Submission by the Center of International Forestry Research (CIFOR)
to the UNFCCC

Issues relating to reducing emissions from deforestation
in developing countries

In accordance with the conclusions of the Conference of the Parties at its eleventh session on agenda item 6 (FCCC/CP/2005/L.2), the Center for International Forestry Research (CIFOR) submits relevant 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".

0. Presentation

The Center for International Forestry Research (CIFOR) welcomes this opportunity to share some of its relevant research and information from other sources on the topic of deforestation. CIFOR is an international research and global knowledge institution that forms part of the Consultative Group on International Agricultural Research (CGIAR). The work of CIFOR is focused on producing research relevant to conserving forests and improving the livelihoods of people in the tropics. It employs over 150 staff at its headquarters in Bogor, Indonesia and at its regional offices in Brazil, Cameroon and Zimbabwe.

The present submission illustrates that deforestation derives from various reasons, most of which belong to activities outside the forest sector. Understanding these reasons is crucial to identify proper incentives to curb deforestation, while at the same time benefit people whose livelihoods depend on forests. Forests provide a number of valuable goods and services to society, however, the returns from alternative land uses and the lack of remuneration for forests' intangible benefits sets these ecosystems at disadvantage and promotes deforestation.

The present submissions is organised as follows:

- Scientific and technical aspects related to methodological issues
- Some figures on deforestation
- A summary of the causes of deforestation
- Incentives to curb deforestation and some policy recommendations
- Concluding remarks

1. Scientific and technical aspects related to methodological issues

Compensating reduced emissions from deforestation in developing countries requires the development of methodologies that are standardized, widely accepted, credible, and scientifically sound. Such methodologies should be cost-effective to attract wide participation of countries harboring significant amount of forested area storing carbon in the biomass.

Remotely sensed forest cover and its changes combined with robust verification and ground truthing of forest types and the associated carbon stocks are the most feasible techniques to monitor emission from deforestation. Once the choice of sensor's resolutions and verification procedures are standardized, the methodologies would to guarantee the transparency, consistency and continuity of data acquisition and processing throughout the commitment period.

Baseline and leakage

A number of country-wide and project-based assessments were generally available during the decade of 1990[1]. These may be used to reconstruct historical deforestation rates, which later may be used as baseline or national target as proposed by Santilli[2]. In the absence of remote sensing data, aggregated statistical data on forest area and its changes should be treated cautiously.

The development of national targets or caps will eventually solve the issue of national leakage. The concept of setting a cap is similar to that of the emission reduction target in Annex I countries. Changes in forest area and the associated carbon stocks monitored with acceptable degree of accuracy will be compared against the target to calculate emissions reduction due to deforestation.

Monitoring and Verification

Monitoring of forest area and estimation of carbon stocks should be carried out within acceptable interval allowing the detection of changes (for details, see e.g. Good Practice Guidance published by IPCC in 2003)[3]. This should also allow countries to optimize the costs of monitoring and verification.

Wall-to-wall mapping of forest cover should be carried out using moderate spatial resolution sensors. However, verification and validation are needed when hierarchical sampling scheme using higher resolution of sensors is adopted to assess deforestation hotspots and forest degradation. Ground survey to verify forest classes and their carbon stocks can be carried out at regular basis.

Forest degradation may not be considered as deforestation. It takes the form of e.g. large canopy gaps, fragmentation, active fire, and burned area. Logging is one of the main causes affecting forest degradation. In the context of deforestation avoidance, forest degradation can be defined as a partial loss of biomass due to logging or other removal of biomass. Forest degradation can not be detected by moderate and low resolution sensors. Quantification of forest degradation requires further development of methods and standards.

Addressing deforestation, however, is not mere monitoring and estimation of forest and carbon loss. It is highly relevant to understand the direct and underlying causes of deforestation as described below. Taking this step will allow Parties to develop options on how the implementation of policies and measures related to avoiding deforestation will promote positive incentives.

2. A brief look at current deforestation rates

Deforestation is one of the main drivers for global environmental change. High rates of tropical deforestation have severe consequences for climate change, loss of biodiversity,

[1] Defries, R., Asner, G., Achard, F., Justice, C., Laporte, NT., Price, K., Small, C, and Townshend, J. Monitoring Tropical Deforestation For Emerging Carbon Markets. In: P. Moutinho and S. Schwartzman (eds.), Tropical Deforestation and Climate Change. IPM and Environmental Defense.

[2] Santilli, M., P. Moutinho, S. Schwartzman, D. C. Nepstad, L. M. Curran, and C. A. Nobre. 2005. Tropical deforestation and the Kyoto Protocol: an editorial essay. Climatic Change **71**:267–276.

[3] IPCC. 2003. Good Practice Guidance for Land-use, Land-use Change and Forestry. IPCC and IGES

reduced timber supply, flooding, siltation, soil degradation and threats to the livelihoods and cultural integrity of forest-dependent people.

People use the term "deforestation" quite variably, so it is important to have a precise definition[4]. The Food and Agriculture Organisation of the United Nations (FAO) includes two different dimensions in defining deforestation. First, according to usage, deforestation is defined as the conversion of forest land to another land use; second, according to crown cover, deforestation is the long-term reduction of this parameter below a 10% threshold. However, both approaches can present some problems at the time of assessing deforestation on the ground: while the first further requires a definition for forest, the second implies an arbitrary threshold. Wunder[5] illustrates how choices with regards to spatial resolution, sample size and time scale may lead to considerable differences in the estimations. Despite the arbitrariness of choice, whenever rates of deforestation are estimated using consistent methods applied to all regions and time periods, the problem is considerably reduced.

