Realizing Global Environmental Objectives through Local Environmental Initiatives: The Incentives behind Stakeholder Participation in Forest Carbon Sequestration Projects

by

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ABSTRACT

Since the early 1990s, dozens of projects have been established and millions of dollars have been invested in jointly-implementated forest carbon sequestration projects in both Annex B and non-Annex B countries. This prompts the question of why, without mandatory emission reduction requirements or promise of any return on their investment in emission reduction credits, governments, companies, and individuals have invested in projects to reduce their greenhouse gas emissions.

To explore this question, I investigated the incentives behind stakeholder participation in three voluntary carbon sequestration projects: the Rio Bravo Carbon Sequestration Pilot Project in Belize, the Klinki Forestry Project in Costa Rica, and the Profafor/FACE Forestry Project in Ecuador. Based on a site visit to Belize and telephone interviews with stakeholders in Costa Rica and Ecuador, I determined that stakeholders participated in these projects because of both the potential international market in emissions reduction credits and the more immediate and local economic, social, and evironmental benefits of the projects.

Despite the numerous incentives to participate in forest carbon sequestration projects, there are still many inherent uncertainties in both the process and the politics of carbon sequestration. A number of general uncertainties regarding project design, international policy, the market in carbon offset credits, and host country capacity still need to be addressed in order to lower transaction costs and advance the development of forest carbon sequestration projects.

The primary principle that I have determined from my research is that in order for jointly implemented forest carbon sequestration projects to be successful, the benefits that a landowner receives, either indirectly through environmental benefits such as reduced erosion or watershed protection, or directly through income from the project or from timber sales, need to continuously equal or exceed the opportunity cost of land on which the forest is planted throughout the project life. The fundamental challenge of carbon sequestration projects is to create a dynamic system that gives adequate long-term returns and flexibility to landowners while maintaining a certain level of carbon sequestration and security for investors.

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List of Acronyms

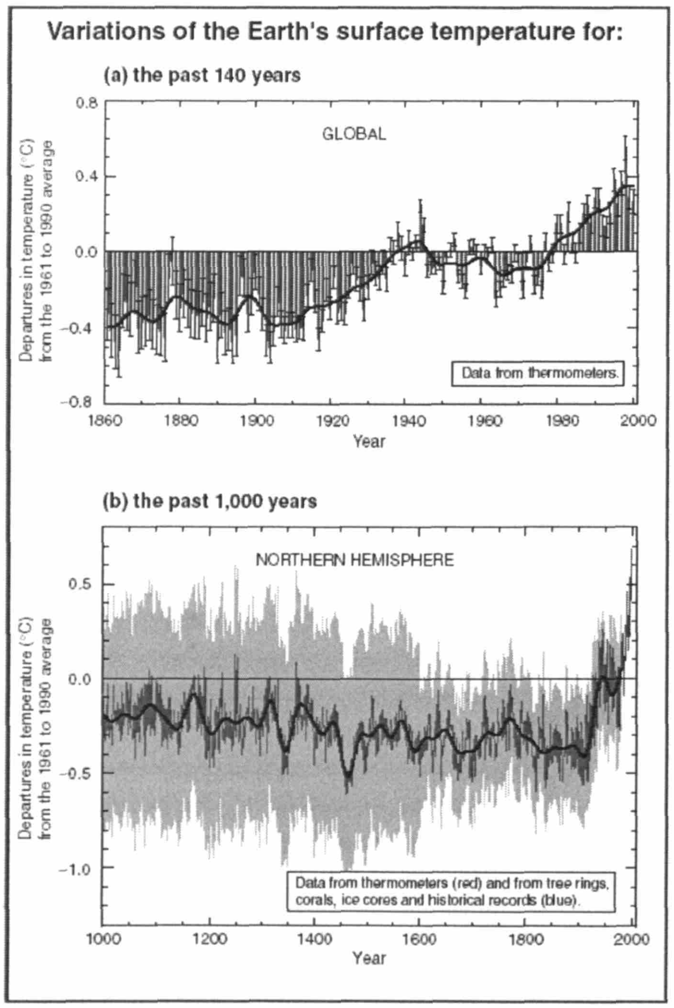
AIJ	Activities Implemented Jointly
CACTU	Centro Agricola de Turrialba
CATIE	Tropical Agriculture Research and Higher Education Center
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CIFOR	Center for International Forestry Research
COP	Conference of Parties to the UNFCCC
CTO	Certified Tradable Offset
ERU	Emissions Reduction Unit
FACE	Forests Absorbing Carbondioxide Emissions
FCCC	Framework Convention on Climate Change
GHG	greenhouse gas
Gt/C	one billion metric tons of carbon
IPCC	International Panel on Climate Change
IUCN	World Conservation Union
JI	Joint Implementation (between Annex B countries)
NGO	non-governmental organization
OCIC	Costa Rican Office for Joint Implementation
OECD	Organization for Economic Cooperation and Development
PFB	Programme for Belize
ppm	parts per million
Profafor	Programa FACE de Forestacion
QELRO	Quantified Emission Limitiation and Reduction Objective
RBCMA	Rio Bravo Conservation Management Area
RBCSPP	Rio Bravo Carbon Sequestration Pilot Project
RIL	Reduced Impact Logging
RTT	Reforest the Tropics
SEP	Dutch Electricity Generating Board
SFM	Sustainable Forestry Management
SGS	Societe Generale de Surveillance
tC	metric ton of carbon
TNC	The Nature Conservancy
UN	United Nations
UNCED	United Nations Conference on Environment and Development
USAID	United States Agency for International Development
USIJI	United States Initiative on Joint Implementation
VBDO	Dutch Association of Investors for Sustainable Development
VER	Verified Emission Reduction
WEPCO	Wisconsin Electric Power Company
WRI	World Resources Institute
WWF	World Wildlife Fund

Chapter 1 - Introduction

1.1 The Problem - Climate Change

Climate change is one of the most daunting problems facing the world today. The Intergovermental Panel on Climate Change's Third Assessment Report, Climate Change 2001, states that the global average surface temperature is projected to increase by 1.4 to 5.8°C between 1990 and 2100. This is a much larger increase than the observed changes during the 20th century, and is very likely to be without precedent during at least the last 10,000 years.[1]

Figure 1 – Global Temperature Change[2]



Despite the many uncertainties regarding the magnitude and character of natural climate variability, the Report concludes that there is "new and stronger evidence that most of the observed warming over the last 50 years is likely due to increases in greenhouse gas concentrations due to human activities."[3] It extends this time frame by stating that the warming over the past 100 years was very unlikely to have been due to internal variability alone, and that reconstructions of climate data for the past 1,000 years also indicate that this warming was unusual and is unlikely to be entirely natural in origin.[4]

Greenhouse gases, which keep the earth warm by absorbing some of the thermal radiation emitted by the earth's surface, have been building up in the atmosphere in unprecedented amounts. The atmospheric concentration of carbon dioxide, the most important greenhouse gas, has increased by 31% since 1750.[5]

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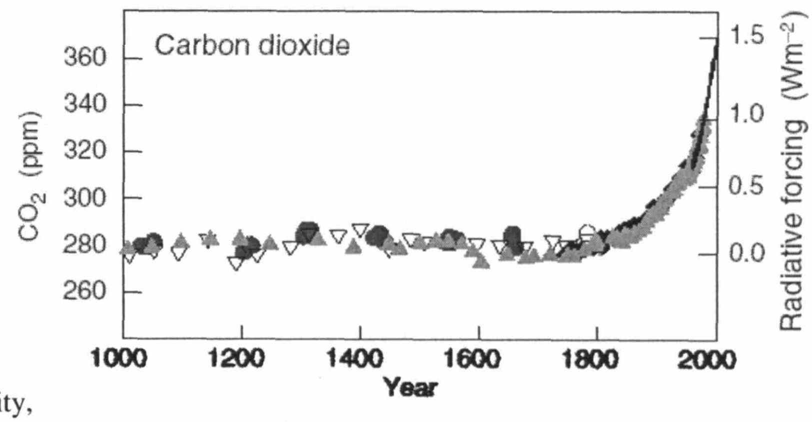
[1] IPCC. "Summary for Policymakers," Climate Change 2001, 2001: 13.
[2] IPCC. "Summary for Policymakers," Climate Change 2001, 2001: 3.
[3] IPCC. "Synthesis Report," Climate Change 2001, 2001: Question 9.
[4] IPCC. "Summary for Policymakers," Climate Change 2001, 2001: 10.

The present concentration of CO_2 in the atmosphere, which now stands at over 365 parts per million, has not been exceeded during the past 420,000 years, and was not likely exceeded during the past 20 million years. In addition, the current rate of increase of CO_2 in the atmosphere is unprecedented during at least the past 20,000 years.[6]

Figure 2 – Atmospheric Carbon Dioxide Concentrations[7]



While the majority of excess CO_2 in the atmosphere has come from the burning of fossil fuels, over the past 150 years, an estimated 30% of the atmospheric build-up of CO_2 has been a result of deforestation.[8] Deforestation is also the driving force behind biodiversity loss, decreased soil fertility, water pollution, and other environmental problems. However, in the international policy arena, the issues of deforestation and climate change have moved in largely unconnected domains.

1.2 The Response - the International Climate Change Regime

1.2.1 Framework Convention on Climate Change (FCCC)

One international response that has linked these two issues is the United Nations Framework Convention on Climate Change (FCCC), signed by 154 countries in 1992 during the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro, Brazil. As stated in Article 2 (Objective), the goal of this Convention is the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."[9] Article 4 (Commitments) of the Convention calls on all developed countries and Annex 1 countries (the 24 original OECD countries, the European Union, and 11 countries with economies in transition) to reduce their GHG emissions to 1990 levels as a way to achieve this goal.

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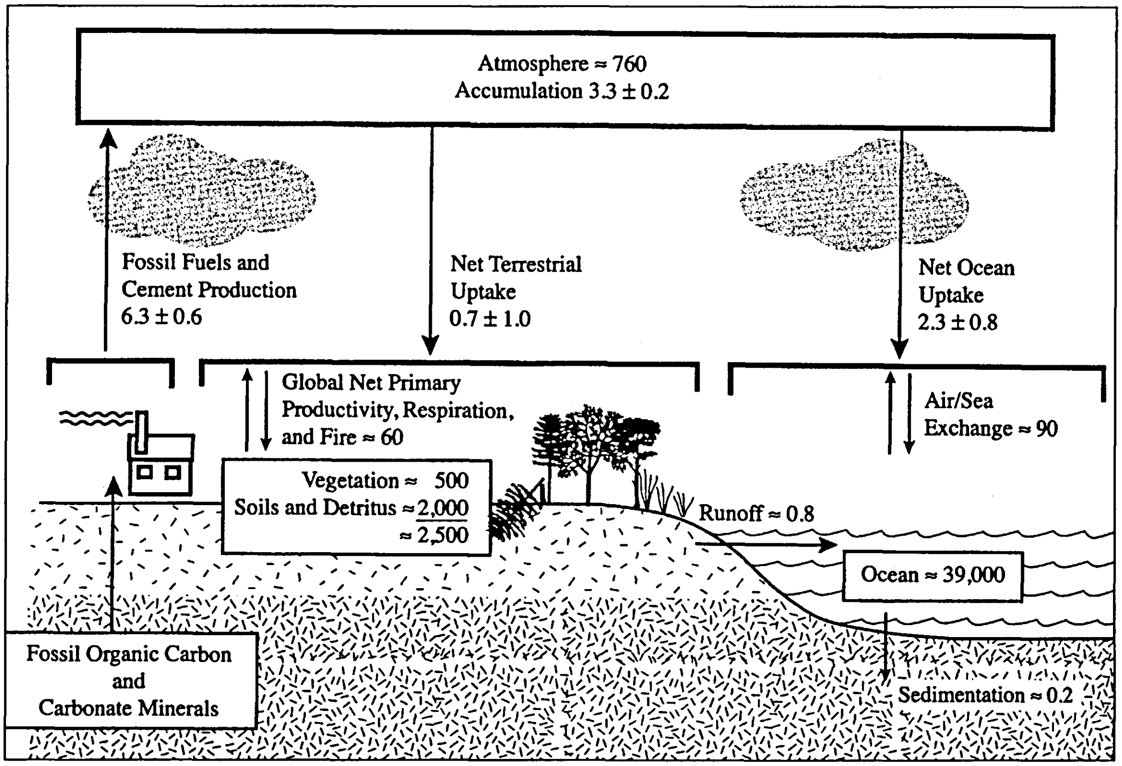
[5] IPCC. "Summary for Policymakers," Climate Change 2001, 2001: 7.
[6] IPCC. "Summary for Policymakers," Climate Change 2001, 2001: 7.
[7] IPCC. "Summary for Policymakers," Climate Change 2001, 2001: 6.
[8] World Resources Institute and The World Conservation Union (IUCN). 1998: Overview.
[9] UNFCCC. 1992: Article 2 - Objective.

1.2.2 The Role of Carbon Sequestration

Along with reducing GHG emissions by addressing sources, the FCCC stresses the role of removing GHG emissions by sinks. Article 4.1d of the FCCC states that Parties should "Promote sustainable management, and promote and cooperate in the conservation and enhancement, as appropriate, of sinks and reservoirs of all greenhouse gases not controlled by the Montreal Protocol, including biomass, forests and oceans as well as other terrestrial, coastal and marine ecosystems."[10]

Figure 3 – The Global Carbon Cycle[11]



For the purposes of reducing GHG emissions, carbon sequestration involves a flux of carbon dioxide from the atmosphere into sinks of carbon on land or in the oceans, where it cannot interact directly with the climate system and cause climate change. While the oceans represent the largest potential sink for sequestration of CO2 emissions, it is almost impossible to naturally increase the uptake of carbon from the atmosphere by the oceans. The two current strategies for artificially enhancing ocean carbon sequestration are:

- Enhancement of net oceanic uptake from the atmosphere by fertilization of phytoplankton with micro- or macronutrients

[10] UNFCCC. 1992: Article 4 - Commitments.
[11] Bolin and Sukumar. 2001: 30.

- Direct injection of a relatively pure CO_2 stream to ocean depths greater than 1000 meters.

However, the long-term effectiveness and potential environmental consequences of either of these strategies are unknown.[12]

Forests, agricultural lands, and other terrestrial ecosystems represent the next largest sink for sequestration of CO_2 emissions. These ecosystems have the ability to absorb a significant amount of carbon at relatively low social costs through the growth of plants and the accumulation of carbon in the soil.[13] There are three main ways in which terrestrial ecosystems can be managed to influence the global carbon cycle:

- Conservation of existing carbon stocks in forests and other ecosystems, including soils, which would avoid emissions. An example is reducing the rate of deforestation.
- Sequestration of additional carbon in forests and other ecosystems, as well as in soils, forest products, and landfills. An example is planting trees on land that has not been forested in the past (afforestation).
- Substitute renewable biomass fuels for fossil fuels (fuel substitution), or use biomass products to replace products such as steel or concrete that require more energy in their production and use (materials substitution).[14]

Although not necessarily permanent, conservation and sequestration of carbon in terrestrial ecosystems may allow time for other options to be further developed and implemented. Also, by conserving existing carbon stocks and by increasing the size of carbon stocks through sequestration, atmospheric CO_2 concentrations could be significantly reduced. The IPCC Second Assessment Report estimated that about 60 to 87 GtC could be conserved or sequestered in forests by the year 2050.[15] Hypothetically, if all of the carbon released by historical land-use changes could be restored to the terrestrial biosphere over the course of the century (e.g., by reforestation), CO_2 concentrations would be reduced by 40 to 70 ppm.[16]

1.2.3 The Concept of Joint Implementation

Since reductions in the total amount of atmospheric CO_2 occur regardless of where the actual reductions or sequestrations take place, one of the mechanisms by which the Annex 1 countries' voluntary commitments could be met is through joint implementation. At the initiative of Norway, the FCCC approved – in principle – of activities between countries to collectively reduce GHG emissions or

[12] US DOE Office of Science website. "Carbon Sequestration Focus Areas."
[13] Kauppi and Sedjo. 2001: 303.
[14] Marland and Schlamadinger. June 2000: 6.
[15] Kauppi and Sedjo. 2001: 303.
[16] IPCC. "Summary for Policymakers," Climate Change 2001, 2001: 12.

promote the sequestration of atmospheric CO2.[17] The investing participants in these projects could presumably claim emission reduction "credits" for activities financed in another country, which could then be deducted from their country's total amount of GHG emissions. Article 4.2a of the Convention specifies that developed country Parties and other Parties included in Annex I "may implement such policies and measures jointly with other Parties and may assist other Parties in contributing to the achievement of the objective of the Convention."[18] The overall rationale of joint implementation is that the marginal costs of emission reduction or CO2 sequestration can vary dramatically, and that such costs are generally lower in developing nations than industrialized countries. This is especially true for forestry projects, because of lower land and labor costs, and higher plant growth and therefore carbon sequestration rates in the tropics.

Although such crediting arrangements were not officially endorsed by the FCCC, this promise of potential transfers by jointly implementing projects initiated several bilateral and multilateral emissions reduction projects. During the two years between UNCED and the First Conference of Parties (COP-1) in 1995, an average of 3.3 new forest-related joint implementation projects and $50 million were committed yearly. The average price (usually equating costs) paid for carbon sequestration is estimated to be around $1.97/tC ($0.53/tC02), a 10-fold increase from the prices paid before the FCCC was signed.[19]

1.2.4 Activities Implemented Jointly

At the 1995 COP-1 in Berlin, a pilot phase was initiated to advance the concept of joint implementation. Projects initiated during this pilot phase are called Activities Implemented Jointly (AIJ) projects. The guidelines adopted at Berlin mandated that countries participating in AIJ projects would not receive emission reduction credit during the pilot phase, although the possibility still exists that credit could be awarded retroactively.[20]

The absence of credit transfer substantially decreased the number of new joint implementation projects. Between late 1994 and late 1996, only three new AIJ forestry projects were initiated, with an average yearly committed investment of $6 million. The willingness to pay for carbon also declined, down to an average of $0.59/tC ($0.16/tCO2). However, while fewer investments occurred during this phase, the supply of "potential projects" continued to increase as more companies became interested in offsetting their GHG emissions. Also, an increasing number of developing countries began to recognize these projects as a potential new source of capital for sustainable development.[21]

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[17] Moura-Costa and Stuart. 1998: 4.
[18] UNFCCC. 1992: Article 3 - Principles.
[19] Moura-Costa and Stuart. 1998: 5.
[20] Busch, Sathaye, and Sanchez-Azofefa. July 2000: 5.
[21] Moura-Costa and Stuart. 1998: 6.

During 1997, four new forestry projects were initiated. While the level of investment remained low ($4.5 million per year), the price paid for carbon raised to an average of $12/tC ($3.24/tCO2) in anticipation of the announcement of formal emissions reduction commitments at COP-3 in Kyoto, Japan.[22]

Figure 4 – History of jointly implemented projects (data not from official sources)[23]

	Pre-Unced	Pre-CoP 1	AIJ PP	Pre-Kyoto	Post-Kyoto
Number new projects per year	0.5	3.3	1.5	4	14
Area of new projects (ha/year)	93,000	628,467	501,740	893,000	2,002,082
Investment committed (US$ millions/year)	1.00	49.25	6.05	4.48	347.00
Carbon price (US$/ton C)	0.19	1.97	0,59	11.07	> 12.00

Pre-UNCED = before 1992; Pre-CoP 1 = phase between UNCED and the 1st Conference of Parties to the FCCC, 1992 to 1995; AIJ PP = Activities Implemented Jointly Pilot Phase, from 1995 to 1996; Pre-Kyoto = 1997; Post-Kyoto = January to June 1998.

1.2.5 The Kyoto Protocol

With increasing pressure to formalize the voluntary commitments that were pledged in 1992, representatives from 160 countries gathered in December 1997 at COP-3 to negotiate the Kyoto Protocol to the FCCC. After much deliberation, agreement was reached on binding commitments that required Annex 1 countries to reduce their overall emissions of the six major greenhouse gases by 5.2% between 2008 and 2012. The Protocol approved the use of four "flexibility mechanisms" to facilitate the achievement of these emissions reduction targets. These are commonly known as Bubbles, Emissions Trading, Joint Implementation, and the Clean Development Mechanism.

- *Bubbles* allow groups of countries to cooperatively address their emission reduction commitments by trading among themselves if they agreed to do so at Kyoto. The European Community is an example of such a bubble.[24]
- *Emissions Trading*, also known as QELRO (Quantified Emission Limitation and Reduction Obligation) trading, allows Annex B[25] countries that reduce emissions below their commitment level to sell their excess emission reduction units to other Annex B countries.
- *Joint Implementation (JI)* allows Annex B countries to acquire Emission Reduction Units (ERUs) from investments in emissions reduction projects located in other Annex B countries in order to supplement domestic actions.

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[22] Moura-Costa and Stuart. 1998: 7.
[23] Moura-Costa and Stuart. 1998: Appendix.
[24] Busch, Sathaye, and Sanchez-Azofefa. July 2000: 5.
[25] Countries with QELROs. At this point, Annex B countries are almost the same as Annex 1 countries.

- *The Clean Development Mechanism (CDM)* allows Annex B countries to acquire Certified Emission Reduction (CER) credits for investment in emissions reduction projects in non-Annex B countries to supplement domestic action while promoting sustainable development in non-Annex B countries.[26] A newly formed central authority will regulate the criteria for the CDM.[27]

Since the Kyoto Protocol, the latest Conference of Parties (COP-7 in Marrakech) has specified that afforestation and reforestation are eligible activities for JI and CDM projects. Forest management is also an eligible activity for a JI project. By supporting these activities, the Kyoto Protocol's flexibility mechanisms will help to reduce both greenhouse gas emissions and deforestation.

1.3 Forest Carbon Sequestration Projects

Since the early 1990s, dozens of projects have been established and millions of dollars have been invested in jointly-implementation forest carbon sequestration projects in both Annex B and non-Annex B countries. This prompts the question of why, without any formal obligation, governments, companies, and individuals have invested in projects to reduce their greenhouse gas emissions without mandatory emission reduction requirements or promise of any return on their investment in emission reduction credits.

To explore this question, I have chosen to investigate the incentives behind stakeholder participation in three voluntary carbon sequestration projects. These projects are illustrative of the way local environmental action takes place in response to the global environmental objective of mitigating climate change. They also show an avenue of multi-stakeholder cooperation that is still being worked out as a way to respond to climate change. The projects are the Rio Bravo Carbon Sequestration Pilot Project in Belize, the Klinki Forestry Project in Costa Rica, and the Profafor/FACE Forestry Project in Ecuador.

1.3.1 Belize - the Rio Bravo Carbon Sequestration Pilot Project

The Rio Bravo Carbon Sequestration Pilot Project in Belize is one of the first fully funded forest-sector projects implemented under the U.S. Initiative on Joint Implementation (USIJI), and is a result of cooperation between The Nature Conservancy, Programme for Belize (a Belizean environmental NGO), Winrock International (a forest carbon monitoring firm), the Government of Belize, and the electric utility and energy companies Cinergy, Detroit Edison, Nexen, PacifiCorp, Suncor, Wisconsin Electric Power Company, and the Utilitree Carbon Company. The project is expected to reduce, avoid or mitigate an estimated 2.4 million tons of carbon during the project's 40-year life through two primary approaches: the

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[26] Busch, Sathaye, and Sanchez-Azofefa. July 2000: 5.
[27] Moura-Costa and Stuart. 1998: 7.

purchase of 13,300 hectares of land to prevent deforestation and sustainable forest management on a combined total of over 52,000 hectares.

