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Market for Ecosystem Services

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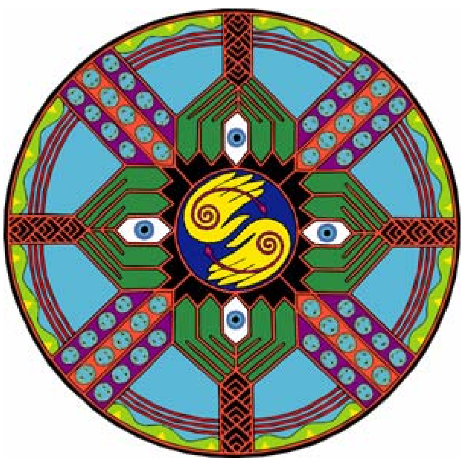

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1. Introduction

Ecosystems and biodiversity provide a wide range of services through their bio-geo-chemical processes that are critical for sustenance of humans. An ecosystem, which is a dynamic complex of plant, animal and micro-organism communities and other non-living environmental components interacting as a functional unit, provides services which sustain, strengthen and enrich various constituents of human well-being. Human well-being here refers to a wholesome set of basic material for a good life, freedom to act and make choices, good social relations, and security. There are various types of ecosystems that are mentioned and discussed in the literature of conservation and development. The recently completed Millennium Ecosystem Assessment (MA) classifies the ecosystems into 10 major categories (MA, 2003, 2005). The services rendered by those ecosystems have been categorized into provisioning, regulating, cultural and supporting. They are mentioned in the Table 1 against each major ecosystem.

Table 1: Main ecosystem types and their services.

Ecosystem										
Ecosystem Service	**Cultivated**	**Dryland**	**Forest**	**Urban**	**Inland water**	**Coastal**	**Marine**	**Polar**	**Mountain**	**Island**
Fresh water			.		.	.		.	.	
Food	.	.	.	.	.	.		.	.	.
Timber, fuel, and fiber	.		.		.					
Novel products	.	.	.		.		.			
Biodiversity regulation	.	.	.	.	.	.	.	.	.	.
Nutrient cycling	.	.	.		.	.	.			
Air quality and climate	.	.	.	.	.	.	.	.	.	.
Human health		.	.	.	.	.	.			
Detoxification		.	.	.	.	.	.			
Natural hazard regulation			.		.	.			.	
Cultural and amenity	.	.	.	.	.	.	.	.	.	.

(Source: Millennium Ecosystem Assessment, Conceptual Framework, 2003).

The unique feature of most of the services emanating from ecosystems is that although acknowledged by people, they are unaccounted, unpriced and therefore remain outside the domain of the market. In conventional parlance, such problems are treated as externalities where the market fails, and decision-makers try to correct the market failure by creating a market-like situation. Subsequently they obtain the value of services through various valuation techniques based on the stated preferences of the people. In the case of the regulating services of ecosystems, like climate regulation, waste treatment capacity, nutrient management and various watershed functions, classic examples of market failure appears (Bator, 1958). The missing market for ecosystem services adds to the problem because most of the vulnerable segments of society, primarily in developing countries, depend upon those services directly or indirectly for their livelihoods. Therefore, any decision proves to be inefficient and infeasible from a social perspective, causing problems for sustainability and human well-being. In recent years, there has been an added focus on creating a situation where markets can be created and desired outcomes can be achieved in of terms implications of different decisions culminating through the impact on ecosystems and, in turn, human well-being (Costanza et al., 1995).

2. Valuation of Ecosystem Services

One of the main reasons that scientists and decision-makers are worried about the loss of ecosystems is that ecosystems provide valuable services and there are strong indications that these services have been degraded considerably in last 50–60 years (MA, 2005). For example, more land was converted to cropland since 1945 than in the 18^{th} and 19th centuries combined; 25 per cent of the world's coral reefs were badly degraded or destroyed in the last several decades; 35 per cent of mangrove area has been lost in this time; the amount of water in reservoirs has quadrupled since 1960; and withdrawals from rivers and lakes have doubled since 1960 (MA, 2005). The subsequent question that arises is, how valuable are these services? We need to be able to answer this question to inform the choices we make in how to manage ecosystems. Economic valuation attempts to answer these questions. Valuation provides insight into the losses (or gains) across different stakeholders, arising out of perturbances in ecosystems and subsequent services. They enable the choice to be better informed by assessing losses and gains which are very important in public policy. It is based on the fact that human beings derive benefit (or "utility") from the use of ecosystem services, either directly or indirectly, whether currently or in the future. Several aspects of this paradigm need to be stressed:

- The utility that an individual human being derives from a given ecosystem service depends on that individual's preferences. The utilitarian approach, therefore, bases its notion of value on attempts to measure the specific utility that individual members of society derive from a given service, and then aggregates across all individuals, weighting them all equally.
- Utility cannot be measured directly. In order to provide a common metric in which to express the benefits of the very diverse variety of services provided by ecosystems, the utilitarian approach usually attempts to measure all services in monetary terms. This is purely a matter of convenience, in that it uses units that are widely recognized, saves the effort of having to convert values already expressed in monetary terms into some other unit, and facilitates comparison with other activities that also contribute to societal well-being. It explicitly does not mean that only services that generate monetary benefits are taken into consideration in the valuation process. On the contrary, the essence of practically all work on valuation of environment and ecosystems has been to find ways to measure benefits which do not enter markets and so have no directly observable monetary benefits.

