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CHALLENGES OF FORESTRY INCARBON TRADING

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Introduction

Forests play central and primary roles in the mitigation of climate change. Forests are important carbon pools which continuously exchange CO_2 with the atmosphere, due to both natural processes and human action. At the global level, 19% of the carbon in the earth's biosphere is stored in plants, and 81% in the soil. In tropical forests, approximately 50% of the carbon is stored in the biomass and 50% in the soil (Karsenty *et al*, 2003). Wood products derived from harvested timber are also significant carbon pools.

The earth's biosphere constitutes a carbon sink that absorbs approximately 2.3 GtC annually. This represents nearly 30% of all fossil fuel emissions (totaling from 6.3 to 6.5 GtC/year).

Planting new forests, rehabilitating degraded forests and enriching existing forests contribute to mitigating climate change as these actions increase the rate and quantity of carbon sequestrationin biomass.

Tree planting projects are doubly interesting from the point of view of CO_2 sequestration, inasmuch as carbon storage in durable products such as boards, plywood, or furniture complements the permanent stock in standing trees. Even if the life span of products is limited, an average life span of several dozen years is still significant, since it allows to "gain time" while waiting for cleaner technologies in the energy and transportation sector to develop, and it can also help avoid concentration peaks of CO_2 in the planet's atmosphere. If a part of the annual harvest replenishes and increases the pool of wood products, the forestry sector's storage capacity can increase considerably without occupying more space in the landscape (Karsenty *et al*, ibid.).

The carbon reservoir in the forest biomass and soils is very large, highlighting the importance of conserving natural forest, and eliminating agricultural practices which contribute to the deterioration of these reservoirs.

Using lumber instead of materials requiring large amounts of energy during production helps fight the greenhouse effect, e.g. in replacing concrete or steel constructions by wood as frames, beams, etc. Using 1m^3 of lumber in buildings sequesters 1 ton of CO_2 for an average period of 20 years, and reduces net emissions by 0.3 t of CO_2 if concrete is replaced and 1.2 t of CO_2 if steel is substituted.

Producing wood for energy purposes mitigates climate change by combining sink action with emissions reduction. Substituting fossil fuels, such as coal, natural gas, or oil by fuelwood for domestic use, electricity production, or industrial use, e.g. in iron smelters, reduces CO_2 emissions because wood is renewable. The expected sequestration of carbon through the growth of trees after sustainable harvest compensates for the CO_2 emitted by combustion.

In addition to helping protect the environment, forestry activities that mitigate climate change can provide global, regional and local benefits, as long as they are adapted to the local context.

They can offer potential income to rural populations in forest areas. Industrial plantations can generate employment in nursery operations, harvesting, tending operations. Community plantation projects may involve direct payments to villagers by an investment fund.

Carbon Emission Trading

Emissions trading or cap and trade is a market-based approach used to control pollution by providing economic incentives for achieving reductions in the emissions of pollutants. A central authority (usually a governmental body) sets a limit or *cap* on the amount of a pollutant that may be emitted. The limit or cap is allocated or sold to firms in the form of emissions permits which represent the right to emit or discharge a specific volume of the specified pollutant. Firms are required to hold a number of permits (or allowances or *credits*) equivalent to their emissions. The total number of permits cannot exceed the cap, limiting total emissions to that level. Firms that need to increase their volume of emissions must buy permits from those who require fewer permits.

The transfer of permits is referred to as a trade. In effect, the buyer is paying a charge for polluting, while the seller is being rewarded for having reduced emissions. Thus, in theory, those who can reduce emissions most cheaply will do so, achieving the pollution reduction at the lowest cost to society.

Emission trading has its origins in economic theories; first formulated in the 1960s, it aims at attaching a production cost to pollution. The theory held that if pollution had a price, market forces would eventually deter businesses from polluting the environment because it would become less cost effective for them to do so. In the 1990s, emissions trading went from economic theory to practice, with the controversial Sulphurtrading scheme, which saw the USA using a trading approach while other countries simply brought in anti-pollution regulation.

A cap-and-trade system constrains the aggregate emissions of regulated sources by creating a limited number of tradable emission allowances, which emission sources must secure and surrender in number equal to their emissions.

The cap which is the allowable overall level of pollution is defined and allocated among firms in the form of permits. Firms that keep their emission levels below their allotted level may sell their surplus permits to other firms or use them to offset excess emissions in other parts of their facilities. Compliance is established by comparing actual emissions with permits surrendered including any permits traded within the cap.

The overall goal of an emissions trading plan is to minimize the cost of meeting a set emissions target or cap.C:\Users\hp\Documents\carbon trading\Emissions trading - Wikipedia, the free encyclopedia.htm - cite_note-cap101-6

There are active trading programs in several air pollutants. In the case of greenhouse gases the largest is the European Union Emission Trading Scheme, whose purpose is to avoid dangerous climate change. In the United States there is a national market to reduce acid rain and several regional markets in nitrogen oxides.

The use of "market-based" instruments such as emissions trading has been argued to be more suitable in addressing environmental problems instead of the prescriptive "command and control" regulation. Command and control regulation is criticized for being excessively rigid, insensitive to geographical and technological differences, and inefficient (Wikipedia 2014a).

