Valuing Water in Watershed in the Absence of Market Prices

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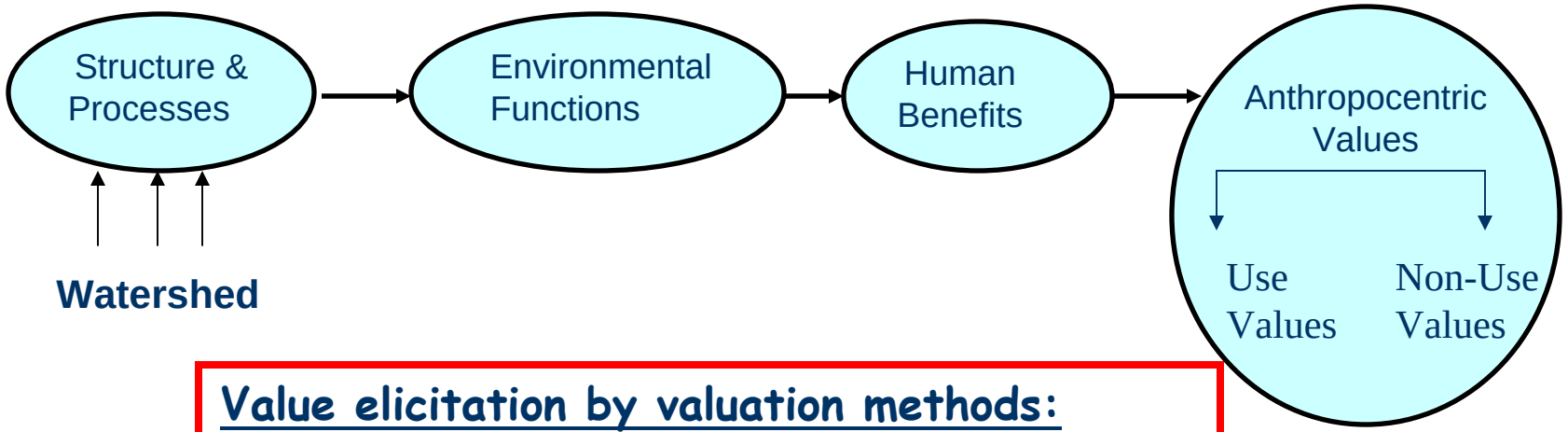
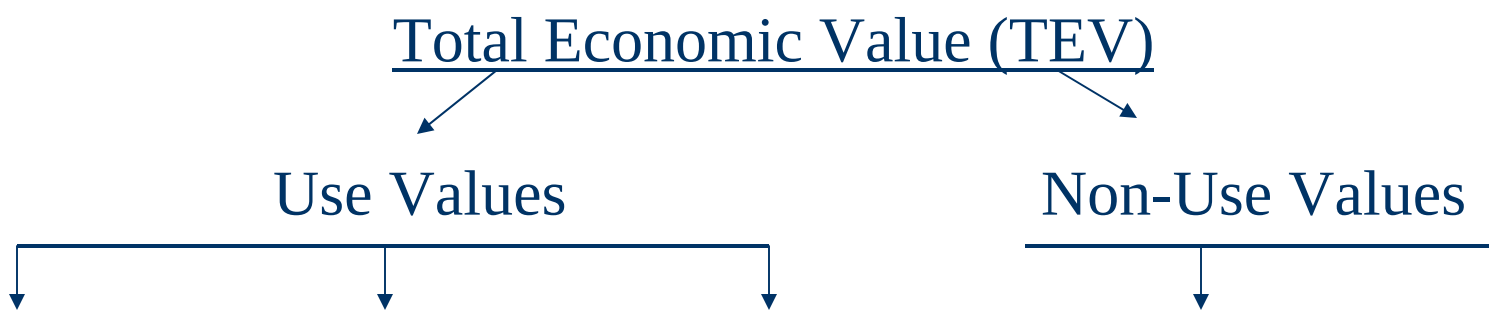
A simple framework relating water resources to environmental functions, human benefits and anthropocentric values



Value elicitation by valuation methods:

Hedonic Analysis
- Travel Cost Method
- Contingent Valuation
- Choice Experiments
- Meta-analysis
- Residual Analysis
- Replacement/Restoration Cost Method

