

**THE COSTA RICAN EXPERIENCE WITH
MARKET INSTRUMENTS TO MITIGATE CLIMATE
CHANGE AND CONSERVE BIODIVERSITY**

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“Costa Rica's official commitment to a policy of sustainable development has set the stage for creative market opportunities that generate added value to its natural capital and make operative an innovative financial mechanism that activates the self-sustainability of conservation.”

Abstract. Two decades of developing relevant legal and institutional regimes for the sustainable and nondestructive use of natural resources have framed Costa Rica's pioneer approach to mitigate climate change and conserve its rich biological diversity. This policy framework provides an appropriate context for the actual and proposed development of market instruments designed to attract capital investments for carbon sequestration and biodiversity conservation, and allows the establishment of mechanisms to use those funds to compensate owners for the environmental services provided by their land. As a developing economy, Costa Rica is striving to internalize the benefits from the environmental services it offers, as a cornerstone of its sustainable development strategy.

Key words: climate change, mitigation, market instruments, Costa Rica.

1. Background

Two international conventions, the Framework Convention on Global Climate Change (UNFCCC) and the Convention on Biodiversity (CBD), drafted at the 1992 Earth Summit in Rio de Janeiro, Brazil, recognize the importance of global climate change and losses of biodiversity. These conventions, both ratified by Costa Rica, incorporate language favoring north-south equity and the idea that markets might be used to achieve some of their aims.

The CBD seeks to protect the diversity of the world's biological resources by promoting their sustainable use and ensuring that their benefits are equitably shared. Resources for the implementation of the Convention include the distribution of funds (such as the GEF) to assist developing countries, but could also be advanced through mechanisms such as debt swaps, tax incentives and the elimination of subsidies for environmentally damaging activities. The Costa Rican biodiversity conservation strategy promotes equity by enhancing Costa Rica's technical and human resource capacities, and

relies on a legal framework that allows conservation lands to benefit from the products and services derived from the protected ecosystems, such as markets for ecotourism and biodiversity prospecting.

The UNFCCC seeks to avert global warming by reducing net emissions of the gases believed to contribute to this phenomenon (most importantly carbon dioxide [CO₂], methane [CH₄], nitrogen dioxide [N₂O] and ozone [O₃]). Joint Implementation (JI) is an idea advanced by the Convention, whereby one country might strive to meet the objectives of the treaty by investing in the reduction of greenhouse gas emissions in another country, where such investments could buy both greenhouse gas reduction and economic development benefits concurrently. Such projects would theoretically benefit the investor by addressing his commitments under the treaty. They should also benefit the countries in which the projects occur, allowing them to capture some of the value represented by the difference between the estimated \$250 billion that would be required to meet UNFCCC greenhouse gas emissions reduction goals if the developed world were to try to do so within its borders, versus the estimated \$80 billion required if developing countries were allowed to sell their emissions' potential. The idea has the potential to promote equity because industrialized countries are the dominant greenhouse gas emitters per capita and have the highest GDP per capita (see Figure 1). In the spirit of the Rio meeting, it is commonly felt that JI should be used whenever possible to support the goals of the CBD as well.

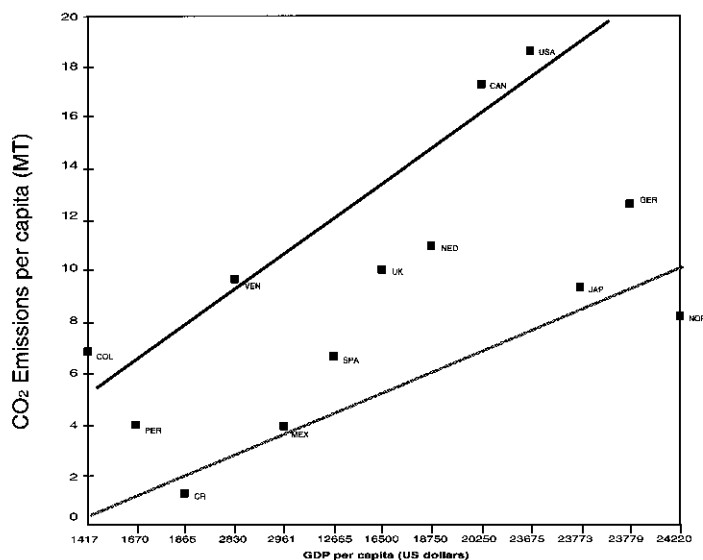


Figure 1. CO₂ emissions/capita vs. GDP/capita for 13 countries. (Source:OCIC)

Each convention reflects a global interest in protecting the natural environment, although the specific value of doing so will vary from one place to another, reflected in locally variable costs and benefits. These variations in costs and benefits from one place to another suggest that the marketplace could be used to achieve the environmental goals

of the conventions, though to date it has not succeeded in doing so. The market failure to compensate Costa Rica for the value of its conservation and reforestation efforts and the resulting benefits, such as carbon sequestration and biodiversity conservation, has inspired novel policies. These can be viewed as initial attempts to correct such market failures by harnessing the market to compensate Costa Rica for the environmental services it offers to the world.

While the costs of habitat preservation are borne by private landowners, and in the case of national parks, by the government, relatively few benefits accrue directly to these parties as a result of their investments in habitat conservation. The only environmentally beneficial land uses that occasionally benefit landowners directly are wood production and ecotourism. Both activities vary in terms of environmental impact and sustainability. For example, neither of the two provides clear incentives to restore wild areas, given the long periods of time required for pasture lands to undergo the transition to become complex forests. In sum, market failure to internalize the benefits of conservation results in most conservation costs being borne by affected landowners, whether they are public entities, such as a parks service, or private ones, such as small farmers. This state of affairs makes the landowner perceive conservation largely as a cost and a sacrifice of his economic possibilities. This is a troubling reality, especially in a developing country where a landowner's inability to benefit from the environmental services that conserved land could provide will often mean that the very trees or habitats that benefit the global community will be harvested or altered to benefit local interests.

