Economic valuation of ecosystem services – an introduction

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Workshop on Valuing Ecosystems – can it help make business make better decisions?
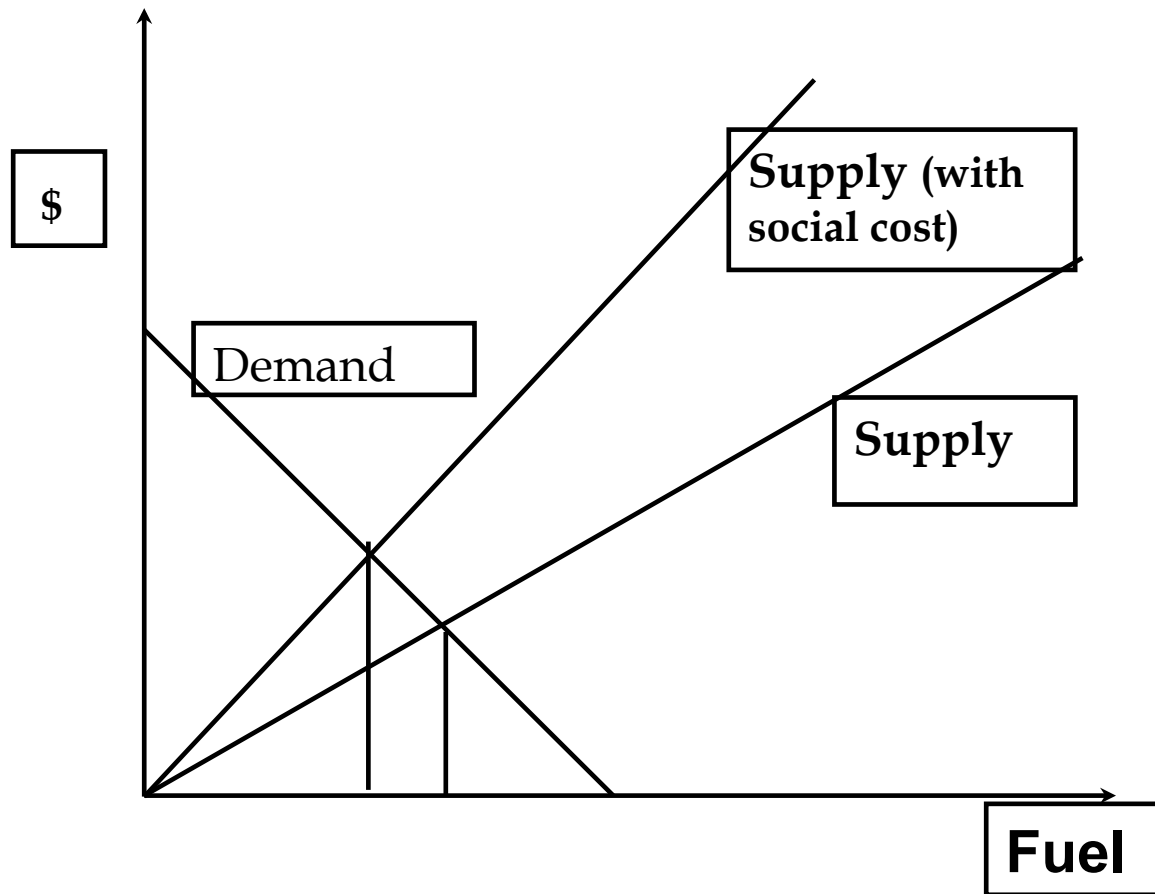
WCC Jeju, 9 September 2012

