INT-0205
C. 1

SEMINARIO INTERNACIONAL – ECOTURISMO:
POLÍTICAS LOCALES PARA OPORTUNIDADES GLOBALES

Organizado por la CEPAL y la Corporación Nacional Forestal (CONAF)

Santiago de Chile, 24 y 25 de mayo de 2001

LOCAL COSTS, GLOBAL BENEFITS: VALUING BIODIVERSITY IN DEVELOPING COUNTRIES

John A. Dixon and Stefano Pagiola
Environment Department, World Bank

Las opiniones expresadas en este documento son de exclusiva responsabilidad de los autores y pueden no coincidir con las de los organizadores del Seminario..

OECD –forthcoming (2001)

Local Costs, Global Benefits: Valuing Biodiversity in Developing Countries

John A. Dixon
Stefano Pagiola
Environment Department, The World Bank

The views expressed in this paper are the authors' own and do not necessarily represent those of the World Bank Group.

5 May, 2000

The question of the conservation of global biodiversity presents an interesting paradox: although biodiversity provides us with many benefits – and, indeed, may be indispensable for our very existence – it is being lost at unprecedented rates.

Biodiversity, and the ecosystems that contain it, provide benefits at multiple levels (Daily, 1997). Locally, it provides benefits to farmers, villagers, and other landusers such as harvestable products and services such as crop pollination. Nationally, it provides benefits such as hydrological regulation and water purification to populations living downstream. Globally, it provides benefits such a carbon sequestration and genetic information. Why, then, is biodiversity so threatened? Why are we not doing more to protect it?

To the extent that biodiversity produces benefits at the local level, individual land-users and countries have an incentive to conserve it. Likewise, national governments have an incentive to provide the resources needed to protect biodiversity to the extent that it provides benefits at the national level. Neither local land-users nor national governments, however, have any incentive to protect the global benefits provided by biodiversity. Moreover, even at the national level, the benefits provided by biodiversity are often very poorly understood – if at all. As a result, national governments all too often view biodiversity conservation in terms of the development options that must be given up to ensure conservation. At the local level, land-users receive but a small fraction of the total benefits of biodiversity. Conversely, the forgone benefits of biodiversity protection – in terms of increased agricultural or livestock production, or the cutting and sale of forest products – loom large to the local population.

Hence the paradox: biodiversity conservation is usually "underprovided" by the market – that is, market forces will lead to more conversion of habitat, and biodiversity loss, than would be either optimal or economically justified, precisely because of the divergence between local costs and global benefits. This situation is illustrated in Figure 1, which shows the sets of land-use that would maximize local, national, or global benefits. In an ideal world, these three sets would coincide. In practice, the overlap between these sets is only partial: activities that maximize local benefits overlap only partially with those which maximize national or global benefits (the area LNG in Figure 1).

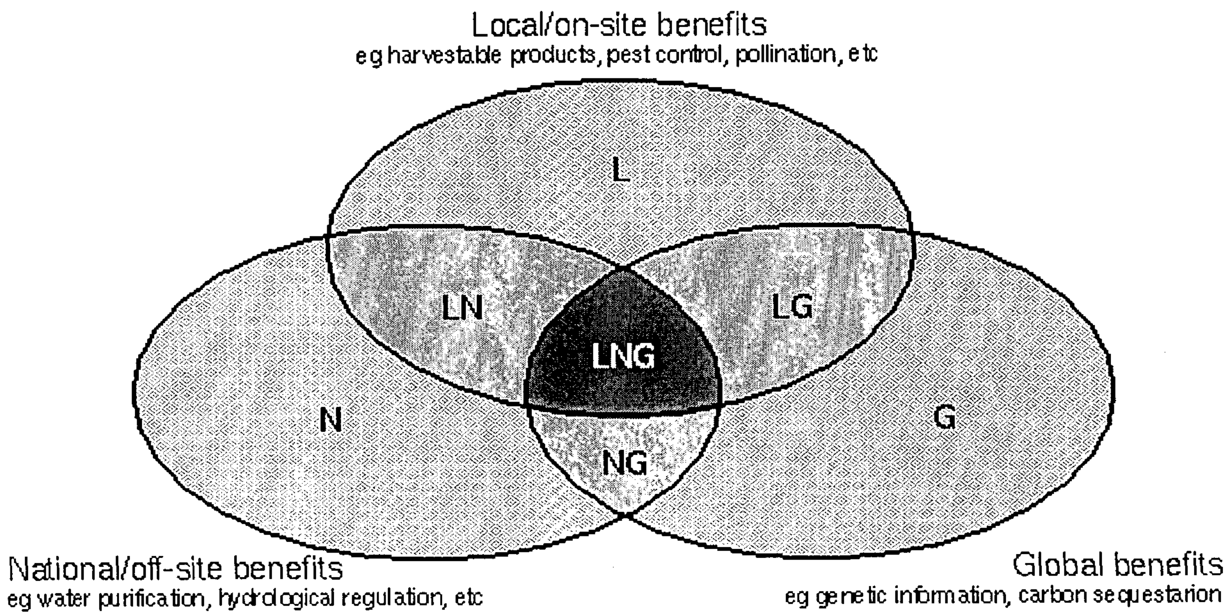

Figure 1. Benefits of Biodiversity Use at the Local, National, and Global Level

What role can economics play in understanding this dilemma and illuminating the trade-offs inherent in biodiversity conservation decisions, and what are the policies that are likely to help resolve this conflict? This paper discusses these issues and illustrates some of the approaches being tried in a number of countries. At the international level, the role of the Global Environment Facility (GEF) as one means of bridging this gap is also described. (Additional discussion on valuing biodiversity can be found in the chapter by Pearce in this volume.)

