THE

CLEAN DEVELOPMENT MECHANISM

DIALOGUE PAPERS

THE ELIGIBILITY OF LAND USE, LAND-USE CHANGE AND FORESTRY PROJECTS UNDER THE CLEAN DEVELOPMENT MECHANISM

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September, 2000

BRIDGING THE GAP

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Acknowledgments

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The Clean Development Mechanism (CDM) Dialogue Papers

The *CDM Dialogue Papers* are intended to help advance the design process for the Clean Development Mechanism. The concepts developed and opinions expressed in these papers are those of the Center for Clean Air Policy (CCAP) or the Foundation for International Environmental Law and Development (FIELD), although these views have been informed by extensive interactions with participants in the "CDM Dialogue." Since May 2000, CCAP, in partnership with FIELD, has facilitated three meetings of the dialogue, which brings together a group of high-level climate negotiators from European Union, Umbrella Group and G-77 countries. The process gives participants a chance to informally discuss different approaches to the design of the CDM in a relaxed, off-the-record, non-negotiating setting. Financial contributions for these meetings were provided by the European Commission Directorate-General for Environment, the Canadian Department of Foreign Affairs and International Trade, the United Kingdom Foreign and Commonwealth Office, the Danish Ministry of Environment and Energy, the United States Environmental Protection Agency, the Netherlands Ministry of Housing, Spatial Planning and the Environment, the Australian International Greenhouse Partnerships Office, and the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety.

The *CDM Dialogue Papers* do not reflect consensus recommendations of the participants; rather, they are an attempt to harvest the thoughts and discussions that have been part of the process.

The papers in this series include:

- *Developing Terms of Reference for the CDM Executive Board and Operational Entities* (CCAP)
- *Implementing the Additionality Requirement & Ensuring the Stringency of Project Baselines under the CDM* (CCAP)
- *The Eligibility of Land Use, Land-Use Change and Forestry Projects under the CDM* (CCAP)
- *Sharing the Benefits: Mechanisms to Ensure the Capture of Clean Development Mechanism Project Surpluses* (CCAP)
- *Ensuring CDM Project Compatibility with Sustainable Development Goals* (CCAP)
- *Defining and Distributing the "Share of the Proceeds" under the CDM* (FIELD)

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Since its inception in 1985, the Center for Clean Air Policy has developed a strong record of designing and promoting market-based solutions to environmental problems in the areas of climate change, air quality regulation, electricity restructuring, and transportation policy. CCAP's analytical work and dialogue on acid rain in the 1980s identified many of the elements of the emissions trading program for SO_2 in the US. CCAP has also played an active role in the global climate change debate. CCAP staff have participated in the Framework Convention on Climate Change negotiations, helping to shape the Joint Implementation provisions of the Rio Treaty and the Kyoto Protocol Mechanisms. CCAP brokered the world's first energy-sector joint implementation project, a coal-to-gas fuel switch and cogeneration project in Decin, Czech Republic with investment from three US utilities. CCAP has also developed a series of papers, the *Airlie Papers,* on domestic carbon trading in the US and a series, the *Leiden Papers,* on international emissions trading.

About the Foundation for International Environmental Law and Development

The Foundation for International Environmental Law and Development (FIELD) was founded in 1989 to tap the potential of law at the international, regional and domestic level, to encourage environmental protection and sustainable development. FIELD's work in the area of climate change has focused on conducting research and on providing legal and policy advice and assistance to developing countries, as well as intergovernmental and non-governmental organizations involved in the climate change process. FIELD lawyers have participated directly in the negotiations of the 1992 United Nations Framework Convention on Climate Change and the Kyoto Protocol, where they have been providing legal advice and assistance to the Alliance of Small Island States.

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The Eligibility of Land Use, Land-Use Change and Forestry Projects under the Clean Development Mechanism

Executive Summary

The eligibility of land use, land-use change and forestry (LULUCF) projects under the Clean Development Mechanism (CDM) has become a highly controversial issue that will command attention at the Sixth Conference of the Parties. The Parties recognize that the treatment of LULUCF emissions and sequestration in Article 12 is ambiguous, and that they will need to issue some kind of decision on the eligibility of the various categories of LULUCF projects prior to the implementation of the CDM. Whereas some Parties argue that LULUCF projects offer important greenhouse gas benefits as well as other environmental and socioeconomic benefits that should justify their eligibility, others question the environmental integrity of the greenhouse gas benefits from LULUCF projects relative to those of projects in other sectors such as energy and industry. This paper provides an overview of the role of LULUCF activities in the global carbon cycle, and identifies three categories of projects – conservation management, storage management, and substitution management – whose eligibility should be evaluated separately by policy makers. This paper then analyzes the technical issues underlying the political debate on LULUCF projects in the CDM, and lays out a comprehensive framework of options for ensuring the environmental integrity of carbon credits from LULUCF projects. These options address the key risk factors associated with LULUCF projects: measurement uncertainty, baselines and additionality, leakage, and permanence.

I. Introduction

The eligibility of land-use, land-use change and forestry (LULUCF) projects under the Clean Development Mechanism (CDM) is one of the most contentious issues facing negotiators as they prepare for the Sixth Conference of the Parties. A broad range of LULUCF projects potentially could be used by Parties to generate greenhouse gas benefits under the CDM. For the purpose of determining project eligibility, it is useful to group LULUCF projects into three categories:

(1) <u>*Conservation management projects*</u> seek to maintain existing carbon stocks on forest and agricultural land. These projects produce greenhouse gas benefits in the form of *carbon emission reductions or avoided carbon emissions* from biomass and soils. An example is the public acquisition of threatened primary forest and the designation of that land as a protected national park.

(2) <u>*Storage management projects*</u> seek to increase carbon storage on forest and agricultural land as well as in durable forest products. These projects produce greenhouse gas benefits in the form of *carbon sequestration*, or the uptake of carbon from the atmosphere and storage in biomass and soils. An example is the afforestation of degraded pasture land to create a

timber plantation that is harvested sustainably such that the carbon stocks remain constant over time.