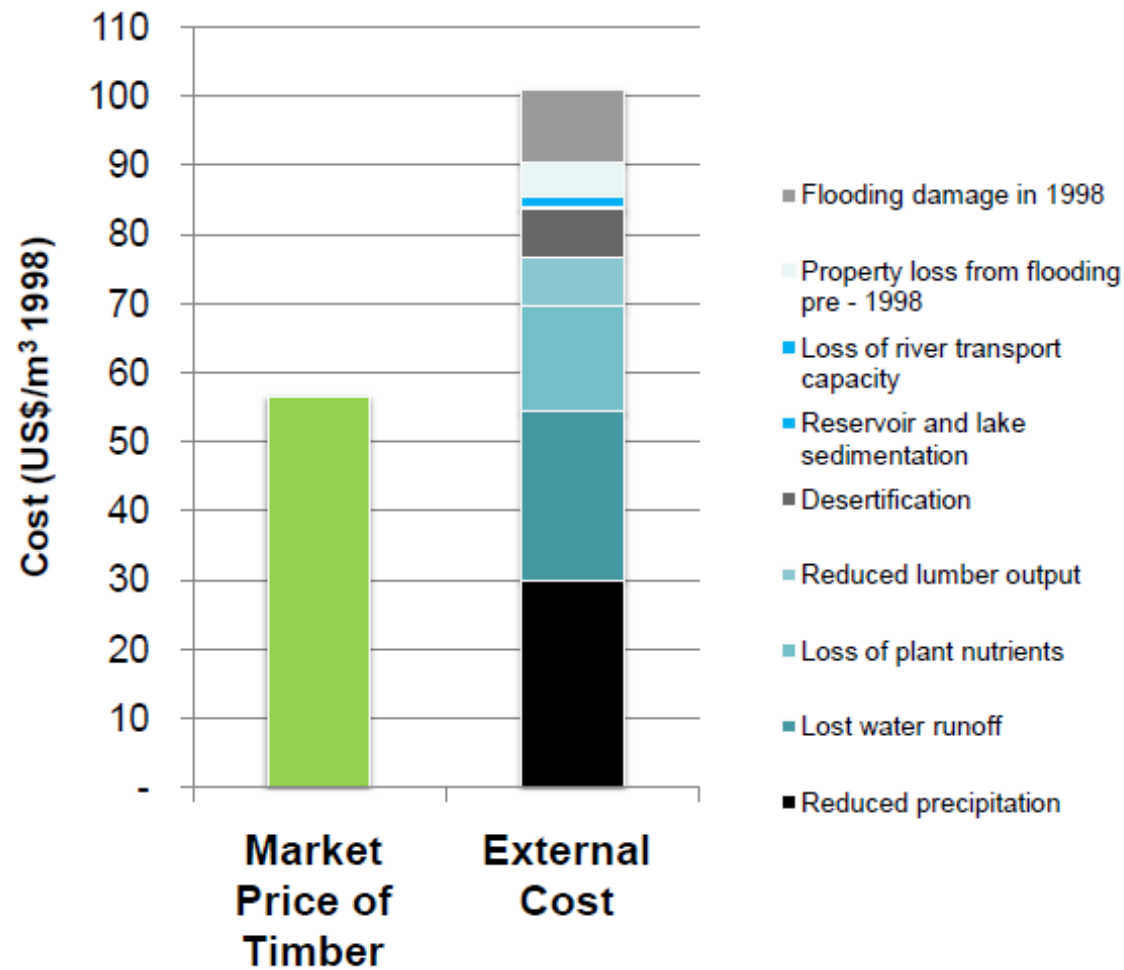# Why do we try to place monetary values on environmental goods and services?

- Many market activities have consequences **external** to the market - that fall on the public.

- Whenever the **activity** impacts some global public good – e.g. The landscape or some ecosystem service such as dlimate regulation or nutrient recycling.

- Global public goods are non-excludable and non-rival → Unpriced.

- The market fails to provide ecosystem services in their optimal 'quantities'

- Global public GOODs will be underprovided.

Accounting for externalities

Business impacts at sector & country-level

Chart — Y-axis: Cost (US$/m³ 1998), ranging 0 to 110. Two bars: "Market Price of Timber" (green) and "External Cost" (stacked segments).

Legend:
- Flooding damage in 1998
- Property loss from flooding pre - 1998
- Loss of river transport capacity
- Reservoir and lake sedimentation
- Desertification
- Reduced lumber output
- Loss of plant nutrients
- Lost water runoff
- Reduced precipitation

