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Reducing Emissions from Deforestation in Developing Countries: Approaches to Stimulate Action

Submission by Environmental Defense[1] to the XXIV Session of the Subsidiary Body on Scientific and Technological Advice (SBSTA) of the UN Framework Convention on Climate Change (UNFCCC), 30 March 2006.

Summary. In 2005, a historic milestone was reached in Montreal when the UNFCCC Parties, at the initiative of Papua New Guinea and Costa Rica, launched a two-year process to decide how to address emissions from deforestation in developing nations. Deforestation is the largest greenhouse gas (GHG) emitting sector in the developing world, accounting for up to 20% of global emissions – an amount roughly comparable to the entire annual fossil fuel emissions of the United States. Yet the Kyoto Protocol fails to address these emissions. The UNFCCC's ultimate objective, stabilizing GHG concentrations at a level that will avert dangerous climate change, can only be achieved by addressing *all* major sources of GHG. Absent "urgent and strenuous" emissions cuts in the next 20 years, the world will almost certainly be committed to a temperature rise, by 2050, of between about 0.5º C and 2º C relative to today, with possible breakup of the Greenland ice sheet and sea level rise that could render many cities uninhabitable.[2]

Although the time window for action is narrowing, there are reasons for hope: most Annex I Parties have, as a first step, capped emissions under Kyoto; in the US, public support for mandatory emission caps is growing steadily; and under a new proposal, **"Compensated Reduction,"** developing countries that reduce deforestation could be compensated with tradable emission allowances.[3] The carbon market has great potential to provide incentives for forest protection and emission reductions on a large scale.

Previous efforts to address deforestation in the context of the Kyoto Protocol were focused on 'sinks' and were plagued by disagreements. The 2001 Marrakesh Accords established rules for crediting afforestation and reforestation projects in the Clean Development Mechanism; however, in light of concerns expressed about additionality, leakage and permanence issues associated with projects that

[1] Environmental Defense, formerly Environmental Defense Fund (EDF), is a non-profit, non-partisan NGO specializing in the development of scientifically sound, economically sensible environmental policy. On behalf of our 400,000 members, we have participated in the UNFCCC as an accredited observer since its inception. Environmental Defense was instrumental in the design of the highly successful 1990 U.S. Acid Rain Trading Program to cut sulfur dioxide emissions, a program that served as a partial template for the 1997 Kyoto Protocol and the 2005 European Union Emissions Trading System (EU-ETS). We are working to obtain emission caps in the US, including in California and the nine-state Regional Greenhouse Gas Initiative (RGGI). Our motto is "Finding the Ways that Work." For more information, see www.environmentaldefense.org/go/CR and www.fightglobalwarming.com, or contact Mr. Gustavo Silva-Chavez, gsilva-chavez@environmentaldefense.org.

[2] HJ Schnellnhuber *et al*. (eds.), *Avoiding Dangerous Climate Change*. Cambridge University Press 2006; V. Bellassen & B. Chameides, "High Water Blues: The Climate Science Behind Sea Level Rise and Its Policy Implications–2005 Update" (Environmental Defense 2005), online: www.environmentaldefense.org.

[3] P. Moutinho and S. Schwartzman (eds.), Tropical Deforestation and Climate Change (IPAM, Belém, Pará, Brazil & Environmental Defense, Washington, DC, 2005); M. Santilli et al., "Tropical Deforestation and The Kyoto Protocol," Climatic Change (2005) 71: 267–276, DOI: 10.1007/s10584-005-8074-6.

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reduce emissions by avoiding deforestation, the Accords prohibited crediting for such projects. The new approach of "Compensated Reduction," by focusing exclusively on actual *emissions* of greenhouse gases from deforestation at the *national level*, addresses the concerns that originally led to the exclusion of this issue at Marrakesh – and just in time.

Action is needed today – time is running out

- The world's forests are disappearing. Large-scale incentives are needed immediately to protect the last remaining forests.
- Compensated Reduction can make a significant difference in meeting Article 2 of the Convention by reducing the largest source of emissions from developing countries.
- If nations wish to limit warming to not more than 2.0-2.5 degrees above pre-industrial levels, it is vital to include emissions from deforestation.

Compensated Reduction – The proposal is simple

- Under Compensated Reduction, any nation that achieves ***measurable long-term reductions*** in its ***national rate of deforestation*** below a historical ***base period*** would receive compensation, in the form of ***tradable emissions allowances.***

Applying Compensated Reduction at national levels overcomes or addresses the primary barriers to crediting – leakage[4]*, additionality*[5]*, and permanence*[6]

By addressing deforestation at national levels, Compensated Reduction reduces "leakage"

- Compensated Reduction deals with intra-country leakage by moving away from the project-based approach, which is prone to high leakage.
- Under Compensated Reduction, inter-country leakage may still occur, but:
  - The more countries that adopt Compensated Reduction, the less the leakage.
  - Residual leakage can be addressed via market modeling and a discount rate.

Using Historical Base Periods addresses "additionality"

- Measuring reductions from a historical base period of deforestation avoids the need to calculate project-by-project "additionality."
- Deforestation in large remaining forests will continue at current rates or increase over the next century, until forests are exhausted, and could release as much as 87 - 130 Pg C[7]. Consequently, *any* reduction below recent rates will help reduce global emissions. Base periods will have to be negotiated, but need not be a technically complex process.
- Ideally, using a base period that is a 5-10 year average will account for annual variations.
- At a minimum, two historical data points can be sufficient to establish a base period.

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[4] In this context, "leakage" refers to the possibility that protecting forests in one place will simply shift deforestation to another place.

[5] In this context, "additionality" refers to the deforestation that likely would otherwise have occurred in the absence of a global program for addressing deforestation.

[6] In this context, "permanence" refers to the possibility that forest protection might not be permanent, i.e., that forests once protected could later be destroyed, resulting in carbon emissions.

[7] Houghton, RA. 2005. Tropical deforestation as a source of greenhouse gas emissions. In: Tropical Deforestation and Climate Change, supra.

How Compensated Reduction addresses Permanence

- Reductions in deforestation need to be proved over a period of years (e.g. 5 years) before allowances will be awarded.
- "Banking", i.e., holding a portion of earned emission allowances in reserve, can address permanence by acting as an insurance against carbon losses.

Compensated Reduction allows flexibility for different deforestation rates in countries

- Compensated Reduction can be applied to countries with current deforestation and a majority of forests still remaining.
- For countries that have low rates of deforestation, little forest cover left or increasing forest cover, Compensated Reduction can be adapted to country-specific circumstances.

Which path for compensation - market or fund?

