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Global Trade for Local Benefit: Financing Energy for All in Costa Rica

by

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Introduction

First movers often have an advantage. Yet in the environment area, we now see that latecomers, too, can sometimes enjoy an advantage.

To illustrate this counter-intuitive proposition, we look at one of Costa Rica's domestic policy concerns, viz. clean and sustainable electricity for all, through the lens of global public goods (GPG). For people and policy-makers in Costa Rica this lens easily suggests itself. Like other Central American countries, Costa Rica is acutely aware of the risks that global warming would entail for the region. Many interpreted the recent experiences with El Niño as serious warning signs. Costa Rica is rich in natural resources, such as forests, which now appear to becoming a globally sought after commodity. But Costa Rica, again like many other countries, also does not want to pursue its national economic growth and development at the expense of the global public good "atmosphere". Encouraging economic growth and poverty reduction, and to this end, electricity for all, can only be achieved as a dual goal: by reaching the foregoing goals through the provision of electricity for all that comes from renewable and non-polluting energy sources.

Section I of the paper[1] will present the policy challenge of providing electricity for all, especially for the rural poor, still "off-the-grid". The use of solar energy is one policy option. But national financial resources alone would not suffice to realize this objective. Therefore, section II will review possible offsetting arrangements with industrial countries as one of the most promising financing options for electricity expansion in Costa Rica. The third section will discuss the implications and the possibility of going beyond bilateral trading arrangements between Costa Rica and developed countries and participating in an eventually global system of emissions trading in order to promote a more reliable long term financing situation. The paper will conclude by considering steps that could lead in this direction.

Three main points emerge from the analysis in this chapter:

- Global climate stability matters to people's life in Costa Rica. It is an important local public-policy concern with global dimensions.

- Costa Rica's people and policy-makers are, in a way, "fortunate" to face a dual challenge: to provide electricity for all and to know that they have to accomplish that in a way that is environmentally sound lest Costa Rica contribute to the very problem about, which it is concerned, viz. global climate change. This is a fortunate challenge, because it creates the incentive structure for giving preference to the globally more sustainable route.

- But Costa Rica also benefits from its being a latecomer in fossil-fuel consumption and energy efficiency. Its "lagging" position in these two respects now allows it to be among

[1] This paper is based on a more extensive and detailed contribution by Castro and Cordero (forthcoming).

some of the first movers in carbon trading. But carbon trading is only an option because global climate stability and a clean atmosphere are GPGs that follow a summation production process: All actors, public and private, will have to cooperate in order for the good to emerge. This creates the demand for the now more highly natural resources and environmental services that Costa Rica has to offer.

The following sections will elaborate these points in more detail.

I. The dual challenge: providing clean electricity for all in a globally sustainable way

Poverty and lack of electricity are often positively correlated. Access to energy increases and diversifies the choices and economic opportunities of the poor (UNDP 2000; UNDP, UNDESA and World Energy Council 2000). In Costa Rica, as in many other developing countries, providing electricity to every household is an important policy priority. Usually, policy-makers have a choice between different energy sources: traditional fossil fuels (i.e. oil, natural gas and coal) or renewable energy sources (i.e. biomass, geothermal, hydropower, solar or wind). The former produce energy services with air pollutants potentially affecting the health of local communities and with green house gases (GHGs) affecting global climate stability. The latter produce energy services free of air pollutants and GHGs.

The choice of using either source must be context-specific. It depends on natural endowments, access to relevant technology, economic and political considerations.

Costa Rica’s dependency on fossil fuels for electricity generation has remained below 10% since the 1970s (ECLAC 2001, p. 700). This figure reflects Costa Rica's preference for hydropower over fossil fuels (with, which it is not richly endowed). Hydropower now makes up 85% of the country's sources of energy for electricity (op. cit.).

So far, however, some six percent of the population, or 50,000 families, lack access to electricity. These "off-the-grid" rural households usually have low energy needs and live in isolated and geographically dispersed settlements. Extending the grid is seven times more costly than in urban areas (World Bank 1996). The provision of decentralized clean energy power systems would, thus, be an appropriate solution.

Broad consensus has emerged among experts that the development of renewable energy technologies has reached a stage where their application in developing countries is increasingly feasible, at least technically (UNDP, UNDESA and World Energy Council 2001, pp. 219-272; World bank 2000). For example, photovoltaic solar power (PV) systems, which convert the sunlight into electricity, have been adapted for situations of low and varying demand. Moreover, Anderson (1997) says that for low and moderate energy loads in areas with good solar exposition — such as most of Costa Rica's rural areas — the cost of photovoltaic systems with short-term battery storage might even be lower than those of grid supplies.

Hence, photovoltaic power seems to be one of the promising energy options for Costa Rica to pursue.

