Valuation of biodiversity and associated ecosystem services

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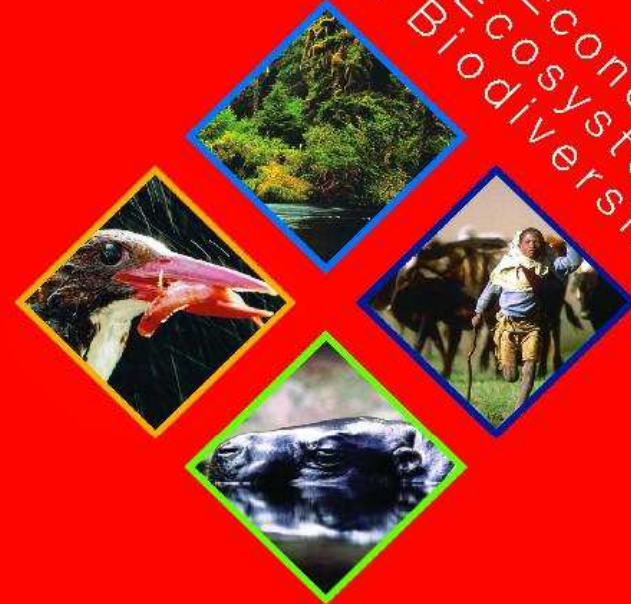# AN EXPLORATION OF TOOLS AND METHODOLOGIES FOR VALUATION OF BIODIVERSITY AND BIODIVERSITY RESOURCES AND FUNCTIONS

The Economics of Ecosystems & Biodiversity

TEEB FOR LOCAL AND REGIONAL POLICY MAKERS

Options for the Application of
TOOLS FOR VALUATION OF BIODIVERSITY
and Biodiversity Resources and Functions

Biodiversity and its resources and functions generate substantial ecosystem services many of which are not traded on markets and whose value is therefore not reflected in market prices. Consequently, private and public decision-making and the allocation of funds will be distorted if the repercussions of activities on biodiversity resources and functions, and the associated ecosystem services, are not adequately taken into account. This distortion is an important underlying cause of biodiversity decline. Undertaking valuation of biodiversity resources and functions and the associated non-marketed ecosystem services has the potential of improving private and public decision-making, thereby contributing to the target of the Convention to significantly reduce by 2010 the current rate of biodiversity loss.

TOTAL ECONOMIC VALUE (TEV) Most public and private resource management and investment decisions are strongly influenced by considerations of the monetary costs and benefits of alternative policy choices. Undertaking valuation should seek to address the relevant components of the Total Economic Value of non-marketed ecosystem services, bearing in mind that the concept of Total Economic Value includes both the direct and indirect use value as well as non-use value of ecosystem services and hence goes beyond the immediate benefits of commercial exploitations of biodiversity resources. Decisions can be improved if they are informed by the economic value of alternative management options and involve mechanisms that bring to bear non-economic considerations as well.

The options of valuation tools provided in the accompanying table should not be taken as a closed set of tools, considering the evolutionary character of this field.

Aichi target 2 of the Strategic Plan

"By 2020, at the latest, biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems."

Different types of biodiversity values…

"…the <u>intrinsic</u> value, <u>ecological</u>, <u>genetic</u>, <u>social</u>, <u>economic</u>, <u>scientific</u>, <u>educational</u>, <u>cultural</u>, <u>recreational</u> and <u>aesthetic</u> values of biological diversity and its components;" (decision X/3, paragraph 9 (b) (ii))

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"By 2020, at the latest, biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems."

Different types of biodiversity values…

*"…the intrinsic value, ecological, genetic, social, **economic**, scientific, edu cational, cultural, recreational and aesthetic values of biological diversity and its components;" (decision X/3, paragraph 9 (b) (ii))*

→ now: focus on <u>economic values</u>

What are economic values?
Some important observations…

Economic value ≠ commercial value

individuals may assign value for different reasons or motives, and <u>not only for the immediate benefits of commercial exploitations of resources</u>

Where there are tradeoffs/exchanges to be made, valuation can provide information based on "willingness-to-pay" and/or "willingness to accept"

Valuation ≠ monetization (nor 'commodification')

other 'payment vehicles' possible

(combination with) qualitative or semi-qualitative methods

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Environment IS a development problem:
E-GDP of the poor

Ecosystem services dependency

	Indonesia 99 million	India 352 million	Brazil 20 million
Ecosystem services as percent of classical GDP	21% / 79%	16% / 84%	10% / 90%
Ecosystem services as percent of "GDP of the Poor"	25% / 75%	47% / 53%	11% / 89%
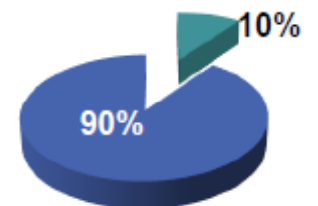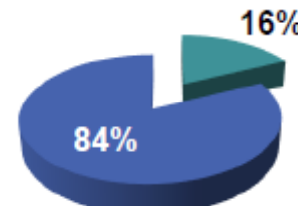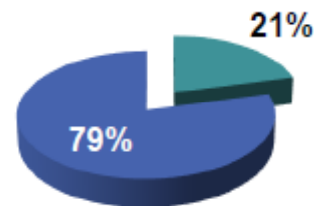
Ecosystem services