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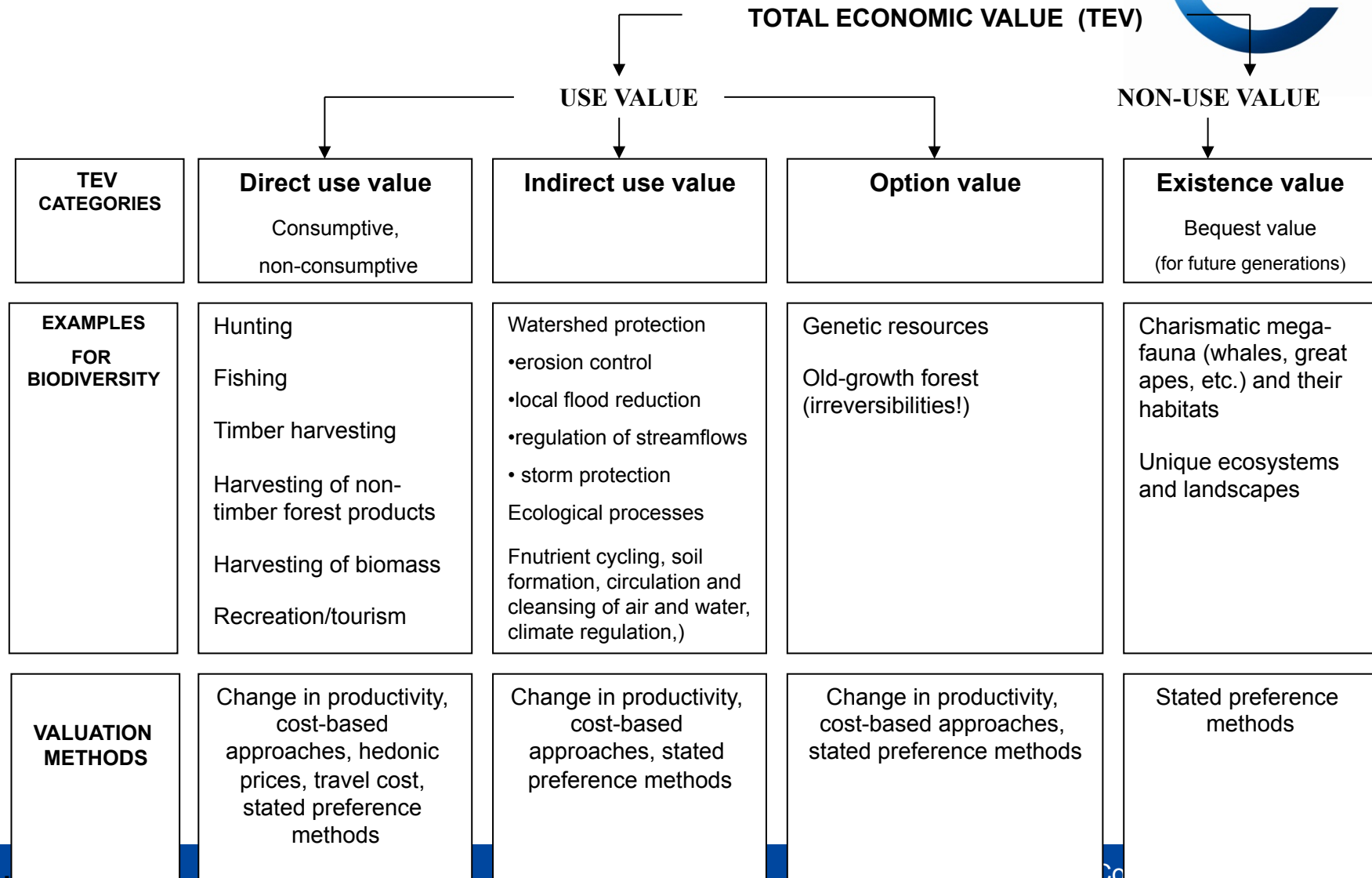- External costs = 178% of the market price of timber (1998)

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

Cost Benefit Analysis &
Total Economic Value

- There is no absolute measure of a good or a service.

- We need to know what we are valuing relative to some other state.

- Need to account for the Total Economic Value of that change.

Cost Benefit Analysis & Total Economic Value

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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 Fnutrient cycling, soil formation, circulation and cleansing of air and water, climate regulation,)	Genetic resources Old-growth forest (irreversibilities!)	Charismatic mega-fauna (whales, great apes, etc.) and their habitats Unique ecosystems and landscapes
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

Measuring and valuing bio-physical changes

- All valuation methods rely on the integration of ecology and economics

Figure 1: Evaluation sequence building on scientific information

Policy change → Impacts on ecosystem → Changes in ecosystem services → Impacts on human welfare → Economic value of changes in ecosystem services

Welfare Economics
Revealed preference methods

- Estimate peoples' WTP from choices made in a market complementary to the 'good or service' we are valuing.