Costa Rica has taken bold steps to drive internalization of benefits from environmental services specified in new legislation, to create market instruments to pay for them, and to channel the resulting revenues into the hands of both property owners who choose to conserve or reforest their land and conservation organizations. To the extent that these initiatives have begun to work, they are resulting in transfers of funds described schematically in Table 1.

Types of Benefits	Benefit internalized by:		
	Owner	Country	World
Sustainable wood production	x		
Hydropower production potential	x<—	x	
Water supply		x	
Watershed protection		x	
Scenic beauty	x	x	x
Carbon sequestration	x<—	x<—	x
Biodiversity	x<—	x<—	x

Table 1. Trend towards internalization of benefits from environmental conservation activities in Costa Rica.

2. Costa Rica's natural resources endowment

Costa Rica perhaps has recognized the value of its ecological wealth earlier than what the global norm has been. As a result, Costa Rica has a goal of protecting no less than 25% of its territory as wildlands. The derived economic benefits of Costa Rica's conservation commitments include important revenue streams from hydropower, ecotourism and scientific activity.

Still largely covered with forests in 1940, today Costa Rica's land area is around 40% forested; approximately 1.5 million hectares of forests remain. Based on land use capability, less than 40% of Costa Rica's land is suitable for agriculture and approximately 60% is most suitably left as forest. Of the 35% of Costa Rica's pasture land, only 8% is appropriate to that use. Averting further destruction and restoring forest habitat is impeded by the fact that many of the potential values associated with protecting natural habitats and other forested areas have not historically been monetized and internalized to benefit Costa Rica and its individual citizens. The results of an effort to quantify some of these potential benefits are reproduced below.

Type of Benefit	Average Annual Value
1. Hydrologic benefits	
a) water supply for urban centers	2.3 - 4.6
b) loss of hydroelectric production potential	10 - 20
c) protection of agricultural land	0.25 - 2.0
d) flood control	4 - 9
TOTAL	~17 - 36
2. Carbon sequestration	60 - 120
3. Ecotourism (non-consumptive use values)	~13 - 25
4. Future pharmaceuticals (option values)	0.15
5. Funds transfers (existence and option values)	~13 - 32
TOTAL	~102 - 214
Net present value at 8%	~1277 - 2671

Table 2. Estimated environmental values of primary forests (in 1989, \$US/ha). Adapted from (Constantino and Kishor, 1993).

The challenge to Costa Rican policy-makers in recent years has been to develop legal instruments and institutional arrangements that would enable the internalization of these values. Since 1980, incentives have been in place to promote tree plantations and to reduce the demand for "natural" forest timber. Beginning in the late 1980s, incentives were put in place to encourage "sustainable forestry", the use of primary and secondary forests as sustainable sources of wood products. However, these programs have given way in the mid-1990s to:

- a lifting of an existing ban on wood exportation that had artificially held down local prices;

- deregulation of forest plantations; and
- an incentive scheme that rewards outright forest conservation for the first time, and targets other incentives to the protection and afforestation of lands considered priority for public policy objectives, such as watershed protection and biodiversity conservation.

3. Using markets to drive climate change and sustainable development in Costa Rica

Costa Rica is evolving as a testing ground to for the hypothesis that markets can be used to drive sustainable development. The current government has established a goal aimed at completely protecting primary forest, allowing secondary forest to flourish, and promoting tree plantations on degraded soils to meet demands for lumber and paper products. Selective logging can be undertaken in secondary forests to the extent that it has been planned with a view to sustainability as evidenced by the approval of a forest management plan by a licensed forester. The quantity of land that is apt for one of these uses, but that is currently under another use, can be viewed as the supply for potential consumers of new conservation set-asides and related environmental services payments. This supply should respond to the level of incentives to enter some form of conservation or related scheme. The Costa Rican government has begun to test this supply response by offering conservation and related incentive payments described below, with promising results.

3.1. CLIMATE CHANGE POLICY AND FORESTRY ENVIRONMENTAL SERVICES PAYMENTS

Based on its broader economic development, the country has developed a multi-faceted strategy to combat climate change. This strategy includes the promotion of a modernized public transportation fleet, including the use of electric vehicles, significant reliance on electricity from wind-power sources, and innovative approaches to conservation of natural resources and reforestation. Novel schemes have been designed to attract international investment in these initiatives, schemes that include the sale of resulting greenhouse gas benefits in the form of carbon sequestered. New economic opportunities open for Costa Rica's forest management potential in an emerging international carbon market.

During the 1960s and 1970s Costa Rica had one of the highest deforestation rates in the world. As early as 1979, however, national forestry laws included incentives such as income tax credits to encourage reforestation. Forestry incentives, which have been redesigned and redirected several times, seem to have had an impact over time. Between 1979 and 1987, approximately 2000 hectares per year were reforested under the incentive structure of the law. In 1991, the National Forestry Financing Fund (FONAFIFO) was established to provide loans and incentives for reforestation. After the establishment of FONAFIFO, the average amount reforested under the government incentive programs for 1991-1995 jumped to 17,500 hectares per year. FONAFIFO plays an additional role today in implementing innovative features of the Costa Rican JI policy.