A Question of Values

Biodiversity is notoriously difficult to define, let alone measure. In light of these difficulties, it should come as no surprise that estimating its value is extremely difficult. A helpful first step is to decompose the many benefits that biodiversity provides. This can be done, for example, by using the Total Economic Value (TEV) framework (Pearce and Warford, 1993). As can be seen in Figure 2, the TEV concept recognizes that the value of biodiversity depends on the total benefits provided by each of a series of types of benefits, which range from the very tangible 'direct use' values (e.g. biodiversity as a producer of medicines, genetic stock for agricultural production, or actively experiencing an ecosystem or particular plant or animal species), through a series of increasingly less tangible 'indirect use' values (e.g. watershed protection, or storm protection from coral reefs), to completely intangible 'non-use' values (eg the pleasure people derive from the knowledge that biodiversity in general or certain specific components such as charismatic species exist). There is a dotted line between the Non-Use Values and Option Value, since this component of value straddles the two broad groupings.

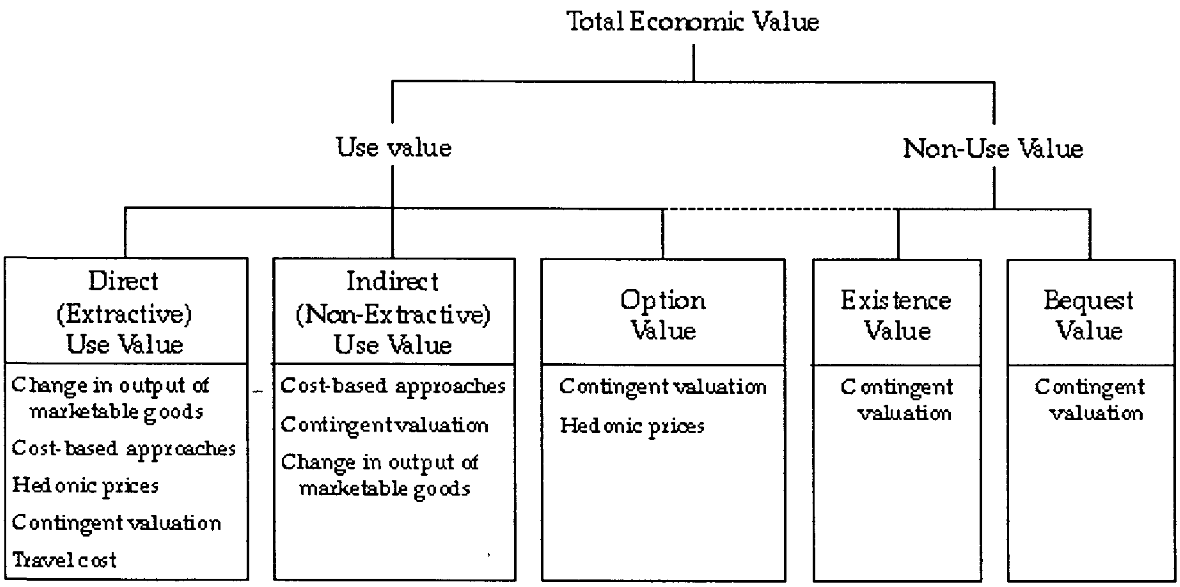

Figure 2. Total Economic Value and Valuation Techniques

Decomposing the value of biodiversity into components helps to avoid the common trap of calling biodiversity 'invaluable.' At one level, biodiversity could certainly be said to be infinitely valuable, since life would be impossible without it. But most decisions do not concern choices between complete preservation or complete destruction of biodiversity, but rather small changes in the level and quality of biodiversity. Thus, estimates such as those by Costanza *et al* (1997) that the world's ecosystems are worth some US$33 trillion are of very little use even if they are correct – which in this particular case they are unlikely to be (Toman, 1998). Most current economic work is aimed at giving more precise quantitative answers to more narrowly defined – and more policy-relevant – questions. Although such answers will of necessity not include all 'values', they can often be a useful starting point for fuller analyses of the economic values of biodiversity conservation.

Economic valuation techniques exist to measure all of the many component values of biodiversity, some with greater degrees of confidence than others (Dixon *et al.*, 1994). The distinction can also be made between biodiversity *per se* (biological or genetic material) and biological resources. Biological resources are often easier to identify and value and include many of the goods and services produced by healthy ecosystems. In this paper the terms are often used interchangeably. Figure 2 shows some of the techniques which might be used for each type of value. Assuming the necessary data are available, many **use values** are relatively straightforward to estimate. In the case of products that are harvested directly, the biggest constraint is generally in obtaining accurate measurements of the quantities harvested. In addition, it is often difficult to determine whether current harvest rates are sustainable or whether they are degrading the biodiversity upon which the harvests depend. Considerable work has also been undertaken on valuing recreational use, and we now have several analytical techniques at our disposal, such as travel costs and contingent valuation (CV) studies, that can place fairly precise economic values on such use. Even in these cases, however, the '**option value**' of preserving potential future uses of biodiversity is difficult to assess. An interesting example of the application of these approaches to value non-timber forest benefits in Turkey is given in Box 1.

Box 1. Value of Turkey's Forests

A recent review of the non-timber benefits provided by Turkey's forests (Bann and Clemens, 1999) illustrates both the TEV technique and – although the study was not intended to value biodiversity *per se* – the value of some of the services provided by the biodiversity they contain. As can be seen in the table below, the non-timber benefits of Turkish forests – many of which depend on biodiversity – are substantial at the local, national, and global levels, and exceed the timber benefits, which are of about US$26/ha/year. Equally clearly, however, decisions which focus on only one of these levels will omit important additional benefits, and so will tend to under-protect forests.