(3) *Substitution management projects* seek to substitute sustainably produced biofuels for fossil fuels and wood products for more emission-intensive alternatives. These projects produce greenhouse gas benefits in the form of *carbon emission reductions or avoided carbon emissions* from fossil fuel consumption or the manufacture of emission-intensive products. An example is the use of sustainably harvested biofuels to offset coal combustion for energy production.[1]

The language in Article 12 of the Kyoto Protocol is arguably ambiguous regarding the potential eligibility of these types of projects. Article 12.2 states that the purpose of the CDM is "to assist non-Annex I Parties in achieving sustainable development and in contributing to the ultimate objective of the Convention, and to assist Parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments under Article 3." Sustainable management of the LULUCF sector is a key component of the sustainable development strategies of many non-Annex I Parties. The use of LULUCF activities for climate change mitigation is clearly established in the Framework Convention on Climate Change. Likewise, Annex I Parties may use domestic LULUCF projects, subject to the restrictions under Articles 3.3 and 3.4, to meet their Protocol commitments. These points argue for the inclusion of LULUCF activities in the CDM, either with or without the restrictions under Articles 3.3 and 3.4.[2]

However, the remainder of Article 12 uses the term "emission reductions" to refer to the greenhouse gas benefits produced by CDM projects. Some Parties have interpreted the intent of this language to be that only emission reduction (or emission avoidance) projects qualify under the CDM, and therefore that LULUCF projects involving emission reductions are automatically eligible but carbon sequestration projects are not. However, some Parties have pointed to the Protocol's inconsistent use of the term "emission reductions" to refer sometimes to both emission reduction and sequestration activities. These Parties suggest that both emission and sequestration projects could be eligible. Other Parties have argued that because Article 12 does not make an explicit reference to LULUCF projects, these projects are automatically ineligible under the current Protocol. The Parties recognize that in order to resolve the ambiguities in

[1] Because the greenhouse gas benefits of these projects typically are reflected in sectors other than LULUCF, this project type is not addressed in depth in this paper. However, some of these projects may involve a sink component that could potentially be eligible for credits beyond those from avoided emissions in the energy/industrial sectors (e.g., afforestation to produce a sustainable biofuel plantation).

[2] Article 3.3 enables Annex I Parties to use "net changes in greenhouse gas emissions by sources or removals by sinks resulting from direct human-induced land-use change and forestry activities, limited to afforestation, reforestation, and deforestation since 1990, measured as verifiable changes in carbon stocks in each commitment period" to meet their commitments. Article 3.4 creates the possibility for "additional human-induced activities related to changes in greenhouse gas emissions by sources and removals by sinks in the agricultural soils and the land-use change and forestry categories" to become eligible. If CDM projects were subject to the restrictions under Article 3.3, then projects involving activities such as agricultural sink enhancement and forest management (without land-use change) would not be eligible. The Parties have yet to determine which additional activities, if any, to approve under Article 3.4, and whether these activities would be eligible during the first commitment period.

Article 12, they will need to issue some kind of decision on the eligibility of the various categories of LULUCF projects prior to the implementation of the CDM.

Underlying the debate regarding the literal interpretation of Article 12 are two fundamental questions regarding the environmental effectiveness of including LULUCF projects in the CDM:

- Can LULUCF projects in the CDM produce greenhouse gas benefits that are comparable in quality to those from CDM projects in other sectors (i.e., energy and industry) with regard to certainty and permanence?

- Even if the greenhouse gas benefits from LULUCF projects are comparable in quality to those in other sectors, would excluding LULUCF projects from the CDM result in more effective long-term climate change mitigation?

After providing a brief overview of the contribution of LULUCF activities to the global carbon cycle, this paper delves into each of these questions and analyzes the potential benefits and risks of including the various categories of LULUCF projects in the CDM. The paper concludes by identifying the potential framework elements of a decision by the Parties on the eligibility of LULUCF projects. The paper draws on the newly published *IPCC Special Report on Land Use, Land-Use Change and Forestry* (IPCC, 2000) as a source of technical information.

II. The Role of LULUCF Activities in the Global Carbon Cycle

The greenhouse gas impacts associated with land-use change and forestry activities are linked to the continuous cycling of carbon between biomass, soils, and the atmosphere. Biomass and soils can serve as a source, a sink, and a reservoir (or neutral storage pool) of carbon. Through the process of photosynthesis, biomass converts atmospheric carbon dioxide (CO_2) to oxygen, which is released to the atmosphere, and carbon, which is stored in plant stems, branches, leaves, and roots. Approximately half of the dry weight of biomass is carbon. The carbon stored in biomass is eventually returned to the atmosphere through the processes of respiration, decay, or combustion. Respiration, the breakdown of carbohydrates by plant cells, produces CO_2 emissions. Biomass decay under aerobic conditions (i.e., in the presence of oxygen) also produces CO_2 emissions, whereas decay under anaerobic conditions (i.e., in the absence of oxygen) produces methane (CH_4) emissions. Biomass combustion emits carbon in the form of CO_2 as well as in trace amounts of CH_4, carbon monoxide (CO), and non-methane volatile organic compounds (NMVOCs). Soils can both emit and sequester carbon, depending on the type of land use and local conditions. Soil carbon stocks are released to the atmosphere when soils are disturbed by natural and anthropogenic forces, such as fires, flooding, clearing, and tillage.

All components of this cycle may be impacted by anthropogenic land-use practices (e.g., afforestation, reforestation, deforestation, and prescribed burning) as well as by natural forces (e.g., climate, pests, diseases, and wildfires). Whether the LULUCF sector constitutes a net source or sink of GHGs in a specified land area over a specified period of time depends on the net impact of the processes described above.

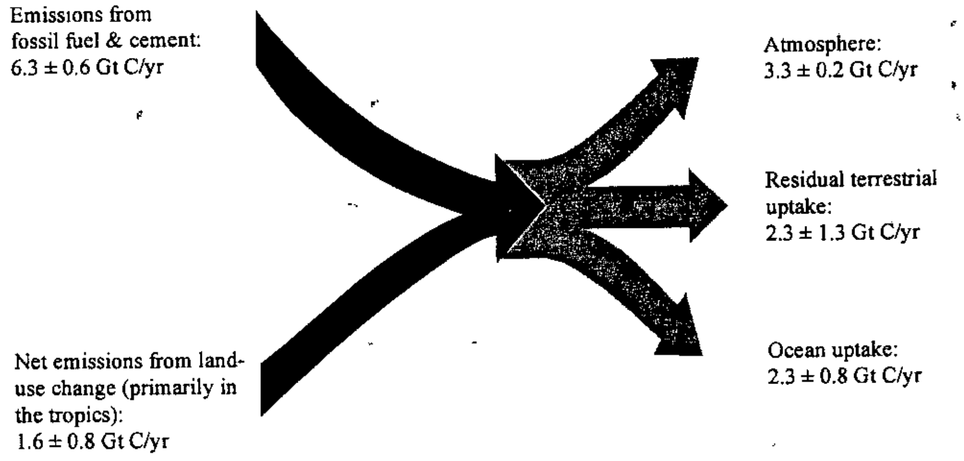
In its *Special Report on LULUCF* (IPCC, 2000), the IPCC reports that at the global level over the past 20 years, the net result of carbon emissions from land-use change (primarily tropical deforestation) and carbon sequestration in terrestrial ecosystems (both anthropogenic and non-anthropogenic) has been a small net sink on the order of 0.2 ± 0.8 Gt C/yr from 1980 to 1989, and 0.7 ± 1.0 Gt C/yr from 1989 to 1998. There is obviously considerable uncertainty associated with these estimates. The average annual budget of CO_2 for 1989 to 1998 is provided in Figure 1.

