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PLANTATIONS AND GREENHOUSE GAS MITIGATION: A SHORT REVIEW

Based on the work of

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The purpose of these papers is to provide early information on on-going activities and programmes, and to stimulate discussion.

Comments and feedback are welcome.

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CONTENTS

1 INTRODUCTION

Since the establishment of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992, policy developments associated with the role of forests in mitigating greenhouse gases have been both rapid and complex. The Kyoto Protocol, with its binding commitments to reduce greenhouse gas emissions, outlines the ways in which afforestation, reforestation and deforestation, and other land use activities have potential in achieving the framework's aims. Included in the Protocol are three flexibility mechanisms designed to facilitate the realisation of emission reduction targets. The exact definition of how forestry can be included under the Protocol is not entirely clear and open to different interpretations. This is particularly true for the eligibility of land use based activities under the clean development mechanism.

Despite these uncertainties, an increasing number of forestry-based emission reduction projects have been established in parallel to the ongoing policy developments. To date, there are more than 40 forestry projects with the main objective of fixing carbon or preventing its release to the atmosphere. Many are based on reforestation or other tree-planting activities. Although the market for forestry based carbon offsets is still dependent on policy decisions, there is the potential for considerable infusion of capital into the forestry sector. For such investment foresters need greater understanding of carbon markets and the mechanisms for credit transactions, and how this new commodity will affect management practices.

This working paper reviews the evolution of the markets and transaction mechanisms for carbon offsets and greenhouse gas reductions. Although the concepts and ideas are generic and applicable to any type of greenhouse gas mitigation option, the paper focuses on forestry-based carbon offsets.

2 POLICY BACKGROUND

2.1. The UNFCCC and the concept of Joint Implementation

In July 1992, representatives from 155 nations gathered in Rio de Janeiro for the United Nations Conference on Environment and Development (UNCED). Recognition that climate change was a reality led to the signature of the United Nations Framework Convention on Climate Change (UNFCCC), which resulted in a voluntary commitment by industrialised countries (Annex 1 countries, see Box 1) to reduce their emissions to the 1990 levels until the year 2000. Imbedded in the agreement was the concept of Joint Implementation (JI) with other countries to reduce greenhouse gases. Investors financing these projects would be allowed to claim credits for the carbon emission reduction or carbon sequestration. These credits should be equivalent to the carbon sequestration derived from the investment, and investors would be allowed to use them to lower greenhouse gas related liabilities (e.g. carbon taxes, emission caps, etc.) in their home countries. The rationale of JI is that the marginal costs of emission reduction or CO_2 sequestration are generally lower in developing than developed countries.

2.2. The 'Activities Implemented Jointly' pilot phase

Dissatisfaction between G77 countries over the concept of JI led to a growth in opposition to this JI model. Perceived problems included that this was a mechanism for industrialised countries to avoid addressing the real issues of reducing emissions at source. It was also felt that developing countries might hand over all their cheap offset opportunities to industrialised countries in this initial phase while they had no commitments to greenhouse gas reductions.

In the first Conference of the Parties (CoP 1) to the UNFCCC held in 1994, this dissatisfaction was voiced as a formal refusal of JI. Instead, a compromise was accepted to have a pilot phase during which projects were called 'Activities Implemented Jointly' (AIJ). During the AIJ Pilot Phase, JI projects were conducted with the objective of establishing protocols and experiences, but without allowing actual transfer of carbon credits between developed and developing countries.

2.3. The Kyoto Protocol

In December 1997, the Kyoto Protocol was conceived during CoP 3 of the UNFCCC. The most important aspect of the Kyoto Protocol is the binding commitment by 39 developed countries and economies in transition (Annex B countries, see Box 1) to reduce their greenhouse gas emissions by an average of 5.2% of 1990 levels by the commitment period in 2008-2012. The Protocol also approved the use of three 'flexibility mechanisms' for facilitating greenhouse gas emission reduction targets. These are QUELRO trading, Joint Implementation (JI) and the Clean Development Mechanism (see Box 1 for definitions).

Another important output of the agreement was the recognition of forestry activities or 'sinks' as valid options for reducing the net concentration of atmospheric greenhouse gases. This is mentioned in Articles 3.3 and 3.4 of the Protocol, which deal with "afforestation, reforestation and deforestation" and "additional human-induced activities related to … land use change and forestry", respectively. It is clear in the Protocol that Annex 1 countries are required to report on land use changes that have occurred since 1990, and are responsible for any changes in carbon stocks associated with these. It is less clear in the Protocol which forestry activities can be conducted as part of Article 12, the Clean Development Mechanism (see below).