Source: Gundimeda and Sukhdev, D1 TEEB
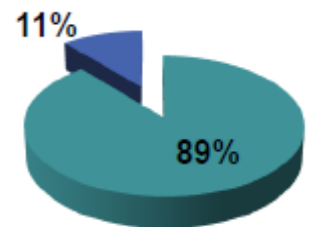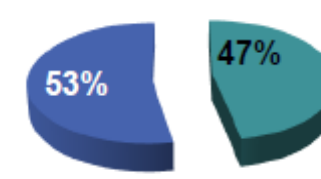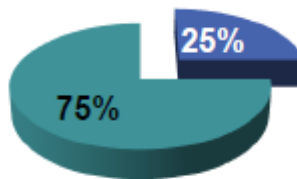
What is this?

A water purification plant

A flood control mechanism

A paradise for flyfishing

Food

Beauty

A place of worship

Leisure

A pollinator

A cure

A way of life

One ecosystem
→many _different_ services and benefits
→require different approaches/tools to valuation

Valuing ecosystems

Valuation: expresses economic significance of the links

ECOSYSTEM SERVICES

CONSTITUENTS OF WELL-BEING

Direct values

Indirect values

Existence values

Option values

Provisioning
• Food
• Fresh water
• Wood and fiber
• Fuel
• …

Supporting
• Nutrient cycling
• Soil formation
• Primary production
• …

Regulating
• Climate regulation
• Flood regulation
• Disease prevention
• Water purification
• …

Cultural
• Aesthetic
• Spiritual
• Educational
• Recreational
• …

Life on earth - biodiversity

Security
• Personal safety
• Secure resource access
• Security from disasters

Basic material for good life
• Adequate livelihoods
• Sufficient nutritious food
• Shelter
• Access to goods

Health
• Strength
• Feeling well
• Access to clean air & water

Good social relations
• Social cohesion
• Mutual respect
• Ability to help others

Freedom of choice and action
Opportunity to be able to achieve what an individual values being and doing

Source: Millennium Ecosystem Assessment 2005

Why undertaking (economic) valuation? The basic narrative

Some valuable ecosystem services are traded and valued in markets…

e.g., many (but not all) provisioning services

…but many others are not:

Public goods: nobody can be excluded from their use

Externalities: Boundaries of analysis.

Weak price signals/ incentives for individual conservation/sustainable use efforts

`Measure better in order to manage better`
`(Economic) valuation shall elicit "hidden"
biodiversity values for better decision-making.`

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Business impacts at sector & country-level
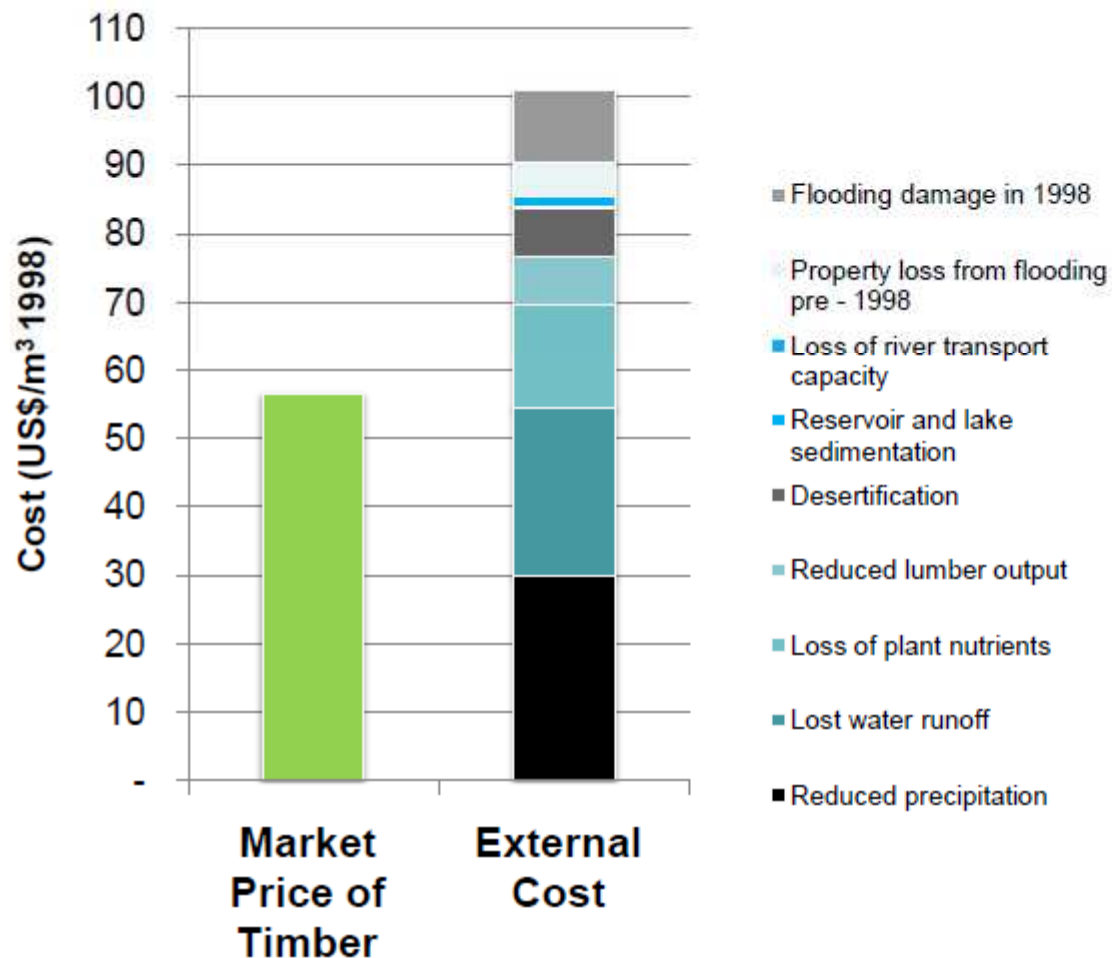
> US$12.2 billion estimated ecological cost of deforestation in China (1950-88)