Moreover, Costa Rica has already gained locally relevant experience with solar energy through various pilot schemes. Based on data generated by such pilots, it has been estimated that a 120 kilowatts (kw) photovoltaic panel can meet the basic needs of one rural family.[2] Considering Central America as a whole, Castro, Cordero and Gomez-Ibanez (2001) suggest that an investment of US$120 million would be needed to provide electricity services to about 100,000 households. This means, that the cost to be incurred by Costa Rica to provide solar electricity to its 5% off-the-grid households would be roughly in the range of US$ 60 million.

But how much are Costa Rican rural households able and willing to pay for solar power?

One way of answering this question is to analyze the potential users' willingness to pay. Willingness-to-pay surveys[3] conducted in Costa Rica found that off-grid rural people could apparently afford to pay between US$16 and US$2 a month (including all the equipment and installation costs of PVs) (Castro, Cordero and Gomez-Ibanez 2001). Butonly 10% of the off-the-grid people were willing to pay up to US$16, and 50% up to US$3 (op. cit.). Though only rough indications, these figures, nevertheless, reveal that most off-the-grid households could not afford solar technology that requires US$ 1,200 per household.

So, what other possible financing mechanism could be considered?

Complementary finance could include: 1) subsidizing capital costs nationally, 2) improving financial terms by extending credit to potential users, and 3) mobilizing external financial and technical assistance. . Yet, Costa Rica's policy experience with indirect subsidies to industries generating power from renewable resources has not been very successful. In addition, improving the terms of available financing for photovoltaic systems is restricted by the low credit access for rural Costa Ricans. The third financing option is already in use, e.g. through support that Costa Rica gets from the Global Environmental Facility (GEF) for the Plantas Eólicas project in Tejona.

The GEF was created to pay for the incremental costs of projects with global environmental benefits undertaken by developing countries, i.e. “the additional costs associated with transforming a project with national benefits into one with global environmental benefits”[4]. GEF is important for developing countries to afford the often-considerable up-front investment costs involved in switching toward more environmentally sound economic activities. But it is not an appropriate instrument for providing longer-term incentives, notably the type of subsidies that would be required to bring photovoltaic energy to the poor in Costa

[2] With an estimated cost of US$1,200 per unit, this system supplies four hours of lighting (with two high-efficiency 15watts bulbs), three hours of a 10 watts radio, and one hour of an 80 watts black and white TV per day (World Bank 2000, p. 87). On average, it produces 0.35 kwh per day, or 10.5 kwh per month (with a 3.5h effective daily use).

[3]The surveys were conducted by the Costa Rican public opinion surveys and market research company “CID Gallup” between November 2000 and February 2001. The authors conducted personal interviews among rural off-grid people (nation-wide). A 405 stratified random sample was estimated, with a standard error of ± 4.8%.

[4]For the complete definition, please refer to the GEF website:
http://www.gefweb.org/Operational_Policies/Eligibility_Criteria/Incremental_Costs/incremental_costs.html

Rica. GEF is working on an ad hoc, project-by-project basis and with very limited, unpredictable resource levels, which depend on voluntary contributions. This is no sound basis on which to build a longer-term energy and electricity policy.

II Selling environmental services as a contribution to climate stability

A more reliable financing option may, in effect, present itself as a result of the growing global concern about climate change. It has generated new demand for environmental services, which Costa Rica is well endowed to supply efficiently.

II.1. The international regime to curb global warming

For two decades scientists have alerted the international community to the risk of global warming. The most recent findings of the Intergovernmental Panel on Climate Change (IPCC) now confirm that emissions of GHGs caused by human activities "continue to alter the atmosphere in ways that are expected to affect the climate" (IPCC 2001, p. 3) and that 75% of the emissions of CO_2 (the main GHG) are due to the burning of fossil fuels and 25% to deforestation (op. cit., p. 4).

In 1992, the international community adopted the United Nations Framework Convention on Climate Change (UNFCCC). It urges countries to cut their emissions of GHGs. This goal was turned into a binding commitment with the adoption of the Kyoto Protocol in 1997. The Protocol requires Annex 1 countries (i.e. industrial countries and most of the transition economies) to cut their GHG emissions to an average of 5.2% from their 1990 emissions level. These targets are to be reached during the 2008-2012 commitment period and sustained through the year 2012. Under the Protocol, developing countries did not commit to specific reduction targets because Annex 1 countries took the lead as they had the main responsibility for past emissions.