While ecosystem valuation is certainly difficult, one choice we do not have is whether or not to do it. The valuations are simply the relative weights we give to the various aspects of the decision-making problem. When we value the services of ecosystems and decision-makers take these values into account when making policies that affect these, a framework for distinguishing and grouping these values is also required. The concept of Total Economic Value (TEV) provides such a framework and there is an increasing consensus that it is the most appropriate framework to use. The total economic valuation distinguishes between use values and non-use values, the latter referring to those current or future (potential) values and are unrelated to use (Pearce and Warford, 1993). Typically, use values involve some human "interaction" with the resource whereas non-use values do not. Use values are grouped according to whether they are direct or indirect. The former refers to those uses that are most familiar to us: harvesting of fish, collection of fuel wood and use of the wetlands could involve both commercial and non-commercial activities, with some of the latter activities often being important for the subsistence needs of local populations in developing countries. Commercial uses may be important for both domestic and international markets. In general, the value of marketed products (and services) of different ecosystems is easier to measure than the value of non-commercial and subsistence direct uses. As noted above, this is one reason why policy-makers often fail to consider these non-marketed uses of ecosystems in many development decisions. A special category of value is option value, which arises because an individual may be uncertain about his or her future demand for a resource and/or its availability of the services of the ecosystems in the future. In most cases, the preferred approach for incorporating option values into the analysis is through determining the difference between *ex ante* and *ex post* valuation. If an individual is uncertain about the future value of a service, but believes it may be high or that current exploitation and conversion may be irreversible, then there may be quasi-option value derived from delaying the development activities. Quasi-option value is simply the expected value of the information derived from delaying the use of services today. In contrast, however, there are individuals who do not currently make use of the ecosystem services but nevertheless wish to see them conserved "in their own right." Such as "intrinsic" value is often referred to as existence value. It is a form of non-use value that is extremely difficult to measure, as existence value involves subjective valuations by individuals unrelated to their own or others' use, whether current or future. An important subset of non-use or preservation values is bequest value, which results from individuals placing a high value on the conservation of any ecosystem—tropical wetlands, for example—for future generations to use. Bequest values may be particularly high among the local populations currently using a wetland, in that they would like to see the wetland and their way of life that has evolved in conjunction with it passed on to their heirs and future generations in general.

The non-existence of markets for many biological resources and the public good nature of ecosystems make the valuation far from trivial. These issues imply that the social value of biological resources can't be derived from simple aggregation of their value to individuals in society, the sum of their private values[1]

Generally, economists follow one of two alternative strategies to obtain behavioural observations directly from markets for environmental resources. The first referred to as stated preference methods avoid conventional markets and searches simulated markets (Carson, 1991). By this, it is meant that a survey instrument is designed in which a market-like situation is created. Respondents are asked some hypothetical questions and the data collected are used to value environmental amenities and other goods or services. It is called "direct" or stated preference, because the analysis is based on direct taste and preferences.

The second strategy is to infer values from data on behavioural changes in actual markets related in some way to the missing markets for environmental resources. Travel costs, hedonic valuation and production function approaches are some of the examples (Freeman, 1991). Here, for instance, though there may be no market value for a wilderness area, its value can still be derived by analyzing the demand for trips to the area, by those who face different costs per trip.

There is a whole range of examples where one or several components of ecological systems like forests, wetlands, coastal and their contributions have been estimated. In the past, there have been several attempts to value the contributions of the world's ecosystems. Costanza et al. (1995) estimate the current economic value of 17 ecosystem services for 16 biomes. They do it on the basis of already published research and find that the value comes to be around US$33trillion. Of course their estimate relies upon some of the highly heroic assumptions and loud approximation. This value not only crated a furor among ecologists but invited very sharp criticism from the fellow economists

[1] For a latest comprehensive review of the issue, please see Dasgupta and Maler, 2004.

(Arrow et al., 1998) as well. The methodology adopted by Costanza et al. was straightjacketed and values derived were misleading in their message. Once again the assumption and methodology (reductionist and mechanical) were under severe attack and scrutiny. In recent years, there have evolved various methods for measuring the utilitarian values of ecosystem services, which are found in the resource and environmental economics literature (Hanemann, 1991; Freeman, 1991). Some are broadly applicable, some are applicable to specific issues and some are tailored to particular data sources. As in the case of private market goods, a common feature of all methods of economic valuation of ecosystem services is that they are founded in the theoretical axioms and principles of welfare economics. These measures of welfare change are reflected in people's willingness to pay (WTP) or willingness to accept (WTA) compensation for changes in their level of use of a particular good or bundle of goods (Hanemann, 1991).

A number of factors and conditions determine the choice of specific measurement methods. For instance, when the ecosystem service in question is privately owned and traded in the market, its users have the opportunity to reveal their preferences for such a good compared to other substitutes or complementary commodities through their actual market choices, given relative prices and other economic factors. For this group of ecosystem services a demand curve can be directly specified based on observed market behaviour. However, many ecosystem services are not privately owned and not traded and hence their demand curves cannot be directly observed and measured. Alternative methods have been used to derive values for such ecosystem services. Different users and authors often classify the various methods of measuring ecosystem services values differently, but the different grouping and naming systems converge to a broad classification that depends on whether measures are based on observed or hypothetical behaviour, and whether measures are direct or indirect.

Valuation is a two-step process. First, one has to clearly identify the services being valued. This includes understanding the nature of the service and its magnitude, and how it would change if the ecosystem changed; who makes use of the service, in what way and for what purpose, and what alternatives they have; and what trade-offs there might be between different kinds of services an ecosystem might provide. The bulk of the work involved in valuation actually concerns quantifying the biophysical relationships. Valuation in the narrow sense only enters in the second step in the process, in which the value of the impacts is estimated in monetary terms. Some of the predominant valuation methods popular in the literatures are:

Changes in productivity. It consists of tracing through chains of causality so that the impact of changes in the condition of an ecosystem can be related to various measures of human welfare. Such impacts are often reflected in goods or services that contribute directly to human welfare, and as such are often relatively easily valued.