The annual carbon emissions and sequestration by biomass and soils are very small compared to the amount of carbon that they store. Global carbon storage in vegetation and soils is illustrated in Figure 2. However, emissions from anthropogenic land-use change are still a significant contributor to increases in atmospheric concentrations of CO_2, and management of terrestrial ecosystems offers significant potential to reduce or avoid emissions as well as sequester and store carbon. The *IPCC Special Report* contains multiple projections, based on current trends, for the potential carbon impacts from anthropogenic afforestation, reforestation, and deforestation (ARD). Table 1 presents the emissions and sequestration that are anticipated from these activities in tropical, temperate, and boreal regions during 2008 to 2012 under the IPCC Definitional Scenario.[3] For comparative purposes, consider that Annex I net emissions totaled 4.82 Gt C in 1990 (UNFCCC, 2000), and that Annex I Parties will need to reduce their annual net emissions relative to business-as-usual projections by approximately 0.7 Gt C/yr in 2010 (Newcombe, 2000) in order to meet their commitments under the Kyoto Protocol.

Although scientists, modelers, and policy makers could argue for years over the technical and definitional assumptions and uncertainties associated with the projections in the *IPCC Special Report*, the underlying message is clear. Terrestrial ecosystems play an important role in the global carbon cycle, and anthropogenic activities will continue to exert a substantial influence on whether terrestrial ecosystems are a net source or a net sink of carbon over time. The magnitude of potential greenhouse gas benefits from preventing deforestation and enhancing sinks could be significant relative to the emission reductions sought by Annex I Parties under the Kyoto Protocol's first commitment period. The question currently facing policy makers is the extent to which the Parties should rely on LULUCF activities in the CDM to achieve the environmental and sustainable development goals laid out in the Kyoto Protocol.

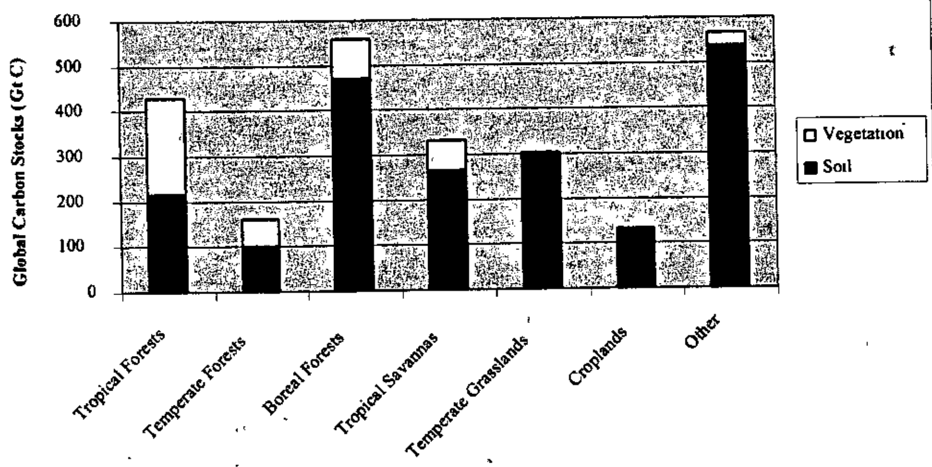
[3] Under the IPCC Definitional Scenario, afforestation, reforestation and deforestation activities are based on transitions between forest and non-forest uses, and the harvest/regeneration cycle is excluded from the scope of these activities.

Figure 1
Average Annual Budget of CO_2: 1989 to 1998



Source: IPCC, 2000

Figure 2
Global Carbon Stocks in Vegetation and Soil Carbon Pools (1 m depth)



Source: IPCC, 2000

Table 1: IPCC Definitional Scenario – Emissions/Sequestration from ARD Activities: 2008-2012

Activity	Tropical Regions Gt C/yr	Temperate Regions Gt C/yr	Boreal Regions Gt C/yr
Emissions from Deforestation	-1.644	-0.126	-0.018
Sequestration from Afforestation/Reforestation	0.170 to 0.415	0.027 to 0.167	0.0002 to 0.0016

Note: Consistent with the IPCC sign convention in the Table 3-17 in the *Special Report*, emissions are assigned a negative value and sequestration a positive value. The emission and sequestration estimates account for above- and belowground biomass only; soil carbon and wood products are excluded.

III. Evaluating the Benefits and Risks of Including LULUCF Projects in the CDM

A. The Benefits

The proponents of including LULUCF projects in the CDM have offered the following arguments to make their case:

- More sustainable management of forest and agricultural resources in developing countries will contribute to achieving stabilization of atmospheric greenhouse gas concentrations at a level that prevents dangerous anthropogenic interference with the climate system, the objective of the Framework Convention as presented in Article 2.
- For many non-Annex I Parties, afforestation, reforestation, forest conservation, and other LULUCF activities are consistent with their existing sustainable development goals. Including LULUCF projects in the CDM could result in important research and capacity-building activities that would assist developing countries with implementing sustainable land-use policies and practices and making more effective use of their natural resources.
- Including LULUCF projects in the CDM could increase the economic value of afforestation, reforestation, forest conservation, and agricultural conservation activities in developing countries, helping to make these activities more cost competitive with alternative land uses that degrade terrestrial carbon stocks.
- Many LULUCF activities can produce important non-GHG environmental benefits of value to developing countries, including biodiversity conservation, improved water quality, erosion prevention , cropland productivity conservation , and desertification prevention.
- Some Annex I Parties view LULUCF projects under the CDM as a relatively inexpensive source of CERs that could help to reduce the overall costs of compliance with the Kyoto Protocol and increase the chance of achieving compliance.

