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Policy and Management Tools for Ecosystem Services

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INTRODUCTION

The living fabric of this planet — its ecosystems and biodiversity — is in rapid decline worldwide. This palpable degradation is the result of a combination of human activities such as commercial overexploitation, population pressure, and ill-informed policies. At a very fundamental human level, however, it is due to the lack of awareness that there is a problem with human society's disconnection from nature.

Economics is blamed for many of our woes these days and credited with little. This popular sentiment begs the question as to whether our perspective on economics is part of the problem of ecosystem degradation and biodiversity loss. The answer to this is a fairly obvious "yes."

The economic invisibility of nature in our dominant economic model is both a symptom and a root cause of the problem. We value what we price, but nature's services — providing clean air, fresh water, soil fertility, flood prevention, drought control, climate stability, etc. — are almost never traded in any of our markets and as a result are not priced. These ecosystem services, which are all freely available public goods, are given a back seat by our tendency to value private wealth creation over improving public wealth. As a result, creating a healthier natural world does not seem to be a priority on the economic agenda.

THE ECONOMIC INVISIBILITY OF NATURE

Water is the most important natural resource, but it is an invisible part of nature because its benefits are not proportionately recognized. While numerous studies have highlighted the climate change mitigation services provided by tropical rainforests (Eliassch 2008; Lewis and White 2009; Trumper et al. 2009), few account for the water losses associated with deforestation. The Amazon rainforest "water pump" is believed to return 20 billion metric tons of water into the atmosphere through evapotranspiration, some of which falls as rain over the Rio Plata Basin, the granary of Latin America (Marengo et al. 2004). The agricultural economy of Latin America, which is estimated to be worth US \$240 billion (World Bank 2009), is dependent on this water. Despite this dependence, the value is never accounted for in the valuation process, owing to the economic invisibility of water.

Another aspect of the economic invisibility of nature has to do with the poor and their relationship with nature. When dealing with poverty, an important question to ask is: how do we manage the risk to the poor associated with losing nature? Coral reefs demonstrate this issue well. Huge coral bleaching events have already occurred, and their rate is likely to increase in the future. These reefs provide food and employment to nearly 500 million people (Wilkinson 2004), or about 8% of the world's population, who live primarily in less developed countries and whose economic and social well-being is directly tied to the ecological health of the reef. This makes the health of coral reefs not only a biodiversity issue, but also a people issue. There is a need for better understanding and appreciation of the natural and human impacts resulting from this loss. We need to understand the poverty dimension. Societies in the developed world will be impacted to some extent by coral reef bleaching, but not nearly as much as those societies whose residents depend on the reefs for their livelihoods.

To help illustrate the invisibility of ecosystem services, Figure 8 below summarizes the findings of a study conducted in Thailand in 2001 and 2007 (Barbier 2007), which observed a loss of mangrove forests due to the conversion of mangroves to shrimp aquaculture. This conversion has a huge economic discrepancy in the form of subsidies that incentivize shrimp aquaculture. Without these subsidies, the conversion of mangroves to shrimp aquaculture is far less attractive, delivering only a slight economic advantage.

Furthermore, if one were to account for the ecosystem services affected and make them visible, the benefits would change substantially. Not only is there an immediate loss of area in mangrove ecosystems, but overall fertility decreases after just a few years under shrimp agriculture. The decrease is so extreme that shrimp farming can no longer continue. In the end, mangroves, which provide additional public wealth benefits to local villages, such as storm and surge protection, and act as fish nurseries, are converted to produce only a few



years of immediate private profits from shrimp aquaculture. A completely different tradeoff diagram results when such public wealth factors are included.

