Cost-Benefit Analysis

Economic Analysis

Externalities

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Objective of the presentation

To define/estimate environmental externalities (not only) in order to be included in the Economic Analysis as monetary values

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Content of the presentation

1. Identifying the economic benefits of the ecosystems;
2. Main methods for valuating benefits/disbenefits of projects in monetary terms
3. Other externalities
4. Some examples

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1. Economic benefits of the ecosystems; the causal chain

ECOSYSTEMS ⇨ ECOSYSTEM FUNCTIONS ⇨ ECOSYSTEM GOODS & SERVICES ⇨ CONTRIBUTION TO HUMAN WELBEING

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Goods and services provided by ecosystems

- Ecosystems and the biological diversity contained within them provide a stream of goods and services, the continued delivery of which remains essential to our economic prosperity and other aspects of our welfare. In a broad sense, ecosystem services refer to the range of conditions and processes through which natural ecosystems, and the species that they contain, help sustain and fulfill human life.
- These services regulate the production of ecosystem goods, the natural products harvested or used by humans such as wild fruit and nuts, forage, timber, game, natural fibers, medicines and so on.
- More importantly, particularly, ecosystem services support life by regulating essential processes, such as purification of air and water, pollination of crops, nutrient cycling, decomposition of wastes, and generation and renewal of soils, as well as by moderating environmental conditions by stabilising climate, reducing the risk of extreme weather events, mitigating droughts and floods, and protecting soils from erosion.

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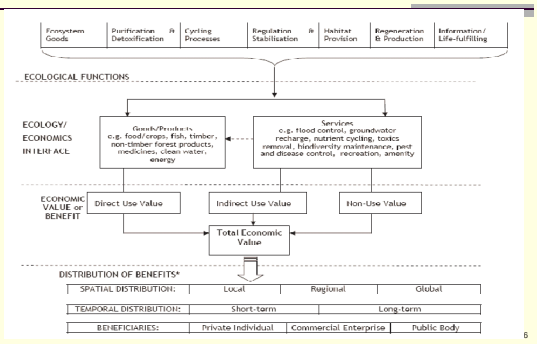
Integrated Framework for Environmental Valuation



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Environmental Services

Environment services could be split in two categories: direct and indirect environmental services provided by ecosystems:

- **Direct services**: production of oxygen, water, fresh food, fodder and fertilizer, genetic resources, fuel and energy, raw materials,
- **Indirect services as**: regulation of hydrological cycle, water catchments and groundwater recharge, regulation of climate, storage and recycling of nutriment, biomass production, production of top soils, assimilation of waste, maintenance of biological diversity and so on.

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Main categories

Ecosystem services have been grouped into six categories broadly based on both their ecological and economic function. These are:

1. Purification and Detoxification: filtration, purification and detoxification of air, water and soils;
2. Cycling Processes: nutrient cycling, nitrogen fixation, carbon sequestration, soil formation;
3. Regulation and Stabilisation: pest and disease control, climate regulation, mitigation of storms and floods, erosion control, regulation of rainfall and water supply;
4. Habitat Provision: refuge for animals and plants, storehouse for genetic material;
5. Regeneration and Production: production of biomass providing raw materials and food, pollination and seed dispersal; and
6. Information/Life-fulfilling: aesthetic, recreational, cultural and spiritual role, education and research.

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Measuring the value of ecosystem services; total economic value

An important concept is total economic value (TEV), which offers a useful framework for analysis

- Direct use value: involves human interaction with the ecosystem itself rather than via the services it provides. It may be consumptive or extractive use, such as fisheries or timber, or it may be non-consumptive, as with some recreational and educational activities.
- Indirect use value: derives from services provided by the ecosystem. This might, for example, include the removal of nutrients, providing cleaner water to those downstream, the prevention of downstream flooding and diseases and provision of information.
- Non-use value is associated with benefits derived simply from the knowledge that the ecosystem is maintained. By definition, it is not associated with any use of the resource or tangible benefit derived from it, although users of a resource might also attribute non-use value to it. It can be split into three basic components:
- Existence value: derived simply from the satisfaction of knowing that ecosystems continue to exist, whether or not this might also benefit others (also associated with 'intrinsic value').
- Legacy (bequest) value/ Altruistic value : associated with the knowledge that ecosystems and their services will be passed on to descendants to maintain the opportunity for them to enjoy it in the future.

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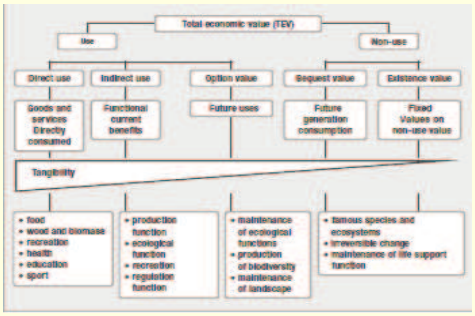
Total Economic Value



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Valuation methods

The main problem to express environmental goods is related to the fact that there is neither market nor price for them.

In such cases, the methods of economic valuation provide several tools that may be employed to estimate these 'non-market' or 'external' benefits. What these techniques have in common is that they express economic value in units of money. This has the advantage of allowing the non-market benefits of ecosystem goods and services to be compared with financial gains from their use.