Latest figures on deforestation can be found in the Global Forest Resources Assessment (FRA 2005)[6]. FAO estimates that current global area of forests is less than 4 billion hectares (about 30% of the land area) [7], unevenly distributed in the globe, as illustrated in the following table (Source: copied from FAO, FRA 2005: 18):

Forest cover by subregion 2005

Region/subregion	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	277 829	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**

[4] A definition for deforestation is in place for the Kyoto Protocol, which applies to Articles 3.3, 3.4 and 12. 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.

[5] Wunder, S. No date. Forests without trees? A note on problematic forest definitions and change assessments. Center for International Forestry Research.

[6] Food and Agriculture Organisation of the United Nations (FAO), 2005, Global Forest Resource Assessment 2005: progress toward sustainable forest management, FAO Forestry Paper 147, Rome, FAO.

[7] 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 percent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use. Forest is determined both by the presence of trees and the absence of other predominant land uses. The trees should be able to reach a minimum height of 5 metres (m) in situ.

The global forest resources assessment affirms that deforestation continues at alarming rates. Latest figures show that 13 million hectares are lost annually, accounting 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 from the period 1990-2000, whose average deforestation was 8.9 million hectares per year.

Highest deforestation occurred in South America, with 4.3 million hectares per year, followed by Africa with 4 million hectares per year. The following table from FRA 2005 illustrates differences in deforestation rates across regions (Source: copied from FAO, FRA 2005: 20):

Annual changes in forest area by subregion 1990–2005

Region/subregion	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 or gained each year during the respective period.

3. Why does deforestation happen?

As explained above, deforestation occurs when forest cover decreases below the 10% canopy cover threshold. Note that a selective logging operation does usually not reduce canopy cover so much, so predatory logging causes forest degradation, not deforestation. Deforestation is normally a more drastic land use change. It will often happen through the felling of trees and conversion to alternative land uses, predominantly agriculture. But deforestation can also be achieved through repeated burning, clearance of land for open-pit mining, urban sprawl, or road building. Forest degradation and deforestation happen because those engaging in these actions perceive a private, direct and tangible benefit from doing so.

Behind the simple act of forest clearing lies an intricate set of social, economic and political realities, which make deforestation a multi-dimensional phenomenon. Moreover, most of the causes do not operate at the forest level, but originate from sectors such as agriculture, infrastructure development and others. Activities outside the forest sector usually contribute much more to deforestation than predatory forestry. Furthermore, the multi-dimensional causal factors can differ much across countries, making it hard to generalize. .

Deforestation causes operate at two different levels: factors that are directly linked to the act of clearing land (**direct or proximate causes**), versus background societal factors that drive these direct causes (**underlying causes**). Another distinction is between deforestation causes in the forest sector itself (intrasectoral) versus factors originating from other activities (extra-sectoral factors) (Contreras Hermosilla 2000). As an example, think of an urban income boom that raises the demand for meat, paper and housing construction. This boom boosts demand

for pastures, pulp and timber for construction. All three exert pressures for forest degradation and deforestation. 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” ones (forest harvest for construction timber and for pulpwood).

For a long time, researchers debated whether deforestation was best explained by single causation (blaming one single factor, e.g. shifting cultivation) or multiple causation models (suggesting a combination of factors at different levels). Today, some consensus has been reached that deforestation usually results from a combination of factors. Direct and underlying causes of deforestation interact in complex and variable ways. For example, Wunder and Sunderlin[8] illustrate how oil booms may affect deforestation in opposed ways: while wealth from oil can lead to forest protection due to mainly 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 have a key role in determining differential forest-cover impacts.

From analysis of deforestation patterns in 152 countries, Geist and Lambin[9] suggested three dominant proximate causes of deforestation (infrastructure extension, agricultural expansion wood extraction), which interact with five principal underlying factors (demographic, economic, technological, policy and cultural variables). Biophysical, environmental and social events do also play a role in triggering deforestation. Their study concludes that deforestation is best explained by a combination of proximate and underlying causes.

Direct causes of deforestation

The following main direct causes of deforestation[10] have been used in the literature:

- Agricultural expansion: Agricultural activities clearing forestland include the establishment of permanent crops, shifting cultivation and cattle ranching. The expansion of the agricultural frontier is usually the main cause of deforestation. Factors affecting the decision to convert forestland include environmental conditions (for example, forests in areas with good drainage are more likely to be converted into agriculture), agricultural practices, wages (higher wages, more labour costs of forest clearing, and thus less deforestation) and prices for agricultural outputs (higher price, more profitable production, and thus more clearing). Angelsen and Kaimowitz[11] conclude that agricultural expansion is the main cause for deforestation, highlighting the Latin American cases of beef production in Central America and soy bean in Brazil.
- Wood extraction: Intra-sectoral deforestation causes are mainly clear-cutting for pulpwood and for fuelwood (incl. charcoal). Logging does not directly trigger deforestation as practices do not change land use, only degrade forest resources. However, this degradation and dry debris can sometimes promote repeated fires that lead to deforestation. Moreover, the building of roads to transport timber can indirectly facilitate access for settlers who convert the land (see box 1). Factors that affect the trajectory of logging include timber prices, road building, labour costs, consumer preferences and institutional frameworks (for example, concession schemes and timber