Carbon emissions tradingor carbon trading which is a form of emissions trading, specifically targets carbon dioxide (calculated in tonnes of carbon dioxide equivalent or tCO_2e) and it currently constitutes the bulk of emissions trading.

As is common to emission trading in general, the model used in all current carbon trading schemes is called 'cap and trade'. In a 'cap and trade' scheme, a government or intergovernmental body sets an overall legal limit on emissions (the cap) over a specific period of time, and grants a fixed number of permits to those releasing the emissions. A polluter must hold enough permits to cover the emissions it releases. Each permit in the existing carbon trading schemes is considered equivalent to one tonne of carbon dioxide equivalent (CO_2e).

Carbontrading is a practice which is designed to reduce overall emissions of carbon dioxide, along with other greenhouse gases, by providing a regulatory and economic incentive. Carbontrading provides a very obvious incentive for companies to improve their efficiency and reduce their greenhouse gas emissions, by turning such reductions into a physical cash benefit. In addition, it is a disincentive for being inefficient, as companies are effectively penalized for failing to meet emissions goals. In this way, regulation is accomplished largely through economic means, rather than through draconian government measures, encouraging people to engage in carbontrading because it's potentially profitable.

As a general rule, carbontrading is paired with an overall attempt to reduce carbon emissions in a country over an extended period of time, which means that each year the number of available credits will be reduced. By encouraging companies to become more efficient ahead of time, a government can often more easily meet emissions reduction goals, as companies will not be expected to change practices overnight, and the carbontrading system creates far more flexibility than setting blanket baseline levels (wiseGEEK, 2013).

This form of permit trading is a common method countries utilize in order to meet their obligations specified by the Kyoto Protocol; namely the reduction of carbon emissions in an attempt to reduce (mitigate) future climate change (Wikipedia 2014b).

The carbon trade came about in response to the Kyoto Protocol. Signed in Kyoto, Japan, by some 180 countries in December 1997, the Kyoto Protocol calls for 38 industrialized countries to reduce their greenhouse gas emissions between the years 2008 to 2012 to levels that are 5.2% lower than those of 1990. Article 17 of the Kyoto Protocol established emissions trading by allowing countries that have emission units to spare (emissions permitted to them but unused) to sell this excess capacity to countries that are over their emissions limits. In effect, this created a new commodity in the form of emissions and created a carbon market. Since CO_2 is the principal greenhouse gas, emissions trading effectively became carbon trading (SourceWatch, 2011).

The idea behind carbon trading is quite similar to the trading of securities or commodities in a marketplace. Carbon would be given an economic value, allowing people, companies or nations to trade it. If a nation bought carbon, it would be buying the rights to burn it, and a nation selling carbon would be giving up its rights to burn it. The value of the carbon would be based on the ability of the country owning the carbon to store it or to prevent it from being released into the atmosphere.

A market would be created to facilitate the buying and selling of the rights to emit greenhouse gases. The industrialized nations for which reducing emissions is a daunting

task could buy the emission rights from another nation whose industries do not produce as much of these gases. The market for carbon is possible because the goal of the Kyoto Protocol is to reduce emissions collectively.

Carbon trading seems like a win-win situation in the sense that greenhouse gas emissions may be reduced while some countries reap economic benefit (Investopedia, 2013). Carbon trading has therefore become the central pillar of international efforts to halt climate change.

Carbon Offset, Credit and Market

A carbon offset is a reduction in emissions of carbon dioxide or greenhouse gases made in order to compensate for or to offset an emission made elsewhere. The Joint implementation and Clean Development Mechanism approaches in the Kyoto protocol are good examples of carbon offset.

Carbon trading runs in parallel with a system of carbon offsets. Instead of cutting emissions themselves, companies, and sometimes international financial institutions, governments and individuals, finance "emissions-saving projects" outside the capped area to generate carbon credits which can also be traded within the carbon market. The UN's Clean Development Mechanism (CDM) is the largest such scheme with almost 1,800 registered projects in developing countries by September 2009, and over 2,600 further projects awaiting approval.

Carbon offsets are a form of trade. When you buy an offset, you fund projects that reduce greenhouse gas (GHG) emissions. The projects might restore forests, update power plants and factories or increase the energy efficiency of buildings and transportation. Carbon offsets let you pay to reduce the global GHG total instead of making radical or impossible reductions of your own (Dowdey, 2014).

Carbon offsets are measured in metric tons of carbon dioxide-equivalent (CO_2e) and may represent six primary categories of greenhouse gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), and sulfur hexafluoride (SF_6). One carbon offset represents the reduction of one metric ton of carbon dioxide or its equivalent in other greenhouse gases.

There are two markets for carbon offsets. In the larger compliance market, companies, governments, or other entities buy carbon offsets in order to comply with caps on the total amount of carbon dioxide they are allowed to emit. This market exists in order to achieve compliance with obligations of Annex 1 Parties under the Kyoto Protocol.

In the much smaller voluntary market, individuals, companies, or governments purchase carbon offsets to mitigate their own greenhouse gas emissions from transportation, electricity use, and other sources.
Offsets are typically achieved through financial support of projects that reduce the emission of greenhouse gases in the short- or long-term. The most common project type is renewable energy, such as wind farms, biomass energy, or hydroelectric dams. Others include energy efficiency projects, the destruction of industrial pollutants or agricultural byproducts, destruction of landfill methane, and forestry projects.