3.2. THE COSTA RICAN JOINT IMPLEMENTATION REGIME

Costa Rica has done more than any other developing country to establish a comprehensive JI regime as a strategy to meet the objectives of the climate treaty and promote its own sustainable development goals. The Costa Rican government began to develop official JI policy and programs in 1994. A high level Consultative Committee on Climate Change was formed to shape JI policy, within the context of the national greenhouse gas emissions inventory. In September 1994, Costa Rica and the United States signed a bilateral statement of intent on cooperation for sustainable development and joint implementation. This agreement led to the “Cooperative Assessment of Baselines and Certifiable and Transferable Greenhouse Gas Emissions Offsets.”

The Costa Rican Office for Joint Implementation (OCIC) was established in 1996, with the authority to formulate JI policy, reporting to the Ministry of Environment and Energy (MINAE). The office established project approval criteria and assisted in the development of more than fifteen project proposals, many internationally noted as among the best-designed of the first generation of similar attempts. More recently, the OCIC strategy has been exclusively to promote three national-scale projects focusing on 1) consolidation of parks, 2) natural forest management by private landowners, and 3) renewable energy. The first two of these “umbrella” projects, known as the Protected Areas Project and the Private Forestry Project, which focus on land use, will eventually encompass most of the forested areas of the country.

The development of JI projects of national scope addresses one of the most important obstacles to developing-country participation in joint implementation: it reduces the per-ton transaction costs associated with the development, evaluation and marketing of projects. Moreover, the national proposals complement the Costa Rican land tenure structure of traditional small and medium-sized farm ownership, engaging and supporting such landholders.

The Protected Areas Project (PAP) and the Private Forestry Project (PFP) include long-term monitoring of carbon benefits, using satellite imagery, ground verification and independent third party verification. The PAP has already been assessed by SGS Forestry and will be monitored annually. Carbon offsets will be certified annually as accrued and the assessment will report against the requirements of the SGS Forestry’s Carbon Offset Verification Service (SGS, 1997). The World Bank has subscribed with Costa Rica the Eco-Markets Agreement for \$US 500,000 donated by Japan to improve commercialization mechanism for GHG reductions generated by the PFP and the activities described above.

3.3. THE NEW FORESTRY LAW AND ENVIRONMENTAL SERVICES PAYMENTS

Changes in Costa Rica’s forestry laws during the 1980s and 1990s supported substantial tree planting in Costa Rica. Additional legislation to the 1996 new Forestry Law – *Ley Forestal #7575* – goes further, providing the legal and regulatory basis to compensate landowners for “environmental services” offered by their lands; these incentives reward outright natural forest conservation. The law addresses four key environmental services

offered by plantations and forests: 1) carbon fixation, 2) watershed protection, 3) biodiversity resources and 4) protection of natural forest ecosystems located in life zones of particular interest. It empowers the Forestry Authority to contract with landowners, subject to provisions such as the availability of a forest management plan certified by a licensed forester, to compensate them for the environmental services offered by their lands (Asamblea Legislativa, 1996).

The regulations to the Forestry Law establish the conditions for and levels of environmental services payments authorized. Payment levels established are:

- (a) for new plantations, 120,000 colones per hectare, for a period of 15 years, paid in advance during the first five years – 50% during the first year, 20% during the second year, 15% during the third year, 10% during the fourth year and 5% during the fifth year;
- (b) for natural forest management (sustainable logging), 10,000 colones per hectare per year for five years with a commitment on the part of the landowner to keep the forest in natural forest management for an additional 15 years; and
- (c) for conservation of natural forest, 12,000 colones per hectare per year under the same terms as above.

The FONAFIFO, which already successfully manages the domestic administration and finances of the national forestry incentives, executes payments to all property owners, but with priority for those holding an international green seal designation.

In all cases, property owners eligible to receive these payments must apply to the Forestry Authority, indicating the area of land to be managed under the contract on the property plan, and presenting a forest management plan certified by a licensed forester. Additionally, the commitments associated with the contract (*e.g.*, a prohibition from cutting trees for the duration of the contract) must be registered with the deed to the property, so that they would transfer as a legal easement to any subsequent owner. Fulfillment of these requirements and contracts with a landowner gives the State the right to claim compensation for the environmental services of greenhouse gas mitigation in international diplomatic and financial fora.

The payments stipulated in the 1997 regulations to the Forestry Law do not approach the environmental services values estimated by Constantino and Kishor in their 1993 analysis. However, they are closer to those suggested by the Tropical Science Center (San Jose, Costa Rica), in a recent review of the relevant literature. The TSC analysts calculated possible values per hectare of the four key environmental services mentioned in the forestry law, in primary and secondary forests (Table 3).

Environmental Service	Primary Forest			Secondary Forest		
	(min.)	med.	max.)	(min.)	med.	max.)
Carbon sequestration	19	38	57	14.63	29.26	43.89
Protection of water	2.5	5	7.5	1.25	2.5	3.75
Biodiversity protection	5	10	15	3.75	7.5	11.25
Ecosystem protection	2.5	5	7.5	1.25	2.5	3.75
<i>Totals</i>	<i>29</i>	<i>58</i>	<i>87</i>	<i>20.88</i>	<i>41.76</i>	<i>62.64</i>

Table 3. Minimum, medium and maximum potential total annual cost (in \$US per hectare) to the Government of Costa Rica to compensate landowners for the four environmental services named in the Forestry Law of 1996. Adapted from (Carranza, Aylward *et al.*, 1996)

The sums of these values per hectare range from \$29 to \$87 for primary forest and from \$21 to \$63 in secondary forest. Though the study examines values of each of the four key types of environmental service mentioned in the law, the regulatory strategy does not oblige the government to compensate landowners differentially for each individual environmental service, a process that has been deemed unduly burdensome. Rather, a uniform lump sum per hectare is paid to all landowners under contract.