The various available valuation measures can be divided into two categories. The first is based on actual observed behaviour data, including some methods that deduce values from behaviour in surrogate markets, which are hypothesized to have a direct relationship with the ecosystem service value. The second category is based on hypothetical rather than actual behaviour data, where people's responses to direct questions describing hypothetical markets or situations are used to infer value. Wherever possible, methods based on observed behaviour are considered preferable to those based on hypothetical behaviour, and more direct measures are considered preferable to more indirect measures.

Cost-based approaches. When a particular good or service has no market price, or where that market price is considered an unreliable indicator of value, an order of magnitude estimate can be obtained by using the cost of replacing the services provided by the environmental resource. For example, if ecosystem change reduces the availability of drinking water, one could use the cost of piping in water from an alternative source. The major underlying assumptions of these approaches are (i) that the nature and extent of physical damage expected is predictable (there is an accurate damage function available), and (ii) that the costs to replace or restore damaged assets can be estimated with a reasonable degree of accuracy. It is further assumed that these costs can be used as a valid proxy for the cost of environmental damage. That is, the replacement or restoration costs are assumed not to exceed the economic value of the service. This assumption may not be valid in all cases. It simply may cost more to replace or restore a service than it was worth in the first place. Also, there may be more cost-effective ways to compensate for environmental damage than to replace the original service or restore it to its original condition, and these substitution possibilities are ignored with the use of this technique. If substitutes are available, the method will likely over-estimate the value of the service. Because of this, these methods are generally thought to provide an upper-bound estimate of value.

Travel cost. The travel cost (TC) method is an example of a technique that attempts to deduce value from observed behaviour in a surrogate market. It uses information on visitors' total expenditure to visit a site to derive their demand curve for the site's services. The technique assumes that changes in total travel costs are equivalent to changes in admission fees. From this demand curve, the total benefit visitors obtain can be calculated. (It is important to note that the value of the site is not given by the total travel cost; this information is only used to derive the demand curve.) This method was designed and has been used extensively to value the benefits of recreation, but has limited utility in other settings.

Contingent valuation. Contingent valuation (CV) is carried out by asking consumers directly about their willingness to pay (WTP) to obtain an environmental good or service. A detailed description of the good involved is provided, along with details about how it will be provided. The actual valuation can be obtained in a number of ways, such as asking respondents to name a figure, having them chose from a number of options or asking them whether they would pay a specific amount (in which case, follow-up questions with higher or lower amounts are often used). CV can, in principle, be used to value any environmental benefit. Moreover, since it is not limited to deducing preferences from available data, it can be targeted quite accurately to ask about the specific changes in benefits that the proposed project would result in. Because of the need to describe in detail the good being valued, interviews in CV surveys are often quite time-consuming. It is also very important that the questionnaire be extensively pre-tested to avoid various sources of bias. CV methods have been the subject of severe criticism by some analysts. A "blue-ribbon" panel was organized by the U.S. Department of Interior following controversy over the use of CV to value damages from the 1989 Exxon Valdez oil spill. The report of this panel (NOAA, 1993) concluded that CV can provide useful and reliable information when used carefully, and provided guidance on doing so. This report is generally regarded as authoritative on appropriate use of the technique.

In a nutshell, in the context of valuation of ecosystem services, its purpose and appropriateness of methodology are the key considerations. Stefano et al. (2004) summarize the approach, rationale and methodological framework for exercise in the ways given in Table 2.

Table 2: Valuation of ecosystem services – when, why and how?

Approach	Why do we do it?	How do we do it?
Determining the total value of the current flow of benefits from an ecosystem.	To understand the contribution that ecosystems make to society.	Identify all mutually compatible services provided: measure the quantity of each service provided; multiply by the value of each service.
Determining the net benefits of an intervention that alters ecosystem conditions	To assess whether the intervention is economically worthwhile.	Measure how the quantity of each service would change as a result of the intervention, as compared to their quantity without the intervention; multiply by the marginal value of each service.
Examining how the costs and benefits of an ecosystem (or an intervention) are distributed	To identify winners and losers, for ethical and practical reasons.	Identify relevant stakeholder groups; determine which specific services they use and the value of those services to that group (or changes in values resulting from an intervention).
Identifying potential financing sources for conservation	To help make ecosystem conservation financially self-sustaining.	Identify groups that receive large benefit flows, from which funds could be extracted using various mechanisms.

(Source: Stefano, 2004)

2.1 Challenges to Economic Valuation

Several issues pertinent to valuation of ecosystem services and application to decision-making have emerged especially with a better understanding of the mechanisms of ecosystem functioning. The relevance of state of ecosystem functioning has not been given adequate emphasis in derivation of ecosystem values, thereby rendering the values derived, of little worth, when one is examining especially issues related to sustainability.

In order to provide true and meaningful scarcity indicators of ecosystem values and functions, economic valuation should account for the state of ecosystems. Though, ecosystems can recuperate through several shocks and disturbances through an inherent property of resilience, there are several circumstances when the ecosystem shifts to an entirely new state of equilibrium (Holling, 2001). Standard economic theory-based concepts deriving ecosystem values based on marginal analytic methods are limited to situations when ecosystems are relatively intact and functioning in normal bounds far away from any bifurcation (Limburg et al., 2002). This is of particular significance to developing countries, wherein significant trade-offs exist between conservation and economic development, and decisions often favour the latter. Therefore, decisions made based on "snapshot" ecosystem values can provide false policy directives.

