Economic valuation of ecosystem services – an introduction

Nathalie Olsen & Vanja Westerberg – IUCN Economics

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 climate 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

- 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)

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

TOTAL ECONOMIC VALUE (TEV)

USE VALUE

DIRECT USE VALUE
- Consumptive, non-consumptive

INDIRECT USE VALUE
- Watershed protection
  - erosion control
  - local flood reduction
  - regulation of streamflows
  - storm protection
- Ecological processes
  - Nutrient cycling, soil formation, circulation and cleansing of air and water, climate regulation,

OPTION VALUE
- Genetic resources
  - Old-growth forest (irreversibilities!)

NON-USE VALUE
- Bequest value
  - (for future generations)
- Charismatic mega-fauna (whales, great apes, etc.) and their habitats
- Unique ecosystems and landscapes

EXAMPLES FOR BIODIVERSITY
- Hunting
- Fishing
- Timber harvesting
- Harvesting of non-timber forest products
- Harvesting of biomass
- Recreation/tourism

- Watershed protection
- Genetic resources
- Stated preference methods

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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**

<table>
<thead>
<tr>
<th>Policy change</th>
<th>Impacts on ecosystem</th>
<th>Changes in ecosystem services</th>
<th>Impacts on human welfare</th>
<th>Economic value of changes in ecosystem services</th>
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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
Destination A: Coherent environmental policy and offshore wind farm at 5 km with associated recreational activities.

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 transferring 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?

\[ NPV = \sum_{t=0}^{T} \frac{(B_t - C_t)}{(1 + r)^t} \]