The key land use with which the Costa Rican forestry incentive program must compete is the grazing of cattle livestock. This follows from the sheer amount of Costa Rican pasture land, constituting about one third of the country. Thus, it is particularly relevant to ask what the opportunity cost to dairy and beef cattle ranchers would be if they were to dedicate their land to reforestation schemes, or leave any remaining forest on their properties standing rather than converting them into pasture. Analysis of the cattle sector has shown that profits per hectare vary tremendously – from \$8 to \$125 per year – depending on the specific ranching practices and the location of the land (altitude, soil and climate conditions, access to markets). To address this variance, the most useful measure of opportunity costs in the Costa Rican marketplace is the local cost of renting a hectare of pasture. An active pasture rental market exists in all regions of the country, and this market offers clear measures, region by region, of what farmers consider an acceptable income per hectare in exchange for forfeiting access to other productive possibilities of their land. In the Cordillera Central area where FUNDECOR (a private foundation for this conservation area) operates, for example, such rents are currently from \$20 to \$30/ha per year. The area of former pasture land currently under reforestation through the payment of environmental services amounts to 14000 ha, suggesting that cattle ranchers come forward to avail themselves of the payment of environmental services.

3.4. FINANCING THE PAYMENT OF ENVIRONMENTAL SERVICES

Funding for the payment of environmental services contracts derives from a sales tax on fossil fuels established under *Ley 7575* in 1996, in a bipartisan legislative move that dedicated these revenues to the reduction of greenhouse gases and the protection of biodiversity. Additionally, Costa Rica has established a Carbon Fund to serve as a depos-

itory for moneys from domestic and international sources and to distribute “rights” or “credits” in exchange for such deposits. While FONAFIFO can only compensate private landowners for environmental services, the Carbon Fund will also be able to finance joint implementation activities related to the Protected Areas Project and the energy “umbrella” project; *e.g.*, to public sector entities, and to projects that do not involve land use. Landowners who wish to receive Carbon Fund moneys must cede their environmental services rights to the Fund, for its use and possible resale. The seed capital received by FONAFIFO is now being used to buy environmental services rights from farmers. Next, the Carbon Fund markets and sells those rights internationally, producing the initial Certifiable Tradable [Greenhouse Gas] Offsets, or CTOs, a financial instrument described in greater detail below. These funds, in turn, are being passed back to FONAFIFO, to be distributed to landholders under contract. The Carbon Fund serves as the financing agent for the national joint implementation projects by supplying funds both to purchase park lands in order to continue and expand the government forestry incentives, and to support renewable energy projects. The scheme is depicted graphically in Figure 2.

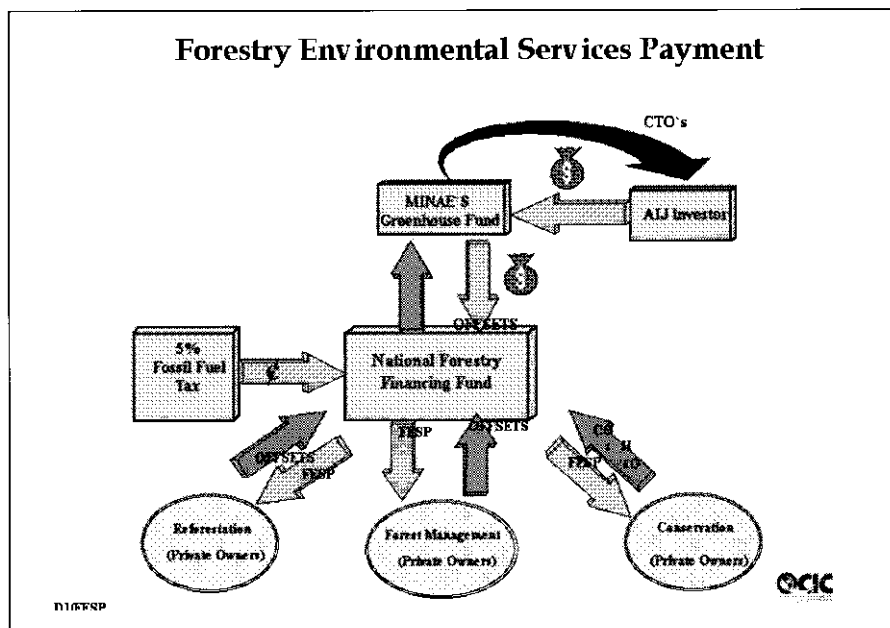


Figure 2. The Forestry Environmental Services Payment Scheme. (OCIC)

3.5. THE CERTIFIABLE TRADABLE OFFSET (CTO)

Costa Rica has designed a financial instrument that can be used to transfer (sell) greenhouse gas offsets in the international marketplace, called the Certifiable Tradable Offset, or CTO. A CTO represents a specific number of units of greenhouse gas emissions expressed in carbon equivalent units reduced or sequestered. The home-country verifi-

cation process certifies that the offsets are of high enough quality to allow them to count against national and company-level greenhouse gas reduction commitments, if such crediting is eventually permitted under the UNFCCC.

When an investor purchases a CTO, he or she is truly providing additional finances to Costa Rica, as required under the UNFCCC. CTOs should appeal to investors interested in avoiding the costs of developing and submitting individual joint implementation projects to home and host-country authorities for evaluation. CTOs are pre-approved and the investor simply purchases the offsets. CTOs are fully transferable to others and are guaranteed by MINAE for 20 years. Investor confidence in the CTOs may be further strengthened if a third-party monitoring, verification and certification process is established.

