The Economics of Ecosystems & Biodiversity

MAINSTREAMING THE ECONOMICS OF NATURE

A SYNTHESIS OF THE APPROACH, CONCLUSIONS AND RECOMMENDATIONS OF TEEB

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PREFACE

Pavan Sukhdev and the TEEB team

In 2007, environment ministers from the governments of the G8+5 countries[1], meeting in Potsdam, Germany, agreed to "initiate the process of analysing the global economic benefit of biological diversity, the costs of the loss of biodiversity and the failure to take protective measures versus the costs of effective conservation."

The Economics of Ecosystems and Biodiversity (TEEB) study, which emerged from that decision, has delivered a series of reports (see insert) addressing the needs of major user groups: national and local decision makers, business and the wider public.

This synthesis complements, but does not attempt to summarize, the other products of TEEB (see insert, section 4 and Annex 1). The aim of this synthesis is to highlight and illustrate the approach adopted by TEEB: namely to show how economic concepts and tools can help equip society with the means to incorporate the values of nature into decision making at all levels.

Applying economic thinking to the use of biodiversity and ecosystem services can help clarify two critical points: why prosperity and poverty reduction depend on maintaining the flow of benefits from ecosystems; and why successful environmental protection needs to be grounded in sound economics, including explicit recognition, efficient allocation, and fair distribution of the costs and benefits of conservation and sustainable use of natural resources.

The analysis of TEEB builds on extensive work in this field over the last decades. TEEB presents an approach that can help decision makers recognize, demonstrate and, where appropriate, capture the values of ecosystems and biodiversity (see section 2). TEEB also acknowledges the plurality of values which people hold for nature, as well as the multitude of techniques available for their assessment.

The values of nature vary according to local biophysical and ecological circumstances and the social, economic and cultural context. Intangible values, which may be reflected in society's willingness to pay to conserve particular species or landscapes, or to protect common resources, must be considered alongside more tangible values like food or timber to provide a complete economic picture.

Valuation is seen not as a panacea, but rather as a tool to help recalibrate the faulty economic compass that has led us to decisions that are prejudicial to both current well-being and that of future generations. The invisibility of biodiversity values has often encouraged inefficient use or even destruction of the natural capital that is the foundation of our economies.

The aim of TEEB is to provide a bridge between the multi-disciplinary science of biodiversity and the arena of international and national policy as well as local government and business practices. The scope of TEEB is intentionally broad and it should therefore be seen as an inspiration and as an invitation for others to deepen its findings and to develop more context-specific recommendations. Ideally, TEEB will act as a catalyst to help accelerate the development of a new economy: one in which the values of natural capital, and the ecosystem services which this capital supplies, are fully reflected in the mainstream of public and private decision-making.

The completion of the study and the publication of this synthesis come at a time when the global community has an unprecedented opportunity to rethink and reconfigure the way people manage biological resources. A new vision for biodiversity, with proposals for time-bound targets and clear indicators, is being drawn up by the Convention on Biological Diversity (CBD), in this International Year of Biodiversity. TEEB's approach to incorporating nature's values into economic decision making can help turn that vision into reality.

Crucially, TEEB's recommendations are aimed far beyond the remit of most environment ministries and environmental institutions. TEEB seeks to inform and trigger numerous initiatives and processes at national and international levels, including:

- the deliberations of the G8+5 and the G20 groups of nations, which have committed to move toward greener, more sustainable growth;
- the Millennium Development Goals, to which all nations subscribed and pledged to achieve by 2015;
- the United Nations Conference on Sustainable Development, also referred to as the 'Rio + 20' Earth Summit, planned for 2012;
- efforts to mainstream the environment in financial services, spearheaded by the United Nations;
- the on-going review and update of Guidelines for Multinational Enterprises, which seek to promote responsible business conduct, by the OECD and several developing countries; and
- various voluntary declarations, codes and guidelines related to biodiversity and ecosystem services drawn up by, and for, industry.

In the following pages, we make the case for systematic appraisal of the economic contribution of biodiversity and ecosystem services to human well-being; and for routine steps to prevent that contribution being lost or diminished through neglect or mismanagement. It is an appeal to each of us, whether a citizen, policy maker, local administrator, investor, entrepreneur or academics, to reflect both on the value of nature, and on the nature of value.