[8] Wunder, S. and Sunderlin, W. Oil, Macroeconomics, and Forests: assessing the linkages. The World Bank Research Observer Vol. 19 No. 2.
[9] Geist, H. and Lambin E. 2002. Proximate Causes and Underlying Driving Forces of Tropical Deforestation. Bioscience 52 (2): 143-150p. See also Contreras-Hermosilla (2000). The underlying causes of deforestation. Center for International Forestry Research, Ocasional Paper No. 30. Bogor, Indonesia
[10] Sometimes these are also referred to as “sources of deforestation”.
[11] Kaimowitz, D. and Angelsen, A. 1998. Economic models of tropical deforestation: A review. Center for International Forestry Research. Bogor, Indonesia.

certification). According to Angelsen and Kaimowitz[12], logging has mainly led to deforestation in Southeast Asia, whereas unsustainable fuelwood extraction primarily occurs in the drier parts of Sub-Saharan Africa.

- Infrastructure expansion & others: Finally, forests can also be cleared to construct roads, settlements, public services, pipelines, open-pit mines, hydro-electric dams, etc. By far, road construction and improvement is the infrastructure development that most contributes most to deforestation, not through the direct space they occupy but through their reduction of transport costs enabling productive activities in remote areas and promote the conversion of forests. Ecuador is one example where road building has been a prime driver.[13]

> Box 1. Logging and deforestation
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> It is crucial to understand the links between logging, road construction and deforestation. Logging can lead to deforestation by promoting immigration and land colonisation when the following conditions coincide:[14]
>
> - Construction of roads open up access to new forestland
> - Forests tenure and extractive regulation are poorly enforced
> - There is a large inflow of immigrants, due to demographic and poverty-push factors in the migrant-sending areas.

As stated above, direct causes of deforestation differ much across countries, obeying to broader patterns (see next section), as illustrated by Geist and Lambin (2002):

Table 2. Frequency of specific proximate causes in tropical deforestation.

	All cases (n = 152)		Asia (n = 55)		Africa (n = 19)		Latin America (n = 78)	
	abs	rel (%)	abs	rel (%)	abs	rel (%)	abs	rel (%)
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)	42	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 percentages;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.

Underlying causes of deforestation

Over the last decade, the strong effects of between macroeconomics and policies on deforestation and forest degradation have been amply documented. In some cases, policies to control underlying causes of deforestation may be possible, but in most cases these factors follow broader economic interests that have higher priority to policy makers than deforestation. Hence, analysis of these effects can mainly serve to predict arising pressures on forests, and possibly take safeguards to counteract them. Main factors are:

[12] See footnote 4.

[13] Wunder S. 2000. The economics of deforestation. The example of Ecuador, Macmillan, St.Antony's Series, Houndmills (UK), pp.262.

[14] Kaimowitz *et al.* 1998.

- Macroeconomic factors and market forces: Actors responding to market forces will often clear land to accommodate higher demand. Economic growth may increase deforestation at early economic development stages (forests making room for agricultural commodity production) while reducing it in later stages agricultural production becomes more concentrated, service sectors increase their share in the economy, and the demand for forest products and services rises. Other macroeconomic factors with significant potential to impact deforestation include external debt, foreign exchange-rate policy, and trade policies (protectionism versus liberalisation) of sectors linked to deforestation (mainly agriculture and cattle ranching) and forest degradation (mainly timber). A review made by Wunder and Verbist[15] indicates that rise in agricultural area is the main economic factor underlying deforestation. Rising agricultural output prices and reduced inputs prices act in a similar way in making agricultural production more profitable and expanding it. See box 2 for a list of policy factors de facto promoting deforestation.
- Policy, institutions and political decisions: The capacity of forestry institutions, including the ability to enforce the law and contain corruption, can reduce deforestation – although the political will is also key. Deforestation can happen as a consequence of undefined property rights, including system that rewards deforestation with tenure establishment. Other factors such as ineffective agrarian and environmental policies, marginalization of civil society groups in the design and execution of policies and ambiguous forest policies can also play a role.

Box 2. Macro-economic policies that promote deforestation

- Repeated currency devaluation, by making agricultural expansion more profitable;
- Drastic austerity adjustment packages curtailing the urban economy, as they drive people back to the agricultural frontier;
- Trade policies that protect land-extensive and timber sectors from imported substitutes, as they pose more pressure on land development to meet local demand;
- Gasoline and transport subsidies, as they facilitate remote timber extraction or land development more profitable;
- Population resettlement programs; those that "bring people without land to land without people"
- Land colonization support programs and heavy investments in agricultural frontier areas, as they induce people to go/ to stay in frontier areas and clear forests
- Lack of family planning policies, as increased rural population is a vital long-run driver for deforestation

(See Kaimowitz & Angelsen[16] and Wunder[17])