The second issue primarily deals with aggregation of individual values to arrive at larger values, viz "*societal values*." Ecosystem goods and services, by definition, are public in nature, meaning that several benefits accrue to society as a whole, apart from the benefits provided to the individuals (Daily, 1997; Wilson and Howarth, 2002). The theoretical fundamentals of development of economic valuation methodology rest on the axiomatic approaches of individual preferences and individual utility maximization, which does not justify the public good characteristic of ecosystem services. Valuation methodologies, viz contingent valuation, utilize individual preferences as the basis of deriving values subsequently used for resource allocation of goods largely public by character. A considerable body of recent literature therefore favours adoption of a discourse-based valuation (Wilson and Howarth, 2002). The primary focus of these approaches is to utilize a discourse-based valuation approach to come up with a consensus societal value of scarcity indicator, derived through a participatory process, to be used for allocation of ecological services, largely falling into the public domain.

Application of conventional fundamentals of economic valuation becomes further constrained when sustainability and social equity are also included as goals along with economic efficiency for ecosystem management (Costanza and Folke, 1997). While the methodologies for deriving values with economic efficiency as goals is comparatively well developed, integrating equity and sustainability requires a better understanding of functional relationships between various parameters and phenomenon responsible for provisioning of the services in the first place and the social processes governing the mechanism of value formation (discourse-based valuation being one such approach).

In terms of insights from the valuation methodology and their application, Table 3 provides useful suggestions.

Table 3: Avoiding common pitfalls to valuation.

Use net benefits, not gross benefits	Failing to consider the costs involved in using resources (the cost of harvesting products, for example, or the cost of piping water from its source to the user) result in an over-estimate of the value of ecosystem services.
Include opportunity costs	The cost of an action is not limited to the out-of pocket costs involved in implementing it. They also include the opportunity costs resulting from the foregoing benefits of alternative actions (or inaction). Omitting opportunity costs makes actions seem much more attractive than they really are.
Don't use replacement costs	…Unless you can demonstrate (i) that the replacement service is equivalent in quality and magnitude to the ecosystem service being valued;(ii) that the replacement is the least cost way or replacing the service; and (iii) that people would actually be willing to pay the replacement cost to obtain the service.
Don't use benefits transfer	…Unless the context of the original valuation is extremely similar to the context you are interest. Even then, process with caution. However, it is a good idea to compare your results to those obtained elsewhere.
Don't use value estimates based on small changes in service availability to assess the consequences of large changes in services availability	Economic value estimates are not independent of the scale of the analysis. Value estimates are almost always made for small ("marginal") changes in service availability, and should not be used when contemplating large changes.
Be careful about double-counting	Many valuation techniques measure the same thing in different ways. For example, the value of clean water might be measured by the avoided health care costs or by a survey of consumer WTP for clean water, but consumer WTP for clear water is due (at least in part) to their desire not to fall sick, so these two results should not be added together, if they are, the value of clear water will be over-estimated.
Don't include global benefits when the analysis is from a national perspective	More generally, only consider benefits (or costs) that affect the group from whose perspective the analysis is being undertaken. Including benefits, which are primarily global in nature an analysis undertaken from a national perspective, is a particularly common from of this mistake, and results in an over-estimating of the benefits to the country.
Adjust for price distortions	…When concluding the analysis from the perspective of society as a whole, but not when conducting the analysis from the perspective of an individual group.
Avoid spurious precision	Most estimates are by necessity approximate. Don't simply paste the result in the spreadsheet, with its three decimal points, into the report; round the result appropriately. When there is substantial uncertainty, report the results as ranges.
Submit results to sanity checks	Are the results consistent with other results? Are they reasonable in light of the context? Extraordinarily results are not necessarily wrong, but must be checked carefully. Extraordinary results require extraordinary proof.

(Source: Stefano, 2004)

3. Current Status of Market for Ecosystem Services: Evidence from Around the World

Determining precise and credible value of ecosystem services strengthens the functioning of markets for them. This provides for a transparent mechanism not only for acceptable payment mechanism in place but sustainable management of ecosystems as well. In the last decade, payment for different types of ecosystem services has emerged as one for the innovative responses for management of ecosystems. Overall, the U.S. government spends over $1.7 billion per year to induce farmers to protect land (USDA, 2001), and The Nature Conservancy, with an annual budget of more than $700 million, operates almost exclusively through land purchases and easements (TNC, 2002). Payment for Catskill/Delaware watershed benefits in New York is widely discussed and cited but there are other successful examples where various responses have yielded effective results. In Latin America, especially in Costa Rica and Mexico, different stakeholders like irrigation water user groups, municipal water supply agencies and other governmental bodies have initiated and executed such responses and policies entailing virtually no cost. Conservation International is protecting 81,000 hectares of rain forest in Guyana through a conservation concession that costs $1.25 per hectare per year (Ferraro and Kiss, 2002*)*; and The Wildlife Foundation in Kenya is securing migration corridors on private land through conservation leases at $4 per acre per year (Ferraro and Kiss, 2002). The scale of operation is varied from Quito, Ecuador, with 1.2 million people, to Yamable, El Salvador, with only 3,800 (IUCN 2004). With enacting of new legislation by Costa Rican Government on "Valuation and Retribution for Environmental Services Act" in 1998, a number of new responses are being considered by the policy-makers as viable options.