Many Annex I countries are not only in the "high polluter" group but they also operate at high levels of energy efficiency. This is why for many of them it will be costly to achieve emission reductions at home. Many developing countries, Costa Rica included, operate at lower levels of energy consumption and energy efficiency. As a result, the current climate regime offers not only an incentive to cut emissions but also gives an advantage to some developing countries, as latecomers in energy consumption: They now can offer corrective, off-setting arrangements to industrial countries. Under the Kyoto Protocol, this advantage can be transformed into financial or development benefits through the 'flexibility mechanisms'. Three such mechanisms are foreseen: joint implementation (Article 6), emissions trading (Article 17) and the clean development mechanism (CDM) (Article 12). The first two concern trade among Annex 1 countries. The last one is to "assist Parties not included in Annex 1 in achieving sustainable development and in contributing to the ultimate objective of the Convention, and to assist Parties included in Annex 1 in achieving compliance with their quantified emission limitation and reduction commitments […]" (Article 12, para. 2). In other words, the CDM is a mechanism through which industrial countries can earn emissions credits when they invest in emission-reduction projects located in developing countries.

However, to enter into force, the Kyoto Protocol must be ratified by 55 countries, including Annex 1 countries representing at least 55% of the global emissions for 1990. As of 26 September 2001, 84 countries have signed the Protocol and 40, including only one Annex 1 country, have ratified it. Even though the global regime for climate stability is not yet effective the mounting global concern and the prospect of a treaty have led to many pilot initiatives for carbon emission trading. Costa Rica hosts one of them.

II.2. The Costa Rican national carbon trading system

Under the present international regime for climate change, developing countries are not committed to cut their GHG emissions because of their historically modest contributions to this global public bad. But they are encouraged to limit the growth of their emissions. This incentive reflects the summation process of the production function of the global public good at stake. In other words, each single effort to cut GHG emissions is a step —even if a modest one— to curb global warming. This incentive also reflects the equitable feature of the regime, i.e. countries have common but differentiated responsibilities in the provision of the global public bad thus there is not, yet, binding targets for developing countries. In this context, some developing countries have taken initiatives to explore the value of their assets and the services they could offer. Indeed, three different types of services matter in the context of climate change: improving energy efficiency (using less fossil fuel to produce the same power), switching to less carbon-intensive fuels (developing clean energy) and sequestrating carbon released in the atmosphere (promoting forests and controlling land uses and changes). Originally Costa Rica's pilot project was aimed at promoting forests.

Costa Rica has been one of the first developing countries to start a carbon emissions trading program through bilateral contracts selling carbon sequestration services to developed countries. The development of its emissions credit program has gone through three stages. In the first stage (1994 to 1995), the government tried to facilitate trades between individual landowners in Costa Rica and foreign governments or corporations. The purpose of this first phase was to compensate farmers or landowners for any income loss they experienced as a result either of 1/ adopting land use programs releasing fewer GHGs or 2/ adopting logging methods that better preserve the carbon sequestration potential of forest covers. The concerned authorities soon realized that it would be more efficient to bundle and consolidate individual emissions reduction initiatives: Negotiating one deal for a smaller reforestation initiative was almost as costly — such as for translators, lawyers, air tickets and the like — as doing the same for several consolidated initiatives.

The first stage clearly revealed the need to think about — and reduce — transaction costs to allow carbon emissions trading to be a viable, and even, profitable option.

In the second stage (1995 to 1997), the Ministry of Environment and Energy assumed the responsibility for consolidating small projects and offering them for sale. This effort resulted in the first-ever sale of an emission credit based on reforestation. Two hundred and thirty eight individual reforestation initiatives, many bordering the Wildlife Conservation Areas (WCAs), were consolidated to offer a credit for 200,000 tons of carbon for 20 years. This credit was sold to the Norwegian Government in 1996 for US$10 a ton. This price reflected the

expected payments to cattle ranchers to induce them to convert their ranches into plantation forests. Despite the success of the transaction, the Inspector General, the head of a Government watchdog agency, soon criticized the Ministry for having sold the credits at mere cost. It was queried why the Ministry had not asked for a higher price and obtained a better bargain.

Thus, the second phase raised the complex issue of how precisely to determine the price of a commodity not yet valued in a proper market.

In the third phase (1997 to 1998), the Ministry decided to address the Inspector General's concerns by auctioning credits to the highest bidder. This time it assembled enough projects to sequester 1,000,000 tons of carbon and offered them at a floor price of US$20 a ton. Although several governments and multi-national firms expressed interest in the auction, in the end there were no bidders. When consulted, some bidders privately told the Minister that the floor price had been too high. In March 1998, to help address the additionality question, the Ministry hired a French technical certification firm to audit the project and attest that the reforestation would take place as promised.[5] Nevertheless, the Ministry delayed offering the credits for auction again until after national elections that were scheduled for later that year.

Hence, the third phase generated a further lesson: It highlighted the concern of buyers for *ex post* compliance with *ex ante* commitments by the seller.

