

**PART II -- U.S. CREDITS FOR SEQUESTRATION OF CARBON
IN OTHER COUNTRIES**

CHAPTER 5 -- INTERNATIONAL SINK OFFSETS AND CREDITS

Sequestration of carbon within the boundaries of the United States can play a major role in achieving reductions of CO₂ in the earth's atmosphere. However, sequestration within the United States is not necessarily the optimal choice. In many cases, carbon can be sequestered in other countries at lower costs. In terms of overall efficiency of the world response to climate change, the lowest cost alternatives should be pursued ahead of higher cost sequestration alternatives. In other words, if there is a choice between sequestration in the United States and sequestration in another country, the efficient action from a worldwide perspective will be to choose the other country. Of course, this depends on the willingness of other countries to allow the US to offset its emissions abroad. To assure that foreign countries participate fully in carbon sequestration projects, it is important to note that they will receive benefits—including financial and technological transfers—that will aid their economic development

If levels of overall sequestration that might prove to be desirable worldwide exceed those which can be accomplished domestically in the United States (and other developed nations), the United States may need to find ways to help developing countries pursue sequestration alternatives. Of course, there are also other basic alternatives to sequestration for reducing carbon dioxide in the atmosphere. It should not be assumed that sequestration will always be the most efficient alternative. Getting a handle on world carbon emissions will almost certainly require addressing the carbon status of developing nations, which were responsible for almost 30 percent of global energy demand in 1990. Their share is expected to increase to almost 70 percent by the year 2050.

In light of these considerations, the United States has sought in the Kyoto Conference and other Conferences of the Parties (COPs) to encourage mechanisms for international trading in offsets and credits for carbon emissions. These mechanisms include Joint Implementation (JI), the Clean Development Mechanism (CDM), and international emissions trading. Thus far, trading involving sinks is only clearly permissible with respect to forest sinks. As part of the Conference of the Parties meeting in 2000, the overall carbon reducing potential of sinks will be discussed and further decisions may be made to define more precisely their role in an international trading regime.

The use of these mechanisms abroad will lower emission reduction costs significantly. A recent study by the Clinton Administration concluded that the cost of meeting the Kyoto targets range from \$14 to \$23 per ton if the US makes full use of the international trading authorized by Kyoto Protocol (Yellen, 1998). By contrast, if the US should be forced to reduce all of its Kyoto (or any other international treaty) obligations domestically, the marginal cost of meeting the Kyoto targets in this manner could be \$125 per ton (Nordhaus, 1998; Boyer, 1998). Another study suggested they could be as high as \$240 per ton of carbon by 2010 (Manne and Richels, 1998). Overall, if an international emissions trading regime is developed that allows full global participation, the Clinton administration estimates that the developed countries of the world together could save as much as \$109 billion per year among themselves.

Although the developing countries (Annex B) have thus far been skeptical of the Kyoto provisions for international trading, these countries in fact stand to benefit significantly from these provisions. Their skepticism revolves around questions of fairness and financial concerns. Most developing countries believe that the US, as the world's largest historical and current carbon emitter, should reduce emissions domestically rather than pay for reductions abroad. In

addition, developing countries have more important and pressing issues to worry about than future global climate change. If money is to be devoted to reduce the risk of climate change, the source of this money should be the developed countries.

However, developing nations are more likely to see an increase in financial flows, technology transfers, infrastructure development, promotion of economic growth, job creation, reductions in local pollution, and the conservation and expansion of wild areas and biodiversity if they participate in an emissions trading scheme. Many billions of dollars in foreign capital could flow from developed to developing nations as part of carbon trading. By one conservative estimate, developing nations would receive financial benefits that would exceed \$10 billion per year. Indeed, under some assumptions, an international carbon-trading regime could offer larger financial transfers to developing nations than have been available under traditional foreign aid programs (Ellerman et al., 1998).

Because forestry has been the focus of international sink discussion to date, this chapter and Chapter 7 will address mainly forestry. However, most of the discussion could apply equally to other international sink forms such as agricultural, biomass energy, and the sequestration of power plant emissions.