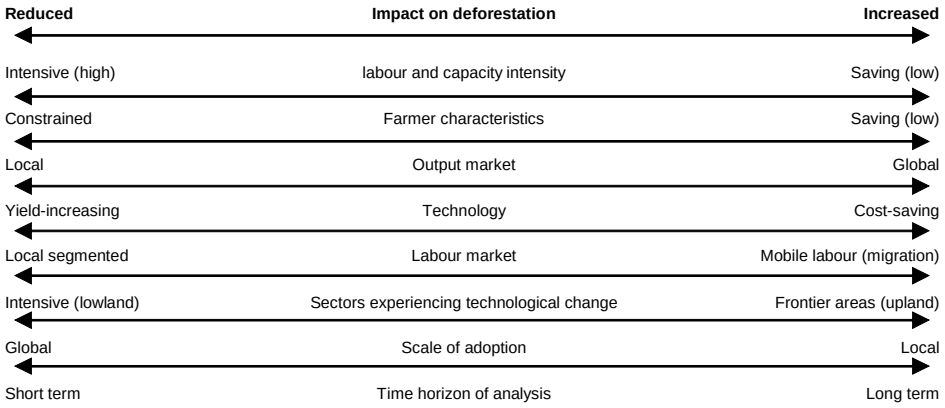
- Demographic factors: Increasing rural population, and migration to the agricultural frontier increase deforestation. An increasing population raises demand for food, thus requiring more land to produce (in particular, with extensification of agriculture).
- Technological factors: Technological improvements affect deforestation rates. Even more land-intensive technologies can ultimately lead the more profitable production to expand, i.e. extensification of agriculture at the cost of forests. However, the role of improved agricultural technologies on deforestation is ambiguous, since it seriously

[15] Wunder, S. and Verbist, B. (2003). The impact of trade and macroeconomic policies on frontier deforestation. ASBL lecture note 13. World Agroforestry Centre, Indonesia.
[16] Kaimowitz, D. and A. Angelsen (no date). The World Bank and Non-Forest Sector Policies that Affect Forests. Centre for International Forestry Research. Available upon request.
[17] Wunder, S. (2003). Oil wealth and the fate of the forest. A comparative study of eight tropical countries. Routledge: London and New York, 432 pp.

depends on a series of framework variables. Figure 1 shows the results of an in-depth analysis of the topic.[18]

- 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, e.g. a "cowboy culture" in Latin America goes along with large meat consumption and most forest clearing is for pastures.

Figure 1. Links between agricultural technologies and deforestation[19]



Forest transitions

"Forest transition" describes a long-run process in which economic development drives a pattern of forest loss followed by forest recovery (see Rudel *et al.*[20]). Deforestation is in early development phases 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. First, in developed regions like Europe or North America, better paid jobs have pulled people out of agricultural activities, which is also concentrated on less but high-productive land. Forest will the eventually grow back on abandoned agricultural lands. Second, forest re-growth is also motivated by a wealthier population that demands scarce forest products (especially in Asia) and forest services (in Europe and the US), thus driving an increase in forest cover through plantations.

4. Policy instruments and incentives for reducing deforestation rates

As illustrated above, deforestation happens in the light of an intricate linkage of people's behaviour, market conditions and policies (or lack of them), all exacerbated by market failure. Instruments to curb deforestation operate by having an effect on these factors. The present chapter briefly summarises available options, starting with a description of generic incentives

[18] Angelsen and Kaimowitz (2001). Agricultural Technologies and Tropical Deforestation. CABI publishing. Walling ford, UK. The book presents a thorough revision of the link between deforestation and agricutlural technologies in several regions of the world.
[19] From Kaimowitz and Angelsen, 2001
[20] Rudel, T., Coomes, O., Moran, E., Acgard, F., Angelsen, A., Xu, J. and E. Lambin 2005). Forest transitions: towards a global understanding of land use change. *Global Environmental Change* 15: 23-31.

and policy instruments, and a summary of policies that can be directly implemented with the objective of decreasing deforestation rates.

4.1 Generic incentives and policy instruments

A review of the literature on incentives and policy instruments to abate deforestation coincides in a classification distinguishing framework conditions, economic and financial instruments, direct regulation and property right schemes:

Framework conditions: These refer to institutional incentives that enhance the capacity of society to act and generally create the conditions for specific policies to be effective. Related incentives include:

- Provision of information: to the extent that individuals make rational decisions, availability of information enhances the capacity to bargain and make decisions
- Capacity and institutional building: The capacity of a government to design, implement and enforce policies is key to ensure their effectiveness. Capacity needs to be nurtured at several levels to ensure that each of these levels (national, regional, local) is allocated an adequate responsibility and counts with the resources to fulfil it.
- Public participation, in particular, local stakeholders and communities: because forest related policy usually targets and affects local people, their participation, interest and awareness is key in ensuring that policies meet their objectives and are followed

Economic and financial instruments: Market failure has often been identified as the major pitfall in recognizing less tangible forest goods and services. Economic and financial incentives are instruments targeting the behaviour of individuals through price signals and by compensating providers for foregone profits from not converting land. Alternatives include:

- Transfer payments: payment of a specific, conditional compensation for not undertaking an action (e.g. forest clearing). Financial resources are usually established through funds which, according to specific criteria, are allocated to actors. Examples include Payment for Environmental Services (PES) schemes (see Box 3)[21] and debt for nature swaps.

> Box 3. Payment for environmental services
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> Payments for environmental services (PES) are part of a new and more direct conservation paradigm, explicitly recognizing the need to bridge the interests of landowners and outside beneficiaries through compensation payments. They 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' only to pay if the service is actually delivered - is the most innovative feature of PES. Most PES are found in developed countries, and the majority of these are state-run, rather than private-sector schemes. Four environmental services from forests are likely to be targeted by PES: carbon sequestration and storage, biodiversity conservation, watershed protection and landscape beauty.