The Kyoto Protocol was opened for ratification on March 16, 1998 and becomes legally-binding 90 days after the 55th government ratifies it, assuming that those 55 countries account for at least 55 percent of developed countries emissions in 1990. As of February 2001, 84 Parties had signed the Kyoto Protocol and 32 had ratified it.

2.4. Project-based mechanisms: the Clean Development Mechanism (CDM) and Joint Implementation (JI)

The Kyoto Protocol created two flexibility mechanisms related to project-based activities: the Clean Development Mechanism (CDM) and Joint Implementation (JI). In short, the CDM involves investment by developed countries in carbon offset projects in developing countries. As defined by the Protocol, its purpose is twofold: firstly, to assist developing countries (non-Annex I Parties) in making progress towards sustainable development and contributing to the UNFCCC's objectives; and secondly, to assist developed countries and economies in

BOX 1. A GLOSSARY OF TERMS RELATED TO CLIMATE CHANGE MITIGATION PROJECTS

Since the early 1990's, a variety of terms have been used to refer to different project-level climate change mitigation mechanisms and their outputs. The meanings of these terms have changed gradually. Below are some of the definitions that have been used. Most bear some relation to stipulations of the UN Framework Convention on Climate Change (UNFCCC) signed in 1992, whose provisions are fleshed out by the Kyoto Protocol, signed in December 1997.

MECHANISMS (1) --- EARLY PRE-KYOTO DEFINITIONS

Joint Implementation (JI)
The concept of joint implementation (JI) was introduced by Norway into pre-UNCED negotiations in 1991. This was reflected in Article 4.2(a) of the UNFCCC which gives Annex I countries (see below) the option of contributing to the Convention's objectives by implementing policies and measures jointly with other countries. The investing participants in these projects could presumably claim emission reduction 'credits' for the activities financed, and these credits could then be used to lower greenhouse gas related liabilities (e.g., carbon taxes, emission caps) in their home countries.
Activities Implemented Jointly (AIJ)
In the first Conference of the Parties (CoP 1) to the UNFCCC held in 1995 in Berlin, a Pilot Phase of Activities Implemented Jointly (AIJ) was created. During the AIJ Pilot Phase, projects were conducted with the objective of establishing protocols and experiences, but without allowing carbon credit transfer between developed and developing countries. The AIJ Pilot Phase is to be continued at least until the year 2000.

MECHANISMS (2) --- POST-KYOTO DEFINITIONS

The Kyoto Protocol of the UNFCCC created three instruments, collectively known as the 'flexibility mechanisms', to facilitate accomplishment of the objectives of the Convention. A new terminology was adopted to refer to these mechanisms, as detailed below. Note that because of the Kyoto Protocol's distinction between projects carried out in the developed and developing world, some AIJ projects may be reclassified as CDM or JI projects.

Joint Implementation (JI)
Set out in Article 6 of the Protocol, JI refers to climate change mitigation projects implemented between two Annex 1 countries (see below). JI allows for the creation, acquisition and transfer of "emission reduction units" or ERUs.
The Clean Development Mechanism (CDM)
The CDM was established by Article 12 of the Protocol and refers to climate change mitigation projects undertaken between Annex 1 countries and non-Annex 1 countries (see below). This new mechanism, whilst resembling JI, has important points of difference. In particular, project investments must contribute to the sustainable development of the non-Annex 1 host country, and must also be independently certified. This latter requirement gives rise to the term "certified emissions reductions" or CERs, which describe the output of CDM projects, and which under the terms of Article 12 can be banked from the year 2000, eight years before the first commitment period (2008-2012).
QUELRO (Quantified Emission Limitation and Reduction Obligations) trading
Article 17 of the Protocol allows for emissions-capped Annex B countries to transfer among themselves portions of their Assigned Amounts (AAs) of greenhouse gas emissions. Under this mechanism, countries that emit less than they are allowed under the Protocol (their AAs) can sell surplus allowances to those countries that have surpassed their AAs. Such transfers do not necessarily have to be directly linked to emission reductions from specific projects.

WHICH COUNTRIES IN WHICH MECHANISMS?

Annex 1 countries
These are the 36 industrialised countries and economies in transition listed in Annex 1 of the UNFCCC. Their responsibilities under the Convention are various, and include a non-binding commitment to reducing their greenhouse gas emissions to 1990 levels by the year 2000.
Annex B countries
These are the 39 emissions-capped industrialised countries and economies in transition listed in Annex B of the Kyoto Protocol. Legally-binding emission reduction obligations for Annex B countries range from an 8% decrease (e.g., EC) to a 10% increase (Iceland) on 1990 levels by the first commitment period of the Protocol, 2008 – 2012.
Annex 1 or Annex B?
In practice, Annex 1 of the Convention and Annex B of the Protocol are used almost interchangeably. However, strictly speaking, it is the Annex 1 countries which can invest in JI/CDM projects as well as host JI projects, and non-Annex 1 countries which can host CDM projects, even though it is the Annex B countries which have the emission reduction obligations under the Protocol. Note that Belarussia and Turkey are listed in Annex 1 but not Annex B; and that Croatia, Lichenstein, Monaco and Slovenia are listed in Annex B but not Annex 1.