I. Worldwide Forest Sink Potential

Although U.S. forestry sinks tend to be cost-effective, they have a limited total magnitude of sequestration capacity as a result of land availability. On a worldwide scale, however, the sequestration capacity associated with forestry is immense. Table 5.1 provides carbon sequestration potentials and estimates of available lands for various regions and forest types around the world. The forest types included were chosen because of their expected high carbon sequestering capacity and probability of establishment, as well as data availability.

As shown in Table 5.1, there is much greater potential for carbon mitigation through forestry projects in regions outside of the United States and Western Europe. From these specific forest types alone, there is potential to sequester approximately 100 MMTCE per year in areas in Asia, Australia, and South America. The potential to sequester an additional 30.9 MMTCE per year exists in Russia. This analysis does not include potential from preventing deforestation in South American regions. At present, outside North America, forests are a large net emitter of carbon, due mostly to deforestation. Changes in land use, including deforestation and forest degradation in tropical areas, are believed to emit one to three billion tons of carbon per year (Trexler et al., 1996). Changes in land use patterns can reduce the emission of CO₂ and remove emitted CO₂. Such changes include both slowing and stopping deforestation and adding vegetative cover through reforestation. Some studies estimate that over 800 million hectares of unforested tropical land are capable of sustaining forest cover and are not currently in agricultural or other identifiable use (Trexler et al, 1996). An area of this size could potentially sequester 2,800 MMTCE per year (based on an average annual carbon uptake of 3.5 MMTCE per year). However, it is difficult to determine how much land is truly available for forestation. Many lands that appear to be abandoned or degraded might actually be used for grazing or other types of low-intensity agriculture.

Table 5.1 Worldwide Carbon Sequestration Potentials

Forest Type		Region/Country	1	2	3	4	5
1	Heavily logged evergreen rainforest	Southeast Asia	14 4	2.4 0	92	5.0	12.00
2	Selectively logged evergr. rainforest	Southeast Asia	20 7	2.8 5	10 2	2.0	5.70
3	Heavily logged semi-evergr. rainforest	Southeast Asia	76 7	1.0 7	76	5.0	5.35
4	Selectively logged semi-evergr. rainforest	Southeast Asia	15 1	2.0 3	98	2.0	4.06
5	Afforestation of wasteland Southeast Asia		12 1	1.6 9	67	30. 0	50.70
6	Logged rainforest hampered by lianas	Southeast Asia	12 5	0.7 9	92	20. 0	15.80
7	Norway spruce in central Europe	Central Europe	13 7	2.0 2	11 7	0.3	0.606
8	Mixed deciduous in central Europe	Central Europe	11 0	1.3 5	10 5	0.2	0.270
9	Douglas-fir in northwest USA	Northwest US	19 6	3.4 3	14 3	0.1	0.343
10	Norway spruce in boreal zone of Russia	Russia	53	1.0 3	13 9	30. 0	30.90
11	Poplar on former agricultural land	Europe	62	2.2 3	75	0.2	0.446
12	Black locust on former agricultural land	Europe	11 1	3.3 5	84	0.1	0.335
13	Radiata pine in N. Zealand and Australia	Australia/N. Zealand	12 6	4.5 4	97	0.3	1.362
14	Caribbean pine in Brazil and Venezuela	Brazil/Venezuela	89	5.1 2	90	0.5	2.56
15	Loblolly pine in southeast USA	Southeast US	59	3.2 1	81	0.2	0.642
16	Slash pine in Brazil	Brazil	11 1	3.8 8	80	0.3	1.164

- 1: Long-term average amount of carbon (after 300 years) in the living biomass and the forest products (stems, branches, foliage, roots, undergrowth and products) (MMTCE/ha).
- 2: Average Net annual carbon flux over the first rotation (MMTCE/ha/yr) (accumulation through photosynthesis minus decomposition of stable humus, litter, dead wood, logging slash and products). This is only valid for the first rotation as the net carbon flux tends to zero in the long term.
- 3: Long-term average amount of carbon (after 300 years) in the soil organic matter (i.e., litter, dead wood and stable soil humus) (MMTCE/ha).
- 4: Area technically suitable and socially available for this forest type, based on estimates by Winjum et al. (1992) after Howlett & Sargent (1991), Brown et al. (1992) & Birdsey (1990) (in millions of hectares).
- 5: Potential carbon sequestration based on Average Net annual carbon flux over the first rotation and the area technically suitable and socially available (MMTCE/yr). This figure is only valid over the first rotation period; in the long-run, carbon uptake slows as maximum carbon storage is achieved. Carbon is stored permanently, but reductions in yearly emissions declines.