- Some non-Annex I Parties believe that LULUCF projects constitute their most competitive project opportunities, and that if these projects are ineligible, they will not be able to attract CDM investments.

B. The Risks

The opponents to including LULUCF projects under the CDM have raised the following objections:

- It may not be possible to measure the greenhouse gas benefits from LULUCF projects with the same degree of certainty as the benefits from projects in other sectors. The level of certainty is a function of multiple factors, including the ability to precisely measure or estimate terrestrial carbon stocks and carbon fluxes, the ability to formulate credible and verifiable baselines, the potential for off-site leakage of emissions, and the permanence of benefits. If the greenhouse gas benefits from LULUCF projects cannot be measured with a degree of certainty that is comparable to that of projects in other sectors, then LULUCF project benefits should not be considered equivalent to emission reductions from projects in other sectors. In this case, assuming full fungibility would undermine the environmental integrity of the Protocol.

- Given the potential uncertainty and impermanence associated with the benefits from LULUCF projects, it does not make practical sense to direct CDM investments toward these project types at the expense of investments in the energy and industry sectors that are more likely to contribute to long-term sustainable development and greenhouse gas mitigation.

The opponents of including LULUCF projects in the CDM recognize the ecological, social, and other values of conserving existing forests and increasing forest cover in developing countries. However, they suggest that the CDM may not be the appropriate means for achieving those ends if including LULUCF projects results in nonattainment of the climate change mitigation goals of the Protocol.

The remainder of this section evaluates each of the risk factors associated with including LULUCF projects in the CDM, and identifies the options that are available for addressing or mitigating these risk factors. The risk factors are broken down as follows:

(i) Measurement of terrestrial carbon stocks and carbon fluxes
(ii) Baselines and additionality
(iii) Leakage
(iv) Permanence

The section concludes with a brief assessment of the implications for the comparative environmental value of investments in LULUCF projects.

(i) Measurement of Terrestrial Carbon Stocks and Carbon Fluxes

Issues

The measurement of carbon stocks and carbon fluxes associated with LULUCF activities differs from that of carbon fluxes from fossil fuel consumption and industrial production. In the case of LULUCF projects, the emission impacts of land management activities tend to be highly location specific and can continue for long periods of time. While some data are available for average carbon stock densities (i.e., tons of carbon in biomass or soil per unit of area) for different forest types, regions, and land-use activities, the actual carbon stocks can be highly variable by site, and even average data may be lacking for some regions and land-use activities. Therefore, the measurement of carbon fluxes associated with LULUCF activities at the project level typically requires statistical sampling of on-site carbon stocks (above- and belowground biomass and soils) on a periodic basis over an extended period of time, and in some cases, modeling of carbon fluxes and/or remote sensing. This introduces the possibility of sampling, measurement, and regression errors.

The bottom line is that the level of certainty associated with estimates of changes in terrestrial carbon stocks over time depends on the sampling, measurement, and modeling protocols. The more extensive and more frequent the carbon stock inventory that is required, the better the estimates of stock changes and the higher the cost of the project. Well-designed site inventories can achieve relatively precise estimates of terrestrial carbon stocks. For example, the developers of the Noel Kempff Climate Action Project undertaken through the U.S. Initiative on Joint Implementation were able to report carbon stock estimates with a precision level of ± 4 percent (with a 95 percent confidence interval), based on sampling error only. Additional error may be associated with regression and measurement (IPCC, 2000).

In some cases, modeling and remote sensing can be used to compensate for less frequent site inventories. Models can be used to estimate annual carbon fluxes between stock inventories. Models can also be used to estimate changes in carbon pools that are more difficult or costly to measure directly, such as litter, belowground biomass, soil, and wood products. Models and model outputs can be difficult to verify, however, because they tend to be complex (reflecting the complexity of ecosystem processes) and lack transparency. Satellite remote sensing can be used to monitor absolute changes in land-cover type by area over time, but it currently is not a substitute for on-site measurement of biomass stocking densities and biomass condition. The results from satellite remote sensing can be used in conjunction with on-site sampling and modeling to estimate changes in biomass stocks over time. New satellite remote sensing technologies are being developed that may be better able to collect information on aboveground biomass stocking densities (IPCC, 2000).

The concern that different projects offer different levels of measurement certainty is not unique to the comparison of LULUCF projects against projects in other sectors. The fact is that the estimation of benefits from different projects in all sectors will have different levels of certainty, in much the same way as Annex I inventories contain emission estimates whose certainty varies considerably by sector and by country. For example, the IPCC reports that the *IPCC Guidelines for National Greenhouse Gas Inventories* (IPCC/UNEP/OECD/IEA, 1997) may produce inventory estimates with relative uncertainties (from emission factors and activity data) ranging from ±10 percent in the energy sector to ±50 percent in the industrial processes sector and ±60 percent in the LUCF, oil and natural gas, and coal mining and handling sectors (all uncertainty ranges are reported with a 95 percent confidence interval). It is important to note that there are significant differences between the assessment of emissions and sequestration at the project level and at the national-inventory level. Under the current IPCC guidelines for the LULUCF sector, national inventories must account for anthropogenic changes in terrestrial carbon stocks and/or carbon fluxes over time. By contrast, LULUCF projects must account for changes in terrestrial carbon stocks and carbon fluxes that are associated with both project activities *and* the baseline scenario (i.e., the hypothetical course of events in the absence of the project). They must also account for potential leakage and loss of benefits over time. All of these factors can introduce additional uncertainty into the estimates of project benefits. These factors are discussed further below.

Options

To address the measurement uncertainty issue in the CDM, policy makers could designate an "acceptable" uncertainty range (e.g., ±10 percent with a confidence interval of 95 percent) that would be applied to the estimate of benefits from *all* CDM projects. A project that failed to meet this requirement would need to reduce the number of CERs claimed by the project to compensate accordingly. Guidance for the consistent calculation of uncertainty ranges would be required by project developers. When determining the acceptable level of uncertainty, policy makers should consider whether to hold CDM projects to a common standard of their own, or to standards that are consistent with the uncertainty levels in Annex I national inventories that are used to allocate assigned amount units (AAUs).