The incoming new President, Miguel Angel Rodriguez, singled out emission-credit trading as one of the few of his predecessor's programs that he intended to retain. One reason for this may be that President Rodriguez holds a doctorate in economics, which may have made him sympathetic to the rationale for and potential of such a scheme. In addition, environmental protection was always popular in Costa Rica, and the President's party had won in part by appealing to voters in rural areas who could potentially benefit from the environmental trading scheme.

The pilot project thus generated several lessons, which are typical of creating a new market. They pointed to the challenge of defining precisely the commodity on offer, clarifying and allocating property rights, and instituting monitoring and compliance mechanisms. In the next part of the paper we will show how these issues have in the meantime been addressed and could be approached even more systematically in the future.

III. Creating a new market for environment and development services

Following the pilot forest project, bilateral agreements were developed for clean energy offsetting arrangements. In April 2001, Costa Rica sold 260,000 tons of emission reductions at US$20.80 a ton from reducing the use of fossil fuels with a wind power plant. Along the same lines, the development of photovoltaic decentralized systems for the poor in the rural areas could be financed through emission credits sold to industrialized countries wanting to meet their global commitments. Would the price of carbon be enough to finance the provision of electricity to the 6% of the population off the grid? What rules of the game need to be defined

[5] The firm is Société Générale de Surveillance Group which had established a special Forestry Offset Carbon Verification Service.

at the local, national and international levels to transform the current context into a win-win situation where emissions are cut and the poor have access to electricity in the long run?

III.1. What is the right price of carbon for offsetting arrangements?

In July 1999, the World Bank Prototype Carbon Fund announced a price range of US$20 to US$30 a ton of carbon. Other studies conducted in the United States (US) say that the appropriate price for carbon sequestration services should be US$ 20 a ton (see Exhibit 1). The lack of consensus on the pricing calls for additional specific investigation on the valuation of sequestration and other environmental services offeredby developing countries.

In an attempt to fill this gap, Castro (1999) analyzed the implications of different price scenarios on forest conservation and agriculture in Costa Rica. The study confirmed two things: 1) Landowners would respond positively, i.e. with expanding supply, to rising carbon prices. 2) Costa Rica could supply carbon sequestration services more efficiently than domestic suppliers in industrial countries could. The study thus demonstrated that Costa Rica has a comparative advantage in selling carbon sequestration services and that, if there exits a solvable demand, trading these services internationally makes everybody better off.

Castro's study also suggests that carbon emissions trading would have a beneficial impact on biodiversity and fragile ecosystems protection. For example, prices for a ton of carbon closer to US$100, 25% of the national territory could be maintained as a protected area.

If Costa Rican landowners were adequately paid for carbon sequestration, many of them might switch from crops to planting forests. The forest projects would probably first replace traditional activities such as raising cattle and rice, which need considerable land extensions. Forests would less likely replace the more profitable export-oriented crops such as coffee, bananas, and pineapples. For example, Castro found that if the carbon price were at least US$83 a ton, a farmer now producing — or having the potential to produce — the average agricultural mix for Costa Rica might then switch to a pine plantation (*Pinus patula)*.

Carbon sequestration payments might also induce landowners to protect their natural forests outside the protected areas. For example, if a hypothetical private owner of natural forest were considering whether to preserve the natural forest or to use it to raise beef cattle or rice, he would find that preserving the natural forest is a more profitable option if the price were US$20 a ton (see Exhibit 2). Yet if that same owner had natural forestland suitable for growing export-oriented crops, he might well use it for those crops unless the carbon price were to exceed US$100 a ton.

The findings of the Castro study thus suggest to reassess Costa Rica's natural endowments anew — through the lens of the GPG "climate stability" now of growing concern — and against the backdrop of the interest of many high polluters in global emissions trading. Such a reassessment would, of course, have to impartially discuss all pros and cons. Sometimes, if forest projects replace subsistence agricultural activities, there is an obvious trade-off between food security and environmental services such as climate change mitigation. Environmental considerations might interfere against poverty alleviation in this case. The issue