*source: (Naaburs and Mohren, 1993)

The most common option for mitigating carbon in tropical regions is plantation forestry. Such projects are already in operation in tropical areas through foreign aid projects that have included broad reforestation initiatives. However, these efforts have been implemented on a small scale compared to rates of forest loss. Many of these projects have been failures for a variety of reasons. For example, some projects pay for the planting of seedlings but fail to involve local people in long-term management plans. Most projects expect results in too short of a time period. Remote projects have difficulty attracting a sufficient labor force. Pests and diseases pose problems for many forestry initiatives (particularly in monoculture plantations). The timeline for forest projects is often unrealistic, and government infrastructure in many countries is inadequate for taking on large-scale planting programs.

If projects could be carried out successfully, they would have great potential to mitigate atmospheric carbon. Organizations that have had the most successful projects employ an approach that emphasizes benefits to the local people first, with carbon sequestration as an ancillary benefit. They rely upon a wide variety of species, sustainably increasing biomass yields and land productivity through soil conservation techniques, conservation of biomass through establishing community forest-fire brigades, providing technical forestry extension services to farmers, and promoting long-term sustainability of projects through empowerment of local and national organizations.

Preventing Deforestation -- An opportunity with great potential for carbon mitigation is the prevention of deforestation the tropical areas. The World Resources Report estimates that the world is losing 25.4 million hectares of tropical forest annually. Deforestation on this scale releases one to three billion tons of carbon into the atmosphere per year (Trexler et al, 1996). If tropical forests should continue to disappear at this rate over the next 50 to 100 years, as much carbon would be released to the atmosphere as has been emitted by fossil fuels in the past 150 years.

Because of the magnitude of this threat, slowing tropical forest loss offers the largest forestry-based opportunity to slow the release of CO₂ into the atmosphere. A model designed by the Oak Ridge National Laboratory estimated that land use changes in sub-Saharan Africa could shift annual emissions of 169.4 million tons of carbon to a net sequestration of 189.2 million tons (Trexler et al, 1996). Forest protection efforts can contribute to rural development, promote ecological stability, and contribute to the conservation of biological diversity, all while slowing carbon releases (Trexler et al, 1996). There are numerous forestry opportunities in the tropics that can accomplish carbon sequestration while also serving other important objectives. Government policies can be changed to discourage deforestation, land tenure reforms can be instituted to give farmers long-term interest in preserving land productivity, protected areas can be designated, and sustainable agricultural practices can be adopted.

However, not all efforts to slow deforestation would necessarily slow carbon emissions. Closing off a forest area may simply drive local residents to find other means of satisfying their basic needs for forest products. Implementing sustainable agricultural practices should be more effective in slowing carbon emissions than simply closing off a forested area, but it is difficult to monitor the impacts of such practices, particularly when the resources are exploited by numerous local communities. It is also difficult to estimate each country's potential for controlling deforestation, because variables responsible for deforestation can be site-specific. Also, because

protecting forests often must be done indirectly, it may be difficult to calculate what benefit is obtained for the investment.

While these problems can pose significant obstacles, there are still many advantages to forestry initiatives in tropical areas. Deforestation leads not only to soil erosion but also to the erosion of many countries' overall natural resource base. Sustainable economic development can be furthered by efforts to address forestry problems in many tropical countries. If implemented with close attention to local interests, many of these projects can also be the lowest cost option, since many social, economic, and environmental interests can be advanced simultaneously.

