The Economics of Ecosystems and Biodiversity (TEEB)

Integrating biodiversity and ecosystems with national accounts

UNCEEA Meetings
24 – 26th June, New York

Haripriya Gundimeda
co-head D2, study leader group
IIT Bombay
on behalf of UNEP and
Pavan Sukhdev (Study leader)
1. TEEB Background

2. The links: Biodiversity, Ecosystems, Functions, Benefits and Value

3. TEEB Phase 1: Results and impacts

4. TEEB Phase 2: Challenges ahead – and how they are approached
Potsdam 2007: Meeting of the Environmental Ministers of the G8+5

“Potsdam Initiative – Biological Diversity 2010”

1) The economic significance of the global loss of biological diversity

In a global study we will 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.
To mainstream the economics of ecosystems and biodiversity

To review extensively the current state of the science and economics of ecosystems and biodiversity, and recommend a valuation framework and methodology

To address the needs of the “end-users” of these economics: policy-makers, local administrators, corporations and citizens

Phase 1 (2007-2008):
• Preliminary scoping work,
• Some first analysis,
• Clarification as to how to address the wider goals,
• Preliminary identification of experts and organisations to contribute

Source: Pavan Sukhdev, Bonn 2008

Phase 2 (2008-2010):
• Valuation framework
• Broaden the scope of studies (methods; ESS and biomes addressed)
• Focus on End-user products
• Stronger Involvement from different experts & organisations
1. TEEB Background

2. The links: Biodiversity, Ecosystems, Functions, Benefits and Value

3. TEEB Phase 1: Results and impacts

4. TEEB Phase 2: Challenges ahead – and how they are approached
The link between biodiversity, ecosystems, their services, and benefits to mankind...

- **Biophysical structure or process** (e.g. woodland habitat or net primary productivity)
- **Function** (e.g. slow passage of water, or biomass)
- **Service** (e.g. flood protection, or harvestable products)
- **Benefit (Value)** (e.g. willingness to pay for woodland protection or for more woodland, or harvestable products)

Source: Jean-Louis Weber (EEA) presentation at the Workshop: *The Economics of the Global Loss of Biological Diversity 5-6 March 2008, Brussels, Belgium*
Biodiversity, ecosystems and their services

Source: TEEB Interim Report, p.34
1. TEEB Background

2. The links: Biodiversity, Ecosystems, Functions, Benefits and Value

3. TEEB Phase 1: Results and impacts

4. TEEB Phase 2: Challenges ahead – and how they are approached
Economic Size & Welfare Impact of Losses

Deep Links with Poverty

Discount rates are ethical choices
Level of Biodiversity in the World in 2000 (OECD baseline, Globio-3 model, “MSA” indicator)

Remaining MSA in %

- Red: < 10
- Orange: 10 - 20
- Brown: 20 - 30
- Yellow: 30 - 40
- Green: 40 - 50
- Dark Green: 50 - 60
- Medium Green: 60 - 70
- Light Green: 70 - 80
- Light Yellow: 80 - 90
- Pale Yellow: 90 - 100

Source: Ben ten Brink (MNP) presentation at the Workshop: The Economics of the Global Loss of Biological Diversity 5-6 March 2008, Brussels, Belgium.
Level of Biodiversity in the World in 2050
“Business as Usual” Scenario of the future

❖ MSA loss from 72% to 61%
❖ Natural Areas decline by 7.5 Million Sq. Km.

Source: Ben ten Brink (MNP) presentation at the Workshop: The Economics of the Global Loss of Biological Diversity 5-6 March 2008, Brussels, Belgium.
Main drivers of Biodiversity Loss
2000 - 2050 (Globio-3)

Biodiversity (MSA) loss between 2000 and 2050 and contribution of pressures: World

COPI Figure 4.4a: Contribution of different pressures to the global biodiversity loss between 2000 and 2050 in the OECD baseline
Perverse Subsidies are a key driver of the loss of fisheries.

Half of wild marine fisheries are fully exploited, with a further quarter already over-exploited.

- at risk: $80-100 billion income from the sector
- at risk: est. 27 million jobs
- but most important of all.....

at risk: Health ... over a billion rely on fish as their main or sole source of animal protein, especially in developing countries.