To assist project developers with meeting the certainty requirements for LULUCF projects, policy makers could develop uniform guidelines for the sampling, measurement, and modeling of carbon stocks on forest and agricultural lands. Another option would be for policy makers to limit the eligible carbon pools to those that can be measured and verified effectively, such as aboveground biomass, and exclude carbon pools such as soil that are more difficult or costly to measure (or model) and verify. The relative importance of soil carbon benefits from LULUCF projects varies by project, forest type, and region. Figure 2 shows the variation in the relative storage of carbon in biomass and soils for temperate and tropical forests and other land types. Excluding the soil carbon pool could significantly reduce the estimate of project benefits in some cases. Another way to address this would be to credit carbon benefits associated with the soil carbon pool if the developer were willing to invest in the level of sampling and frequency of monitoring that would be necessary to document the estimates with an acceptable level of certainty. Yet another option would be to require the assessment of the carbon pools that were likely to be affected significantly by the project, and exclude other carbon pools on a project-by-project basis.

(ii) ***Baselines and Additionality***

Issues

As with all CDM projects, the determination of environmental additionality for LULUCF projects is likely to involve the development of project baselines representing the annual emissions/sequestration associated with the course of activities under business as usual (i.e., without the project). In the case of LULUCF projects, the project developer must estimate what land-use activities would occur under business as usual, which GHG sources and sinks would be affected by these activities, and how and when these GHG sources and sinks would be affected. This can be a very difficult exercise because land uses are driven by multiple factors, including the availability of and demand for forest and agricultural resources, population growth, socioeconomic trends, government policies, cultural traditions, and natural disasters. Two approaches can be used by project developers to develop the reference scenario: (1) analyzing historical trends and extrapolating those trends into the future, or (2) modeling future changes in land use based on projected changes in the key drivers of land use, such as population growth and socioeconomic trends. In both cases, it can be difficult to verify whether the baselines proposed by project developers represent realistic scenarios.

The development of project baselines is perceived as being more problematic for carbon conservation projects (i.e., avoided deforestation) than for carbon storage projects (i.e., afforestation and reforestation). In the case of carbon conservation projects, the baseline is determined by two primary factors: (1) the size of the existing carbon stocks on the land, and (2) the rate at which the land would have been converted under business as usual.[4] Although land-use records, satellite imagery, and models can be used to estimate historical deforestation rates at the national, regional, or local levels, it can be very difficult to predict the rate at which a specific parcel of land would have been deforested in the future in the absence of a project. This creates the potential for baseline inflation and gaming of the system. For example, if a region expects a deforestation rate of five percent per year, then it could be reasonable to assume that its remaining forest will likely be cleared within 20 years in the absence of intervention. In that context, how does an auditor evaluate one developer's baseline claim that his parcel will be cleared within 15 years, and the next developer's baseline claim that his parcel will be cleared within only 5 years? Both developers could be right, but how does the auditor verify this for a fact? The second developer would receive all of his GHG credits much sooner than the first. Models can be used to evaluate these kinds of claims by integrating risk factors such as the type of landowner and the proximity to existing or planned logging roads, etc. However, these types of models can be project specific, complex, and difficult to verify.

Afforestation and reforestation projects likewise can face difficult baseline issues. However, it can be easier to defend the argument that an abandoned or degraded piece of land will remain unforested if it has already done so for the past ten years and there are no policies or measures already in place to promote the afforestation/reforestation of that land. In addition, the magnitude and timing of the potential credits from afforestation and reforestation projects on a

[4] In some cases, the disposition of the cleared biomass (e.g., on-site burning, on-site decay, off-site burning for energy, wood products) can also have a significant impact on the baseline.

per-hectare basis are quite different from those of forest conservation projects involving primary forest with a high carbon density that faces an immediate threat of conversion.

Another important baseline consideration is the choice between static (i.e., fixed) versus dynamic (i.e., changeable) baselines. At the time a GHG mitigation project is initiated, the baseline is hypothetical. Throughout the project lifetime, it may become possible to verify at least some of the key assumptions made when developing the baseline. This raises the question of whether the baseline should be modified during the course of the project to reflect observed changes in key factors, or whether the baseline should remain fixed throughout the project lifetime.

Developing a fixed emission baseline from which to measure project benefits may appeal to project developers and investors, since it represents a form of guarantee that if the project is implemented as anticipated, it will generate the anticipated benefits. However, if the assumptions made in developing the reference scenario turn out to be unrealistic, then using a static emission baseline will produce an inaccurate estimate of project benefits.

Using a dynamic baseline that can be updated as external factors change may produce a more realistic estimate of project benefits. This may be a particularly strong option for developers who can select a proxy area to represent the baseline, and monitor events in the proxy area throughout the project. A dynamic baseline may enable the developer to account more accurately for unexpected changes in project benefits due to factors that affect both the project and reference scenarios. Consider the example of a sustainable harvesting project in a forest that is damaged by an unanticipated fire during the course of the project. Presumably, the project area would have been equally threatened by fire under the project and baseline scenarios. Accounting for the effects of the fire under both the baseline and project scenarios would produce a more realistic estimate of project benefits.

The use of dynamic baselines raises the following questions:

- *How frequently should the baseline be reevaluated?* Revising the baseline frequently would involve a high level of effort and cost for data collection and analysis. In some projects, it could be practical to update the emission baseline every five or ten years, but not more frequently than that. If the baseline were to remain fixed between assessments, investors would gain some additional security regarding the magnitude of project benefits that could be claimed.

- *What boundaries should be placed on baseline reevaluation?* Standard methods would need to be developed for monitoring and updating the baseline so that investors would have some understanding of the level of uncertainty involved in the preliminary assessment of project benefits. One important issue to be considered is whether the baseline evaluation should be restricted to the factors evaluated at the beginning of the project. Consider the example of a baseline scenario consisting of forest conversion to agricultural land. Suppose the developer created the baseline using projected changes in the regional rate of forest conversion based on government land-use policies at the time of project implementation. If, during the project lifetime, a new administration implemented unanticipated forest conservation projects in the region, should the developer be required to modify the forest conversion rate used in the original baseline? Or would these new developments be considered outside of the project boundary?

Options

Concerns relating to the development of baselines are not unique to the LULUCF sector. Parties' data systems do tend to be better adapted to predict changes in market share among different technologies and fuel sources than changes in land use and terrestrial carbon stocks. However, the challenges related to baseline determination for LULUCF projects are not insurmountable. Options for policy makers include the following:

1) Developing guidelines for the determination of baselines for different types of LULUCF projects in different regions. These guidelines could promote the use of very conservative assumptions regarding emissions and sequestration from land use under business as usual. The guidelines could lay out parameters for modeling future rates of land-use change, and for extrapolating past land-use trends into the future. The guidelines could also address the use of static and dynamic baselines, and methods for monitoring the baseline assumptions over time.