- Dedicated funds can be important for building national capacity and infrastructure.
- The potential revenue from the market is much larger than the funding that would be available through conventional bilateral and multilateral development assistance.
- For a very conservative example, taking a weighted average of carbon market prices in 2004-2005 of $\$5.63/t/CO_2$[8]: if Brazil reduced its deforestation by 10% over five years, these reductions could earn $495 million per year, or $2.47 billion over five years.[9]
- A market has built-in incentives for short and long-term emission reductions.

Time is of the essence

- If Parties can reduce deforestation starting today, the COP can make any reductions earned between now and 2012 eligible for compensation post-2012.
- Awarding allowances for early action can promote immediate voluntary participation.
- By moving to a national-level approach, Compensated Reduction avoids project-by-project transaction costs, and can achieve reductions on a much larger scale.

Remote Sensing/Monitoring

- It can be done today with current technology.[10]
- A fund or a market can help pay for the remote sensing costs of creating a base period and monitoring reductions.

Where should Compensated Reduction be negotiated-the Kyoto Protocol or the Convention?

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[8] Weighted average for the period January 2004-April 2005 derived from International Emissions Trading Association, "State and Trends of the Carbon Market, 2005", Washington, DC, May 2005.

[9] Brazil's deforestation rate is 20,000 km² and a 10% reduction is equivalent to 2,000 km² annually. Carbon content is estimated to be 120tC/ha.

[10] The Workshop on Monitoring Tropical Deforestation for Compensated Reduction met in Jena, Germany on March 21-22, 2006 under the auspices of the Global Terrestrial Observing System's Global Observations of Forest Land Cover Dynamics (GOFC/GOLD). GOFC/GOLD formed the ad hoc working group to provide technical guidance on remote sensing capabilities for monitoring tropical deforestation in the context of UNFCCC discussions on reducing emissions from deforestation in developing countries. The workshop considered current capabilities for monitoring deforestation and forest degradation at global and national levels. **The major conclusion was that changes in forest area can be monitored from space with confidence. The remote sensing and forestry communities represented at the workshop are ready to provide guidelines and protocols for monitoring emissions from deforestation in developing countries.** The working group is preparing a report to assess technical capabilities for estimating emissions as input to the upcoming SBSTA meeting.

- Although this issue does need not be decided right now, discussions regarding GHG emissions from deforestation should continue under the UNFCCC. However, the option of eventually addressing GHG emissions from deforestation in the second commitment period of the Kyoto Protocol should not be excluded.
- Parties should focus on the issues that need to be resolved to create the mechanism, and establishing absolute mandatory caps post-2012, with a trading system that recognizes Compensated Reduction.

Co-benefits

- Reducing deforestation emissions can help preserve biodiversity, conserve land areas for indigenous people, and provide ecosystem benefits to local communities and the planet.

Effect of Compensated Reduction tons on the carbon market

- Compensated Reduction tons will not enter the market until 2013.
- Given the need for capacity-building, the reductions will likely be small at first and gradually increase over time.
- The scale of reductions needed to avert dangerous climate change means that incentives to encourage the maximum possible reductions should be offered.
- At the same time, experience indicates that reductions achieved will not necessarily be placed on the carbon market immediately. Sellers of reductions understand that it is in their best interest to maintain a supply and demand balance.
- Creating a pathway for bringing Compensated Reduction tons to the market provides leverage to seek steeper reductions from Annex I nations in the future.

The scientific case: why it is essential to create incentives for reducing GHG emissions from deforestation

The world is rapidly running out of time to avoid dangerous climate change. Only by acting immediately and including all major sources of GHG emissions can we maximize the probability of avoiding the most severe, irreversible changes. Reducing emissions from deforestation is absolutely critical, for four reasons. First, the chance of avoiding dangerous climate change improves if all major sources of GHG emissions are included. Second, there is a steep price for delay, so it is important to address deforestation emissions as soon as possible. Third, because deforestation rates are higher than previously appreciated, estimates of how steeply industrial emissions will need to be cut are likely to be too low. Finally, deforestation itself contributes to climate change, independent of GHG emissions. The best available scientific information makes it clear that we must reduce emissions from deforestation to maximize our chances of meeting the ultimate objective of the UNFCCC and avoiding dangerous climate change.

1) Reducing deforestation improves the chance of avoiding dangerous climate change.
Including deforestation in a GHG reduction framework decreases total emissions more quickly than if deforestation is allowed to continue at present rates (see Figure 1). As an example, we present two simple, illustrative scenarios: one in which deforestation continues along a business as usual path, and a second with a modest reduction of deforestation emissions. In the first scenario, we defined a business as usual deforestation trajectory based on Houghton's projection of 21st century deforestation.[11] We adjusted industrial emissions so that there was a 50% chance of global mean temperature rising no more than 2 °C above pre-industrial levels.[12] The second scenario used the same industrial emissions, but also included a reduction in deforestation that began in 2010 and, over the next four decades, reduced total emissions 20% compared to business as usual. As shown in Figure 1, total GHG emissions drop more quickly when both industrial and deforestation emissions are reduced. As a result, the chance of staying below a temperature target (and avoiding dangerous climate change) improves.

[11] Houghton, RA. 2005. Tropical deforestation as a source of greenhouse gas emissions. In: *Tropical Deforestation and Climate Change*. Moutinho, P. & Schwartzman, S. (eds). IPAM, Belém, Pará, Brazil & Environmental Defense, Washington, DC. Our trajectory is in the middle of Houghton's range of values: 2.1 GtC per year until 2020, with a total of 110 GtC released between 2000 and 2100.

[12] For these scenarios we used the MAGICC 4.1 model (Wigley & Raper, 2001; 2002; Wigley, 2003), which has been used in the IPCC Third Assessment Report (TAR) (IPCC, 2001) and in other studies. The model's default settings include a cooling effect from bioaerosols, which are scaled with deforestation. This is based on the TAR (IPCC, 2001). However, post-TAR estimates range from -0.06 to 0.22, with a mean of 0.06 W m^{-2}, suggesting that aerosols from biomass burning have a net warming effect (Iversen & Seland, 2002; Kirkevag & Iversen, 2002; Koch, 2001; Liu & Penner, 2002; Myhre *et al.*, 2003; Pitari *et al.*, 2002; Reddy & Boucher, 2004; Stier *et al.*, 2005; Takemura *et al.*, 2005). For the examples shown here, we set MAGICC's bioaerosol feedback to 0.06. For all other values, we used MAGICC's defaults, including a climate sensitivity range of 1.5 to 4.5 °C. We scaled CH_4, N_2O and SF_6 with fossil CO_2; all other GHG followed the SRES median scenario (P50 in MAGICC 4.1). We present results as CO_2 equivalents.