Estimated lower-bound of non-timber benefits from Turkish forestland

		US$/ha/year
Mainly local benefits:	Non-wood forest products	18.4
	Wildlife	2.0
	Recreation	0.1
	Informal fuelwood	2.2
Mainly national benefits:	Watershed protection	7.4
Mainly global benefits:	Carbon storage	26.0
	Genetic resources	5.0
Total		**61.5**
Additional values associated with protected areas		2.6

Note: All estimates are lower-bounds, and dependent on the assumptions described in the paper. Estimates are average expected benefits for the entire forested area (18 million ha) except for the additional benefits from protected areas, which apply only to the 2.5 million ha of protected forests.

Adapted from Bann and Clemens, 1999.

Other values associated with biodiversity can be frustratingly hard to assess. For example, the genetic information contained in intact ecosystems is often identified as an important benefit of biodiversity. However, both the extent of this information and its potential future usefulness are largely unknown, making it hard if not impossible to place an economic value on it. The potential benefits from as yet undiscovered genetic information is included in the economists' notion of **'quasi-option value'**, which arises from the desire to preserve a resource in the expectation that as information and knowledge develop, we can learn more about the values of the resource and whether or not we want to preserve it. How much should we be willing to pay for this, however? The record of actual payments from potential users of this information, such as pharmaceutical companies, is hardly encouraging. Even in Costa Rica, which is a megabiodiversity country with well established protected areas and an internationally known biological research center (INBio), actual payments for the option of the use of this biological information is only several million dollars in total – hardly the sorts of sums that are likely to meet the opportunity costs of protecting significant areas of tropical ecosystems![1]

The last major categories of non-use value are **existence value** and **bequest values.** Existence values arise from he pleasure people derive from the existence of biodiversity, even if they do not plan to use it. This value and can be important, especially for charismatic species such as elephants, pandas, whales, or tigers, and for special, unique ecosystems such as certain pristine mountain, arctic, forest or coastal areas. Bequest values are those values that come from leaving something for our children and future generations. Because existence value reflects

[1] There are some interesting, and instructive, parallels between prospecting for oil and 'prospecting' for biodiversity. In the case of oil, companies pay very large sums for prospecting rights. These costs often total 80% of total production costs. In contrast, actual payments for biodiversity 'prospecting' have been very small. Part of this difference arises from the high degree of certainty on the market value of oil, once found. In the case of biodiversity, in contrast, there is uncertainty over both discovering new genetic material, and over its value if found. In addition, the time horizon from new discovery to commercial sales may be very long. All of these factors result in a much lower willingness-to-pay for biodiversity prospecting rights as compared to oil and gas prospecting rights.

preferences which are not reflected in any market behavior, survey-based methods such as CV are the sole means of measuring it.[2]

As a result of these problems, there are obviously differing levels of confidence in economic estimates for different resources and for different countries. Table 1 lists selected important uses and values associated with biodiversity and the level of confidence in the economic value estimates for each. In general the level of confidence is highest for direct-use, consumptive uses (often of biological resources rather than biodiversity *per se*). Here one usually has a definite P (price) and Q (quantity). The lowest level of confidence is for existence or option values for genetic material, not surprising since the level of certainty here is also the lowest.

Table 1. Levels of Confidence in Estimates of the Economic Value of Biodiversity

Direct use values	High
Tourism/ recreation	Medium
Ecosystem services	Low-Medium
Existence/ option values (individual)	Medium
Existence/ option values (genetic)	Very low-Medium

It is interesting that there are many similarities between biodiversity valuation and another new valuation area – the valuation of cultural heritage (Pagiola, 1996). In both cases, much of the measurable value resides in various direct or indirect uses by individuals and societies, not in intrinsic structural values. There are a number of parallels: both biodiversity and cultural heritage are often said to be 'invaluable', both 'use' and 'non-use' values are common, there are a number of difficult valuation areas, and there is wide-spread uncertainty and examples of market failures.

Values for Whom?

Simply measuring the benefits provided by biodiversity – no matter how accurately we may be able to do so – will not be sufficient to ensure its preservation. What matters is the incentives faced by individual decisionmakers – such as the farmers who decide what crops to plant and what inputs to use, whether to increase their cultivated area by clearing some forests,

2 A vast literature has developed on contingent valuation techniques. Although the technique has long been controversial, a 'blue-ribbon' panel composed of several Nobel prize winners found that, properly used, it can lead to reliable estimates of existence value (which the panel called 'passive use' value). The report of this

and which and how much of an ecosystem's products they will harvest. These, and many other decisions that affect biodiversity, will be made by individual decisionmakers in light of their own objectives and constraints and not according to any theory of the social good.

As indicated in Figure 1, many nationally-important benefits of biodiversity may not be felt at the local level, and so are likely to be ignored by local decisionmakers. Consider the case of farmers deciding whether to clear a particular area of natural habitat – thus destroying the biodiversity it contains – for agricultural use. In making this decision, they would certainly consider the net benefits they expect to derive from increased crop production. They may also consider the loss of some goods and services from the uncleared area, such as fuelwood or pasture for livestock, since converting the area would mean having to find alternative sources of fuel and fodder. They will almost never consider the loss of benefits such as watershed protection, however, since they will not bear ensuing costs of downstream flooding and sedimentation – these costs will be borne by people living far downstream. In some cases, activities designed to maximize local benefits will happen to coincide with those that maximize national and/or global benefits. In many cases, however, they will not.

It is important to understand that this divergence is not due to ignorance *per se* (although it may well be that local land-users have no knowledge of the downstream consequences of their actions). Rather, it is a perfectly rational response to the incentives they face.

It is also important to understand how government policies affect biodiversity. In doing so, it must be borne in mind that only a few of the decisions that affect biodiversity directly are made by governments. Rather, government policies are important because they can have a significant—albeit often inadvertent—influence on the actions of individual decisionmakers both directly (through legislation, regulation, zoning ordinances) and indirectly (through taxation, subsidies, price policies).

