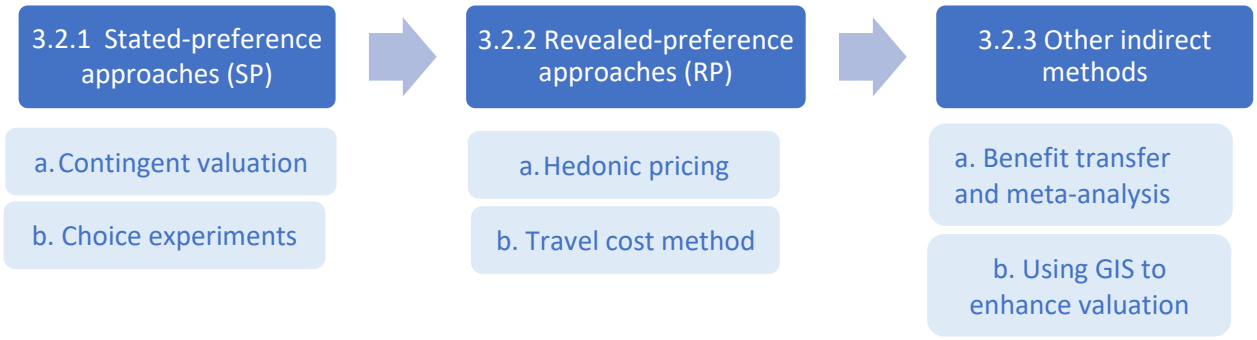
# Topic 3.2: Valuing the Environment: Methods

**How to estimate economic values for non-market environmental goods and services?**
(e.g., services provided by environment & damages caused by pollutions)




## 3.2.1 Stated-preference approaches (SP)

**SP is Survey-based** approach T an estimate of an individual's willingness to pay (WTP) or willingness to accept (WTA)

**a. Contingent valuation method (CVM)** create a hypothetical market and ask respondents directly a willingness-to-pay question contingent on the existence of this market (e.g., a clearly specified hypothetical increase or decrease in environmental quality) or what value they would place on an environmental change.

Q: "What is the maximum you are willing to pay for the change?"
Q: "Would you pay $X to preserve the species?"

**Several main design features of a CVM questionnaire include:**

- Provide the purpose of a CVM survey and how it will be used to help inform decision (e.g., to estimate the benefits of an improvement in river quality → extra local tax revenues needed to finance wastewater treatment)
- Use a credible and uncontroversial bid vehicle (e.g., to measure local taxes, entrance fee)
- Consider different formats to ask WTP/WTA question (e.g., open-ended format, bid price format, etc.)
- Identify protest bids (e.g., to prevent 'genuine zeros' responses → not value/not afford)

**Advantages of CVM**

- A generalized method that can be applied in any situations, from benefits of preserving biodiversity to the benefits of improving a city's air quality, or protecting forest areas
- Capable of measuring both use (e.g., timber harvested from the forest) and non-use (e.g., existence value to ensure that a resource continues to exist in the absence of any interest in future use) values → Gain insights into why people value a given environmental good, and how this valuation would change given uncertainties such as when the supply of goods changes.

**Potential biased answers**

1. Strategic bias (e.g., to influence a particular outcome)

2. Information bias (e.g., to value attributes with which they have little or no experience)
3. Starting-point bias (e.g., sensitivity to a starting point under a predefined range of possibilities)
4. Hypothetical bias (e.g., ill-considered answers when they do not actually have to pay)
5. Observed gaps between WTP and WTA (e.g., report higher value for WTA than WTP for the same good or service due to different context such as the psychological value of something you own, the absence of good substitutes, consumer's rate of time preference and willingness to take risks)

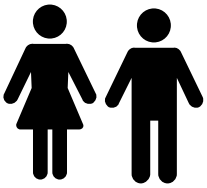


*Figure 1 The Philippines Eagle*

**b. Choice experiment method (CE)**

create hypothetical choices between alternatives with characteristics or attributes and ask an individual to choose among different bundles of attributes.