PROJECT OUTPUTS

Carbon offsets – used in a variety of contexts, most commonly either to mean the output of carbon sequestration projects in the forestry sector, or more generally to refer to the output of any climate change mitigation project.
Carbon credits – as for carbon offsets, though with added connotations of (1) being used as 'credits' in companies' or countries' emission accounts to counter 'debits' i.e. emissions, and (2) being tradable, or at least fungible with the emission permit trading system.
ERUs (emission reduction units) – the technical term for the output of JI projects, as defined by the Kyoto Protocol.
CERs (certified emission reductions) – the technical term for the output of CDM projects, as defined by the Kyoto Protocol.

transition (Annex I Parties) in achieving their emission reduction targets. Non-Annex I Parties are supposed to gain the economic, developmental and environmental benefits from

implemented projects that generate Certified Emission Reductions (CERs) for export. An important facet of the CDM is that these CERs are supposed to be bankable from the inception of the CDM that was originally planned to start in 2000.

Other features of the CDM include:

- project activities must be additional to activities that would happen in a business-as-usual scenario;
- the CDM is open to participation by either private or public entities, or combinations of the two;
- projects must have the express approval of the host government;
- CDM projects must be independently certified;
- the CDM also has a mandate to use a portion of its proceeds to assist those countries, which are particularly vulnerable to climate change, to adapt to those changes.

The operational structure of the CDM is under development and is expected to be defined during the Sixth Conference of Parties to the UNFCCC (CoP 6).

Joint Implementation, on the other hand, is a parallel mechanism based on projects involving Annex I parties only. Article 6 of the Protocol defines JI as the creation, acquisition and transfer of emission reduction units (ERUs) between Annex I parties (developed countries and economies in transition), that result from projects aimed at reducing emissions at sources or enhancing greenhouse gas removals by sinks. Credits from JI will only start accruing from the beginning of the first commitment period in 2008-2012.

2.5. The Clean Development Mechanism and forestry - are land use activities eligible?

Although Article 3.3 of the Kyoto Protocol specifically mentions the role of afforestation, reforestation and deforestation (although not forest conservation) for reaching the targets agreed by Annex B countries, Article 12 on the CDM refers only to “emission reductions” with no mention of any specifically eligible activities. This vagueness of the Protocol has allowed a disturbingly broad scope for interpretation, and totally opposite views have been put forward.

Countries that want forestry included have argued that Article 12 implicitly refers to the activities listed in the main body of the Protocol text (Articles 3.3 and 3.4), while those that do not want forestry included argue that only fossil fuel based emission-reduction activities should be allowed. Even among those promoting forestry, a further point of contention is the types of forestry activities which should be allowed. Some countries propose only those activities listed in Article 3.3, afforestation, reforestation and deforestation, and others promote a much wider range of land use activities as in the spirit of Article 3.4 (“other activities”).

Contention over the inclusion of forestry in the CDM led delegates at the CoP 4 meeting in Buenos Aires in November 1998 to defer any decision until CoP 6. This has been a central issue during the CoP 6, leading to the breaking of the talks in November 2000. This issue will now be revisited in the second part of CoP 6, expected to take place in June-July 2001. In the meantime, an international collaborative research network of forest scientists under the auspices of the IPCC (Intergovernmental Panel on Climate Change) was commissioned to prepare a special report on land use, land use change and forestry (IPCC, 2000). The objective

was to provide policy makers with the necessary information to allow the implementation of the forestry aspects of the Kyoto Protocol, by reviewing the requirements and outcomes of different policy options. Chapter 5 of the special report deals with forestry projects, and is generally positive about the potential and feasibility of using this greenhouse gas mitigation option.

Since the CDM was initially proposed many developing countries have supported the inclusion of some types of land use activity. Latin American countries, and in particular Costa Rica, Argentina, and Bolivia, have been the most vociferous proponents of CDM forestry, with the equally vocal exception of Peru. Brazil has recently moved to supporting the inclusion of reforestation and afforestation, but remains opposed to activities involving forest conservation. Indeed this position was explicitly stated at CoP 5, and enshrined in the so-called Cochabamba Declaration in June 1999, at which the Ministers of Bolivia, Brazil, Ecuador, and Colombia agreed on a common strategy regarding the CDM and the Amazon Basin. This declaration included the following paragraphs:

"(We) recommend the inclusion of forestry projects within the CDM, including activities for forestation, re-forestation, restoration, and sustainable management of the natural forests.