> 60% of this cost is attributed to logging

> 64% of logging was for construction and materials sectors

> External costs = 178% of the market price of timber (1998)

Source: TEEB for Business, 2010 (Annex 2.1).

Limits to (economic) valuation…

Economic valuation puts biodiversity values 'on an equal footing' with other economic benefits and costs, BUT:

Some values cannot be measured…

> (e.g., intrinsic, religious values)

> …but need to be **recognized** nevertheless.

Others can be measured but are difficult to monetize…

> …their values need to be **demonstrated** (by other tools).

Still others can be measured and monetized…

> …their value can be **captured** by applying <u>economic valuation tools</u>.

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Valuing biodiversity, ecosystems, or ecosystem services?

Valuing ecosystem services is easier than valuing biodiversity

Role of biodiversity in ecosystem functions, and role of ecosystem functions in providing ecosystem services

Valuing individual ecosystem services is easier than valuing whole ecosystems

➢ Stock vs flow

➢ Achieving comprehensiveness while avoiding double-counting

➢ Net present value and the role of discount rates

Situation specific: You must know what you want to do with the information in order to decide whether to use valuation:

➢Absolute Total Economic Valuation (TEV) for awareness raising and accounting

➢Relative TEV for policy and decision making.

Applications

Awareness raising

Stand alone valuation exercise, for instance of one or a few ecosystem services which are key in the specific national context (Aichi Target 1)

Project analysis

Project appraisal: integration into economic decision-making tools

Cost-benefit analysis (CBA)

Cost-effectiveness analysis

Correcting prices (e.g. entry fees for national parks) (Aichi Target 3)

Programme/policy level

Integration into/interaction with other assessment tools (SEA)

Development of (sector) strategies and planning processes, land use planning

Integration into national accounting (SEEA) (Aichi Target 2)

What are your country's national objectives and priorities?

Valuation and national accounting

➢ UN SEEA (system of integrated economic and environmental accounts)

➢ Latest version 2003, currently under review

➢ Strengthening ecosystem components one goal of the review

➢ Environmental accounts are <u>satellite</u> accounts and mainly bio-physical

➢ Some sectoral accounts are operational and being already implemented by countries (e.g., water)

➢ Strengthen ecosystem (service) components in existing sectoral accounts.

➢ Global Partnership on Wealth Accounting and the Valuation of Ecosystem Services (WAVES)

Total economic value (TEV)

USE VALUES			NON-USE VALUES
DIRECT VALUES Raw materials and physical products that are used for production, consumption and sale	**INDIRECT VALUES** Ecological functions that provide esssential life support and maintain and protect natural and human systems	**OPTION VALUES** The premium placed on maintaining ecosystems for future possible uses that may have economic value	**EXISTENCE VALUES** The intrinsic value of ecosystem attributes and their component parts, regardless of current or future possibilities to use them
e.g., timber, minerals, food, fish, fuel, building materials, medicines, fodder, recreation	e.g., watershed protection, nutrient cycling, pollination, flood attenuation, micro-climate regulation and the protection of human settlements and infrastructure against storms and other natural disasters	e.g., new industrial, agricultural or pharma-ceutical applications of wild species; future tourism and recreational developments; and novel possibilities for resource use	e.g., historical or cultural sites; aesthetic appeal; local, national or global heritage; and bequest for future generations

More tangible and more likely to be dealt with by the market

Less tangible and less likely to be dealt with by the market

Total Economic Value (TEV)

