/or ownership is contested, a process to establish clear property and/or access rights would have to precede implementation of transfer payments as well as the liability of failure for forest protection.

Further research is needed on the necessary conditions for PES schemes to be effective, efficient and equitable, linking global concerns, such as controlling climate emissions, with national and local interests. In addition, further research is required into how schemes can integrate multiple environmental services (such as both carbon storage and watershed protection). REDD pilot efforts could provide "laboratories" for such research, but need to be accompanied by careful monitoring and feedback, to ensure that unintended negative consequences are identified and addressed. Research is also needed to illuminate best practices in clarifying and securing forest tenure in ways that are both efficient and minimize conflict.

In the meantime, efforts to control deforestation in areas without effective or legitimate stewards, will in large part have to rely on regulatory approaches that in most cases, have not been very successful up until now, as discussed in Section 4.2, and which themselves carry risks. Pursuit of any exclusionary policy must be accompanied by efforts to protect customary forest use and address weaknesses in current approaches to law enforcement, which often render them ineffective and inequitable. Further research is required towards understanding how to enlist government commitment and local support for better law enforcement.

Comparative studies across countries could provide guidance regarding which approaches are most effective (Tacconi 2007).

As a complement to direct transfer payments, there are quite a few "stroke of the pen" policy changes suggested in Section 3 that could have a significant impact on rates of forest conversion and degradation. Indeed, the first step towards decreasing forest loss is to eliminate existing policies and institutions that favour unambiguously inappropriate deforestation. Such actions include the removal of subsidies originating from other sectors for activities that increase pressure for forest conversion, including agricultural expansion, settlement schemes, and plantation and road development in forest areas. Implementation of such policies would require inter-agency co-ordination across sectors.

Within the forestry sector, withdrawal of support for companies engaged in destructive logging, or industries engaged in building excess capacity for wood processing, would address key factors leading to forest degradation. However, the political viability of such policy reforms is judged to be low because they would require significant political will to overcome vested interests in current policies and plans. Research could illuminate how new financial and other incentives associated with REDD pilots could alter the political economy of commercial access to forest resources.

## 5.3 Institutional and governance needs

Weak institutional and governance environments characterize many of the tropical countries and regions containing significant remaining forest area. As a result, any attempts to deal with deforestation and degradation - whether in the context of REDD efforts or otherwise - must incorporate long term efforts to create and reform institutions, strengthen the processes of governance, and build the capacity to implement new models of forest management.

The design and implementation of REDD programs will require trade-offs among efficiency, effectiveness and fairness, and apportionment of risk. For example, should resources be targeted to areas with the greatest potential for emissions reductions (such as peatland areas in Indonesia) or those

with the highest incidence of poverty? Should REDD proceed where there is the risk of elites capturing transfer payments or funds being lost to corruption? Such choices are political decisions that can be informed but not determined by, scientific research and economic analysis.

REDD will only be able to proceed at a pace that allows the meaningful participation of all relevant stakeholders in consensus-building, with regard to the way forward in how best to harness forests resources toward climate change mitigation. New governance norms, skills, and practices on the part of relevant government authorities and other key stakeholder groups will be necessary to support transparent and inclusive decision making.

In addition to improved procedures for decision making, implementation of REDD efforts will require clarification of forest-related rights and responsibilities. As mentioned above, for the proposed transfer payment schemes to be effective, rights to forest land and resources will need to be clarified and secured in the hands of forest stewards, with both the legitimacy and capacity to affect what happens to the forest. In many cases, this will mean strengthening the stake of local communities in protecting forest assets, and building on links with local organizations for community based management activities, such as controlling the exploitation of forest products, enforcing regulations against outsiders, and fire control. Local communities and small scale producers are likely to need support to be able to access new REDD mechanisms on an equal footing with larger actors. Careful sequencing of these efforts will also be important: securing forest tenure in the absence of appropriate incentives and institutions could inadvertently lead to increased forest loss.