2) Requiring in-depth assessment of regional land-use trends on a project-by-project basis by developers and by operational entities prior to approval of project baselines as part of project validation/registration.

3) Excluding carbon conservation projects from the CDM, as their baselines tend to be very sensitive to the assumptions made regarding the rate of land conversion, but retaining afforestation/reforestation projects, subject to the restrictions identified above.

If the third option is selected by policy makers, then they should be wary of creating incentives for increased deforestation. If a non-Annex I Party cannot host projects that prevent deforestation, but can host projects to reforest land that has been cleared, there may be some incentive to clear forested land and replant fast-growing species in order to generate CERs. To prevent this kind of incentive, the Parties could place a restriction on the land areas eligible for creditable afforestation and reforestation activities on the basis of how long they have been deforested.

(iii) Leakage

Issues

Leakage is defined in the *IPCC Special Report* as "the unanticipated decrease or increase of GHG benefits outside of the project's accounting boundary (the boundary defined for the purposes of estimating the project's net GHG impact) as a result of project activities." In the context of LULUCF projects under the CDM, leakage could occur if the land uses being altered by the project are merely displaced to other areas instead of being replaced altogether. Failing to account for negative leakage (i.e., increases in emissions outside of the project area as a result of activities undertaken by the project) would result in the overestimation of project benefits. Consider the example of a project to conserve primary forest that would otherwise be cleared to create agricultural land. If the project does not address the unmet demand for agricultural land, then the population that needs the land will simply clear forests in other areas to meet their needs and the project benefits will be offset. Because leakage can occur at the regional, national, and international levels, it can be very difficult to predict or measure.

The risk of leakage is not unique to LULUCF projects, but does tend to be more common in the case of LULUCF projects. Leakage may pose a greater concern for carbon conservation projects than carbon storage projects, since carbon conservation projects tend to reduce the supply of resources (i.e., timber and agricultural land) from the project area, whereas afforestation and reforestation projects are likely to occur on marginal cropland or pasture and create new, more valuable resources. However, this generalization may not apply to all cases.

Options

The developers of CDM projects can take steps to reduce the potential for leakage, and to measure the impacts of leakage. The reduction of leakage potential can be achieved through project design. For example, a developer can evaluate the likely impacts of the project on the existing supply of and demand for goods and services, and seek to change this supply/demand or meet this supply/demand through alternative actions. The developer can attempt to predict where leakage is likely to occur, monitor leakage impacts over time, and adjust the estimate of project benefits accordingly. Another solution to this problem is the development of leakage coefficients by project type and region that can be used to adjust the estimate of project benefits in a more standardized way to account for leakage (IPCC, 2000). Broad monitoring of land-use trends at the local, regional, and national levels can also be used to help detect leakage. However, it can be very difficult to distinguish the effects of leakage from those of other factors driving land use.

Policy makers could require that leakage potential and leakage mitigation measures be reported in CDM project design documents and assessed by operational entities as part of the project validation/registration process. If leakage were found to pose a significant risk to the project benefits and inadequate leakage prevention measures were undertaken, then the CERs awarded to the project could be reduced accordingly.

(iv) Permanence

Issues

The most significant difference between LULUCF projects and projects in other sectors relates to the relative permanence of the projects' greenhouse gas benefits. In the case of energy and industrial projects, the greenhouse gas benefits from reducing or avoiding carbon emissions can be considered permanent and irreversible. For example, every kilowatt-hour of electricity generated by wind that is consumed in place of electricity from fossil fuel combustion produces a permanent greenhouse gas benefit. Demonstrating the permanence of benefits from land-use change and forestry projects is complicated by the continuous cycling of carbon between biomass, soils, and the atmosphere. For example, the benefit from storing carbon in a specific tree will be lost eventually when that tree dies and its carbon is oxidized from decay or burning. However, the benefit from storing carbon in a forest that reaches equilibrium (i.e., in which biomass mortality is offset by biomass growth) will endure as long as the forest is protected against natural and anthropogenic threats.

The GHG benefits from land-use change and forestry projects may always be subject to a higher threat of loss or reversal than the GHG benefits from projects in other sectors such as energy. For example, the GHG benefits of forest conservation, afforestation, and reforestation can be lost as a result of natural disasters (e.g., fire, flooding, and storms); lack of long-term commitment of landowners to the project due to factors such as cultural traditions, political unrest, and changes in the local economy; and lack of control over land disposition after the project has ended. In some cases, developers may be able to argue that the GHG emissions from many of these events will be offset if the damaged forests are allowed to regenerate. However, forest regeneration may not always occur, and if it does, the rate of carbon uptake from forest regeneration after such an event will tend to be much slower than the rate of carbon emissions from the event.

Project developers and policy makers are faced with the difficult question of how to account for the benefits of afforestation/reforestation projects that involve harvesting and regeneration cycles, and forest conservation projects whose carbon stocks realistically cannot be protected forever. This kind of accounting problem applies to the project-based measures under the Kyoto Protocol more so than to the mitigation activities undertaken by Annex I Parties under Article 3. Assuming that Annex I Parties will continue to have emission limitations in subsequent commitment periods, any future loss of benefits from LULUCF activities credited during the first commitment period will be captured in the accounting system. In the case of the CDM, some mechanism must be put in place to withdraw CERs from the market if their underlying project benefits are lost over time, or compensate for this loss in some other way. Otherwise, the environmental integrity of the Protocol will be compromised.

Attempts to compare the permanence of benefits from LULUCF projects and other projects have raised the basic question of what is meant by permanence. Does "permanence" have to mean that avoided carbon emissions or sequestered carbon must remain out of the atmosphere "in perpetuity" in order to qualify as an emission offset? Or would it be acceptable to consider project benefits to be permanent if they offset the atmospheric impact of the equivalent amount of emissions for, say, 100 years? After all, 100 years is the timeframe used in the Kyoto Protocol for evaluating the relative global warming potentials (GWPs) of different greenhouse gases.

The latter line of reasoning has led to the concept of ton-year accounting. In commonsense terms, this accounting system awards credits to LULUCF projects on the basis of both how much carbon benefit has been produced *and* how long this carbon benefit has been retained. Full credit is awarded to each ton sequestered (or ton of avoided emissions) if that ton stays out of the atmosphere long enough to offset the effect of one ton of emissions. Partial credits can be awarded cumulatively over time. Researchers have proposed different time requirements (i.e., equivalence periods) for the retention of carbon out of the atmosphere before full credit is awarded. One option is 100 years – the assumed atmospheric lifetime of one ton of emitted CO_2 used to calculate the GWPs applied in the Kyoto Protocol. However, the model used by the IPCC to calculate GWPs actually operates on the assumption that atmospheric CO_2 residency declines over time. According to the application of this model by Moura-Costa (as cited in

IPCC, 2000), it may only be necessary to keep one ton of CO_2 out of the atmosphere for 46 years to offset the equivalent of one ton of CO_2 emissions. Using an alternative application of this model, the "Lashof Method" credits carbon sequestration projects to the extent that they postpone emissions beyond a 100-year timeframe (IPCC, 2000).