The Kyoto Protocol has sanctioned offsets as a way for governments and private companies to earn carbon credits that can be traded on a marketplace. The protocol established the Clean Development Mechanism (CDM), which validates and measures projects to ensure they produce authentic benefits and are genuinely "additional" activities that would not otherwise have been undertaken. Organizations that are unable to meet their emissions quota can offset their emissions by buying CDM-approved Certified Emissions Reductions.

Offsets may be cheaper or more convenient alternatives to reducing one's own fossil-fuel consumption. Offsets are thus viewed as an important policy tool to maintain stable economies (Wikipedia 2013a).

A carbon credit on the other hand, is a generic term for any tradable certificate or permit representing the right to emit one tonne of carbon dioxide or the mass of another greenhouse gas equivalent to one tonne of carbon dioxide (tCO_2e).

Carbon credits and carbon markets are a component of national and international attempts to mitigate the growth in concentrations of greenhouse gases (GHGs). One carbon credit is equal to one metric tonne of carbon dioxide, or in some markets, carbon dioxide equivalent gases. Since GHG mitigation projects generate credits, this approach can be used to finance carbon reduction schemes between trading partners and around the world.

There are also many companies that sell carbon credits to commercial and individual customers who are interested in lowering their carbon footprint on a voluntary basis. These carbon offsetters purchase the credits from an investment fund or a carbon development company that has aggregated the credits from individual projects.

Buyers and sellers can also use an exchange platform to trade, such as the Carbon Trade Exchange, which is like a stock exchange for carbon credits (Wikipedia, 2013b). The quality of the credits is based in part on the validation process and sophistication of the fund or development company that acted as the sponsor to the carbon project. This is

reflected in their price. Voluntary units typically have less value than the units sold through the rigorously validated Clean Development Mechanism.

The Kyoto Protocol

The Kyoto Protocol to the United Nations Framework Convention on Climate Change(UNFCCC) is an international treaty that sets binding obligations on industrialised countries to reduce emissions of greenhouse gases. The UNFCCC is an environmental treaty with the goal of preventing "dangerous" anthropogenic (i.e., human-induced) interference of the climate system. The Protocol "recognises that developed countries are principally responsible for the current high levels of GHG emissions in the atmosphere as a result of more than 150 years of industrial activity, and therefore places a heavier burden on them under the principle of common but differentiated responsibilities". There are 192 parties to the convention, including 191 states (all the UN members, except Andorra, Canada, South Sudan and the United States) and the European Union C:\Users\hp\Documents\carbon trading\CDM\Kyoto Protocol - Wikipedia, the free encyclopedia.htm - cite_note-Ratification_of_Kyoto-12 The United States signed but did not ratify the Protocol and Canada withdrew from it in 2011. The Protocol was adopted by Parties to the UNFCCC in 1997, and entered into force in 2005.

As part of the Kyoto Protocol, many developed countries have agreed to legally binding limitations/reductions in their emissions of greenhouse gases in two commitments periods. The first commitment period applies to emissions between 2008 and 2012, and the second commitment period applies to emissions between 2013 and 2020. The protocol was amended in 2012 to accommodate the second commitment period.

The Kyoto protocol was the first agreement between nations to mandate country-by-country reductions in greenhouse-gas emissions. Kyoto emerged from the UN Framework Convention on Climate Change (UNFCCC), which was signed by nearly all nations at the 1992 Earth Summit. The framework pledges to stabilize greenhouse-gas concentrations "at a level that would prevent dangerous anthropogenic interference with the climate system". To actualize the pledge, a new treaty was needed, one with binding targets for greenhouse-gas reductions. That treaty was finalized in Kyoto, Japan, in 1997, after years of negotiations, and it went into force in 2005.

As part of the Kyoto Protocol, many developed countries have agreed to legally binding limitations/reductions in their emissions of greenhouse gases in two commitments periods. The first commitment period applies to emissions between 2008 and 2012, and the second commitment period applies to emissions between 2013 and 2020. The protocol was amended in 2012 to accommodate the second commitment period.

Nearly all nations have now ratified the treaty, with the notable exception of the United States. Developing countries, including China and India, weren't mandated to reduce emissions, given that they'd contributed a relatively small share of the current century-plus build-up of CO_2.
Under Kyoto, industrialized nations pledged to cut their yearly emissions of carbon, as measured in six greenhouse gases, by varying amounts, averaging 5.2%, by 2012 as compared to 1990. That equates to a 29% cut in the values that would have otherwise occurred.

The core commitment under the Kyoto Protocol, contained in Article 3, paragraph 1, requires each Annex I Party to ensure that its total emissions from GHG sources listed in Annex A to the Kyoto Protocol over the commitment period do not exceed its allowable level of emissions.

The allowable level of emissions is called the Party's assigned amount. Each Annex I Party has a specific emissions target inscribed in Annex B to the Kyoto Protocol, which is set relative to its emissions of GHGs in its base year. The Annex B emissions target and the Party's emissions of GHGs in the base year determine the Party's initial assigned amount for the Kyoto Protocol's five-year first commitment period (2008-2012). The quantity of the initial assigned amount is denominated in individual units, called assigned amount units (AAUs), each of which represents an allowance to emit one metric tonne of carbon dioxide equivalent (t CO2 eq).