Most forests in developing countries have a climate that is suitable for high tree and plant growth rates, resulting in faster carbon sequestration. Tropical forests, found mostly in developing countries, can sequester as much as 200 metric tons per hectare, and an average hectare of Amazonian rainforest contains 125 tons of carbon. The forest sector in developing countries alone is expected to be able to sequester approximately 60-90 MMTCE over the next 50 years with another low estimate at just 30 MMTCE by 2050 through plantations, agroforestry and assisted forest regeneration in the tropics (Butcher et al., 1998). By regions, another estimate puts the potential of the tropics at 59 MMTCE with tropical America sequestering 27 MMTCE, tropical Asia 20 MMTCE and tropical Africa 12 MMTCE (API, 1999). Yet these figures do not take account of all possible sources for sinks in developing countries and should be used as rough guidelines; future research may reveal the number is significantly greater or maybe not as great as hoped for if costs are too high.

Undertaking reforestation, conservation, and carbon sequestration projects in developing countries makes good economic sense because in addition to faster carbon uptake rates, these countries have lower opportunity costs of land. In addition, most of the land that would be targeted as sinks is either marginal, degraded, or inefficiently managed, and the plantation of trees and plants would help the land recuperate and become productive again, assuming monoculture plantations are not used. A healthier environment will also provide benefits to non-human species and will help protect biodiversity.

More research needs to be done on the costs of preventing deforestation. Furthermore, each situation will require a different set of policies, which will result in different costs. However, one study found that protecting against deforestation would be an inexpensive way to mitigate greenhouse emissions (Table 5.2). The costs of increased carbon sequestration in

Table 5.2: Cost of Protecting Forests

Country	Cost (\$ per MMTCE)
Brazil	2.3-4
Cote d'Ivoire	8
Indonesia	15
Thailand	0.4-0.8
Mexico	1-6
India	0.5
Central America	1-3
Russia	1-3

*Source: (Brown et al., 1995)

tropical forests are much lower than the costs of most other carbon reduction alternatives, in the United States and around the world.

The greatest constraint on carbon sequestration in developing countries is land availability. There are over 1.9 billion acres of land that have been cleared by human activities and up to 90 percent of this land is marginal or poorly managed. However, there is a finite amount of land that could be put to use as carbon sinks, especially since some land will be reserved for human activities. Other land will be set aside for non-human interests, and still other land will not be very efficient at sequestering carbon—along steep mountain slopes, for example. Furthermore, once all available land is utilized for carbon sequestration, it will have to be protected and monitored to prevent the carbon from leaking back into the atmosphere.

One country that presents a significant potential for establishing forest plantations is Mexico. It has about 45.5-49.0 million acres that are available and suitable for establishing forest plantations, and the cost of carbon sequestered is \$5-\$11 per ton for the establishment of the plantation and \$0.3-\$3 for its management, a figure that is much lower than comparable projects in the US.

If developed nations are allowed to offset their emissions through sinks in non-Annex B countries, money will flow to these countries as Annex B nations move toward lowering their costs of complying with the Kyoto Protocol. The money that flows to these participating developing countries will have other benefits besides carbon sequestration—less forest degradation, improvements in agriculture, increased local employment and a rising standard of living. For example, in the forest plantation estimate for Mexico, if we assume that Mexico will charge \$2-\$4 above the cost, they will receive money to cover the cost and management of the projects and will receive an additional amount as profit. Since the new prices, \$7-\$16, are still cheaper than in developed countries, it is still cost-effective.

More importantly, developing countries will have an incentive to expand carbon sinks in order to attract additional money and technology that they can use for their development—by improving land use patterns and preventing soil erosion, for example. This situation gives both parties a vested interest in ensuring that emission reductions are taking place, since both are receiving benefits. Thus, the global climate change problem will be addressed by lowering GHG emissions, and developing countries will be taking measures that aid their development.