Example of choice experiment for valuing Australian wetlands

| Attributes | Option A | Option B | Option C (Status quo) |
|---|---|---|---|
| Wetland area conserved (ha) | 1,000 | 800 | 700 |
| Bird species conserved (number) | 40 | 30 | 25 |
| Farm jobs protected | 15 | 16 | 20 |
| Cost per household (increase in local taxes) | 30 | 15 | 0 |

Q: Which option would you prefer the government to choose – A, B or C?

**Advantages of CE**

- Represent the choices that people make (probability to choose each option)
- Estimate the marginal utility (a change in value) from a change in each attribute.

**Issues with choice experiment design**

- What attributes to include
- How to describe them to respondents
- What levels are to be used for each attribute
- What price or cost term will be used
- How the attributes are combined in the choice sets
- How may choice sets respondents can deal with
- How many choice options are included in each choice set.

Hypothetical market bias: i) how well hypothetical choices predict real choices ii) how close predicted WTP from hypothetical choices is to real WTP in an actual market. Next topic on revealed preference approach will explore market-based methods

### 3.2.2 Revealed preference approach (RP)

**RP is a market-based** approach to infer the value of environmental goods and services based on people's actual behavior.

**a. Hedonic pricing method (HPM)**

estimates people's valuation on environmental attributes inferred from the amount people are willing to pay for changes in an attribute. Similar to choice experiment characteristics, people place value on goods in terms of the bundles of attributes they possess.

HPM has been widely applied to study implicit prices of changes in air quality, noise, proximity to waste sites. For example, the implicit value of an environmental attribute inferred from house prices, which reflect the premium the house buyer would be willing to pay (identified from market transactions).

House attributes: Site characteristics (Si), neighborhood characteristics (Ni), environmental characteristics, etc.

To estimate house prices, $\mathbf{P_i = f(S_{i1},....S_{is}, N_{i1},....N_{in}, E_{i1},...E_{ie})}$

Collect data on house prices and house attributes, then apply regression analysis to estimate the house price function.

Example of results: 1% improvement in air quality levels increases house prices by 0.2% on average → implied monetary value of WTP for air-quality improvement

Graph: The value in housing market of an improvement in air quality

Day et al. (2007) use HVM to collect data on 10,848 house sales and attributes to estimate the benefits of reducing urban noise levels to inform the UK Department for Transport's assessment methods for transport system investment.

**Some drawbacks** of the HVM include:

- Many environmental goods are not linked to housing markets
- The implicit value may indicate only partial value of environmental goods, for example, the benefit of air-quality improvement to non-houseowners such as visitors, societies.
- Assume all buyers and sellers are well-informed about environmental attributes
- In case of house purchases as investments for anticipation of capital gains, the maximum WTP for a house not only depends on current levels of environment attributes, but also on expectation of changes in these attributes over time.

**b. Travel-cost methods** are used to estimate the value of a recreational resource (such as a park, fishery, hill-walking areas, etc.) based on expenditure required to visit that place (e.g., time and money spent in travelling to recreational sites) as an alternative approach to CVM.

For example, the value (consumer surplus) of a recreationalist can be inferred to by observing the relationship between visits and travel costs. The consumer surplus from visiting equals to the difference between the maximum that visitors would pay for a trip and what they actually pay.

Through a survey, visitors could be asked "how far they had travelled to make this visit, and how often in the last 12 months they had visited the site", including other socio-economic characteristics.

The number of visits $\ln V_i = a - bC_i + \varepsilon$ (where Ci = the costs per visit)

**Some drawbacks** of this method include:

- **Substitute sites**: There may be many similar sites. How do we know that an individual will visit a given site out of a list of alternatives?
- **The value of travel time**: What is the monetary value of leisure time? → an opportunity cost of travelling to a recreational site. If leisure time = wage rate, what about unemployed workers and retired people?