(We) recommend the analysis of the inclusion of conservation of natural forests, with the requirement that this type of project not be eligible for implementation among Annex 1 countries."

Asian countries have been less active on CDM issues, but Malaysia and Indonesia appear to support the inclusion of forestry while India and China are strongly against. Reasons for this opposition are essentially that India favours energy and technology transfer projects, while China opposes the use of any market-based instruments *per se*. African countries have moved from their generally sceptical position on carbon offset forestry, driven in part by their negotiating position's focus on capacity building and developmental assistance, to one of partial endorsement. At CoP 5, the Africa Group stated its support for the inclusion of afforestation and reforestation in the CDM, as well as the preservation of wetlands. Uganda leads this position having already hosted two carbon-offset projects.

Industrialised countries are also divided on their views of forestry in the CDM. The European Union, whilst not in complete opposition, is keen to maintain the current 'slow track' approach, even in the light of the conclusions of the IPCC report. Within the European Union however, Holland is a relatively strong proponent (having led the way with carbon offset projects through the FACE Foundation), with Germany and the United Kingdom more cautious. Japan, United States, Canada, Australia, New Zealand and Iceland, all strongly in favour of a wide role for sinks in meeting the Kyoto commitments, the CDM included. Furthermore, the United States is pushing strongly for agriculture and particularly agricultural soils to be included, under the open-ended Article 3.4. The degree to which this will also apply to eligible land use activities under the CDM is unclear.

Polemic also prevails amongst the international Non Governmental Organisations (NGOs). While some NGOs strongly favour forestry's inclusion in the CDM (e.g., The Nature Conservancy, Conservation International, Winrock Foundation, Sierra Club), other NGOs are still quite uncertain and suspicious (e.g., WWF International, Greenpeace, Friends of the Earth). There is some support for the CDM from grass-roots organisations and local NGOs. They see the CDM as a potential source of funding for their programmes (e.g., see Letter of

Brasilia, 1998; also the variety of NGOs involved in carbon offset projects - Tipper 1997). However, others see it as another threat to the rural poor from the processes of globalisation (e.g., Centre for Science and Environment, India).

3 SCIENTIFIC CONCEPTS

Carbon sequestration through forestry is based on two premises. First, carbon dioxide is an atmospheric gas that circulates globally and, consequently, efforts to remove greenhouse gases from the atmosphere will be equally effective whether they are based next door to the source or on the other side of the globe. Second, green plants take carbon dioxide gas out of the atmosphere in the process of photosynthesis and use it to make sugars and other organic compounds used for growth and metabolism. Long-lived woody plants store carbon in wood and other tissues until they die and decompose at which time the carbon in their wood may be released to the atmosphere as carbon dioxide, carbon monoxide, or methane, or it may be incorporated into the soil as organic matter.

Plant tissues vary in their carbon content. Stems and fruits have more carbon per gram dry weight than do leaves, but because plants generally have some carbon-rich tissues and some carbon-poor tissues, an average concentration of 45-50 percent carbon is generally accepted (Chan 1982). Therefore, the amount of carbon stored in trees in a forest can be calculated if the amount of biomass or living plant tissue in the forest is known and a conversion factor is applied.

Carbon fixation through forestry is a function of biomass accumulation and storage. Therefore, any activity or management practice that changes the biomass in an area has an effect on its capacity to store or sequester carbon. A variety of forest management practices can be used to reduce the accumulation of greenhouse gases in the atmosphere, through different approaches. One is by actively increasing the amount or rate of accumulation of carbon (i.e., “sink” creation or enhancement). The second is by preventing or reducing the rate of release of carbon already fixed in an existing carbon “pool”. For forest plantations the first mechanism is important.

New tree planting results in the creation of new carbon sinks, i.e., carbon fixation during tree growth in afforestation, reforestation, forest rehabilitation, or agroforestry schemes. In the context of the Kyoto Protocol, these activities conform to the concept of Article 3.3. Although carbon sequestration is often discussed in the context of the establishment of new forests, carbon fixation can also be achieved by improving the growth rates of existing forests. This can be achieved through silvicultural treatments such as thinning, liberation treatments, weeding or fertilization. Since substantial amounts of carbon are stored in soils management practices that promote an increase in soil organic matter can also have a positive effect. These activities fit into the spirit of Article 3.4 of the Protocol.

When considering carbon storage, not all forests are equal. Generally, longer-lived trees with high density wood store more carbon per volume than short-lived, low density, fast-growing trees. However, this does not mean that carbon offsets which involve big, slow-growing trees are necessarily better than those involving plantations of fast-growing trees and *vice versa* (Moura-Costa 1996a and b).