	TOTAL ECONOMIC VALUE (TEV)			
	USE VALUE			NON-USE VALUE
TEV CATEGORIES	**Direct use value** Consumptive, non-consumptive	**Indirect use value**	**Option value**	**Existence value** Bequest value (for future generations)
EXAMPLES for Biodiversity	Hunting Fishing Timber harvesting Harvesting of non-timber forest products Harvesting of biomass Recreation/tourism	Watershed protection (erosion control, local flood reduction, regulation of streamflows, storm protection) Ecological processes (fixing and cycling of nutrients, soil formation, circulation and cleansing of air and water, climate regulation, carbon fixing, global life support)	Genetic resources Old-growth forest (irreversibilities!)	Charismatic mega-fauna (whales, great apes, etc.) and their habitats
COMMONLY USED VALUATION METHODS	Change in productivity, cost-based approaches, hedonic prices, travel cost, stated preference methods	Change in productivity, cost-based approaches, stated preference methods	Change in productivity, cost-based approaches, stated preference methods	Stated preference methods

Tools

1. **Revealed-preference methods**

   individuals reveal their willingness-to-pay in actual behavior (e.g., in "surrogate" markets)

2. **Stated-preference methods**

   individuals state their willingness-to-pay in hypothetical behavior, by responding to questionnaires

3. **Benefit (functions) transfer**

   transfer results of one or several studies to a comparable site

Tools

General assessment

- Valuation tools can generally provide useful and reliable information when applied carefully and according to best practice.
- Choice of tools is situation-dependent
  - Cost vs accuracy
  - Total vs relative; Accounting vs policy; Awareness vs Development
- Analyses require technical expertise
- Economic values and valuation provide some of the information needed to make better decisions
  - Needs to be put into context and to be part of a broader deliberative and participatory process in order to be useful.

Apply a cost-benefit criterion to the valuation itself-

Example: Mangrove forests in Southern Thailand

➢ Study covers some (direct and indirect) use value of mangrove forests

➢ Direct use values: fish/seafood, honey, timber (boat repairs)

➢ Indirect use values: fish breeding ground (for offshore fisheries); coastal protection; [carbon storage – not considered in trade-off analysis]

➢ Change-in-productivity approach; replacement cost

➢ Policy question: mangrove conservation or conversion to shrimp farms?

➢ Source: Sathratai and Barbier 2001 and updates, TEEB

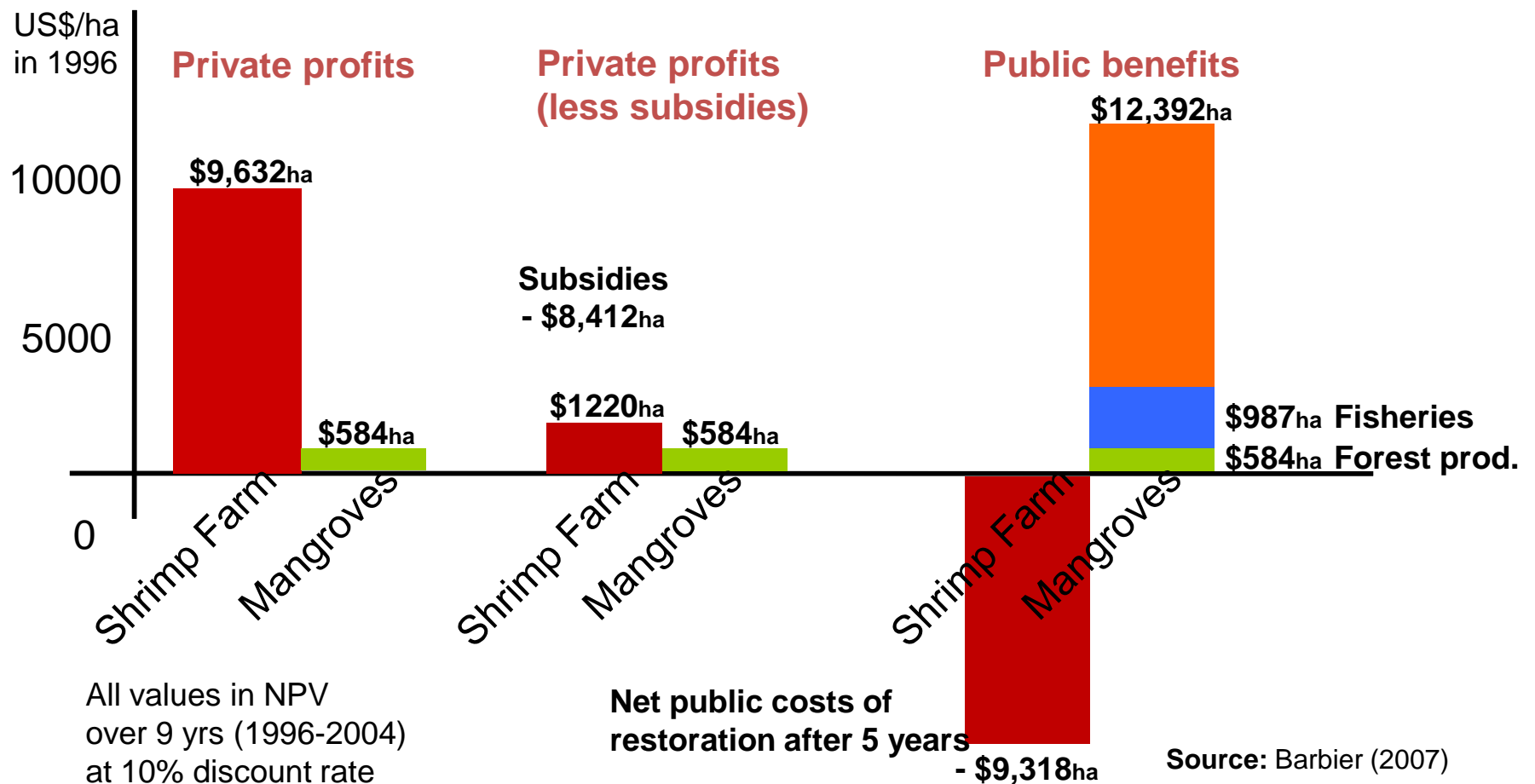# Example: Mangrove forests in Southern Thailand