1.3.2 Costa Rica - the Klinki Forestry Project

The Klinki Forestry Project in Costa Rica is also a USIJI-approved project, but it differs from Rio Bravo in that it involves transforming low-carbon pastures into high-carbon farm forests of mixed native and naturalized species that includes the Klinki pine, a fast-growing non-native tree species suitable for use as utility poles and lumber. The stakeholders involved in this project include Reforest the Tropics (a US non-profit organization that supports forest carbon sequestration projects by linking American CO2 emitters with Costa Rican farmers), individual and collective groups of farmers, and a number of technical assistance providers, including the Cantonal Agricultural Center of Turrialba (an Ecuadorian farmer-managed non-profit agency that helps develop farm forestry), the US Department of Agriculture Forest Products Laboratory, the Yale School of Forestry and Environmental Studies, and the Tropical Agriculture Research and Higher Education Center. The benefactors of Reforest the Tropics are a diverse group of small businesses, institutions, and individuals. They include Connecticut College, the Mohegan Tribe of Indians of Connecticut, Connecticut Municipal Electric Energy Cooperative, Superior Nut Company, St. Mark's Church of New Canaan, several Connecticut elementary, middle, and high schools, and a number of private individuals. Lastly, the Government of Costa Rica is involved through its Office on Joint Implementation (OCIC). The project hopes to sequester an average of 8.2 tons of carbon per hectare on 6,000 hectares over the project's 40-year lifetime. However, so far the project has only solicited enough funding for the planting of 87 hectares.

1.3.3 Ecuador – the FACE/Profafor Forestry Project

The FACE/Profafor project in Ecuador was established for the purpose of afforestation, primarily on the high slopes of the Andes where deforestation began during the rise of the Incas. The land is being afforested using a mixture of non-native (mostly pine and eucalyptus) and native tree species via collaboration between FACE (**F**orests **A**bsorbing **C**arbon dioxide **E**missions - a Dutch non-profit foundation that manages forest carbon sequestration projects), Profafor (**Pro**grama **FA**CE de **For**estacion – FACE's counterpart in Ecuador), and individual and collective groups of farmers and indigenous communities. SGS International, the world's largest inspection, verification, and testing organization, verifies and certifies the carbon sequestered by the project, which originated from an agreement signed in 1993 between FACE and the Ecuadorian Ministry of Environment to plant 75,000 hectares of forest. As of January 2001, 25,200 hectares were under contract, but have not yet entirely been planted.

1.4 The Incentives behind Forest Carbon Sequestration Projects

Global warming is the epitome of a global commons issue. It affects all states, and requires broad international cooperation to mitigate its effects. However, the institutions that currently exist to manage the problem of climate change have been found to be sorely inadequate to deal with the magnitude and the immediacy of the responses required to avoid dangerous changes in the world's climate system. Climate change, as a transboundary threat, cannot be addressed solely by national policy, and international treaties leave open the possibility for significant free rider problems. As a case in point, the USA, which is the world's largest of emitter of greenhouse gases, is refusing to ratify the Kyoto Protocol, and so would not be under any obligation by any higher authority to do anything about climate change. This exposes the need for the international community to develop different strategies and mechanisms to deal with global environmental issues. These case studies are examples of initiatives that either pre-empt or go beyond institutionalized legal and political approaches in order to solve global environmental problems.

Through these case studies, I show how global environmental objectives are realized through local environmental initiatives, and expound on the role that multi-stakeholder partnerships have in facilitating what are necessarily local solutions to global problems. More specifically, I determine the incentives that each of the stakeholders in the three carbon sequestration projects had to participate in these projects. Through this analysis, I uncover the structures and motivations that are needed to promote these kinds of participatory and mutually beneficial partnerships in other projects within the context of the Kyoto Protocol as well as in the context of other multilateral environmental agreements.

1.5 Summary of Chapters

In Chapter 2, I discuss the four main types of forest carbon sequestration projects and their place in the current climate change regime. I also examine forest carbon sequestration's role in sustainable development, in particular its relationship to forest resources and biodiversity. In Chapter 3, based on field research conducted in Belize during January 2002, telephone interview with Rio Bravo investors, telephone interview with stakeholders in Costa Rica and Ecuador, and secondary research on all three projects and forest carbon sequestration projects in general, I describe my three case studies to show why and how, despite much uncertainty, carbon sequestration projects have been implemented. In Chapter 4, based on these case studies, I present the factors that have most clearly indicated why forest carbon sequestration projects have been initiated voluntarily, discuss the uncertainties that are keeping more projects from taking place, and speculate on the importance of these factors for the establishment of forest carbon sequestration projects in general. In Chapter 5, I extract a set of principles and recommendations from my research that could be used by prospective stakeholders interested in forest carbon sequestration projects. I use the case of a fossil-fuel power plant in Massachusetts looking for carbon offsets to purchase as an example, since Massachusetts has recently passed laws that require certain older power plants as well as new plants to reduce and/or offset their CO_2 emissions. I conclude in Chapter 6, where I will summarize my findings and discuss their implications on the future of forest carbon sequestration.

Chapter 2 – Forest Carbon Sequestration Projects

2.1 Types of Forest Carbon Sequestration Projects

Figure 5 – Estimated Net Costs of Carbon Offset Measures[28]

Country	Project Type	Discount Rate*	Net Cost/ton of carbon offset ($US 1997)**
Brazil		12%	
	Plantation: Pulp		-7.2
	Plantation: Charcoal		-0.5
	Plantation: Sawlogs		-14.7
	Forest Management		Net Carbon Loss
Thailand		10%	
	National Parks		1.7 to 3.3
	Wildlife Sanctuaries		2.3 to 4.3
	Watershed Protection Areas		0.9 to 5.4
	Community Woodlot: Eucalyptus		1.0
	Semi-Public Plantation: Eucalyptus		-3.8
	Private-Sector Plantation: Eucalyptus		-13.0
	Semi-Public Plantation: Teak		-2.5
	Community Plantation: Teak		-18.5
	Agroforestry: Eucalyptus/Maize		-1.2
	Agroforestry: Eucalyptus/Fruit Trees		-25.6
Tanzania		10%	
	Protected Area		1.3
	Agroforestry: Eucalyptus/Maize		-1.8
	Public Plantation: Eucalyptus		0.1
China		Not Indicated	
	Plantation		-12.4 to 1.8
	Agroforestry		-13.1 to -1.4
Mexico		10%	
	Natural Forest Management: Temperate		-8.3
India		12%	
	National Parks		10.4
	Natural Regeneration of Degraded Forest (w/ Harvesting)		-1.8
	Enhanced Regeneration of Degraded Forest (w/ Harvesting)		-0.4
	Agroforestry		-4.5
	Community Woodlot		-0.8
	Soft Wood Plantations		-1.6
	Timber Plantation		-0.6

*The rate of return offered by comparable investment alternatives, used to calculate the present value of investments.
** Negative net costs indicate profits.
Source: Frumhoff, Peter, D. Goetze, J. Hardner, Linking Solutions to Climate Change and Biodiversity Loss Through the Kyoto Protocol's Clean Development Mechanism, UCS Reports, Union of Concerned Scientists, Cambridge, Mass., Oct. 98.

Forest carbon sequestration projects were among the first jointly implemented projects to be initiated due to their low cost and high number of secondary benefits. Since the uncertainty regarding climate change negotiations and the creditability of forest carbon sequestration projects was high when many projects were first established in the early 1990s, these qualities were important in getting stakeholders involved in forest carbon sequestration. Qualities such as sequestration rates, costs, and secondary benefits vary widely depending on the host country, the ecosystem of the project area, and the type of forest carbon sequestration project. The choice of ecosystem affects sequestration rates in that trees generally absorb more carbon in tropical areas than in temperate areas. While there is a wide range of costs, mitigation through forestry is generally much cheaper than other alternatives. Costs range from $0.10-$20/tC ($0.03-$5.40/tCO_2) in some tropical developing countries to $20-$100/tC ($5.40-$27.00/tCO_2) in developed countries because of higher land prices and wages. Costs would be expected to rise if large areas of land were taken from

[28] Totten. 1999: 28.

alternative use.[29] Figure 5 gives an example of the prices per ton of carbon offset for different forest carbon sequestration projects in a range of developing countries.

Of the over two dozen jointly implemented forest carbon sequestration projects in existence today, four main types of projects have emerged.[30] These are: Afforestation, Reforestation, Conservation, and Sustainable Forest Management.

Figure 6 – Jointly Implemented Forestry Projects 1990 - 1998[31]

Project name	Date proposed/ Initiated	Carbon offset (1000 t C)	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 R.	Netherlands	Park rehabilitation
Face Netherlands	1992	885	5,000	Netherlands	Netherlands	Urban forestry
ICSB-NEP 1	1992	56	1,400	Malaysia	USA	Reduced Impact Logging
AES – Oxfam – Coica	1992	15,000	1,500,000	South America	USA	Forest protection
AES – Nature Conservancy	1992	15,380	58,000	Paraguay	USA	Forest protection
Face-Profafor	1993	9,660	75,000	Ecuador	Netherlands	Small farmers plantation forestry
RUSAFOR-SAP	1993	79	450	Russia	USA	Plantation forestry
Face Uganda	1994	6,750	27,000	Uganda	Netherlands	Forest rehabilitation
Rio Bravo	1994	1,300	87,000	Belize	USA	Forest protection and management
Carfix	1994	2,000	91,000	Costa Rica	USA	Forest protection, and management
Ecoland/Tenaska	1995	350	2,500	Costa Rica	USA	Forest conservation
ICSB-NEP 2	1996	39	980	Malaysia	USA	Reduced Impact Logging
Noel Kempff M.	1996	14,000	1,000,000	Bolivia	UK/USA	Forest conservation and management
Klinki forestry	1997	1,600	87,000	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
PAP OCIC	1997	18,000	570,000	Costa Rica	Norway, USA	Forest conservation
Norway-Costa Rica	1997	230	4,000	Costa Rica	Norway	Forest rehabilitation and conservation
Tesco "green petrol"	1998	n.a.	n.a.	Undefined	UK	Forestry
Green fleet initiative	1997	n.a.	n.a.	Australia	Australia	Reforestation
AES - Ilha Bananal	1998	n.a.	n.a.	Brazil	USA	Forest rehabilitation
NSW + Pacific Power + Delta Electricity	1998	69	1,041	Australia	Australia	Reforestation
World Bank Prototype Carbon Fund	1998	n.a.	n.a.	International	International	Renewable energy and forestry
Totals/average	-	103,310	3,970,171	-	-	-

2.1.1 Afforestation and Reforestation

Afforestation and reforestation both generally refer to the establishment of trees on non-treed land. Reforestation refers to establishment of forest on land that recently had tree cover, whereas

[29] Kauppi and Sedjo. 2001: 303.
[30] Brown, Masera, and Sathaye. 2000: Section 5.2.2.
[31] Moura-Costa and Stuart. 1998: Appendix.

afforestation refers to land that has been without forest for much longer.[32] For the purposes of accounting under the Kyoto Protocol, however, these two mechanisms are the same. Afforestation and reforestation are activities that are both fully expected to be creditable under the Kyoto Protocol. Article 3.3 of the Protocol states, "The net changes in greenhouse gas emissions from sources and removals by sinks resulting from direct human-induced land use change and forestry activities, limited to afforestation, reforestation, and deforestation since 1990, measured as verifiable changes in stocks in each commitment period, shall be used to meet the commitments in this Article of each Party included in Annex I." At COP-7, it was further specified that the eligibility of land-use, land-use change and forestry project activities under Article 12 (the CDM) would be limited to afforestation and reforestation.[33] It was also agreed that afforestation and reforestation projects could be started and that projects already started could generate Certified Emission Reductions (CERs), which are the verified and authenticated units of greenhouse gas reductions from abatement or sequestration projects certified by the Clean Development Mechanism. These CERs would be creditable retroactively as from January 1, 2000, provided they meet the technical requirements that will be decided upon at COP-9 in 2003.[34] In the meantime, however, these requirements and many other clarifications, including the precise definition of reforestation, will not be agreed upon until COP-9 in 2003.

2.1.2 Conservation

Conservation of existing forests for the purpose of carbon sequestration is one of the most effective mechanisms by which emissions can be reduced because it both prevents the release of emissions from deforestation and enables existing emissions to be absorbed. The largest (in terms of area) forest carbon sequestration project initiated to date, the Noel Kempff Mercado Climate Action Project in Bolivia, is a conservation project that protects 696,000 hectares from logging and deforestation and is expected to reduce, avoid, and mitigate up to 7 million tons of carbon in the atmosphere over 30 years.[35] Most environmental organizations are in support of including conservation in the Kyoto Protocol because deforestation is a very real threat to biodiversity in many areas of the world. Healthy ecosystems also help lower the poorest people's vulnerability to the adverse effects of climate change. The IUCN (World Conservation Union) has stated, "Good conservation and management practices today may therefore be the most cost-effective and practical way of dealing with the variations and changes in climate in the future."[36]

[32] Noble *et al.* 2000: Section 2.2.3.1.
[33] UNFCCC COP-7. 2001: "Annex D: Article12," #13, #14, #15.
[34] European Union website, "Climate Change: COP-7 Marrakech Final Report," November 10, 2001.
[35] The Nature Conservancy website, "Climate Action Project: Noel Kempff Mercado National Park, Bolivia."
[36] IUCN (The World Conservation Union) website, "Climate Change & IUCN's Mission," 1999.

Since the negotiation of the Kyoto Protocol, however, conservation has appeared less and less likely to be a creditable activity under the land use, land use change, and forestry section of the Protocol's mitigation agenda. It has been argued that the conservation of an existing forest does not help mitigate climate change because there is no variation in the atmosphere's CO2 concentration as a result of the mere fact of conserving a forest and, supposedly, avoiding its deforestation. It is also difficult to prove that the forest, if not deliberately conserved, would be deforested in the future. Conversely, it is hard to ensure that the forest, once conserved, would not be at least partially deforested sometime after or even during the project life. Moreover, even if the forest is conserved, it cannot be guaranteed that the areas surrounding it would not be deforested. Also, without appropriate safeguards, credit could be issued for "paper" reductions, whereby forests that are not truly at risk from deforestation are "set aside" for the purpose of garnering emissions reductions credits.[37]

In addition, many developing countries, such as Brazil, are concerned that forest conservation may not be as profitable as other land uses, such as plantations. Conservation also inherently denies a landowner the right to transform his/her forestland into some other land use. Finally, if all existing natural forests were eligible for conservation, then their inclusion as part of the Kyoto Protocol's flexibility mechanisms would practically nullify the Protocol's emissions reduction requirements, as the magnitude of possible sink activities would be at least twice greater than the reduction targets agreed in Kyoto.[38]

With the publication of the IPCC's report entitled Land Use, Land Use Change, and Forestry in 2000, the door began to close on conservation as a mechanism by which Annex B countries could meet their QELROs. At the November 2001 COP-7 meeting in Marrakech, a definitive decision was made to exclude conservation from the Kyoto Protocol's flexibility mechanisms by stating that while "the implementation of land use, land-use change and forestry activities contributes to the conservation of biodiversity and sustainable use of natural resources," "the mere presence of carbon stocks [shall] be excluded from accounting."[39] This has shifted the focus of many new projects towards the other types of forest carbon sequestration projects, primarily afforestation and reforestation.

2.1.3 Forest Management

Forest management includes activities such as forest regeneration, forest fertilization, fire management, management of harvest quantity and timing, reduced forest degradation, and reduced impact

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[37] WWF website, "Integrating Climate Change and Forest Conservation Policies: The WWF Perspective," June 1999.
[38] Brazilian Ministry of Science and Technology website, "Brazilian Views on the Clean Development Mechanism (CDM)," 2002.
[39] UNFCCC COP-7. November 2001: Section K.

logging.[40] Reduced Impact Logging (RIL) is one form of forest management that has been demonstrated in several ongoing projects. In comparison to RIL, conventional logging operations can significantly alter a forest's physical structure. Removal of as little as 3% of the trees can reduce canopy cover by 50%. The impact on undergrowth can also be significant in that the removal of just three trees per hectare can destroy nearly 40% of the undergrowth. Shifting to RIL practices can reduce logging damage by as much as 50% through pre-cutting vines, directional felling, and planned extraction of timber on properly constructed and utilized skid trails. The NEES (New England Electric Systems) pilot project in Sabah, Malaysia, completed in 1995, reduced logging damage by 50% and saved roughly 40 tons of carbon per hectare (58,000 tons over the 1,400 hectare area) at a cost of $7.60/tC saved at two years after logging. In addition, RIL practices help to retain wildlife habitat, lower fire risks, and reduce soil erosion. RIL can also lead to better-stocked forest stands that are less damaged, faster growing, and produce greater volumes and higher-value forest products in the future.[41]

While COP-7 established that Parties can claim emissions reductions from forest management activities within Annex I countries in order to meet their QELROs for the first commitment period, the decision to allow forest management as a creditable activity under the CDM in future commitment periods will not be made until the negotiations on the second commitment period, which will take place in 2005.[42] In addition, the official definition of creditable forest management activities will not be determined until COP-9 in 2003.

2.2 Forest Carbon Sequestration Projects and Sustainable Development

Forest carbon sequestration projects contribute to sustainable development in many ways. Even before the Kyoto Protocol's requirement that CDM projects contribute to the host country's sustainable development goals, forest carbon sequestration projects were found to benefit both the local and national economic and environmental development priorities of their host countries. In regard to economics, forest carbon sequestration projects can provide local revenue from project investment and returns, generate employment, diversify farm economies, enhance firewood security, and increase timber production. Besides sequestering carbon, carbon sequestration projects benefit the environment by protecting or enhancing biodiversity, increasing wildlife habitat and soil fertility, reducing soil erosion, and protecting watersheds. Increased forest cover also helps prevent flooding, and the growth of forest plantations or community woodlots helps to reduce the pressure to log in natural forests.

[40] Lim, Farquhar, and Ravindranath. 2000: Section 6.3.2.1.
[41] Totten. 1999: 27.
[42] UNFCCC COP-7. November 2001: "Annex C-Article 3.4," #6.

2.2.1 Forest Carbon Sequestration and Deforestation

The environmental benefits of forest carbon sequestration, especially biodiversity, are particularly important when put into the context of deforestation and species loss in the tropics. Tropical Latin America is one of the most biodiverse places on earth. It is also one of the areas most threatened by deforestation. While rates of deforestation have declined slightly in the last decade in some tropical countries, the average net loss of forest carbon stocks has continued.[43]

Latin America accounts for 51% of the global area of tropical forests, the ecosystem that contains the highest stock of carbon. Mature tropical humid forests represent the largest stock of terrestrial carbon in the tropics, with a mean carbon content of around 150 tC/hectare and a range of up to 800 tC/hectare (including root and soil carbon) for the cloud forests of southern Mexico.[44]

Figure 7 - Estimates of Global Carbon Stocks in Vegetation and Soils to 1m Depth[45]

Biome	Area (10^6 km^2)	Carbon Stocks (Gt C) *Vegetation*	*Soils*	*Total*
Tropical forests	17.6	212	216	428
Temperate forests	10.4	59	100	159
Boreal forests	13.7	88	471	559
Tropical savannas	22.5	66	264	330
Temperate grasslands	12.5	9	295	304
Deserts and semideserts	45.5	8	191	199
Tundra	9.5	6	121	127
Wetlands	3.5	15	225	240
Croplands	16.0	3	128	131
Total	151.2	466	2011	2477

The conversion of this ecosystem to arable land typically results in a large reduction of biomass and a loss of about 30% of the carbon in the first meter of soil (about 40% in tropical soils).[46] In the tropics, the associated CO2 emissions from forest conversion to pastures or agriculture were estimated to be 1.6 +/- 1.0 GtC/year between 1980 and 1989.[47] In temperate zones, where there is little expansion of agricultural lands now, losses of carbon stocks have largely abated. In tropical zones, however, the release of CO2 to the atmosphere remains an important problem because of the widespread clearing of new land and the reduced duration of fallow periods in shifting cultivation.[48] According to the UN FAO, about 15.4 million hectares of natural tropical forest are lost each year. Of this, 42% occurs in Latin America, 31% in Africa, and 27% in Asia.[49]

[43] Kauppi and Sedjo. 2001: 303.
[44] Bass, Dubois, Moura-Costa, Pinard, Tipper, and Wilson. 2000: 25.
[45] IPCC. "Summary for Policymakers," Land Use, Land Use Change, and Forestry, 2000: Part 1.
[46] Kauppi and Sedjo. 2001: 306.
[47] Bass, Dubois, Moura-Costa, Pinard, Tipper, and Wilson. March 2000: 23.
[48] Kauppi, and Sedjo. 2001: 306.
[49] Kauppi, and Sedjo. 2001: 306.

Figure 8 – Estimated forest cover and deforestation rates at regional and global levels based on 1990 and 1995 satellite data[50]

	Forest cover at 1990 (Mha)	Forest cover at 1995 (Mha)	Deforestation rate 1980 to 1995 (Mha yr⁻¹)	Deforestation rate 1980 to 1995 (%)
Tropical Africa	523.38	504.9	3.70	0.7
Tropical Asia	295.04	279.77	3.06	1.1
Tropical Oceania	42.66	41.90	0.15	0.4
Tropical and subtropical North and Central America	84.63	79.44	1.04	1.3
Tropical South America	851.22	827.95	4.66	0.6
Total tropical	1,796.93	1,733.96	12.59	0.7
Worldwide	3,510.73	3,454.38	11.27	0.3

The potential for land management strategies as a way to conserve existing carbon sinks is clearly illustrated by global deforestation rates. In 1990, global forest cover was estimated at 3,510 million hectares.[51] Global deforestation rates were estimated at between 13.9 million and 20.4 million hectares/year during the 1980s and early 1990s,[52] but have now been found to be much higher, since in 1999 forest resources stood at 3,221 million hectares. This amounts to an average deforestation rate of around 32 million hectares/year.[53]

2.2.2 Forest Carbon Sequestration and Biodiversity

Biological diversity is being eroded as fast today as at any time since the dinosaurs died out some 65 million years ago, and most of this extinction is taking place in tropical forests. Of the estimated 10 million species that live on earth, tropical forests house between 50 and 90% of them. About 17 million hectares of tropical forests - an area four times the size of Switzerland - are now being cleared annually, and scientists estimate that at these rates roughly 5 to 10% of tropical forest species may face extinction

[50] Bass, Dubois, Moura-Costa, Pinard, Tipper, and Wilson. March 2000: 24.
[51] Bass, Dubois, Moura-Costa, Pinard, Tipper, and Wilson. March 2000: 23.
[52] Bass, Dubois, Moura-Costa, Pinard, Tipper, and Wilson. March 2000: 23.
[53] Bass, Dubois, Moura-Costa, Pinard, Tipper, and Wilson, March 2000: 26.

within the next 30 years.[54] Already, half the world's tropical forests have been cleared or degraded. Every hour, at least 1,800 hectares are cut down, and another four plant or animal species die out, most of them in the tropics.[55]

In addition, climate change is predicted to severely accelerate the rate of species loss. The Hadley Center for Climate Change at the United Kingdom Meteorological Office has predicted that, by 2050, the earth's forests will become a significant net source of CO_2 emissions when huge blocks of remaining forests, such as the northern Amazon, succumb to changing climate and die back, becoming grassland, steppe, or desert.[56] Forest carbon sequestration is therefore not only important as a way to offset GHG emissions from anthropogenic sources, it is necessary to offset the forces that threaten the forest itself.

[54] WRI website, "Losses of Biodiversity and Their Causes."
[55] Miller and Tangley. 1991: Introduction.
[56] WWF website. "Integrating Climate Change and Forest Conservation Policies: The WWF Perspective," June 1999.

Chapter 3 - Case Studies: Forest Carbon Sequestration in Latin America

To better understand how forest carbon sequestration can be used to mitigate climate change, I investigate three projects that cover the range of forest carbon sequestration project types in three different Latin American countries. I chose projects in Latin America not simply because that is where most of the forest carbon sequestration projects have taken place, but because of the potential and the need that exists for these kinds of projects there. Specifically, while Latin America contains the bulk of the world's remaining tropical forests, it also has the world's fastest rate of deforestation.