In July 1996, Costa Rica sold its first CTOs. At that time, the governments of Norway and Costa Rica agreed to cooperate on a JI project, that involves, among other things, reforestation and forest conservation as part of the Private Forestry Project. The project is directed to the expansion and reconstruction of a hydroelectric facility. Costa Rica signed a contract with a mix of private and public sector entities from Norway, for \$2,000,000 worth of carbon sequestration services at \$10/ton of carbon sequestered. The Norwegian parties are contributing to the Private Forestry Project – \$1.7 million from the Norwegian government, financed by a Norwegian carbon tax, and \$300,000 from Consorcio Noruego – in exchange for 200,000 CTOs. The Norwegians will be the final users of the bonds and do not intend to resell them.

Two cooperation projects with the Dutch governments have enabled Costa Rica to take this initiative further and to issue CTOs in new market niches other than carbon sequestration. The first project consists in the anaerobic treatment of organic waste from coffee processing, which results in cuttings in methane emissions and the implementation of clean technologies and energy savings through the use of biogas. The second project is directed to the reforestation of 78 ha of former banana plantations that will contribute carbon sequestration and environmental sustainability conditions for banana production. The Netherlands will receive the corresponding CTO's for the annual reduction of 500 tons of methane gases in addition to the ones resulting from carbon sequestration.

Recently, Costa Rica has signed two memorandum of intent with the governments of Switzerland and Finland to promote private sector investments in CTOs and to design a regional strategy for CTO's offer in the world market.

Costa Rica's goal for CTOs is to see them traded in a manner similar to the USA market for sulfur oxides (SO_x) pollution, which has surprised many observers by reducing emissions of these compounds at a far less cost than what was originally believed as possible. The Centre for Financial Products, Ltd., an active participant in the development of SO_x trading launched in 1993 at the Chicago Board of Trade, is promoting the development of the CTO market. The Centre had already purchased 1000 CTOs for resale in secondary financial markets and recently placed CTOs that account for 350,000 tons. The Centre Financial Products has an exclusive contract to broker 4,000,000 tons of Costa Rican carbon over the next 20 years, with a floor price of US \$10 that will generate a minimum of US \$40,000,000 in revenues. Based on its carbon sequestration models and the total amount of forest area registered under FONAFIFO for environmental services

payment, Costa Rica's goal is to deliver two million tons of carbon during 1997, and eventually to deliver 15,000,000 tons of carbon.

This price per ton of reduced greenhouse gas emissions may be evaluated within the context of the few available indicators of the value of what a ton of carbon may represent to the potential investor. The average annualized cost per ton of greenhouse gas reductions required in the state of Wisconsin, USA, to meet the UNFCCC goal of stabilizing year 2000 emissions at 1990 levels, was estimated at US \$6 in 1995, while the marginal cost was estimated at US \$22. According to the Center for Clean Air Policy, meeting the goal of reducing emissions 20% from 1990 levels by the year 2010, would cost instead US \$34/ton approximately. (The Center for Clean Air Policy, 1995).

4. Costa Rica's biodiversity conservation regime

Although Costa Rica contains varied habitats and tremendous biodiversity, its resources may be threatened in the future by an increasing population growth and urbanization. Additionally, though the decades-old commitment to conservation has resulted in the declaration of scores of protected areas, a recent study of the land-tenure status of these areas indicates that close to 15% of this land requires full legal protection; *e.g.*, measured, surveyed, titled to the government and registered as conservation land (SINAC, 1997).

The Private Forestry Project and the Protected Areas Project are designed to work together to protect Costa Rica's remaining forests and biodiversity, while capturing the attendant environmental service benefits. Lands included in the two projects were prioritized based on a 1994-95 GRUAS Commission Report, which identifies priority areas for protection. The Commission recommended a coherent plan to protect at least 90% of Costa Rica's biodiversity. These recommendations thus guide and help prioritize investments to consolidate the national system of conservation areas and the distribution of environmental services payments as incentives to conserve critically important habitats on private lands.

A serious concern is that the system of conservation areas is not financially self-sufficient. Although the government budget and entrance fees to the parks provide important revenue streams, the acquisition, subsequent development and interpretation for ecotourism and educational purposes, as well as the protection of conservation land have frequently depended on infusions of charitable and bilateral aid funds. These donations have declined markedly in recent years, since trends towards peace and democracy in the region have made Costa Rica a lower geopolitical priority for international donors, and there is a heavy global competition for limited conservation-related grants and loans.

In this context, Costa Rica's signing of the CBD must be seen both as a commitment to the biodiversity conservation objectives of the Convention, and as an acceptance of and support to the treaty's explicit requirement that the developed world bring resources to the table to help finance its goals. As with Costa Rica's approach to fulfill its commitments to the UNFCCC, the national strategy vis-à-vis the CBD is to harness market forces to finance a biodiversity conservation strategy wherever possible. At anticipated market rates for carbon, Costa Rica's projected offering of 15,000,000 tons would be

enough to generate US \$150-\$300 million, enough to consolidate the national parks system, and, we hope, enough to establish a trust fund that would subsidize its operating income. Other markets that we are counting on to help protect our biodiversity are identified in the following sub-sections.

4.1. TOURISM: AN IMPORTANT COSTA RICAN MARKET FOR BIODIVERSITY

There is no question that, from the perspective of revenue generation, tourism is currently one of the most important markets for Costa Rica's biodiversity. The growth in visitorship to Costa Rica's protected areas and corresponding revenues during the past fifteen-year period appear in Figure 3.

Costa Rica's foreign visitors expect to experience tropical nature, and it can be argued that the existence of and traditional commitment to public conservation lands is the most important factor shaping that expectation. The \$2.2 million generated through fees charged to visitors at the national parks in 1996 is only a portion of the revenues to the economy at large provided by visitorship to protected areas, many of which are in private hands and managed as tourist destinations.