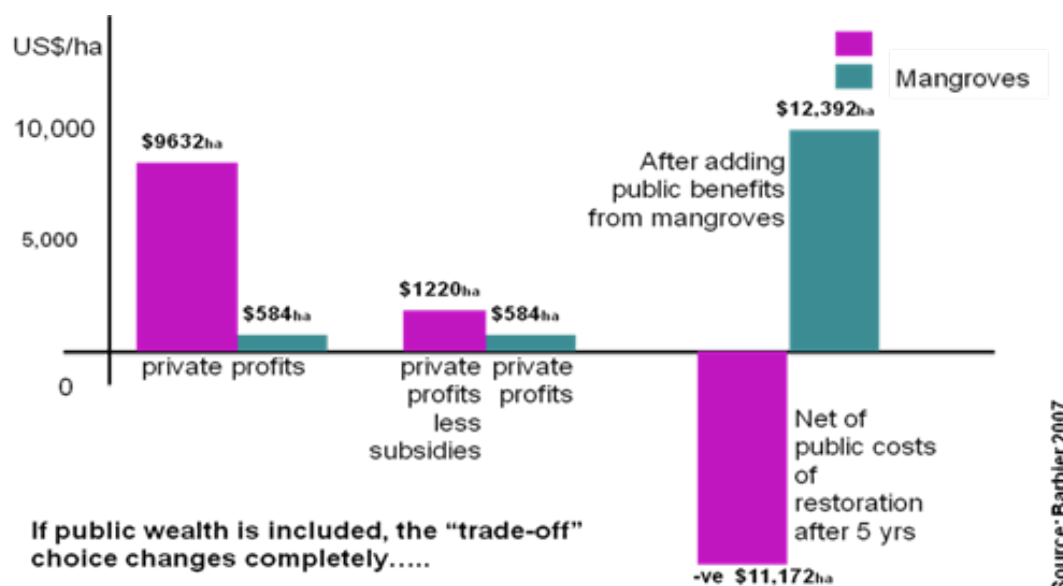


Figure 8: Private Profits, Public Losses: Shrimp Farming, South Thailand.

The story of shrimp farming in Thailand is not unique; all over the world, private profits trump public wealth. A United Nations Principles for Responsible Investment (UNPRI) study that examined a database of the top 3,000 publicly listed companies in the world estimated that the cost of "business as usual" practices was US\$2.15 trillion (UNPRI and UNEP FI 2010). This represents 7% of their combined revenues and 35% of total global environmental costs. Although none of the practices cited are illegal, they are an indication of the way business is conducted today.

THE ECONOMICS OF ECOSYSTEMS AND BIODIVERSITY

In 2007, amid findings such as the ones presented above, environment ministers from the governments of the G8+5 countries meeting in Potsdam, Germany, agreed to "initiate the process of analyzing 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" (TEEB 2010b). The Economics of Ecosystems and Biodiversity (TEEB) project, which emerged from that decision, has delivered a series of reports addressing the needs of major user groups: national and local decision-makers, businesses, and the wider public.

"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." (TEEB 2010b)

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 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. To enable this, TEEB has come up with a set of recommendations, shown in Text Box 1.



TEEB does not use a cost-benefit approach to valuation. Instead, it recognizes valuation as a human institution, a way for society to give itself feedback. One can assign value with no use of economics whatsoever. For example, take a sacred grove. To members of the local community, that grove has plenty of value and should not be destroyed, yet they communicate the value differently, without the use of economics.

Payments can be identified for preserving values that are captured. One can pay to maintain biodiversity in order to continue harvesting products, i.e. timber, pharmaceuticals, and carbon sequestration. In this case, the purpose of ecosystem service payments is to provide compensation. The TEEB view of valuation is cautious and layered through three approaches: recognizing value, demonstrating value, and capturing value.

There have been several success stories using this approach to valuation, including a prominent one at the Tubbataha Marine Park in the Philippines. Following a large bleaching event in 1998, the community collectively decided to create no-take areas based on collective action. The highly successful legislation did not use economic valuation, but instead recognized the needs of all members of the community — both those pushing for greater conservation (e.g., divers, dive operators, non-governmental organizations [NGOs], and government agencies) and those claiming their rights to extract resources from the park (e.g., local fishermen, commercial fishing operators, and agencies governing the fishing areas). As a result, between 1998 and 2004 there was a 10% increase in live coral cover, and the availability of fish biomass increased to twice that of the average healthy reef (Matt and Gebser 2010).