Water Socio-Economic Values



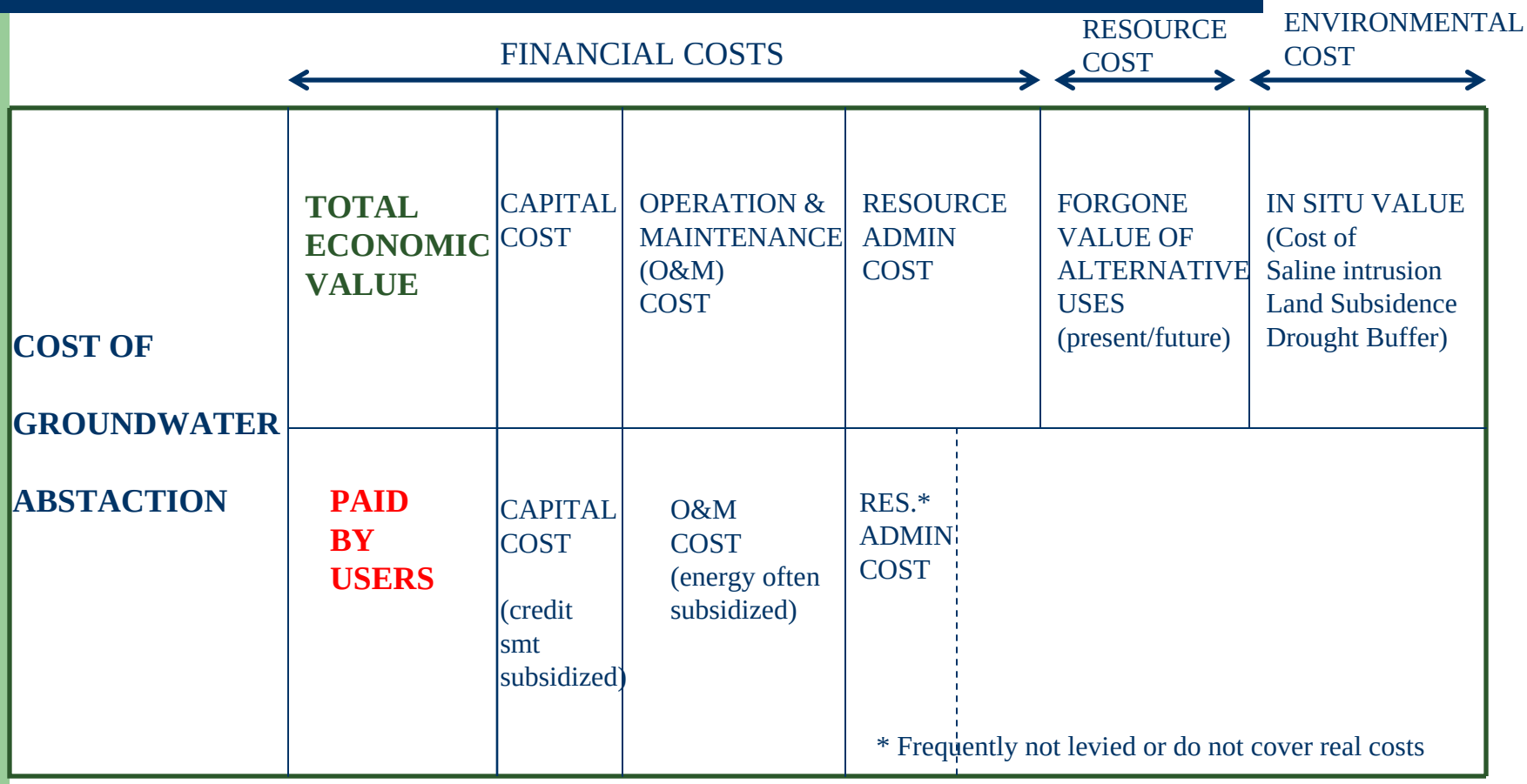
Direct
e.g.
Hydropower
Drinking water
Irrigation
Water in production
Recreation
Fishing

Indirect
e.g.
Flow regulation
Biodiversity

Option
e.g.
Future use values

Existence
e.g.
Preserved biodiversity

Absence of Market Prices → Difficulty in Calculating TEV: An Example.