- Other market based approaches: These directly influence the behaviour of actors through price signals. They provide incentives for good behaviours (subsidies) and disincentives for undesired ones (taxes). An example would be the taxing of agricultural commodities that clear forest. An alternative to taxes is permit trading, by which a fixed quantity of, for example, greenhouse gases is established and stakeholders are allowed to trade. Another

[21] Extracted from Wunder, S. 2005. Payments for environmental services: some nuts and bolts. CIFOR Occasional Paper #42, Bogor, Indonesia, pp. 24.

set of market incentives do not send price signals but create competitive advantage to "value added" products through certification schemes. Products that avoid deforestation can gain market advantages (eco-premium), depending on consumer preferences .

- Private/public investment flows: They refer to schemes that make financial resources available to land holders through, for example, microfinance schemes. Such schemes could be used, for example, to give incentives to activities that do not clear forest, such as the intensification of agriculture or alternative income generating activities.

Direct regulation: This is usually referred to as "command and control" and it refers to the implementation of laws steering the behaviour of actors. Direct regulation is the most common form of environmental policy and land-use planning. It directly addresses land conversion by making such action illegal. However, its effectiveness strongly depends on the ability of a government to enforce laws and to penalize non-compliance. Examples include the establishment of national parks, logging bans and land-use zoning.

Enhancement of property rights: Land tenure regimes and property rights can have strong implications for the way land is used. Economists argue that well defined property rights are essential to realize the private benefits from the use of natural forests. In addition, well defined property rights provide long-term certainty that could help sustainably manage forests and prevent land speculation.

4.2 Policies to reduce inappropriate deforestation

Kaimowitz, Byron and Sunderlin[22] undertook a thorough analysis of policies to abate deforestation. Their 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; and
- Increasing the opportunity costs of capital and labour used in forest clearing

The paper also establishes a normative distinction between appropriate and inappropriate deforestation, which derives from the fact that some forest clearance supports development objectives whenever forests provide low utility to users, while other land uses provide higher and/or longer lasting benefits. Inappropriate deforestation occurs in lands that are less suitable for other land uses; lands with high biodiversity; lands with large number of forest dependent people or environmentally fragile areas where conversion results in negative "downstream effects". However, it should in this context be noted that all deforestation is bad from a climate change point of view, as it releases greenhouse gases.

Policies that affect prices and demand for tropical agricultural and forestry products

To the extent that land clearing for agriculture causes deforestation, higher demand for agricultural and cattle products may promote land clearing because more land is needed for production. This is exemplified by the case of Central America where deforestation is linked closely to beef production. Policies to influence demand for these goods include those that affect income, relative prices, consumer preferences and trade. However, such policies are

[22] Kaimowitz, D., Byron, N. & Sunderlin, W. 1998. Public policies to reduce inappropriate deforestation. In E. Lutz, ed. Agriculture and the environment: perspectives on sustainable rural development, p.303-322. Washington, DC, USA, World Bank.

blunt instruments that are difficult to target to deforestation reduction, and are thus likely to have strong negative side effects on human welfare and livelihoods. Related policies are:

Table 22.2. Demand-Related Policies

Policies	*Effectiveness*	*Targetability*	*Direct costs*	*Indirect costs*	*Equity*	*Political viability*
Population control	Limited	None	Moderate	Low	Unknown	Moderate[a]
Limits on economic growth	Moderate	None	Low	High	Unknown	Low
Appreciated exchange rates	Moderate[b]	None	Variable[c]	High	Mixed	Variable[c]
Price controls on tropical products	Moderate	Limited	Moderate	High	Mixed	Low
Export bans and taxes on logging	Moderate[d]	Limited	Low	Variable[e]	Favorable	Variable
Import restrictions on primary products (coffee, cocoa, timber, or beef)	Moderate[d]	Moderate	Low[f]	Unknown	Favorable	Moderate

Policies that make production associated with deforestation more costly and risky

An alternative to affecting demand for tropical products that require land clearance is to target the proper production activities, by making them more risky and costly. From an economic perspective, this implies the internationalization of negative environmental impacts associated with the conversion of forests. In most cases, related policies include the elimination of subsidies and other price distorting policies from the past, which have artificially raised the returns from, for example, agriculture or favoured colonization.

For example, government policies that promote the intensification of agriculture tend to decrease deforestation rates and vice-versa. On the other hand, the effect of eliminating subsidies depends on whether the subsidy is favouring or not the extensification of agriculture; however, elimination of subsidies alone is not sufficient to slow deforestation as can be witnessed by the cases of Brazil and Central America, where deforestation was temporarily reduced but later boomed again, even after subsidies were eliminated (see Box 4).

Box 4. Which underlying causes: policies or markets?

Kaimowitz[23] 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' credits to implement activities that increase deforestation. These findings suggest that policies to halt deforestation only work if the true underlying causes of deforestation are understood and addressed.

With regards to logging, policies could be set to increase stumpage charges and reducing a number of subsidies, but are often seen as against the promotion of forest investment. There are importance issues relating to the financial due diligence of the forestry sector, i.e. the ease some Asian pulp and paper companies have had in the past in obtaining loans for non-sustainable operations that converted rich natural forests in wood chips. Many companies underplayed the risks, defaulted on their loans, and effectively passed on the risk related to

[23] Kaimowitz, D. (2002). Amazon deforestation revisited. Latin American Research Review 37(2): 221-235.

their ample deforestation activities to the international banking community. Increased due diligence can hopefully avoid these scenarios in the future.

Finally, other policies within this class include those that affect infrastructure development given the link between road construction and land clearance. It is argued that such policies should, rather than targeting the costs of land clearing, be more of a "command and control" nature that regulate the better selection of sites for infrastructure.