Implementation of REDD activities in the absence of the conditions described above poses the risk that vulnerable communities could be made worse off. Marginalization of forest-dependent people could result if more powerful actors appropriate newly available carbon storage rents from forest resources[4], or if repressive law enforcement effort is directed

[4] In South Sumatra, for example, new landlords emerged to take advantage of profitable out-grower scheme opportunities with a large *acacia* plantation company (Awang *et al*. 2005).

at small scale forest users. Further research is warranted to illuminate the minimum necessary governance conditions to achieve REDD objectives, while addressing equity concerns and managing risk.

To the extent that deforestation and degradation is caused by illegal forest exploitation and conversion at a commercial scale, the success of REDD will depend on a number of reforms. As described in Section 4, these include legal and regulatory reform to clarify and rationalize legality standards, the strengthening of judiciary systems to deal with forest crimes, and political will at the highest levels to reduce tolerance for forestry sector corruption. In addition, international co-operation will be required to address the underlying causes of deforestation that lie beyond national borders, including the demand for illegally produced wood products. Research to monitor the various national and international efforts under the FLEGT banner (the European Union's Forest Law Enforcement, Governance and Trade initiative) could provide guidance on the policies and approaches that are proving most effective.

To the extent that governments choose to implement the transfer payment mechanisms envisioned under REDD, they will need to support the creation of new institutions with the legitimacy and capacity to allocate and administer such payments in a transparent and efficient manner. A key challenge will be to ensure that payment mechanisms are designed in such a way as to reach local actors who are actually in a position to control what happens to the forest. As REDD pilots get underway, further research will be necessary to illuminate which models of payment mechanisms achieve success in terms of efficiency and minimizing leakage.

Last but not least, research on deforestation suggests that building the capacity of national and local institutions will be essential for successful REDD implementation. Some capacity needs are technical - for example, staff of relevant agencies will require the development of skills related to new carbon monitoring methods, communities will need training in fire control methods, and officials from customs, financial and judiciary agencies will need new capacities to address forest crime. However, the greatest challenge will be the development of new institutional capacities, on the part

of government agencies as well as on the part of affected stakeholder groups.

REDD schemes will not be effective - in other words, trees will not grow on money - unless there are governance mechanisms to translate international financial assistance into meaningful change on the ground. International REDD funding will be important, but must be complemented by clear incentives and a strong commitment from the governments of the deforesting countries to undertake such reforms.

Not just the environment ministers, but also those ministers that are in charge of economic development, and lower-level government, community, and private-sector actors, need to see an advantage in committing to REDD. In the absence of transparent and inclusive decision making processes, prospective REDD payments could create a new source of conflict over forest resources among those constituencies in recipient countries. Alternatively, meaningful consensus-building processes could help foster broad domestic alliances for change. Such alliances would be strengthened by including objectives "beyond REDD", so as to achieve the goal of sustainable forest management. Various actors then could work together to shift predominant development scenarios based on land abundance to new strategies emphasizing carbon-stock protection, providing a badly needed boost to the mitigation of climate change.

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Deforestation and forest degradation are identified as important sources of the greenhouse gases associated with climate change, with emissions from land-use change accounting for one-fifth of current global carbon emissions. Accordingly, there is a renewed focus on maintaining existing forests - highlighted as one of the least expensive climate change mitigation options. Reduced emissions from deforestation and forest degradation (REDD) in developing countries has emerged as a likely component of the global climate protection regime being negotiated to follow on from the Kyoto Protocol, which ends in 2012.

This report summarizes the key drivers of deforestation and forest degradation, and the policy options available to reduce the resulting carbon emissions. It reviews current deforestation rates and the associated issues related to monitoring forest-based carbon emissions and establishing baselines. The findings of research into the direct and underlying causes of deforestation and degradation provide a basis for outlining REDD policy options, while highlighting the associated challenges. Analysis suggests that policies will need to address diverse local situations and include economic, regulatory and governance reforms. The paper concludes by summarizing the implications of its analysis for the REDD options currently under discussion.

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