Another good example of using the ecosystems approach for planning is that of the Nakivubo swamp in Kampala, Uganda. A study evaluated the cost of converting the swamp to agriculture, wherein ecosystem services provided by the swamp were estimated at US \$1–1.75 million/year (Almack 2010). The cost of constructing and maintaining a new sewage plant, estimated at US \$2 million/year (Emerton et al. 1999), was greater than the cost of keeping the wetland, and therefore it was decided to preserve the wetland.

The Reducing Emissions from Deforestation and Forest Degradation (REDD+) project in the Ulu Masen Ecosystem, Aceh, Indonesia, combines land-use planning and reclassification, increased monitoring and law enforcement, reforestation, restoration, and sustainable community logging on 750,000 hectares of forest in the Ulu Masen Ecosystem and peripheral forest blocks located in Aceh province. This is an ideal example of collaboration between governments, civil society, and the private sector. In this case, the provincial government was responsible for looking into compliance issues and integration with government and regulatory structures. The NGO Flora and Fauna International facilitated participatory processes for community development, spatial and land-use planning, collaborative law enforcement, and community-based forest management. The project design, development, start-up, and carbon finance were managed by the firm Carbon Conservation Ltd. Estimates suggest that this activity will reduce deforestation and save up to 3.5 million metric tons of CO₂ emissions (Rafli et al. 2007).

KEY RECOMMENDATIONS OF TEEB

- System of national accounts: Upgrade the SNA to include changes in natural capital. Start with physical accounts for forest stocks and carbon storage.
- Business: Standardize, measure, and disclose all major “nature” externalities in statutory annual reports.
- Subsidies: Measure and annually disclose environmentally harmful subsidies, manage them down, and phase them out.
- Ecological infrastructure: Evaluate and invest in ecosystem conservation/restoration for freshwater, soil, mitigation (“Making REDD+ Real”) and adaptation (TEEB climate issues update).
- Local and regional government: Build ecosystem service values into regional land plans, protected area budgeting, eco-certification, and payment for ecosystem services (PES).

Text Box 1: Key Recommendations of TEEB. Source: TEEB 2010b.

TEEB CASE STUDY DATABASE: SUCCESSES AND FAILURES

The TEEB Cases, a case study database, compiled in collaboration with GIST Advisory, India, and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) presents case studies of success stories and failures categorized under regional planning, participatory rural appraisal, PES, legal framework, certification, economic evaluation, and cost-effective adaptation (European Environmental Agency” 2010).¹ These case studies identify best-practice examples from different parts of the world regarding effective policy actions based on economics that have improved conservation and livelihoods. The examples selected for the case studies substantiate the point that economic values can help conserve biodiversity in various ways. Each case study provides the background of the problem, the policy uptake, an overview of what it is and how it works, which ecosystem services are considered, and how the relevant strategy can result in

¹ To access TEEB Cases, please visit <http://www.teebweb.org/TEEBcases>.



improving the quality of the ecosystem under consideration. Some of these success stories and failures, and the lessons learned from them, are described below.

Success Story: The Kennecott Inland Seashore Reserve, Utah, USA

Kennecott Utah Copper LLC, a subsidiary of Rio Tinto PLC, is North America's largest copper mine. In the mid-1990s, the company needed additional storage capacity for tailings and purchased an area of degraded salt pans and industrial land along the south shore of Great Salt Lake (Ten Kate et al. 2004). It was later observed that this area contained a designated wetland habitat. Great Salt Lake is an important ecological resource and home to many migratory birds. Therefore, as per U.S. laws, Kennecott was required to offset or mitigate the loss of wetlands by creating an agreed number and value of habitat units (Ten Kate et al. 2004). Since many of the habitats had deteriorated due to overgrazing, the creation of salt evaporation ponds, off-road vehicle use, and illegal waste dumping, successful mitigation required the restoration and creation of water bird habitats.