Since 1994, a series of adjustments to admission fees to protected areas have been implemented to address, in part, the issue of its financial self-sufficiency. The thinking behind the raise and the differential fees obey to the need of protected areas to capture revenues from tourists and tour operators under a more equitable sharing of benefits. The goal consists of reinvesting those revenues into the protected areas to finance tourism needs in infrastructure and services.

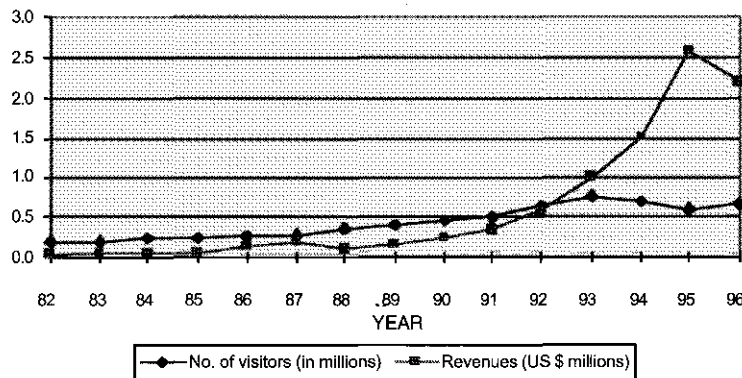


Figure 3. Growth in visitorship and revenues from admission fees to protected areas in Costa Rica, 1982-1996. Based on data from the MIRENEM, 1991; MINAE, 1996 and Bermudez 1997.

Costa Rica's tourism policy is evolving to adapt to the dramatic growth in the importance of this sector to the economy; tourism surpassed banana and coffee exports in 1993. It is critical to the ongoing growth of this sector that revenues from protected area be reinvested in the improvement and maintenance of infrastructure and services for visitors. Such mechanism in the conservation areas should doubly benefit Costa Rica's conserva-

tion goals by increasing visitorship and revenues to SINAC, and by limiting the destructive impacts of visitors in sensitive areas. System expenditures on operations and infrastructure development during 1996 were nearly \$11,000,000, but SINAC could comfortably spend another \$2,000,000 annually on operations. The costs of fully consolidating the system of public conservation areas (see Table 4) are currently estimated at \$150 million.

Activity	Budget (in millions of \$US)
Land surveying and purchasing	44
Trust fund to subsidize SINAC operations	92
Other indirect costs	21
Total	157

Table 4. Highlights of the Protected Areas Project Budget

Two of the key goals of the Protected Areas Project are the consolidation of approximately 530000 ha of land in the National Parks and Biological Reserves throughout the country, and the establishment of a trust fund that will contribute to the financial independence and security of the Costa Rican system of conservation areas.

4.2. BIODIVERSITY PROSPECTING: A MARKET FOR BIODIVERSITY TO FINANCE CONSERVATION

Biodiversity can generate value from extractable products, and other values can be derived from the compounds and genetic material produced by living organisms. These products include pharmaceuticals, pesticides, agricultural and personal-care products, such as perfumes and cosmetics. The Instituto Nacional de Biodiversidad (INBio), founded in 1989, has a collaboration agreement with MINAE to conduct a National Biodiversity Inventory, an agreement that regulates the sustainable collection of biological material to increase knowledge of biodiversity in Costa Rica, and to share benefits from bioprospecting between INBio and the Ministry. Within its bioprospecting process, INBio seeks collaborations with international industries and academia which, when implemented, benefit Costa Rica's related conservation and scientific capacity. To the extent that future fundamental research and product development can be carried out by national scientists, Costa Rica is destined to reap more rewards from the enterprise, but even if a product is developed abroad based on a Costa Rican sample, Costa Rica's conservation efforts benefit from up-front payments, technology transfer, know-how, capacity building and eventual royalty streams.

Earnings from a successful new drug can be enormous, justifying the extremely complex, expensive and risky process of drug research. But these potential earnings provide little indication of the potential value of the genetic material in the source country, which can be as little as nothing. Although bioprospecting is only one possible source for such new products, it is a sufficiently interesting one to have attracted some investment from the international business community. The history of INBio collaborations to date is described in Table 5.

INBio Partner	Potential benefits to biodiversity conservation in Costa Rica
Merck	Signed in 1991, the agreement has been renewed twice. Merck provides a research budget, technology and “know-how” transfer in exchange for biological samples. Income from royalties would be devoted to biodiversity research and conservation in Costa Rica. The agreement gives Merck limited exclusive access to samples provided to it.
Recombinant BioCatalysis	Terms similar to those described above. Partners are working with the Center for Molecular and Cellular Biology at the University of Costa Rica to prepare DNA from extreme habitats such as hot volcanic springs. Research is targeting thermostable biological catalysts for chemical processes and medical diagnosis.
Givaudane Roure	Terms similar to those described above. Research is targeting new fragrances and aromas.
USA Govt. sponsored Intl. Cooperative Biodiversity Group (ICBG)	INBio, the Guanacaste Conservation Area and the University of Costa Rica are cooperating with Cornell University and Bristol Myers Squibb to target development of natural compounds from arthropods and mollusks. Terms similar to those described above, but samples are also subjected to screening assays for new anti-malarial, anti-inflammatory and anti-microbial compounds in Costa Rica, giving them locally added value.
INDENA	INBio screens samples for possible applications to phytochemistry and phytomedicine. A large portion of the developmental work is done in INBio labs.
AnalytiCon	AnalytiCon transfers “know-how” and equipment to INBio to support the institute in characterizing natural compounds, and will integrate INBio’s research capacity into its contract research with pharmaceutical companies. Intellectual property rights are to be shared.
BTG-La Pacifica	Using a patent held by the British Technology Group Ltd., this collaboration involves a Costa Rican agricultural company in the process of developing a biological and non-toxic nematicide that could be domestically produced and marketed.