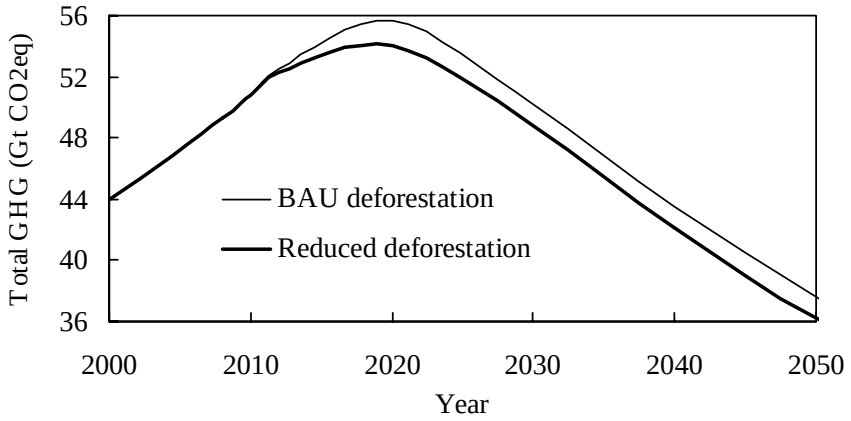

Figure 1. The thin line shows total GHG emissions if deforestation follows a business as usual (BAU) path and only fossil fuel emissions are reduced. This scenario has a 50% chance of keeping global mean temperature from rising more than 2 °C above pre-industrial levels. The thick line shows a scenario in which deforestation emissions are reduced 20% relative to BAU deforestation between 2010 and 2050.

2) Reducing deforestation can help offset the steep price of delay. Because GHGs persist in the atmosphere for decades to centuries, the later emission cuts are delayed, the harder it will be to avoid dangerous climate change. As Figure 2 illustrates, if global emissions begin to decline in 2020, emissions would have to decline by 1.5% per year starting not later than 2040 in order to have a 50% chance of avoiding 2 °C warming above pre-industrial levels. But if the peak is delayed by ten years – i.e., if total GHG emissions do not begin to decline until 2030 - then global emissions would have to decline more steeply to meet the same temperature target. Delaying the peak until 2030 means that global emissions would have to decline by 2.1% per year starting not later than 2050, and by 2.5% per year by 2060, to meet the same temperature target. These scenarios are two out of many possibilities, but the lesson is the same in all cases: the longer we wait to act and the fewer GHG sources we address, the more severe cuts need to be in order to stay "on target".

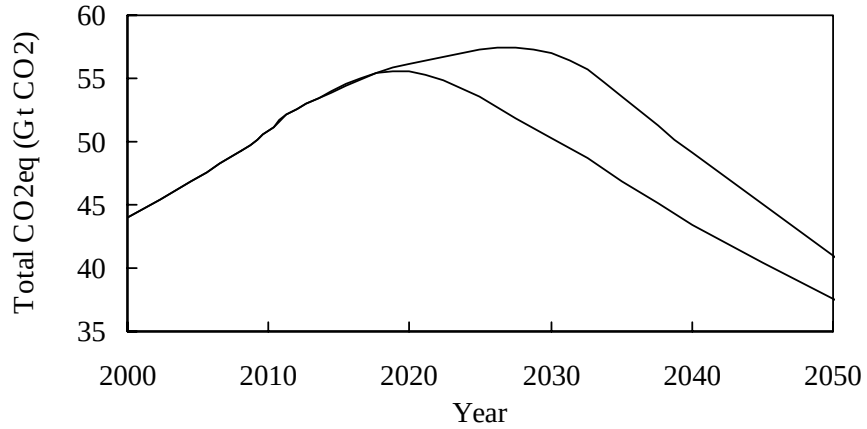

Figure 2. Emissions trajectories with a 50% chance of avoiding dangerous climate change. If global GHG emissions begin to decline in 2020, emissions would have to be reduced by 1.5% per year starting not later than 2040 to meet the target. If global emissions begin to decline in 2030, emissions must be reduced by more than 2.1% per year starting not later than 2050 to meet the same target.

It is important to note, however, that these reduction rates are for <u>just a 50% chance</u> of avoiding dangerous climate change—a probability that is hardly reassuring, given the risk involved. More aggressive action will be required in order to maximize the probability of avoiding catastrophic,

irreversible climate changes. Both the price and the risk of delay underscore the urgency of reducing all GHG emissions as quickly as possible.

3) *Reduced deforestation is assumed in many calculations of future emissions pathways*
Estimating current rates of deforestation (and projecting future trends) is a difficult and contentious exercise; reported values range from approximately 1 to 3 Gt C per year. However, the most up-to-date calculations of current and future deforestation rates are higher than previous estimates because many studies reporting rates at the lower end of the range ignored fires and/or used coarse-resolution satellite imagery that missed small-scale activity such as selective logging.[13] These most recent calculations also indicate that the SRES scenarios[14] underestimate deforestation (see Figure 3). The underestimation of deforestation is important because studies that use deforestation trajectories from SRES scenarios then underestimate the magnitude of reductions of industrial GHG that will be required to avoid dangerous climate change.[15] Thus it is imperative to create positive incentives for developing nations to begin reducing emissions from deforestation.

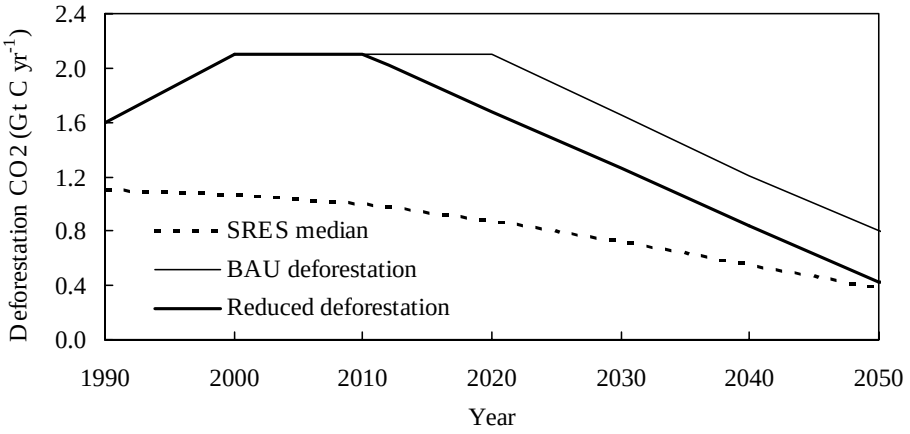

Figure 3. Projections of future deforestation emissions. The dashed line shows the SRES median, the thin solid line shows a business as usual (BAU) projection based on Houghton (2005) and the thick solid line shows deforestation that is reduced beginning in 2010. The BAU and reduced deforestation trajectories shown here are the ones included in the total emissions trajectories of Figure 1.