4 MARKET EVOLUTION

During the last ten years, forestry-based carbon offsets have evolved from a theoretical idea to a market mechanism for accomplishing global environmental objectives. We are still a long way from an organised market with prices defined according to supply and demand forces. However, there has already be seen some evolution from the initial voluntary schemes and bartering transactions common in the early 1990's, to a market mechanism for accomplishing binding commitments under the Kyoto Protocol. To date more than 40 forestry projects have been established with the main objective of fixing carbon or preventing its release to the atmosphere (Moura-Costa and Stuart 1998), with at least 14 based on reforestation or other tree-planting activities (Table 1).

Table 1: Carbon offset projects involving tree-planting activities implemented to date. The list is comprehensive until 1997, but a series of initiatives have been conducted since then which have not necessarily been registered with official Activities Implemented Jointly registration bodies.

Project name	Date proposed/ initiated	Estimated Carbon offset (1000 t C)[a]	Area (ha)	Host Country	Investor country	Project description
AES – Care	1990	10,500	186,000	Guatemala	USA	Agroforestry
Face Malaysia	1992	4,250	25,000	Malaysia	Netherlands	Enrichment planting
Face-Kroknose	1992	3,080	16,000	Czeck Rep.	Netherlands	Park rehabilitation
Face Netherlands	1992	885	5,000	Netherlands	Netherlands	Urban forestry
Face-Profafor	1993	9,660	75,000	Ecuador	Netherlands	Small farmers plantations
RUSAFOR-SAP	1993	79	450	Russia	USA	Plantation forestry
Face Uganda	1994	6,750	27,000	Uganda	Netherlands	Forest rehabilitation
Private Forests Project (PFP)	1996	open ended	open ended	Costa Rica	open	Reforestation, forest protection, and management
Klinki forestry	1997	1,600	6,000	Costa Rica	USA	Reforestation with klinki
Burkina Faso	1997	67	300,000	Burkina Faso	Denmark	Fire wood community forestry
Scolel Te	1997	15	13,000	Mexico	UK/France	Community forestry
New South Wales State Forests and Pacific Power	1998	69	1,041	Australia	Australia	Reforestation
NSW and Tokyo Electric Power Company (TEPCO)	1999	130 to 5,200	1,000 to 40,000	Australia	Japan	Reforestation
Australian Plantations Timber	1999	3,075	25,000	Australia	undefined	Reforestation

Source: Moura-Costa *et al.* 1998.

a. **These figures relate** to the average storage capacity of the planted stands, which may not reflect the amount of carbon credits which different policy regimes will authorise to be traded.

Traditional financial cost/benefit calculations weigh heavily against plantations. Carbon offset payments, however, could improve the situation. There is growing recognition that the investment in plantations has been inhibited by low positive cash flows until the end of the rotation. Furthermore these high capital costs and delayed returns favour using high-yield species in monocultures, short rotations, and minimal cost management, that may have environmental consequences (see Working Paper FP/2). Risky locales without track records are also negatively weighted in such financial calculations. Despite the forest product industry's increasing reliance on plantations (see Working Paper FP/13), there are still fears that there is insufficient investment in them to ease market pressure on dwindling natural

forests (FAO 1991). Joint Implementation investments can theoretically make lower growth areas financially viable, or it possible to use longer rotations and a wider range of species.

4.1. Early days: voluntary projects

The first company interested in the possibility of compensating for greenhouse gas emissions through the planting of trees was the American electricity company AES (American Electric Systems), who invested US$2 million in an existing social agroforestry scheme in Guatemala, managed by CARE, an international poverty-relief NGO. The objective of the project was to plant 4.5 million trees over a 10-year period on 186,000 hectares. Re-evaluation of the project, in 1994, showed that these initial objectives were not met (Faeth *et al*., 1994). In a later stage, AES invested another US$5 million in two other projects in South America.

In the early 1990s, the Dutch Electricity Board (SEP), a consortium of five electricity companies in the Netherlands, created the Face (Forests Absorbing Carbon-dioxide Emissions) Foundation. The mandate of the Face Foundation was to promote the planting of enough forests to absorb an amount of CO_2 equivalent to the emissions of a medium-sized coal-fired power plant (400 MW) during its 40-year life time (Face Foundation 1994; Dijk *et al*., 1994). In this way, SEP would be able to build a new power plant in the Netherlands, with no net emissions to the global atmosphere. A budget of US$ 180 million was allocated to Face, for the establishment of a portfolio of forestry projects in different parts of the world.

These initiatives illustrate the first transactions for CO_2 emission mitigation worldwide. They were voluntary in nature, since there were no legislation requirements for polluters to reduce greenhouse gas emissions. Projects were established anticipating changes in environmental legislation, while capitalising in the public relations value of projects. In the case of AES, their first projects did not even have any contractual arrangement for carbon credit allocation and transfer, and they were never submitted as Joint Implementation initiatives. This voluntary aspect was somewhat reflected in the low average price paid for carbon sequestration that averaged US$0.01/ton C.