Note to the reader

This synthesis builds on the results of **six TEEB reports** over the last 3 years. To make referencing easy, **we refer to these reports in the text with single letters** followed by the corresponding chapter number:

I	TEEB Interim Report
C	TEEB Climate Issues Update
F	TEEB Ecological and Economic Foundations
N	TEEB for National and International Policy Makers
L	TEEB for Regional and Local Policymakers
B	TEEB for Business

Example: (F5) refers to: TEEB Ecological and Economics Foundations, Chapter 5

Short summaries of all reports are provided in the insert.
Information on contributors can be found in Annex 3.
Glossary terms: The terms indicated with an → are further defined in the glossary in Annex 1.
TEEBcases: Examples from across the globe that illustrate how ecosystem services have already been taken into account in local/regional policy making. TEEBcases were reviewed by independent experts and are being uploaded to **TEEBweb.org** upon completion.

TABLE OF CONTENTS

This report includes an insert providing an overview of all TEEB reports.

1 INTRODUCTION

Biodiversity is defined by the CBD as "the variability among living organisms from all sources including, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems" (CBD 1992). In other words, biodiversity includes diversity within species populations (genetic variation); the number of species, and the diversity of ecosystems.

Both quantity and quality attributes of biodiversity are important when considering the links between nature, economic activity and →*human well-being*. In addition to the diversity of species, genes and ecosystems, the sheer abundance of individual animals and plants, as well as the extent of ecosystems such as forests or living coral reefs, are critical components of →*natural capital* and key determinants of the benefits delivered.

In recent literature, the links between nature and the economy are often described using the **concept of →*ecosystem services***, or flows of value to human societies as a result of the state and quantity of natural capital. The Millennium Ecosystem Assessment defined four categories of ecosystem services that contribute to human well-being, each underpinned by biodiversity (MA 2005; for a more detailed description, see Annex 2):

- **Provisioning services** – for example wild foods, crops, fresh water and plant-derived medicines;
- **Regulating services** – for example filtration of pollutants by wetlands, climate regulation through carbon storage and water cycling, pollination and protection from disasters;
- **Cultural services** – for example recreation, spiritual and aesthetic values, education;
- **Supporting services** – for example soil formation, photosynthesis and nutrient cycling.

The concepts of ecosystem services and natural capital can help us recognize the many benefits that nature provides [F1]. From an economic point of view, the flows of ecosystem services can be seen as the 'dividend' that society receives from natural capital. **Maintaining stocks of natural capital allow the sustained provision of future flows of ecosystem services**, and thereby help to ensure enduring human well-being.

Sustaining these flows also requires a good understanding of how ecosystems function and provide services, and how they are likely to be affected by various pressures. Insights from the natural sciences are essential to understanding the links between biodiversity and the supply of ecosystem services, including ecosystem →*resilience* – i.e. their capacity to continue to provide services under changing conditions, notably climate change [F2].

There is growing evidence that many ecosystems have been degraded to such an extent that they are nearing **critical →*thresholds*** or tipping points, beyond which their capacity to provide useful services may be drastically reduced. However, there is **considerable uncertainty** about how much use or disturbance different ecosystems can withstand before irreversible harm is caused. Hence **precaution** is needed in order to maintain 'healthy' ecosystems and the continued flow of ecosystem services over the long-term. [F2]

Few ecosystem services have explicit prices or are traded in an open market. Those ecosystem services most likely to be priced in markets are the consumptive, →*direct use* ***values*** of 'provisioning services,' such as crops or livestock, fish or water, which are directly consumed by people (see box far left in Figure 1). Non-consumptive use values, such as recreation, or →*non-use values*, which may include the spiritual or cultural importance of a landscape or species, have often been influential in decision making but these benefits are rarely valued in monetary terms.

Box 1: The Economics of Ecosystem Services: some numbers

Conserving forests avoids greenhouse gas emissions worth US$ 3.7 trillion

Halving deforestation rates by 2030 would reduce global greenhouse gas emissions by 1.5 to 2.7 GT CO_2 per year, thereby avoiding damages from climate change estimated at more than US$ 3.7 trillion in NPV terms. This figure does not include the many co-benefits of forest ecosystems (Eliasch 2008).

Global fisheries underperform by US$ 50 billion annually

Competition between highly subsidized industrial fishing fleets coupled with poor regulation and weak enforcement of existing rules has led to over-exploitation of most commercially valuable fish stocks, reducing the income from global marine fisheries by US$ 50 billion annually, compared to a more sustainable fishing scenario (World Bank and FAO 2009).