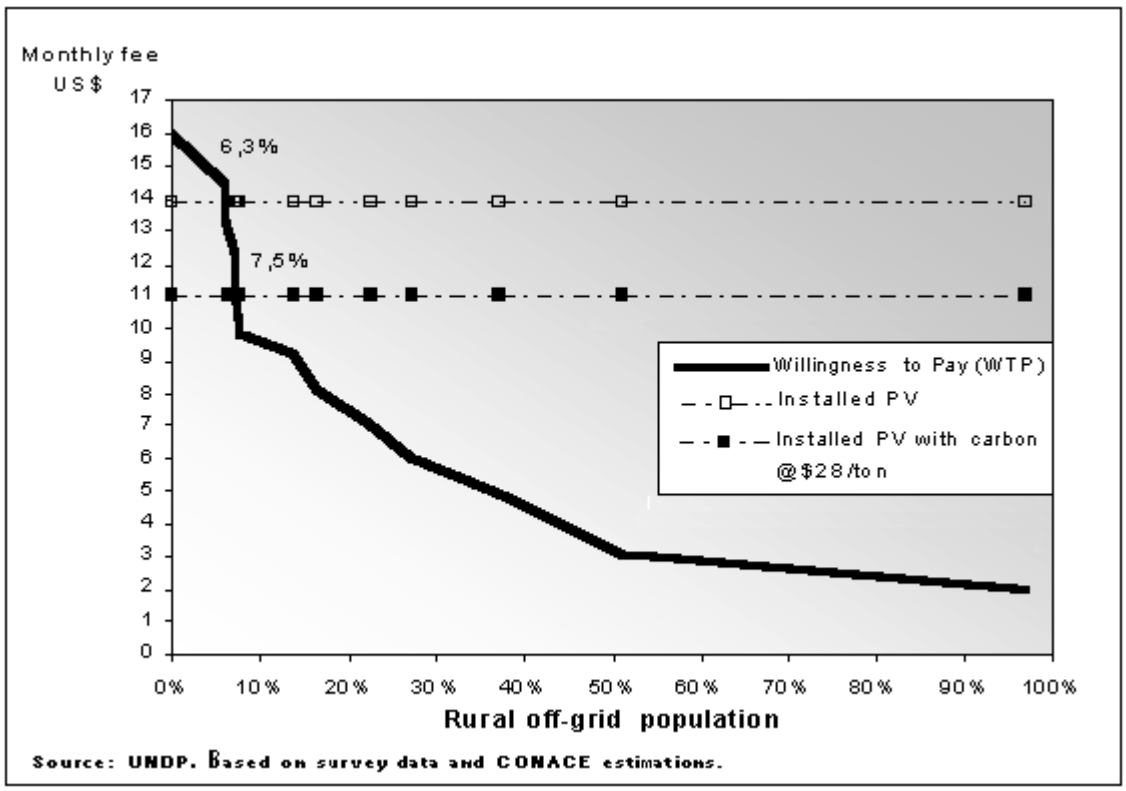
of balancing local/global, public/private benefits, addressed in the case study on biodiversity by Perring and Gadgil in this volume, also applies here.

To recap, Costa Rica can benefit from its natural resources endowments to sell carbon sequestration services. The price defined in the trading arrangement with buyers will define the benefits. A price of US$ 20 the ton of carbon would already be an incentive for local actors to protect forests. A price of US$ 100 would bring additional positive global externalities — viz. biodiversity preservation — and local benefits — i.e. the local services offered by ecosystems. Yet to get it "right", a lot of balancing would be called for between private and local and global public interests and private and public interests of different types.

In the same vein, access to photovoltaic systems could be subsidized by the emission credits that they generate for the international community. Then, if the CO_2 emissions avoided with the installation of 1,900[6] PV-systems were traded at a price of US$28 per carbon ton, it could be possible to finance 20% of the user monthly cost (US$3) (Figure 1).

[6] The Costa Rican Commission in charge of rural electrification estimated that 1,900 out of 50,000 rural off-the-grid families can be efficiently supplied by PV systems only.

Figure 1
The willingness to pay for electricity of households in Costa Rica



These credits could be, as in the Costa Rican pilot forest project, bought through bilateral arrangements with developed countries or in an international market for carbon emissions.

III.2. Making the carbon market global

In the previous sections we have shown how creating new markets for environmental services (carbon sequestration or clean energy) could help pay for access to electricity for off the grid rural poor in Costa Rica. The issue of price for the traded commodities addressed earlier did not encompass the variety of alternatives that exist for market-based instruments to achieve this theoretically win-win situation. We have mentioned the bilateral arrangements of the pilot project but how can they be systematized within the currently built international regime using the flexibility mechanisms?

As mentioned earlier the Kyoto Protocol sets up three market-based mechanisms to reach global emissions reductions in the most efficient way. Estimates undertaken show that the larger the global market, the cheapest the price of the ton of carbon: If abatement is only undertaken domestically for Annex 1 countries, the estimated price is US$ 77 whereas if the two other flexibility mechanisms are added, the price falls down to US$ 30 a ton (Morozova

and Stuart 2001, p. 39). These prices are higher than the price used in bilateral offsetting arrangements between Costa Rica and developed countries and than the US$ 28 estimated by Castro (1999) to improve access to solar electricity in rural Costa Rica.

At the same time, the larger the market, the lower the implementation costs to provide the final GPG, stabilizing the climate. Based on the "G-cubed" model cited by Baron (1999) without emissions trading, the cost will be equivalent to 0.3 percent of GNP in the United States, 0.8 percent of GNP in Japan, and 1.4 percent of GNP in the other industrialized countries that belonged to the Organization for Economic Cooperation and Development (OECD). With trading, emissions controls would absorb only between 0.2 and 0.5 percent of GNP in those same countries.