4) Tropical deforestation, warming and drought can interact to cause runaway climate change
Tropical forests transfer tremendous amounts of water from the soil to the atmosphere. As the water evaporates, it cools the air and adds moisture that later falls as rain. As a result, deforestation alters the climate and hydrology of a region, most often leading to warmer, drier conditions.[16] This change can in turn lead to drought stress and decline of the remaining forest, reinforcing the warming trend. Combined with the large emissions of GHG, this phenomenon makes deforestation a key player in climate change.

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[13] Houghton, 2005; Lewis *et al*. 2006. Tropical forests and atmospheric carbon dioxide: current conditions and future scenarios. In: *Avoiding Dangerous Climate Change.* Schnellnhuber, HJ, *et al*. (eds). Cambridge University Press 2006.

[14] Nakicenovic *et al*. 2000. IPCC Special Report on Emission Scenarios.

[15] See for example den Elzen & Meinshausen. 2006. Multi-gas emission pathways for meeting the EU 2°C climate target. In: *Avoiding Dangerous Climate Change.* Schnellnhuber, HJ, *et al*. (eds). Cambridge University Press. They note that "if land use CO_2 emissions do not decrease as rapidly as assumed here, but continue at presently high levels, an additional reduction of Kyoto-gas emissions (excl. land use CO_2) by around 10% are required up to 2050."

[16] Laurance & Williamson. 2001. *Conservation Biology* 15(6): 1529-1535; Stocker *et al*. 2001. Chapter 7 in IPCC TAR; Zhang *et al*. 2001. *Climatic Change* 49 (3): 309-338; Betts, *et al*. 2004. *Theoretical and Applied Climatology* 78: 157-175.

Of course, warming (and, in many areas, drought) also occur because of the greenhouse effect and global climate change. One modeling study has suggested that with enough global warming, drought will become so severe in the Amazon that there will be massive forest dieback and release of carbon to the atmosphere—so much, in fact, that it would be impossible to reduce industrial emissions enough to counter the GHG emitted from vegetation and soils.[17]

These scenarios of forest decline depend, however, on the assumption that emissions follow a business as usual path. Including deforestation in a GHG reduction framework not only minimizes the direct effect of deforestation on climate, but also plays an important role in pulling emissions down below a business as usual trajectory, thus decreasing the probability that climate change will trigger drought and tropical forest dieback in the Amazon, along with the tremendous negative socio-economic consequences that would accompany such a change.

Conclusion

The effects of climate change are already evident: more extreme storms, more intense heat waves and droughts, melting ice and rising sea levels. The best available scientific information indicates that there are temperature thresholds for additional effects of climate change (see Table 1). Every day that action is delayed—not only for industrial emissions but also for deforestation—the climate system creeps closer and closer to these thresholds. To slow warming and maximize our chances of avoiding dangerous climate change, we must reduce emissions from deforestation.

[17] Cox *et al.* 2000. *Nature* 408:184-187. Cox *et al*. 2004. *Theoretical and Applied Climatology* 78: 137-156. Their model shows that under a business as usual scenario, carbon loss from terrestrial vegetation and soils could be as high as 4 Gt C per year by the end of the 21st century.

Table 1. Synthesis of published sources: Estimated temperature thresholds for irreversible, dangerous climate changes (in degrees Celsius above pre-industrial levels).

Threshold (°C)	Effect
≤ 2	Regional declines in food production[18] Severe damage to Arctic and alpine ecosystems, leading to the decline and possible extinction of some Arctic and alpine species[19] Widespread death of coral reefs[20]
1.7 – 2.7	Irreversible disintegration of the Greenland ice sheet (with prolonged exceedance of threshold), leading to sea level rise of up to 7 meters and submergence of heavily populated coastal areas[21]
2 – 3.5	Collapse of thermohaline circulation ("the ocean conveyor belt")[22]
2.5	Complete disappearance of Arctic summer sea ice, leading to the collapse of traditional hunting societies, extinction of polar bears, and accelerated warming due to reduced planetary reflectivity[23]
2.7 – 3.7	Irreversible disintegration of the West Antarctic ice sheet, leading to an additional sea level rise of about 5 meters[24]
3	Massive dieback of Amazon rainforest[25]

[18] Heij, B. 2005. *Limits to warming: In search of targets for global climate change*. Netherlands Environmental Assessment Agency, Bilthoven.

[19] Heij, 2005; ACIA, 2004. *Impacts of a Warming Arctic: Arctic Climate Impact Assessment*. Cambridge University Press.

[20] O'Neill & Oppenheimer. 2002. *Science* 296: 1971-1972.

[21] Gregory *et al*. 2004. *Nature* 428: 616; Heij, 2005.

[22] O'Neill & Oppenheimer, 2002.

[23] ACIA, 2004; Johannessen *et al*. 2004. *Tellus A* 56: 328-341; Lindsay & Zhang. 2005. *Journal of Climate* 18 (22): 4879-4894.

[24] Oppenheimer. 1998. *Nature* 393: 325-332; O'Neill & Oppenheimer, 2002.

[25] Cox, *et al*. 2000. *Nature* 408: 184-187.

Appendix 1:

Deforestation in developing countries: definitions and main drivers

One of the first steps to reducing emissions from deforestation is to clearly and unambiguously define the terms that are needed to develop methodological issues, and implement policies and positive incentives. These include defining a forest and when deforestation occurs, including forest degradation and selective logging, as well as understanding the primary and secondary drivers that are causing deforestation. SBSTA should use existing definitions for carbon crediting purposes and refine them as needed.

What is a forest?
A clear definition of a forest is needed for crediting reductions in deforestation. Forests play a critical function in the global carbon cycle and in the Earth's climate. Forest plants and soils drive the global carbon cycle by sequestering carbon dioxide through photosynthesis and releasing it back into the atmosphere through respiration. Although net carbon uptake eventually declines as trees age, they remain major stores of carbon and often continue to sequester further carbon in their soils. Clarification of which forests types to include within the delineated area needs to be explicitly addressed, e.g. whether a monitoring system should extend over only humid tropical forests or should include dry tropical forests. L.2 is silent on this issue and SBSTA should make a recommendation to determine which types of forests would be eligible. We believe that deforestation in both humid and dry forests – in fact, in all forests in developing nations - should be included.