Source: Ben ten Brink (MNP) presentation at the Workshop: The Economics of the Global Loss of Biological Diversity 5-6 March 2008, Brussels, Belgium. Original source: Pauly
Ecosystem Losses & Links to MDG’s

HAITI

DOMINICAN REPUBLIC

MDG 1: Eradicate extreme poverty and hunger
MDG 8: Develop a Global Partnership for Development
MDG 5: Improve maternal health
MDG 4: Reduce child mortality
(1) Economic size of losses (COPI 1 study)

A: 50-year impact of inaction or ‘business as usual’

Welfare losses equivalent to 7% of GDP, horizon 2050

B: Natural Capital Loss every year

Valuation and Ecosystem service losses

A year’s biodiversity loss leads to ecosystem services losses into the future: B

Natural Capital Lost: Annually EUR $1.35 \times 10^{12}$ to $3.10 \times 10^{12}$

(@ 4% Discount Rate) (@ 1% Discount Rate)

Source: Braat & ten Brink (Eds., 2008): Cost of Policy Inaction

3. TEEB Phase 1 results
India Example: 480 Million people in small farming, animal husbandry, informal forestry, fisheries …

Ecosystem services to classical GDP

Ecosystem services to “GDP of the Poor”

Source: GIST’s Green Accounting for Indian States Project, 2002-03 data
(3) Ethics of discounting
Three hidden stories

1. Declining Growth Paths in the per-capita flow of nature’s services … *imply that discount rates should be negative*!

2. Marginal Utility of $1 to the Rich vs Poor … *is too different to merit the same discounting treatment*

3. Inter-generational Equity … *following ‘market practise’ means valuing nature’s utility to your grandchild at one-seventh of your own*!

---

**Cash flow 50 years in the future**

<table>
<thead>
<tr>
<th>Cash Flow</th>
<th>Annual Discount Rate</th>
<th>Present Value of the Future Cash Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1,000,000</td>
<td>4%</td>
<td>140,713</td>
</tr>
<tr>
<td>$1,000,000</td>
<td>2%</td>
<td>371,328</td>
</tr>
<tr>
<td>$1,000,000</td>
<td>1%</td>
<td>608,039</td>
</tr>
<tr>
<td>$1,000,000</td>
<td>0%</td>
<td>1,000,000</td>
</tr>
</tbody>
</table>
This stock collapse is petty when compared to the nature crunch.

The financial crisis at least affords us an opportunity to now rethink our catastrophic ecological trajectory.

― The Guardian, Tuesday October 14 2008

George Monbiot

Rodungen kosten Billionen

Das Abholen der Wälder wird die Menschheit jährlich mit sechs Prozent der globalen Wirtschaftsteilung bedroht. 

Times Online

From The Times

May 30, 2008

Destroying the world’s wildlife costs economy £40bn a year

The Economic Times India, 30.05.2008

Printed from

The Economic Times

Nature loss could halve living standards for the world’s poor

London: An environmental review, headed by an Indian, has concluded that damage to forests, rivers, marine life and other aspects of nature could halve living standards for the world’s poor.

nomisch sinnvoller als die rück-sichtslose Ausbeutung der Natur.

Environment correspondent, BBC News website, Barcelona
1. TEEB Background

2. The links: Biodiversity, Ecosystems, Functions, Benefits and Value

3. TEEB Phase 1: Results and impacts

4. TEEB Phase 2: Challenges ahead – and how they are approached
EEEB
from macro to micro

TEEB, phase 1 focused on the macro picture

TEEB, phase 2 will explicitly address the local, business and consumer level
The Process for TEEB Phase 2

Inputs from Science and Economics experts through the Call for Evidence, participation in Working Groups, etc.

Val’n Framework, Methodologies, Cost Analyses

TEEB for Policy-Makers

TEEB for Administrators

TEEB for Business

TEEB for Citizens

Continuous involvement of End-User Groups

2008

2009

2010

End-User Outreach

CBD COP9 - Bonn, Germany

CBD COP10 - Nagoya, Japan
The problem

Nature's Interactions with Humanity

Money: today's Yardstick

Photo: C.Neßhöver, UFZ
The problem

No Value =
No Counterweight ...

$$\text{Nature}$$

Photo: C.Neßhöver, UFZ
Important - How we measure what we value?