Table 5. An overview of contract terms between INBio and its collaborators with the potential to benefit biodiversity conservation in Costa Rica Adapted from (Nader and Mateo, in press)

Generally, these contracts stipulate that 10% of direct contributions to INBio from collaborators be given to MINAE, and that 50% of any eventual royalties received by Costa Rica would devolve back to SINAC.

The public sector and NGOs are also sources of biodiversity-related revenues to INBio and to Costa Rica; these fund transfers may be seen as a partial proxy for the existence value of Costa Rica's biodiversity. For example, in 1997 an agreement was signed with the Government of The Netherlands for US \$8,300,000 concerning the first phase (4 years) of a project focused on capacity building at INBio, SINAC and other organizations with respect to an awareness of biodiversity and its sustainable use, biodiversity inventory work and ecological mapping of five conservation areas, and biological information management systems. Additionally, a US \$7,000,000-agreement with the GEF and NORAD supports a seven-year project on development of biodiversity resources. The Government of Canada has arranged to relieve Costa Rica of a debt of approximately CDN \$11,356,000, of which one half of this sum is dedicated to the consolidation of the Arenal Conservation Area and the other half, to support INBio's efforts in the areas of bioprospecting, community work and other projects, with a vision of financial independence of the Institute.

Costa Rica has developed a corps of trained rural biodiversity investigators, referred to as parataxonomists. These individuals, mostly young men and women from communities adjacent to the wildlands where they work, are trained in field collection techniques and basic taxonomic research skills. They are the field workers who conduct a substantial component of the National Biodiversity Inventory, in addition to the local and international taxonomists.

The INBio data management system is a sophisticated source of value added to INBio's biological samples. Maintaining strict standards for specimen labeling and tracking, INBio assures that scientists or business people interested in a sample can learn exactly where it came from, and how it was collected, preserved and processed. INBio's database includes, along with taxonomic information, natural history and descriptive information that can be useful to potential product developers as well.

5. Lessons Learned in Costa Rica

Despite the fact that rates of deforestation have dropped in recent years, the policy challenge remains: how can remaining threats of ecological destabilization and forest loss be averted in Costa Rica. While the country has done a great deal to design market instruments that should allow it to monetize some of the values associated with its natural resources, the reality is that these markets are incipient.

5.1. FINANCIAL IMPACTS TO DATE AND LESSONS LEARNED

The overall financial impacts of the initiatives described in this paper can be assessed for a few years. Initial capital flows have included:

- An approximate US \$ 900,000 investment in two forestry JI projects for (less than one fifth of the total project cost). Most of the funding comes from an independent power producer in the United States in response to a requirement of a power purchase agree-

ment to invest a fixed sum of money in carbon offsets. Other organizations donated money for habitat protection for these projects but without transferring CTOs.

- US \$2,000,000 from Norwegian private and public sector JI investment.
- US \$25,000 from a utility in the USA to cover some equipment and research costs for another forestry project, without CTOs in return, and a small amount of funding to cover some pre-implementation costs (for a fuller discussion of these transactions see LeBlanc, 1997)
- Funding resulting from the Merck-INBio agreements are on the order of US \$3,000,000, and from the ICBG project, another US \$1,000,000. Between 1991 and May 1997, INBio has transferred 2,263,826 colones to conservation in Costa Rica. (Mateo, 1997) The other INBio agreements have generated smaller revenue streams to the Institute and MINAE.
- A first-ever contract has recently been signed between Costa Rica and a private hydropower electricity generator, which will use the FONAFIFO mechanism to contract and compensate owners of 6000 ha for watershed protection services. The contract has a net present value of US \$1-\$1.2 million and will result in the transfer of US \$10/ha./yr to FONAFIFO. (Energía Global, 1997)

Experience to date with environmental services payments in Costa Rica suggests that property owners will indeed restrict their land use options and contract to do so for 20-year periods in response to incentive payments of US \$50/hectare. This price has fetched contracts for 20,000 hectares to date under the new Forestry Law of 1996 incentives, and there was enough demand to attract an additional 50,000 hectares had funds been available during 1996. The government has budgeted to contract for another 50,000 hectares during 1997, but early indications suggest that there is actually a demand for 140,000 hectares' worth of incentives. More highly capitalized landowners are expected to require a greater return than will typical small farmers for their willingness to compromise their freedom to log and/or develop their land. It is certainly not the government's goal to contract all the land in Costa Rica, however. The government biodiversity conservation and watershed protection strategy targets specific lands for protection, and, ideally, the policy instruments described in this paper will protect them.

Experience to date with developing a market for bioprospecting confirms the contention of Ten Kate in her thorough survey of pharmaceutical bioprospecting that stakeholders need to identify realistic objectives in the process, and put in place the policies, agreements and mechanisms to secure them (Ten Kate, 1995). Such instruments should be carefully developed in light of contemporary understanding of such issues as intellectual property rights and best ecological practice. Contracts should ensure equitable benefit sharing and, wherever possible, should emphasize capacity development. Institutions should be designed to ensure a reliable natural products supply, including correct taxonomic identification, quality control, full support from government and adherence to regulations on access to resources. Developing country priorities should influence the research agenda, and effects of new product introductions on local economies should be carefully evaluated. Modern biotechnology may soon eliminate or

displace traditional export commodities from developing countries by finding alternatives that can be produced in the northern hemisphere. As a result, developing countries must be vigilant in diplomatic and legislative settings to avoid the patenting and subsequent monopolization of traditional seed and livestock on the part of the biotech industry (Tamayo, Nader *et al.*, in press).