The Kyoto Protocol allows Annex I Parties to add to and subtract from their initial assigned amount, in effect changing the level of their allowed emissions over the commitment period, through LULUCF activities and through participation in the Kyoto mechanisms. Through these activities, Parties may generate, cancel, acquire or transfer emission allowances, which will raise or lower their assigned amount. These emission allowances are collectively called Kyoto units, and are subject to specific rules, depending on the particular unit type (*The Guardian*, 2011).

The Protocol defines three "flexibility mechanisms" that can be used by Annex I Parties in meeting their emission limitation commitments. The flexibility mechanisms are International Emissions Trading (IET), the Clean Development Mechanism (CDM), and Joint Implementation (JI). IET allows Annex I Parties to "trade" their emissions (Assigned Amount Units, AAUs, or "allowances" for short).

These Kyoto mechanisms enhance the flexibility of Annex I Parties to meet their emission reduction or limitation commitments, by allowing these Parties to take advantage of lower-cost emission reductions outside their territories.

The economic basis for providing this flexibility is that the marginal cost of reducing (or abating) emissions differs among countries. "Marginal cost" is the cost of abating the last tonne of CO_2-eq for an Annex I/non-Annex I Party. At the time of the original Kyoto targets, studies suggested that the flexibility mechanisms could reduce the overall (aggregate) cost of meeting the targets.C:\Users\hp\Documents\carbon trading\CDM\Kyoto Protocol - Wikipedia, the free encyclopedia.htm - cite_note-hourcade_2001_economic_costs_of_flexibility_mechanisms-61 Studies also showed that national losses in Annex I gross domestic product (GDP) could be reduced by use of the flexibility mechanisms.

The CDM and JI are called "project-based mechanisms", in that they generate emission reductions from projects. The difference between IET and the project-based mechanisms is that IET is based on the setting of a quantitative restriction of emissions, while the CDM and JI are based on the idea of "production" of emission reductions. The CDM is designed to encourage production of emission reductions in non-Annex I Parties, while JI encourages production of emission reductions in Annex I Parties.

The production of emission reductions generated by the CDM and JI can be used by Annex I Parties in meeting their emission limitation commitments. The emission reductions produced by the CDM and JI are both measured against a hypothetical baseline of emissions that would have occurred in the absence of a particular emission reduction project. The reductions are called "credits" because they are emission reductions credited against a hypothetical baseline of emissions (Wikipedia 2013c).

In the Joint implementation (JI), Annex I Party can invest in a project that reduces emissions or enhances sequestration in another Annex I Party, and receive credit for the emission reductions or removals achieved through that project. The unit associated with JI is called an emission reduction unit (ERU). ERUs are converted from existing AAUs and RMUs before being transferred.

The Clean Development Mechanism
The Clean Development Mechanism (CDM) allows Annex I Party to invest in a project that reduces emissions or enhances sequestration in non-Annex I Party, and receive credit for the emission reductions or removals achieved through that project. Thus credits may be generated from emission reduction projects or from afforestation and reforestation projects in non-Annex I Parties.

These reductions are "produced" and then subtracted against a hypothetical "baseline" of emissions. The emissions baseline is the emissions that are predicted to occur in the absence of a particular CDM project. CDM projects are "credited" against this baseline, in the sense that developing countries gain credit for producing these emission cuts.

The CDM permits Annex I countries to partly meet their Kyoto targets by financing carbon emission reductions projects in developing countries. The economic rationale for including developing countries in efforts to reduce emissions is that emission cuts are thought to be less expensive in developing countries than developed countries. Thus emission reduction projects carried out in developing countries are arguably more cost effective than projects implemented in richer nations because developing countries have on average lower labor costs, weaker regulatory requirements, and less advanced technologies. The CDM is also meant to deliver sustainable development benefits to the host country (Stockholm Environment Institute and Greenhouse Gas Management Institute 2011).

The CDM has a dual objective:

- To help developing countries achieve sustainable development, and contribute to the ultimate objective of the Convention. Emissions in developing countries, which are presently low, might soon exceed those of developed countries, if measures are not taken to introduce reduced-emission technologies. The principle is to encourage investment flow and the transfer of technologies from the developed countries to the developing countries, to help them in their development trajectory while minimizing their greenhouse gas emissions.
- To help the developed countries fulfill their commitments to limit or reduce emissions (Kasenty et al Ibid).
- The CDM could play three important roles in climate change mitigation.
- Improve the cost-effectiveness of GHG mitigation policies in developed countries.
- Help to reduce "leakage" (carbon leakage) of emissions from developed to developing countries.
- Boost transfers of clean, less polluting technologies to developing countries (Wikipedia 2013d).

The CDM grants "Certified Emission Reductions" (CERs) to projects located in developing countries that contribute to reducing greenhouse gas concentrations in the atmosphere. CERs are emission permits that can be purchased and used by entities in Annex I countries for reaching the assigned amounts set by the Protocol for the first commitment period in 2008-2012. They can be remunerated, and are therefore added revenue for a project. The CDM could therefore be a windfall for developing countries, and could promote transfers of funds and technologies from private or public entities in the developed world. Thus, the CDM is designed to function as a lever for clean development.