II. International Carbon Trading

The Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) provides a means for developed countries to gain credit toward their emissions reductions through Joint Implementation (JI) and the Clean Development Mechanism (CDM). The concept of JI was formally adopted into the UNFCCC in 1992. JI involves arrangements between two or more countries in which projects are implemented that seek to reduce or sequester greenhouse gas (GHG) emissions. The projects offer potential for Annex I countries to reach their target reduction commitments through an offset, such as reducing GHGs in other countries rather than domestically. In 1995, the Conference of Parties to the UNFCCC established a five-year pilot phase for JI under the name of Activities Implemented Jointly (AIJ). During the pilot phase, projects in AIJ are voluntary, and countries will not receive credits for emission reductions or offsets. Initially, JI referred to projects in developed and developing countries, but the terminology changed slightly at Kyoto. JI now refers to activities undertaken

between Annex I (now called Annex B) countries, which are primarily industrialized countries and countries with economies in transition (e.g., Russia).

Kyoto established a new institutional mechanism for carbon trading—the CDM. This mechanism refers to projects in which developed (Annex B) countries reduce emissions or sequester carbon through projects in developing countries (or non-Annex B). The primary purpose of CDM, according to Article 12 of the Kyoto Protocol, is to help developing countries achieve sustainable development while allowing developed countries to meet their reduction commitments.

Carbon sequestration projects are included in the accepted activities for climate change mitigation, although the role of carbon sinks in emissions trading, JI, and CDM was not central to Kyoto negotiations. For JI, the acceptable sink activities are specified as “afforestation, reforestation, and deforestation” (Witthoeft-Muehlmann, 1998). It is uncertain whether sinks involving changes in forest management and in agricultural practices will be allowed to apply in obtaining emission reduction credits (Sedjo, 1998). The discussion of sinks occurs mostly in the context of JI, and it is not clear whether activities involving carbon sinks are applicable to CDM and emissions trading. The Intergovernmental Panel on Climate Change (IPCC) is currently working on a report, due in 2000, about land use change and forestry activities.

Despite the questions associated with sinks, many carbon sequestration projects, including activities not defined in Kyoto, are underway via AIJ. Carbon sequestration projects under AIJ are in developing countries or countries with economies in transition and not in industrialized countries, thus introducing an important linkage to CDM (Witthoeft-Muehlmann, 1998). Some examples of carbon sequestration projects are forest preservation, sustainable forestry management, agroforestry, reforestation and afforestation. Several countries and agencies, such as the United States, the Netherlands, Norway and the World Bank, have created programs to implement and evaluate projects during the pilot phase (Table 5.3).

Private industry and other entities have had various incentives to participate. Some are interested in protecting and improving the environment (e.g., non-profit environmental organizations such as The Nature Conservancy), while others are interested in the public relations aspect while positioning themselves for possible credit when the pilot phase is over (e.g., utility companies). Still others are looking to establish markets for their products in the host countries.

III. The USIJI Pilot Projects and Other AIJ Programs

To assess approaches to developing joint implementation projects, the US established its own pilot program, the US Initiative on Joint Implementation (USIJI) in 1994. As of March 1998, this program, which encourages US organizations and firms to invest in CO₂-abatement projects in countries outside the US, had reviewed proposals for 97 different projects and accepted 32 of them. According to USIJI estimates, these approved projects, if fully funded and implemented, will result in net emissions reductions of about 200 MMTCE of CO₂ (GAO, 1998).

Of the 32 pilot projects accepted to date, 12 involve sequestering CO₂ through terrestrial sinks, by promoting afforestation or reforestation or protecting forests that would have otherwise been harvested. The inclusion of sequestration projects in a future Joint Implementation program

“depends on their ability to deliver verifiable carbon benefits.” International acceptance will be contingent upon their credibility in bringing about promised benefits.

Table 5.3 shows a partial list of current forest projects under the AIJ program (a more complete list is shown in the Appendix). Cumulatively, the projects in Table 5.3 offer the possibility of sequestering 13.59 to 27.42 MMTC of carbon. Their greatest significance, however, does not lie in the actual amounts of carbon sequestered but in the lessons learned for