But some researchers (see Baron 1999 for an illustration) suspect that the models' cost estimates are likely to be optimistic, for two reasons. First, all the models assume that each country would choose the most cost-effective domestic emissions control strategy. If policy makers chose to protect politically sensitive domestic industries and regions from adopting even low-cost measures, however, then the costs of abatement without trading might be much higher than estimated.

Second, the models assume fully fluid markets for emissions credits with no significant barriers or transaction costs. In practice, however, that the developing countries have not committed to specific emissions targets is a source of concern among Annex 1 countries. In particular, they are concerned with two phenomena: leakage and slippage. The Convention uses these terms to refer to the possibility that the net benefits of a carbon sequestration project will be reduced if a landowner takes the money earmarked for forest conservation and uses it to convert a forest to cropland in another area (leakage). Or otherwise he might increase his carbon emissions by, for example, buying more vehicles (slippage). This situation might prove a major impediment to carbon reduction trading and at the very least it would mean that some neutral party would have to be sure that the additionality requirement was met—that is, that the emissions reduction would not have occurred anyway under business as usual. Germany had emerged as the spokesperson for a number of industrialized countries that were opposed to allowing significant trading with developing countries until the countries committed to emission targets. Germany argued that without emissions commitments, additionality would be hard to determine and easily evaded.

Despite these theoretical concerns and without a clear definition of how the additionality test would be met for the CDM, some countries and large multinational businesses with high emissions control costs were interested in buying credits. British Petroleum, a big international energy company, had recently set up an experimental system to trade emissions credits among its plants in industrialized and developing countries, for example, and discovered that even with inter-plant trading its marginal costs of abatement were likely to be close to US$70 a ton. Buying some low-cost credits from other sources might be worthwhile as a method for hedging its bets. And it didn't hurt that purchasing credits generated favorable corporate publicity.

Most of the proposed emission credit trades at the global level are for electric power generating projects and thus compatible with the current Costa Rica political concern to

develop clean electricity for the poor. However there is a growing interest to include reforestation in the CDM. Reforestation credits are usually offered for a limited period of time, say 20 years, with the idea that at the end the forest might be logged and replanted. This causes some environmental groups to oppose reforestation credits since they would have to be replaced if the forest is logged. Greenpeace, the international environmental group, labeled credits for reforestation a "time bomb" that would cause serious problems when they expired. But advocates of reforestation pointed out that other credits are for only a limited period as well — for example, a wind turbine could be expected to last only 20 years. Hopefully, moreover, in 20 years technological progress would have cut the costs of emissions abatement. What are currently the additional steps to take to finance such projects in the global emission market under the Kyoto Protocol?

III.3 Additional steps toward the global market

Progress in shaping the global regime is slow. This section aims at presenting the status of decisions in international negotiations on climate change and is followed by a possible alternative coming from Costa Rica.

During the negotiations of the seventh session of the Conference of the Parties to the UNFCCC (COP 7) in Bonn (July 2001) and in Marrakesh (October-November 2001), the United States reaffirmed that it would not ratify the Kyoto Protocol. Non-participation of the biggest emitter of GHG (24% of the world emissions) to the global trading system would have important economic consequences for all parties (Grubb, Hourcade and Oberthur 2001, p.28): it would lower the compliance costs but also lower the international price for carbon (down to US$ 25 a ton (op. cit. p. 31)) and reduce the level of resources flowing trough the flexibility mechanisms.

However, the recent Marrakesh agreement moved forward on the procedures for the CDM (Decision -/CP.7 (Article 12))[7] by deciding to ease a prompt start of the CDM (with a financial support of US$ 6.5 million in the 2002-2003 budget) and by authorizing the CDM executive board to approve methodologies for baselines, accrediting operational entities and developing and maintaining the CDM registry. The Marrakesh Accords also authorizes unilateral CDM through which a developing country can undertake a CDM project without an Annex 1 country and market the resulting emission credits. In addition the Accords stipulates that afforestation and reforestation are eligible under the CDM but that they will not exceed 1% of base year emissions of the concerned Party. The role of the CDM executive board will be specified at COP 8 scheduled for 23 October-1 November 2002. In the meantime, the Subsidiary Body for Scientific and Technological Advice (SBSTA) is requested to define and develop modalities to include afforestation and reforestation, i.e. non-permanence, additionality, leakage, uncertainties and environmental impacts, discussed earlier in this paper.