In response, Kennecott Utah Copper LLC created and now manages the Inland Sea Shorebird Reserve (ISSR) and also preserves Great Salt Lake habitats to attract migratory birds. This wetland offset project is recognized as one of the largest and most successful mitigations in the United States, resulting in the creation of 1,011 hectares of shorebird and waterfowl refuge, where approximately 150,000 migratory birds and waterfowl visit each year. The total number of bird species at the ISSR has grown from 50 in 1995 to more than 150 in 2010 (TEEB Case 2010). The outcome of this project is a net gain for biodiversity. In addition to the legally required offsets, Kennecott restored surplus land adjacent to the mitigation site. Credits from this "bank" of surplus restored land can be used by Kennecott or sold to others for wetlands mitigation in accordance with the terms of the bank agreement with the U.S. government (Brownlie 2008).

Success Story: Hiware Bazaar- A Village of Millionaires, Maharashtra, India

Hiware Bazaar presents one of the best-known examples of using a development approach based on integrated watershed management to turn a village's misfortune into an ecological and economic success. From the late 1970s to early 1990s, Hiware Bazaar, in the state of Maharashtra, was a typical semi-arid village that had run out of most of its natural assets: forests had been cut, water sources had run dry, and the land had become unproductive. The village faced an acute water crisis and its traditional water storage systems were in ruins. In 1989-1990, only 12% of the land was cultivable, and there was rampant poverty and unemployment (Singh 2010). This led to large-scale migration to cities. In addition, the village was beset by social problems such as alcohol addiction and gambling. According to a survey in 1995, 168 out of 180 families lived below the poverty line (Sangameswaran 2006; Naik 2008; Sakhuja 2008).

The turnaround happened when, under the leadership of the village head, watershed development programs were undertaken in conjunction with government-run employment generation and poverty alleviation schemes. In order to regenerate degraded village forests and catchments and to restore watershed ecosystems, the village was divided into three micro-watersheds on which contour trenching and tree plantation, contour bunding, and nala (drain) bunding were executed. The result was an increase in irrigated area from 70 hectares (in 1993) to 260 hectares (in 2006), with livestock numbers increasing from 20 (in 1998) to 340 (in 2003) (Singh 2010). Hiware Bazaar is now an icon of ecological development, called the "millionaire's village," with an average per capita income that is twice the average of the top 10% in rural village areas.

Failure: Willingness to Pay for Conservation of Asian Elephants in Colombo, Sri Lanka

Rapid population growth and decades of violent conflict have worsened one of Sri Lanka's major poverty-related rural problems: human-elephant conflict, namely crop raiding by elephants. Prevention strategies (such as watchtowers and firecrackers) in densely populated areas have not to date presented viable long-term solutions. According to many studies (Jayawardene 1998; De Silva 1998; Bandara and Tisdell 2002), the total economic value of crop and property damage caused by elephants (for the entire elephant range in Sri Lanka) is Rs (Sri Lankan rupee) 561 million per cropping season and Rs 1,121 million per annum. Every year, approximately 150 elephants and 50 to 70 humans die because of this conflict (Oswin Perera 2009), and farmers with meager resources often resort to poisoning, traps, guns, and live electric wires to counter elephant destruction.

To counter this problem, Ceylinco Insurance presented a scheme based on corporate social responsibility and willingness to pay to reduce conflict and the growing problem of crop raiding. The company proposed to add a small monetary amount to policyholders' premium payments for life and vehicle insurance. To implement the scheme, the firm created awareness about the socioeconomic and cultural benefits of elephants, with the intention of creating a market for its product. A survey was undertaken to assess both town residents' willingness to pay more for their life insurance premiums to support elephant conservation and villagers' willingness to participate in the plan. The survey showed that the willingness to pay for elephant conservation was greater than the price demanded by those affected by elephant damage. Furthermore, to "establish ownership" of the program, farmers were expected to pay a nominal annual fee of Rs 650



(less than US \$6). A commission of 10% was set aside for government agencies or organizations selected by the wildlife conservation department, to compensate them for the cost of implementing the program in remote areas.