4.2. UNCED and early generation Joint Implementation projects (1992-1994)

In 1992, the Framework Convention on Climate Change was proposed at the UNCED meeting in Rio, and the concept of Joint Implementation (JI) of activities to reduce greenhouse gas emissions or promote the absorption of atmospheric CO_2 was put forward.

Although not officially endorsed by the convention, this promise of credit transfer through JI activities has led a series of companies to engage in JI-type activities. One of the first to move was the Face Foundation, with a 25,000 ha enrichment planting initiative in Malaysia (see Box 2; Moura-Costa *et al*. 1996). This was followed by four other projects involving the reforestation of degraded pasture land by small farmers in Ecuador (1992), rehabilitation of an acid-rain degraded park in the Czech Republic (1992), urban forestry in the Netherlands (1993), and rainforest rehabilitation in Uganda (1994). Another American utility, SAP, initiated a reforestation project in Russia. Approximately US$120 million were committed to the implementation of these projects during this phase, with an average of US$ 4.50 paid per ton C, a substantial increase from the previous phase.

BOX 2: THE INNOPRISE-FACE FOUNDATION RAINFOREST REHABILITATION PROJECT (INFAPRO)

This is a cooperative venture between Innoprise Corporation, a semi-government forestry organisation which has the largest forest concession in the state of Sabah, Malaysia, and the Face (Forests Absorbing Carbon-dioxide Emissions) Foundation of the Netherlands. The latter organisation was set up by the Dutch Electricity Generating Board to promote the planting forests to absorb CO_2 from the atmosphere to partially offset the emissions of their power stations. The objective of the project is to rehabilitate 25,000 ha of logged forests by enrichment planting and reclamation of degraded areas using indigenous tree species such as dipterocarps, fast growing pioneers, and forest fruit trees, over a period of 25 years (Moura-Costa 1996a and Moura-Costa *et al*. 1996). The total investment committed by the Face Foundation amounts to US$15 million over 25 years.

In the pilot phase (1992-1994), 2,000 ha of logged-over forests were planted as an initial trial of the effectiveness of this system. The planting phase will be extended for 25 years and the forests maintained for 99 years. The long-term nature of the project should enable the maintenance and silvicultural treatments required to sustain growth rates during the project life. It is expected that at the end of the first 60-year growth cycle, these forests will be exploited for timber, which will belong exclusively to Innoprise. However, timber harvesting will have to be done in a careful way, so that a healthy residual stand can again regenerate into a well-stocked forest. This maintains the carbon pool for the Face Foundation, which has the exclusive rights to the carbon sequestered through the 99 years of the project. It is expected that the project will sequester at least 4.25 million tonnes of carbon (15.6 million tonnes CO_2) during its lifetime at an average cost of US$3.52 per ton of carbon (US$0.95 per ton CO_2).

The project will also produce over 4 million m^3 of hardwood sawn timber, worth about US$800 million, which belongs to the Innoprise Corporation. Given that Innoprise is fully owned by the Sabah Foundation, a semi-government organisation with the mandate of improving people's welfare in the state of Sabah, it is expected that the project will generate considerable social spin-offs. Additionally, during its initial 25-year planting phase, the project will directly generate 230 jobs, for various activities such as field planting, silviculture, nursery work, mapping and geographical information systems, computing, financial control, and research. It is important to note that 90 % of the project's budget is spent on personnel.

4.3. Activities Implemented Jointly pilot phase: more uncertainty (1994-1996)

With the establishment of the AIJ pilot phase in 1994, there was a reduction in investments in carbon offset projects. Because of the lack of incentives for investor participation, as no carbon credit transfer was allowed, the results of the AIJ pilot phase were not representative of the full potential of JI in terms of international investment and greenhouse gas reductions (Stuart and Moura-Costa 1998). Only four new tree planting projects were initiated between 1996 and 1997, with a much reduced level of investment of US$4 million. These included: a 6,000 hectare reforestation project with klinky trees in Costa Rica; a 13,000 hectare community forestry project in Mexico, financed by the International Automobile Association; and a community forestry project for woodfuel production in Burkina Faso, financed by the Government of Norway through the World Bank. At the same time Costa Rica initiated the development of its large national carbon offset programs (see Box 3), including the Private Forestry Project (PFP), and attracted US$2 million from the Government of Norway.