### 3.2.3 Other indirect methods

**a. Benefit transfer (BT) and meta-analysis** Benefit transfer refers to the use of existing information on the non-market value of goods and services. As original valuation studies ('study sites') are both expensive and time-consuming, the BT technique predicts WTP values for an environmental value at one site ('policy site') based on data collected at other sites using SP or RP methods. There are 3 forms of BT.

1. **Value transfer**: The actual benefit values derived from point estimates can be directly transferred from one context to another, adjusted for the difference between the study site and the policy site.
2. **Benefit function transfer**: Involve using a previously estimated benefit function that relates site characteristics to site values.
3. **Meta-analysis:** Or 'the analysis of analyses' takes empirical estimates from a sample of studies, statistically relates them to the characteristics of the studies, and calculates the degree to which the reported differences can be attributed to differences in location, subject matter, or methodology.

Advantages are quick and inexpensive method, however; the accuracy of the estimates reduces as the new context deviates (either temporally or spatially) further from the context used to derive the estimates.

**Welcome to the EVRI website.**

The Environmental Valuation Reference Inventory is a searchable storehouse of empirical studies on the economic value of environmental assets and human health effects.

https://www.evri.ca/en

**b. Using GIS to enhance valuation**

A Geographic Information Systems (GIS), computerized mapping models and analysis tools, can be used to inform economic analysis. GIS has proven to be useful for nonmarket valuation.

For example, Lewis et al. (2008) use GIS to evaluate the impacts of dam and dam removal on local property values. They found that homeowners are willing to pay higher for identical housing that located further away from the dam. GIS technology is used to facilitate the calculation of the distance from each home to both the river and the nearby dam.

Example from the study of Koulov et al. (2017) on *GIS-based Valuation of Ecosystem Services in Mountain Regions: A Case Study of the Karlovo Municipality in Bulgaria*.

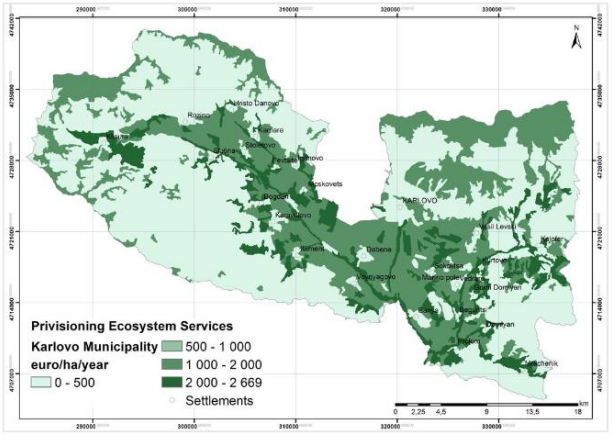



Figure 5.
Economic Value of Provisioning Ecosystem Services in Karlovo Municipality.

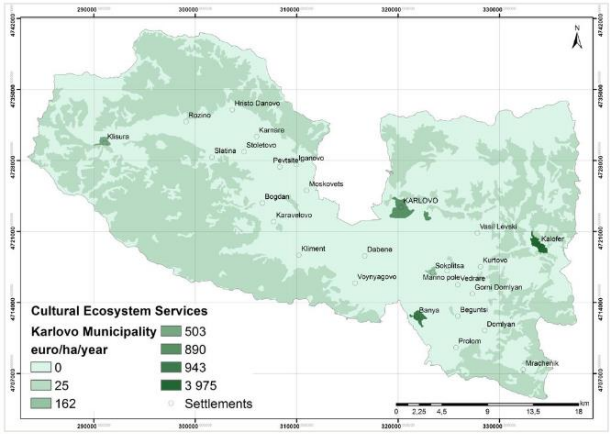



Figure 7.
Economic Value of Cultural Ecosystem Services in Karlovo Municipality.

**Reference:**

**[HSW]** – Hanley, N., Shogren, J. and White, B., Introduction to Environmental Economics 2013 (2nd edition), Oxford University Press, Chapter 4.

**[TL]** – Tietenberg, T. and Lewis, L. Environmental Natural Resource Economics, 2015 (10th edition), Pearson, Chapter 4.