The CDM's innovation resides in its quasi infinite potential – as long as a demand for emission permits exist – to attract investment flows from developed countries to developing countries. The value of CERs will be the result of transactions on the carbon market, and, at the project level, of a contractual agreement between the investor, the project developer, and the land-owner

Unlike emissions trading and JI, projects under the CDM create new Kyoto units and their acquisition by Annex I Parties increases both the total assigned amount available for those Annex I Parties collectively and their allowable level of emissions.

CDM projects result in three types of Kyoto units. Certified emission reductions (CERs) are issued for projects that reduce emissions, while temporary CERs (tCERs) and long-term CERs (lCERs) may be issued for projects that enhance removals through afforestation and reforestation projects.

The Afforestation /Reforestration Project in the Clean Development Mechanism

The decisions of the 9th Conference of the Parties (CoP9) of the United Nations Framework Convention on Climate Change (UNFCCC) prepared the inclusion of afforestation and reforestation projects within the framework of the CDM. This class of projects is based on the fact that forests absorb atmospheric carbon-dioxide for a certain time (the lifetime of the forest).

Forestry projects can therefore be used as a buffer until the CO_2 reductions in energy production and other processes are feasible in an affordable manner and on a large scale.

The Clean Development Mechanism Afforestation/reforestation (CDM AR) project is one of the major groups of projects under CDM. The other project types include renewable energy, methane abatement, energy efficiency and fuel switching.

The CDM AR projects are defined under article 3, paragraph 3 of the Kyoto Protocol. Article 3, paragraphs 3 activities which are defined on the basis of landuse, encompass land which has been subject to direct, human-induced conversion from a forested to a non-forested state, or vice versa. The land conversion must have occurred after 31 December 1989, and must be consistent with the Party's parameters for the definition of a forest, as reported in its initial report. Article 3, paragraph 3, activities are as follows:

Afforestation and reforestation (AR) activities refer to the conversion of non-forested land to a forested state. Afforestation means the human-induced conversion to forest of

land that has been non-forested for at least 50 years at the time of conversion; reforestation refers to the conversion to forest of land that has been non-forested for a shorter period of time. Since the methodologies for estimating emissions and removals from afforestation and reforestation are identical, the two activities are treated as one for reporting and accounting purposes under the Kyoto Protocol (UNFCCC, 2008).
According to Manguiat *et al* (2005), possible types of CDM AR projects include agroforestry, monocultural or mixed industrial plantations, forest landscape restoration projects on degraded or protected lands, community forest projects, and other AR projects which focus on timber production, biomass energy, and watershed management.

Agroforestry refers to systems of mixing agricultural or horticultural crops and/or livestock with woody perennials. Integrating trees on farms into the wider agricultural landscape can improve the balance between food production, poverty alleviation and environmental management. Agroforestry is practised in temperate as well as in tropical regions, in arrangements varying from simple (e.g. scattered trees in and live fences around farmland) to complex (e.g. multi-storey home gardens). It includes silvo-pastoral systems, urban agroforestry and crop-fallow rotations. Agroforestry is attractive to small-scale farmers, who can benefit from the income, products (fruits, vegetables, fodder, medicines, oils, nuts, fibres, fuel-wood and timber) and services (recycling of nutrients, water retention, and soil protection) that it provides. Manguiat *et al* (Ibid.) quoting the Intergovernmental Panel on Climate Change, reiterated that agroforestry holds the largest potential for global carbon sequestration.

Monocultural or mixed industrial plantations are for economic reasons quite popular indeveloped and developing countries. They require intensive technical knowledge as well as significant up-front investments, but also feature relatively simple management schemes while offering competitive rates of return to invested capital. While in many cases plantations may represent an ecological deterioration compared to the natural ecosystem, they also often represent the only viable option for already highly degraded sites.

Forest landscape restoration can generate considerable environmental and socio-economic benefits. It is a framework that builds on a number of existing rural development, conservation and natural resource management principles and approaches. It helps restore many of the goods and services that enhance ecological integrity and provide tangible benefits to local people living in degraded or deforested landscapes. It differs from more conventional approaches, which tend to be limited to increasing tree cover, usually for a limited range of goods and services. Forest landscape restoration employs many technical approaches, including natural regeneration, tree planting and agro-forestry. In many settings, wood-lots, scrub, forest fragments and other natural

vegetation can be restored to perform the main functions of a forest, on which households and communities rely for their livelihoods.

Community forestry emphasizes the social dimension of forestry and its contribution to sustainable livelihoods of rural people. It includes efforts by communities to recognize and make use of the economic, social and environmental opportunities provided by local forest resources. Technically, community forestry may include inter alia agroforestry, plantation or forest restoration measures. Community forestry projects are often, but not necessarily, small- to medium-sized.

Biomass energy projects serve the production of energy in the form of electricity, solid, liquid or gaseous fuels and heat, which is based on biomass. Biomass would refer to any organic matter that is available on a renewable basis and could include agricultural crops, timber and organic waste. Fire wood is a very basic, widely spread and often highly inefficient form of biomass energy medium. Elaborated biomass energy projects include, e.g. gasification of woodchips or industrial production of charcoal for purposes such as pig iron production.