The Marrakech Accords define a forest as "a minimum area of land of 0.05-1.0 hectares with tree crown cover (or equivalent stocking level) of more than 10-30 per cent with trees with the potential to reach a minimum height of 2-5 meters at maturity *in situ*. A forest may consist either of closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground or open forest. Young natural stands and all plantations which have yet to reach a crown density of 10-30 per cent or tree height of 2-5 meters are included under forest, as are areas normally forming part of the forest area which are temporarily unstocked as a result of human intervention such as harvesting or natural causes but which are expected to revert to forest".

What is deforestation?
Deforestation generates carbon emissions through the degradation, decay and burning of wood, debris, and organic soil matter. When deforestation is the result of commercial logging, approximately one-third of sequestered carbon is released into the atmosphere within five years, one-third of carbon is stored in the resulting wood products (which in turn lose about 2% per year to decay), and one-third of the carbon is initially retained on the site. Emissions are more rapid when caused by land-use activities that involve clear-cutting, for example agriculture or road building.

A clear and unambiguous definition of deforestation is central to understanding what the problem is and how to address it. In addition, an effective monitoring program for carbon allowances requires a very clear and simple definition of what constitutes deforestation. The Intergovernmental Panel on Climate Change report on Land Use, Land Use Change, and Forestry[26] includes multiple definitions. The

[26] Land Use, Land-Use Change and Forestry. 2000. Special Report of the Intergovernmental Panel on Climate Change Robert T. Watson, Ian R. Noble, Bert Bolin, N. H. Ravindranath, David J. Verardo and David J. Dokken (Eds.) Cambridge University Press, UK. pp 375
Available from Cambridge University Press, The Edinburgh Building Shaftesbury Road, Cambridge CB2 2RU ENGLAND

Marrakech Accords define deforestation as the "direct human-induced conversion of forested land to non-forested land". The most straightforward definition is the "permanent removal of forest cover," typically seen in complete (clear-cut) land clearing. Removal of forest cover results from a variety of processes. Some processes, such as hurricanes, floods, and some fires are not human-induced and are outside the realm of the definition of deforestation for the purpose of carbon allowances, and for this submission. Human-caused forest disturbances include selective logging, clear-cut logging, clearing for shifting cultivation, and removal of forest for agricultural expansion, urban growth, or other human uses. A monitoring system also needs to specify the minimum clearing size to be identified. The minimum size depends on the types of forest disturbances included and the feasibility of accurate detection by available satellite sensors.

Deforestation versus forest degradation

In addition to complete deforestation, other types of land changes generate large amounts of greenhouse gas emissions, but can be more subtle and harder to detect. Nevertheless, the emissions from these partial deforestation processes are significant and need to be taken into consideration by SBSTA. Some of the activities that are not full deforestation but fall in the category of partial deforestation or forest degradation include:

- Sub-canopy fires
- Selective logging

Selective logging is not often a "permanent removal" of forest cover, unless the damage is excessive (e.g., via high-grading or multiple-entry harvesting; references). Determining the threshold at which selective logging is a problem and falls into the category of deforestation, as defined here, is one issue that SBSTA should examine. Clearing for small-scale shifting cultivation is part of a dynamic clearing-planting-fallow cycle that can easily be mistaken for new deforestation in a monitoring system if shifting cultivation areas are not excluded from the analysis. A carbon credit system needs to clearly define the types of forest disturbances included in a monitoring system.

Drivers of deforestation

Deforestation has a variety of primary and secondary drivers, and these vary widely across geographic regions. In some countries, there is a clear primary driver. In Bolivia for example, the main driver is soybean production. In Brazil, a combination of anthropogenic activities including cattle ranching, agriculture, including soybean production, highway expansion, illegal occupation of public land, logging, forest fires and plantation establishment are the main drivers. In African countries like Ghana, and in Southeast Asia, logging is the main deforestation driver.

Estimates of carbon emissions from deforestation

Deforestation, including both the permanent conversion of forests to croplands and pastures and the temporary or partial removal of forest for shifting cultivation and selective logging, is estimated to have released on the order of 1-2 PgC/yr (15-35% of annual fossil fuel emissions) during the 1990s. The magnitude of emissions depends on the rates of deforestation, the biomass of the forests deforested and other reductions in biomass that result from forest use. If, in addition to carbon dioxide, emissions of methane, nitrous oxide, and other chemically reactive gases that are released by deforestation and subsequent land use changes, annual emissions during the 1990s accounted for about 25% of the total anthropogenic emissions of greenhouse gases. Trends in the rates of deforestation are difficult to predict, but at present rates, another 85 to 130 PgC will be released over the next century, with decreases in emissions occurring only as the tropics vanish.

Monitoring deforestation through the use of remote sensing

Changes in forest area can be monitored from space with confidence

One of the key questions for SBSTA to examine is how to detect deforestation in the first place, and how to monitor declining deforestation rates in order to reward or compensate those countries that can demonstrate real and measurable reductions in their emissions from deforestation. Although there have been many concerns about how to establish initial historical deforestation base periods, and then conduct frequent and accurate annual monitoring, the fact is that in the Amazon region deforestation has been measured by remote sensing for three decades. The Carnegie Institution held a remote sensing workshop in July 2005 and our recommendations to SBSTA are based on the main findings and recommendations by some of the leading remote sensing experts, as well as recent developments in the remote sensing community.[27] The most recent remote sensing findings indicate that:

- Satellite data from a combination of sensors can effectively identify deforestation. However, current limitations in the availability, cost, and acquisition strategies for high resolution data from Landsat, IRS, ASTER, and other sensors must be resolved to enable routine monitoring of forests in developing nations.
- A variety of methods have been developed to effectively monitor and verify deforestation. The appropriate method varies with the type of forest and disturbance; *no single method is most appropriate for all situations*. Consensus among technical experts on best practices and acceptable methodologies is needed to develop standardized systems for monitoring deforestation for Compensated Reduction.
- A workable system for monitoring deforestation for Compensated Reduction depends on clear definitions of initial forest extent, types of forest disturbance, and minimum clearing size to be monitored.
- Satellite data from a combination of sensors can effectively identify deforestation. However, current limitations in the availability, cost, and acquisition strategies for high resolution data from Landsat, IRS, ASTER, and other sensors must be resolved to enable routine monitoring of forests.
- Developing institutional capabilities for monitoring deforestation calls for a coordinated effort that: (1) brings cutting-edge satellite monitoring technology from the North to countries; (2) provides a conduit for validation studies on a timely basis; (3) develops regional capabilities within developing countries for data acquisition and analysis, and (4) allows for dissemination of results by both outside and host country stakeholders.
- Routine monitoring of forests depends largely on access to data from high resolution sensors such as Landsat, ASTER, and IRS. The historical database is adequate to develop baselines of deforestation in the 1990s. However, current limitations in availability, cost, and acquisition strategies must be resolved to monitoring deforestation in the current and future decades.
- With current data processing and storage capabilities, effective methods are available to monitor deforestation with largely-automated techniques. No single method is appropriate in all situations. Technical agreement on best practices and appropriate methods in varying forest types and land use practices is needed to harmonize approaches. Agreement on specific definitions of forest disturbances and extent to be considered for Compensated Reduction is also needed.
- A critical need is to develop national and regional technical capabilities within developing countries for acquiring and analyzing satellite data to monitor deforestation. Currently,