NET PRESENT VALUE OF MANGROVE FOREST BENEFITS*	
BENEFIT	Value (US$) per ha
DIRECT USE VALUE:	
Net income from timber and non-timber products	87.84
INDIRECT USE VALUE:	
Offshore fishery linkages	20.82–68.90
Coastline protection	3,678.96
TOTAL DIRECT AND INDIRECT USE VALUE	3,787.62–3,835.70
DIRECT USE VALUE ONLY:	
Net present value (10% discount rate)	822.59
Net present value (12% discount rate)	734.83
Net present value (15% discount rate)	632.27
DIRECT AND INDIRECT USE VALUES:	
Net present value (10% discount rate)	35,470.72–35,920.98
Net present value (12% discount rate)	31,686.34–32,088.57
Net present value (15% discount rate)	27,264.13–27,610.22

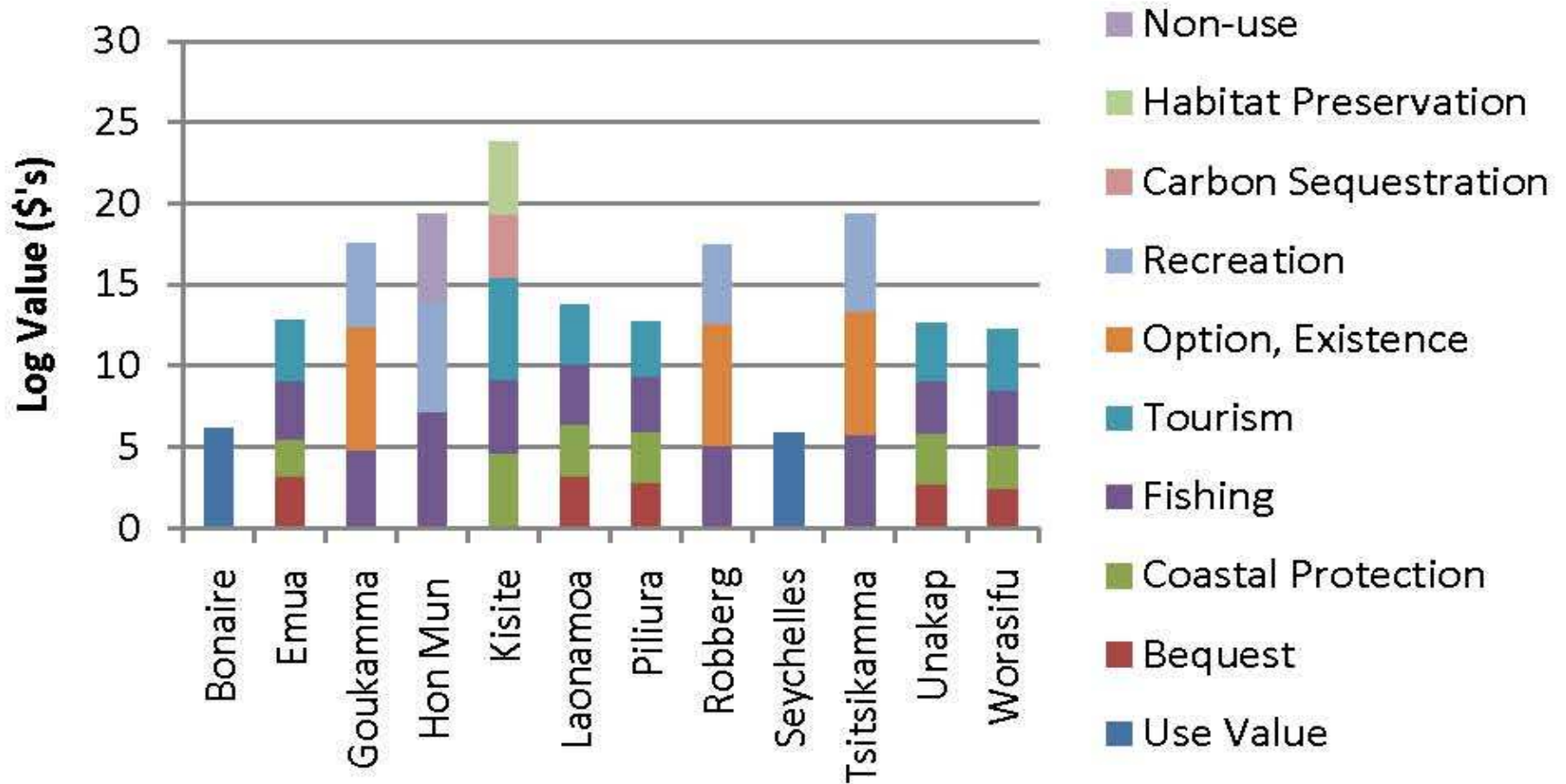* All net present value calculations are based on a 20-year time line.