Table 5.3 Partial List of Activities Implemented Jointly under Pilot Phase

Project Type	Project Title	AIJ Pilot Phase Program	Countries and/or Parties Involved	Life of project (years)	Emission Reductions (in MMTCE)
Afforestation	CARFIX: Stabilize Existing and Expand Forest Cover	U.S. Initiative on Joint Implementation (USIJI)	US and Costa Rica; Wachovia Timberland., FUNDECOR	25	0.55
Afforestation	RUSAFOR: Saratov Afforestation Project	USIJI	US and Russian Federation; EPA, EDF, Oregon State Univ., Russian Fed. Forest Service	40	0.08
Agroforestry, Reforestation	CARE/Guatemala	(prior to USIJI)	US and Guatemala; Allied Energy Services; WRI, CARE	40	4.2 – 15.8
Forest Preservation	ECOLAND: Piedras Blancas National Park	USIJI	US and Costa Rica; Tenaska Inc., Nat. Fish and Wildlife Foundation	16	0.37
Forest Preservation	Reforestation and Forest Conservation	Norway – Ministry of Foreign Affairs AIJ Program	Norway and Costa Rica;	25	0.23
Forest Restoration	BIODIVERSIFIX	USIJI	US and Costa Rica, Guanacaste Conservation Area, TNC	51	5.04
Forest Preservation	Reduced Impact Logging for C Sequestration in East Kalimantan	USIJI	US and Indonesia:	40	0.06
Reforestation	Forest Rehabilitation in Krkonose & Sumava National Parks	FACE (Netherlands AIJ Program)	Netherlands and Czech Republic	15	0.44 – 2.67
Reforestation	PROFAFOR	FACE	Netherlands and Ecuador; INEFAN, Ecuador Forestry Service	?	2.62

*sources: (SBSTA, 1998; WRI, 1999; USIJI, 1999).

future sequestration efforts, including trading in carbon sinks. If the immense world potential of sinks is to be realized, an institutional structure will have to be put in place to serve this purpose. The experiences with current projects are showing the key issues to address, as well as providing a forum for working out solutions to problems.

Selected Case Studies -- Most of the current carbon sequestration projects are taking place in developing countries, so the context for examination will be the CDM. Two exceptions are projects in Russia and the Czech Republic, which by virtue of being considered economies in transition, would be included under JI. The case studies used are Face Foundation's project in Czech Republic and USIJI projects in Costa Rica and Russia. A project in Guatemala that occurred prior to USIJI is briefly examined as well.

CARE/Guatemala Agroforestry Project -- The project was proposed and implemented by CARE, the international development and relief organization, with the support of the U.S. Peace Corps, U.S. Agency for International Development, the Guatemalan Directorate General of Forests, and World Resources Institute (WRI). The idea of using forestry projects for carbon offsets was conceived in the late 1980s when Allied Energy Services (AES), a utility company, wanted to find a way to offset its carbon dioxide emissions of a plant in Connecticut. The project resulted in the first forestry project funded explicitly to offset GHG emissions (WRI, 1999a).

Originally started in the 1970s by CARE, the project lost funding in 1989, which prompted CARE to send a proposal to WRI to use money from AES. The CARE/Guatemala project emphasized tree planting in agroforestry and woodlot applications. The project included planting 12,000 hectares of community woodlots, and implementing 60,000 hectares of agricultural land for fuelwood, fodder, soil nitrogen fixation, and fruit and nut production. In addition, the project included building terraces to protect 2,000 hectares of vulnerable slopes and training a community forest fire brigade to protect the newly planted trees and natural forests (WRI, 1999a).

Face Foundation in Krkonose and Sumava National Parks, Czech Republic -- Face (which stands for "Forests Absorbing Carbon dioxide Emissions") aims to sequester some of the carbon dioxide emitted by burning fossil fuels in Dutch power plants. The Face Foundation focuses on planting and preserving forests and has projects in Malaysia, Ecuador, Uganda, Czech Republic, and a project in preparation in Indonesia (Face Foundation, 1999a).

In the Face Foundation's project in the Czech Republic, the purpose is to rehabilitate the forests in Krkonose and Sumava National Parks. As a result of the increases in acid rain from 1950-1990, these forests have died or become moribund. The Face Foundation is replanting trees using a mixture mainly consisting of Norway spruce, beech and mountain ash. In Krkonose National Park, a total of 9,000 hectares is planned for restoration. In the Sumava National Park, reforestation will be on a total of 5,000 hectares, but the first phase involves planting 1,200 hectares (Face Foundation, 1999b).