[27] DeFries, R., Asner, G., Achard, F., Justice, C., Laporte, N., Price, K., Small, C., and Townsend, J. 2005. Monitoring tropical deforestation for emerging carbon markets. Tropical deforestation and climate change. Moutinho, P., and Schwartzman, S. (eds.). Instituto de Pesquisa Ambiental da Amazônia; Washington DC-USA: Environmental Defense, 2005.

capabilities and institutions exist in only a few developing countries and in research facilities and academic institutions in the US and Europe.

- Changes in forest area can be monitored from space with confidence.
- The remote sensing and forestry communities are ready to provide guidelines and protocols for monitoring emissions from deforestation in developing countries.
- The working group (GOFC) is preparing a report to assess technical capabilities for estimating emissions as input to the upcoming SBSTA meeting.

Methodological Issues to Consider

Historical base periods

Base periods should be designed in accordance with different regional dynamics of deforestation in the tropics. In the Amazon with ~80% of original forest cover, and high current deforestation rates, a baseline of the average annual deforestation in the 1980s since 1990 is the year of reference for the Kyoto targets) would be adequate. Any historical average since the 1970s over a sufficient time period to compensate for anomalous yearly highs and lows would be adequate, provided that the baseline refers to a period prior to adopting Compensated Reduction, so that no incentive to increase deforestation in order to get credit for reductions is created. The specific period (1980s, 1990s, 1995–2005) will determine how much deforestation must be reduced in order to obtain credit, and so will necessarily be a political negotiation. Developing countries with substantial forests, but relatively little deforestation to date (e.g., Peru, Bolivia) might be allowed base periods higher than their recent deforestation rates (along the lines of Australia's "growth cap") as an inducement to participate and avoid future increases.

For heavily logged regions such as Kalimantan, Sumatra and Sulawesi, for example, where 70–80% of lowland dipterocarp forest cover has been removed in logged areas and conversion to oil palm plantations is underway, a base period could be expressed in terms of existing carbon stocks at some point in the past, with crediting for any increase in total carbon stocks between 2008–2012, making reforestation or re-growth an alternative to oil palm plantations. Specific base period or mechanisms could be designed to take advantage of particular opportunities. Preventing fires in peat forests is an example. Burning peat forests released between 0.81 to 2.57 Pg of carbon, and vast amounts of sulfur oxides into the atmosphere in 1997.[28] [29] Peat swamps are low value lands unsuitable for agriculture that sequester enormous quantities of carbon, and peat fires are easily located and monitored via satellite. The principle in all cases is to set base periods in terms of historic deforestation or destruction of carbon stocks and create incentives for progressive reductions, or avoiding future increases. As a motivation for countries to continue reducing their deforestation rates, the historic base period might be revised downwards in 20 years, a plausible time period for a nation such as Brazil to re-order its land use practices.

Additionality[30]

The most recent and thorough deforestation studies offer no suggestion that deforestation is decreasing, either of its own accord or in consequence of policy interventions; to the contrary, increasing global integration of markets, demand for agricultural commodities, road building and other factors identified

[28] Page, S.E., Siegert, F., Rieley, J.O., Boehm Hans Dieter, V., Jaya, A., and Limin, S.: 2002, 'The amount of carbon released from peat and forest fires in Indonesia during 1997', Nature 420, 61-65.

[29] Houghton, J. T., Ding, Y., Griggs, D. J., Noguer, M., van der Linden, P.J., Dai X., Maskell, K., and Johnson, C.A. (eds.): 2001, Climate Change 2001: The Scientific basis: Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), Cambridge University Press, Cambridge, UK, 944 pp.

[30] In this context, "additionality" refers to the deforestation that likely would otherwise have occurred in the absence of a global program for addressing deforestation.

under the "drivers of deforestation section", indicate that in many nations deforestation rates are substantially increasing, even though in the long run deforestation rates will eventually decline as forests disappear.[31] [32] [33] Deforestation in all major developing country forest regions can certainly be expected to continue for the 20 years following 2008, after which time Compensated Reduction baselines could be adjusted, and global time horizons for forest carbon crediting based on total forest carbon stocks should be calculated.

Leakage

Calculating reductions against a national baseline and a monitoring system for deforestation addresses the problem of leakage that has vexed the CDM. Deforestation does not "leak" into the energy or transport sectors, and if reductions in one region are equaled or exceeded by increases in another, this will be apparent in comparing national rates over time. Deforestation can be measured at the beginning and end of a commitment period just as can national emissions for Annex I countries. International "market leakage" for timber exports, where a participating country ceases to export timber to get carbon investments, and a non-participating country increases its exports correspondingly, can be calculated. If needed, discount factors can be applied to account for leakage.

International market leakage is potentially a much bigger issue under current Kyoto Protocol rules – forest sinks, and activities that increase carbon stocks in Annex I countries are credited, but developing country forest destruction is not debited[34]. An Annex I country could in principle cease timber harvests altogether at home and replace them with imports and still receive credit under Article 3.3 of the Kyoto Protocol. Enlisting any developing countries to Compensated Reduction programs would, by creating a framework for engaging developing countries in emissions controls, begin to address this problem. Leakage of deforestation from one country to another could in principle occur if only one or a few countries elect to participate in Compensated Reduction. The same risk, however, obtains for all sectors as long as only some countries have emissions caps – multinational corporations might for example reduce emissions in Kyoto countries and invest in high-emissions operations in non-Kyoto countries. While remote sensing monitoring of deforestation rates could be used to mitigate international leakage, ultimately only drawing more major emitters into an international reductions regime will solve the problem.

Permanence

Permanence of reductions is an issue for countries and all sectors that participate in emission reductions. For Compensated Reduction, the security of emission reductions could be enhanced by a system of "banking" allowances: allowances could be issued for a portion of the reductions achieved in a 5-year period, and would then be tradable in the following period, while the remainder could be banked for use in future commitment periods (unlike CERs, which are only valid for the first commitment period under the Marrakech Accords).