In spite of its sound ecological science and economic feasibility, the scheme failed because of the management risk associated with implementing it through a single insurer. Although it seemed to be a strong design, the project was plagued by corruption and scandal and ultimately failed. This example provides an important lesson: new products such as this are best launched on an industry-wide basis rather than relying on a single organization for implementation.

IMPLEMENTING THE TEEB APPROACH: SIX –STEP ASSESSMENT

In its report *TEEB for Local and Regional Policy Makers*, TEEB has proposed a set of steps for effectively appraising ecosystem services. The approach is not a fixed recipe, but is intended to guide policy-makers in designing their own processes. Text Box 2 summarizes the six steps, and the rest of this section uses an example to illustrate how the TEEB approach can be applied.

Example

Sumatra has abundant biodiversity; it is the only place on earth where tigers, elephants, orangutans, and rhinos all reside. Local communities rely on many ecosystem services, particularly the provision of a clean and regular water supply for drinking, hydropower, irrigation, protection from floods, droughts, forest fires, landslides, regulation of air pollution, and maintenance of fertile soils for agriculture.

STEP 1: AGREE ON THE ISSUE

In October 2008, the ten provincial governors of Sumatra and four Indonesian government ministers made a historic commitment to protect the remaining forests and critical ecosystems of Sumatra. Local land-use planning is critical for achieving this commitment. Indonesia's national spatial planning process operates on a five-year cycle. Spatial planning has been undertaken in Indonesia for many years, but has only had a legal basis for measures to enforce compliance since 2007, following the adoption of the Spatial Planning Law 26/2007 (Hudalah and Woltjer 2007). In 2010, the Indonesian government was working to design spatial plans at the provincial and district levels. Much decision-making power resides on the local scale because of decentralization. At the national level, renewed spatial planning efforts involve all relevant ministries, whereas at the provincial level, an NGO forum supports planning efforts.

STEP 2: IDENTIFY RELEVANT ECOSYSTEM SERVICES

Forest conversion, mostly for palm oil, pulp and paper plantations, and illegal logging, is causing biodiversity loss and degrading many ecosystem services. In particular, conversion of lowland deep peat forests, mostly in eastern Sumatra, is a major contributor to global carbon emissions. Existing and prospective forest concessions threaten to have even greater adverse impacts. It is commonly overlooked that forests provide a range of valuable ecosystem services beyond standing timber, such as soil conservation and water augmentation. The lack of incentives to sustain ecosystem services is one of several root causes of these problems.

STEP 3: DEFINE INFORMATION NEEDS AND CHOOSE ASSESSMENT TOOLS

InVEST, a mapping tool provides information on where ecosystem services are supplied and in what quantity — in this case, on the Sumatran landscape — and how these patterns might change under future land-use scenarios.² It can be overlaid with biodiversity information to see where ecosystem services and conservation priorities overlap. InVEST models are based on production functions that define how an ecosystem's structure and function affect the flows and values of ecosystem services. The models account for both service

SIX STEPS FOR EFFECTIVELY APPRAISING ECOSYSTEM SERVICES

- 1) Specify and agree on policy issues with stakeholders.
- 2) Identify which ecosystem services are most relevant.
- 3) Define the information needs and select appropriate methods.
- 4) Assess ecosystem services.
- 5) Identify and appraise policy options.
- 6) Assess the distributional impacts of policy options.

Text Box 2: Six Steps for Effectively Appraising Ecosystem Services. Source: TEEB 2010c.