In an effort to help bridge the gap between local costs and global benefits, new ways are required to help increase the amounts that individuals or countries are willing to pay for protection of various national or global (or non-local) benefits. This is equivalent to expanding the overlap between the local/on-site benefit space in Figure 1 (and hence increase the overlap found in those areas identified as LN, LG, and LNG). Three ways of doing this are considered:

---

panel (NOAA, 1993) is generally regarded as authoritative on appropriate use of the technique. For an overview of recent work in this field, see Carson (1997).

Payment for national environmental services; payments for global environmental services, and the use of tourism/ecotourism to generate increased local economic benefits. In each case the objective is the same: increase the perception at the local level of the amount of biodiversity conservation that is justified because it generates "local" economic benefits.

Paying for Environmental Services

Concern over the loss of valuable ecosystem services and the increase in problems such as reservoir siltation and downstream flooding has led many governments to attempt to encourage land uses that preserve these services. Some governments adopted legislation and regulations intended to prevent land users from undertaking degrading activities or to compel them to adopt conservation practices, while others opted to subsidize the adoption of particular practices. The results of these efforts have often fallen far short of expectations. Land use rules have proven exceedingly difficult to enforce because of the vast spatial dispersion of agricultural activities and the often weak enforcement powers available to developing country governments. Subsidies have often succeeded in stimulating the adoption of conservation measures, but farmers frequently abandon their use – and sometimes actively destroy conservation structures – once subsidies cease (Pagiola, 1999; Lutz, Pagiola, and Reiche, 1994). At other times, efforts to encourage conservation have achieved only token cooperation by farmers (Enters, 1997).

In recent years, recognition of the problem and of the failure of previous approaches to dealing with it has led to efforts to develop systems in which land users are compensated for the environmental services they generate. In this way, land users would have a direct incentive to include these services in their land use decisions, resulting in more socially-optimal land uses. The logic behind this approach is shown in Figure 3: by paying local land-users for the environmental services they generate, the overlap between land uses that maximize local and national benefits is increased (as seen by the increased area found in LN and LNG in Figure 3).

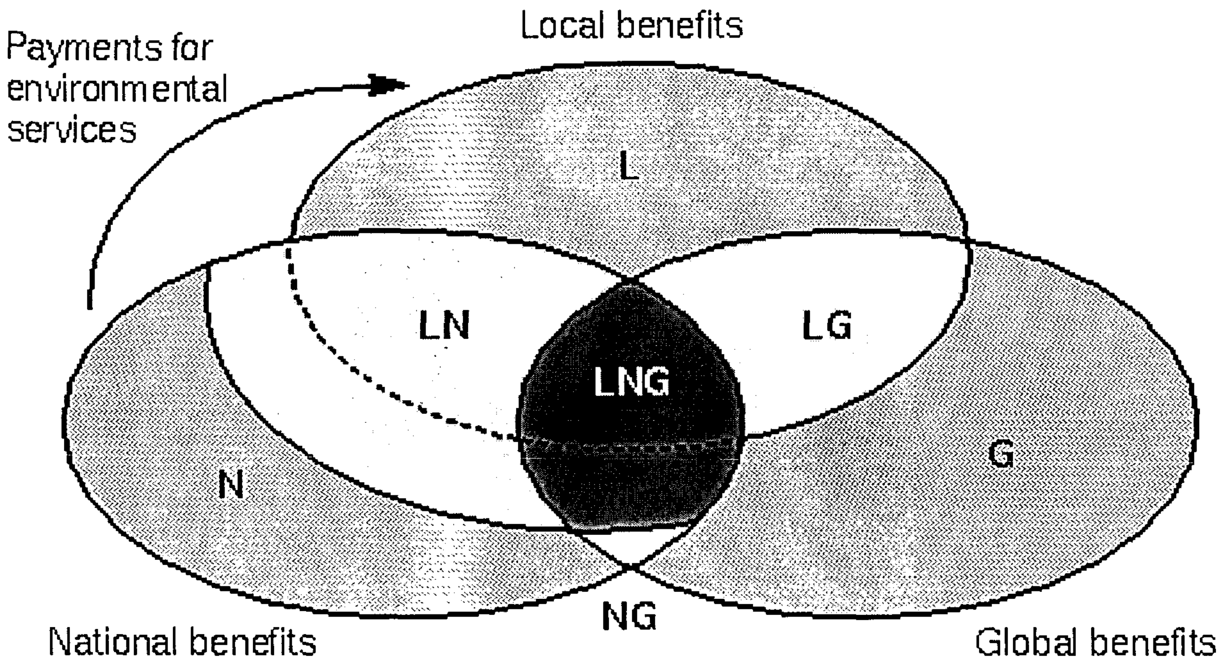

Figure 3. Using Payments for Environmental Services to Increase Local Incentives to Conserve Biodiversity

Reid (forthcoming) discusses the potential for capturing part of the value of ecosystem services to finance biodiversity conservation efforts, and argues that there is significant scope for doing so, especially in the case of services associated with water quantity and quality carbon sequestration, while the scope for capturing part of the benefits of services such as pollination, pest control, waste treatment, and flood and storm protection, is more limited.