Finally, developing-country policy makers should be conscious of the risky nature of the biodiversity business: tourism is a famously cyclical business and rarely a stable source of revenues; the likelihood of a very profitable "hit" from commercial bioprospecting activity is low; biosuppliers currently receive low prices per sample; there is the potential for fierce competition in the bioprospecting market and it could become saturated – at least temporarily – at any time (Reid, Laird *et al.*, 1993). Additionally, taxonomic expertise on a global level is a limited resource. Should the demand for fully characterized biodiversity continue to grow, the limitations of this resource will become apparent. Given these risks, it would be best for developing nations not to count on revenues from bioprospecting for essential operations or purchases, although it should certainly be seen as an innovative component of a sustainable development initiative.

In closing, it is clear that an understanding now exists between the nations of the world that protecting climate and conserving biodiversity are important goals. The key to fulfilling these goals will be to find ways for developing nations to turn these goods into business opportunities for them and for their citizens. This is what Costa Rica is trying to do with carefully crafted legal and institutional innovations at the national level and through committed advocacy of the related UN Conventions, the CBD and the UNFCCC, as international treaties for environmental protection.

References

- Asamblea Legislativa de la Republica and Gobierno de Costa Rica: 1996. 'Ley Forestal No. 7575.' *Alcance No. 21 a La Gaceta No. 72*. San José, Costa Rica: 1-8.
- Barrantes, G. and X. Morice : 1995. *Estudio de la Competitividad de la Ganadería frente a la Actividad Forestal*. San José, Costa Rica, Facultad de Ingeniería, Escuela de Ingeniería Industrial, Universidad de Costa Rica.
- Bermudez, Fernando: 1997. *Tesis: Propuesta de Variables para Definir Tarifas de Ingreso a las Areas Silvestres Protegidas para Visitantes No Residentes*. San Jose, Costa Rica. *Administracion de Empresas y Actividades Turisticas*, Universidad Internacional de las Americas.
- Carranza, C. F., B. A. Aylward, et al.: 1996. *Valoración de los Servicios Ambientales de los Bosques de Costa Rica*. San José, Costa Rica, Centro Científico Tropical.
- Calvo, J.C., C. Quesada, et al.: 1998. *Estudio de Cobertura Forestal de Costa Rica empleando Imágenes LANSAT 1986-1987 y 1996-1997*. San Jose, Costa Rica. Centro Científico Tropical, CIEDES- Universidad de Costa Rica y Conservation International.
- Constantino, L. F. and N. M. Kishor: 1993. *Forest Management and Competing Land Uses: An economic analysis for Costa Rica*. Washington, DC, The World Bank.
- Energía Global: 1997. Internal Memorandum.
- García, R.: 1996. *Propuesta Técnica de ordenamiento territorial con fines de conservación de la biodiversidad*. San José, Costa Rica, MINAE, SINAC.
- LeBlanc, A. (In Press). *An Emerging Host Country Joint Implementation Regime: The Case of Costa Rica*. Washington, DC, The World Bank.

- Mateo, N.: 1997. 'The INBio Pilot Project: A new approach to biodiversity management.' In: *The Globalization of Science: The Place of Agricultural Research*. C. Bonte-Freidheim
- MINAE: 1997. National Proposal for the Territorial and Financial Consolidation of Costa Rican National Parks and Biological Reserves, with the Costa Rica EARTH Council Foundation, the Costa Rican National Parks Foundation, the United States Earth Council Foundation and Centre Financial Products Ltd.
- MINAE: 1997. No. 25828-MINAE. *La Gaceta No. 40*. San José, Costa Rica: 3.
- MIRENEM, Museo Nacional de Costa Rica, et al.: 1992. *Estudio Nacional de Biodiversidad: Costos Beneficios y Necesidades de Financiamiento de la Conservación de la Diversidad Biológica en Costa Rica*. San José, Costa Rica.
- Nader, W. and N. Mateo (In Press). 'Biodiversity; Resource for New Products, Development and Self Confidence.' *Proceedings of the International Symposium on Biodiversity, Bonn, 1996*. W. Barthlott. Heidelberg, Germany, Springer Verlag.
- Olson, N. (In Press). *Environmental Sustainability Aspects of Tourism in Costa Rica*. Alajuela, Costa Rica, Center for Competitiveness and Sustainable Development, INCAE.
- Reid, W. V., S. A. Laird, et al. (1993). *Biodiversity Prospecting: Using Genetic Resources for Sustainable Development*. Washinton, DC, World Resources Institute.
- SGS: 1997. *Certification of the "Protected Area Project" (PAP) in Costa Rica for OCIC (the Costa Rican Office for Joint Implementation)*. Oxford, United Kingdom. SGS Forestry.
- SINAC: 1997. *Situación de las Áreas Silvestres Protegidas de Costa Rica. Sistema Nacional de Áreas de Conservación*. San Jose, Costa Rica. Ministerio del Ambiente y Energía.
- Tamayo, G., W. Nader, et al. (In Press). 'Biodiversity for the Bioindustries.' *Biotechnology and Plant Genetic Resources: Conservation and Use*. B. F. Ford-LLOYD, H. J. Newbury and J. A. Callow. Wallingford, Oxon, England, CAB International.
- Ten Kate, K.: 1995, *Biopiracy or Green Petroleum? Expectations and Best Practice in Bioprospecting*. London, UK, Overseas Development Administration.
- The Center for Clean Air Policy: 1995, *Wisconsin's Strategy, Phase Two: Cleaning the Air, Protecting the Climate, Sustaining the Economy; Executive Summary*. Report to Governor Thompson by the Southeast Wisconsin Dialogue Group and Analysis by the Center for Clean Air Policy of Greenhouse Gas Emissions Reduction Strategies. Washington, DC, USA, The Center for Clean Air Policy.