The case studies I chose include the Rio Bravo Carbon Sequestration Pilot Project, which involves conservation and forest management in Belize; the Klinki Forestry Project, which involves reforestation in Costa Rica; and the FACE/Profafor Forestry Project, which involves afforestation in Ecuador. While these case studies are by no means typical of forest carbon sequestration projects in general, they illustrate the multi-stakeholder relationships characteristic of these kinds of projects and give insight into project design, locational specificities, and the benefits that provide the incentives to undertake them.

3.1 Belize – the Rio Bravo Carbon Sequestration Pilot Project

3.1.1 Country Overview

Belize, slightly smaller than Massachusetts at 22,966 square kilometers, is Central America's most forested and least populated country. Approximately 79% of the country is comprised of forest and other wooded areas, 65.1% of which is tropical broadleaf forest.[57] The rest of Belize's total land area is made up of arable land (10%), permanent cropland (1%), permanent pasture (2%), and other land uses (3%).[58] Approximately 38.5% of Belize's total land area is protected in public or private parks and reserves,[59] which is made possible in part because of the country's low population of only 256,062 people.[60]

Belize's small, essentially private enterprise economy is based primarily on agriculture, food processing, and merchandising, with tourism and construction assuming greater importance. Sugar, the chief crop, accounts for nearly half of exports, while the banana industry is the country's largest employer. The government's austerity program in 1997 resulted in an economic slowdown that continued in 1998.

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57 Belize Central Statistical Office. "Table 18b-Forest Classes, Areas, and Percentages for Belize Mainland – 1994," April 1999: 18.
58 CIA World Factbook 2001, "Belize-Land Use (2000 est.)." Note: this source puts the percentage of Belize's land under forest and woodland at 84%.
59 Belize Central Statistical Office. "Table 26a-Declared Protected Areas of Belize (up to 1998)," April 1999: 26.
60 CIA World Factbook 2001, "Belize-Population (July 2001 est.)."

The trade deficit has been growing, mostly as a result of low export prices for sugar and bananas. The tourist and construction sectors strengthened in early 1999, supporting growth of 6% in 1999 and 4% in 2000.[61] Tourism is now Belize's single largest income generator, with ecotourism being Belize's primary niche market.[62]

Aided by international donors, the government's key short-term objective remains the reduction of poverty, since 33% of its people live below the poverty line.[63] The country remains plagued by a 12.8% unemployment rate,[64] growing involvement in the South American drug trade, and increased urban crime.[65] While logging is still a major earner of foreign exchange in Belize,[66] declines in productivity resulting from the depletion of Belize's two main timber species, mahogany and pine, has quickened the pace of conversion from forest to farmland.[67] Currently, large-scale, permanent agriculture has taken over from logging as the primary cause of deforestation in Belize.[68]

3.1.2 Rio Bravo Carbon Sequestration Pilot Project (RBCSPP)

The Rio Bravo Carbon Sequestration Pilot Project in Belize, started in 1995, was one of the first fully funded forest sector projects implemented under the U.S. Initiative on Joint Implementation (USIJI). USIJI, which was started in 1994, is a government program that has provided a framework for developing and implementing climate change mitigation projects. It facilitates linkages between project developers, investors, technical experts, and project host countries. The RBCSPP is a result of one of these linkages, in this case between The Nature Conservancy (TNC), Programme for Belize (PFB), Winrock International, the Government of Belize, and a number of electric utility and energy company investors, including Cinergy, Detroit Edison, Nexen, PacifiCorp, Suncor, Wisconsin Electric Power Company (WEPCO), and the Utilitree Carbon Company, which is a non-profit corporation established by the electric utility industry to invest in forest carbon sequestration projects. Through the protection of land from deforestation and the implementation of sustainable forest management practices, the RBCSPP is expected to reduce, avoid or mitigate an estimated 2.4 million tons of carbon during its 40-year lifetime.[69]

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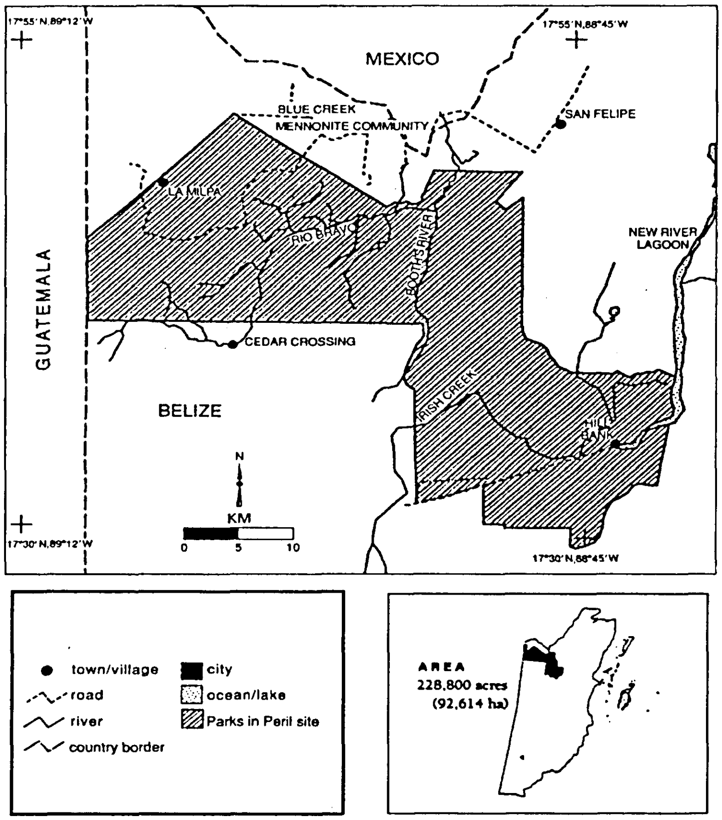
[61] CIA World Factbook 2001, "Belize-Overview."
[62] Fuller, Carlos. Interview January 29, 2002.
[63] CIA World Factbook 2001, "Belize-Population Below the Poverty Line (1999 est.)"
[64] CIA World Factbook 2001, "Belize-Unemployment Rate (1999)"
[65] CIA World Factbook 2001, "Belize-Overview"
[66] Belize Central Statistical Office. "Forests," April 1999: 18-19
[67] Brandon, Redford, and Sanderson. 1998: 242.
[68] Platt, Elizabeth. 1998: 128-129.
[69] The Nature Conservancy website, "Climate Action Project Rio Bravo Conservation and Management Area, Belize."

Figure 9 – Rio Bravo Conservation Management Area



3.1.3 Rio Bravo Conservation and Management Area (RBCMA)

Located in Belize's northwest corner near the border of Mexico and Guatemala, the Rio Bravo Conservation and Management Area, at 4.6% of Belize's total land area, is the country's largest private reserve and second largest single protected area.[70] Owned and managed by PFB, this 104,892-hectare parcel is part of a million-acre forest corridor that is vital to biodiversity conservation in Central America. The RBCMA supports a valuable assemblage of biodiversity that includes 392 species of birds, 200 species of trees, 70 species of mammals, and 12 endangered animal species, including the black howler monkey and the jaguar.[71] Besides containing forest cover types protected nowhere else in Belize, the RBCMA also protects one of Belize's richest remaining stocks of mahogany.

PFB holds title to the RBCMA in a contract with the Government of Belize to manage the area for the people of Belize in perpetuity. PFB established the RBCMA in 1988 through the purchase and donation of several private landholdings made possible by the activism of Belizean and international conservationists, and by the Belizean government's favorable attitude towards conservation NGOs.[72]

3.1.4 Project Design

As reported by the USIJI, the objective of the RBCSPP is to demonstrate an optimal balance between cost-effective carbon sequestration, economically sustainable forest yield, and environmental protection. To accomplish this, the project uses two main strategies to sequester carbon: conservation through the acquisition of land threatened by deforestation and sustainable forest management of existing protected forestland.

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[70] The Nature Conservancy website, "Belize Program."
[71] Programme for Belize website.
[72] Brandon, Redford, and Sanderson. 1998: 218-219.

Component A of the project involved the purchase of a 5,602 hectare parcel of forestland, 5,504 hectares of which would have been converted to farmland in five years time if not for intervention by the project. Carbon offsets from this purchase were calculated by subtracting the total estimated carbon stock of the Component A land that would have been deforested (1,568,907 tC) by the total estimated carbon stock of a reference case (here, a nearby field of local crops at 467,815 tC) to arrive at a figure for total emissions avoided of 1,101,093 tC.[73]

Component B of the project seeks to increase the level and rate of carbon sequestration on a 44,383-hectare parcel of existing RBCMA land through the establishment and implementation of an economically sustainable forest management program. The primary activities of this program include sustainable reduced-impact logging, pine stocking enhancement, and fire protection.[74]

Carbon sequestration benefits from Component B are calculated by determining the average annual biomass accumulation rate, the impacts of sustainable harvesting and low-impact logging approaches, and fire protection practices. Over the project's lifetime, the estimated carbon stock for all of Component B is expected to grow from 4,199,218 tC in 1995 to 4,741,032 tC in 2035, for a net gain of 541,814 tC.[75]

A second phase of the RBCSPP was initiated in 1997, when PFB purchased an adjacent 7,707 hectare parcel, 4,587 hectares of which would have been deforested and converted to farmland. The total estimated emissions avoided by this purchase totaled 978,407 tC. This parcel will be added to Component B, where it is expected to sequester an additional 3,904 tC/yr for a total of 156,160 tC over the project's 40-year lifetime.[76]

The remaining RBCMA lands have been left undisturbed for conservation and research purposes, and are managed as protected forest. These lands are also used for ecotourism and the protection of Mayan ruins located in the area.

3.1.5 Project Stakeholders

The funding for the project, totaling more than $5.6 million over a ten-year investment period, was spread out among the electricity utilities and energy company investors and PFB. In the first phase, WEPCO put in over $1 million for project development, and later invested an additional $520,000 for project implementation, which was matched by Cinergy, Detroit Edison, Pacificorp, and Utilitree. Programme for Belize contributed over $1.2 million towards the project as a whole, and Suncor has added over $400,000. In 2000, Nexen, Suncor, WEPCO, and PFB shared the cost of the second phase of the

[73] USIJI - Rio Bravo Carbon Sequestration Pilot Project. September 1999: 16-21.
[74] USIJI - Rio Bravo Carbon Sequestration Pilot Project. September 1999: 11.
[75] USIJI - Rio Bravo Carbon Sequestration Pilot Project. September 1999: 16-21.
[76] USIJI - Rio Bravo Carbon Sequestration Pilot Project. September 1999: 21.

project, which was about $2 million for the purchase of the 7,707-hectare parcel, and $1 million for project management.[77] Through the establishment of an endowment fund, the project is expected to continue its activities beyond the 10-year investment period and on through its 40-year lifetime.

3.1.6 Project Benefits

The benefits of the RBCSPP extend to its stakeholders in a variety of ways. All of the finance providers of the project hold an equal share in the carbon offsets that are generated.[78] However, at the time of the first phase investment in 1995, it was unclear whether conservation and forest management would be creditable under the climate change regime. At COP-7 in 2001, it was decided that conservation would not be creditable under the first commitment period, and that forest management would also not be creditable for joint implementation projects between Annex 1 and non-Annex 1 countries. There is still some hope that this project might be creditable under the second commitment period or under some kind of emissions trading system set up by the US, but the probability of this is unknown.

Despite the lack of guaranteed credits, the project has generally been considered a success, because as a pilot project, all stakeholders have learned and benefited from the process of establishing the project. TNC and PFB have learned about the management of carbon sequestration projects, Winrock has gained experience in establishing carbon sequestration monitoring protocols, and the government of Belize has been able to show that Belize is a friendly and cooperative place in which to invest in carbon sequestration projects.

In addition, the project has contributed to local scientific and managerial capacity, provided jobs and training in forestry, forest management, and park security, contributed to environmental and economic outreach programs, and improved roads and other infrastructure. The project has also helped with a number of scientific studies, including research on the feasibility of sustainable logging and mahogany regeneration. In terms of forest resources and habitat conservation, it has ensured the conservation of over 13,300 more hectares in the biologically significant Maya forest corridor, increased protection of the RBCMA as a whole, and improved forest resource management.

3.2 Costa Rica – the Klinki Forestry Project

3.2.1 Country Overview

Costa Rica is the most successful Central American country in terms of political and economic stability. Although still a largely agricultural country, it has achieved a relatively high standard of living.

[77] USIJI - Rio Bravo Carbon Sequestration Pilot Project. September 1999: 12.
[78] USIJI - Rio Bravo Carbon Sequestration Pilot Project. September 1999: 34.

A small country of 51,100 sq km (slightly smaller than West Virginia), Costa Rica has a population of 3,773,057.[79] The percentage of its population under the poverty line has been substantially reduced over the past 15 years to 20.6%, and a strong social safety net has been put into place.[80] Costa Rica's basically stable economy depends on tourism, agriculture, and electronics exports. Foreign investors remain attracted by the country's political stability and high education levels, and tourism has been rapidly expanding. However, traditional export sectors have not kept pace. Low coffee prices and a glut of bananas have hurt the agricultural sector. Also, the government continues to grapple with its large deficit and massive internal debt.

Since the early 1990s, Costa Rica has been implementing its vision for sustainable development. The two sectors on which Costa Rica is basing its plans are tourism and energy. The country produces 83.32% of its electricity from hydropower, and is a net exporter of energy, with 165 million kWh exported in 1999.[81] Also, from 1987 to 1995, the number of tourists visiting the country grew at an average annual rate of 15%, which was much better than the world average, due in part to Costa Rica's positioning in the ecotourism market.[82]

The only way a vision based on these two sectors is possible is if the processes of environmental degradation in the country, e.g., deforestation and watershed deterioration, are controlled. Stopping and reversing these processes is critical for the development of these two vital sectors, both of which depend on the presence of forests. This logic has pushed Costa Rica to make strong decisions on the use of its natural resources, particularly its forested areas. During the 1960s and 1970s, Costa Rica had one of the world's highest deforestation rates, with thousands of hectares of forest lost to cattle ranching and large-scale agriculture.[83] As an example of the extent of deforestation, between 1961 and 1989, the area of pastureland in Costa Rica more than doubled, while the area covered by forest fell by more than 50%.[84] While the deforestation rate has since declined due to changes in land use policy (and in part because most of the land suitable for cattle and agriculture has already been cleared), and now that 24% of Costa Rica's national territory has been designated as national parks or protected areas, the present challenge is the protection of existing forests and the revitalization of degraded lands.

3.2.2 Klinki Forestry Project

In terms of forest resources, only 31% of Costa Rica is covered in forest and woodland, as deforestation from cattle ranching, agriculture, logging, and development has steadily eroded the

[79] CIA World Factbook 2001, "Costa Rica-Population (July 2001 est.)"
[80] CIA World Factbook 2001, "Costa Rica-Population below Poverty Line (1999 est.)"
[81] CIA World Factbook 2001, "Costa Rica-Electricity (1999)"
[82] Cuellar, Herrador, Gonzalez, and Rosa. 1999: 4.
[83] Cuellar, Herrador, Gonzalez, and Rosa. 1999: 5.
[84] Menkhaus and Lober. 1996: 1-10.

country's forest base. 1993 estimates put 46% of the country's land under permanent pasture, 6% as arable land, 5% as permanent cropland, and 12% under other land uses.[85]

The Klinki Forestry Project, which began in 1997, is a USIJI-approved project that seeks to reforest pastures and marginal cropland with a native and naturalized tree mixture that includes the Klinki pine, a fast-growing non-native tree species that is suitable for use as utility poles and lumber. The project takes place on individual and collective farms in the Turrialba Valley of Costa Rica's Atlantic zone and to the north towards San Carlos.[86]

The objective of the project is to involve farmers in carbon sequestration as an economic activity by using the latest silvicultural technology to provide wood production and GHG mitigation benefits. The forests that are planted are designed to meet the two goals of carbon sequestration and timber production. The mixture of tree species, called the Klinki Matrix, was developed for this purpose over more than 40 years of research and development in Costa Rica. The Matrix includes three distinct tree types:

- super-fast-growing trees at wide spacing growing over the main stand
- a main stand of very-fast-growing species
- moderate-growing and very long-lived shade tolerant species

This tree mixture produces a layered canopy in which the super-fast-growing trees (mainly the Klinki pine) can grow up to 15 feet in height per year, while the moderately-fast growing trees grow up to 5 feet per year, depending on site quality. The first thinning of this type of forest can be expected to take place between 10 and 15 years after planting, thus enabling the farmer to earn income during the project's 25-year lifetime. While the super-fast-growing trees provide early yields, the very-fast-growing species carry out the early sequestration of carbon and income for the farmer, and the long-lived/moderate-growing trees provide the bulk of the carbon sequestration and the long-term carbon storage beyond the end of the contract.[87]

3.2.3 Project Stakeholders

As of April 2002, 46.5 hectares of Klinki Matrix forest have been planted on five farms in Costa Rica to offset the CO2 emissions of 37 US emitters, and an additional planting of 40.5 hectares has been funded for establishment in May 2002.[88] While the project hoped to plant 6,000 hectares, it has only received enough funding to sequester a fraction of that amount. This is in part due to the intent and the design of the project. While the project involves reforestation, which is a creditable activity, the project

[85] CIA World Factbook 2001, "Costa Rica-Land Use (1993 est.)"
[86] USIJI - Klinki Forestry Project." September 1999: 1.
[87]Reforest the Tropics website, "About the Forests."
[88] Reforest the Tropics website, "About Reforest the Tropics, Inc."

was created to demonstrate the involvement of farmers in carbon sequestration as an economic activity while providing GHG, wood production, and conservation benefits. The carbon offsets that are generated are only valid for the buyer's personal use and are not tradable in any market because they receive no third-party verification, which would raise the project's operating costs considerably. Under the Kyoto Protocol, projects need to be independently verified in order to be creditable.

The stakeholders involved in this project include Reforest the Tropics (RTT), individual and collective groups of farmers, and a number of technical assistance providers, including the Cantonal Agricultural Center of Turrialba (CACTU), the US Department of Agriculture Forest Products Laboratory, the Yale School of Forestry and Environmental Studies, and the Tropical Agriculture Research and Higher Education Center (CATIE). The benefactors of Reforest the Tropics are a diverse collection of small businesses, institutions, and individuals, most of whom have in some way have a personal connection to Dr. Herster Barres, RTT's founder. They include Connecticut College, the Mohegan Tribe of Indians of Connecticut, Connecticut Municipal Electric Energy Cooperative, Superior Nut Company, St. Mark's Church of New Canaan, several Connecticut elementary, middle, and high schools, and a number of private individuals. Lastly, the Costa Rican government is involved through its Office on Joint Implementation (OCIC). OCIC is the national entity that promotes investment, provides project guidelines, evaluates and follows up on AIJ projects, makes reports to the Secretariat of the FCCC, and represents the Costa Rican government in the climate negotiations within the FCCC and other multilateral and bilateral organizations. RTT has an agreement with OCIC to conduct jointly implemented reforestation activities in Costa Rica.

Figure 10 – Benefactors and respective areas planted under Klinki Project[89]

LIST OF DONORS WITH CARBON SEQUESTRATION FORESTS
Reforest The Tropics
26-Oct 01

	Sponsor	Type	Year funded	Donation	Area, acres	Annually Processed	in 25-yr contract
A	26-donor Project						
1	Hartman, John & Kelly	Foundation	1998	$ 400	1.00	16	400
2	Perrine, Hugh	Retired	1998	$ 400	1.00	16	400
3	Hintlian, Harry	Businessman	1998	$ 400	1.00	16	400
4	Anderson, David	ex-Legislator from CT	1998	$ 525	1.31	21	524
5	Cutler Middle School	Middle school	1998	$ 437	1.09	17	436
6	Barres, Miranda	House wife	1998	$ 400	1.00	16	400
7	Foulkes, Don	Retired aircraft engineer	1998	$ 400	1.00	16	400
8	Geballe, Gordon (Yale)	Asst. Dean Yale Forestry	1998	$ 800	2.00	32	800
9	Strickler, William B	Patent lawyer	1998	$ 400	1.00	16	400
10	The Home Depot	Business	1998	$ 400	1.00	16	400
11	Ayer, Frank & Harriet	Retired	1998	$ 525	1.31	21	524
12	Lyon, Tom	Retired	1998	$ 400	1.00	16	400
13	Woodland Dr. Apts	Business	1998	$ 400	1.00	16	400
see 5	Cutler Middle School	Middle School	1998	$ 304	0.76	12	304
14	St. Mark's Church	Church	1998	$ 580	1.45	23	580
15	Rotary Club of New London, CT	Social organization	1998	$ 831	1.00	16	400
16	Homer Wright	Advertising executive	1998	$ 400	1.00	16	400
17	Rotary Club of Essex, CT	Social organization	1998	$ 300	0.52	8	208
18	Rotary Club of Mystic, CT	Social organization	1998	$ 165	0.29	5	116
19	Rotary Club of Norwich, CT	Social organization	1998	$ 180	0.31	5	124
20	Rotary Club of Stonington, CT	Social organization	1998	$ 120	0.21	3	84
21	Mr. & Mrs. Graves, Norwich, CT	Individual	1998	$ 100	0.17	3	68
22	Rotary Club of Madison, CT	Social organization	1998	$ 160	0.19	3	76
23	Rev. Herster Barres	Minister	1998	$ 100	0.12	2	48
24	Rotary Club of Groton-Ledyard	Social organization	1998	$ 160	0.19	3	76
25	Stonington, ME Elementary School	Elementary school	1998	$ 400	1.00	16	400
26	J. Winthrop High School	High School	1998	$ 573	1.00	16	400
	Additional planted by the farmers		1998		3.00	48	1,200
		Total for the 26 emitter / donors		$ 10,260	25.92	415	10,368
27	Superior Nut Co., Cambridge, MA	Business	1998	$ 25,876	29.00	464	11,600
28	Connecticut Municipal Electric Energy Cooperative (CMEEC)	Building and fleet of cars	1999	$ 12,000	14.85	238	5,940
29	Connecticut College	Crozier-Williams Center	1999	$ 36,252	37.08	593	14,832
30	Zonex Project, Karen Valente	School teacher	1999	$ 2,053	2.47	40	988
31	Zonex Project, Klinki Academy	School	1999	$ 831	1.00	16	400
32	Zonex Project, Morton, John	Individual	1999	$ 850	1.00	16	400
33	Zonex Project, Ann & Anis Racy	Doctor and wife	1999	$ 2,053	2.47	40	988
34	Zonex Project, St. Mark's Church	Church	1999	$ 891	1.00	16	400
35	Zonex Project, The Home Depot	Business	1999	$ 831	1.00	16	400
36	Zonex Project, Unitarian Church, Rutland, VT	Church	1999	$ 395	0.48	8	190
37	Kathleen & Michael Schiano, Weatoque, CT	Married couple	2001	$ 2,053	2.47	40	988
38	The Mohegan Tribe, Uncasville, CT (planting in May '02)	Offsetting fuel cell emissions	2001	$ 120,100	100.00	1,600	40,000
	Grand total for all Projects	Grand total		$ 214,446	218.74	3,500	87,494

3.2.4 Project Design

The project is designed to take place in four stages. First, RTT helps its benefactors determine how much CO2 they emit, and thus how much they should offset. They then arrange the funding for the amount of forest to be planted to make up this offset through carbon sequestration. Second, RTT locates a farmer in Costa Rica who is willing to convert his pastures or marginal cropland into forest. Third, RTT organizes a link between the benefactor and the farmer through a 25-year legal contract that gives cash grants, seedlings, and technical assistance to the farmer through RTT along with the promise of periodic monitoring and reports. The farmer remains the owner of the land, the forest, and all of the forest's products, except for the credit for the carbon sequestered, which is given to RTT in the name of the benefactor. The farmer is allowed to thin his forest as it grows, leaving behind an adequate stock of trees containing an agreed-upon amount of sequestered carbon. This legal contract is made possible through the US and Costa Rica's approval of the project. Beyond the funding of the project, the benefactor has no

[89] RTT website.

other legal commitments. Fourth, RTT's Costa Rican counterparts within CACTU who are responsible for the forest's long-term management, ASOFORES (Asociacion para el Desarollo Forestal or Association for the Development of Forestry), monitor and report on the amount of sequestration that actually occurs.[90]

3.2.5 Project Benefits

In general, benefactors to the project pay $2,500 to plant and maintain 1 hectare of forest for 25 years, which is expected to sequester an average of 8.2 tC/year.[91,92] This works out to a price of approximately $12.20/tC/year. Farmers receive $1,000 per hectare over a 3-year period, plus seedlings and technical assistance on siting, planting, and forest management.[93] Since pastureland net income per hectare is low (only about $50/hectare/year to raise beef cattle), and the farmers chosen do not require cash income on all their lands every year, the Klinki project works out to be a sound land use option for them.[94] This is especially true when trees are planted on hilly, degraded land. Besides generating short-term income and future cash flow from the sale of some of the trees, the project helps stabilize and enrich the soil, improve water habitats and stream flow, reduce the use of chemicals as low-yield crops are shifted to forest plantations, increase biodiversity by nurturing a new understory with native species, and reduce energy use by substituting concrete with Klinki pine plywood.[95] The project also reduces pressure to log on natural forest, provides more affordable housing through local, lower-priced construction materials, and creates a more diversified farm economy.[96] While the scale of the project is small at this point, the principles of the project are in line with Costa Rica's sustainable development goals of protecting its watersheds and tourism resources.