This approach is not a panacea, however. In some cases, the desired environmental services can be generated by land uses which bring limited or no benefits in terms of biodiversity conservation. For example, forests logged with sustainable logging practices might provide the same hydrological services as intact primary forest, but have much lower biodiversity (Bruijnzeel, 1990; Hamilton and King, 1983)

In Central America, the payment for land use changes to increase carbon sequestration and provide other benefits has been pioneered by Costa Rica (Castro *et al.*, 1997; Chomitz *et al.*, forthcoming). Under the 1997 Forestry Law, land users can receive payments for specified land uses – including new plantations, sustainable logging, and conservation of natural forests – which are intended to generate a variety of environmental services, including regulation of hydrological flows, biodiversity conservation, and carbon sequestration. Since 1995, over 200,000ha have been incorporated into the program, at a cost of about US$47 million. Other

Central-American countries are adopting similar approaches (Pagiola, 2000). Costa Rica is now extending this approach to the local level. In another recent development, in April of 2000, Costa Rica approved a law that established a trial "environmentally adjusted water tariff" the proceeds of which will be used to help maintain watershed areas near Heredia. This payment for local environmental services is notable since it is a transfer from downstream beneficiaries (the user of water and payers of the water tariff) to upstream resource managers.

Paying for Global Environmental Services

Just as local land users have no incentive to conserve biodiversity except insofar as it generates local benefits, national governments have no incentive to conserve biodiversity except insofar as it generates national benefits. The Global Environment Facility (GEF) was created to help fill this gap. The GEF provides grant financing to countries to undertake activities that generate global benefits, such as biodiversity conservation, but which are not in the country's direct interest. The logic here is similar to that of national governments attempting to encourage activities that generate national benefits: by providing grant financing, the GEF increases the overlap between activities that generate global benefits and those that generate local and national benefits (Figure 4). Since 1992, the GEF has provided over US$400 million in financing for biodiversity conservation through the World Bank alone.[3]

[3] The World Bank is one of three implementing agencies for the GEF. Additional GEF financing for biodiversity conservation has been channeled through the other two implementing agencies, the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP). During the same time period, the World Bank and its soft-loan window, IDA, provided an additional US$750 million in financing for biodiversity conservation (World Bank, 2000).

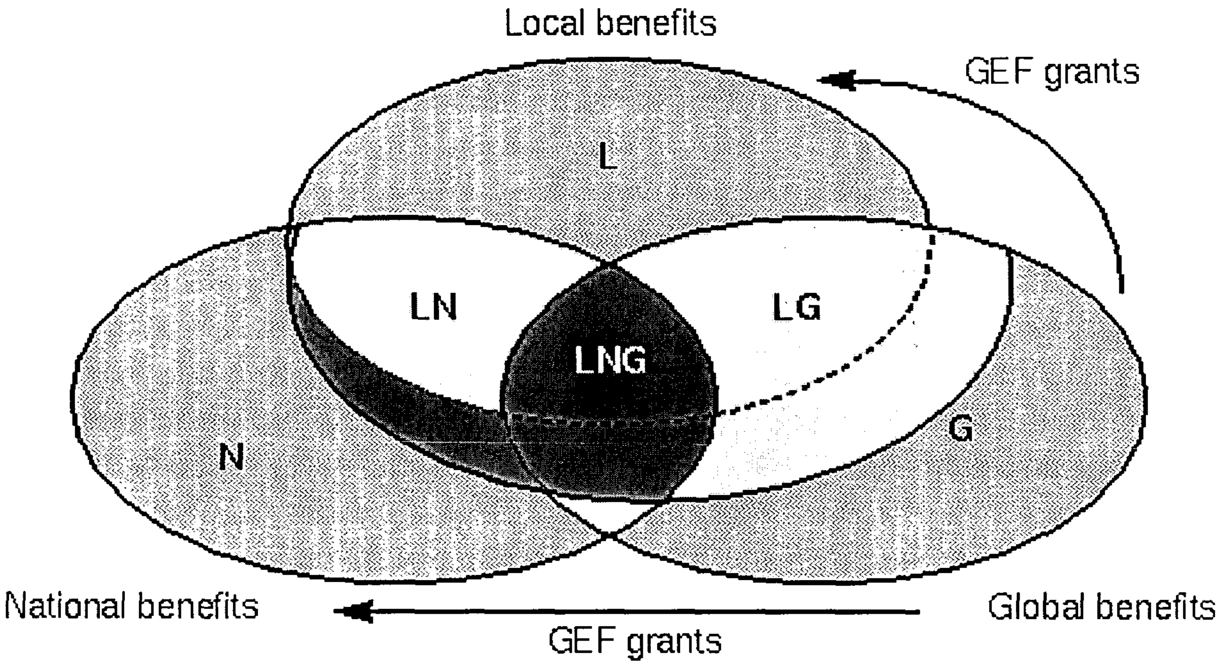

Figure 4. Using GEF grants to Increase Local and National Incentives to Conserve Biodiversity

The GEF is not the only organization paying for global environmental services. Many conservation NGOs have financed the acquisition or management of protected areas. Some commercial organizations have also played a role. Merck and other pharmaceutical companies, for example have established contracts with Costa Rica's National Institute of Biology (INBio) that gives them exclusive rights to first use of selected genetic material in exchange for support for INBio's program of collection and analysis of genetic material. Unfortunately the amounts generated by this program have been modest – usually several million dollars per contract spread over a number of years – and would not be sufficient in and of themselves to provide compensation to local populations who are asked to forgo conversion options in order to maintain these ecosystems intact.

In a 1998 GEF project, the World Bank provided grant funds to Costa Rica to INBio to help support its work on biodiversity resource development. The economic analysis of the project estimated the additional national benefits to Costa Rica from the proposed activities and supported only those costs that were not offset by increased national benefits (World Bank, 1998). The analysis found that the limited increase in national benefits, largely from additional tourism, with smaller amounts from new bioprospecting contracts, would yield less that US$0.13 million per year. In contrast the proposed project would cost more than US$1.0 million per year.

Hence the increase in economic benefits that Costa Rica would receive from the project activities were small (less than US$0.9 million) over the seven year life of the project, and almost all of the project costs were thus eligible for GEF financing. In essence, this is an international payment to Costa Rica for providing global benefits above what it would be justified in doing itself from a national benefit-cost perspective.