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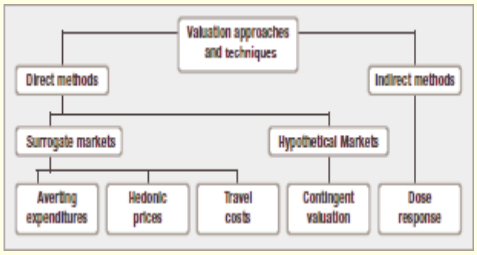
II. Valuation methods



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Main techniques

1. **Dose-response functions;** The dose-response technique aims to establish a relationship between environmental impacts (the response) and physical environmental impacts as pollution (the dose).
- The major fields of application of the methodology are in evaluating of losses (in crops for example) due to pollution, the pollution effects on ecosystems, vegetation and soil erosion and the impacts of urban air pollution on health, materials and buildings.

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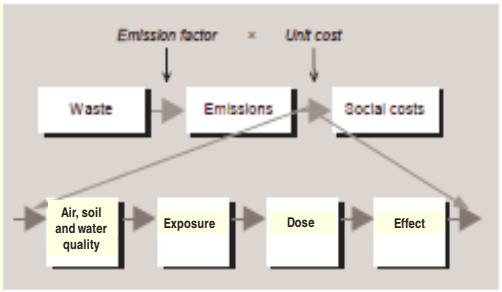
Dose response function



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Hedonic price method

The hedonic price technique analyses existing markets for goods and services where environmental factors have an influence on the price. Hedonic price approach is most often used in analysing the effect of environmental quality on house prices.

A house near an airport, for example, can be expected to present a lower price than a house located far away because of the sound nuisance. The difference in value can be viewed as the value attached to the difference in environmental quality.

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Travel cost method

- The travel cost approach seeks to value the individual's willingness to pay for an environmental good and service by the costs incurred to consume it.
- For example, a visit to a national park will imply loss of time (to travel), entry fee, petrol and other travel costs. These elements are used to evaluate a demand curve to environmental asset based on the relationship between travel costs and the number of visitors.

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Method based on hypothetical markets (contingent valuation)

- In the case when there is no proper market for an environmental good it is used a method that artificially creates a hypothetical market. This method is called contingent evaluation.
- The contingent method is likely to be the most applied among the economic evaluation techniques and is the only one to be extensively used when calculating non – use values or option value.

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Contingent valuation in UK

Policy Option	Current Policy	Policy Option A	Policy Option B
 Change in area of Heather Moorland and Bog	A loss of 2% (-2%)	A gain of 5% (+5%)	A loss of 2% (-2%)
 Change in area of Rough Grassland	A loss of 10% (-10%)	A gain of 10% (+10%)	A loss of 10% (-10%)
 Change in area of Mixed and Broadleaf Woodlands	A gain of 3% (+3%)	A gain of 20% (+20%)	A gain of 10% (+10%)
 Condition of field boundaries	1 or every 1km, 100 m is restored	For every 1km, 200 m is restored	For every 1km, 60 m is restored
 Change in farm building and traditional farm practices	Rapid decline	Much better conservation	No change
 Increase in tax payments by your household each year	£0	£70	£10

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III. Economic Benefits of infrastructure projects

The benefits of infrastructure projects are commonly defined as reductions in costs (transport cost). These are the benefits most commonly considered in benefit-cost analysis of transportation projects:

- Travel time or delay reductions
- Accident reduction
- Emissions reductions
- Reduction in vehicle operating cost

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Other Economic Benefits of infrastructure projects

Other effects are difficult to value but may still be considered in the Economic Analysis in which they are considered critical to making the choice among alternatives:

- Induced Travel, including new trips and changes in mode, route, and time of travel
- Noise effects
- Construction disbenefits
- Habitat fragmentation and water quality impacts (Natura 2000)
- Economic effects; the effect that a project has on business operating cost or net profitability, and household cost of living is named economic effect.
- Community effects

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IV. Examples of economic effects

- A new highway interchange directly requires that some households and businesses be relocated (displacement effect).
- The right-of-way for a new rail line or busway divides a clearly defined neighborhood, making it more difficult or more dangerous for residents to take part in neighborhood activities or otherwise enjoy neighborhood amenities to which they previously had access (barrier effect).
- A new transit terminal reduces sunlight and blocks views for a section of the neighborhood (visual effect).
- Converting a road with several intersections to an expressway with limited access diminishes access to businesses and households located between the interchanges (accessibility effect).
- Roadway reconfiguration makes it possible to locate new offices and shops in a depressed neighborhood as a consequence of improvements in safety and ease of access (land use and property value effects).

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Economic benefits in the wetland area near Victoria lake

Economic benefits	Current value ($ per year)	Value per unit area ($ per ha)
Wetland resources		
Crop cultivation	169,000	940
Less dryland cultivation value	*-75,000*	*-420*
Papyrus harvesting	15,000	960 - 3,630
Brick-making	27,000	2,120
Fish-farming	5,000	270 - 1,580
Total direct values	140,000	
Wetland services		
Water treatment and purification	1,352,000-2,254,000	2,560 - 4,270
Less costs of reticulation	*-296,000*	*-560*
Total indirect values	1,056,000 - 1,958,000	
Total wetland value	1,492,000 - 2,098,000	

Source: Emerton et al, 1998.

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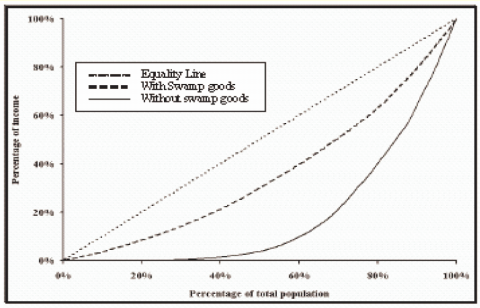
Lorenz curves of income distribution, with and without the contributions of wetland goods



Source: Maclean et al, 2003a.