Improving Measurement can be a long process, but of fundamental importance to being able to obtain a solution (TEEB, D1, chapter 3, work in progress)
Ecosystem services
public goods & difficulty of valuation

<table>
<thead>
<tr>
<th>Service</th>
<th>Economic Valuation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spiritual &amp; religious</td>
<td>?</td>
</tr>
<tr>
<td>Aesthetic</td>
<td>?</td>
</tr>
<tr>
<td>Flood/Fire regulation</td>
<td>?</td>
</tr>
<tr>
<td>Disease regulation</td>
<td>?</td>
</tr>
<tr>
<td>Water purification</td>
<td>?</td>
</tr>
<tr>
<td>Climate regulation</td>
<td>?</td>
</tr>
<tr>
<td>Freshwater</td>
<td>?</td>
</tr>
<tr>
<td>Genetic resources</td>
<td>?</td>
</tr>
<tr>
<td>Recreation &amp; tourism</td>
<td>?</td>
</tr>
<tr>
<td>Fiber</td>
<td>?</td>
</tr>
<tr>
<td>Food</td>
<td>?</td>
</tr>
</tbody>
</table>

Economic Value ($)

Source: Jeffrey A. McNeely, Chief Scientist, IUCN-The World Conservation Union from presentation: FUNDING MECHANISMS FOR BIODIVERSITY. Inter-American Development Bank Workshop on Biodiversity Loss.
Range of opportunities to take natural capital into account

- Biodiversity indicators: needs for measurement/monitoring, modeling and targets.
- Ecosystem services indicators important for instrument design (PES, REDD)
- Ecological footprints valuable for policy targets and communication
- Critical importance of ecosystem services to the poor – refocus poverty policy?
- National policy makers with more comprehensive national income accounts
1. **Species Richness** (to quantify species diversity, its recreational, medicinal, etc. values, including contribution to ecosystem resilience and robustness)

2. **Species Rarity** (to quantify species close to extinction, their ethical and recreational values, global citizens significant "WTP" for these. Note that Species Rarity is closely and inversely related to another biodiversity attribute, Population Viability, hence a reflection of physical dispersion, mean range size & separation)

3. **Biomass Density** (because of its role in delivering very important services, especially Carbon storage, water provisioning and regulation, and others)

4. **Primary Productivity** (to measure the natural rate of production of biomass, & its food production potential through the human appropriation of net primary productivity - to feed 9 billion of us in 2050)

5. **Genetic diversity** (to quantify bio-prospecting values and insurance values for future foods, etc)
From indicators to ESS

Source: Chapter 3 Do TEEB work in progress
• Offer the unique opportunity to describe the flow of benefits provided by biodiversity and ecosystems.
• Some examples from D1 TEEB (ten brink et al..)
• **Provisioning services**
  • Food – Crop production from sustainable [organic] sources in tonnes/ha
  • Number of wild species used as food
• **Regulating Services**
  • Climate / climate change regulation (Total amount of carbon sequestered/stored)
  • **Natural hazards control** (Trends in number of damaging natural disasters
  • Probability of incident)
  • **Water regulation** (Infiltration capacity/rate of an ecosystem, Soil water storage capacity in mm/m, Floodplain water storage capacity in mm/m)
• **Cultural and social services**
• **Ecotourism & recreation** (Number of visitors to protected sites per year,
  • Amount of nature tourism)
Measuring Benefits of Ecosystem services
Answers are needed at all levels

The Benefits Pyramid

- Non-Specified Benefits
- Increasing up the benefits pyramid
- Monetary Value
  - Monetary: eg avoided water purification costs, avoided flood damage, tourist value, value of medicines / pharmaceuticals from natural products
  - Quantitative: eg level of service, number people benefiting from wood from forests, # of avoided health impacts; number of visitors
  - Type of benefits: health benefits from clean air, social benefits from recreation, income from products, security, wellbeing.
- Qualitative Review
  - Knowledge gaps
    - The “known-unknowns” and “unknown-unknowns”
- Quantitative Review of Effects
- Full range of ecosystem services from biodiversity

Source: P. ten Brink: presentation at March 2008 workshop Review of Economics of Biodiversity Loss, Brussels
Our Economic Space... and our Economic Compass...