3.3 Ecuador – the FACE/Profafor Forestry Project

3.3.1 Country Overview

Ecuador, at 283,560 sq km (slightly smaller than Nevada) is a resource-rich but troubled country. 50% of its 13,183,978 people live below the poverty line despite its substantial oil reserves and rich agricultural areas, as most of its land and resources are held by the country's elites.[97] Ecuador's economy, based on the export of primary products such as oil, bananas, and shrimp, is vulnerable to fluctuations in

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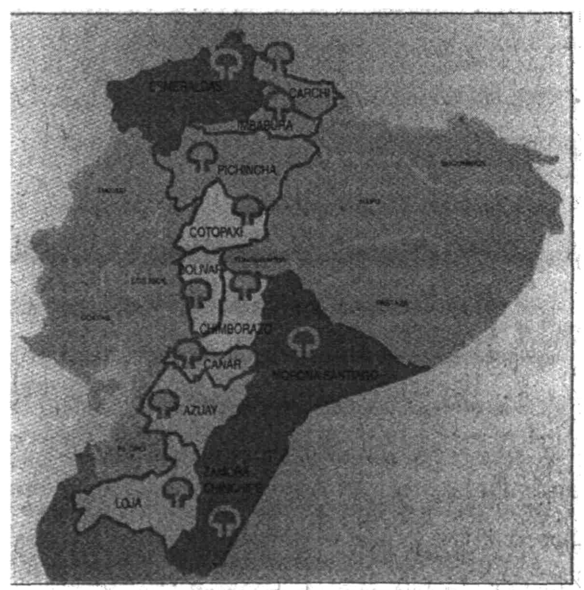
[90] Reforest the Tropics, Letter to Potential Benefactor explaining RTT's mission, March 13, 2002.
[91] Reforest the Tropics brochure, 2001.
[92] USIJI - Klinki Forestry Project. September 1999: 13.
[93] Barres, Herster. Interview March 14, 2002.
[94] Rojas, Carlos Manuel. Interview March 20, 2002.
[95] USIJI - Klinki Forestry Project. September 1999: 11.
[96] USIJI - Klinki Forestry Project. September 1999: 11.
[97] CIA World Factbook 2001, "Ecuador-Population (July 2001 est.), Population below the Poverty Line (1999 est.)"

world market prices, and has been growing unevenly due to ill-conceived fiscal stabilization measures. While Ecuador joined the World Trade Organization in 1996, it has failed to comply with many of its accession commitments. The aftermath of El Nino and the depressed oil market of 1997-98 caused Ecuador's economy to plunge in 1999. The beginning of 1999 also saw the banking sector collapse, which helped precipitate an unprecedented default on external loans later that year. Throughout 1999, continued economic instability drove a 70% depreciation of the currency, which eventually forced the government to "dollarize" the currency regime in 2000.[98] The move stabilized the currency, but the government was forced to changed hands, an event that has taken place on an average of every two years since independence in 1822.[99]

Ecuador's political, economic, and social instability are the greatest threats to the sustainability of its natural resources. In the tropical Andes of northwest Ecuador, if deforestation rates remain at current levels, forests in the region will disappear completely within 30-35 years.[100] This would constitute one of the most serious losses to the world's biodiversity, as the tropical Andes contains the highest number of unique plant and animal species found anyplace on earth.[101] While 56% of Ecuador remains as forest and woodland, this number continues to decline. Other land uses in Ecuador are permanent pasture (18%), arable land (6%), permanent cropland (5%), and other land uses (15%).[102]

Figure 11 – FACE/Profafor Project Areas [103]



3.3.2 FACE/Profafor Forestry Project

The FACE/Profaror project in Ecuador was established in 1993 for the purpose of afforestation, primarily on the montane grasslands of the Andes where the original forests have almost completely disappeared. The land is being afforested using a mixture of non-native (mostly pine and eucalyptus) and native tree species via collaboration between FACE, Profafor, and individual and collective groups of farmers and indigenous communities. SGS is responsible for verifying and certifying the carbon sequestered by this project, which originated from an

[98] CIA World Factbook 2001, "Ecuador-Economy"
[99] Sacco, Christoher. "A Brief History of Ecuador," EcuadorExplorer.com website.
[100] Sierra and Stallings. 1998: 135.
[101] Conservation International 2001 Annual Report: 11.
[102] CIA World Factbook 2001, "Ecuador-Land Use (1993 est.)"
[103] Profafor Manual de Contratos: 5.

agreement signed in 1993 between FACE and the Ecuadorian Ministry of Environment to plant 5,000 hectares of new forest per year for a total of 75,000 hectares. As of January 2001, over 25,200 hectares have been put under contract and are being planted.

3.3.3 Project Stakeholders

The FACE Foundation was established in 1990 by NV SEP, the Dutch Electricity Generating Board, which was a consortium of four Dutch electricity companies. The purpose of the FACE was to establish a portfolio of forestry projects around the world to accrue carbon offsets equivalent to the emissions from new fossil-fuel power plants in the Netherlands.104 FACE invests in the capacity of the forest to absorb CO2; all the other benefits of the forest are for the landowner, and FACE does not buy land. FACE currently has projects in five countries: the Netherlands, Malaysia, Uganda, the Czech Republic, and Ecuador. In 2000, FACE formally ended its relationship with NV SEP and became an independent non-profit. However, its largest client is still BV NEA, the legal successor to NV SEP. Funding from past orders by NV SEP has been paid by BV NEA, which enables FACE to keep its projects and office running until the end of 2003.[105]

To generate revenue, FACE has the rights to sell the CO2 sequestered by the forests planted under NV SEP. This revenue is then invested in the development of more projects to plant and manage sustainable forests.[106] Since its independence, FACE has sought new investors for which it initiates and manages forest carbon sequestration projects. Its plan is to sells SGS-certified Verified Emission Reductions (VERs)[107] to clients wishing to offset their GHG emissions from its existing forests through its commercial outlet, Business for Climate, which is a partnership between FACE and Triodos Bank, a socially-responsible lender in Europe. Some of their current and prospective investors include the Museon in The Hague, the government of Utrecht province, Autoclick (a European car sales and information website), Between-us (a media marketing consultancy), Polyprint (a professional printing company), Peeze (a coffee company), and VBDO (the Dutch Association of Investors for Sustainable Development).

The Museon in The Hague, by deciding to have 644 tons of CO2 sequestered in forest on its behalf every year, has become the first climate-neutral museum in the world, meaning that it has offset the GHGs emitted from its operation in order to achieve a net-zero impact on the earth's climate. The growing interest in climate-neutrality has increased FACE's efforts to develop the idea further in terms of

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[104] Totten. 1999: 10.
[105] FACE Annual Report 2000: 17.
[106] FACE Annual Report 2000: 17.
[107] VERs are created, in the absence of government rules, by project-based activities that are defined by the buyer and seller and verified by an independent third party. They have the possibility, but not the guarantee, to be creditable by governments as CERs under the CDM and used to meet future emissions reductions requirements.

marketing.[108] Also, pressure from the Dutch government to reduce GHG emissions will likely increase the demand for FACE's products and services. In contrast to the Dutch government's original commitment to reduce CO2 emissions by 3% from 1990 to 2000, the country's emissions have risen by 17% over the same period, which makes the Dutch government's Kyoto target of a 6% reduction from 1990 levels by 2008-12 seem highly unlikely, even when the possibility of emissions trading is taken into account.[109]

3.3.4 Project Design

Profafor, which manages FACE's project in Ecuador, was started in 1993 by FACE and is responsible for the coordination of project activities. Its office in Quito assesses applications, communicates with the Ministry of Environment and landowners, supervises tree planting, and deals with project administration. It negotiates the contracts with the project's main beneficiaries: individual landowners, institutional landowners, cooperatives, and indigenous communities. For these landowners, project sites are 50 hectares minimum, 600 hectares maximum for indigenous communities, and 300 hectares maximum for other landowners.[110] Profafor also allows large private landowners to be eligible for projects if they meet the criteria and contract requirements that FACE stipulates in its large overseas projects. The forests in these contracts must be composed primarily of original native species and have a long rotational period, and a minimum of 1,000 hectares must be planted annually in the first three years.[111]

In its contracts, Profafor pays landowners $97-$367 per hectare depending on location (mountains or coast) and species (non-native, native, or a mixture of both) and supplies them with seedlings to plant and maintain as forest for a 99-year period. Payments are made in several phases, with the final installment paid at the end of planting after roughly three years. Monitoring of the project continues regularly during the following years, as does external verification by SGS. If trees are lost after the first three years of the project, the landowner is required to replant at their own cost. It is assumed that after 20 years, some of the trees will be cut and replanted.[112] The landowner is required to reserve 30% of the harvest revenue for the costs of replanting and in this way retain the forest's capacity to absorb CO_2 for 99 years.[113]

Before contracts are made, FACE/Profafor requires that the areas be ecologically sustainable, economically viable, accepted by the community, have secure land tenure, and have no existing forest on

[108] FACE Annual Report 2000: 8.
[109] Gummer and Moreland. June 2000: 33.
[110] FACE/Profafor. "Manual de Contratos," 2002: 8.
[111] FACE website, "Projects: Latin America: Ecuador."
[112] FACE website, "Projects: Latin America: Ecuador."
[113] CIFOR. 2001: 6.

the proposed site. Also, technical feasibility studies and site inspections must be conducted and approved by the project. In addition, according to the technical regulations, each contract must also have a forestation plan and management plan.[114] These requirements are crucial to the project's success.

As of November 2000, there were 151 Profafor contracts located over ten provinces in the Andean region that have established over 23,000 hectares of new forest.[115] Profafor also has seven contracts in the northwest coastal provinces of Esmereldas and Manabi for 500-600 hectares of forest, but these contracts are now on hold while more studies are done to better determine the project baseline and to investigate land titles.[116]

3.3.5 Project Benefits

The benefits from the Profafor/FACE projects in Ecuador are numerous. For landowners with limited access to credit and degraded pasture or farmland, the project provides a source of short-and long-term capital, generates local employment, contributes to public infrastructure, and diversifies the area's economy while stabilizing and enriching the soil. The project also increases access to firewood (and saves on the cost of gas), reduces the incidence of fires, improves wildlife habitat and species diversity, protects the watershed, and provides scenic value for ecotourism. Furthermore, the project lowers the threat of land invasion for some communities, and increases environmental awareness among all communities. Finally, although most of the communities in which the project takes place have plantations, the community members lack training in the maintenance and marketing of timber.[117] These are issues that Profafor has committed itself to addressing as part of the project design.

[114] CIFOR. 2001: 5-6.
[115] CIFOR. 2001: 7.
[116] Jara, Louis Fernando. Interview April 5, 2002.
[117] CIFOR. 2000: 11.

Chapter 4 – The Incentives and Disincentives of Forest Carbon Sequestration

4.1 Incentives to Participate in Forest Carbon Sequestration Projects

While these three case studies are interesting examples of how global environmental objectives are being realized through local environmental initiatives, they do not explicitly reveal the underlying incentives behind stakeholders' participation in these kinds of projects or the fundamental challenges that these projects face. In this chapter, I present the factors from these case studies that have most clearly indicated why forest carbon sequestration projects have been initiated voluntarily, and discuss the major scientific, social, economic, and political uncertainties that need to be addressed in order for forest carbon sequestration projects to be better implemented.

4.1.1 Primary Incentive – the Market in GHG Emissions Reduction Credits

In general, the primary and underlying incentive to participate in these three forest carbon sequestration projects was the potential market in GHG emissions reduction credits. Establishment of this market would enable emitters to lower their emissions more cheaply in order to meet what are currently voluntary emissions reduction goals, but what are expected to be mandatory requirements in the future. Therefore, to reduce the risks that could be incurred by these requirements, participants set out to prove the viability of forest carbon sequestration, which they recognized as one of the least-cost and most environmentally sound ways to mitigate CO2 emissions. By amassing project experience and scientific knowledge on forest carbon sequestration, participants hoped to influence policy in its favor, because when these projects were started, the Kyoto Protocol had not yet been negotiated, and the details of its flexibility mechanisms were still being worked out.

Figure 12 - GHG Emissions Reduction Credits - Definitions

Carbon offset	A "carbon offset" is the generic term for a metric ton of carbon, CO2, or CO2 equivalent that is reduced or sequestered in a place other than where the emissions that it offsets were generated. A carbon offset is not necessarily verified or authenticated in any way.
VER	A "Verified Emission Reduction" is a unit created, in the absence of government rules, by project-based activities that are defined by the buyer and seller and verified by an independent third party. VERs have the possibility of being creditable by governments as CERs or ERUs if they fulfill the criteria that will be set for them at COP-9 in 2003. VERs are equal to one metric ton of CO2 equivalent.
CER	A "Certified Emission Reduction" is a verified and authenticated unit of GHG reduction from abatement or sequestration projects certified under Article 12 (CDM) of the Kyoto Protocol. A CER is equal to one metric ton of CO2 equivalent.
ERU	An "Emission Reduction Unit" is a verified and authenticated unit of GHG reduction from abatement or sequestration projects certified under Article 6 (JI) of the Kyoto Protocol. An ERU is equal to one metric ton of CO2 equivalent

While some participants got involved in these projects in order to acquire inexpensive carbon offsets for which they hoped to get credit retroactively under a future formal emissions reduction program, this was not a primary incentive when these projects first began. At the time, the chance to gain practical experience in forest carbon sequestration, along with the low cost per ton of carbon and high number of local economic and environmental benefits, were incentive enough for investors to put money into these projects despite the uncertainty regarding the creditability of these projects in the global climate change regime.

To landowners, the establishment of a market in carbon offsets was an incentive for them because it adds value to existing forests in the form of people's willing to pay for the service of carbon sequestration. Payment for this service provides discrete monetary returns for the conservation of standing forests that are additional to the benefits from their scenic value and value as wildlife habitat. It can also make forested land more profitable than other land uses, giving landowners the option to afforest or reforest their land and take advantage of its attendant benefits.

By undertaking these projects, participants also hoped to demonstrate environmental leadership, and in the case of many of the companies and NGOs, to generate positive public relations for their business or organization. For some emitters, projects were invested in for purely altruistic reasons, because they believed that they had a responsibility as corporate or private citizens to reduce their GHG emissions.

4.1.2 Secondary Incentives – Local Economic and Environmental Benefits

The secondary incentives to participate in these projects were the numerous local economic and environmental benefits, including support for sustainable development and local capacity building, the protection and enhancement of biodiversity, and the provision of environmental services. These benefits were most important to the landowners, the host country governments, and the NGOs that managed the projects. They were also important to the emitters, because even if these projects did not turn out to be creditable, then they would still have achieved many positive social and environmental impacts. Some of the other incentives to participate in these projects were to gain a better understanding of tropical ecosystems, promote sustainable forestry, and raise environmental awareness.

Therefore, despite emissions reductions not being mandatory, stakeholders participated in these projects because of both the potential international market in emissions reduction credits and the more immediate and local secondary benefits of the projects.

4.2 The Benefits of Developing a Market in Carbon Offsets

In the case studies in Belize and Ecuador, the primary motivation for participation was the potential market in carbon offsets. This was because the primary investors in these projects were electric utilities and energy companies likely to be faced with regulation of their CO2 emissions in the future. For the Klinki project in Costa Rica, the primary motivation for participation was to engage local farmers in carbon sequestration as an economic activity. This project thus depends on a system that endows carbon sequestration with a monetary value, e.g. a market (albeit a very informal one, in this case) in carbon offsets. Therefore, by implementing these projects, all three cases sought to develop the market in carbon offsets, not just for their own purposes, but also for the benefit of having a market in general.

While the Rio Bravo and Klinki projects both involve carbon sequestration on behalf of specific investors, the FACE Foundation, since its separation with NV SEP, has evolved as more of a non-profit carbon business that both plants trees for specific investors and sells carbon offsets from trees already planted through its commercial outlet, Business for Climate. This has fully entered it into the emerging market of carbon commerce.

4.2.1 To Lower Compliance Costs and Reduce Business Risk

All of the electric utilities and energy companies involved in these projects expect their compliance costs to increase with stricter emissions regulations. To mitigate these costs, these companies want to be able to use carbon offsets as part of their emissions reduction strategy. For example, American Electric Power (AEP), one of the members of the Utilitree Carbon Company, emits over 40 million tons of carbon per year. If AEP were required to reduce its emissions by 7% as was proposed for the US under the Kyoto Protocol, it would be necessary for it to buy credits to meet this goal, as it would not be able to reduce all of its emissions on-site. Getting involved in activities that would help create a market for carbon credits therefore needs to be a part of its overall business plan.[118]

So far, AEP has spent $30 million on overall emissions reductions.[119] In terms of cost per ton of carbon offset or prevented, reducing emissions at its plants would have cost it much more than the offsets produced by the Rio Bravo project, which were priced at $1.36/tC ($0.37/tCO2).[120] This figure was considered reasonable compared to other emissions reduction projects (such as fuel switching and energy efficiency projects),[121] and is at the very low end of the range for credits offered in the emerging carbon

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[118] Kaster, Gary. Interview March 7, 2002.
[119] Kaster, Gary. Interview March 7, 2002
[120] USIJI – Rio Bravo Project Proposal, 1994.
[121] Cutright, Noel. Interview March 14, 2002.

market.[122] For the two Canadian investors (Nexen and Suncor), the price was 10-20% lower than the price of offsets available in Canada.[123]

Even though the US has since made it clear that it will not ratify the Kyoto Protocol, the development of a market in carbon credits would help to reduce any costs associated with the US's plan to reduce emissions intensity (the amount of GHG emissions per $1 million GDP) by 18% by 2012. While the plan is purely voluntary, it expands the program that encourages businesses to monitor and report their GHG emissions[124] in expectation of their use in a future formal emissions trading program.

In the case of the FACE Foundation, the fiscal value of the CO2 credits (1 CO2 credit=1 tCO2) produced by its projects around the world were declared at 8 euros ($7.22) per credit as of the end of fiscal year 2000.[125] (Note: 1 tCO2=0.27 tC, so 1 tC from FACE would cost $26.47).[126] FACE transfers its credits to Business for Climate, which then resells them to third parties for approximately 20-25 euro/tCO2 ($66.05-82.72/tC). While this price is much higher than the price per tC in the Rio Bravo project, it represents the current market price for VERs. For NV SEP, the cost of the carbon offsets it received from its investment in FACE is presumably lower than what it would have paid to reduce an equivalent amount of CO2 from its power plants in the Netherlands. FACE's wholesale price is also competitive with offsets from investments in renewable energy as illustrated by the Dutch government's 2001 purchase of 4.62 million tons of CO2-equivalent for just under 9 euros ($8 USD) per ton.[127]

While the offsets from the Rio Bravo project are worth less now that conservation has been ruled ineligible in the CDM, the project's investors still consider the project a good deal because their first-mover advantage enabled them to get a low initial price per tC along with valuable early gains in carbon sequestration experience.[128] The FACE/Profafor project has also benefited from "first-mover advantage" in that they were able to obtain low-priced carbon offsets early on and develop standards in project design and verification protocol that are now considered to be among the most reliable in the nascent international market in carbon credits. In addition, by showing that voluntary action was being taken to reduce emissions, the companies that participated in these projects helped stave off the advance of mandatory regulations. In this sense, the project was a sensible "pre-emptive strike" to reduce business risk.

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[122] Rio Bravo investors named a range from $1-$25 as the current price for carbon offsets.
[123] Robson, Wishart. Interview March 12, 2002.
[124] The Energy Policy Act section 1605(b) database
[125] FACE Foundation Annual Report 2000: 17.
[126] To convert tCO2 to tC, multiply the uptake of CO2 by the ratio of 44 tCO2/12 tC.
[127] This investment was for the development of wind, hydro, and biomass power plants in three eastern European countries between 2008 and 2012. "Dutch Claim 1st Flexible Climate Deal Under Kyoto Protocol," April 19, 2001 [http://www.ens-news.com/ens/apr2001/2001L-04-19-03.html].
[128] Kuhn, Eric. Interview Mach 11. Edmonds, Bill. Interview March 8, 2002.

4.2.2 To Prove the Viability of Forest Carbon Sequestration

In 1995, the electric utility industry established the Utilitree Carbon Company, whose purpose was to fund forest carbon management programs as a way to offset CO2 emissions. From its involvement in the Rio Bravo project, Utilitree has been able to show that if properly implemented, carbon sequestration and forest management practices "are technically proven and can offset a large amount of CO2."[129] As a consortium of electric utilities, Utilitree has a stake in proving the effectiveness of forest carbon sequestration projects because it wants carbon offsets to be included as "a major component of any domestic and international strategy to respond to greenhouse gas emissions."[130] This support of market-based mechanisms was echoed by all of the electric utility and energy company stakeholders, including NV SEP of the Netherlands.

In Costa Rica, the Klinki project set out to prove that forest carbon sequestration is not only a technically sound way to store carbon, it is also an economically viable activity for farmers. Local economic viability is an essential component to the success of forest carbon sequestration projects. To date, the Klinki model has proved to be beneficial for the small number of farmers involved in it, since they receive more income per hectare from the project than from cattle grazing, plus income from the trees that will be logged from the site over time.[131] However, the long-term success of the project is less clear because of the short amount of time and small amount of land involved in this project so far.

4.2.3 To Build Capacity and Scientific Knowledge

Proving the viability of forest carbon sequestration has involved a fair amount of scientific inquiry, which is yet another incentive for stakeholder participation. In the case of the Klinki project, the USDA, the Yale School of Forestry, and CATIE all offered technical assistance for the sake of scientific inquiry without any expectation of remuneration. For the monitors and third-party verifiers whose business it is to ensure the scientific validity of forest carbon sequestration (Winrock in the case of Rio Bravo and SGS in the case of FACE/Profafor), these projects have enabled them to gain experience in the development of monitoring and verification protocols which may be used in the formation of international standards for these practices. The NGOs (TNC, PFB, RTT, CACTU, and FACE/Profafor) were also interested in the scientific knowledge that could be gained as part of a forest carbon sequestration project. For example, through the Rio Bravo project, PFB has been able to carry out detailed forest inventories in

[129] Utilitree Carbon Company Factsheet.
[130] Utilitree Carbon Company Factsheet.
[131] Rojas, Carlos Manuel. Interview March 20, 2002.

order to do sustainable, reduced-impact logging, and has learned more about mahogany regeneration and the carbon content of pine savannahs.[132]

Host countries and local communities also benefit from increased scientific understanding of their ecosystems. Through the FACE Foundation, the Ecopar research project, a joint initiative between Loja University in Ecuador and Amsterdam University and Larenstein International College in the Netherlands, was set up to investigate native species reforestation.[133] This project has been important for Ecuador, where deforestation and non-native plantation forestry has resulted in little remaining local knowledge about where forest used to grow, on what scale, and with which species. Through Ecopar, the planting methods, silvicultural requirements, and practical value of many native species are being investigated and documented, not only for FACE but also for the benefit of all Ecuadorians.