Source: CBD TS 28, p.46, Sathratai and Barbier 2001.

Example: Mangrove forests in Southern Thailand

Shrimp farms vs mangroves

US$/ha in 1996

Private profits

$9,632ha (Shrimp Farm)
$584ha (Mangroves)

Private profits (less subsidies)

Subsidies - $8,412ha
$1220ha (Shrimp Farm)
$584ha (Mangroves)

Public benefits

$12,392ha
$987ha Fisheries
$584ha Forest prod.

Net public costs of restoration after 5 years
- $9,318ha

All values in NPV over 9 yrs (1996-2004) at 10% discount rate

Source: Barbier (2007)
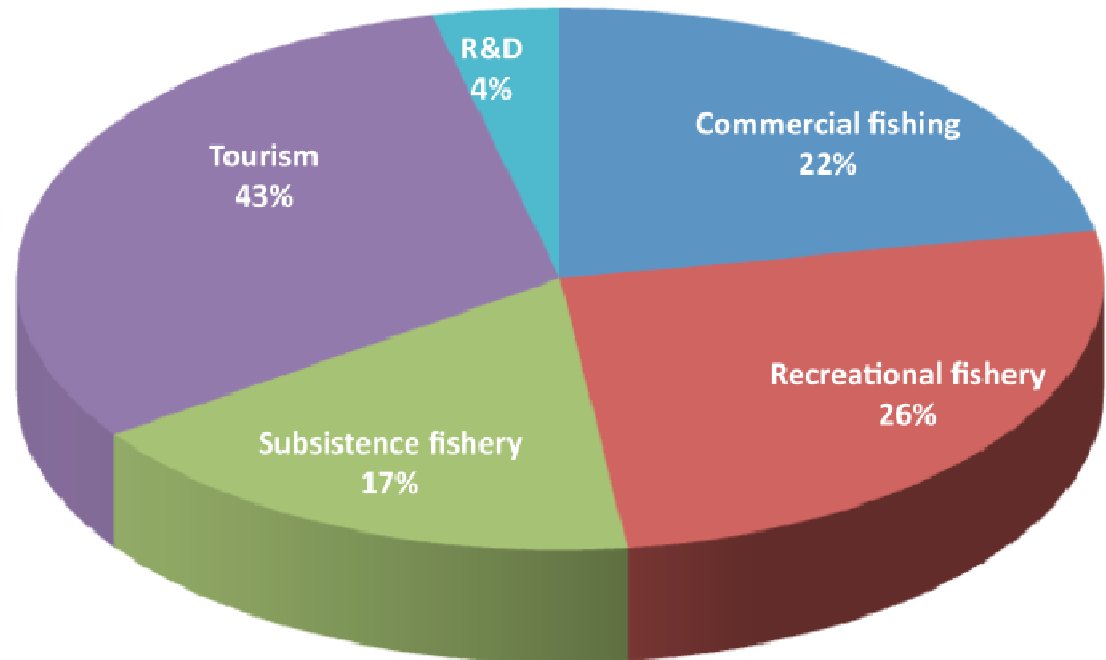
Marine Protected Area Total Economic Values

Using valuation for awareness raising:
Coral reef ecosystem service benefits in Fiji

Component of TEV	Economic value per year	PV (20-year period, $i=10\%$)
Fisheries	1,359,257	12,863,808
Bequest value		
using WtCT	62,521	594,795
using WTP	23,539	223,942
Research/education	7,625	64,787
Coastal protection		
Coral reefs	851,352	8,099,387
Mangroves	170,797	1,624,888
Waste assimilation	621,890	5,916,385
Total	3,034,460 – 3,073,442	28,793,197 – 29,164,050