The following table provides a brief analysis of these ploicies:

Table 22.3. Policies That Increase the Costs and Risks of Production Activities Associated with Deforestation

Policies	*Effectiveness*	*Targetability*	*Direct costs*	*Indirect costs*	*Equity*	*Political viability*
Reduced subsidies for certain agricultural inputs linked with expansion of farm areas	Moderate	Moderate to high	Saves money	Low	Favorable	Very low
Reduced support for colonization and settlement schemes	Moderate	High	Saves money	Low	Favorable to mixed	Very low
Reduced technical and advisory support for activities on newly cleared lands	Low	Low	None	None	Unclear	Low to moderate
Reduced road and transportation subsidies	Moderate	Moderate	Saves money	Low	Favorable to mixed	Variable
Removal of subsidies to logging and forest industries doing destructive exploitation	Moderate to high	High	Saves money	Some possible decline in exports	Favorable	Variable
Removal of tax and credit subsidies for agriculture on newly cleared lands	High	Moderate	Saves money	Low	Favorable	Low

Policies that discourage forest clearing to establish property rights

In some countries, property rights to land depend on whether the land is used or not and, thus continuous clearance of forests is employed as proof of "active use" to secure land tenure and avoid expropriation. Delinking forest clearing from land tenure is thus a crucial first step, eliminating a perverse incentive. Related steps applied in some countries have been, for instance, to apply lower taxes on lands where forest is conserved. An innovative form of policy is also the establishment of common property regimes used to sustainably manage forest and combat land speculation, as used for instance in the Brazilian extractive reserves. The following table provides a brief analysis of such policies:

Table 22.4. Policies That Discourage Deforestation to Establish Property Rights

Policies	*Effectiveness*	*Targetability*	*Direct costs*	*Indirect costs*	*Equity*	*Political viability*
Land titling policies	Negative to low	Moderate	Moderate	Low	Unknown	Moderate
Support for common property regimes	Moderate	Moderate	Low to moderate	Low	Mixed	Variable
Land and capital gains taxes	Unknown	Low	High	Low	Unknown	Low
Fewer credit, tax, and road subsidies	Moderate	Moderate	Saves money	Low	Favorable to mixed	Variable
Anti-inflationary macro policies	Unknown	Low	Low	Variable	Mixed	Moderate to high

Policies that increase the profitability of maintaining forests

These policies have the objective to increase the profitability of activities such as forest conservation and sustainable forest management. Some options include recognizing goods and services provided by forests to society through the establishment of, for example, transfer payments. Others encourage logging activities that are less damaging through, for example,

environmental requirements for logging concessions, timber certification and marketing of non-timber forest products. International frameworks support these policies and are considered under international efforts such as ITTO, CBD and the UNFCCC. The following table provides a brief summary of these policies.

Table 22.5. Policies That Increase the Profitability of Maintaining Forests

Policies	*Effectiveness*	*Targetability*	*Direct costs*	*Indirect costs*	*Equity*	*Political viability*
Niche marketing for tropical timbers, including certification and ecolabeling	Moderate	To be determined	Undetermined	Undetermined	Moderate	High in Europe, doubtful in exporting countries
Abolition of disincentives for long-term sustainable management	Moderate	High	Low?	Low; inequitable	Possibly	Variable
Greater security of tenure for forest people	Moderate to high	High	Low to moderate	Low	Favorable	Variable
Development of markets for nontimber forest products	Moderate to low	High	Low	Low	Favorable	High
Creation of a system for transfer payments for biodiversity conservation, carbon storage, and watershed management	Unknown	Unclear	Low	Low to moderate	Undetermined	Unclear to date

Policies relating to opportunity costs of capital and labour

Because labour and capital are major factors for forest clearance, increasing opportunity costs of these could lead to decreased deforestation: if production factors can be employed more effectively elsewhere, they will be drawn away from the forest margins and deforestation will slow down. In practice, the most important factors here is labour being drawn to booming urban sectors; CIFOR work particularly in Cameroon has shown that this type of urban labour absorption can be an effective pathway to halt poverty. The following table provides a brief analysis of these policies

Table 22.6. Policies That Increase the Opportunity Costs of Labor and Capital Used in Deforestation

Policies	*Effectiveness*	*Targetability*	*Direct costs*	*Indirect costs*	*Equity*	*Political viability*
Increased urban employment and wages	Moderate	Low	Ambiguous	Low; high potential indirect gains	Ambiguous	High
Improved capital markets	Low	Low	Low	Low	Unclear	High

Experiences so far with these policies are mixed, but it seems clear that governments will have to apply a mix of measures crafted to local conditions, and that there often will be “hard trade-offs” between conservation and development objectives, at different scales. For instance, the most powerful causal factor triggering deforestation is new road construction, but .at the same time this is also an important driver for local development: many remote communities have a new road as top of their priority list. Kaimowitz et al. (1998) suggest that principal government reforms to slow down tropical deforestation could realistically include:

- Eliminate subsidies for agriculture, ranching, and other land uses causing deforestation.
- Eliminate legal requirements to clear forests as a basis for claiming ownership of the land.
- Reform forest industry concessions and licences so that they set incentives for longer term sustainable forest management.
- Devolving land tenure and forestland decision making to those whose livelihoods are directly linked to the quality and quantity of tropical forests.

- Encourage voluntary market differentiation so that consumers can discriminate positively toward products that are sustainably produced and penalize those that cause deforestation.
- Facilitate the recognition of forest environmental services, and make sure these are being paid for by the users to the providers of services.