BOX 3: THE COSTA RICAN SYSTEM OF DIRECT PAYMENT FOR ENVIRONMENTAL SERVICES

In 1997 Costa Rica launched two national level innovative forestry-based carbon offset programmes. Commercialisation of CO_2 reduction credits is done through the sale of Certified Tradable Offsets (CTOs), the first security-like instruments backed by carbon offsets, which are issued by the recently created Costa Rican Office on Joint Implementation (OCIC). These CTOs are credits of carbon fixation based on the amount of CO_2 fixed in forests or emission reductions derived from their renewable energy plants. The first batch of CTOs (200,000 tons of carbon) was sold to a Norwegian consortium at US$10/ton C (US$2.70/t CO_2), for a total of US$2,000,000.

The Private Forestry Programme (PFP) encourages landowners to opt for forestry-related land uses by providing direct payment for environmental services. Environmental services include CO_2 fixation, water quality, biodiversity, and landscape beauty. The monetary incentives aim at increasing the attractiveness of forestry compared to higher impact forms of land use. Incentives are paid to landowners over a period of 5 years following the signing of a contract to keep their land under a specified type of utilisation for a minimum period of 20 years. Farmers who receive these incentives assign the rights of to the environmental services of the government, who bundles them for potential sale. The resources for initiating the PFP programme were raised by a domestic 15 percent tax on fossil fuels, which is expected to raise US$21 million per year. It is hoped that future payments to farmers will be based upon successful sales of resultant CTOs.

The value of PFP incentives varies. There are three main areas of interest: conservation of existing forests, selective harvesting for sustainable wood production, and reforestation or natural regeneration of degraded pasture or agricultural land. In the case of private forest conservation, farmers receive US$56 $ha^{-1}year^{-1}$ to a total of US$280 ha^{-1}. They are also waived payment of land tax. Those opting for natural forest management receive US$47 ha^{-1} $year^{-1}$, to a total of US$235 ha^{-1}, in addition to the revenue derived from timber harvesting. In order to enforce compliance with low impact logging guidelines, the law requires that any harvesting operation must be supervised by a trained forester. Farmers who choose to reforest part of their agricultural land receive a series of payments related to the costs of plantation establishment, to a total of US$558 ha^{-1}.

The institution co-ordinating the administration of the private sector incentives is called Fonafifo (Forestry Financing Fund), an office created by the MINAE (Ministry of Energy and Environment). Fonafifo has the role of receiving and analysing applications, conducting field verifications, carrying out the payments, and monitoring field implementation of forestry projects.

Costa Rica is also working on a second national level land use project, called Protected Areas Programme (PAP), with the objective of reducing deforestation rates by consolidation of its national parks network. The programme aims at consolidating 570,000 ha within 28 national parks, and claim the carbon savings derived from avoided deforestation, which historically has averaged 3% per year. Costa Rica expects to avoid the release of about 18 million tonnes of carbon (66 million tons CO_2) through the implementation of the PAP. These savings have been independently verified by the international certification company (Moura-Costa *et al*. 1997) and CTOs will be issued accordingly. At a projected price of US$10 per tonne of carbon, Costa Rica expects to raise US$180 million through PAP. The sale of CTOs from the PAP has been done with the assistance of international environmental brokers. In conjunction with the Earth Council, who is providing some of the catalytic finance for the PAP, Costa Rica will use a portion of those proceeds to finance construction of the Earth Centre. This will be a research and demonstration project highlighting various aspects of sustainable development and environmental values.

These Costa Rican programmes provide good examples of how carbon trading could be utilised by developing countries to attract international investment into national priorities. The whole programme has been entirely conceived by the Costa Rican government and, consequently, totally conforms to national priorities. While Costa Rica managed to secure catalytic funding for the initial phase of the PAP (provided by the Earth Council and the World Bank), all other costs will be borne by Costa Rica itself, who is also responsible for determining the sale price of CTOs. In this way Costa Rica maintains full control of the production costs and profits associated with the commercialisation of CTOs, which will be redirected into priority areas within the country.

4.4. The Kyoto Protocol and its aftermath (post 1998)

In December 1997, 170 countries signed the Kyoto Protocol during the CoP 3 of the UNFCCC. The establishment of binding commitments has led to more demand for offsets. According to a study of the MIT/World Bank (Ellermann *et al*., 1998), if these targets were accomplished through greenhouse gas emissions trading, this would generate a demand for Emission Reduction Units (ERUs) in the order of US$20 billion a year. This is a substantial change from the previously voluntary phase.