The ton-year accounting method offers a useful way to compensate for the impermanence of LULUCF project benefits relative to projects in other sectors. The benefits of this approach are summarized in the *IPCC Special Report* as follows:

> As long as the policy time horizon is finite or a non-zero discount rate is applied to determine the present value of future emissions/removals, even short-term sequestration will have some value. The explanation of this proposition is made clearer by considering the converse case: emission of 1 ton CO_2 followed 20 years later by removal of 1 ton CO_2. Although the net emission over the entire period is zero, there clearly has been an effect on the atmosphere. A ton-year equivalency factor can be used to determine the relative climate effect of different patterns of emissions and removals over time. For a given pattern, this factor will be a function of the time horizon and discount rate selected.

However, the concept of ton-year accounting raises some troubling questions as well. Is it fair to future generations to grant equal credit to projects that produce permanent benefits and to those that only delay emissions beyond a 100-year timeframe? Although the option for ton-year accounting could reduce the need for long-term monitoring, and reduce associated project costs, investors may be wary of ton-year accounting because it could slow the stream of CERs from LULUCF projects. For example, using the Moura-Costa method with a 46-year equivalence period and applying equivalence-factor yearly crediting (see below), each ton of carbon sequestered by a project would only be awarded 1/46 of a ton each year through the forty-sixth year of storage. It is not clear what would happen after year 46 if the carbon storage continued. Would it be possible for one ton of sequestered carbon to be worth more than one ton over time? Furthermore, in terms of cost effectiveness, it could be very difficult for LULUCF projects using ton-year accounting to compete against other CDM projects using standard accounting as well as against Article 3.3/3.4 mitigation opportunities in Annex I countries.

Options

The *IPCC Special Report* identifies the following options for crediting LULUCF projects under the CDM, both with and without ton-year accounting:

1) *Stock change crediting:* Crediting projects according to the carbon stock change over time. This approach is consistent with the language in Article 3.3. Developers would be awarded full credits for stock increases relative to the baseline, as the stock increases occur. This approach was typically used by project developers under the AIJ pilot phase. If the carbon benefits were lost over time, the developers would have to compensate for the full loss in some way or the CERs would have to be withdrawn from the market. Guidelines would be needed for the length of time over which a developer would have to continue monitoring activities in order to show that the benefits had not been lost.

2) *Average storage:* Crediting projects for the average storage of carbon over time. This approach is particularly useful in the case of projects involving the cyclical harvesting and regeneration of timber stocks. Although the stocks drop to zero after each harvest, the developer still gets credit for the average rate of carbon storage over time.

3) *Credit reserve/insurance:* Maintaining a reserve of credits or purchasing insurance that can be used to compensate for the future loss or reversal of the greenhouse gas benefits underlying CERs sold in the marketplace. This is the approach used by the Costa Rican Protected Area Project under the U.S. Initiative on Joint Implementation.[5]

4) *Equivalence-adjusted average storage:* Applying the average storage approach (above), but modifying the amount of storage to reflect the concept of the equivalence period under ton-year accounting. Under this system, projects that sustained the harvesting/regeneration cycle over longer periods of time would be credited for greater average storage than those with shorter lifetimes.

5) *Stock change crediting with ton-year liability assessment:* Applying the stock change approach (above), but using the ton-year method to calculate the amount of credits to be removed in the case of loss of benefits. In this way, project developers would receive full credits representing actual stock increases as they occurred. If the carbon stocks were lost prematurely, the developer would retain partial credits according to the duration of carbon storage that had been achieved, and would have to surrender the remainder of the credits or compensate in some other way.

6) *Equivalence-factor yearly crediting (ton years):* Crediting a project annually with a fraction of its total GHG benefit using a ton-year accounting system. If the project's carbon stocks were lost at some point, the developer would still be able to keep the credits already accrued to that point.

7) *Equivalence-delayed full crediting:* Crediting a project only after the equivalence time has been met.

8) *Ex-ante ton-year crediting:* Giving a project a number of credits upon project initiation, according to the planned project duration, using the ton-year approach. If the project's carbon stocks were lost at some point, the developer would have to refund the portion of ton-year carbon credits that had not been achieved as planned.

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[5] The Protected Area Project involves the purchase or transfer of primary and secondary forest and pasture, and the designation of that land as protected National Parks or Biological Reserves. The carbon benefits result from avoided deforestation and carbon sequestration. To ensure against the loss of greenhouse gas benefits (called Certified Tradable Offsets -- CTOs) during the project lifetime, the government of Costa Rica provided a guarantee for each CTO sold. If monitoring or third-party verification showed that the greenhouse gas benefits were not achieved, the government would guarantee the provision of replacement offsets for the remaining life of the CTO. A reserve pool of creditable excess greenhouse gas offsets is being maintained by the developers for this purpose (USEPA, 1998).