In many cases, fiscal instruments such as subsidies are used to compensate for environmental services generated. In Brazil, on average, each tapper family uses 300 hectares of forest, their stay in the forest ensures its conservation, and the latex is tapped in such a way that the forest structure remains virtually intact (Born et al., 2002). In El Salvador, the Coffee and Biodiversity project executed by the GEF and the World Bank between 1998 and 2001 was harvesting synergy of biodiversity and improving habitats on shade-grown coffee plantations. Through certification and by creating a niche in the international market, "biodiversity-friendly coffee" was successful.

There are many cases where the regulating services of wetland or forest ecosystem have been quantified and monetized which has either enabled market to function efficiently or led to a situation for the market to work, although not very efficiently. . In a study in Kampala by Emerton and Bos, the treatment of wastewater was costing US$2 million a year that was being performed by Nakivubo Swamp (wetland), Uganda, through its bioremediation process without any cost being incurred. Similarly, for urban floodplains of Yamuna in the vicinity of Delhi the preservation benefits (ecosystem services) exceed the developmental benefits by 1.8 to six times (Kumar et al. 2001). On the benefits side, ecological functions like nutrient cycling, bioremediation and ground water recharge were assessed and monetized with the help of market and non-market valuation methods. The market can be designed to capture these benefits for a sustainable response strategy. There are also cases where, for the regulating services of ecosystems, innovative responses like marketable permits are already being used. For example, for Nitrogen (N) control to coastal water in several locations, including Pamlico Sound (North Carolina) and Long Island Sound., tradable permits have been quite successful. The Environmental Quality Incentives Program of the United States Department of Agriculture is a well-known example of using subsidies (through direct payments) to encourage specific activities, such as nutrient management, fertilizer management, integrated pest management, irrigation management and wildlife management. However, the rules of this system tie payments for farm size which proves to be against the interest of of the small farmers. In 1999, 61 per cent of the US$22 billion paid out was received by 10 per cent of the farms. Since big farms get their subsidies, they stay profitable even if they sell below their production cost. Small farmers cannot compete under this scheme because they do not have enough land to obtain a subsidy level that would enable them to stay in the market.

There are numerous examples where market instruments have been used to achieve the goal of sustainability by serving the interests of different stakeholders. The examples of markets for ecosystems range from provisioning live watershed functions to regulating live nutrient management and climate regulation. The geographical spread is broad—from North and South America to various parts of Europe, Africa, China, Mangolia and South East Asia. Each case has unique feature and revealing lessons to be learned. For the purpose of illustration, we provide the cases where a marker was used for watershed function, institutions and instruments involved, along with the insights they have to offer. Table 4 summarizes this.

Table 4: Examples of payments for watershed functions.

Name of case study	Water-related ecological service provided	Supplier	Buyer	Instrument	Intended impacts on forests	Payment
Self-organized private deals						
Upstream dairy farmers and forest landholders	Quality drinking water		A bottler of natural mineral water	Payments by bottler to upstream landowners for improved agricultural practices and for reforestation of sensitive infiltration zones	Reforestation but little impact because program focuses on agriculture	Vittel's pays each farm about US$230 per hectare per year for seven year. the company spent an average of US$155,000 per farm or a total of US$3.8 million.
Reforestation but little impact because program focuses on agriculture	Regularity of water flow for hydroelectricity generation	Private upstream owners of forest land	Private hydroelectric utilities, Government of Costa Rica and local NGO	Payments made by utility company via a local NGO to landowners; payments supplemente d by government funds	Increased forest cover on private land; expansion of forests through protection and regeneration	Landowners who protect their forest receive US$45 /hectares/year, those who sustainable manage their forests receive US$70/hectate/year, and those who reforest their land receive US$ii6/hectare/year.
Cauca River, Colombia: associations of irrigators payments	Improvement of base flows and reduction of sedimentation in irrigation canals	Upstream forest landowners	Associations of irrigators; government agencies	Voluntary payments by associations and government agencies to private upstream landowners; purchase by agency of lands.	Reforestation, erosion, control, springs and waterways protection, and development of watershed communities	Association members voluntarily pay a water use fee of US$1.5-2/litre on top of an already on top of an already existing water access fee of US$0.5/litre. The total investment was over US$1.5 billion between 1995-2000

Name of case study	Water-related ecological service provided	Supplier	Buyer	Instrument	Intended impacts on forests	Payment
Trading Schemes						
United States: nutrient trading	Improved water quality	Point - source polluters discharging below allowable level; on-point source polluters reducing their pollution	Polluting sources with discharge above allowable level	Trading of marketable nutrient reduction credits among industrial and agricultural polluting sources	Limited impact on forests; mainly the establishment of trees in riparian areas	Incentive payments of US$5-10 per acre
Australia: irrigators financing upstream reforestation	Reduction of water salinity	New South Wales State (state government agency)	An association of irrigation farmers	Water transpiration credits earned by State forests for reforestation and sold to irrigators	Large-scale reforestation, including planting of desalination plants, trees and other deep-rooted perennial vegetation	Irrigators pay US$40/hectare/year for ten years to NSW State Forests. Revenues are used by State Forests to reforest on private and public lands. Private landowners receive an allowance but rights remain with Staler Forests.