Ecotourism as a Way to Generate Local Benefits

As long as the benefits local decisionmakers derive from biodiversity are limited primarily to extractive use, their incentive to conserve it will remain limited. Ecotourism[4] has been seen as a way of solving this problem by generating income from aspects of biodiversity and biological resources which had hitherto been of little local interest, and so helping to bridge the gap between local costs and global benefits (Dixon, 1999; Brandon, 1996). With tourism in general and ecotourism in particular growing rapidly worldwide[5], considerable hopes have been placed on this solution. The reality, of course, has often fallen short of these high expectations. Rather than seeing ecotourism as a panacea, it is more useful to ask to what degree, and under what conditions, ecotourism can help meet the twin challenges of biodiversity conservation and local income generation.

Type of tourists. The potential for ecotourism to generate income from biodiversity obviously depends on the type and number of tourist concerned. As noted, the 'ideal' ecotourist is often thought to be low-impact and high-spending. Even when such an ideal ecotourist exists, however, there are some important trade-offs to be considered. For example, visitors to Rwanda's Parc des Volcans paid several hundred dollars per person in entrance fees, plus substantial additional amounts for supplies, to visit the area inhabited by the mountain gorillas made famous by naturalist Dian Fossey. Because the need for low impact resulted in a very low

4 Definitions of ecotourism have varied substantially. While some use the term very broadly to cover any form of tourism in which nature-based activities are important, others make a sharp distinction between ecotourism and 'nature-based tourism'. The Ecotourism Society (TES) defines ecotourism as "travel to natural areas that conserves the environment and sustains the well-being of local people". Brandon (1996) emphasizes that ecotourism must be small scale "with limited ecological and social impacts."

5 No specific data are collected on ecotourism, and so estimates of its importance, both in terms of numbers and economic impact, vary substantially. The Ecotourism Society estimates the number of nature tourists in 1994 at 211-317 million, and the number of wildlife-related tourists at 106-211 million. Note that the two definitions provided focus solely on the *purpose* of the trip, and say nothing about some of the other aspects contained in the Society's own definition of ecotourism. Note also that these purposes are themselves defined extremely broadly, and that it is not clear whether the two categories are meant to be mutually exclusive or if, for example,

permissible number of visitors, however, the total revenue generated was very low (and even at these low numbers, Fossey believed the impact was unacceptably high). In general, though, the number of tourists willing to pay large amounts is likely to be small and – as ecotourism destinations multiply around the world – spread thin. Generating sufficiently high levels of revenue may thus require attracting a larger number of tourist, which is likely to have a higher impact on biodiversity, both from the larger numbers of visitors and from the infrastructure they require. This does not automatically mean that mass-based tourism is the only viable option. While small-scale tourism may generate low total revenues, it may also have lower costs, since mass-based tourism is likely to require substantially greater investment in support infrastructure (such as transport and lodging). Whether *net* revenues are higher with a small number of higher-paying tourists or a large number of lower-paying tourists will vary from case to case.

Type of ecosystem. The sensitivity of different ecosystems to visitation can vary substantially. Sites such as the Parc des Volcans in Uganda are very sensitive to outside intrusions, and will quickly deteriorate if mismanaged. Other sites are much more resilient. Thus, while the mountain gorillas of the Parc des Volcans are easily disturbed even by low levels of visitation on foot, wildlife in Kenya's Masai Mara is often all but oblivious to gaggles of minibuses. This is not to say that sites such as the Masai Mara cannot be damaged — perhaps irreversibly so — if mismanaged, but that the requirements for "low impact" visitation differ.

Type of site. Depending on the nature of the site, different types of visits will be most appropriate. Some will hold visitors' interest over several days, while others will only attract visitors for a few hours. Sites with particularly unusual or popular attractions may bring in tourists from far away, while others may be visited only as an adjunct to a different trip.

Depending on the specific situation both the ideal and the feasible trade-offs will differ greatly; it would be wrong, therefore, to expect that a unique 'ecotourism' solution exists which would work in every case. The extent to which the objectives of biodiversity conservation and local income generation can be met will likewise vary substantially.

Involving local populations. Even if ecotourism does generate high net revenues, this will not necessarily contribute to biodiversity conservation unless a large proportion of these revenues is retained locally. In most countries, however, the funds collected by entrance fees,

---

wildlife-related tourists are a subset of nature tourists. These kinds of problems bedevil all available statistics on ecotourism.

tourist taxes, and other mechanisms are often channeled to the central government with only a small proportion, if any, remaining on-site. Likewise, the benefits of economic activities supporting ecotourism (lodging, food, transport) are often captured by economic agents from outside the immediate area. Involving local stakeholders is both practical and equitable. Since a primary challenge is to enlarge the circle of benefits that the local population is willing to help provide (see Figure 1), the active planning of biodiversity conservation with local populations is essential – both to obtain their support for the effort, but also to make sure that they share in the generation (and capture of) economic benefits.

The case of the Mantadia National Park, Madagascar, is one example (see Box 2). In another example, villagers living around the Royal Chitwan National Park in Nepal, the habitat for the endangered Indian rhino and other threatened species, are allowed into the park on certain times each year to collect grass for roof thatch. In this way the villagers benefit from protection of the ecosystem, and the rhino and tall grasses, while restricting their encroachment into the National Park. Such symbiotic approaches are increasingly finding favor with protected area managers around the world.