One of the most important and complex steps to come is to scientifically find out the precise amount of carbon saved from a CDM project. Many models have been used to estimate

[7] For an advance unedited version of the Marrakesh Accords and Marrakesh declaration see http://www.unfccc.org/cop7/documents/accords_draft.pdf

an order of magnitude of the sequestration and mitigation potential. Early models calculated that around 500 million hectares were needed (Sedjo and Solomon 1989) or available (Nordhaus 1991) at the global level for carbon sequestration. All Latin American and African early models consistently showed that these countries could provide at least 50% of the required amount of land, with a low preparation cost and a high forest-growing rate. These combined factors could offer, especially to tropical countries, a highly competitive position in a carbon market that includes forest projects. More recent studies such as the Harvard University study for Central America (Central American Bank forthcoming) and the University of Mexico study (Inter-American Development Bank 2000) compared carbon and fossil fuel options. The first calculates the carbon cut coming from forest (conservation, forest management and reforestation) in 54 million tons a year compare with 6 million coming from the potential of fossil fuel emission reduction in Central America. The second calculates that forest makes up 87% of the 40 million tons available in Mexico for the year 2000.

Economists agree that carbon sequestration through forest or reduced deforestation may be a cost-effective approach to cut global atmospheric concentrations of GHG (Castro and Cordero 1999; Masera 2000; Stavins and Newel 2000).[8] Now that afforestation and deforestation are included in the international regime, it is essential to gather and develop scientific evidences to value the environmental services that developing countries can offer in the global market for emissions.

III.4. Plan B: Reduction of Debt and Carbon Emissions

Due to the uncertainties surrounding the future of the Kyoto Protocol, even developing countries such as Costa Rica, which have been pioneers in developing trade arrangements to market carbon credits, are now considering alternative resources mobilization options for global emissions trading.

In 1995 the Costa Rican government promoted a mechanism that links debt reduction in developing countries to carbon reduction in developed countries (Washington Times 2001). This "Trees for Debt" initiative is a variation of what Taylor **(ref?)** calls a "world fund that would be financed with debt claims of the developed country parties upon developing country parties of the Kyoto Protocol."**(p.?)**. These claims would be used to generate instruments that would be sold to carbon producing companies in developed countries as part of their carbon reduction programs, using instruments such as the Certified Emission Reduction (CERs) (Costa Rican Office of Joint Implementation 1997). Taylor adds, "The depositing country would participate in the proceeds of the sales to rescue part of the debt value and cancel the liabilities of the debtor countries. In exchange for the debt cancellations, the developing and debtor country parties, by entering into agreements with the Fund, would commit domestic resources equivalent or proportional to the annual service alleviation, toward the development of national carbon fixation programs in their territories."(ibid).

[8] In their article, Stavins and Newell state: "even for highly industrialized countries such as the United States, carbon sequestration through land-use changes could arguably be part of a cost-effective portfolio of short term strategies".

However the “Trees for Debt” proposal is, of course following a different rationale than emission trading. It looks at developing countries as aid recipients rather than equal partners in a global bargain. The financial agreement proposed between the debtor and the developing country is based on poverty considerations. Creating adequate rules of the game for developing countries within new markets is, by opposition, based on recognizing the services that they offer to the international community, i.e. their contribution to the global welfare. This should be the discriminatory criterion ruling their participation in the global production function of a stable climate.

Conclusion

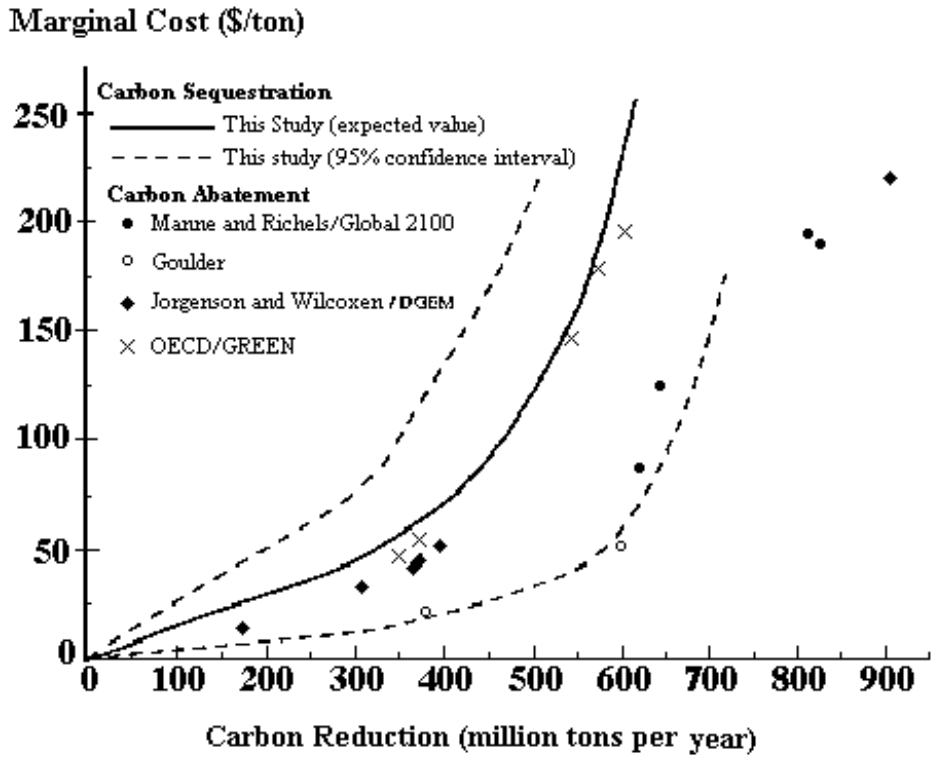
Through the example of solar electricity and forest conservation in Costa Rica, this case study has explored how in certain instances, developing countries' scarcity of resources that prevents them from moving toward sustainable energy and development could be exchanged with the scarcity of GHG emission rights that richer actors, public or private, may face. It has been shown that local initiatives to enhance development by providing electricity or by paying local farmers for protecting the forest can contribute to the production function of global public goods, such as averting the risk of climate change, at the same time. Indeed, one could argue that combining the two objectives is probably the most efficient sef-sustaining longer-term strategy.