USIJI in Piedras Blancas National Park, Costa Rica -- ECOLAND stands for “The Esquinas Carbon Offset Land Purchase Initiative” and was an early USIJI pilot forest preservation project to purchase private lands. The project proposed to purchase 2,000 to 3,200 hectares of the 12,500 previously privately owned hectares in the Piedras Blancas National Park. A consortium of organizations with a broker, Trexler and Associates, Inc., initiated ECOLAND. Funding was provided by Tenaska Inc., a U.S. utility company, several non-governmental organizations in the United States and Costa Rica, and the OSA Conservation Area, the Costa Rican governmental organization responsible for eventual management of the area (Chacon, 1998).

According to the developers, ECOLAND was designed to protect the carbon storage and sequestration capacity of Piedras Blancas National Park. The project was intended to protect land that was threatened by deforestation. The purchased land is considered one of the most biologically important protected areas in Costa Rica. It is an integral part of a vital humid forest on the Pacific side of Central America and part of a proposed trans-isthmus biological corridor (Chacon, 1998).

USIJI in Saratov, Russia -- The RUSAFOR project is another early USIJI project and was sponsored by the U.S. Environmental Protection Agency, Oregon State University, the Environmental Defense Fund, the Russian Federal Forest Service and the International Forestry Institute. The project plans to afforest three sites totaling 500 hectares in Saratov, Russia. One site is a burned forest stand, and the other two are areas that are considered agricultural wasteland (USIJI, 1999b; Brown, et. al.). The project has several objectives, including assessing the value of forest management projects as options for GHG mitigation (WRI, 1999a). Also, the RUSAFOR afforestation project includes agreements that timber may be harvested for applications wherein the timber will be preserved for 100 or more years (USIJI, 1999b).

USIJI in Guanacaste Conservation Area, Costa Rica -- The BIODIVERSIFIX project is a USIJI forest project located in the Guanacaste Conservation Area in Costa Rica. The project will regenerate tropical dry forest and tropical wet forest for sustainable use without damaging biodiversity. BIODIVERSIFIX also proposes to purchase private lands located in the national parks in the Guanacaste Conservation Area in order to promote ecotourism, biodiversity prospecting and limited sustainable forestry practices (Chacon, 1998).

The Guanacaste Conservation Area encompasses 120,000 hectares that include dry forest near the coast and humid forests inland. Consequently, the BIODIVERSIFIX project is comprised of two subprojects: DRYFIX and WETFIX (Chacon, 1998). DRYFIX will restore 45,000 hectares of abandoned or marginal pasture within an 80,000-hectare dry forest. During the same time, WETFIX will restore 13,500 hectares of abandoned or marginal pasture that is within a 40,000 hectare wet forest (USIJI, 1999c).

IV. Conclusion

International carbon sinks offer an enormous potential to store carbon at a lower cost than domestic reductions in energy consumption or domestic sequestration methods. While it is important to note that the US has to begin to scale back its energy consumption

in the near-future, it is also true that carbon reductions abroad must be pursued as yet another policy tool in the fight against global climate change.

The US should vigorously lobby for future global climate change protocols to explicitly allow and expand the use of credits abroad, and to allow carbon sequestration projects taken by the US in other countries to be counted as emissions reductions agreed to under the Kyoto Protocol. Reductions abroad seem to be significantly cheaper than domestic reductions; some studies estimate that the savings could be as high as \$125 per ton of carbon reduced if international participation of developing countries is allowed. In addition, the faster tree growth rates and larger physical land available in developing countries--most of which are located along the equator and in warmer, tropical climates--especially in the forest and agricultural sectors, will allow a greater amount of carbon to be sequestered than could ever be done exclusively through domestic measures.

However, developing countries must be willing to work together with the US, and vice-versa, in order to establish projects that will sequester carbon and allow the US to claim these reductions under its Kyoto commitments. The benefits that developing countries will receive primarily include financial and technological transfers but also extend into the areas of deforestation prevention, increases in biodiversity and more sustainable land-use practices. These benefits will almost certainly make their economic development faster and more sustainable in the long-term. For example, an international trading regime is expected to produce over \$100 billion, almost all of which will be received by developing countries from sales of carbon permits to developed nations, including the US. These financial rewards will give a further incentive to developing countries to use their newly acquired technology and financial resources to become efficient energy consumers since they will be able to sell excess permits to developed countries and gain additional resources.