Box 2. Ecotourism in Mantadia National Park, Madagascar

Madagascar is one of the world's 'mega-diversity' countries, with both a very high level of biodiversity and high rates of endemism. This rich biodiversity is an important factor in attracting tourists from all over the world, but has been under considerable stress from conversion of natural habitats to alternative uses. The government is attempting to protect biodiversity by creating a system of protected areas. The government, however, lacks the budgetary resources necessary to cover the expenses of park maintenance and to compensate local communities for the losses they bear as a result of the creation of protected areas. A set of studies carried out in the early 1990s examined the benefits tourists obtained from visiting national parks in Madagascar, as well as the cost to local communities of giving up their traditional uses in areas brought into the protected area system (Kramer *et al.*, 1993).

Two different methodologies were used to estimate the benefits tourists would obtain from the creation of a new national park at Mantadia. The travel cost method, which uses information on the costs borne by tourists to visit a location to derive their demand curve for the location, and hence the enjoyment they receive from visiting it. The contingent valuation method, in which visitors are asked directly for their willingness to pay for such visits, was also used. Both methods have their strengths and weaknesses, but both gave similar estimates of the benefits, namely about US$24-65 per trip. Assuming that the number of visitors to this new park is about the same as in neighboring parks, the total benefit generated would be about US$0.8-2.2 million.

The costs to local communities of losing their traditional access to the protected area were also estimated in two different ways – using contingent valuation, and by estimating the opportunity cost of lost income from the park area. These methods also gave very similar estimates of costs of about $90-110 per household, for a total cost of about $0.6-0.7 million. It would thus seem that even at the lower end of likely tourism benefits, income might be sufficient to compensate local communities. Some of this compensation will occur indirectly, through employment and other income opportunities generated by tourism, but it will also be necessary to capture at least a portion of the tourism benefits directly and to redistribute them to local communities. How much of this benefit the park is ultimately able to capture will depend partly on the approach adopted, and on the desires of the tourists.

Conclusions and Recommendations

Recent years have seen a considerable expansion in the use of economic valuation of biodiversity and biological resources, both in the academic literature and in operational work such as in World Bank projects. Considerably experience has been accumulated in the use of a variety of valuation techniques to estimate the benefits of various components of the total economic value of biodiversity. These techniques tend to be most robust when used to estimate direct-use values, but non-use values can also be estimated (although with less certainty in many cases). In many cases there are 'best practice' examples of the applications of these approaches and they are increasingly being used for decision making by governments. Although many conceptual, methodological, and empirical problems remain, these techniques often provide valuable assistance in deciding specific, well-defined operational questions.

Valuation by itself is not sufficient to guarantee that biodiversity will be conserved. First, it may well be that in certain specific instances biodiversity conservation is in fact more costly than alternative courses of action, even when all the many benefits of biodiversity are accounted for.

Perhaps most important, however, valuation alone will not save biodiversity if it remains an academic exercise. What matters is the incentives that individual decision makers have to conserve or not to conserve individual bits of biodiversity – the actual costs and benefits they will receive from conservation compared to alternative courses of action. Often, these decision makers stand to gain only a small part of biodiversity's total benefits, while they stand to gain the full benefits from alternative courses of action such as clearing virgin forest for agricultural use. And so they quite understandably will tend to underprotect biodiversity. *Mechanisms must thus be found by which at least part of these broader benefits of biodiversity are channeled to the local level where actual resource use decisions are made.* Systems of payments for environmental services and GEF grants are two such mechanisms, which aim to preserve the national and global benefits provided by biodiversity, respectively. Developing ecotourism is another mechanism.

The process of implementing these incentive measures is complicated and time is often an enemy of biodiversity conservation. Three broad lessons flow from the previous statements:

1. **Avoid extinction and other irreversible actions.** Once a species is extinct, or a unique habitat is destroyed, we will never know what we have lost (or its potential economic or scientific value). When irreversible actions are possible the cautionary principles of the Safe Minimum Standard (SMS) and the use of the Opportunity Cost approach are helpful (see Ciriacy_Wantrup, 1952, or Bishop , 1978, for a fuller discussion of the cautionary principle.)

2. **Capture important direct use values, especially from tourism and other non-consumptive uses of biological resources.** Since a major challenge is to increase the generation of economic benefits from biodiversity conservation, sometimes the easiest (and potentially most lucrative) approach is to capture a larger share of the economic rents associated with various direct uses (both consumptive and non-consumptive) of biological resources. This both helps to generate economic returns, and also demonstrates to decision makers that there are concrete (and capturable) economic values associated with these resources.

3. **Identify and attempt to capture part of the non-use values associated with biodiversity conservation.** Although harder to do than capturing rents from users of the resource, there is a substantial willingness-to-pay for certain types of biodiversity and biological resources. These altruistic payments (whether they are for bequest or existence values, and somewhat for option values) can be important sources of income that can help offset some of the local costs of biodiversity conservation. The major problem with this aspect is that non-use values may be small, and may heavily favor certain "charismatic" species, rather than those in greatest need or of greatest potential scientific values.

Final Thoughts on What Can be Done

We started this paper by saying that there was a paradox between the amount of biodiversity that would be provided by the market due to the divergence between local costs of conservation and the national and global benefits provided from the same biodiversity and associated habitats. Even if the latter benefits greatly exceeded the local costs, unless there is a change in the accounting framework (or a mechanism to capture part of the national and global benefits and transfer them to offset local costs) we will end up with less biodiversity conserved worldwide than is optimal – from either a scientific or economic perspective.

We see that economic valuation has an important role to play in identifying and quantifying some of these values. However, in most cases, those parts that we can value(various forms of direct use values, both consumptive and non-consumptive), are often not the most important components or what is potentially the most valuable (genetic material, genetic diversity, the "unknown" discovery). In this situation, how does one set priorities for biodiversity conservation, especially when there are limited quantities of financial and human resources available and more demands for conservation than can be financed.