Name of case study	Water-related ecological service provided	Supplier	Buyer	Instrument	Intended impacts on forests	Payment
Trading Schemes						
New York City: watershed management program	Purification of New York City's water supply	Upstream landowners	Water users taxed by New York city with supplemental funds provided by federal state and local governments	Taxes on water user; New York City bond; entrust funds; subsidies; logging permits; differential land use taxation; development rights; conservation easements; development of markets	Adoption of low impact logging; retirement of environmentally sensitive land from agricultural production; forest regeneration	Dairy farms and foresters who adopted buys management practices swear compensated with US$40 million, which covered all their additional costs. Foresters who improved their management practices (Such as low impact logging) received additional lagging permits for new areas, and forest landowners owning 50 acres or more and agreeing to commit to a ten-year forest management plan are entitled to an 80% reduction in local property tax.
Columbia; environmental services tax (eco-tax) for watershed management	Regularity of water flow for industrial uses; regularity and water puri8ty for drinking water	Private landowners and municipalities	Industrials water users and municipalities	Eco-tax on industrial water users; payments by municipalities and watershed authorizes to landowners	Improved forests management expansion of forests	NA
State of Parana, Brazil; Public redistribution mechanism	Rehabilitation of private and public areas for watershed protection	Municipalities and private landowners	State of Parana	Public-sector redistribution mechanism: State provided additional funds to those municipalities with protected areas and which harbor water shed supply neighboring municipalities	Rehabilitation of degraded forest areas	US$170/hectare

Name of case study	Water-related ecological service provided	Supplier	Buyer	Instrument	Intended impacts on forests	Payment
Trading Schemes						
US; conservation reserve program	Reduction of soil erosion; improvement of water quality and regularity of stream flow	Owners of cropland and marginal pasture lands	US Department of Agriculture	Conservations easements; restoration cost-share agreements; yearly rental payments to landowners for engaging in conservation; additional incentive payments	Though the program is directed at farms, advantages to trees are many; tree-planting strips, riparian buffers, grassed waterway, field windbreaks, shelter belts, living snow fences, and establishment of bottomland timber.	Farmers receive US$125/hectare/year and are compensated for 50% of costs to establish approved conservation practices. Total government cost; US$1.8billion/year.

(Source: Compiled by the Author from ITTO, 2004)

These examples where market for ecosystems were effective or promising, are from different contexts and situations. The agents and instruments of the market had relatively robust characters. Institutions—formal and informal—were in place and various enabling conditions were relatively developed. Such cases are less frequent, especially in the case of developing countries where functioning of the market, even for normal factors like capital and labour, is far from perfect, the degree of governance is low and social and institutional developments are nascent. In such situations functioning of markets for ecosystems services is difficult to realize. However, a careful analysis suggests that proper focus on instruments, which can enable the market, may be a desirable action on behalf of governments, social planning bodies or similar institutions. Table 5 synthesizes the evidence of payments for ecosystem services around the world highlighting the main actors, who paid and how much. These examples provide insights on the issues at hand needed to strengthen the instruments for effective markets.

Table 5: Instruments to promote ecosystem services.

Lead actors	Instrument	Examples	Who pays?
Government	Public direct management of forest resources	National forests and forests protected areas	Government (taxpayer)
Government	Regulation of private forest resource management	Harvest permits, rules on logging methods	Private forest owners & managers
Government	Support services for forest owners/ uses own initiatives	Technical assistance program for forest owners to improve management	Government or NGO's
Government	Public pricing policies to reflect ecosystem costs and benefits	Lower tax rate on forested land	Mixed; indirect incentive (outcome not measured)
Government/ market	Open trading deal sunder a regulatory cap or floor	Carbon trading under the Kyoto Protocol	Consumer or producers subject to cap (least cost)
Government/ market	Public payments to private land and forest owners to maintain or enhance ecosystem services	Agro-environmental payments for forest conservation easements on farmers	Government
Market	Self-organizing private deals	Payment by a water bottling company to upstream watershed managers	Private company, NGO, community (user)
Market	Ecolabelling of forest or farm products	Forest certification	Consumer, intermediary

(Source: ITTO, 2004)

3.1 Payments for Biodiversity

In this paper, although we are dealing exclusively with the market for ecosystem services, it would be inappropriate if we do not discuss the various payment mechanisms adopted in recent years for the payment of biodiversity services (even if they are in tangible form, e.g., genetic material for getting the clue for new drugs, etc). Here too, we have plethora of examples from various parts of the world—South America, Europe and Asia. One of the famous examples is of direct payments in agriculture policy by the Foundation for the Conservation of Cultural Landscapes (FLS) in

Switzerland. On one hand, direct payments were introduced to ease the transition of Swiss agriculture towards global and free-market conditions. On the other hand, direct payments were supposed to compensate formers who were willing to accept more ecologically and biodiversity-sound management practices (Schelske, 1998). Ecological direct payments were divided into payments that avoid environmental damages, and payments that support ecological achievement in the public interest. Farmers adopted the required management practices very quickly, especially the integrated production scheme. The growth of organic farming, however, was slower.

The FLS, founded in 1991, supported specific projects or nature and landscape conservation. Compared with direct payments, the FLS proved to be a more "bottom-up" approach for biodiversity conservation than "top-down" agricultural policy. The FLS financed very different projects, such as the conservation and sustainable use of old orchards, the connectivity of regional ecosystems and the conservation of old chestnut plantations in southern Switzerland. The Foundation was merely financed by federal, cantonal and communal authorities. The case of biodiversity protection in the Randen area in Canton Schaffhausen showed that the FLS successfully accomplished the evolution of innovative institutions like the KURA that organized cooperation between farmers and conservationists.

Although both instruments support the removal of perverse subsidies, there remain subsidies nonetheless. Ecological standards are set by policy and should be met with the help of these instruments; therefore, the government needs to legitimize the distribution of taxpayers' money. Unfortunately, an overall evaluation of the ecological effectiveness has not yet been undertaken, although studies reveal that the ecologization of agricultural policy is heading in the right direction. Changes were necessary and will be influenced by different agriculture interest groups in much the same way that they influenced the shape of the 1992 policy reforms. A glimpse at the international discussion shows that countries with comparative advantages in agriculture are taking a closer look at the compliance of direct payments to WTO policies.