Ogarra et al 2006

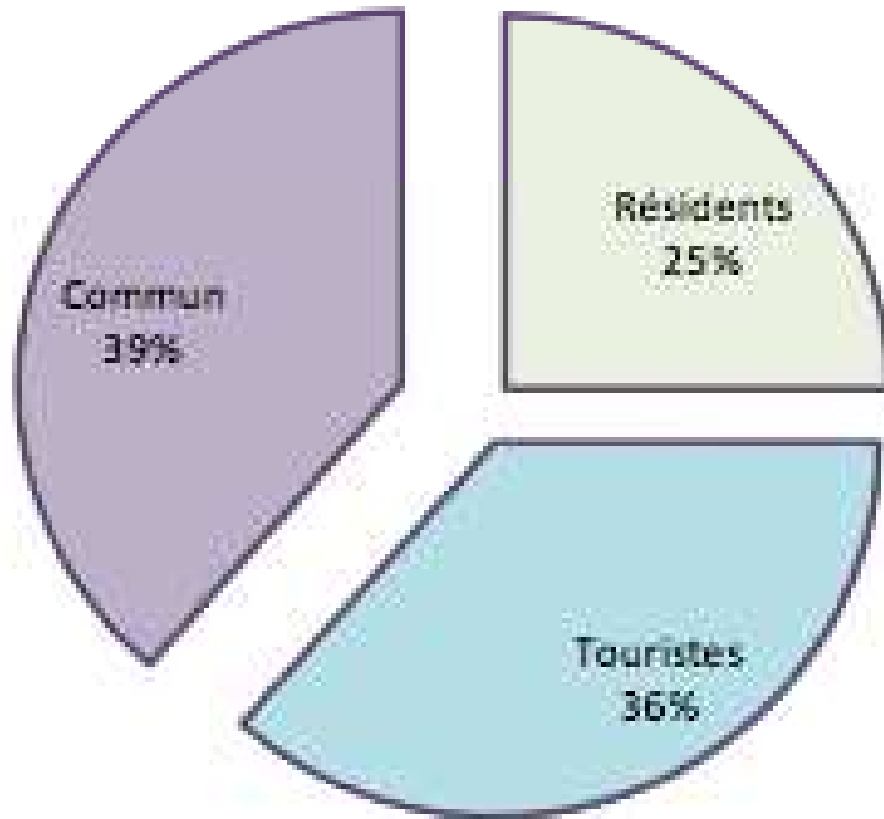# Using valuation to identify the distribution of benefits (New Caledonia: 190-320 M€/y)

Financial value of coral reef ecosystem services - Use values
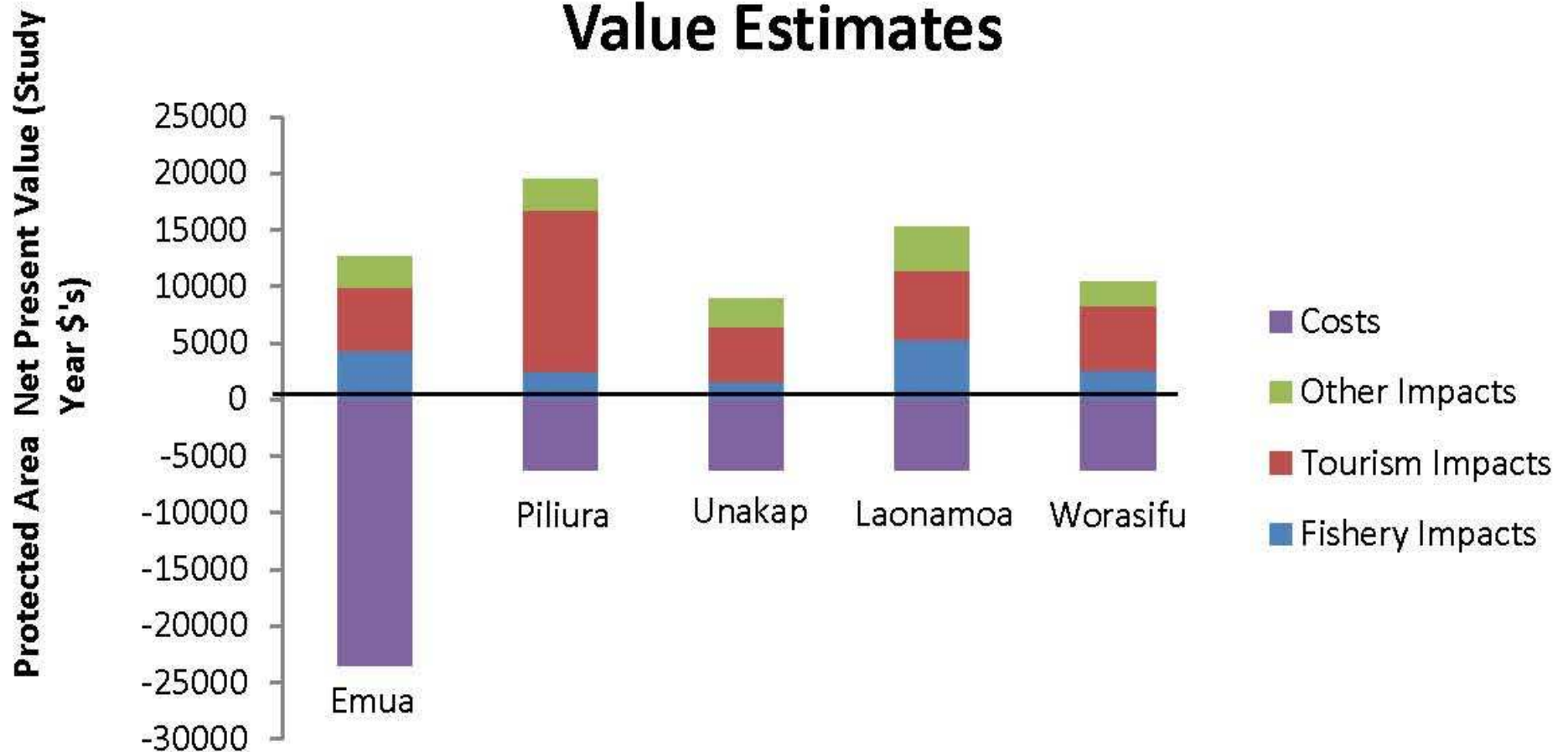2008 : 9,000- 12,000 MFcfp (78-103 M€, 100-137 M usd)