The importance of coral reef ecosystem services

Although just covering 1.2% of the world's continent shelves, coral reefs are home to an estimated 1-3 million species, including more than a quarter of all marine fish species (Allsopp et al. 2009). Some 30 million people in coastal and island communities are totally reliant on reef-based resources as their primary means of food production, income and livelihood (Gomez et al. 1994, Wilkinson 2004).

Green products and services represent a new market opportunity

Global sales of organic food and drink have recently been increasing by over US$ 5 billion a year, reaching US $46 billion in 2007 (Organic Monitor 2009); the global market for eco-labelled fish products grew by over 50% between 2008 and 2009 (MSC 2009); and ecotourism is the fastest-growing area of the tourism industry with an estimated increase of global spending of 20% annually (TIES 2006).

Bee keeping generates US$ 213 million annually in Switzerland

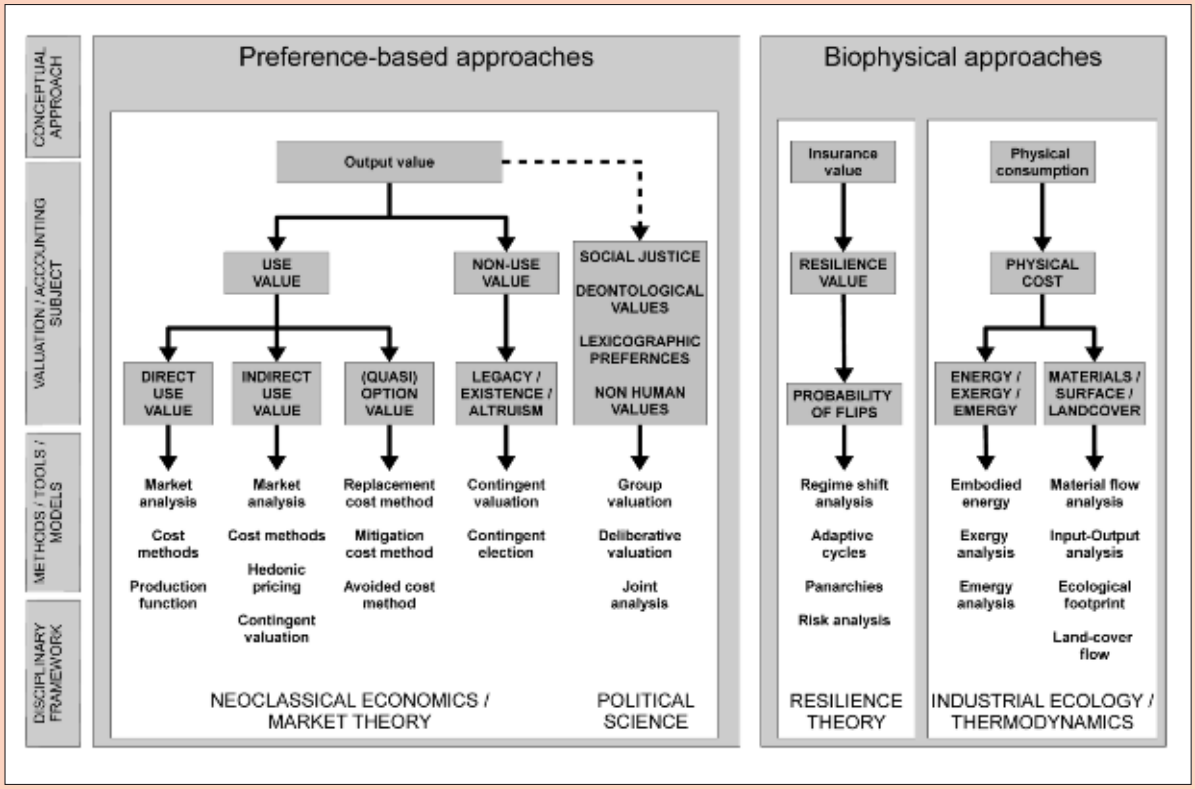
A single bee colony ensured a yearly agricultural production worth (US$ 1,050) in pollinated fruits and berries in the year 2002, compared to just US$ 215 for direct products from beekeeping (e.g. honey, beeswax, pollen) (Fluri and Fricke 2005). On average, Swiss bee colonies ensured a yearly agricultural production worth about US$ 213 million by providing pollination, about five times value of the production of honey (TEEBcase: Valuation of pollination spurs support for bee keepers, Switzerland). The →*total economic value* of insect pollination worldwide is estimated at €153 billion, representing 9.5% of world agricultural output in 2005 (Gallai et al. 2009).