Biodiversity protection policies are beginning to be implemented into agricultural and landscape policies. Because biodiversity protection is a broad concept, a concentration on funds from agricultural and landscape policies will not be sufficient; therefore, instruments focussing on other sectors with positive and negative impacts on biodiversity should be suggested.

Table 6: Value of payments for biodiversity conservation: selected examples.

Payment scheme	Country	Type of payment/ commodity	Estimated value
Critical Ecosystem partnership (World Bank, Conservation International, Global Environment Facility)	Developing countries	Fund to finance groups to protect biodiversity	US$150 million capitalization
BOCOSA Project (Osa Penninsula)	Costa Rica	Payment to farmers to conserve their lands	US$24/hectare/year
Payment for environmental services	Costa Rica	Compensation to forest owners for the ecosystem services of their lands, as included in 1996 Forest Law	US$221-344/hectare/year Total: US$14 million
Shade-grown coffee	Mesoamerica	Coffee trees grown among other tress, enhancing biodiversity	US$ billion for sale of shade-grown coffee in US alone.
Privately protected areas.	Chile	Private investments in land conservation including: private parks, land donations to national park system, conservation communities, eco-real estate and eco-tourism, and private administration of government conservation lands	NA
Bioprospecting	World wide	Biodiversity prospecting, primarily pharmaceutical, to market products and conserve forests	US$17.5 billion (natural-product drugs)
Ecological value-added tax	Brazil	Mechanism that compensates municipalities that have conservation areas. Stimulates improvement of existing areas or creating of new areas	USD$150 million (Parana State) US$45 million (Minas Gerais).

(Source: ITTO, 2004)

3.2 International Experiences and Lessons in Compensating for Ecological Benefits

In compensating for ecological benefits, there are mainly two types of arrangements, namely public fiscal payment and market-based instruments. It is believed that fiscal arrangements are prone to a number of shortcomings, such as high transaction costs, low efficiency in fund use and ambiguity in target beneficiaries. According to prevailing theories, market-based compensation would require clearly defined tenure for the ecosystems, measurable benefits/value of the benefits and low transaction costs. This implies a relatively well-developed market infrastructure as the basis for such transactions.

In practice, a number of interesting instruments such as carbon offset trading and bio-prospecting deals have been widely employed. Carbon offset trading is transaction process in which the emitting party of CO_2 (a company or a country) pays the forest owner or management unit for the carbon offsets their forests generate. This market-based process is founded on the willingness to pay for controlling global climate change. Forests in two ways are generating carbon benefits: absorbing carbon dioxide via growth and strong carbon in biomass. Sequestering carbon via tree planting is believed to be quick and cost effective way to absorb carbon dioxide. According to the estimation of FAO, carbon sequestration by tropical forests would cost $2–10 per ton, whereas reducing carbon emissions by switching to alternative fuel would typically cost $137 per ton (Sun and Chen, 2000).

Carbon offset transactions could eventually form a market for trading. This would allow countries to maximize their carbon reduction strategy according to their resource endowments, technology and the nature of their economic activities. Since 1992 there have been reports of 25 cases of forest-based carbon trading. Australia, the U.S. and Canada are among the pioneering countries. In November 1997 the Kyoto Protocol established a Clean Development Mechanism to promote carbon trading.It is estimated that global carbon trading market would reach some US$1 billion in the next decade. In 1997 the World Bank established a Prototype Carbon Fund that has an initial capital of US$150 million. Carbon trading provides a market-based instrument for financing ecological forests development.

The World Bank began with three funds to invest in projects for reducing industrialized greenhouse gas emissions while promoting sustainable development and engaging public and private partnerships. By following the joint implementation under the Clean Development Mechanism (CDM), it established a unique interface of carbon asset creation, private project finance, and intergovernmental market regulation. In fact the World Bank, committed $1.25 billion in loans, credits and grants for projects with explicit objectives of conserving biodiversity between 1988 and mid-1995. The money leveraged an additional half billion dollars (Jana and Cooke, 1996). The Prototype Carbon Fund (PCF) began operations in April 2000 and by June 2002 had contributions of US$180 million from six investing countries and 17 companies. The Fund allocated US$90 million up to October 2003, primarily in renewable energy and energy efficiency projects. Two years after the creation of the PCF, the World Bank launched the Community Development Carbon Fund (CDCF) and the BioCarbon Fund. Because high transactions costs involved with the Kyoto Protocol have led to significant bias towards large-scale projects, poorer rural communities have been left out of the carbon market. The CDFC seeks to work with local intermediaries to lower transaction costs and enhance the lives of the poor trough carbon financing. With a target size of US$100 million, the CDFC will finance small-scale projects with specific community development benefits. Such projects include renewable energy, energy efficiency, methane capture and agro-forestry.

The BioCarbon Fund buys certified emission reductions (CERs) from land-use, land-use change and forestry projects admissible under the Kyoto Protocol and for diverse carbon sequestration and conservation projects under emerging alternative or voluntary carbon management programs. The fund's target size is US$100 million and it will target agricultural and forestry projects that enhance other ecosystem services, such as biodiversity and watershed protection, while improving the livelihoods of local people. Example projects include conservation agriculture—such as shade-grown coffee, agro-forestry to restore degraded areas, improved agricultural practices, such as shifting from subsistence farming to organic agriculture—and reforestation. The fund is also looking into bundling projects in order to achieve optimum benefits for all stakeholders.