Natural Capital

Human & Social Capital

Financial & Physical Capital

GDP Growth
Sustainable measurement
need of the hour

- Economic assets – Natural assets
- Infrastructure – Green infrastructure
- Gross fixed capital formation – Natural capital formation
- Trade deficits – Green deficits
- National net savings – Genuine savings
- National Accounts – Satellite Accounts for nature
- GDP – EDP

There is a natural counterpart to many of our economic measures, which is equally important, yet we do not take it into account. This must change to achieve true sustainable development (TEEB, D1, Chapter 3)
Integration of ecosystems into national accounts - vital

- Compute ecosystem asset accounts
- Compute the loss in flows due to capital consumption
- Derive Adjusted net domestic product/income
- Integrate ecosystem accounts with the national accounting matrices and the monetary and physical indicators used for policy making.
Example from India
GAISP project for forests

- Opening stocks
  ➢ Changes due to economic activities
  ➢ Other Changes
- Closing stocks

Detailed components for forestland, timber and carbon are slightly different for each

Total economic value (Timber, fuelwood, fodder, nontimber forest products, carbon, ecotourism and biodiversity)

Monetary accounts
Depletion Adjusted NSDP (ESDP) to NSDP

Regions

- ESDP/NSDP using net price method
- ESDP/NSDP using weighted net price method
Ecotourism and biodiversity

ESDP/NSDP

States
• A ‘tale of two tragedies’ for mixed economies pursuing a traditional GDP-growth-led development paradigm.

Gundimeda and Sukhdev, D1 TEEB
## Quantification of linkages

<table>
<thead>
<tr>
<th>Contribution of agricultural, forestry, fisheries and livestock to agriculture</th>
<th>Per capita GDP</th>
<th>Gini coefficient</th>
<th>Total wealth</th>
<th>Natural wealth</th>
<th>Biodiversity index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contribution of agriculture, forestry, fisheries and livestock to GDP</td>
<td>1.00</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Per capita GDP</td>
<td>-0.48</td>
<td>1.00</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Gini coefficient</td>
<td>0.15</td>
<td>-0.55</td>
<td>1.00</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total wealth</td>
<td>-0.47</td>
<td>0.96</td>
<td>-0.53</td>
<td>1.00</td>
<td>-</td>
</tr>
<tr>
<td>Natural wealth</td>
<td>-0.32</td>
<td>0.49</td>
<td>-0.16</td>
<td>0.35</td>
<td>1.00</td>
</tr>
<tr>
<td>Biodiversity index</td>
<td><strong>0.12</strong></td>
<td><strong>-0.39</strong></td>
<td><strong>0.47</strong></td>
<td><strong>-0.35</strong></td>
<td><strong>-0.04</strong></td>
</tr>
</tbody>
</table>

Source: Gundimeda and Sukhdev D1 TEEB
GDP of the poor

Contribution of agriculture, forestry, fishing, hunting and livestock

Dependence on forestry, fishing, hunting, livestock

Source: Gundimeda and Sukhdev D1 TEEB

Consumer Theme : Ecological Footprints - Land and Water use by various foods
“Society must urgently replace its defective economic compass so that it does not jeopardize human well-being and planetary health through the under-valuation and consequent loss of ecosystems and biodiversity.”

Pavan Sukhdev, TEEB Study Leader
29.5.2008, CBD COP9
Message from TEEB community

- Qualitative indicators are an important tool in underlying quantitative and monetary information and help to close gaps where no such information exists.

- Economic values are critical means of communicating urgency, addressing need of action or designing effective policy instruments.

- Greening the national accounts are necessary to correct defective economic compass

- Indicators like GDP of the poor are also necessary to analyse the vulnerability of poor people to environmental degradation. For transitional economies where rural and forest-dweller poverty is a significant social problem, we advocate using a measure of GDP which is sectoral and focused on their livelihoods: we call this “GDP of the poor”.

- Beyond GDP indicators important for policy targets and communication

- For TEEB each aspect is important – integration into the national accounts, monetary indicators, the quantitative and the qualitative.
Recommendations for UNCEEA

• Three methods recommended - Green National Accounting; Genuine Savings; Inclusive Wealth - all require stock adjustments
• Flow adjustments also needed, and reflected against GDP for Governments, to stop using GDP as the only progress indicator
• SEEA-2003 revision to become a more comprehensive "guidebook"
• Countries who can move ahead should do so...
• The Key here is to set the direction, not try to dictate the speed at which countries migrate to 'Green Accounting'
• Therefore ....a Tier 1 should form of countries who can simultaneously do ecosystem accounting etc and prepare comprehensive Green Accounts (eg: India).
• Tier 2 should be countries who can do some, not all, the key recommendations.
• Tier 3 are those for whom WB or UN just has to make their own spreadsheet estimations of value adjustments
Thank You!