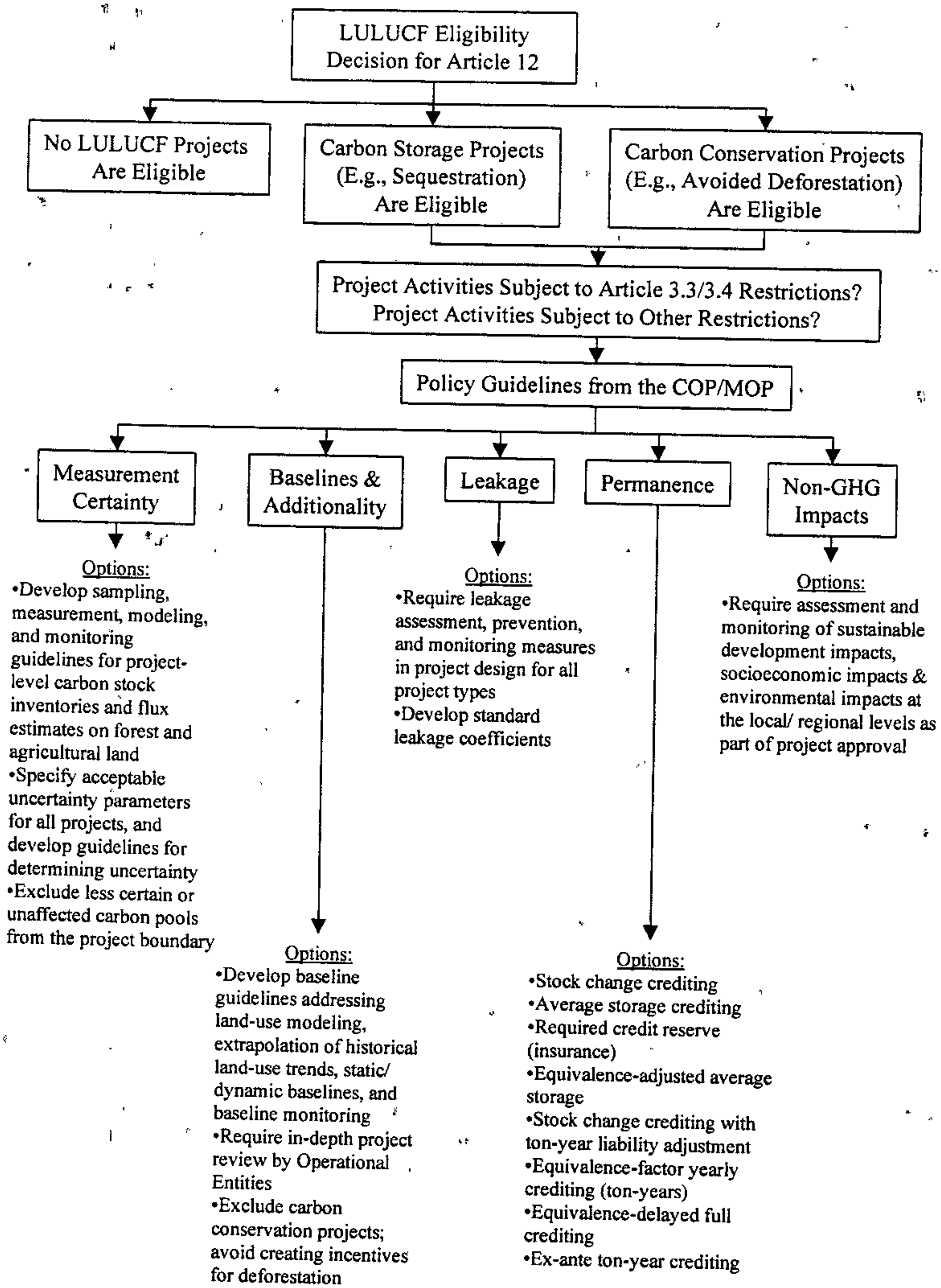
These options offer different variations on the level of permanence required for projects to receive at least partial credit for carbon sequestration, and the rate at which investors can obtain CERs from a project. The key distinction among the ton-year options (Options 4 through 8) relates to when the investors get the credits. This determination will have important implications for the relative competitiveness of LULUCF CDM projects, CDM projects in other sectors, and LULUCF activities undertaken under Article 3.3/3.4. Options 6 and 7 would be the least attractive to investors, as they would significantly slow the rate at which CERs were awarded to a project. Options 5 and 8 would be the most attractive to investors, since investors would receive either full credits as the stocks accrued (Option 5) or up-front credits calculated using ton-years (Option 8), but would only surrender a portion of the credits if the benefits were lost prematurely.

(v) Implications for the Comparative Environmental Value of Investments in LULUCF Projects

The discussion above has shown that the accounting of benefits from LULUCF projects is not easy. In many cases, the accounting difficulties are shared by projects in other sectors. In other cases, particularly with regard to the assessment of permanence, LULUCF projects pose unique challenges. Given these difficulties, some policy makers propose that it simply makes better sense to invest in categories of projects that offer a higher level of certainty. Furthermore, some policy makers argue that investments in energy and industrial projects under the CDM may be more effective than investments in LULUCF projects in the long term because they will promote technological advancement, market development, and capacity building, all of which will hopefully have a multiplier effect in driving future climate change mitigation. This is a very difficult issue to address. The resolution of this issue by the Parties ultimately may reflect their political and philosophical convictions as much as technical concerns about how well we can measure the GHG benefits from LULUCF projects.

IV. Decision-Making Framework for the Parties

The Parties face the challenging task of deciding whether to allow no, some, or all types of LULUCF projects in the CDM. If some or all types of LULUCF projects are to be eligible, then the Parties will need to develop a policy framework for ensuring the environmental integrity of these projects. This policy framework will need to address the accounting issues discussed above. It may also need to evaluate other factors such as the non-greenhouse gas impacts of LULUCF projects. The following figure outlines one option for structuring this decision-making process and identifying the key issue areas for discussion.


LULUCF Eligibility
Decision for Article 12
No LULUCF Projects
Are Eligible
Carbon Storage Projects
(E.g., Sequestration)
Are Eligible
Carbon Conservation Projects
(E.g., Avoided Deforestation)
Are Eligible
Project Activities Subject to Article 3.3/3.4 Restrictions?
Project Activities Subject to Other Restrictions?
Policy Guidelines from the COP/MOP
Measurement
Certainty
Baselines &
Additionality
Leakage
Permanence
Non-GHG
Impacts
Options:
•Develop sampling, measurement, modeling, and monitoring guidelines for project-level carbon stock inventories and flux estimates on forest and agricultural land
•Specify acceptable uncertainty parameters for all projects, and develop guidelines for determining uncertainty
•Exclude less certain or unaffected carbon pools from the project boundary
Options:
•Require leakage assessment, prevention, and monitoring measures in project design for all project types
•Develop standard leakage coefficients
Options:
•Require assessment and monitoring of sustainable development impacts, socioeconomic impacts & environmental impacts at the local/ regional levels as part of project approval
Options:
•Develop baseline guidelines addressing land-use modeling, extrapolation of historical land-use trends, static/ dynamic baselines, and baseline monitoring
•Require in-depth project review by Operational Entities
•Exclude carbon conservation projects; avoid creating incentives for deforestation
Options:
•Stock change crediting
•Average storage crediting
•Required credit reserve (insurance)
•Equivalence-adjusted average storage
•Stock change crediting with ton-year liability adjustment
•Equivalence-factor yearly crediting (ton-years)
•Equivalence-delayed full crediting
•Ex-ante ton-year crediting

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