Going further in the details of developing such win-win strategies, the paper has highlighted the complexity of defining the rules of the game for new markets at the national and at the global levels. As Carlton Bartels from CO2e.com notes it "Emissions reductions are not a natural commodity but a regulatory one" (2001, p.42). The Costa Rica pilot project has born out this lesson. It corroborates the view of financial experts that the global market for carbon emissions, like all other new markets, will effectively emerge from such sub-global initiatives.

Creating new markets, such as the one for carbon emissions trading, will not be an easy task to accomplish. Experts recall that it took ten years for another new market, the sulfur emission market in the US, to be created at the national level only. Yet, while difficult, it would be a worthwhile challenge to take on.

In parallel, the full participation of developing countries in international negotiations on climate change is crucial to make the final climate regime both efficient and equitable. Thus it is not too early to participate to the design of the global architecture envisioned under the Kyoto Protocol. Developing countries will have binding commitments to cut their own GHG emissions after 2012. As Blanchard and others stress in this volume, the rules of the game for the next stage should combine efficiency and equity. Whether and to what extent they do so depends in no small measure, on the developing countries' involvement in this debate.

Exhibit 1:
Estimates of the Marginal Cost of Forest Carbon Sequestration and Energy Carbon Emissions Reduction Projects in the United States



Note: The carbon sequestration lines are estimates of marginal costs for reforestation in the United States. The carbon abatement points are estimates of the marginal costs for emissions reductions from U.S. power plants.

Source: (Stavins 1999)

Exhibit 2
Carbon Indifference Price between Private Natural Forest Protection and Competing Agricultural Activities

Crops or Activity	Region or Private Natural Forest (cost estimates ($/ton)							
	La Amistad	Rincón de la Vieja	Palo Verde	Piedras Blancas	Barra Honda	Guanacaste	Carara	Barbilla
Coffee	386	219	275	168	228	226	211	227
Pineapples	372	458	522	524	502	469	549	487
Watermelons	309	378	432	431	415	389	455	403
Yams	251	305	350	346	335	314	368	327
Avocados	245	298	342	338	327	307	360	320
Plantains	244	297	341	337	326	306	359	319
Tiquisque*	198	240	277	270	263	248	291	258
Passion Fruit	189	228	263	256	250	235	276	245
Tomatoes	170	204	236	228	224	211	248	221
Forest plantations	124	35	71	14	51	50	54	62
Bananas	102	118	140	129	130	124	147	131
Palm hearts	98	114	135	124	125	119	142	126
Yucca*	91	106	126	114	116	111	132	118
Coconuts	73	82	99	87	91	87	104	93
Dairy cattle	66	74	90	77	81	79	94	84
African palms	63	70	85	72	77	74	89	80
Oranges	63	71	86	74	78	76	90	81
Sugar cane	61	68	83	70	75	73	87	78
Beef and dairy cattle	51	55	68	55	61	59	71	64
Lemons	35	35	46	32	39	39	48	44
Beans	27	25	35	20	28	29	36	33
Melons	23	20	30	15	23	24	31	28
Potatoes	22	19	29	14	22	23	30	27
Rice	12	6	14	<0	8	10	14	14
Beef cattle	11	6	13	<0	7	9	13	13
Mangoes	3	<0	1	<0	<0	<0	<0	1
Managed forestry	3	<0	2	<0	<0	<0	1	2
* Tiquisque and yucca are roots similar to cassava.								

Source: (Castro 1999)

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