Constraints to Clean Development Mechanism Afforestation/ Reforestation Project

The inclusion of project activities from the land use, land use change, and forestry (LULUCF) sector into the Clean Development Mechanism (CDM) and Joint Implementation (JI) frameworks has been a subject of great contention. According to Streck *et al* (2006) the issues for concern comprise the loss of temporarily stored carbon (the *permanence* problem), the problems of additionality, leakage, measurement and monitoring, loss of biodiversity and livelihood as well as sustainable development issues.

Additionality

Additionality implies that CDM projects must demonstrate that the carbon sequestration or emission reductions would not have occurred if it were not for the incentives provided by the existence of the Kyoto Protocol.

Regarding the additionality aspect of the Kyoto Protocol, LULUCF projects do not differ from any other emission reduction projects leading to permanent carbon credits. Rules, regulations and procedures for handling the additionality problem equally apply to all climate project types.

The Marrakesh Accords and subsequent decisions on the CDM state that a LULUCF project is additional if the actual net greenhouse gas removals by sinks are increased above the removals that would have occurred in the absence of the proposed project activity (i.e., in the baseline scenario).The difference is the amount of greenhouse gas reductions that can be claimed as CDM credits.

Projects can demonstrate they are additional when:

(i) The project faces barriers to its implementation that cannot be surmounted without carbon finance (e.g., costs of converting open gardens to agroforestry);

(ii) The activity without carbon finance is not economically or financially the most attractive course of action even if it is the most climate and environmentally and socially acceptable, and hence will not attract the required project financing (e.g., in small-scale forestry projects); or

(iii) The project brings together several activities that would not have been carried out other than because of the incentive provided by carbon finance (e.g., implementing a mix of agroforestry, community forestry and forest conservation across a landscape).

Leakage

Some projects will be successful in sequestering carbon within the project area, but the project activities may change activities or behaviours elsewhere. These changes may lead to reduced sequestration or increased emissions outside the project boundary, negating some of the climate benefits of the project. These unintended side effects are called leakage. A simple example is a project that reforests an area of poor-quality grazing land, but leads to the owners of the displaced livestock to clear land outside the project boundaries to establish new pastures. The types of activities that might result in leakage vary by project type, but both LULUCF and non-LULUCF projects are subject to leakage.

Developers of LULUCF and non-LULUCF CDM projects are recommended to address leakage in the project design, or otherwise account for it by subtracting it from the project performance. Only negative leakage (increased GHG emissions) must be included. Positive leakage (reduced GHG emissions) – although a beneficial result of the activity – may not be accounted for.

By excluding avoided deforestation projects from the CDM, the negotiators eliminated the project class that raised most concerns with respect to the leakage risk.

Leakage can often be minimized by good project design – such as in the example above, by including improved pasture management around the plantation so that displaced livestock can be accommodated without further clearing. A well-designed monitoring plan helps further mitigate leakage-related project risks.

Measurement and Monitoring

Scientific complexity, insufficient data and the challenge of monitoring LULUCF projects has also led to criticism of such projects. The accounting rules for carbon removals therefore command a cautious approach in measuring and monitoring sequestration activities.

Full carbon accounting, i.e., the assessment of carbon fluxes within all compartments of a forest ecosystem, can be achieved by choosing between various scientific models, which have been developed by the FAO and scientific forestry research institutions. Reliable and approved measuring methods, the design and application of a comprehensive monitoring methodology and the verification of specific project setups by an experienced Designated Operational Entity (DOE) is intended to resolve the most critical arguments brought up against LULUCF projects, such as imprecise estimation of carbon sequestered, leakage or potentially negative environmental and social impacts.

Applying state-of-the-art remote sensing techniques in combination with terrestrial surveys guarantees the accurate monitoring of activities and impacts during the project's lifetime. In many countries complex Geographic Information Systems (GIS) have been installed which provide useful information on the history and development of natural resources, and facilitate monitoring.

Sustainable Development

The sustainable development concern focuses on the probability of CDM projects to unintentionally promote the development of LULUCF projects that are detrimental to local communities and the environment. Such a project for instance can be an insensitively managed monoculture plantations, which cheaply sequestered carbon, but at the expense of sustainable livelihoods and biodiversity.

The sustainable development concern has been partly taken care of with the CDM additionality test which stipulates that typical large-scale timber projects, which make economic sense without carbon finance, are not eligible for crediting. Furthermore, the Protocol attempts to directly address the sustainable development concern by requiring that all CDM projects describe socio- economic and environmental impacts in their Project Design Documents, which must be submitted and approved before credits can be issued. Host governments are expected to deny approval to projects that do not further their country's sustainable development goals.

To further address project impacts, qualitative criteria such as the Climate, Community & Biodiversity (CCB) Standards can be used to design and evaluate land-based carbon projects. CCB certified projects are independently verified to ensure that the project conserves biodiversity and supports local communities in addition to benefiting the global climate. In addition, most major funders/donors have their own sustainability screening criteria, which include environmental and social assessments to ensure the integrity of the projects they support.

Permanence

A major and exclusive challenge of CDM AR is the permanence risk which expresses serious concern that credits issued for carbon sequestration may become void in cases where human action or natural events, such as wildfires, reversed the carbon benefits.
As forest absorption of CO_2 is limited by its lifetime and deforestation processes consequently lead to re-emitting the CO_2, forestry projects suffer from the problem of *non- permanence*.