- R&D 4%
- Commercial fishing 22%
- Recreational fishery 26%
- Subsistence fishery 17%
- Tourism 43%

Pascal et al 2010

Distribution of benefits amongst stakeholders of coral reef ecosystem services in Martinique

Commun 39%

Résidents 25%

Touristes 36%

Failler et al 2010

Vanuatu Marine Protected Area Net Present Value Estimates

Protected Area Net Present Value (Study Year $'s)

Legend:
- Costs
- Other Impacts
- Tourism Impacts
- Fishery Impacts

Locations: Emua, Piliura, Unakap, Laonamoa, Worasifu

•Main benefits: subsistence fishery (30%) and rural tourism (70%)
•Main beneficiaries : village communities (65%)

Pascal et al 2010

Marine Protected Area Economic Valuation of Impacts, Vanuatu

Y-axis: Annual Impacts (Study Year Euros) — 0, 2000, 4000, 6000, 8000, 10000, 12000, 14000, 16000

X-axis: Emua, Piliura, Unakap, Laonamoa, Worasifu

Legend:
- Tourism (National Level)
- Coastal Protection (National & Village Level)
- Bequest Value (National & Village Level)
- Commercial Fishery (Village Level)
- Tourism (Village Level)
- Social Capital (Village Level)
- Subsitence Fishery (Village Level)

*** = Certain Village Level Benefits

Valuation: a flexible stepwise approach

Picking the low-hanging fruit in valuation…

➢ Aim to capture the most important ecosystem services/elements of TEV in a specific context – do not seek comprehensiveness at all cost

➢ Use simpler tools whenever appropriate

➢ Consider using qualitative/semi-quantitative representations; do not monetize at all cost

Valuation: a flexible approach

A simple step-wise approach…

1. Define the **decision-making problem** at hand

   ➢ This may involve the definition of (stylized) scenarios for the different options

2. Identify the **most important ecosystem services** (or components of TEV) in the specific context

   • In many situations, these will be a few key direct and indirect use values

   • Stakeholder involvement will be critical

   • Aim for option and existence value only when there is a clear indication that these values are of particular significance in the specific context (because those are particularly difficult to evaluate and typically have a limited development dimension)

Valuation: a flexible approach

3. Considering using the following (comparatively simple) tools:

- Existing market data: for many direct use values (e.g.: local market prices for many NTFR; tourism revenues;…)

- Cost-based approaches: e.g. replacement cost associated with the loss of indirect use values

- Travel cost approach for tourism/site-seeing

- Benefits transfer: for rapid assessments, and with due caution

- Change-in-productivity method: for important indirect use values when good scientific data is available

4. Use indicators for human well-being which are meaningful and practicable in the present context

➢ In some cases, using highly aggregated monetary figures will actually obfuscate the contribution of ecosystem services to local well-being

➢ Spatially explicit information will often be helpful

Towards implementing Aichi target 2

✓ Define the national target in accordance with national priorities

  - Agree on role and extent of economic valuation (see 'flexible approach')

✓ Options for implementing activities

  - Integration into national guidelines for application of appraisal tools (CBA, CEA, EIA, SEA);
  - Showcase/focus on critical values (e.g. on key ecosystems) (see also goal 1) at national or sub-national level;
  - Prepare 'national TEEB' and feed results into revisions of PRSPs etc.;
  - Establish or strengthen cooperation with statistics offices; explore opportunities to strengthen ecosystem components in sectoral green accounts (water, forests, land);
  - Build local capacity;

Flexible, well-informed, locally-appropriate, locally-driven.

Exercise

✓   Identify an important biodiversity and ecosystem service based industry in your country (e.g., agriculture, forestry, mining/extractives)

✓   Identify the 3-5 most important ecosystem services that are affected by this industry.

✓   Identify those ecosystem services values that are well reflected in markets and those that are not.

✓   Identify appropriate measures and indicators of the status of these ecosystem services.

✓   Discuss how the value of the stock and flow of these ecosystem services might be assessed.

✓   Discuss how tradeoffs between these various ecosystem services might be addressed.

Questions for country discussion

- ✓ What are the most important areas of applying (economic) valuation in your country (e.g., awareness-raising, application within CBA/CEA, SEA, land use planning, green accounting)?

- ✓ What are the most important ecosystem services in your countries where you believe valuation would be useful?

- ✓ Have valuation studies already been undertaken in your countries? Is there a need to update or broaden them?

- ✓ Is valuation been used systematically to inform policy-making? If not, in which areas does it need strengthening, and what are the gaps?