Two options can be offered:

First, there is an important role for various sorts of expert opinion to select priority areas (especially those that can "justify" their conservation through application of the economic valuation techniques presented in this paper). Expert opinion may take the form of a Delphi approach (a process of multiple questioning of experts to arrive at a consensus decision on areas to protect) or some other expert-based process.

Second, the high level of uncertainty over biodiversity values, and the irreversible nature of extinction, argue persuasively for serious attention to the need to maintain representative ecosystems. Whether this is an application of the Safe Minimum Standard approach of Ciriacy-Wantrup, or just an injunction to "avoid extinction!", this need illustrates why one cannot exclusively rely on market solutions to meet all biodiversity conservation needs.

Squaring the circle of this challenge will not be easy. What may be required is some form of a Global Option Value or Global Existence Value, and the search for some effective mechanism to make this a realistic payment mechanism to help bridge the gap when there is a divergence between local costs and global benefits.

References

Bann, C., and M. Clemens. 1999. "Turkey: Forest Sector Review – Global Overlays Program Final Report." Washington: World Bank (processed).

Brandon, K. 1996. "Ecotourism and Conservation: A Review of Key Issues." Environment Department Paper No.33. Washington: World Bank.

Bishop, R. 1978. "Endangered Species and Uncertainty: The Economics of a Safe Minimum Standard" *American Journal of Agricultural Economics* 60: 10-18.

Bruijnzeel, L.A. 1990. *Hydrology of Moist Tropical Forests and Effects of Conservation: A State of Knowledge Review*. UNESCO International Hydrological Programme. Paris: UNESCO.

Carson, R.T. 1997. "Contingent Valuation: Theoretical Advances and Empirical Tests since the NOAA Panel." *American Journal of Agricultural Economics*, **79**, pp.1501-1507.

Castro, R., F. Tattenbach, with N. Olson and L. Gamez. 1997. "The Costa Rican Experience with Market Instruments to Mitigate Climate Change and Conserve Biodiversity." Paper presented at the Global Conference on Knowledge for Development in the Information Age, Toronto, Canada, 24 June 1997 (processed).

Chomitz, K.M., E. Brenes, and L. Constantino. Forthcoming. "Financing Environmental Services: The Costa Rican Experience and its Implications." *Science of the Total Environment.*

Ciariacy-Wantrup,S.V. 1952. *Resource Conservation Economics and Policies*. Berkeley, University of California Press.

Costanza, R., R. D'Arge, R. de Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R.V. O'Neill, J. Paruelo, R.G. Raskin, P. Sutton, and M. van den Belt. 1997. "The Value of the World's Ecosystem Services and Natural Capital." *Nature*, **387**, pp.253-260.

Daily, G.C., ed. 1997. *Nature's Services: Societal Dependance on Natural Ecosystems*. Washington: Island Press.

Dixon, J.A., 1999. "Ecotourism: Incentives for Conservation Success." Paper presented at the Workshop on Sustainable Tourism in Natural Areas in North America, Playa del Carmen, Quintana Roo, Mexico, 27-28 May 1999 (processed).

Dixon, J.A., L.F. Scura, R.A. Carpenter, and P.B. Sherman. 1994. *Economic Analysis of Environmental Impacts*. London: Earthscan.

Enters, T. 1997. "The Token Line: Adoption and Non-Adoption of Soil Conservation Practices in the Highlands of Northern Thailand." In S. Sombatpanit, M.A. Zöbisch, D.W. Sanders, and M.G. Cook, eds. *Soil Conservation Extension: From Concepts to Adoption*. Enfield: Soil Publishers.

Hamilton, L.S., and P.N. King. 1983. *Tropical Forest Watersheds: Hydrologic and Soils Response to Major Uses and Conversions*. Boulder: Westview Press.

Kramer, R.A., M. Munasinghe, N. Sharma, E. Mercer, and P. Shyamsundar. 1993. "Valuation of Biophysical Resources in Madagascar." In M. Munasinghe, ed, *Environmental Economics and Sustainable Development*. Environment Paper No.3. Washington: World Bank.

Lindberg, K. 1998. "Economic Aspects of Ecotourism." In K. Lindberg, M. Epler-Wood, and D. Engeldrum, eds, *Ecotourism: A Guide for Planners and Managers*. N. Bennington: The Ecotourism Society.

Lutz, E., S. Pagiola, and C. Reiche. "The Costs and Benefits of Soil Conservation: The Farmer's Viewpoint." *World Bank Research Observer*, **9**, pp.273-295.

NOAA. 1993. "Report of the NOAA Panel on Contingent Valuation." *Federal Register*, **58**, pp.4602-4614.

Pagiola, S. 1996. "Economic Analysis of Investments in Cultural Heritage: Insights from Environmental Economics." Washington: World Bank (processed).

Pagiola, S. 1999. "Economic Analysis of Incentives for Soil Conservation." In D.W. Sanders, P.C. Huszar, S. Sombatpanit, and T. Enters, eds, *Incentives in Soil Conservation: From Theory to Practice*. New Delhi: IBH Publishing.

Pagiola, S. 2000. "Payments for Environmental Services." http://www-esd.worldbank.org/eei/.

Pearce, D.W., and J.W. Warford. 1993. *World Without End: Economics, Environment, and Sustainable Development*. Oxford: Oxford University Press.

Reid, W.V. Forthcoming. "Capturing the Value of Ecosystem Services to Protect Biodiversity." In *Managing Human Dominated Ecosystems*. Washington: Island Press.

Toman, M. 1998. "Forum on Valuation of Ecosystem Services." *Ecological Economics*, 25, pp.57-60.

World Bank 1998. *Costa Rica: Biodiversity Resources Development Project*. Project Document, Jan.21.Environment Department. Washington: World Bank.

World Bank. 2000. *Supporting the Web of Life: The World Bank and Biodiversity - A Portfolio Update (1988 -1999)*. Washington: World Bank.