Using WATECO glossary:

Environmental costs: Costs of damage that water uses impose on the environment and ecosystems and those who use the environment (e.g. a reduction in the ecological quality of aquatic Ecosystems; salinization and degradation of productive soils).

Resource costs: Costs of foregone opportunities which other uses suffer due to the depletion of the resource beyond its natural rate of recharge or recovery (e.g. linked to the over-abstraction of groundwater).

Environmental and Resource Costs: Where in the WFD?

- Article 9: E&R costs in the cost-recovery of water services

- Article 9: Member states shall ensure by 2010 that water pricing policies provide adequate incentives for water users to use water resources efficiently, and thereby contribute to the environmental objectives of the WFD

- Annex III and Article 11: Make judgments about the most cost-effective combination of measures with respect to water uses to be included in the programme of measures

- Article 4: Possible economic justification for derogation (including designation of water body status).

TEV: Where in the WFD?

1- Characterisation of the groundwater basin

- economic significance of water uses
- trends in key indicators and drivers
- dynamic path of demand and supply of water
- gaps in water status by the agreed date of meeting 'water balance'?

2- Assess current cost-recovery

- how much water services cost and who pays this cost?
- how much of this cost is recovered?
- potential cost-recovery mechanisms

3- Identification of measures and economic impact

- construction of a cost-effective programme of measures
- cost-effectiveness of potential measures
- financial & socio-economic implications of the programme of measures
- are costs disproportionate? ⟶ Derogations

Steps towards Estimating TEV

1. Identify Uses and Functions
2. Identify Stakeholders (Focus Groups)
3. Choose Appropriate Valuation Methodologies
4. Estimate Monetary Values of Uses

TEV in the absence of markets can be estimated with:

Revealed preference methods (indirect methods):

- Hedonic Pricing Method
- Travel Cost Method
- Averting Behaviour Method
- Residual Analysis (Production Cost Method)

Use Values

Stated preference methods (direct methods):

- Contingent Valuation Method
- Choice Experiment Method

Use & Non-Use Values (value of conservation)

Meta-Analysis Method

Methods not strictly based on economic welfare:

- Replacement Cost Methods
- Restoration Cost Methods

Hedonic Valuation Method (HVM)
(a) hedonic property pricing
(b) hedonic wage risk

If an environmental resource is not itself traded in any market, because it is a public good, then no market price exists which can reveal WTP. The resource can be defined in terms of services it yields or an `attribute' it embodies. This attribute may be embodied in other goods or assets which are marketed, and which do have observable prices. Using these prices you can derive economic value.

Example: Farm prices in an area with good groundwater are most likely higher than in an area without either ground- or surface water. Comparing differences in farm prices across a region and controlling for other influences, then the difference in prices of these farms would lie in groundwater access.

Problems:

-Only capable of measuring the subset of use values that people are WTP for through the related market.

- If consumers are not fully informed about the qualities of the attributes being valued, hedonic price estimates are of little relevance.

Travel Cost Method (TCM)

Inferring the value of a set of attributes from expenditure (time and money spent on the trip) on outdoor recreational facilities or visits to nature reserves.

Example: Valuing the effects on the demand for recreation of a change in water quality in a river.

Problems:

1. Capable of measuring the subset of values that people are WTP for.
2. Found very few applications outside resource-based recreational amenities.
3. Very data-intensive.
4. What value should be assigned to time costs of travel?
6. Statistical problems

Averting Behavior Method (ABM)

Use of expenditures undertaken by households that are designated to offset an environmental risk, in order to infer WTP for avoiding environmental degradation.

Example: Use of water filters.

Problems:

- Limited to cases where households spend money to offset environmental hazards.
- Insufficient studies to comment on convergent validity.

Residual Analysis Method (RAM)

This method values all inputs for the good produced at their market price – except for the water itself. The remaining value of the good, after all other inputs are accounted for, is then attributed to the water input.

Example: Valuing water as an input in production of different crops.

Problems:

- Only part of use-value of water can be captured.
- Market imperfections can bias valuation estimates.

Contingent Valuation Method (CVM)

CVM relies on a constructed, hypothetical market to produce monetary estimates of value. The value of an environmental resource to an individual is expressed as:

- maximum WTP
- minimum WTA (Compensation)

Example: The researcher obtains peoples' bids (either WTP or WTAC) for a specified change in the quality of water in a river, contingent on the description of a hypothetical market where water quality is traded.