Tree planting enhances urban life quality in Canberra, Australia

Local authorities in Canberra have planted 400,000 trees to regulate microclimate, reduce pollution and thereby improve urban air quality, reduce energy costs for air conditioning as well as store and sequester carbon. These benefits are expected to amount to some US$ 20-67 million over the period 2008-2012, in terms of the value generated or savings realized for the city (Brack 2002).

Some other ecosystem benefits, especially **regulating services** such as water purification, climate regulation (e.g. carbon sequestration), and pollination, have only recently begun to be assigned an economic value, referred to as →*indirect use values* in Figure 1. Although the latter values, when calculated, commonly form the majority of the →*Total Economic Value* of an ecosystem, they **remain largely invisible** in the day-to-day accounts of society [F1, F5].

Figure 1: Approaches for the estimation of nature's values



Source: TEEB Foundations, Chapter 5

The results of this economic invisibility are illustrated by the challenge of large-scale commercial deforestation. Companies do not clear-cut forests out of wanton destructiveness or stupidity. On the whole, they do so because **market signals** – influenced by subsidies, taxation, pricing and state regulation, as well as land tenure and use rights – make it a logical and profitable thing to do. It is often profitable and logical because the costs of deforestation are generally not borne by companies clearing the land for agriculture or by companies logging and selling the timber. Rather, these **costs tend to fall on society**, on future generations, and often, on poor households in rural areas who frequently depend on the resources and services of the forest for their daily survival and security.

The most recent assessments of global biodiversity find that species are continuing to decline and that the **risk of extinction is growing**; that natural habitats are continuing to be lost and becoming increasingly degraded and fragmented; and that the principal direct →***drivers*** of biodiversity loss (habitat disturbance, pollution especially nutrient load, invasive alien species, over-exploitation and, increasingly, climate change) are either constant or intensifying (Butchart et al. 2010, GBO3 2010). Further driving forces include economic and human population growth. Finally, the **failure to account for the full economic values** of ecosystems and biodiversity has been a significant factor in their continuing loss and degradation (GBO3 2010, MA 2005).

The same assessments warn of serious consequences for human societies as ecosystems become incapable of providing the goods and services, on which hundreds of millions of people depend (Rockstrom et al. 2009). Such →*thresholds* have already been passed in certain coastal areas where 'dead zones' now exist, for a range of coral reefs and lakes that are no longer able to sustain aquatic species, and for some dryland areas that have been effectively transformed into deserts. Similarly thresholds have been passed for some fish stocks [F5, N1, B2].

The **TEEB Interim Report** [I], published in 2008, provided some initial estimates of the **economic impacts of biodiversity loss at a global scale**. Although such large-scale assessments may be helpful to outline the economic importance of natural capital, estimating the costs of biodiversity loss at a global scale remains a controversial and complex undertaking, and the resulting numbers should be used with care.

Apart from exploring such 'big numbers', and perhaps more usefully, the TEEB reports offer **numerous case studies** of the economic impacts of biodiversity loss, and the economic opportunities from recognizing and responding better to the economic values of biological resources. These case studies are explored from several important perspectives, including those of:

- **National and sub-national policy and management:** ignoring or undervaluing natural capital in economic forecasting, modelling and assessments can lead to public policy and government investment decisions that exacerbate the degradation of soils, air, water and biological resources and thereby negatively impact a range of economic and social objectives. Conversely, investment in natural capital can create and safeguard jobs and underpin economic development, as well as secure untapped economic opportunities from natural processes and genetic resources. [N1, L1]
- **Poverty reduction:** poorer households, in particular in rural areas, face disproportionate losses from the depletion of natural capital due to their relatively high dependence on certain ecosystem services for income and insurance against hard times. Biodiversity conservation and sustainable management of ecosystems should be key elements in strategies to eliminate poverty, contribute to internationally-agreed objectives, such as the Millennium Development Goals, as well as a target for poverty reduction policies at national and local levels [I2, L1].
- **Businesses:** the private sector both impacts and depends to varying degrees on ecosystem services and therefore on the stock of natural capital. Businesses must manage risks to reputation and the bottom line posed by environmental damage – an issue highlighted with unprecedented force by the recent oil spill in the Gulf of Mexico. At the same time, promising new opportunities are offered by green innovation, environmental efficiencies and early entry into technologies and practices that are increasingly demanded by consumers or required by regulation. [B1]
- **Individuals and communities:** biodiversity loss imposes personal and collective costs to health, income, security and many other aspects of well-being. Conversely, conservation opportunities include individual action to improve the quality of life; as well as exercising the right of citizens to hold governments and companies accountable for managing the 'public wealth' of which natural capital is a major part, and in which citizens and communities hold the ultimate stake.