Another incentive for NGOs, host countries, and local communities to participate in forest carbon sequestration projects is the educational benefit to local people from these projects, including training in monitoring and verification procedures, and experience in scientific research. This capacity building took place in all of the projects as local staff were hired and trained in a variety of skills from GIS to silviculture to project management.

Host countries and institutions also benefit from the experience in having a forest carbon sequestration project take place in their country, because officials get to learn first-hand about the management of these projects and how to best take advantage of them and the emerging market in carbon offsets in order to fulfill their country's sustainable development goals.

4.2.4 To Influence Policy

By participating in the Rio Bravo project, the electric utilities and energy companies hoped to get "a seat at the table" in the policy arena.[134] They felt that having experience with carbon sequestration would make them "a more credible voice in world of carbon policy."[135] So far, the experience with the project has been use to support discussions between the companies and the US and Canadian governments regarding GHG offsets and forest carbon sequestration, and on government recognition for emissions reductions.[136]

Participation in the project has also been used by TNC in the negotiations for the Kyoto Protocol to promote forest carbon sequestration through the conservation of existing forests.[137] Although

[132] Novelo, Darrell. Interview January 22, 2002. Sabido, Wilber. Interview January 22, 2002.
[133] FACE website, "Projects: Latin America: Ecuador."
[134] Kaster, Gary. Interview March 7, 2002. Lambert, Gordon. Interview March 26, 2002. Edmonds, Bill. Interview March 8, 2002.
[135] Edmonds, Bill. Interview March 8, 2002.
[136] Lambert, Gordon. Interview March 26, 2002.
[137] Kuhn, Eric. Interview March 11, 2002.

conservation was ultimately not included in the CDM for the first commitment period, TNC plans to use the Rio Bravo project as well as the other forest carbon sequestration projects that it oversees to push for the inclusion of conservation under a US emissions reduction plan or in subsequent commitment periods.[138]

Both the Rio Bravo and Klinki projects were implemented under the AIJ pilot phase to serve as models of how forest carbon sequestration could be successfully accomplished. They hoped to influence policy by demonstrating in real-world examples that the uncertainties of forest carbon sequestration could be managed and that overall carbon benefits could result. Since there was little direction and clarity on carbon sequestration coming from the top down in the international climate change regime at the time, the participants wanted to, literally from the bottom up, sway the policy debate in favor of carbon sequestration.

4.2.5 To Demonstrate Leadership, Obtain Positive PR, and Practice Altruism

All of the electric utilities and energy companies involved in the Rio Bravo project mentioned their participation in the project as a way for them to demonstrate leadership in the environmental arena, to build new partnerships with other utilities, and to establish or further a relationship with TNC and PFB. The project was also an opportunity to generate positive public relations. Gordon Lambert, the vice-president for sustainable development at Suncor, also felt that that the project "educates and involves stakeholders in climate change issues, because it engages the imagination."[139]

TNC and PFB were also interested in the project in order to show leadership in the field of forest carbon sequestration as a way to promote conservation, and for public relations purposes since they rely significantly on donations to keep their organizations and projects running.

NV SEP's decision to found FACE in 1990 and its project in Ecuador in 1993, before many people even knew the term carbon sequestration, was a clear sign of its environmental leadership, and is reflective of the strong position that the Netherlands has taken in regard to many environmental issues, especially climate change. Because about half of the Netherlands is below sea level, it has a huge incentive to slow the rate of climate change, and the FACE Foundation is just one of the many programs through which it is attempting to do this.[140]

For the benefactors of the Klinki project, the reason to engage in the project was, for the most part, altruistic concern for the problem of climate change. None of the benefactors to the project (except perhaps CMEEC) is likely to have their CO2 emissions regulated anytime in the near future, and even CMEEC admittedly got involved in the project for altruistic and personal reasons (Dr. Barres, founder

[138] Hawes, Ellen. Interview January 10, 2002.
[139] Lambert, Gordon. Interview March 26, 2002.
[140] Woodward. September 4, 2001.

and president of RTT, was a friend of the CMEEC board's general counsel).[141] The Klinki project's largest benefactor, the Mohegan Tribe of Indians of Connecticut, invested in the project to offset the CO2 emissions from its integrated fuel cell/boiler/domestic hot water system at its Mohegan Sun Resort and Casino to be in line its own air quality regulatory program that includes greenhouse gases.[142] But they also participated in the Klinki forestry project over alternative emissions reduction methods "because it is easily implemented by a contractor, provides financial and technical assistance to a location where it is seriously needed, compensates for past misuse of the earth, diminishes the negative argument that offsetting is not feasible, provides valuable habitat for threatened wildlife, enhances tribal environmental credibility, and is consistent with Native American cultural philosophy."[143]

One of the individual benefactors to the Klinki project, a professor at the Yale School of Forestry and Environmental Studies, donated to the project in order to carbon-neutralize the effect of his family's four cars.[144] The Superior Nut Company in Cambridge also got involved to carbon-neutralize its operations, as did Connecticut College, which neutralizes the emissions from the energy use of its student center.[145] In the FACE project, carbon neutrality was the reason for investment in FACE by the government of Utrecht province and the Museon at the Hague.[146] This kind of private-sector demand for carbon-neutrality is expected to play an increasing role in the expansion of carbon sequestration projects.

For NV SEP and the energy companies involved in Rio Bravo, a certain amount of altruism and the ethic of corporate social responsibility also played a part in their decisions to participate in these projects. The projects' benefits did not solely accrue to them, they did not make a profit from their investment, and there was no guarantee that the carbon offsets generated would be creditable (and indeed, for the Rio Bravo project, they are not). So why did they invest in forest carbon sequestration projects? Among the many other reasons, some participants also just felt that it was "the right thing to do."[147]

4.3 The Benefits to Sustainable Development, the Local Economy, and the Environment

One of the main reasons why participants considered these forest carbon sequestration projects "the right thing to do" were the projects' local social and environmental benefits. These benefits were a strong incentive because they accrue regardless of whether the carbon sequestered has any value in a carbon market. This factor made these projects into "win-win" investments for their participants.

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[141] Stearn, Gabe. Interview March 18, 2002.
[142] Richards, Norman. Interview April 1, 2002.
[143] Richards, Norman. Interview April 1, 2002.
[144] Geballe, Gordon. Interview March 27, 2002.
[145] Hintlian, Harry. Interview March 20, 2002.
[146] FACE Annual Report 2002: 8.
[147] Hintlian, Harry. Interview March 20, 2002. Cutright, Noel. Interview March 14, 2002.

4.3.1 The Importance of Secondary Benefits to TNC and PFB

The environmental benefits of the Rio Bravo project are obvious incentives for TNC, whose mission is "To preserve the plants, animals and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive,"[148] and for PFB, whose goal is to "promote the conservation of the natural heritage of Belize and to promote wise use of its natural resources."[149] By providing funding for conservation, the Rio Bravo project helps TNC and PFB to achieve these objectives.

Specifically, the RBCSPP contributes positively to the RBCMA's biodiversity, wildlife habitat, water quality, and soil stability. The project secures habitat for nine mammals on CITES (Convention on International Trade in Endangered Species) Appendix 1 and over 341 migratory and resident bird species, and promotes the regeneration of a diverse range of native flora. It also maintains water quality by preserving land as forest instead of converting it to farmland, which would expose it to the use of fertilizers, pesticides, and fungicides. In addition, the project's sustainable forestry regime and forest management program increase the amount of ground cover to further reduce soil erosion. Forest management also helps to enhance the commercial value of the forest through the regeneration of valuable timber species and from more complete forest surveys that help ensure the sustainable harvest of forest resources.[150]

Because these activities are labor-intensive, the project has improved employment in the local area and has given workers new technical skills. Funds from the project have also been used to equip the RBCMA's field stations with solar power generating systems and composting toilets, and have been integrated into the management regime for the broader RBCMA, which includes protection of ancient Mayan archeological sites.[151]

The project has also helped PFB get its timber certified by the Forest Stewardship Council and Smartwood.[152] The sale of sustainably-harvested timber, however, which was expected to contributes to PFB's overall operating budget and help maintain the project over its 40-year life, has not been as profitable as was hoped, so logging has been discontinued while PFB reevaluates its feasibility.[153] This lack of revenue from sustainable forestry, combined with the fact that conservation has not turned out to be creditable, shows that while social and environmental benefits are important in getting a project started, there needs to be continued economic benefits in order to maintain a project.

[148] TNC website.
[149] Programme for Belize brochure, "An Opportunity for Positive Action."
[150] USIJI, Rio Bravo Carbon Sequestration Pilot Project. September 1999: 15.
[151] USIJI, Rio Bravo Carbon Sequestration Pilot Project. September 1999: 15.
[152] Kaster, Gary. Interview March 7, 2002.
[153] Sabido, Wilber. Interview January 22, 2002.

4.3.2 The Importance of Secondary Benefits to Rio Bravo Investors

While all of the Rio Bravo electric utility and energy company investors mentioned that forest carbon sequestration was just one of the many options they were using to reduce their GHG emissions, the social and environmental benefits of the Rio Bravo project were found to have played a decisive part in the companies' decision to invest in it. For example, in 1997, Suncor got involved because it was looking for offset projects that were suitable demonstration projects, and Rio Bravo fit its internal action plan commitments. Even though Canada had no domestic policy regarding emissions reductions at the time, Suncor wanted to reduce its emissions, and its seven-element action plan, announced prior to Kyoto, included the use of carbon offsets from forestry projects. Suncor looked into the USIJI program as a source of quality assurance, and through informal networking within the energy industry, found out that there was a share of the Rio Bravo project's Phase 2 still available. Suncor considered TNC to be a credible organization with great project management skills, and through due diligence, were impressed with TNC's work, both technically and managerially. Although they realized there was a policy risk in the recognition of the project's carbon offsets, to their view the project had good environmental benefits, and so Suncor invested.[154,155]

The consideration of secondary benefits was also important to Nexen, who felt that the Rio Bravo project was an attractive alternative to other offset projects because of its benefits to biodiversity conservation, sustainable forestry, environmental education, and research on carbon sequestration in tropical ecosystems. Nexen also mentioned that while the cost of the project was comparable to that of other projects, they had more incentive to invest in Rio Bravo because the other projects lacked these benefits.[156]

For WEPCO, the secondary benefits were important, "because at the time, we weren't expecting to get any real financial reward from the carbon credits."[157] These benefits appeared to WEPCO as an opportunity to "do the right thing" from an environmental perspective, and supported the company's position that market-based mechanisms could be used to solve a multitude of environmental problems.[158]

Cinergy, when asked about the project's cost-effectiveness, evaluated it partly in terms of biodiversity conservation. Cinergy considered the project successful because cat and bird populations in

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[154] Lambert, Gordon. Interview March 26, 2002.
[155] Canadian Environment Minister Christine Stewart said of Suncor's involvement with Rio Bravo: "This is the kind of win-win-win solution envisioned by the Kyoto Protocol last year...Belize protects its endangered forests; Suncor Energy demonstrates a new, cost-effective approach; and the environment wins from a significant reduction in greenhouse gas emissions." "Suncor Energy Supports Forest Conservation Project In Belize," November 12, 1998.
[156] Robson, Wishart. Interview March 12, 2002.
[157] Cutright, Noel. Interview March 14, 2002.
[158] Cutright, Noel. Interview March 14, 2002.

the RBCMA were found to have risen. It was also pleased with its investment because the project contributed to research on carbon sequestration, environmental education programs for children from the US, Mexico, and Belize at Rio Bravo, and economic benefit for local people from non-timber forest products such as sabal palm thatch, chicle, and ornamental plants, and from ecotourism.[159]

Utilitree felt that the opportunities for reduced-impact logging, the certification of sustainably harvested timber, the regeneration of mahogany and other species, research on carbon sequestration, and biodiversity and habitat conservation all made the Rio Bravo project more attractive than other offset projects.[160]

Finally, Pacificorp, who has been involved in carbon offset projects since the early 1990s, found Rio Bravo to be an attractive alternative to other offset projects because of its low cost and because it wanted some international projects in its emissions reduction project portfolio, which would aid in its goal of "being a more sustainable company."[161]

4.3.3 The Importance of Secondary Benefits to the Klinki Project

The Klinki project, because it is more of a charitable tree-planting program to benefit the environment and local farmers than a carbon credit program to offset emissions from industry, depends more highly on the project to obtain local economic and environmental benefits. Primarily, its farmers need to be assured of enough income and environmental service from a Klinki Matrix forest in order to want to reforest their pastures. The project provides for this by developing a mixture of trees that can be sold to generate short- and long-term income for the farmer, which also help stabilize and enrich the soil, improve water habitats and stream flow, reduce the use of chemicals as low-yield crops are shifted to forest plantations, and increase biodiversity by nurturing a new understory with native species.[162]

One of the farmers who had worked with Dr. Barres of RTT earlier on agroforestry projects involving macadamia nuts and heart of palm felt confident enough after seeing the growth of a trial plot of Klinki trees to reforest 24 hectares of his cattle pastures with Klinki Matrix trees.[163] After three years in the project, the farmer commented that his trees were growing well and that thinning would be profitable. Because of this, he put himself at an 8 out of 10 in confidence that the project would be self-sustaining through its 25-year lifetime.[164]

The benefactors of the Klinki project also felt confident about the project and its ability to sequester carbon. While their primary incentive was to offset their carbon emissions, they also donated to

159 Kuhn, Eric. Interview March 11, 2002.
160 Kaster, Gary. Interview March 7, 2002.
161 Edmonds, Bill. Interview March 8, 2002.
162 USIJI - Klinki Forestry Project. September 1999: 11.
163 Rojas, Carlos Manuel. Interview March 20, 2002.
164 Rojas, Carlos Manuel. Interview March 20, 2002.

the project because of its secondary benefits. For example, some of the reasons that the Mohegan Tribe participated in the project were because it provides valuable habitat for threatened wildlife, compensates for past misuse of the earth, and provides financial and technical assistance to rural Costa Ricans.[165] Connecticut College, by compensating for some of its emissions, wanted to create "a more sustainable campus and world."[166] In addition, Superior Nut felt that planting trees was one of the most sensible ways to deal with climate change, and that from an environmental standpoint, the initiative was "a win-win project that not many people could object to."[167]

4.3.4 The Importance of Secondary Benefits to the FACE/Profafor Project

The FACE Foundation, now one of the world's largest producers of VERs, has not lost sight of the need for benefits to accrue to all its projects' stakeholders. FACE's mission is to "establish and protect forests (or enable their establishment and conservation) sustainably and responsibly, in suitable areas, wherever in the world, and by so doing to contribute to reducing the amount of CO2 in the atmosphere."[168] This pledge has meant that FACE has invested a significant effort in making sure that its forests benefit both the natural and the human environment in the areas in which they are planted.

Because FACE only uses one function of the forests it plants - their ability to sequester CO2 - the other properties of the forest are available to the forest owner. For landowners with limited access to credit and degraded pasture or farmland, the FACE/Profafor project provides a source of short-and long-term capital in the form of initial funding and eventual timber revenue, and assists communities in forest management to decrease soil erosion and increase soil fertility. Its planting activities generate local employment, and the development of natural and plantation forestry diversifies the area's economy. The project also increases access to firewood, reduces the incidence of forest fires, improves wildlife habitat and species diversity, protects the watershed, and provides scenic value for ecotourism. In addition, the project lowers the threat of land invasion for some communities, and increases environmental awareness among all communities.[169]

This multitude of benefits is necessary to persuade individuals and communities to plant and maintain forests on their lands for at least 99 years. Figures 13 and 14, generated from a survey of communities and individuals under contract with FACE/Profafor that was carried out by the Center for International Forestry Research (CIFOR) in 2000, shows the constraints that these landowners face, and Figure 15 shows the benefits that the project offers, the needs that the project has met or is

[165] Richards, Norman. Interview April 1, 2002.
[166] "CC First College in Nation to Initiate Carbon Dioxide Emissions Compensation Program." Fall 1999: 3.
[167] Hintlian, Harry. Interview March 20, 2002.
[168] FACE website, "Methods and Projects: Mission Statement."
[169] CIFOR. 2001: 12-13.

expected to meet, and the needs that have not been met by the project. While the project provides many social, economic, and environmental benefits to landowners, these benefits need to be strong enough to make up for the needs that are not and in some cases cannot be helped by the project itself, such as high interest rates, regressive government policies, corrupt external organizations, and bad weather. So far, landowners have been generally satisfied with the benefits from the project.[170] In the future, however, after the benefits from the initial funding have been digested, the project's environmental benefits need to contribute meaningfully to social and economic benefits in order for the project to be successful.

Figure 13 - Community Constraints[171]

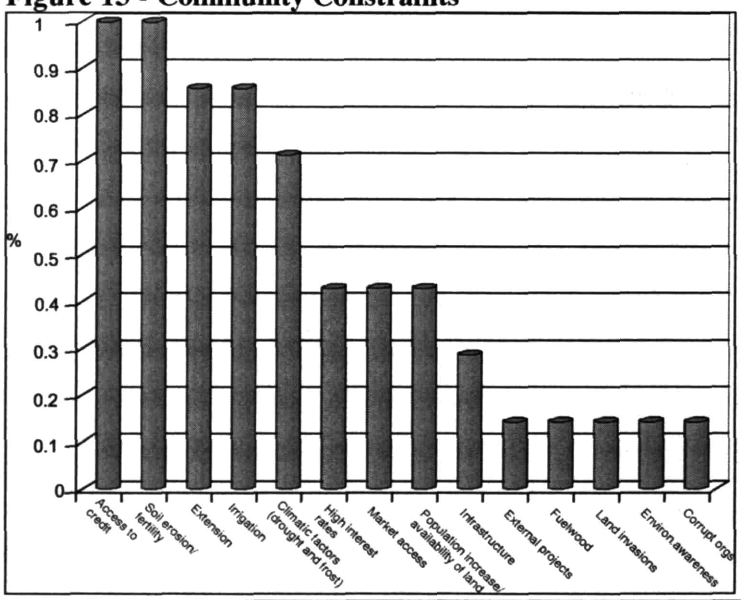
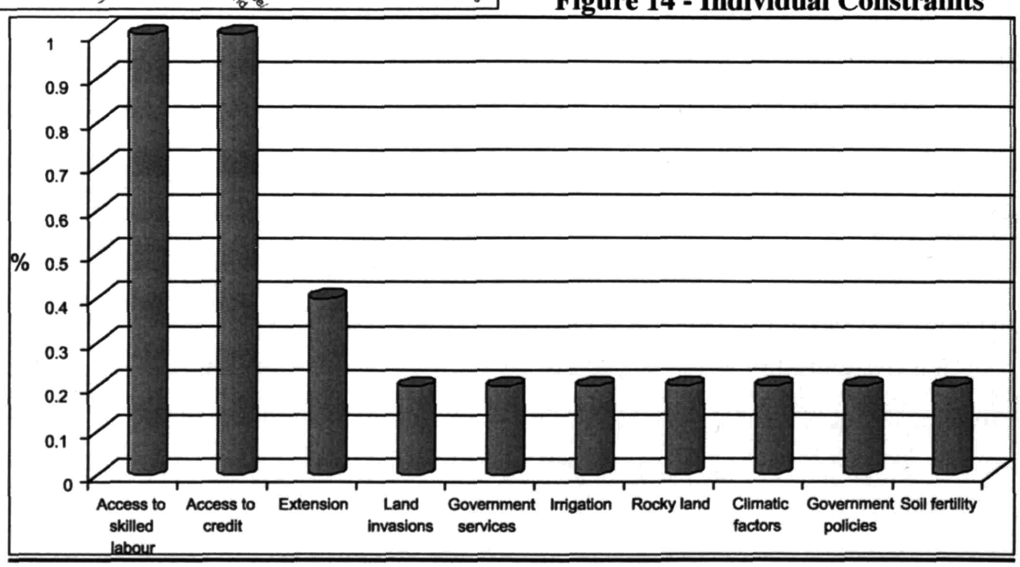


Figure 14 - Individual Constraints[172]



[170] CIFOR. 2001: ix-x.
[171] CIFOR 2001: 9.
[172] CIFOR 2001: 10.

Figure 15 - Community perceptions of FACE/Profafor's impacts on capital endowments[173]

Assets	Community needs met and expected to be met by project	Community needs not met by project
Financial capital		
Short term		
- PROFAFOR reforestation subsidy financed employment in the establishment of the plantation and surplus funds for other individual and communal needs	Access to financial capital	Access to lower interest rates
Long term		
- Timber revenues	According to the project Director, PROFAFOR had begun talks with timber companies on behalf of the beneficiaries	Market access
- Mushroom revenues		
- Firewood revenues (or saved cost of gas) Increased land value		
Physical capital		
- Surplus funds from subsidy invested in communal needs (shelter for plantation manager, benches)	Infrastructure	Irrigation
- Provision of gates by project		
- Timber from plantation for construction		
- Establishment of nursery for plantations over 1000 ha		
Human capital		
- Training in forestry and nursery maintenance	Extension services	Access to skilled labour to work on plantation
Social capital		
- Halted land invasions and theft of livestock	Threat of land invasions	Government policies
- Curbed migration to towns and cities during plantation establishment	External projects	Lack of Government services (roads, water)
- Transfer of knowledge by project to local nurseries		Corrupt external organisations
- Influencing other communities to grow plantations		
- Expected benefits of plantation to future generations		
- Community conflict over grazing in plantation		
Natural/environmental capital		
- Fuelwood	Access to fuelwood	Climatic factors (frosts and drought)
- Increased fauna and native species in plantation areas		Population increase reducing availability of land
- Cleaner air	Environmental awareness	
- Reduced incidence of forest fires		
- Watershed protection		
- Scenic value for ecotourism		

[173] CIFOR. 2001: 13.

4.3.5 The Importance of Secondary Benefits to Host Countries

For the host countries, participation in these forest carbon sequestration projects provides benefits that help fulfill their sustainable development goals, including the restoration of degraded lands, biodiversity and wildlife habitat conservation, watershed protection, renewable resource provision, poverty reduction, and sustainable tourism development.

For Belize, the goal of its present administration is to balance economic development and biodiversity management. To this end, its forest department has recently changed its focus from logging to watershed management, tourism development, carbon sequestration, and non-timber forest products.[174] Having intact, healthy forests is a major part of Belize's overall development plan, because tourism is now its single largest income generator, bringing in more revenue than sugar, bananas, or citrus. Also, because most of its tourists come for ecotourism, Belize needs thriving forests in order to sustain this market niche.[175]

Belize also wanted to participate in forest carbon sequestration to prove that it is a good host. Carlos Fuller, Belize's Chief Meteorologist and Coordinator of the Belize Climate Change Project, stated, "Belize, being the first country to have gotten a forestry project acknowledged and funded under the USIJI, shows that we are on the forefront of any type of climate change project. So we have gained a reputation as a good host for other projects."[176] Belize was also happy to participate in the Rio Bravo project because TNC, PFB, and the investors took full responsibility for it; the government did not have to put anything into the project, except for some staff time. Receiving a share of PFB's carbon offsets was also an incentive to Belize initially, when it was thought that conservation might be creditable under the CDM. Despite the project's lack of creditability, the government of Belize is still very positive about the project, because "while the investors basically lost out, the environment gained."[177]

Costa Rica also sees forest carbon sequestration as a major part of its overall development plan. Since 1994, Costa Rica has based its plan on the concept of sustainable development, which it defines as "development which represents the balance provided by political stability, social equity, economic stability and development in harmony with nature."[178] Some of the priorities laid out between 1994 – 1998 by the administration were to consolidate and improve the management of protected areas, to further increase clean energy generation and energy efficiency, to protect biodiversity by consolidating the park system, to make the economy more open and balanced, and to incorporate civil society and the private sector into the decision making process. Costa Rica's involvement with AIJ projects, including

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[174] Chun, Angel. Interview January 29, 2002

[175] Fuller, Carlos. Interview January 29, 2002.