The most significant difference between CDM AR projects and energy-related CDM projects is the temporary nature of carbon storage- the so-called non-permanence of biologically sequestered carbon. While avoided emissions in energy CDM projects will not reoccur so easily and are therefore considered permanently avoided emissions, carbon stored in biomass and soils can be re-emitted to the atmosphere through decomposition and mineralization, fire, pests, etc.

The effort made to solve the problem of non-permanence was in the direction of creating two different sorts of "temporary" Certified Emission Rights (CERs) that are issued following a verification of the absorbed CO_2: *the tCERs and the lCERs*. In this regard, Certified Emissions Reductions (CERs) arising from CDM afforestation and reforestation projects would be issued with a defined expiry date, but could be re-issued or renewed every five years after an independent verification to confirm sufficient carbon was still sequestered by the project to account for all credits issued.

A project sponsor can decide in the beginning of the project on one of the two approaches. If the lCER approach is chosen, a project generates at first verification a certain amount of lCERs that are valid till the end of the project. The absorbed amount is regularly verified by an independent verifier. If during the verification, it is recognized and reported that the absorbed amount has increased, additional lCERs are issued (as forests grow this should be the usual case). If, however, the absorbed amount has diminished, the respective amount of lCERs is invalidated.

In contrast, tCERs can only be used for compliance or traded in the Kyoto Protocol commitment period during which they were certified, hence their life-time is limited to five years, after which they will have to be re-certified, which in turn increases transaction costs.

The economic attractiveness of temporary CER is expectedly quite limited. lCERs may be valid up to 60 years, but re-verification is due every five years. Additionally, CERs from AR projects may only be used for compliance up to a cap of 1% of each Annex I country's 1990 emissions, and they are not bankable for compliance in future commitment periods.

Both limitations have a few practical implications. tCERs and lCERs will be discounted by market participants for two reasons: On the one hand, the inherent project risk of losing (parts of) the carbon sequestered falls back to the credits' owner on re-verification every five years. On the other hand, their value is determined by the costs of replacing them with other emission allowances after the end of the project lifetime. These may turn out to be much higher than in the time the tCERs or lCERs were acquired. Depending on the expectations for future carbon prices, the net present value of lCERs is unpredictable. The tCER value is estimated at around 14-30% of the value of CERs from GHG source reduction projects.

According to Ohndorf (2006), if the amount of absorbed carbon has diminished from one verification period to another (e.g. due to a forest fire), the buyer country of the temporary CERs is liable for the replacement of those certificates that are no longer available to meet its target. If the temporary CERs have been used by the project investor in order to fulfill his individual emission target as a private entity within the country, the country will probably transfer the obligation of replacement to the respective entity. There is, however, within the Kyoto institutions no possibility to have recourse to the seller country or the project sponsor (who will usually be a private entity registered in the seller country).

In most cases, the influence of the buyer country or the project investor on forest management will be quite small. The forest management activities are likely to be within the responsibility of the project sponsor or some agent sub-contracted by him. Precautions against events that reduce the amount of carbon absorbed by the forest – such as forest fires, infestation with parasites or illegal logging – can be implemented by the project sponsor at lower cost than by the investor.

Economic theory suggests that the responsibility for a damage should be attributed to the party that can best prevent it. By attributing the responsibility for replacing invalid temporary CERs completely to the buyer countries, the Kyoto rules disrespect this "principle of the cheapest cost avoider". If this shortcoming in the Kyoto rules is not corrected for, these rules are likely to lead to an inefficiently low level of precaution.

The resulting higher risk of the investor will be reflected in lower prices for temporary CERs. This obviously leads to a decrease in the implementation of higher-quality projects that usually imply higher costs of precaution. Therefore, the attribution of full liability to the buyerentails a problem of adverse selection that disincentivizes the implementation of projects with higher levels of precaution.

There are several factors that increase this disincentive. One important aspect is the distribution of the investor's payment to the sponsor over time. The higher the "start-up" investment and the lower the contracted unit-price of the temporary CERs, the lower are the sponsor's expected revenues after the initial investment in the future. The level of precaution will therefore decrease the more, the higher the initial investment is. Furthermore, the incentive to lower the cost of precaution will increase with project duration as the remaining future revenue flows decrease with the project's progress in time. As project duration is limited, there might be the possibility of an uncooperative end-game phenomenon.

Another problem with attributing the liability completely to the buyer results from the fact tha the has to bear the risk of changes in the seller's opportunity costs. If, for example, timber prices rise, a breach of the contract by the project sponsor might become profitable. As in a system of pure buyer liability the seller does not have to compensate the investor, the risk of such price changes lies with the buyer of the temporary CERs. Again, if the attribution of responsibility to replace the temporary CERs is not corrected for at the contractual level, this will lead to a decrease of attractiveness of CDM forestry projects and result in lower prices for temporary CERs. The pure buyer liability established in the Kyoto Protocol could be corrected for by a more efficient sharing of responsibilities at the level of the purchase contract.