4. Key Findings and Lessons Learned

Valuation enabling the creation of markets seems to be a viable response for effective management of ecosystem services for human well-being. However, many conservationists show aversion for valuation as they believe that cultural and spiritual value get lost in this process where everything is converted into monetary units reflecting the costs of action/inaction (Economist, 21 April 2005). It is true that there are different views on valuation of ecosystem services however decision-makers definitely require valuation of changes in ecosystem services arising out of perturbation in the ecosystem owing to the anthropogenic activities are most plausible argument in order to weigh the costs and benefits. Valuation of "total" instead of "marginal" could be misleading. For example valuation by Costanza et al. neither reflects societal willingness to pay nor willingness to accept.

Review of valuation studies suggest that the total value of direct ecosystem service payments in tropical countries is presently modest, but has grown dramatically over the past decade and is significant, particularly to low-income producers. Markets for forest ecosystem services are expected to grow, in both developed and developing countries, over the next 20 years.

Governments play a critical role as the principal buyers of many ecosystem services and as catalysts for many private-sector direct-payment schemes. Without constructive intervention through enabling conditions, monitoring institutions and adequate governance, the market, even though based on very accurate valuation methods, is a recipe for disaster. It should not be forgotten that payments for ecosystem services will, in most cases, cover only a modest share of the total costs of good ecosystem management. However the payment for ecosystem services could prove to be a catalyst in the future.

4.1 Ingredients for successful and effective market for ecosystem services

As it is widely known, without the existence and enforcement of property rights and national legal frameworks, markets in general—and for ecosystem services in particular—simply cease to exist and function. They are necessary for ecosystem service markets to develop; yet these are poorly developed in most countries that possess these ecosystem services. No markets for ecosystem services seem to contribute substantially to poverty alleviation programs and policies unless proactive efforts are made to recognize rights and shape markets to provide equal access to low-income producers of ecosystem services. Innovative institutions are an absolute necessity for functioning of the market for ecosystem services. For these, formal and informal institutions besides the effective legal framework are needed because they substantially reduce transaction costs and financial risks.

Coherence among different sectoral policies and vertical and horizontal integration of policies and priorities strengthen the functioning of markets for ecosystem services.

One of the generic issues in the context of payment of ecosystem services which are being discussed in now is whether an indirect or direct payment on ecosystem services is more effective from conservation point of view. A premium on ecosystem or eco-friendly products like rain forest honey, shade-grown coffee are examples of indirect payment, while a transaction between downstream and upstream people for watershed function and subsequent payment by downstream people (e.g., cat skill) is the example of direct payment. Both types of arrangements for ecosystem services require institutional arrangements to be proactive and effective; indirect payment requires it more than any other payment form (Ferraro and Simpson, 2002; Ferraro and Kiss, 2002; Swart, 2003). Indirect and direct approaches require institutions that can monitor ecosystem health, resolve conflict, coordinate individual behaviour, and allocate and enforce rights and responsibilities. In the context of developing countries, these requirements are unlikely to be met. Also, these poor countries suffer from inadequate institutional capacity to make contractual agreements. However, the payment mechanism can be carefully designed to cater to the requirement for protecting entire ecosystems or specific species, with diverse institutional arrangements existing among governments, firms, multilateral donors, communities and individuals (Ferraro, 2003). On the other hand, indirect approaches based on eco-friendly commercial activities are invariably plagued by their ambiguous impact on conservation incentives, by their complex implementations needs and by their lack of conformity with the temporal and spatial dimensions of ecosystem conservation objectives (Southgate, 1998; Chomitz and Kumari, 1998; Simpson, 1999; Ferraro, 2001).

4.2 Lessons Learned

- Decision-makers need objective technical assistance to identify the opportunity and risks of using different types of market instruments for ecosystem services and for designing them to be effective, efficient and equitable.
- There must be opportunities to exchange experiences, perspectives and lessons about the use and design of ecosystem service markets with peers in other countries and regions are also very much desirable.
- Insights for the design of appropriate legal and regulatory frameworks, and the assignment of property rights around ecosystem services should be shared and made available to the parties concerned.
- Ground level data on producer costs for managing ecosystem services, markets, transaction costs and the costs of establishing and operating different types of market mechanisms must be collected, collated and analyzed before saying anything useful on the functioning of markets for ecosystem services.
- Clear and easily comprehensible documentation of the biophysical linkages between land-uses and ecosystem service benefits, forest conservation and enhanced watershed services, conservation territorial and aquatic biodiversity and corresponding benefits, carbon parking and related marketed benefits along with appropriate methods for measuring and monitoring the provision of services, would go a long way in making the market work for ecosystem services.
- Analysis for the site-specific design of market rules and institutions are still in rudimentary stage and there exists a considerable amount of knowledge gaps on this. In order to make it amenable for macro-analysis careful synthesis of findings would be critically needed.
- While the debate on the efficacy of indirect vs. direct payment would continue for some time, it should be clearly understood that although direct payments are reported to be more effective in terms of its implementation and impact on conservation goals, direct payment approaches are not "silver bullets" that can be applied immediately and easily in all situations. As Ferraro and Kiss (2003) put it, "People will generally do what is in their own interest, particularly their short-term interest. If they can receive more benefits from clearing areas of habitat than they could from protecting it, they will clear it. A society would never think to provide a public good like national defense through indirect means. The

conservation community must reconsider its attempts to provide biodiversity through indirect means. If we want to get what we pay for, we must start tying our investments directly to our goals."

- Capacity building to develop national sophisticated expertise in analyzing, designing and implementing ecosystem service markets in the public, private and civic sectors is needed at all levels and probably in every part of the world.

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