[176] Fuller, Carlos. Interview January 29, 2002.

[177] Fuller, Carlos. Interview January 29, 2002.

[178] Hambleton, Figueres, and Kalipada, 2000: 3.

reforestation and conservation, wind and hydropower development, and wastewater treatment, has helped it to achieve these goals.[179] Because Costa Rica was the first developing country to realize that AIJ projects could be used as a tool to finance national sustainable development priorities and establish an office for joint implementation (OCIC), it is now host to the most AIJ projects of any non-Annex 1 country, including four forest carbon sequestration projects.

While the Klinki project is currently at a very small scale, Costa Rica had incentive to participate in it because it had the potential to significantly benefit its sustainable development plan. Besides providing income to farmers through payments for reforestation and revenue from timber sales, the project helps protect water resources, increases wildlife habitat, reduces soil erosion, and also reduces the pressure to log existing forests, much of which lie in parks and protected areas.

In Ecuador, the government's primary incentive to get involved in the FACE/Profafor project was to reforest the once forest-rich Andes.[180] It agreed to cooperate with FACE because FACE was willing to work with the farming communities in this area. Since the Ecuadorian Ministry of Environment signed its 1993 contract with FACE to plant 5,000 hectares of new forest per year for a total of 75,000 hectares, over 25,000 hectares of forest have been planted.[181] Besides providing valuable environmental services and helping the local economy, the project contributes to sustainable development in Ecuador by establishing a link between environmental preservation and economic development, thereby helping its population understand the concept of sustainable development. It also promotes participation by the local population in solving environmental problems.[182] Ecuador further benefits from the research carried out by Ecopar, and is aided by the establishment of an NGO presence that assists and supplements governmental action on environmental issues.

4.4 Uncertainties in Forest Carbon Sequestration Projects

Despite the numerous incentives to participate in forest carbon sequestration projects, there are still many inherent uncertainties in both the process and the politics of carbon sequestration. Because these projects are based on natural systems, engage a multitude of stakeholders, and require complex monitoring and accounting systems to take stock of carbon benefits, carbon sequestration is a continuous work in progress. As shown above, projects differ greatly in terms of stakeholders, project design, host country, and specific locale. This diversity has meant that there has been little standardization between projects, which makes them difficult to compare. Also, there has been little international agreement on

[179] Hambleton, Figueres, and Kalipada, 2000: 5-6.
[180] FACE Annual Report 2000: 14.
[181] FACE website, "Projects: Latin America: Ecuador."
[182] Earth Network for Sustainable Development website, "Ecuador."

the details of the criteria and methodologies for forest carbon sequestration projects under the CDM, in part because many of these details are still being determined through experience with current projects.

While many of the questions about forest carbon sequestration have been answered through projects that have already been established, a number of general uncertainties regarding project design, international policy, the market in carbon offset credits, and host country capacity still need to be addressed in order to lower transaction costs and advance the development of forest carbon sequestration projects. The interconnectedness of this global process means that perhaps the most important task of forest carbon sequestration is to ensure that its benefits accrue to all stakeholders, because without joint benefit from joint implementation, these projects will be quickly undermined.

4.4.1 Project Criteria

When these projects were first started, the criteria for forest carbon sequestration projects had not yet been established by any internationally-agreed upon forum. While FACE, because it was one of the first projects, established its own criteria, the Rio Bravo and Klinki projects followed the later USIJI criteria in order to be USIJI-approved. Established in 1994, the USIJI's nine criteria require that projects:

1. Be acceptable to the government of the host country
2. Involve specific measures to reduce or sequester GHG emissions
3. Reduce or sequester GHG emissions beyond what would happen in absence of the project (additionality)
4. Identify associated environmental and developmental benefits and impacts
5. Provide data and methodological information to establish a baseline of current and future GHG emissions in the absence of the project and as a result of the project
6. Contain adequate provisions for monitoring GHG emissions reduced or sequestered as a result of the project, for periodically modifying such estimates, and for comparing actual results with those originally projected
7. Contain adequate provisions for external verification of the GHG emissions reduced or sequestered by the project.
8. Provide adequate assurance that GHG emissions reduced or sequestered over time will not be lost or reversed (leakage)
9. Provide for annual reports to the Evaluation Panel on the emissions reduced or sequestered, and on the share of such emissions attributed to each of the participants—domestic and foreign—pursuant to the terms of voluntary agreements among participants[183]

[183] USIJI. "Part Three: USIJI National Program Report." September 1999: 3.

A year later at COP-1 in 1995, the Parties to the FCCC adopted three basic criteria for the international pilot phase on AIJ, of which the USIJI projects now became a part. In addition to requiring governmental approval by both Parties, the AIJ criteria further distinguish the concept of additionality by requiring that projects should result in real, measurable and long-term reductions in net GHG emissions that would not have occurred in the absence of such an activity (emissions additionality), and that projects should be financed outside current Official Development Assistance (financial additionality).[184]

In 1997, when the CDM was agreed upon in the Kyoto Protocol, it called for projects to have emissions additionality, but it made no mention of financial additionality. The CDM's additional requirement was that projects should contribute to the sustainable development goals of the host country. At the most recent COP in Marrakech (COP-7 in November 2001), it was agreed that the definitions, criteria, and procedures for CDM projects, including those involving afforestation and reforestation, would be developed as an Annex to the Kyoto Protocol which could be expected to be adopted at COP-9 in 2003.[185] Until then, projects that hope to be creditable under the CDM can only anticipate what these criteria will be.

Of the criteria already established, the most challenging ones have been proving that the emissions reduced or sequestered would not have occurred in the absence of the project (additionality), assuring that emissions reduced or sequestered would not be lost or reversed over time (permanence), establishing a baseline and predicting future emissions, monitoring the emissions reduced or sequestered, and verifying the emissions reduced or sequestered. Another important criteria for forestry projects is ensuring that the emissions reduced or sequestered within the project's boundaries are not negated by actions away from the project site (leakage). Determining ground-rules for accounting and sustainability has also been a challenge. These are discussed below in general and in regard to the three case studies.

4.4.2 Additionality

As mentioned above, the AIJ pilot phase considers two different aspects of additionality: emissions and financial additionality. In the Rio Bravo project, the emissions additionality of its carbon benefits is clear. From contacts with other local landowners, PFB knew that its Mennonite neighbors would have purchased the two newly acquired parcels and converted them to agricultural production. Also, the land now under the sustainable forest management plan would have been logged under customary practices without the funding required to undertake reduced-impact logging.[186] In the Klinki project, the farmers, because they lacked a profitable alternative, would have kept their lands as pasture or

[184] UNFCCC COP-1. 1995: Decision 5.
[185] UNFCCC COP-7. November 2001: Part 3, Decision -/CP.7, 20 Section 10b.
[186] TNC website, "Rio Bravo."

crops.[187] In Ecuador, the previous government fund to reforest the Andes dried up when oil prices fell during the 1980s, and the farmers in the area lack almost all access to credit, so the project would definitely not have happened if FACE did not intervene.[188] The projects are financially additional because the Klinki project relies completely on small-scale private sector donations, and the Rio Bravo and FACE projects were begun as private and voluntary initiatives by electric utilities and energy companies.

Additionality is difficult to prove because it requires assumptions about what would happen in the absence of a project. These assumptions are based on extrapolations of historical land use trends, analysis of the local socio-economic situation, judgment about future regional, national, and even international economic and political developments, as well as other factors that are inherently uncertain and unpredictable. A report on estimating the GHG benefits of forestry projects that used Costa Rica as its case study concluded, "The difficulty of predicting social, demographic, economic, and political developments over time is the greatest analytical challenge in estimating emission reductions in forestry.[189] These predictions, however, are necessary not only to prove additionality, but also to establish the project baseline against which emissions reductions are measured.

4.4.3 Baselines, Monitoring, and Verification

Baselines

For forest carbon sequestration projects, the establishment of a baseline requires first a forecast of the extent of future land use change in the absence of the project, and second an estimation of the carbon flows associated with these changes.[190] As mentioned above, the first part of this process is already a huge analytical challenge. The difficulty of determining a reliable baseline is further compounded by the fact that in a market for carbon offsets, buyers and sellers both have the incentive to establish baselines that exaggerate the amount of offsets resulting from the project, because if more offsets are available, buyers might get lower prices and sellers would receive more revenue. There is a general concern that baseline inaccuracies could lead to a net increases in GHG emissions from forest carbon sequestration projects if Annex 1 countries use inaccurate projects to claim that they have satisfied their emission reduction commitments, when in fact they have exceeded them. Baselines that exaggerate carbon benefits might also divert investment away from better projects with more accurate baselines.[191]

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[187] Barres, Herster. Interview March 14, 2002.
[188] FACE website, "Projects: Latin America: Ecuador."
[189] Busch, Sathaye, and Sanchez-Azofefa. July 2000: 15.
[190] Busch, Sathaye, and Sanchez-Azofefa. July 2000: 2.
[191] Busch, Sathaye, and Sanchez-Azofefa. July 2000: 2.

Because one of the main incentives for the Rio Bravo project was to investigate the scientific accuracy of forest carbon sequestration, the baseline and monitoring protocols for both Component A and B of the project have been thoroughly investigated and refined several times. Winrock's credibility as a forest carbon monitoring firm depends on the accuracy and verifiability of its methodologies, so it has kept the baseline dynamic in order to make it as correct as possible. To this end, its procedures are transparently described in its project documents.

Calculating a baseline for reforestation projects can be somewhat easier. In the Klinki project, it is assumed that without the project, the land would remain pasture or farmland. Therefore, the reference scenario puts emissions at zero since it assumes that carbon stocks would remain the same if the project did not take place.[192] The same can generally be said for the reference scenario in the FACE/Profafor project. In the Klinki project, sequestration rates for Klinki Matrix forest are based on data gathered from pure Klinki stands planted in the Turrialba region over the last 26 years. There was not enough empirical data on the growth of mixed stands to make a more accurate estimate, so the sequestration rate was set conservatively on the Klinki stands to account for that. Estimates were also set conservatively in the FACE/Profafor project for areas of native species reforestation because there was also little evidence on the growth characteristics and sequestration rate of many native species.

One of the issues for FACE/Profafor has been establishing a reliable baseline for its projects in the coastal provinces. The problem here has been a lack of historic information (maps, photos, satellite imagery, etc) on land use, which makes it difficult for them to establish trends and make predictions about future land use patterns in the absence of the project. Because of this and because the landowners in this area do not have clear title to their land, the projects have been called off while further research is done. However, the huge potential for projects in this area because of the faster growth rate of its trees, the ability of FACE to use 100% native species, and the greater biodiversity value of its forests makes FACE willing to try to overcome the challenges of working in this area.[193]

Monitoring and Verification

The problem with monitoring is that, in the absence of international standards, the variables that are monitored, the frequency of monitoring activities, and the reliability of monitoring activities all differ greatly from project to project. Monitoring also differs between the different kinds of forest carbon sequestration projects. Standards need to be developed to be able to compare among and between these projects, and also to facilitate the verification of these projects.

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[192] USIJI – Klinki Forestry Project. September 1999: 13.
[193] Jara, Louis Fernando. Interview April 5, 2002.

For the Rio Bravo project, PFB and Winrock coordinate monitoring activities. Winrock also internally verifies project results. For both Components A and B, data are collected on aboveground biomass and necromass, estimated belowground biomass, and soil carbon. For Component B, the amount of damage per harvested tree (e.g., the road, skid trail, and log landing areas and the volume of coarse woody debris), the destination of harvested biomass (e.g., the proportion of extracted timber in durable products and the fossil-fuel substitution by wood waste), and the impact of fire suppression activities (e.g., actual area burned in a fire event that was suppressed by PFB crews, and estimated amount of land that would have been burned in the absence of fire suppression activities) are also assessed.[194]

Since it takes at least two months to do all these measurements and because the forest was not growing fast enough to warrant frequent measurement, one of the refinements to the process was that monitoring activities were adjusted from being performed every two years to every four years.[195] There have been other technical refinements as well, such as the establishment of nested monitoring plots, additional surveying of the project area, and the determination of better estimates of biomass and soil carbon.

In the Klinki project, Dr. Barres, a tropical forester for over 40 years, developed the baseline calculations and the monitoring protocols with help from colleagues and the many technical assistants to the project (primarily CACTU). The project's monitoring activities include data collection on plot size, vegetation size, soil and subsoil organic matter content, and tree carbon content.[196] While these activities are adequate, they are not as complete as those done in Rio Bravo, in part because the Klinki project does not require a high degree of accuracy.

In both the Rio Bravo and Klinki projects, there is no third-party verification because these projects were not established to sell VERs. In contrast, for the FACE/Profafor project, monitoring is done by Profafor, but verification is done by SGS, who, based on the baseline and monitoring protocols it helped develop, certifies the emissions sequestered by the project. Its methodology includes a risk analysis that estimates losses from fire, landslides, insect and fungal attack, volcanoes and earthquakes, establishment and maintenance, demonstrability,[197] and the position of the baseline and with-project scenario.[198] These potential losses constitute a buffer of approximately 25% of total CO2 sequestered, which is held in reserve and cannot be sold unless risks are found to be lower than previously established. This buffer helps ensure the reliability of the credits that are sold, but it also raises project costs and

[194] USIJI – Rio Bravo Project. September 1999: 13.
[195] Novelo, Darrell. Interview January 22, 2002.
[196] USIJI – Klinki Forestry Project. Septermber 1999: 10.
[197] Demonstrability is the credibility of a particular project to demonstrate its GHG-related results within a tolerable level of uncertainty. The degree of that tolerance is dependent upon the needs of individual participants or regulators. (SGS)
[198] SGS Product and Process Certification. December 5, 2000: iv.

therefore the cost of the credits. While SGS verifies the emissions sequestered and provides for a buffer in case anything happens to the VERs that are sold, prior to the definition of appropriate procedures under the CDM, it cannot guarantee the delivery of eligible Certified Emissions Reductions (CERs) under the Kyoto Protocol.[199]

In regard to monitoring in the FACE/Profafor project, one of SGS's criticisms was that following the three-year establishment phase, there was no formal system for monitoring continued management of the plantations.[200] Specifically, one of the three Minor Corrective Action Requests in SGS's December 2000 certification document was that "No clear guidelines exist how Profafor will continue monitoring the plantations and the partners' ability to comply with the terms of the contract."[201] While monitoring and verification costs are figured into the overall cost of all of the projects, FACE's 99-year project lifetime makes accounting for monitoring especially problematic. The lack of a long-term monitoring plan also calls into question the project's permanence, which is discussed in the following section.

4.4.4 Permanence

Permanence, meaning that emissions reduced or sequestered are not lost or reversed over time, is an issue that is approached differently by each of the projects. Since PFB owns the RBCMA and holds it in trust for the people of Belize, the permanence of the emissions reduced or sequestered by the project can be more reliably ensured. Control of fire and illegal wood harvesting in the area also help to reduce the unintended loss of forest and new emissions of carbon dioxide. In addition, an endowment fund has been established as part of the project in order to keep it going after the initial 10-year investment period and through its 40-year lifetime. However, since conservation has turned out to not be creditable under the CDM, and since the sustainable forestry program has been discontinued because the cost of inventorying the trees was too high, the price of timber too low, and both the general export market and the local market for secondary hardwoods too small, the independent financial viability of PFB is not as optimistic as was hoped.[202] While this is not expected to threaten the existence of the Rio Bravo project, it does show how conservation and sustainable development are difficult to achieve when policy and economics are not in their favor.

In Costa Rica, the issue of permanence has as much to do with institutions as it does with land use change. RTT is a small organization formed solely to develop this project, and is basically a one-man show. When it was first proposed, Dr. Barres, RTT's founder, hoped to obtain $6 million in federal funding to plant and maintain 6,000 hectares of trees to offset emissions, and to establish an operating

[199] SGS Product and Process Certification. December 5, 2000: v.
[200] SGS Qualifor Programme. April 1, 2000: 6.
[201] SGS Product and Process Certification. December 5, 2000: viii.
[202] Novelo, Darrell. Interview January 22, 2002. Sabido, Wilber. Interview January 22, 2002.

fund that would support the program for several decades. Since that funding did not materialize, RTT was established as a non-profit organization in order to receive donations to develop the project as it is today, which consists of 87 hectares. While these 87 hectares will probably remain as forest for 25 years because the farmers with whom Dr. Barres contracts are not small, subsistence farmers but rather medium to large, well-established landowners who do not need to make profit on all their land every year, the permanence of RTT as an institution is less certain. The questionable long-term viability of RTT casts doubt on how well it can ensure the permanence of the forest it establishes through the project life.

In Ecuador, while FACE/Profafor's initial contracts were signed for 15 or 20 years, it has transitioned to offering only 99-year contracts, which were developed to promote sustainability and a longer forest life.[203] To ensure the permanence of the shorter contracts, the project's emphasis has moved from meeting annual planting targets to creating sustainable and productive integrated forestry systems.[204] To ensure the permanence of the 99-year contracts, FACE/Profafor intends to establish an institutional presence in Ecuador that ties into the country's sustainable development goals and helps with the transfer of development aid.[205] Also, it has been contracting with more large individual landowners than communities, and is inquiring with water and power companies who own a lot of land, because they "are not interested in the wood, they don't need it for immediate revenue - they need it for soil and water conservation" and would therefore be less likely to cut down their trees.[206]

The issue of permanence is problematic because all of these countries are developing and undergoing varying amounts of land use change, and because they involve or affect populations who may be more concerned about short-term survival than long-term ecological sustainability. While the projects contain many requirements and incentives to keep the forest as forest through (and hopefully after) the projects' lifetimes while benefiting landowners and the local population, it is difficult to determine how the opportunity cost of the land on which the forest is grown will change, and how this will effect the projects.

The FACE/Profafor project outlines the requirements and incentives to maintain the forests it plants in its legal contracts with landowners. Under the 15-, 20-, and 99-year contracts, if trees are felled before the end of the contract, the landowner is obligated to meet the cost of replanting. If a landowner converts the forest back to pasture or any other land use during the contract period, the project retains 30% of the timber revenues. In the 15- and 20-year contracts, if the landowner clear-cuts at the end of the contract period, the project also retains 30% of the timber revenues, but if the landowner decides to renew

[203] Jara, Louis Fernando. Interview April 5, 2002.
[204] CIFOR. 2001: 7.
[205] Emmer, Igino. Interview March 27, 2002.
[206] Jara, Louis Fernando. Interview April 5, 2002.

the contract, then the 30% is reinvested into replanting.[207] Under the 99-year contracts, FACE/Profafor assumes that after 20 years some trees will be cut and replanting will occur. In these contracts, however, landowners are required to mortgage their land to Profafor, and should they default on their contract, Profafor can expropriate their land.[208] Under Ecuadorian law this clause does not apply to indigenous communities.[209] For its part, FACE/Profafor provides or intends to provide other services to ensure the permanence of its projects, such as technical assistance throughout the project life and help identifying markets for timber.

In a report issued by the Center for International Forestry Research (CIFOR) which used FACE's project in Ecuador as a case study to investigate the impact of forest carbon sequestration projects on rural livelihoods, it was felt that Profafor did not provide the communities enough incentives to ensure that the forests would be kept for the duration of the contract. The report criticized Profafor's adoption of "a 'disincentive' approach" to prevent communities from converting their plantations to other land uses, stating that it was unclear how enforceable its penalties would be and whether they were a sufficient deterrent to prematurely logging the new forests, especially if community income sources were limited.[210] In its 99-year contracts, FACE is attempting to manage these problems by setting up guidelines to evaluate the social and environmental situation in its project areas, executing more extensive research in advance of signing contracts to ensure that landowners can fulfil FACE's criteria and live up to the project's requirements, and by choosing to work with larger individual and institutional landowners as well as more socially cohesive communities that have contiguous landholdings.[211,212]

The report also found that while the shorter-term contracts were expected to be profitable, the 99-year contracts were likely to be unprofitable from a purely financial perspective. This was said to be especially true if the opportunity cost of the land were to rise, which was expected to happen in areas where the communities' populations have been expanding, thus increasing the demand for individual grazing and agricultural land. However, the report concluded that communities interested in both the financial and the environmental benefits of the project would be likely to gain, and that opportunity costs in the Ecuadorian Sierra around 3000-4000 meters above sea level are likely to remain low even with increasing population, because the soil and climate there do not provide better alternatives than forestry.

207 FACE/Profafor. "Manual de Contratos."
208 SGS Qualifor Programme. April 1, 2000: 7.
209 SGS Qualifor Programme. April 1, 2000: 5.
210 SGS Qualifor Programme. April 1, 2000: x.
211 SGS Product and Process Certification. December 5, 2000: vii.
212 Jara, Louis Fernando. Interview April 5, 2002.

4.4.5 Leakage

Another important criteria has been making sure that the emissions reduced or sequestered within the project's boundaries are not negated by actions off-site caused by the project, commonly known as leakage. This can be a problem because it is often difficult to determine causality, especially in countries with imperfect information on land use change, financial transactions, and land ownership.

In the Rio Bravo project, PFB was able to follow the paper trail of the logging company from whom they bought the two parcels of land to make sure they did not invest it in more forestland to log. They also got historical and current LANDSAT data for Belize to research trends in deforestation within the country.[213] For the Klinki project, RTT and CACTU, through social networks, checked to make sure that farmers do not deforest any of their forested lands because of the project. In Ecuador, FACE/Profafor has established the MONIS (monitoring and information) system to keep track of their projects, which is a database that links alphanumeric and graphic information of FACE's project around the world and includes a variety of maps, photos, and satellite imagery that help determine land use trends.[214]

Even with good data on land use trends, it is hard to explicitly prove that forestation in one area caused deforestation in another. Also, even if causality is determined, there is no guideline in any of the projects on what to do about it.

4.4.6 Accounting

Since the rules governing forest carbon sequestration projects have yet to be fully determined, it is difficult to compare the carbon offsets from one project with those of another project according to price or the amount of offsets generated. Project costs vary according to the cost of labor at the project location, the cost of monitoring and verification, and the survival rate of the trees, among many other variables. The amount of offsets generated varies by sequestration method (e.g. conservation vs. reforestation) and by the number of offsets held back in a buffer, if any. Also, offset price can be determined differently from project to project. FACE bases its prices on what it thinks it needs to continue the projects, and on what gives it a good position in the market. For futures, FACE calculates its price based on the net present value of the investment and project costs for the next 50 or 99 years, depending on the product they sell.[215] FACE also puts some of its offsets in a buffer, and resells the available offsets through Business for Climate, both of which increase the price. The Klinki project, on the other hand, bases its offset price on what it needs to pay its farmers a fair amount plus the

[213] Kuhn, Eric. Interview March 11, 2002.
[214] Profafor website, "MONIS."
[215] Emmer, Igino. Interview March 27, 2002.

administrative costs of keeping the project running. It does not have to pay for external verification, nor does it subtract offsets for a buffer. The offsets from these two projects are therefore incomparable. This also underscores the fact that it is hard to tell the quality of a credit (e.g. how permanent it really is) just by looking at its price.

The different variables that projects monitor also influence the overall accounting of estimated emissions reduced or sequestered. For example, the Rio Bravo project monitors the destination of harvested biomass (e.g. the proportion of extracted timber in durable products and the fossil-fuel substitution by wood waste) and the impact of fire suppression activities (e.g. the actual area burned in a fire event that was suppressed by PFB crews, and the estimated amount of land that would have been burned in the absence of fire suppression activities). If other projects did not also take these factors into account then their offset estimates would be fundamentally different.