² Please refer to Seminar II: Valuing Nature — Economics, Ecosystem Services, and Decision-Making for a detailed explanation of InVEST.



supply (e.g., living habitats as buffers for storm waves) and the location and activities of people who benefit from services (e.g., location of people and infrastructure potentially affected by coastal storms). Since data is often scarce, the first version of InVEST offers relatively simple models with few input requirements. These models are best suited for identifying patterns in the provision and value of ecosystem services.

STEP 4: CONDUCT THE ASSESSMENT

InVEST was used to model the quantity and location of high-quality habitat, carbon storage and sequestration, annual water yield, erosion control, and water purification under two scenarios: the Sumatra ecosystem vision of sustainable land-use as proposed in a roadmap action plan, and a business-as-usual scenario corresponding to the government's current spatial plan.

STEP 5: APPRAISE POLICY OPTIONS

Results were disseminated to government representatives from nineteen districts. Preliminary recommendations were offered on specific actions, based on the potential gains or losses in ecosystem services if the Sumatra ecosystem vision and road map were implemented. For example, based on InVEST results, recommendations were made on how to prioritize areas for forest restoration based on habitat quality and the potential for reducing erosion. Information on ecosystem services can also be used to advocate for and help implement incentive mechanisms that reward sustainable land use, such as forest carbon projects, payments for watershed services, certified forestry and agriculture, and ecotourism. InVEST results in informed discussions of forest carbon projects by identifying where carbon storage and sequestration potential is high.

STEP 6: ASSESS THE DISTRIBUTIONAL IMPACTS

An assessment of the distributional impacts of changes in ecosystem services in response to policy options must focus on both global (carbon) and local (water, erosion, etc.) ecosystem benefits. In the case of Sumatra, comparing the scenarios demonstrated the social impacts of forest conversion, but the social impact assessments of policy responses remain unclear. This illustrates that the success of InVEST depends on the people who use it.

MARKET-BASED SOLUTIONS

There are also market-based approaches to valuing ecosystem services, such as PES, an economic conservation tool that has recently gained much attention. It is believed to show a lot of promise in managing natural resources by incentivizing stakeholders to agree on behavioral changes that are more sustainable. The environmental impacts of these behavioral changes are quantified and the changes rewarded. It is an instrument where buyers and sellers voluntarily agree on a payment for the provision of a specific ecosystem service (or for an activity that is believed to ensure such provision), that would otherwise not take place (Wunder 2005).

Such market-based mechanisms are suitable for some situations but not for others. Not everything can be bought and sold in markets; only private claims can be traded in such a way. For instance, markets are not well suited to solve social problems. When it comes to public services like carbon, a monumental effort is needed to create one or two success stories. Carbon markets are associated with derivatives, which imply trading of debits and credits within a ledger system. Hence, the problems of derivative markets will also affect carbon markets. These are compounded by the risk of corruption and free ridership. Carbon markets are an attempt to create rules and develop a synthetic solution to a complex problem; the chances of success are small. What are needed are complex solutions that involve public policy and community cooperation.

There are additional opportunities for valuing ecosystem services by "fixing" and "creating" markets. Attempts are made to "fix" markets by addressing externalities through certification, such as Forest Stewardship Council (FSC) certification for timber markets and the Marine Stewardship Council (MSC) certification for fisheries markets. Similarly, in crop markets polluters can be made to pay by incorporating a charge for pollution into the value of a good. "Creating markets" involves developing new markets, such as premium credits³ under REDD+ and biodiversity banking.

³ Premium credits are the improvements in wildlife and social benefits provided by a carbon project. These credits can be "stripped" and sold separately in a market for biodiversity credits, offsets, and to improve corporate social responsibility (CSR).



THE WAY FORWARD

Solutions to the economic invisibility of nature exist by way of acknowledging the compelling logic for a green economy over a brown economy.⁴ The behavioral changes that are needed are lacking because companies seek out resources where good governance is missing. Today's corporations are hardwired to arbitrage markets. Recognition of the exploitative nature of corporations, which seek to maximize profits instead of aligning their goals with benefits to society, is needed.