- Travel cost methods

- Hedonic pricing analysis

- EX-POST

Hedonic pricing

- Estimates the value of an environmental good or service indirectly in a proxy market

- Compare the prices or values of two goods in an existing market, which differ only with respect to an environmental attribute

- Price differential = value of the environmental attribute

- Main applications:

  - Houses which are identical except for access to scenic view (landscape values)

  - Property in congested areas (air quality, noise), property near green areas (access to recreation, scenic views)

Travel Cost method

- Add up time and travel cost expenses that people incur to visit a site to estimate the minimum willingness to pay for an environmental good or service

- Measure all the costs that occur when visiting a site (travel costs, entrance fees, foregone earnings)

- Main applications
  - To value recreational sites (proposed changes to sites – size, quality)
  - EDP (Portugal) valued fishing and boating on system of reservoirs and canals (part of its hydropower network)

- Challenges
  - Alternative sites may exist, visits may be multi-purpose, only captures use values

Welfare Economics
Stated preference methods

- Hypothetical market

    – Contingent valuation methods

    – Choice experiment

- Merits:

- Use and non-use (existence) values

- Can be used: Ex-ante & ex-post

+ 50 € / week / adult

Destination A: Coherent environmental policy and offshore wind farm at 5 km with associated recreational activities.

- 20 € / week / adult

Destination B : Offshore wind farm at 8 km, wind farm associated recreational activities

Stated preference methods – contingent valuation and choice modelling

- When no proxy markets exist with information about people's preferences for ES goods and services

- Can be used to estimate value of any type of ESS (non-use)

- **Contingent valuation (CV)** asks people directly how much they are WTP (or WTA) for a change in ecosystem service provision

- **Choice modelling (CM)** focuses on the ranking of alternatives with different attributes in order to value individual attributes of environmental quality

Contingent valuation and choice modelling

- Survey methods require:
  - Careful design of a scenario which is easily understood by respondents
  - Choose the target population and identify an unbiased sample (large sample with random selection or smaller stratified samples)
  - Conduct face to face interviews (best) or telephone interview or mail surveys
  - Choose carefully the payment vehicle (tax, donation, who has to pay?)
  - Choose the elicitation method (open-ended questions, referendum questions)
  - follow-up questions: which motives behind answers

Choice modelling

- Similar to CVM, but people are asked to choose between sets of environmental goods and services with different prices

- Focuses on trade-offs among scenarios

- E.g. improved water quality in a lake will affect a number of services – can rank importance of drinking water, fishing, swimming, BD

- may avoid some problems found in contingent valuation
    - Able to compare different aspects of a hypothetical scenario and determine preferences over attributes
    - scale can be inserted into the survey design, which weakens the embedding effect
    - there is less rejection of scenarios by participants

Contingent valuation - some challenges

- problems with surveys may lead to some bias
    - selection bias, starting point bias, payment vehicle problems
    - warm glow or yea saying, protest no
    - information, understanding

- problems of constructed preferences
    - free-riding, difference between real and hypothetical behaviour

- embedding effect = scale effect
    - value for one species same as for whole ecosystem

- Can be costly and time intensive, require survey pre-testing and time spent for respondents to understand questions

- Results affected by survey method, payment vehicle, hypothetical nature of questions

Contingent valuation and financing to save elephants in Sri Lanka

- elephants consume 150kg of food every day: crop raiding is a big problem in densely inhabited areas and causes injuries

- a survey of impacts on 480 local households and their willingness to accept compensation

- a second survey among Colombo city residents: willingness to pay for the conservation of elephants exceeds the funding needed for compensating rural elephant damage

- Ceylinco Insurance presented a new scheme, partly CSR and partly profit driven: proposed small charge on top of premium payments of life and vehicle policy holders to finance a trust for compensation payments

Source: H. Gundimeda TEEB D0

The production function approach

- Based on scientific knowledge of relationship between ESS and a marketed output, e.g. pollination and fruit production

- ESS are inputs into production function of a marketed good

  - Step 1 – identify physical effects of change in ESS on good

    - Relies on precise cause-effect models

  - Step 2 – impact of change valued using quantity and price of marketed good

- Applications

  - E.g. erosion control of forests and rice production

Cost-based and price-based approaches

- The value of an ecosystem service is estimated based on:
  - the cost of actions to replace these services (replacement cost)
    - Dikes replace flood regulation service
  - what people pay to avoid the adverse effects of losing services or to replace lost services (avoided damage costs)
    - Noise

- Price-based approaches
  - Market prices (hunting permits, fish sold in a local market)

- Cost-based and price-based estimates are not based on 'preferences'
  - Underestimated relative to revealed preference and stated preference methods.

Benefit transfer

- Involves transfering value estimates from existing economic valuation studies to the study site in question

- making adjustments where appropriate

- inexpensive and quick to implement

- must be carefully and transparently applied to avoid significant errors.

NPV, positive or negative?

$$NPV = \sum_{t=0}^{T} (B_t - C_t)/(1 + r)^t$$