Based on his study of eight tropical oil countries, Wunder (2003, op.cit.) proposes some additional measures:

- Reconsider trade-offs between livelihood gains and environmental loss of investments at the agricultural frontier (roads, schools, extension services) that likely attract migrants,
- Reconsider trade-offs in government budgetary allocations: supporting colonization agencies and cattle improvement programs may accelerate forest loss; more funding for forestry regulation and national parks may slow it down
- Keep in mind, and possibly reconsider, the forest-cover and –quality effects of key macroeconomic policies, such as:

    - Reduce expenditure on road building, or even ban it, near priority conservation areas – try to intensify production instead in already opened-up areas;
    - Reduce fossil fuel and transport-cost subsidies;
    - Take into consideration the often powerful effects of sharp currency devaluation of increasing agricultural production and area;
    - Avoid giving generous logging concessions that favour over-expansion of non-sustainable, short-term timber-extraction practices
    - Stop the import protection of land-extensive sectors (especially livestock)

5. Concluding remarks

Deforestation is a complex phenomenon that results from an intricate relation between social, economic, environmental and political realities. It is thus difficult to generalize on the precise causes of deforestation and propose generally appropriate responses for its reduction. On the other hand, deforestation is also inherently simple: land is being cleared for alternative uses by a person who can usually get a better economic return by doing so. Any plan to reduce or halt deforestation at any level of aggregation has to somehow address this basic fact.

- There is seldom a one-size-fits-all solution: Different regions feature different underlying and proximate deforestation causes, thus calling for differential responses.
- A first step towards decreasing deforestation rates is to eliminate existing policies and other institutions that favour inappropriate deforestation (stop “lose-lose scenarios”).
- Links between deforestation and poverty are variable, but often there are hard trade-offs (“win-lose” or “lose-win”) between halting deforestation and improved livelihoods. Some integrated approach to bridge these trade-offs is necessary to be effective in reducing deforestation and the greenhouse gas emissions it causes.
- It is a challenge to design incentives that link global environmental concerns like greenhouse gas emissions to national and local level interests. Payment for environmental services (PES) is a promising mechanism to that respect.
- The development of monitoring methodologies requires standardized procedures. International remote sensing community should be consulted and mobilized to develop the standard. It should be noted that not many developing nations have the capacity to operationalize the procedures in timely manner. It is imperative that such capacity should be build at national level.

6. Other publications on deforestation, available upon request

Alencar, A.; Nepstad, D.C.; McGrath, D.; Moutinho, P.; Pacheco, P.; Carmen Vera Diaz, M. del; Soares Filho, B. 2004. Desmatamento na Amazonia: indo alem da "emergencia cronica". Belem, Brazil, Instituto de Pesquisa Ambiental da Amazonia (IPAM). 89p. [online] URL: http://www.ipam.org.br/publicacoes/livros/resumo_desmatamento.php - viewed May 15, 2004.

Alexiades, M.N.; Shanley, P.; eds. 2004. Productos forestales, medios de subsistencia y conservacion: estudios de caso sobre sistemas de manejo de productos forestales no maderables. volumen 3 - America Latina. Bogor, Indonesia, CIFOR. xv, 499p.

Campbell, B.M.; Frost, P.; Goebel, A.; Standa-Gunda, W.; Mukamuri, B.; Veenan, M. 2000. A conceptual model of woodland use and change in Zimbabwe. International Tree Crops Journal 10(4): 347-366.

Kaimowitz, D. 2002. Amazon deforestation revisited. Latin American Research Review 37(2): 221-235.

Kaimowitz, David, Erwidodo, Ousseynou Ndoye, Pablo Pacheco and William Sunderlin. 1998. Considering the Impact of Structural Adjustment Policies on Forest in Bolivia, Cameroon and Indonesia. Unasylva 49(194):57-64.

Kaimowitz, D.; Erwidodo.; Ndoye, O.; Pacheco, P.; Balanza P.P.; Sunderlin, W.D. 1998. Considering the impact of structural adjustment policies on forests in Bolivia, Cameroon and Indonesia. Unasylva 49(194): 57-64.

Medina, G.; Shanley, P. 2004. Big trees, small favors: loggers and communities in Amazonia. Bois et Forets des Tropiques 280(4): 19-25.

Mertens, B.; Kaimowitz, D.; Puntodewo, A.; Vanclay, J.K.; Mendez, P. 2004. Modeling deforestation at distinct geographic scales and time periods in Santa Cruz, Bolivia. International Regional Science Review 27(3): 271-296.

Mertens, B.; Piketty, M.G.; Venturieri, A.; Alves, D.; Tourrand, J.F. 2004. Contrasted land use and development trajectories in the Brazilian Amazon. Bois et Forets des Tropiques 280: 17-27.

Mertens, B.; Poccard-Chapuis, R.; Piketty, M.G.; Lacques, A.E.; Venturieri, A. 2002. Crossing spatial analyses and livestock economics to understand deforestation processes in the Brazilian Amazon: the case of Sao Felix do Xingu in South Para. Agricultural Economics 27(3): 269-294.

Mertens, B.; Sunderlin, W.D.; Ndoye, O.; Lambin, E.F. 2000. Impact of macroeconomic change on deforestation in South Cameroon: integration of household survey and remotely-sensed data. World Development 28(6): 983-999.