Problems:

- interviewing bias
- strategic bias
- hypothetical bias
- non-response bias
- yea-saying bias
- information bias

Undergoing research on wetland valuation in Greece & the UK. (Results expected June 2005)

Choice Experiment Method (CEM)

CEM is a survey-based technique, which can estimate the total economic value of an environmental stock/flow or service and the value of its attributes, as well as the value of more complex changes in several attributes.

Example: In a CEM each respondent is presented with a series of alternatives of the environmental stock/flow or service with varying levels of its price and non-price attributes and asked to choose their most preferred option in each set of alternatives.

Problems:

- Very simplified version of reality

… but CEM eliminates or minimises several of the CVM problems (e.g. strategic bias, yea-saying bias).

Operational at the policy level?

Question: How can methods (developed at an academic level) be made operational in the context of the development of groundwater management strategies at the **policy level**?

Answer: Recent years have seen a growing interest in the potential for producing generally applicable models for the valuation of non-market environmental goods and services, which do not rely upon expensive and time-consuming original survey work, but rather extrapolate results from previous studies of similar assets.

This approach is called **meta-analysis** for the use and non-use values generated by environmental resources.

Meta-Analysis Method (MAM)

Meta-analysis is the statistical analysis of the summary of findings of empirical studies: i.e. the statistical analysis of a large collection of results from individual studies for the purpose of integrating the findings.

Meta-analysis offers a transparent structure with which to understand underlying patterns of assumptions, relations and causalities, thus permitting the derivation of useful generalizations.

Meta-Analysis Method (2)

The increase in meta-analytical research seems to have been principally triggered by:

- increases in the available number of environmental valuation studies;

- the seemingly large differences in valuation outcomes as a result of the use of different research designs;

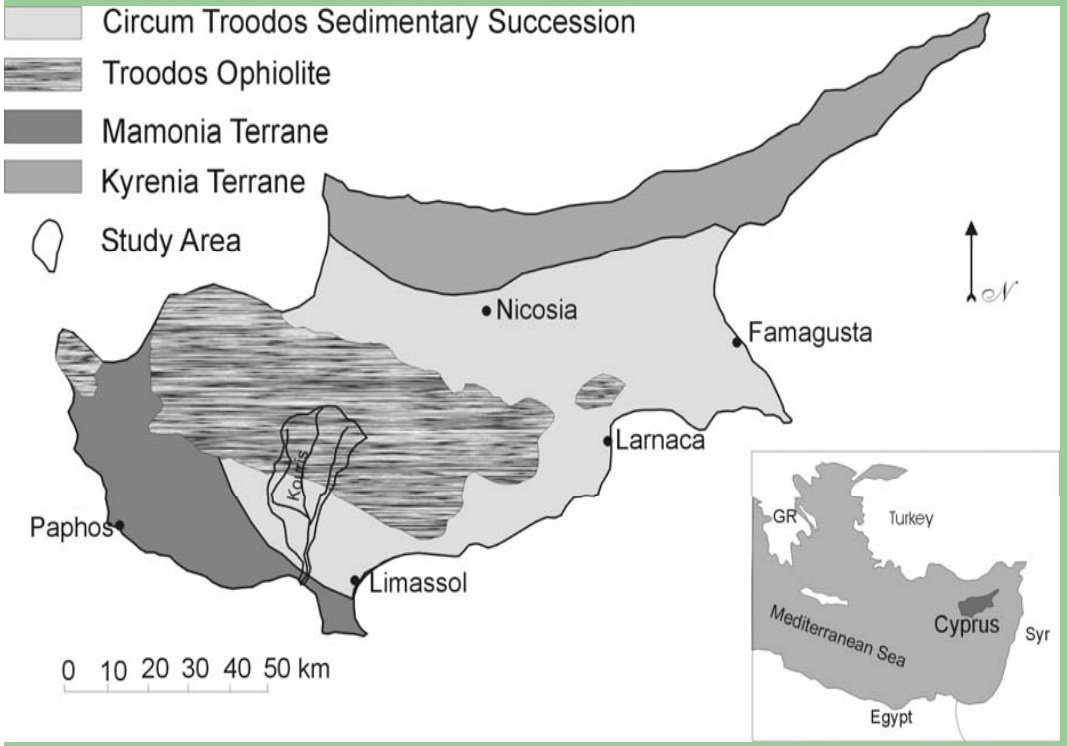
- the high costs of carrying out environmental valuation studies and the increasing demand for transferable valuation results.