Assessment of Needs

[31] PRODES Digital (INPE 2004); http://www.obt.inpe.br/prodes/index.html.
[32] DeFries, R. S., Houghton, R.A., Hansen, M. C., Field, C. B., Skole, D., and Townshend, J.: 2002, 'Carbon emissions from tropical deforestation and regrowth based on satellite observations for the 1980s and 1990s', PNAS 99, 14256-14261.
[33] Curran, L. M., Trigg, S. N., McDonald, A. K., Astiani, D., Hardiono, Y. M., Siregar, P., Caniago, I., and Kasischke, I.: 2004, 'Lowland forest loss in protected areas in Indonesian Boreno', Science 303, 1000-1003.
[34] Niesten, E., Frumhoff, P. C., Manion, M., and Hardner, J.J.: 2002, 'Designing a carbon market that protects forests in developing countries, philosophical transactions of the Royal Society', Math., Phys. Eng. Sci. 360, 1875-1888.

Nations implementing Compensated Reduction could reduce deforestation through adequate funding of programs designed to enforce environmental legislation, support for economic alternatives to extensive forest clearing (including carbon crediting), and building institutional capacity in remote forest regions, as recently suggested in part of the Brazilian Amazon.[35] [36] [37]Moreover, substantial forest can be saved in protected areas if adequate funding is available.[38] [39] [40] More developing countries will be likely to use these mechanisms if they have access to the financial resources necessary to pay for them. Countries that want advance financing for deforestation reduction could make agreements with bilateral or multilateral financial institutions, or attract private sector investments for this purpose. Public financing should not, however, be diverted from existing development assistance, as agreed in the Marrakech Accords. Countries might also issue discounted carbon bonds, redeemable in 2012, but conditioned on verification and certification of reductions. Compensated Reduction differs from previous forest protection programs and agreements in that it promises to give governments, forest communities, and private landowners access to a market for forest ecosystem services, creating the economic value for standing forest long understood as essential for large scale forest conservation.[41] [42]

- Financial resources (up-front financing) and capacity building requirements are needed for:
  - Pilot countries
  - Establishing national programs on deforestation monitoring
  - Constructing appropriate initial base periods
  - Assessing the potential quantity of emissions reductions
  - Implementation of national policies
  - Analyzing ownership issues of carbon allowances generated from avoided deforestation

Legal Framework for Compensated Reduction

In establishing a legal framework for Compensated Reduction, Parties should start from the premise that they will not re-negotiate the 2008-2012 commitments of the Kyoto Protocol or the Marrakesh Accords. Consequently, legal options that entail either of these will not be considered here. Two possibilities for structuring compensation are:

(1) compensation by industrialized nations under a development assistance model; and
(2) compensation via access to the global carbon market.

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[35] FEMA.: 2001, Fundação Estadual de Meio Ambiente, Governo do Estado de Mato Grosso, Sistema de Controle Ambiental em Propriedades Rurais de Matto Grosso.
[36] Nepstad, D. C., McGrath, D., Alencar, A., Barros, A. C., Carvalho, G., Santilli, M., and del Diaz, M. C. V.: 2002, 'Frontier governance in Amazonia', Science 295, 629-631.
[37] Fearnside, P. M.: 2003, 'Deforestation control in Matto Grosso: A new model for slowing the loss of Brazil's Amazon Forest', AMBIO 32, 343-345.
[38] Bruner, A. G., Gullison, R. E., Rice, R. E., and da Fonseca, G. A. B.: 2001, 'Effectiveness of parks in protecting tropical biodiversity', Science 288, 1763-1764.
[39] Pimm, S. L., Ayres, M., Balmford, A., Branch, G., Brandon, K., Brooks, T., Bustamante, R., Costanza, R., Cowling, R., Curran, L., L. M., Dobson, A., Farber, S., da Fonseca, G. A. B., Gascon, C., Kitching, R., McNeely, J., Lovejoy, T., Mittermeier, R. A., Myers, N., Patz, J. A., Raffle, B., Rapport, D., Raven, P., Roberts, C., Rodriguez, J. P., Rylands, A. B., Tucker, C., Safina, C., Samper, C., Stiassny, M. L. J., Supriatna, J., Wall, D. H., and Wilcove, D.: 2001, 'Can we defy nature's end?', Science 293, 2207-2208.
[40] Nepstad et. al. In Press.
[41] Kremen, C., Niles, J. O., Dalton,M. G., Daily, G.C., Ehrlich, P. R., Fay, J. P., Grewal, D., and Guillery, R. P.: 2000, 'Economic Incentives for rain forest conservation across scales', Science 288, 1828-1832.
[42] Bonnie, R., Schwartzman, S., Oppenheimer, M., and Bloomfield, J.: 2000, 'Counting the cost of deforestation', Science 288, 1763-1764.

A range of studies indicates that while traditional foreign aid/development assistance may be useful in helping build capacity and institutions for Compensated Reduction, the amount of funds that realistically could be made available through aid/assistance channels is minuscule compared with the carbon market.[43] Consequently, the legal options identified here including A) the Stand-Alone option; B) Placing Compensated Reduction in subsequent commitment periods post-Kyoto and C) Early Action Agreement, will focus on the market channel. Environmental Defense recommends the third option, Early Action Agreement (EAA).

Legal options for opening the carbon market to Compensated Reduction

Option A-Place Compensated Reduction in a "Stand-Alone" Agreement. One option for nations seeking carbon market access as compensation for reducing emissions from deforestation could be to seek a stand-alone agreement, in the form of a protocol to the UNFCCC; an agreement in a different United Nations venue, e.g. the UN Forum on Forests (UNFF); or entirely outside the UN system.

Such an approach could, in principle, proceed on a clean slate, unencumbered by existing legal frameworks and institutions. Nations that wished to participate in such a negotiation could proceed on their own timetable. The agreement, by its terms, could enter into force with as many or as few parties as the negotiating nations wish. The agreement could offer substantial flexibility as concerns the nature of compensation. And nations that have chosen not to join Kyoto would be free to participate.

A disadvantage is that a stand-alone agreement done outside the framework of either the UNFCCC or the Kyoto Protocol could not guarantee its members access to the global carbon market. That is because it is the presence of mandatory emission caps on at least some nations that creates the scarce commodity of GHG emission allowances; without mandatory emission caps, the "currency" that a standalone agreement might award would not have value because it would not be "creditable" against emission reduction obligations of nations participating in the carbon market. Were such a stand-alone agreement done in the form of a protocol to the UNFCCC, it would only apply to the subset of nations that decided to adopt it, again raising hurdles to the fungibility of any carbon crediting such a agreement might seek to award.