Despite the general myopia, visionary companies like PUMA are leading the way by examining their entire supply chain for impacts on carbon and freshwater based on four tiers: the manufacturing of products; outsourced processes, such as embroiders, printers, and outsole production; processing of raw material, such as leather tanneries, the chemical industry, and oil refining; and raw material production, such as cotton farming, oil, and drilling (PPR HOME and PUMA 2011). In doing so, PUMA has discovered that externalities go beyond its direct activities to the activities of its suppliers. Although most of the damages to society come from its suppliers' externalities, PUMA is still accountable because those supplies make up its products. Only when externalities are reported can people have a complete view and understanding of the products.

What PUMA has done in terms of estimating and reporting business sector externalities is echoed in the main focus areas as defined by the TEEB community:

- TEEB capacity-building in developing countries;
- Country, sectoral, and regional TEEB analysis;
- Green national accounts (Wealth Accounting and Valuation of Ecosystem Services [WAVES] — the World Bank, UNEP, and others);
- Estimating and reporting business sector externalities;
- Identifying and closing ecology and valuation knowledge gaps; and
- Communicating the issues to citizens.

Work has been done in the field of green accounting by the Green Indian States Trust in New Delhi, in the form of the Green Accounting for Indian States Project (GAISP). The project measured sustainable development at the state level in India, sourcing data only from official Indian national databases, and consistent with the United Nations' SEEA-2003 guidelines. Adherence to these guidelines and sourcing data only from official national databases (but with granularity at the state level) ensures legitimacy, fairness, and methodological consistency.

GAISP's results are available through a series of eight monographs, which adjust the official national accounts for externalities such as the non-marketed services of forests (carbon storage, biodiversity values, ecological services, and so forth), the hidden costs of agriculture, losses in freshwater quality, and depletion of sub-soil assets. Human capital externalities, namely the positive externalities of education and the negative impacts of pollution on human health, are also evaluated and adjusted for in the national accounts.⁵

However, this field is relatively new and the science is still developing. It is therefore essential to identify knowledge gaps and limitations and map them into national policies. Some of the challenges and options include:

- **Links between biodiversity, ecosystems, and resilience:** Roles of species interactions and functional diversity for ecosystem resilience are unclear.
- **Dynamics of ecosystem services:** There is a need to develop specific tools to contribute to better assessment of the spatial and temporal dynamics of service provision, especially in relation to defining who benefits, where, and to what extent.
- **Understanding the dynamics of governance and management of ecosystems and ecosystem services:** There are trade-offs and complementarities involved in the provision of bundles of ecosystem services, and it is important to understand how changes in the configuration of ecosystems affect their value.
- **Valuation methods and benefit transfer:** Since marginal values are likely to vary with ecosystem characteristics, socioeconomic characteristics of beneficiaries, and ecological context, care needs to be taken to adjust transferred values when there are important differences between study and policy sites.
- **Valuations and its context:** Valuation is often carried out in a sociocultural context; for example, a patch of forest land considered a "sacred grove" by one community may not have the same significance for another.

⁴ "Green economy" refers to national governments investing in and promoting environmentally sustainable opportunities for economic growth and personal incomes. A brown economy follows the business-as-usual scenario where GDP growth is based mainly on mainstream sectors such as industry, mining, and export and import, and where sustainability is not a key criterion of a country's growth strategy.

⁵ Monographs are accessible at www.gistindia.org.



- **From micro foundation to macro policy:** Most valuation exercises do not allow ecosystems and economies to impact each other simultaneously. (Source: TEEB 2010a)

The way forward from here is three-dimensional capitalism complemented by sophisticated economics. Business must lead the way and seek new rules and behaviors, which will be regulated by governments and observed, analyzed, and summarized by a new-age Adam Smith — and perhaps written up as *An Inquiry into the Nature and Causes of the Three-Dimensional Wealth of Nations* (Sukhdev 2011).



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