Example: Freshwater fishing, meta-analysis of TC valuation studies. (Sturtevant, 1995)

Examples of Valuation Studies

on Water Resources attributes & Wetland functions

The 'Cyprus' EU Project*



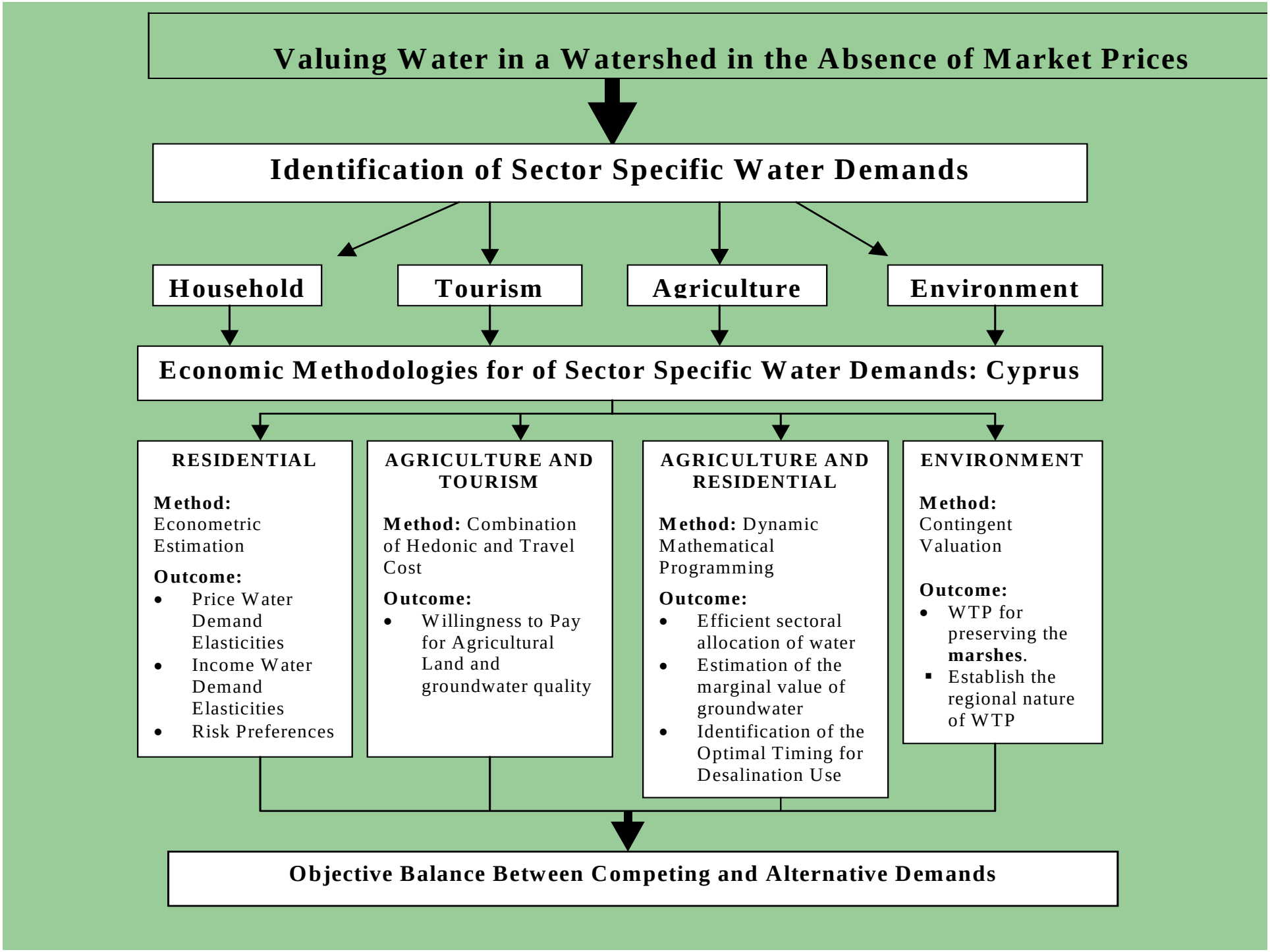
Water Supply	Water Demand
Surface Water	Urban
Groundwater	Irrigation
Diversions	Tourism
Desalination	Environmental
Reuse	