Due to the non-permanent nature of carbon offsets stemming from CDM forestry projects, the buying party of the contract faces the same problem as the buyer country within the regulations of the Kyoto protocol. Changes in opportunity costs, like rising timber prices leading to deliberate harvest, or high control costs with respect to the precaution level can lead to opportunistic behavior on the part of the seller. The incentive problem is most obvious in the case of the lCER approach. The lCERs can be invalidated by activities (deliberate harvest) or inactivity (low levels of precaution) by the project sponsor. In the case of the tCERs the problem may be less obvious. If the number of tCERs that can be sold to the investor is lower than planned, the project sponsor will have a lower cash flow on the project.

However, in the tCER approach there is potential for opportunistic behavior as well, as theproject investor – while managing his carbon portfolio – is planning with the contracted amount. Furthermore, in both approaches there is the risk of being (partly of fully) expropriated of the initial investment.

One possibility to guarantee the planned amount of temporary CERs within the buyers' carbon management is to follow a self-insurance strategy: In this regards, the buyer could foresee possible shortfalls within the management of his offset portfolio by taking into

account the probabilities of underperformance of different sellers. This strategy will, however, not solve the underlying moral hazard problem as the incentives to opportunistic behavior from the part of the seller(s) are not mitigated. From a perspective of economic efficiency it seems to be more reasonable to include contract provisions that deal with non or under performance and to include damage payments.

Furthermore, on a project level, developers can help ensure that the carbon benefits (and credits) associated with their projects will remain intact for many decades by incorporating activities that are sufficiently rewarding to local people so they are encouraged to continue with those activities in the future. This encouragement can be backed by contractual agreements that require the emission reductions to be maintained for a long time. Besides designing projects to reduce permanence risk upfront, prudent project developers hold significant buffer stocks to mitigate against unplanned losses of carbon through disturbances such as fires.

Conclusion

A peculiar and important issue of the CDM AR project is that of the permanence problem which may be informed by natural disasters or opportunistic behaviour of the project sponsor if by chance the value of timber rises. This permanence problem has consequently resulted in low prices for temporary Certified Emission Reductions (tCER and lCER) associated with CDM AR projects.

Urban forestry which is apparently missing from the list of CDM AR possible projects can be a way to mitigate the problem of permanence and also enhance the achievement of the objective of CDM for developing countries. Urban forestry development spearheaded by State Governments is less likely to suffer grievous loss from natural disasters that can be responsible for a significant loss of CER in the rural forest ecosystem. Furthermore, since timber production is not a primary objective of urban forestry, there will be no incentive for opportunistic behaviour by project sponsor or CER seller because even if the prices of timber rises, the essence of the urban forest will be for provision of amenity services.

The idea of using urban forestry for CDM has been successfully implemented in New Delhi, Indian, where the Delhi government's urban forestry project in the wasteland of Deramandi has been chosen by the United Nations Framework Convention Climate Change (UNFCC) for clean development mechanism (CDM) (The Times of India, 2013)

References

Investopedia (2013). What is the Carbon Trade?.www.investopedia.com. Site visited on 06-10-2014

Kasenty A., Blanco C., and T. Dufour (2003). Forest and Climate Change. Instruments related to the United Nations Framework Convention on Climate Change and their potential for sustainable forest management in Africa. Published by FAO, Rome, Italy.

Manguiat, Maria, Socorro Z, Verheyen R., Mackensen J. and G. Scholz (2005). Legal Aspects in the Implementation of CDM Forestry Projects. IUCN Environmental Law Programme. IUCN Environmental Policy and Law Paper No. 59.IUCN – The World Conservation Union.

Ohndorf Markus (2006). Optimal Damage Schemes for CDM Forestry Projects. Second Draft Preliminary Working Paper. Institute for Environmental Decisions.

Sarah Dowdey (2014). How Carbon Offsets Work. www.howstuffworks.com. Site visited on 06-10-2014.

SourceWatch (2011). Carbon trading. www.sourcewatch.orgSite visited on 06-10-2014.

Stockholm Environment Institute and Greenhouse Gas Management Institute (2011). Mandatory and Voluntary Offset Markets.

Streck C., Janson-Smith T. and J. Schnurr (2006). Key Technical Issues Relevant to CDM Forestry Projects.

The Guardian (2011). What is the Kyoto protocol and has it made any difference?www.theguardian.com. Site visited on 06-10-2014.

The Times of India (2013). Delhi's urban forestry project to get carbon credits.

UNFCCC (2008). Kyoto Protocol Reference Manual on Accounting of Emissions and Assigned Amount.

Wikipedia (2013a). Carbon offsets. http://en.wikipedia.org/wiki/Carbon off sets Site visited on 06-10-2014.

Wikipedia (2013b). Carbon credit. http://en.wikipedia.org/wiki/Carbon credit Site visited on 06-10-2014.

Wikipedia (2013c). Kyoto protocol. http://en.wikipedia.org/wiki/Kyoto Protocol Site visited on 06-10-2014.

Wikipedia (2013d). Clean Development Mechanism. http://en.wikipedia.org/wiki/Clean Development Mechanism Site visited on 13-10-2014.

Wikipedia (2014a). Emission trading. http://en.wikipedia.org/wiki/Emission trading Site visited on 06-10-2014.

Wikipedia (2014b). Carbon Emission Trading. http://en.wikipedia.org/wiki/Carbon emission trading. Site visited on 06-10-2014.

wiseGEEK (2013). What is Carbon Trading? www.wiseGEEK.comSite visited on 13-10-2014.