Mertens, B.; Forni, E.; Lambin, E.F. 2001. Prediction of the impact of logging activities on forest cover: a case study in East province of Cameroon. Journal of Environmental Management 62(1): 21-36.

Mindle, I.J.; Kowero, G.; Ngugi, D.; Luhanga, J. 2001. Agricultural land expansion and deforestation in Malawi. Forests, Trees and Livelihoods 11: 167-182.

Mlay, G.; Turuka, F.; Kowero, G.; Kachule, R. 2003. Agricultral policies and forestry development in Malawi, Mozambique, Tanzania and Zimbabwe: complementarities

and conflicts. *In:* Kowero, G., Campbell, B.M., Sumaila, U.R. (eds.). Policies and governance structures in woodlands of Southern Africa. Bogor, Indonesia, CIFOR. 138-164.

Nkamleu, Blaise, Dominique Endamana, Jim Gockowski, Ousseynou Ndoye and William Sunderlin. 2002. Analyse économique de la consommation du bois de feu en régions forestières: leçons des zones urbaines camerounaises. Sécheresse 2(13): 81-86.

Pacheco, P. 2002. Deforestation and forest degradation in lowland Bolivia. *In:* Wood, C.H and Porro, R. (eds.). Deforestation and land use in the Amazon. Gainesville, University of Florida Press. 66-94.

Pacheco, P.; Mertens, B. 2004. Land use change and agriculture development in Santa Cruz, Bolivia. Bois et Forets des Tropiques 280: 29-40.

Ruiz Perez, M.; Almeida, M.; Dewi, S.; Costa, E.M.L.; Pantoja, M.C.; Puntodewo, A.; Postigo, A.A.; de Andrade, A.G. 2005. Conservation and development in Amazonian extractive reserves. Ambio 34(3): 318-223.

Schlamadinger, B., L. Ciccarese, M. Dutschke, P. M. Fearnside, S. Brown, D. Murdiyarso. 2005. Should we include avoidance of deforestation in the international response to climate change?. *In:* D. Murdiyarso and H. Herawati (eds.), Carbon forestry: who will benefit? Proceedings of Workshop on Carbon Sequestration and Sustainable Livelihoods, Bogor 16-17 February 2005, CIFOR, Bogor, Indonesia. pp: 26-41

Sunderlin, William D. and Jacques Pokam. 2002. Economic Crisis and Forest Cover Change in Cameroon: The Roles of Migration, Crop Diversification, and Gender Division of Labor. Economic Development and Cultural Change 50(3):581-606.

Sunderlin, William D., Arild Angelsen, Ida Aju Pradnja Resosudarmo, Ahmad Dermawan and Edy Rianto. 2001. Economic Crisis, Small Farmer Wellbeing, and Forest Cover Change in Indonesia. World Development 29(5):767-782.

Sunderlin, William D. 1997. Deforestation, Livelihoods, and the Preconditions for Sustainable Management in Olancho, Honduras. Agriculture and Human Values 14(4):373-386.

Sunderlin, William D. 2002. Effects of Crisis and Political Change, 1997-1999. Chapter in Carol Pierce Colfer and Ida Aju Pradnja Resosudarmo (eds.) Which Way Forward? Forests, Policy and People in Indonesia. Washington, D.C.: Resources for the Future. pp. 246-276.

Sunderlin, William D., Ida Aju Pradnja Resosudarmo, and Ousseynou Ndoye. 2001. The Effect of Economic Crises on Small Farmers and Forest Cover: A Comparison of Cameroon and Indonesia. Chapter in Matti Palo, Jussi Uusivuori and Gerardo Merry (eds.) World Forests, Markets and Policies. Dordrecht: Kluwer Academic Publishers. pp. 219-229.

Sunderlin, William D. 1999. Crise économique et changements politiques en Indonésie: premiers effets sur le secteur forestier. Bois et Forêts des Tropiques 260(2):79-82.

Sunderlin, William D., Ousseynou Ndoye, Henriette Bikié, Nadine Laporte, Benoît Mertens and Jacques Pokam. 2000. Economic Crisis, Small-Scale Agriculture, and Forest Cover Change in Southern Cameroon. Environmental Conservation 27(3):284-290.

Sunderlin, William D., Ousseynou Ndoye and Henriette Bikié. 2000. Economic Crisis, Farming Systems, and Forest Cover Change in the Humid Forest Zone of Cameroon. International Forestry Review 2(3):173-181.

Sunderlin, William D. and Sven Wunder. 2000. The Influence of Mineral Exports on the Variability of Tropical Deforestation. Environment and Development Economics 5(3):309-332.

Sunderlin, William D. 1999. Between Danger and Opportunity: Indonesia and Forests in an Era of Economic Crisis and Political Change. Society & Natural Resources 12(6):559-570.

Sunderlin, William D. and Ida Aju Pradnja Resosudarmo. 1999. The Effect of Population and Migration on Forest Cover in Indonesia. Journal of Environment and Development 8(2):152-169.

Wunder, S. 2000. The economics of deforestation: the example of Ecuador. London, UK, MacMillan and St. Martin Press in association with St. Anthony's College. 262p.

Wunder, S. 2005. Macroeconomic change, competitiveness and timber production: a five-country comparison. World Development 33(1): 65-86

Wunder, S. 2004. Policy options for stabilising the forest frontier: a global perspective. *In:* Gerold, G., Fremerey, M, Guhardja, E. (eds.). Land use, nature conservation and the stability of rainforest margins in Southeast Asia. Berlin, Springer-Verlag. 3-25.