→ Water Deficit

Predicted Sectoral Growth (GDP: 6%)

- Tourism: 5-10% economic growth.
- Agriculture: 2.2% economic growth and expansion of government schemes
- Residential: 1% population growth

- The approach has been applied on Crete. (http://www.arid-research.net)
- It is now applied on France and Finland. (Results expected this summer)


Valuing Water in a Watershed in the Absence of Market Prices
Identification of Sector Specific Water Demands
Household
Tourism
Agriculture
Environment
Economic Methodologies for of Sector Specific Water Demands: Cyprus
RESIDENTIAL
Method: Econometric Estimation
Outcome:
Price Water Demand Elasticities
Income Water Demand Elasticities
Risk Preferences
AGRICULTURE AND TOURISM
Method: Combination of Hedonic and Travel Cost
Outcome:
Willingness to Pay for Agricultural Land and groundwater quality
AGRICULTURE AND RESIDENTIAL
Method: Dynamic Mathematical Programming
Outcome:
Efficient sectoral allocation of water
Estimation of the marginal value of groundwater
Identification of the Optimal Timing for Desalination Use
ENVIRONMENT
Method: Contingent Valuation
Outcome:
WTP for preserving the marshes.
Establish the regional nature of WTP
Objective Balance Between Competing and Alternative Demands

Sector	PED (-)	IED	Marginal Value/ WTP	Risk Premium
Households	0.4-0.8 increasing in income	0.25-0.48 decreasing in income	£Cy0.45/m^3	-
Agricultural/ Quality	-	-	£Cy1.07/ ha	-
Agricultural/ Quantity	0.48	-	£Cy0.30/m^3	18%
Environmental	-		£15 per household per year for wetland preservation	-

Policy Recommendations:

- **Inter-sectoral allocation of groundwater should be based on the marginal value of the resource for each sector:**

Marginal value higher in residential sector than agricultural sector at current use levels.

Policy should be directed towards reducing the appropriation of water by agriculture.

- **Balance demands through efficient pricing:**

Groundwater: include resource cost

Surface water: Long-run marginal cost (LRMC)

- **With limited supply, PED can guide pricing policy**

PED of water is higher for residential than for agriculture sector.

This means that larger increases in price required for a unit of agricultural demand reduction.

Another Example: Cotentin Wetlands (France)

Value categories	Benefits sources	Policy Measures	Valuation techniques
Use value: recreational value	Wildlife: waterfowl, birds, fish	Countryside protection	TCM, CVM
Use value: aesthetic value	Landscape quality: variety in shape and color, cultural heritage	Management prescriptions & good agricultural practices	TCM,CVM,CE
Indirect-use values:	Flood control	Maintenance and good agricultural practices	CVM
	Ecological value, life support	Biodiversity protection and enhancement	CVM
Existence value:	Wildlife of specific interest	Habitat protection	CVM

Assessment of Environmental Benefits for all Water Bodies in England & Wales

Type of benefit	£ m/year
Informal Recreation	6 – 12
Angling	26 – 27
Amenity	19
Bathing	20
Groundwater	13
Ecosystems & natural habitats – rivers, lakes	189 – 405
Ecosystems and natural habitats – wetlands	16 – 38
Total	289 – 535

Another price we don't know: The long-run discount rate

'There is something awkward about discounting benefits that arise a century hence. For even at a modest discount rate, no investment will look worthwhile'.