4.4.7 Sustainability

Forest carbon sequestration needs to be sustainable in many ways. It needs to contribute to a host country's sustainable development goals, be able to sustain (or at least fairly supplement) the livelihoods of forest landowners, as well as be ecologically sustainable. In an ecological sense, conservation is most the sustainable carbon sequestration activity in terms of reducing CO2 emissions, because it both prevents deforestation and enables sequestration over a long period of time.

As for afforestation and reforestation, three of the issues that have to do with sustainability are the amount of land that gets reforested, the kind of trees that are used for reforestation, and the amount of time that reforested land remains forested. For example, while Costa Rica and Ecuador both welcome forest carbon sequestration projects, if too much of their land gets devoted to carbon sequestration, this might lead to a situation that is economically and politically unsustainable. The Forests and Climate Change Project in Central America (*Proyecto Bosques y Cambio Climatico en America Central*), which started in September 2001, is helping Central American countries identify their opportunities under the CDM, taking into account this issue of scale.[216] In Ecuador, FACE addresses the issue of scale in its projects by mandating that no more than half of a community's land can be put under plantation. This also helps keep land available in the event of future competition with other land uses.[217]

One of the local sustainability conflicts for FACE/Profafor was the issue of whether to plant native or non-native species. The communities prefer non-native species like pine and eucalyptus because they know how to grow them and have a better market for them. However, FACE/Profafor considers native species more ecologically sustainable, and SGS was concerned that eucalyptus may

[216] Frutos, Ramon. January 23, 2002.
[217] Emmer, Igino. Email May 13, 2002.

contribute to the degradation of soils rather than their protection.[218] FACE was also under pressure from investors to plant native species. Initially, FACE/Profafor permitted the planting of non-native species, on condition that after the first felling, native trees would be planted.[219] Research by Ecopar into the value and use of native species was also initiated. In 1998, FACE/Profafor started to require that all new contracts include at least 30% native tree species, and since 1999, the new contracts signed plant more area with native species than with non-native species.[220] As an incentive, FACE/Profafor pays landowners more to plant native rather than non-native species.

An issue related to scale and ecological sustainability that was pointed out by SGS is that FACE/Profafor does not have a system in place which ensures variety of provenance (seed origin) between different contract partners in the region or between different contracts held by one contract partner. In one case, 600 hectares of forest had been planted on one site using one seed lot.[221] However, the requirement that contracts must now contain 30% native species should help with this.

Lastly, the issue of sustainability is intertwined in the decision on project lifetimes. Having a 99-year contract encourages the ecological sustainability of a forest, but it does not necessarily ensure the economic sustainability of the forest to the landowner. For this to happen, returns from a maturing forest would need to keep up with the opportunity cost of land. This is by no means assured in the project contract. There are also certain equity issues to be considered when determining the use of someone's land for a long period of time. Almost all forest carbon sequestration projects take place in poor rural areas with a narrow range of income-generating activities. If one source of income in a project area is negatively impacted, a landowner has little flexibility to compensate for it because of his obligation to maintain his forestland as forest for almost a century or face heavy penalties. Because of the tenuous nature of this existence, forest carbon sequestration projects could impose a severe hardship on poor rural communities, which not only threatens the well-being of these communities but also that of the forests themselves.

4.5 Uncertainties in International Policy and the Market in Emissions Reduction Credits

As mentioned several times above, the lack of clear and detailed guidelines for forest carbon sequestration projects and the market in carbon offset credits has added large amounts of uncertainty to the process of developing forest carbon sequestration projects. Some of the decisions that need to be made in order to lessen this uncertainty are:

[218] SGS Qualifore Programme. April 1, 2000: 7.
[219] FACE website, "Projects: Latin America: Ecuador."
[220] FACE website, "Projects: Latin America: Ecuador."
[221] SGS Qualifor Programme. April 1, 2000: 20.

4.5.1 What is the definition of afforestation and reforestation?

The definition of afforestation and reforestation are really only distinguished by the period of time during which land was without forest. If both actions are treated equivalently in terms of accounting, this distinction is not important for the implementation of the Kyoto Protocol.[222] However, different definitions have different implications for the amount of land that may be available for afforestation and reforestation activities under Article 3.3 of the Kyoto Protocol.[223] For example, if the definition of reforestation is set to mean the establishment of trees on land that has just been logged, then areas under conventional logging and regeneration practices would be considered reforestation carbon sequestration projects. This could greatly increase the size of the land base available for these projects.[224] It could also encourage short-term, high-turnover projects that have much different economic and environmental effects than longer-term forest projects.

4.5.2 Will conservation and forest management be creditable under the CDM?

While forest management activities are creditable under JI, they are not creditable under the CDM, and details on the criteria for forest management have yet to be established. Conservation is not creditable under any current plan, so no specific criteria for it have been developed. Answering the question of whether forest management and conservation will be creditable under the CDM is important from an environmental perspective because there are a many pressing opportunities for both activities in ecologically-valuable areas of the developing world that may not get undertaken if they do not have the added benefit of producing carbon offsets. For investors, conservation and forest management are important because they are attractive investments; they may involves lower project costs than afforestation or reforestation projects (no need for nurseries or labor to plant trees) and they generate a large amount of offsets up-front (no need to wait for trees to grow). They also slow the rate of deforestation, which is the second largest factor contributing to CO2 emissions to the atmosphere.

4.5.3 What are the criteria for project types approved under the CDM?

For forest carbon sequestration projects, criteria that define baseline calculations, monitoring and verification protocols, project lifetimes, environmental sustainability, and many other details are needed to be able to compare between projects and to lower transaction costs due to uncertainty. These details

[222] Noble *et al.* 2000: 66.
[223] Article 3.3 of the Protocol states, "The net changes in greenhouse gas emissions from sources and removals by sinks resulting from direct human-induced land use change and forestry activities, limited to afforestation, reforestation, and deforestation since 1990, measured as verifiable changes in stocks in each commitment period shall be used to meet the commitments in this Article of each Party included in Annex I."
[224] Noble *et al.* 2000: 66.

are scheduled to be determined by COP-9 in 2003, but until then these criteria are being vigorously debated because of the different implications of different criteria and because projects initiated since 2000 face non-creditability if they do not contain the same criteria that are defined in COP-9, unless they are grandfathered in some way.

4.5.4 What is the US's plan to reduce its emissions?

The US is the world's biggest emitter of greenhouse gases in both net and per capita terms, yet it only has a voluntary program based on "emissions intensity" as a plan to reduce its GHG emissions. For the second commitment period, which will be negotiated in 2005 and start in 2013, it is expected that the US will fortify its plans to reduce its emissions (or face international opprobrium). There is also the chance that it will ratify the Kyoto Protocol sometime in the future. Either of these actions would boost the market in carbon offsets and spur the development of more carbon sequestration projects.

4.5.5 When will non-Annex B countries face regulation under the Kyoto Protocol?

If non-Annex B countries have to meet their own emissions reductions commitments some day, they would be more hesitant to approve jointly-implemented forest carbon sequestration projects, as they would want to keep their sinks to themselves. This could serve to discourage CDM-type forest carbon sequestration projects.

4.5.6 What are the guidelines for the market in emission reduction credits?

One of the main questions regarding the emerging market in carbon offsets is the fungibility of credits from forest carbon sequestration with credits from emissions reductions and removals in non-LULUCF sectors. If offsets from forest carbon sequestration are fungible or if they are valued higher than credits from non-LULUCF activities, then there would be more incentive to undertake forest carbon sequestration projects.

4.6 Uncertainties in Host Country Capacity

There are a number of factors regarding host country capacity that either incentivize or disincentivize the development of forest carbon sequestration projects in a host country. Some of the factors identified in the three case studies include:

4.6.1 Governmental Capacity

Of the three countries, Costa Rica has by far the best infrastructure set up to identify and develop joint implementation projects in general. As the first developing country to recognize that AIJ projects could be used to finance national sustainable development priorities, Costa Rica has profited from a comprehensive strategy to promote its own sustainable development goals while helping other countries meet their objectives under the climate change regime.[225] The establishment of OCIC was an important first step in this strategy. OCIC, which is directed by a leading forestry NGO, serves to carry out the country's joint implementation evaluation, acceptance, and promotion activities.[226] Because it is a collaboration among the government, private, and NGO sectors, it is best situated to coordinate projects and align them with Costa Rica's development goals. It has also established its own project approval criteria and procedures, which in an atmosphere of regulatory uncertainty, has facilitated project development by giving prospective projects clear guidelines to follow.

In the development of its joint implementation strategy, Costa Rica has focused on renewable energy projects in order to help it meet its goal of using only renewable energy sources by 2010, and on forest carbon sequestration projects to protect its hydropower resources as well as to protect the natural areas that are important for its tourism industry. The consolidation of small projects into national-scale programs such as the Protected Areas Project (PAP), which has unified its park system, and the Private Forestry Project, which pays forest owners to maintain their land as forest, has also helped it fulfill its conservation goals by securing most of its threatened forest areas.[227] The PAP has also been structured to produce SGS-certified carbon offsets, which Costa Rica sells as Certified Tradeable Offsets (CTOs).[228] In 1997, Costa Rica sold 200,000 CTOs from the PAP to a consortium of private Norwegian companies at $10 per CTO for a total of $2 million.[229] Overall, Costa Rica expects to market a total of 15.7 million CTOs from this project, which could theoretically bring in $157 million to help pay for this and other environmental projects.[230] A recent study, however, suggests that carbon savings from this project amount to only 8.9 MtC when new data showing a slower rate of deforestation in Costa Rica is substituted into the project baseline.[231] While this new estimate still benefits Costa Rica, it highlights the need for reliable estimates of carbon benefits in order for joint implementation to be an effective way to combat climate change.

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[225] Hambleton, Figueres, and Kalipada, 2000: 3.
[226] Hambleton, Figueres, and Kalipada, 2000: 3.
[227] Hambleton, Figueres, and Kalipada, 2000: 4.
[228] CTOs are measured as 1 metric ton of carbon (note: not CO2)
[229] Cuellar, Herrador, Gonzalez, and Rosa. 1999: 7.
[230] Cuellar, Herrador, Gonzalez, and Rosa. 1999: 12.
[231] Menkhaus and Lober. 1996: 1-10.

By September 1998, approximately $140 million had been invested in joint implementation projects in Costa Rica.[232] Its political stability, adequate institutional and legal framework, and proactive environmental stance have all helped it to garner the majority of joint implementation projects in non-Annex B countries.[233] In contrast, neither Belize nor Ecuador have established an office to handle joint implementation projects, and neither country has a clearly defined vision for sustainable development, let alone the resources or the structure to carry it out. An official in the Belizean Forestry Department has stated that while the government of Belize wants to further investigate carbon sequestration projects, no one in the government wants to be responsible for it.[234]

Belize has at least gotten a start in the process of identifying its opportunities under the CDM through the Forests and Climate Change Project in Central America (*Proyecto Bosques y Cambio Climatico en America Central*), which began in September 2001 and which concludes in December 2002.[235] It has also been developing a national biodiversity policy that would prioritize activities, improve coordination among agencies, and elucidate national sustainable development goals.[236] In addition, it expects to follow through on its National Communication to the UNFCCC for 1994, which was completed in 1998 but which still needs to be corrected and passed by the legislature before it is sent out.[237]

Aside from the Rio Bravo project, Belize is host to the BEL/Maya Biomass Power Generation Project. Also, in December 2001, the government of Belize approved a project to reforest 36,450 hectares of the Mountain Pine Ridge Forest Reserve, which was decimated by the southern pine bark beetle. Along with the government of Belize, whose obligation is to protect and sustain the Mountain Pine Ridge Forest Reserve through a long-term management plan, the project is being locally managed by three Belizean businessmen under a venture called Silviculture Belize, Ltd., technically consulted by a Canadian reforestation firm named Global Forest Nursery Development, Inc, and financially managed by Forest Securities, Inc., an international forestry investment management company.[238] Planting is scheduled to begin in June 2002 with native pine seedlings grown in Belize, and project life is set at 55 years. The project is offering 5,000,000 tC for sale at $3.60/tC (18,000,000 tCO2 at $1.00/tCO2).[239] So far, the project does not appear to have any investors. However, the project is indicative of the increasing role of the government in forest carbon sequestration.

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232 Cuellar, Herrador, Gonzalez, and Rosa. 1999: 12.
233 Cuellar, Herrador, Gonzalez, and Rosa. 1999: 4.
234 Chun, Angel. Interview January 29, 2002.
235 Frutos, Ramon. Interview January 23, 2002.
236 Chun, Angel. Interview January 29, 2002.
237 Frutos, Ramon. Interview January 23, 2002.
238 Reforest Belize website.
239 Reforest Belize website.

Ecuador currently has two joint implementation projects, the FACE/Profafor project and the Bilsa Biological Reserve conservation project. Ecuador's high level of political and economic instability, weak legal system, and record of insecure land tenure are the main factors that detract from its government's ability to develop forest carbon sequestration or other joint-implementation projects. Its high population density and the fact that 50% of its people live under the country's official poverty line also make forest conservation or regeneration a challenge. However, it is an ecologically significant and threatened region that is extremely valuable from a biodiversity standpoint. This has prompted a number of mainly conservation organizations to set up projects in Ecuador. For example, TNC, Conservation International, World Wildlife Fund, Wildlife Conservation Society, and CARE all have projects in Ecuador.[240] The USAID, UN, and World Bank also have several projects in Ecuador. By working with the Ministry of Environment, FACE has given the Ecuadorian government a start in taking advantage of forest carbon sequestration projects. FACE also helps keep the Ministry of Environment up to date on its projects as well as on forest carbon sequestration policy in general. The government helps FACE identify potential project areas and beneficiaries, and FACE's monitoring activities help the government register plantations and forest preserves as required under Ecuadorian law.[241]

4.6.2 Scientific and Managerial Capacity

While PFB and Profafor are staffed with well-trained and committed individuals, and RTT can rely on CACTU and CATIE to undertake monitoring activities and give technical assistance, there is a general dearth of people knowledgeable about forest carbon sequestration projects in these countries. This factor, along with the lack of governmental capacity, keeps forest carbon sequestration projects from being country-driven and in the best interest of the host country.

4.6.3 Policies that Incentivize Deforestation

Until fairly recently, Costa Rica had a variety of laws that either directly or indirectly promoted deforestation. For example, squatters could claim title to previously undisturbed forests if they cleared and cultivated the land. These land-titling policies were reinforced by low land taxes that provided only a small setback to those who wanted to claim land.[242] In general, the key driving forces behind deforestation in Costa Rican have been government policies to promote economic development through subsidized loans to agriculture, especially for the coffee, sugar cane, and beef industries. Another area of public policy that has contributed to deforestation is infrastructure development. Costa Rica has one of the

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240 USAID website, "Ecuador: Activity Data Sheet."
241 Jara, Louis Fernando. Interview April 5, 2002.
242 Busch, Sathaye, and Sanchez-Azofefa. July 2000: 34.

densest road networks in the developing world, which has served in effect as a public subsidy for those who would convert forests to other uses.[243]

A measure that started to reverse the effects of these policies was the first Forestry Law in 1979. It introduced the "first generation of incentives," which consisted of income tax deductions on reforestation investments. The second Forestry Law, passed in 1986, provided a direct subsidy for investments in forestry plantations and indirect support for private forestry investments. The new Forestry Law, enacted in 1996, introduced a series of major innovations, such as payment for environmental services and a financing mechanism via a fuel tax.[244] It also establishes a ban on land use changes and the establishment of any type of plantation on public and private forested holdings. Furthermore, it stipulates that these holdings can only be exploited with a management plan that identifies the potential environmental impacts.[245]

The Private Forestry Project, established in 1998 by OCIC to help address concerns about leakage from the Protected Areas Project, was another major innovation. As part of the government's plan to pay for environmental services, landowners participating in the project received payments averaging $120/hectare/year for plantations, $60/hectare/year for forest protection and $45/hectare/year for forest management and reforestation.[246] One of the farmers in the Klinki project is known to have received revenue from the Private Forestry Project for existing forests on his land.[247]

In Belize, the situation is very different because its low population has kept the amount of land under forest cover quite high. However, one issue in Belize is the continued propagation of the policy of giving short-term logging concessions to logging companies. Because of the relatively brief nature of these concessions, logging companies have little incentive to undertake reduced-impact logging techniques. Longer-term concessions would incentivize them to promote forest regeneration, and would result in less damage to forestlands.[248]

In the Andean region of Ecuador, most of the original forest has already been logged, but the remaining coastal and Amazonian forests are threatened by legal and illegal logging, cattle ranching, and commercial and subsistence farming. An agrarian reform law passed in September 1994, which allows rural farming cooperatives to split up their land amongst their members, has in some areas detracted from reforestation activities because it has resulted in the fracture of large community landholdings into parcels

[243] Busch, Sathaye, and Sanchez-Azofefa. July 2000: 35.
[244] Cuellar, Herrador, Gonzalez, and Rosa. 1999: 5.
[245] Cuellar, Herrador, Gonzalez, and Rosa. 1999: 8.
[246] Subak. June 15, 1999.
[247] Rojas, Carlos Manuel. Interview March 20, 2002.
[248] Novelo, Darrell. Interview January 22, 2002.

too small to create a viable forest.[249] Also, having a large number of small landowners causes transaction costs to increase, which further discourages reforestation projects.

4.6.4 Corruption

The presence of corruption threatens forestry projects in many developing countries by contributing to the lax enforcement of protected areas, the permission or support of illegal deforestation, and the lack of recourse to breaches in reforestation contracts, among many other problems.

In a report by World Resources Institute and the World Wildlife Fund on the destruction of tropical forests by multinational companies, Belize was named as one of the top countries that are "suffering large-scale corruption."[250] It was included in a group of other developing countries with "weak forest services, poor monitoring capacity, inefficient tax collection and auditing capacity, and in some cases widespread bribery and corruption" that were vulnerable to unscrupulous foreign investors.[251]

Ecuador has also been named as a country vulnerable to corruption, ranking second worst in Latin America and 79th out of 91 overall in Transparency International's 2001 corruption survey.[252] USAID has commented that corruption in Ecuador is "a serious deterrent to effective biodiversity conservation."[253] The country also contains powerful special interests that lobby strongly against the enforcement of forestry regulations on deforestation activities and against passage of forestry laws.[254]

4.6.5 Timber Markets

The small local market for timber, and especially for secondary hardwoods, was mentioned by PFB as a disincentive for sustainable forestry practices in Belize.[255] The lack of access to a market for timber in Ecuador was also a concern of the communities with which FACE is involved. In addition, there is only a very small export market for timber in both countries (<2% of wood produced).[256] Low timber prices further lower the incentives and the means to practice sustainable forestry.

4.6.6 Infrastructure

Poor or non-existent roads can make it more difficult for forest carbon sequestration projects to succeed. For instance, the difficulty of traveling in the Andean region of Ecuador means that the

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[249] Morris. 1997: 38.
[250] Brown. May 29, 2000.
[251] Brown. May 29, 2000.
[252] Note: 1 is least corrupt, 91 is most corrupt. Transparency International website, "New index highlights worldwide corruption crisis," June 27, 2001.
[253] USAID website, "Ecuador: Activity Data Sheet."
[254] USAID website, "Ecuador: Activity Data Sheet."
[255] Novelo, Darrell. Interview January 22, 2002.
[256] CIFOR. 2001: 27.

transport of plant material is often slow. Profafor managed this by devising a way to transport seedlings in specially modified trucks so that the seedlings would reach the planting site without loss of quality or vitality. Roads also play a role in the export of timber to market. In the Andes, if timber buyers have to travel any distance from the road, prices for timber drop by approximately 50% (see Table).[257] A lack of public transportation also hinders the communities' access to local markets to sell timber and non-timber forest products.

Figure 16 - Prices for *Eucalyptus globules* in the Andean region of Ecuador, 2000[258]

Seller	Actual prices (USD/m^3)
Exporter	26
Middleman	16
Community (near road)	5.2
Community (away from road)	2.8

4.6.7 Socio-economic Pressures

Socio-economic pressures that pose a challenge to forest carbon sequestration projects range by country and by region. In Costa Rica, consumer demand and population growth are factors that have contributed to deforestation and the establishment of pastures over forestland. Costa Rica's population and standard of living has grown rapidly, and per capita beef consumption has grown as well. In 1960, Costa Ricans consumed about 10 kg of beef on average per year. By 1990 that figure had grown to about 20 kg per capita annually.[259]

In Belize, subsistence farmers from Guatemala and Mexico have been a factor in the clearance of forestland on Belize's borders and a threat to its protected areas. To add to this problem, one government official stated that "We don't even know how much land use change is happening on our borders from migrants"[260] and that the government wanted to investigate, but did not have the resources to do so by itself. Belize's increasing agricultural demand is also a factor. In the Rio Bravo area, agriculture is dominated by Mennonite farmers, who produce over half of Belize's maize and rice. They practice an intense form of mechanized farming that leaves hardly a tree standing, in contrast to the subsistence farmers, whose milpas (small-holder cornfields) coexist alongside patches of forest. This contrast is a strong exception to the rule that poverty is the main driver of deforestation in developing countries.[261]

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[257] CIFOR. 2001: 26.
[258] Source: CIFOR. 2001: 26.
[259] Busch, Sathaye, and Sanchez-Azofefa. July 2000: 36.
[260] Fuller, Carlos. Interview January 29, 2002.
[261] Brandon, Redford, Sanderson. 1998: 225.

Figure 17 – Mennonite Field, Fallow Field, and Forest near the RBCMA[262]

In Ecuador, the socio-economic pressures facing the Andean region differ from those facing the coastal and Amazonian lowlands. The Andean region has a lower population and population growth, and is under less pressure from agro-industry and development than the lowlands. Its residents are primarily farmers, ranchers, and indigenous communities that collectively own large landholdings, and its economy is largely based on agriculture. These features make this area more amenable to forest carbon sequestration projects because they represent a productive use for otherwise marginally productive or degraded land, a source of income for people with truly limited economic opportunities, and a way to improve the environment on which they depend.

4.6.8 Payment for Environmental Services

While forests provide ecological services that benefit society as a whole, these benefits (and the costs imposed when the ecological services disappear) are not internalized in the decision-making of private landholders. The failure of the market and of government policy to include these costs and benefits means that landowners have little incentive to keep their land as forest, and are a serious challenge to the success of forest carbon sequestration projects.[263]

Costa Rica's Private Forestry Project, in which landowners are paid to maintain their forests for the environmental services they provide, has been a response to this. However, the current system of payment for environmental services may prove to be unsustainable due to the country's fiscal situation, which prevents it from shouldering the responsibility for the payment of these services. This has made it necessary to limit payments to those already granted. Moreover, it has been necessary to increase the fuel tax, which some argue creates a tax injustice because the cost of the program does not get carried by the

[262] Xantha Bruso. January 2002.
[263] Busch, Sathaye, and Sanchez-Azofefa. July 2000: 36.

service user but instead by a sector of the population that does not directly enjoy the benefits derived from these services.[264]

While this program could be a viable model for Costa Rica sometime in the future, it is generally not applicable to most developing countries because of a general lack of government revenue and taxation ability. Forest carbon sequestration projects could be used as a market-based mechanism to value environmental services, but as shown in this chapter, a great many factors in the market, the environment, local communities, government, and the international policy arena need to be in the right place in order for them to be successful.

[264] Cuellar, Herrador, Gonzalez, and Rosa. 1999: 13.

Chapter 5 – Facilitating Forest Carbon Sequestration Projects

In this chapter, I formulate a set of principles and recommendations for potential stakeholders interested in forest carbon sequestration projects. They are based on the investigation of my three case studies and are supplemented by information gained from other projects during the course of my research. I also outline the key considerations in the selection of a carbon sequestration project for a Massachusetts power plant looking to offset its emissions under a new ruling by the state's Energy Facilities Siting Board that requires new power plants with a capacity of more than 100MW offset 1% of the facility's CO_2 emissions for the next 20 years.