Option B-Place Compensated Reduction in subsequent commitment periods post-Kyoto. A second option would be for nations to include Compensated Reduction in a post-Kyoto framework. At Montreal, the Kyoto Protocol Parties adopted a decision creating an ad hoc working group to commence negotiations on a second commitment period "in time to ensure that there is no gap between the first and second commitment periods."[44] The SBSTA could simply recommend to the Kyoto Protocol Parties directly or through Kyoto's parent agreement, the UNFCCC, that the Kyoto Protocol Parties incorporate Compensated Reduction into whatever framework of for a second commitment period they agree.

A major objection to this approach is that many developing nations want to create pathways that encourage the United States to join them in participating in international carbon markets. Proceeding solely under Kyoto would, at least in the near term, perpetuate the isolation of the US, and leave out one of the biggest potential demandeurs of rainforest tons. Nations at Montreal brought the deforestation issue up in the UNFCCC COP rather than the Kyoto Protocol MOP precisely in order to reach out to the United States. Placing Compensated Reduction in the negotiations on a second commitment period

[43] See Moutinho & Schwartzman, supra n. 1, collecting studies.

[44] Conference of the Parties Serving As the Meeting of the Parties to the Kyoto Protocol, Decision -/CMP.1 Consideration of commitments for subsequent periods for Parties included in Annex I to the Convention under Article 3, paragraph 9, of the Kyoto Protocol (December 11, 2005).

under Kyoto could serve as a fall-back option in the event other options are unsuccessful; however, it is, for the preceding reasons, not a first choice.

Option C-Early Action Agreement. Place Compensated Reduction in a UNFCCC COP decision recognizing that early reductions earned prior to 2012, as well as those earned after 2012, will be rewarded with carbon market access, without prejudice to whether that market arises under the UNFCCC or Kyoto.[45]

The UNFCCC COP could adopt a decision, as early as COP-12 or COP-13, committing that any developing nation that, starting in 2006, reduces its deforestation rate below an agreed multi-year historical base period, will be compensated with tradable allowances that will be cognizable in the international carbon market starting in 2013.
The decision could outline, to the maximum extent possible, such crucial elements as structure of multi-year base periods, minimum requirements for measurement and monitoring, and insurance reserves, but it need not specify these in detail at this juncture. What is urgent is to provide, as soon as possible, a clear signal to developing countries and the international market with that the COP will compensate reductions in deforestation by providing guaranteed carbon market access; and that it will establish a process, with definite timelines, for reaching agreement on outstanding issues.

That the UNFCCC COP has legal competence to issue such a decision is clear. The UNFCCC COP is the Supreme Body of the Convention.[46] The Convention gives the COP the power to adopt, and to make, within its mandate, the decisions necessary to promote the effective implementation of the Convention.[47] The Convention therefore gives the COP full power to make decisions about the future legal regime it will establish.

Advantages. By providing that reductions in deforestation achieved before 2012 would be creditable post-2012, this option does not require amendment of either the Kyoto Protocol or the Marrakesh Accords as they stand for the 2008-2012 time frame. By creating incentives for actions pre-2012, but reserving crediting until post-2012, it avoids any objection about attempts to renegotiate Kyoto. It does not demand that existing institutions divert their attention from their existing mandates in order to undertake this new work.

An early COP decision guaranteeing market access would provide a strong legal foundation. Legal precedent exists, as a similar approach was used under the UNFCCC to move the Marrakesh Accords prior to Kyoto's entry into force, including providing early recognition of CDM credits earned starting in 2000.[48]

Such a decision would provide a powerful signal for nations and investors about a crucial element of the future carbon market. It could help open linkages to the US and any domestic markets that the US, at national or sub-national levels, might subsequently develop. The prospect of this greater market integration, in turn, might help facilitate agreement on the launch of such national and sub-national programs.

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[45] See Appendix 2 for a possible draft decision by the COP
[46] UNFCCC Article 7, para. 2.

[47] Ibid.

[48] See Marrakesh Accords.

Disadvantages. This approach cannot provide complete market certainty, as it leaves many issues open and could be revised by the COP in the future.

Nonetheless, on balance, the advantages of Guaranteed Carbon Market Access appear to outweigh its disadvantages relative to the other options considered, and to provide a clear path forward for Compensated Reduction to incent large-scale forest protection as soon as possible.[49] The science is overwhelming: early reductions are urgently needed if the world is to avert dangerous climate change. Large-scale reductions in deforestation could play a crucial role in keeping pathways open for the future.

[49] In addition, this approach could provide a "template" or model by which other developing nations, including those that do not have significant deforestation, could participate in the carbon market more broadly. That is, nations that decide to try, during the years 2005-2012, to reduce their overall greenhouse gas emissions, could receive an initial endowment of "environmental capital" in the form of assigned amount units (AAUs) established at or above their business-as-usual emissions trajectory, based on reasonable macroeconomic analysis of expected emissions. These nations could use their environmental capital endowments (ECEs) to finance investments in cleaner development, without the need for project-by-project demonstrations of additionality and leakage. When such investments reduce emissions below business-as-usual, they render a larger surplus of AAUs, forming more environmental capital. See, e.g., D. Dudek, J. Goffman, "Emissions Budgets: Building an Effective International Greenhouse Gas Control System", Environmental Defense Fund, New York, New York, February 1997; D. Dudek et al., "Cooperative Mechanisms under the Kyoto Protocol: The Path Forward", Environmental Defense Fund, New York, New York, June 1998. If the world's largest emitters remain outside the market, it may soon become impossible to meet the Convention's Article 2 objective. See M. Oppenheimer and A. Petsonk, "Reinvigorating the Kyoto System, and Beyond: Maintaining the Fundamental Architecture, Meeting Long-Term Goals," G20 Leaders and Climate Change (Council On Foreign Relations, September 2004).

APPENDIX 2: DRAFT DECISION: COMPENSATED REDUCTION

The Conference of the Parties to the UN Framework Convention on Climate Change,

Recalling the objective of the Framework Convention on Climate Change;

Noting the urgency of providing compensation to developing nations that reduce emissions from deforestation;

Aware that market certainty can provide a powerful signal for nations and investors to help build capacity in measuring and monitoring deforestation and to help develop the incentives and institutional infrastructure for reducing deforestation;

Taking into account the recommendations of the Subsidiary Body on Scientific and Technological Advice and the results of the international workshop held in 2006;

Decides that any developing nation that, starting in 2005, reduces its national rate of deforestation below an agreed multi-year historical base period, will be compensated by the issuance of emission allowances, and that such allowances shall be tradable in any post-2012 market under the UNFCCC and any protocol or amendment thereto.