Assessing the costs and benefits of conserving and sustainably using biodiversity and ecosystems is only the first step. Knowing that overfishing is jeopardizing the integrity of a coral reef, and with it the benefits that local communities derive from the reef, **will not by itself lead to changes** in fishing methods, so long as short-term profits and government incentives continue to promote destructive practices.

Recognizing that biodiversity underpins human well-being is one thing; **translating that knowledge into incentives** which influence behaviour for the better is another. It is a challenge – both in political and technical terms – that must be met if the failures of the recent past are not to be repeated and compounded.

The approach promoted by TEEB is based on work carried out by economists over several decades. **Economic assessment** should be seen **as a tool to guide** biodiversity management, not as a precondition for taking action. However, the framework of economic analysis and decision making described in the TEEB reports, if widely implemented, could go a long way towards making **pro-biodiversity investment the logical choice** for a much wider range of actors in the future.

For an overview of the different TEEB stakeholder reports, see insert.

2 RECOGNIZING, DEMONSTRATING AND CAPTURING VALUE: TEEB'S APPROACH

A basic premise of the TEEB study is that the valuation of biodiversity and →*ecosystem services* may be carried out in more or less explicit ways according to the situation at hand. The TEEB study follows a tiered approach in analyzing and structuring valuation.

RECOGNIZING VALUE

Recognizing value in ecosystems, landscapes, species and other aspects of biodiversity is a feature of all human societies and communities, and is sometimes sufficient to ensure conservation and sustainable use. This may be the case especially where the spiritual or **cultural values** of nature are strong. For example, the existence of sacred groves in some cultures has helped to protect natural areas and the biodiversity they contain, without the need to place a monetary value on the 'services' provided. Equally, protected areas such as national parks have historically been established in response to a sense of collective heritage or patrimony, a perception of shared cultural or social value being placed on treasured landscapes, charismatic species or natural wonders.

Protective legislation or voluntary agreements can be appropriate responses where biodiversity values are generally recognized and accepted. In such circumstances, **monetary valuation** of biodiversity and ecosystem services may be unnecessary, or even counterproductive if it is seen as contrary to cultural norms or **fails to reflect a plurality of values**. A more detailed view of the limitations of monetary valuation is provided in TEEB Foundations, Chapter 4 [F4].

DEMONSTRATING VALUE

Nevertheless, **demonstrating value** in economic terms is often useful for policymakers and others, such as businesses, in reaching decisions that consider the full costs and benefits of a proposed use of an ecosystem, rather than just those costs or values that enter markets in the form of private goods. →*Economic valuations* of natural areas are a case in point. Examples include **calculating the costs and benefits** of conserving the ecosystem services provided by wetlands in treating human wastes and controlling floods, compared to the cost of providing the same services by building water treatment facilities or concrete flood defences) (see for example the case of the Kampala wetland valuation in section 3.2.3 below).

A variety of economic valuation methods have been developed, refined, and applied to biodiversity and ecosystem services in a range of different contexts. **TEEB has reviewed the main methods**, which all have their advantages and disadvantages (F5). It first needs to be stressed that valuation is best applied for **assessing the consequences of changes** resulting from alternative management options, rather than for attempting to estimate the total value of ecosystems. In practice, most valuation studies do not assess the full range of ecosystem services but focus on just a few services. Moreover, not all biodiversity values can be reliably estimated using existing methods (see Figure 1). Nevertheless, as a first step, it is important to identify all significant changes in ecosystem services even if it is not possible or necessary to monetize all of these changes. Decision makers also need information about who is affected and where and when the changes will take place.

The demonstration of economic value, even if it does not result in specific measures that capture the value, can be an important **aid in achieving more efficient use** of natural resources. It can also highlight the costs of achieving environmental targets and help identify more efficient means of delivering ecosystem services. Valuation in these circumstances enables policy makers to **address** →***trade-offs*** in a rational manner, correcting the bias typical of much decision making today, which tends to favour private wealth and physical capital above public wealth and →*natural capital*.