The primary mechanisms to be used in international carbon sequestration efforts are Joint Implementation (JI), the Clean Development Mechanism (CDM) and an international trading regime. These mechanisms appear to work in theory and in practice, and must be further pursued and used to the fullest extent possible. While these three mechanisms offer the advantage of carbon sequestration at a relatively low cost, there are problems that must be addressed. These include the initial baseline determination, monitoring, enforcement, and leakage as well as the vulnerability of monoculture tree plantations to disease, the protection of native plant and animal species and the need to eventually move away from using non-renewable fossil fuels as our primary energy source.

In order to fully discover the realistic worldwide capacity for carbon sequestration, more research must be done to determine exactly how much it will cost, the benefits and costs it may have on humans and the environment, and how much time this policy tool will give us to adapt to the effects of global climate change. Only then will we be able to find out the true costs and the true potential that carbon sinks offer to reduce the chances of severely and permanently altering the earth's climate. The AIJ pilot projects, once fully implemented and evaluated, will provide valuable guidance for the establishment of an effective worldwide framework for implementation.

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Appendix 5: USIJI Pilot Carbon Sequestration Projects

Location	Carbon Sequestration Projects
Central America	7
Central and Eastern Europe	2
South America	2
Asia	1
TOTAL	12

COUNTRY	PROJECT TITLE	PARTNERS	NOTES
Belize	Rio Bravo Carbon Sequestration Project	Wisconsin Electric Power Co (WEPCO) Detroit Edison Corp. PacifiCorp The Nature Conservancy (TNC) Program for Belize (PFB)	USIJI 1st Round Pilot
Costa Rica	CARFIX	FUNDECOR Wachovia Timberland Investment Costa Rican Ministry of Nat. Res.	USIJI 1st Round Pilot
Costa Rica	Ecoland: Piedras Blancas National Park	Tenaska, Inc.	USIJI 1st Round Pilot
Russia	RUSAFOR-SAP The Russia/USA Forestry and Climate Change Project - Saratov Afforestation Project	Coordinated through EPA Implemented by: Environmental Defense Fund (EDF) Oregon State University (OSU) Saratov Forest Management District Russian Federal Forest Service (SFMD)	USIJI 1st Round Pilot
Costa Rica	The Klinki Forestry Project	Newton Treviso Corporation Cantonal Agricultural Ctr. of Turrialba	USIJI 2 nd Round Pilot
Costa Rica	BIODIVERSIFIX Forest Restoration Project	The Nature Conservancy (TNC) Guanacaste Conservation Area National Institute of Biodiversity	USIJI 2 nd Round Pilot
Bolivia	Noel Kempff M. Climate Action Project	American Electric Power System (AEP) Fundacion Amigos de la Naturaleza (FAN) The Nature Conservancy (TNC)	USIJI 3 rd Round Pilot
Ecuador	Bilsa Reserve Forest Conservation	World Parks Endowment	USIJI 3 rd Round Pilot

Indonesia	Carbon Sequestration through Reduced Impact Logging	COPEC American Forests Assoc. of Indonesian Forest Concession Holders (APHI) The Center for Int'l Forestry Research	USIJI 3 rd Round Pilot
Panama	Reforestation of Chiriqui Province	CAOBO, Inc. Center for Clean Air Policy	USIJI 3 rd Round Pilot
Russia	Reforestation in Vologda	Center for Environmental Economics Alice LeBlanc Vologda Region Dept. of Nat. Resources	USIJI 3 rd Round Pilot
Costa Rica	Carbon Sequestration through Costa Rican Territorial & Financial Consolidation of Biological Reserves	Earth Council Foundation Costa Rican Ministry of Envir. & Energy Costa Rican Nat'l Parks Foundation	USIJI 4 th Round Pilot

*Source: (USIJI, 1999)