My recommendations are guided by the primary principle that I have determined from my research, which is that in order for jointly implemented forest carbon sequestration projects to be successful, the benefits that a landowner receives, either indirectly through environmental benefits such as reduced erosion or watershed protection, or directly through income from the project or from timber sales, need to continuously equal or exceed the opportunity cost of land on which the forest is planted throughout the project life. The fundamental challenge of carbon sequestration projects is to create a dynamic system that gives adequate long-term returns and flexibility to landowners while maintaining a certain level of carbon sequestration and security for investors.

For the development of this chapter, I assume that the Kyoto Protocol is ratified at COP-8 in September 2002 and that the CDM Executive Board and the criteria for CDM projects are adopted at COP-9 in 2003.

5.2 Recommendations to Project Managers and Investors

Once the standards are established on baseline assessment and monitoring and verification procedures, the main issues for project managers and investors will be ensuring permanence. Permanence depends on a number of factors, the most important of which are project location, project length, and project benefits to landowners.

5.2.1 Project Location

The host country should preferably have a large amount of marginal or degraded land available for reforestation or afforestation, a clearly-defined set of sustainable development goals, an office to handle JI projects, a stable political and economic climate, a strong legal system, an equitable distribution of legal land ownership, a progressive set of land use policies that encourages reforestation and values the provision of environmental services, a strong local timber market as well as an export market in sustainably-harvested timber, adequate roads to get timber to these markets, low population growth (including low immigration), and a low poverty rate. While this rules out almost all developing countries, it is not entirely prohibitive. A well-designed project can help accommodate for host country deficiencies, but there is a point at which the costs of compensating for the lack of host country capacity override the benefits of undertaking a project in that country.

5.2.2 Project Length and Benefits to Landowners

Depending on the profile of the host country, the length of the project can then be determined. Project length depends on both environmental and economic conditions. Obviously, project length can be shorter where trees grow faster, but should be long enough for trees to grow to a marketable size. Aside from this, project length should correspond largely to the opportunity cost of land and the benefits that a landowner receives over the length of the project. If the combination of benefits that a landowner receives, either indirectly through environmental benefits such as reduced erosion or watershed protection, or directly through revenue from timber or non-timber forest products, do not continuously equal or exceed the opportunity cost of land on which the forest was planted throughout the project lifetime, the permanence of a project will be threatened.

While a shorter project life affords a landowner more flexibility and decreases the threat to permanence for the investor, a short project lifetime is not always optimal in terms of sequestering carbon. Mature forests store more carbon in soils and vegetation than do short-rotation plantations. Also, a study that examined the sensitivity of carbon sequestration costs to changes in factors including the nature of forest management and deforestation regimes, silvicultural species, agricultural prices, and discount rates found that the costs of carbon sequestration could be greater if trees are periodically harvested rather than permanently established.[265] Therefore, a solution might be to have projects that are renegotiable after a certain length of time or take place in, for example, 20- or 30-year stages so as to continuously incentivize sustainable forest management.

Threats to permanence can also be mitigated by the development of a buffer, such as the one SGS has developed to protect against variability in emissions reductions resulting from natural disasters, baseline calculation errors, and inconsistencies in project management. Setting aside a certain percentage of offsets as a "hedge" against these risks is a good form of in-project insurance that helps to protect both the project manager and the investor. As the market develops, investors might also be able to get their credits insured by a third party as an additional form of security.

[265] Newell and Stavins. November 1999: 3.

5.2.3 Who bears the risk of impermanence?

In general, if a project fails to generate the specified number of purchased reductions, investors prefer that sellers commit to deliver alternative reductions that could be used for compliance. However, few if any sellers have been willing to undertake such a strong commitment since they would be exposed to the variable and potentially high cost of producing or acquiring approved compliance tools in the market. Instead, sellers typically agree that they may supply alternative reductions or may instead return some, or all, of the sale proceeds to the buyer, possibly with a specified financial penalty. Sellers may be able to claim a higher price per metric ton of reduction in return for accepting greater liability.[266]

Another way to deal with the risks of impermanence could be to require an insurance policy with the sale of the credits as a guarantee that if the project fails, the insurance company would be responsible for replacing the carbon.

5.3 Recommendations To Host Countries

As mentioned above, investors and project managers consider a number of characteristics when choosing a host country. However, a host country need not fulfill every requirement in order to attract forest carbon sequestration projects, as the case of Ecuador shows. Host countries can make a few key policy decisions that would help attract JI projects and improve their investment climate in general.

A host country needs to have a set of clearly defined sustainable development goals that could be fulfilled through a jointly implemented forest carbon sequestration project. It also needs to establish or designate an office or position to handle JI projects because of the multidisciplinary and cross-sectoral nature of joint implementation, and to keep track of the different projects.

In terms of local policy, formalizing rural land tenure and clarifying land ownership through an accurate cadastral system would help simplify project activities. Excising regressive land use policies that encourage deforestation and implementing basic policies such as lower tax rates for forested property, for example, would also foster the promotion of conservation and reforestation. Some key economic moves would be to aid the development of a local timber market and encourage the formation of a value-added export market, by, for example, helping establish a sawmill to produce building materials. These measures would help create the demand that is necessary to ensure the profitability of forest carbon sequestration projects.

Governments can also assist in the identification of areas that would be most suitable for carbon sequestration projects by tracking land use trends and formulating strategic regional land use plans. For instance, if forestry is to become a large component of a rural area's economy, a plan to establish

[266] Rosenzweig, Varilek, Feldman, Kuppalli, and Janssen. March 2002: 15.

commercial plantations on the highlands, agroforestry in the lowlands, and conservation plantings on steep slopes could be used to focus projects where they would be most effective. Areas should also be targeted according to their socio-economic characteristics. For instance, areas that have had experience with plantation forestry as well as lightly populated, isolated, or degraded areas are likely to have more success with forestry projects.

In the oversight role of carbon sequestration projects, host governments should be minimally involved, and let the project managers and investors bear the responsibility of proving the emissions reduced. However, governments should be willing to take a transparent and cooperative approach to working with NGOs and the private sector in the development of forest carbon sequestration projects.

5.4 Recommendations to the Conference of Parties

In its decision on the criteria governing forest carbon sequestration projects, the COP needs to keep in mind the needs of the most vulnerable and important stakeholders: the landowners. While USIJI and AIJ both require a projected emissions scenario as part of their project proposals and reports, the new criteria should also require a projected income scenario for the landowners. For project managers and investors, requiring a buffer or an insurance policy would help lower risk for all stakeholders.

Finally, the COP needs to address one of the most difficult issues concerning the use of forest carbon sequestration to offset GHG emissions: the inherent impermanence of sequestering carbon in trees. As opposed to energy efficiency projects, where a barrel of oil saved means that the CO2 in that oil is simply not emitted, forest carbon sequestration actually removes CO2 from the atmosphere, but it is only stored temporarily. When a tree rots or is burnt, much of its carbon returns to the atmosphere. If a tree is cut down and made into a table or a house, its carbon is sequestered longer, but not permanently. Therefore, if an emitter wants to offset 40 tons of CO2 a year for 25 years with a hectare of Klinki Matrix trees, for example, that hectare of trees would technically need to be there permanently in order to permanently offset that CO2. However, the emitter has only paid to offset his 40 tons per year for 25 years, so he is really only paying for the temporary storage of carbon, not for the permanent offset of carbon. The incomparability between these two concepts is one of the fundamental problems in the way carbon sequestration is currently being quantified.

One way to look at the issue of incomparability could be to equate the lifetime of CO2 in the atmosphere to the length of a forest carbon sequestration project. Because CO2 exists for about 120 years in the atmosphere, a forest carbon sequestration project should also last 120 years in order to more accurately offset the CO2 emitted. However, this amount of time is too lengthy to consider because of the uncertainties involved in forest carbon sequestration projects, especially for this amount of time.

Therefore, I suggest that projects be established for 20, 30, or 40 years, with a multiplier of 6, 4, or 3, respectively, to compensate for the condensed duration of the project life. For example, if a company needs to offset 100 tCO2, it would have to invest in the sequestration of 600 tCO2 for a 20-year project, 400 tCO2 for a 30-year project, or 300 tCO2 for a 40-year project.

Another problem that has arisen is the question of who should bear the responsibility for carbon that is prematurely released into the atmosphere. This is an especially complex issue if the carbon sequestered and subsequently lost was sold in a forward stream transaction. While buffers and insurance policies may help, another way to address this problem would be to only allow the sale of the incremental amount of CO2 that has been sequestered by the forest during the past year, minus the amount of CO2 reserved for a buffer. If a percentage of the yearly sales are allocated to the landowners, the sale of carbon offsets would help to ensure the permanence of the project by providing a steady income (especially while the trees are too young to cut for timber) as well as an incentive to sustainably manage the forest. Also, an incremental sale of CO2 credits could yield more money overall than the discounted value of the futures.

Even if CO2 is accounted for according to a condensed 120-year project and is only sold incrementally, the problem of a tree's carbon eventually being re-released to the atmosphere still remains. While replanting could compensate this for, to account for carbon accurately, these new trees could not be used towards offsetting other emissions. Because trees provide other environmental services besides carbon sequestration, I would advocate that carbon offsets from a 120-year condensed forest carbon sequestration project or an incremental credit should be made equivalent in permanence and fungible to offsets from energy efficiency projects.

5.5 Advice to a Company in Need of Carbon Offsets

Despite the lack of a global consensus on climate change and the refusal of the US to join the Kyoto Protocol, regulatory action to reduce GHG emissions has nonetheless emerged at the local level. In April 2001, Massachusetts became the first U.S. state to impose CO2 emissions limits on old fossil-fired power plants, which have historically been subject to less stringent standards than new plants under the Clean Air Act. The regulations apply to the state's six dirtiest power plants, which produce 40% of the electricity used in Massachusetts. These plants will be required to reduce their CO2 emissions by 10% from their 1997-1999 average emissions baseline by October 1, 2004. Reductions can be met through energy efficiency improvements, fuel switching, installation of renewable energy installations, and carbon sequestration.[267] Massachusetts also requires new power plants to offset a portion of their projected CO2 emissions as a condition of obtaining an operating permit.[268] Specifically, the Massachusetts Energy Facilities Siting Board has stipulated that new power plants with a capacity of more than 100MW offset 1% of their facility's CO2 emissions for the next 20 years, with a limit on emission reduction costs at $1.50 per short ton.[269]

So far, Massachusetts' government has only issued principles to govern the use of offsets for compliance. Specific rules for crediting of offsets have not yet been developed. At a minimum, those seeking to invest in off-site emissions reduction or sequestration projects must demonstrate to the satisfaction of the Massachusetts Department of Environmental Protection that the reductions are real, surplus, verifiable, permanent, and enforceable. These requirements must be met before any claimed reduction generated by off-site projects can be applied toward the reduction requirement. The issues of additionality (both financial and regulatory) are still under consideration as the state establishes rules governing the use of CO2 offsets for compliance.[270]

Under the new requirements of the Massachusetts Energy Facilities Siting Board, the Mirant Kendall Kendall Square Station power plant, located next to MIT in Cambridge, Massachusetts, needs to offset 170,000 tons of CO2 equivalent to compensate for an upgrade project at its plant.[271] These 170,000 tons can be supplied in a single year or over several years. In light of these requirements, I would recommend that Mirant obtain its offsets from a multi-year forest carbon sequestration project, for the following reasons and with a few key considerations in mind.[272]

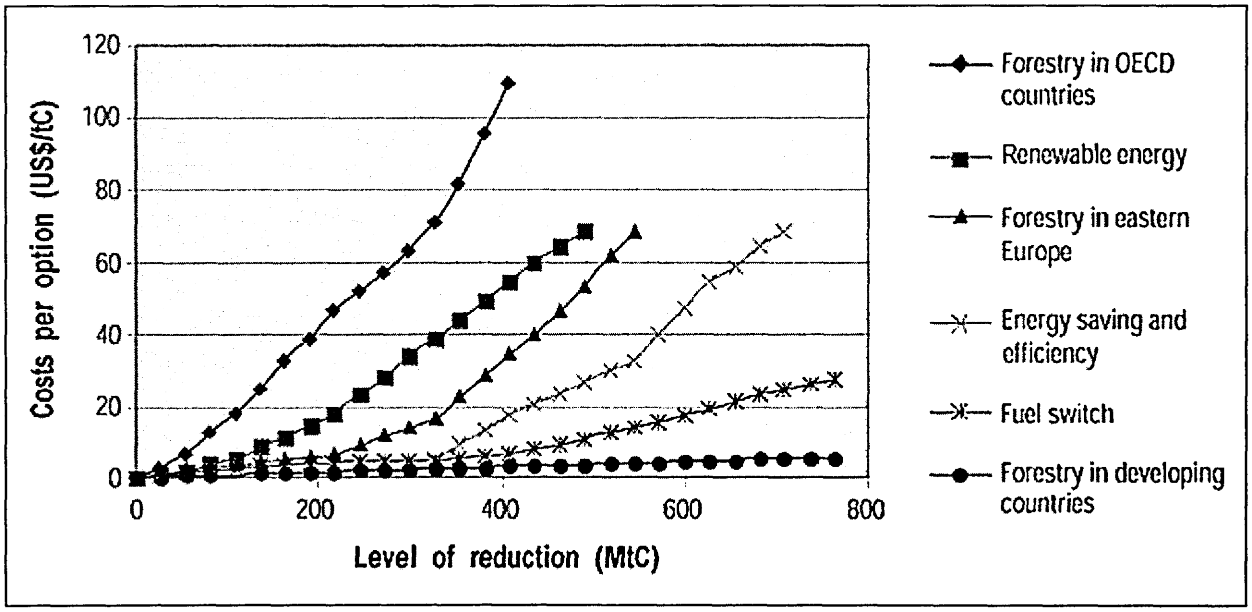
5.6.1 Type of Project

A forest carbon sequestration project would be the best project in which to invest, because the cost per ton of these projects is currently lower than that of all other options. Specifically, a forestry project in a developing country would be the least cost activity in terms of cost per ton of CO2. Since Massachusetts requires reductions of actual GHG emissions below a specified baseline resulting from specific and identifiable actions initiated post-2001, I would recommend that Mirant choose an afforestation/reforestation project as opposed to a conservation project to avoid controversy over whether conservation is an identifiable action. However, if Mirant forsees that it will require additional carbon

[267] Mcelhenny, John. April 23, 2001. Note: Massachusetts by itself emits as much carbon dioxide as Austria, Egypt or Greece.
[268] Egelston, Anne. July-August 2001: 31.
[269] Rosenzweig et al, March 2002: 49.
[270] Rosenzweig et al, March 2002: 58.
[271] Labrie, Laurence. April 29, 2002.
[272] To give an idea of temporal and physical scale, between 1993 and the end of 1999, FACE was able to generate over 136,000 VERs from an estimated 20,000 hectares of forest planted in Andean Ecuador.[272]

offsets in the future, I would advise it to choose an afforestation/reforestation project that has a conservation component in order to maximize the long-term carbon benefits of the project.

Figure 18 - Indicative cost curves of emission reduction or carbon sequestration by level of total reduction.[273]



Note: cost of US$28/tC is equivalent to US$100/t$CO_2$

5.6.2 Location of Project

In terms of which developing country Mirant should investigate for a reforestation project, the tropical countries of Latin America would be the obvious choice. The tropics provide a fast growing climate for trees, and there is an abundant amount of land there that is underutilized, marginally productive, or degraded to a point where it has almost no opportunity cost. Also, most forest carbon sequestration projects implemented to date have been in Latin America, where there is extensive experience with both natural and plantation forestry. The high amount of biodiversity of Latin America which is threatened by its high deforestation rate, also make an investment there worthwhile and timely because of the project's benefits to wildlife habitat and soil, water, and air quality, and to the local communities that depend on these features. In addition, the cost of labor and inputs in Latin America are generally low, and countries like Mexico, Costa Rica, and Panama have adequate physical and institutional infrastructure (i.e. roads, telecommunications, banks) to support such projects, as well as demand for wood and wood products. Mirant should focus its search on projects that take place in lightly

273 IPCC Working Group III. "Climate Change 2001: Mitigation." IPCC Third Assessment Report, 2001: Section 4.5.1.

populated areas with limited economies, as projects there would be better received and maintained by the communities who stand to benefit from them.

Figure 19 - Benefit-cost parameters: criteria for expected economic returns to reforestation projects[274]

B/C criteria	Conditions for positive economic returns	Conditions for negative economic returns	PROFAFOR case studies X = negative factor √ = positive factor
Land	Steep hillsides, wastelands, marginal lands with almost zero opportunity cost Low population density Low negative environmental externalities (eg on crop production)	High opportunity cost of land High population density Significant negative environmental externalities	√ Use of marginal lands and steep slopes X Potential problem due to increasing population density
Labour	Low to medium wage rate (associated with distance to off-farm labour markets) High wage rate for tree planting compared with other local activities	High wage rates (close to markets)	√ High wage rate for tree planting compared with other local activities
Material inputs	Low cost of inputs (access to markets) Access to organizations providing free or subsidized Inputs	High cost of inputs (limited access to input markets) Absence of organizations or subsidizing agencies.	√ Access to organisations providing free or subsidised inputs Low cost of inputs (access to markets)
Output prices	Good access to markets (proximity to roads)	Poor market access	X Poor market access
Discount rates	Low discount rates Good access to credit High potential land yields	High discount rates Poor access to credit Low potential yields	X High discount rates Poor access to credit Low potential yields
Institutional factors	Access to benefits Strong collective action	Restricted access to benefits Weak collective action	X Restricted access to benefits

5.6.3 Project Management

To manage a project in Latin America, Mirant should look for an organization that has both experience in forest carbon sequestration and an established institutional presence in both the US or Europe and the host country. This organization should have a long-range plan for its monitoring and technical assistance activities and the staff and monetary base to carry them out.

[274] CIFOR. 2001: 20.

5.6.4 Project Certification

While Mirant stipulates that the seller is responsible for independent third-party verification, it should make sure that project managers choose a reliable, credible verifier who is familiar with the current best practices of carbon verification and who has experience in carbon sequestration projects in the host country.

5.6.5 Project Benefits

Mirant should invest in a project that not only results in real, measurable, and verifiable carbon offsets, but that also produces clear and continuous benefits to the owners of the land on which the trees are planted. To this extent, Mirant should require a projected income scenario for the landowners along with a projected emissions scenario as part of their project proposals.

5.6.6 The Future of Carbon Sequestration Projects

Massachusetts is not the only state that has begun to require GHG emissions reduction measures. Oregon and New Hampshire also regulate CO2 from the electricity sector, as does Suffolk County in New York. The growth of both mandatory and voluntary emissions reduction programs by states, counties, and companies will be the main drivers behind investment in forest carbon sequestration projects up to and through the ratification of the Kyoto Protocol and the further development of a US GHG management plan. As the world becomes more aware of the impact that GHGs have on our environment, forest carbon sequestration will come to play an increasing role in the development decisions of companies and governments as well as in the land use options of rural communities in the developing world.

Figure 20 – Local-level GHG Reduction Measures[275]

State/regional GHG reduction measures

State/Jurisdiction	*Electricity sector CO_2 reductions*	*State-wide CO_2 reductions*	*GHG registry*	*Emissions trading*
California			✓	
Massachusetts	✓		✓	✓
NE Governors/EC Premiers		✓	✓	✓
New Hampshire	✓		✓	✓
New Jersey		✓	✓	
Oregon	✓		✓	✓
Suffolk County, NY	✓			✓
Wisconsin			✓	

[275] Bubenick and Jones. March 2002: 25.

Chapter 6 – Conclusion

Forest carbon sequestration projects are an effective way to mitigate climate change, but they are only one method among a portfolio of activities that the world needs to take in order to reduce GHG emissions. While the spatial and natural limits of carbon sequestration mean that the benefits of slowing deforestation and promoting reforestation are technically limited, the scale at which forest carbon sequestration projects have been attempted to date leaves room for many more potential projects.

In my three case studies, I determined that the incentives behind participation in these projects were 1) the market in carbon offsets and 2) the local economic, social, and environmental benefits. From my other research, I can stipulate that these incentives were the same for most other forest carbon sequestration projects. However, now that many pilot projects have been undertaken and an emerging market in carbon commerce established, the incentives behind these projects will have to do more with profitability and generating "real, measurable, and long-term benefits related to the mitigation of climate change" as stated in the Kyoto Protocol.[276] Carbon offset producers such as FACE in the Netherlands and Future Forests in the United Kingdom, along with carbon consultants and brokers like Ecosecurities, Natsource, and CO2e.com, have emerged alongside environmental NGOs like TNC to further the market in carbon offsets. Together they are pushing the agenda on forest carbon sequestration.

The disincentives to forest carbon sequestration projects are decreasing as the Conference of Parties to the UNFCCC meets and agrees on technical and accounting criteria and standards, and as the Executive Board to the CDM is formed. Uncertainties in the science of carbon sequestration are also being worked out as research progresses. Greater understanding of tree growth and ecosystem dynamics are yielding new insights that help determine more precise baselines and emissions reduction scenarios, and technologies such as aerial videography are being developed to undertake more accurate scientific monitoring of natural resources and land use. This technique has been used by Winrock International and the Nature Conservancy in projects in Bolivia and Brazil, and will be tested at the Rio Bravo project this year.

Developing countries are getting increasingly organized around the issue of climate change and what they can do to take advantage of their position as non-Annex B countries. The Forests and Climate Change Project in Central America (*Proyecto Bosques y Cambio Climatico en America Central*) is an example of this. Bilateral agreements between Annex B and on-Annex B countries have also been recently negotiated. For example, in February 2002, the Netherlands and Costa Rica signed a

[276] Kyoto Protocol, 1997: Article 12, Section 5b.

Memorandum of Agreement for 30 megatons of CO_2 equivalent to be obtained between 2000 and 2012.[277]

NGOs are also furthering action on climate change mitigation around the world. The WWF Climate Savers Program, Conservation International's involvement in The Center for Environmental Leadership in Business, and TNC's Climate Action Projects are just a few examples of NGO-business partnerships in this arena. To reduce the kind of market failures associated with many environmental issues, the World Bank has also gotten involved by establishing the Prototype Carbon Fund, which is a public and private partnership formed to pioneer the market for project based-based greenhouse gas emissions reductions within the framework of the Kyoto Protocol and to contribute to sustainable development.

While forest carbon sequestration projects and the market surrounding them are becoming increasingly sophisticated, there is still a need for more interdisciplinary studies and models of costs and benefits of these projects. Determining baselines is an inherently uncertain process that depends on many social, economic, and environmental variables, so models that take into account factors such as the growth rate of trees, the price of wood and other agricultural commodities, population growth, the cost of land, and land use change, among other factors, would be helpful in quantifying the process and investigating different scenarios.

Overall, landowners are still the most important part of carbon sequestration projects. The benefits that a landowner receives, either indirectly through environmental benefits such as reduced erosion or watershed protection, or directly through project payments or timber revenues, need to continuously equal or exceed the opportunity cost of land on which the forest is planted throughout the project life in order for a project to be successful. If landowners are not fairly compensated, the permanence of the project and the forest itself is put at risk.

As it stands now, only stakeholders who are interested in both the financial as well as the environmental benefits from these projects should invest their money, effort, and land in forest carbon sequestration projects, as they are currently not 100% viable in a purely financial sense. My findings, however, indicate that forest carbon sequestration projects, while currently risky and uncertain investments, will become more clearly viable in the near future. Greater certainty from international policy agreements will help to reduce the transaction costs of these projects, more experience will lead to better project design and more mutual benefit, and greater involvement by all stakeholders, including companies, governments, NGOs, and communities, will result in effective local environmental initiatives that help solve the global environmental objective of mitigating climate change.

[277] "Memorandum of Understanding on co-operation in the field of the Clean Development Mechanism under Article 12 of the Kyoto Protocol between the Netherlands and Costa Rica," February 21, 2002: Article 2.

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