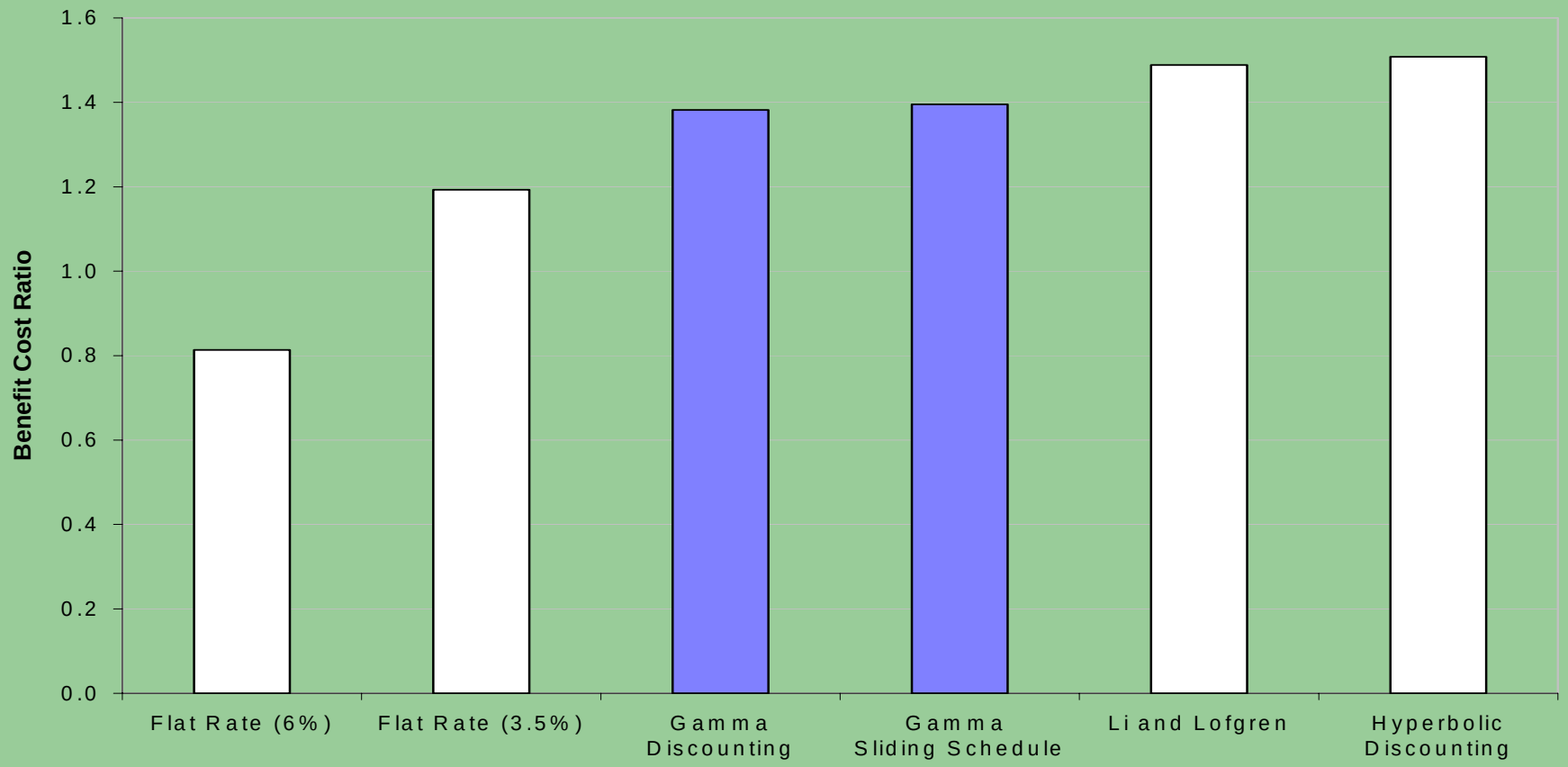
The Economist (1991), March 23, p 73

How can we then implement Sustainable Water Resources Policies?

In the decade since that comment in *The Economist*, the nature of the problem with long-run discounting has become clearer. Four recent theoretical approaches, conclude that this 'awkwardness' can and should be resolved by employing a **discount rate that is a decreasing function of time.**

Stochastic model by Binne, Black & Veatch designed to assess the costs and benefits of investment in flood defense in a protected area in Shrewsbury.

The model determines the net benefit of investment by comparing the damage suffered in a 'do nothing' scenario, with damages in the case where 100-year flood defenses have been constructed. The benefits can then be compared with the costs of constructing and maintaining the defenses.



Forthcoming ARID Cluster Book & "Multimedia Educational Package".

Book: "Water Management in Arid and Semi-Arid Regions: Interdisciplinary Perspectives".

Focusing on:
- classification of a wide spectrum of hydrological conditions
- water use patterns
- and institutional water management frameworks

To be published by Edward Elgar.

Hope to see you all in Cyprus, May 2005!

Thank you.