The provisions in the Protocol, even if still far from certain, greatly increased the attractiveness and reduced the risks of investment in forestry-based offset projects, leading to an immediate response in the, still incipient, carbon market. The supply of offsets became more organised and offered more sophisticated financial instruments. The Costa Rican national programme, the first to produce carbon denominated securities (CTOs – Certified Tradable Offsets), was the first producer-led carbon offset initiative in the world, and the first one to utilise independent certification and insurance (Box 3). This project was followed in 1988 by the New South Wales State Forests, a state organisation, which sold the carbon sequestration services of some of its plantations in the form of CTOs to Australian and Japanese power companies. New South Wales State Forests is currently working with the Sydney Futures Exchange on the development of an Australasian market in forward contracts for forestry-based carbon credits. Other forestry companies also realised that they had the capacity to attract carbon funding, with important implications for the financing of their operations, as illustrated by the prospectus-based forestry investment funds in Australia (Box 4). At the same time, the World Bank launched its Prototype Carbon Fund, with an initial capitalisation of US$130 million, which intends to include some forestry projects.

5 WAYS FORWARD

To date, greenhouse gas mitigation funding covers a cumulative 4 million hectares of forests worldwide. According to the IPCC (Brown *et al*., 1996), forestry has the potential for offsetting approximately 15% of the world's greenhouse gas emissions, a partial solution to the overall problem. If this investment trend continues, we may see a huge infusion of new capital into the forestry sector, which will have enormous implications for forestry, sustainability and conservation.

The potential size of the forestry-based offset market is still very dependent on policy decisions; on how they will be accounted for and which forestry activities will be accepted under the CDM and JI mechanisms. As mentioned in Section 2.5, the IPCC has prepared a special report (IPEC 2000), which will assist policy makers on deciding on these issues. It is generally positive about the feasibility of this greenhouse gas mitigation option. It has been estimated that, if unconstrained by policy regulations, the forestry-based carbon offset projects could attract billions of dollars of carbon funding, which in turn could leverage much higher levels of investment in the forestry sector as a whole.

In order for investment to be directed, however, markets have to be developed. Suppliers will have to learn about this new commodity or environmental service generated by their enterprises. A new production possibilities now exists, involving the relative values of

traditional forest products and of this new environmental value of carbon sequestration, and forest managers have to become aware of it in order to maximise forest output.

Investors will need to identify the full extent of their environmental liabilities and utilise market mechanisms to lower them through the purchase of credits or options. For the environment this may mean a huge infusion of new capital into forestry activities world-wide enabling some global environmental targets to be met more cheaply.

BOX 4: AUSTRALIA PLANTATIONS TIMBER AND PROSPECTUS BASED FOREST INVESTMENT FUNDS

Australian Plantations Timber (APT) is a forestry company specialised in commercial plantations of eucalyptus trees in Western Australia, South Australia and Victoria. Every year, since 1992, APT raises capital from investors for the establishment of new forest plantations, based on investment prospectus offering a pre-tax rate of return of about 7-8 %, derived from the sale of the eucalyptus trees harvested at the end of an 11-year rotation.

In 1999, with the assistance of an environmental finance company specialised on the greenhouse gas mitigation sector, APT included provisions in its prospectus to enable the sale of the carbon sequestration credits which may arise from its forestry operations, becoming the first private company world-wide to do so. In practice, the prospectus alerted investors that the rates of return of this fund could potentially be increased through the sale of carbon credits. Estimates suggest the internal rates of return could rise by 1-3 % depending on the value accrued through carbon sales.

The prospect of higher returns led to an increased amount of investment into APT: the 1999 prospectus was oversubscribed and the company had to limit its capital uptake to A$136 million, because of constraints related to land availability and operational capacity. APT plans to plant 25,000 ha of new forests in 2000, as opposed to the previous rates of 2-3,000 ha.

In April 2000 APT floated in the Australian Stock Exchange, with initial market capitalisation of A$340 million and shares valued at A$3.20 each on the first day of trading. Stock analysts from Macquarie Equities in Australia have valued the company at A$4.50 per share and have attributed A$0.50 of the share price to the value of carbon credits to be produced by APT's plantations.

APT is currently working towards selling the carbon credits generated, and is likely to benefit from the various financial mechanisms that have been developed to facilitate the trade of carbon credits, creating liquidity for this new type of securities. Amongst them, the Sydney Futures Exchange have plans to launch futures contracts on carbon credits and their derivatives, and a series of brokers are already offering derivatives such as options based on carbon.

This case study provides an example of how carbon credits are beginning to be used for promoting the funding of forestry activities. Increasingly, carbon is being incorporated into project finance structures, in addition to other debt and equity sources of finance, leveraging the amount of capital that is currently available for forest finance.

With regards to the environment, this type of project is fully aligned with Australia's objectives of increasing forest cover, in order to reduce salinisation problems currently affecting large tracks of agricultural lands. In relation to the Kyoto Protocol, this example illustrates the *additionality* effect that extra financial returns can generate. In global terms, this demonstrates how market approaches could facilitate reaching global environmental objectives at optimal financial costs.

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