Value of Water Quality Improvements

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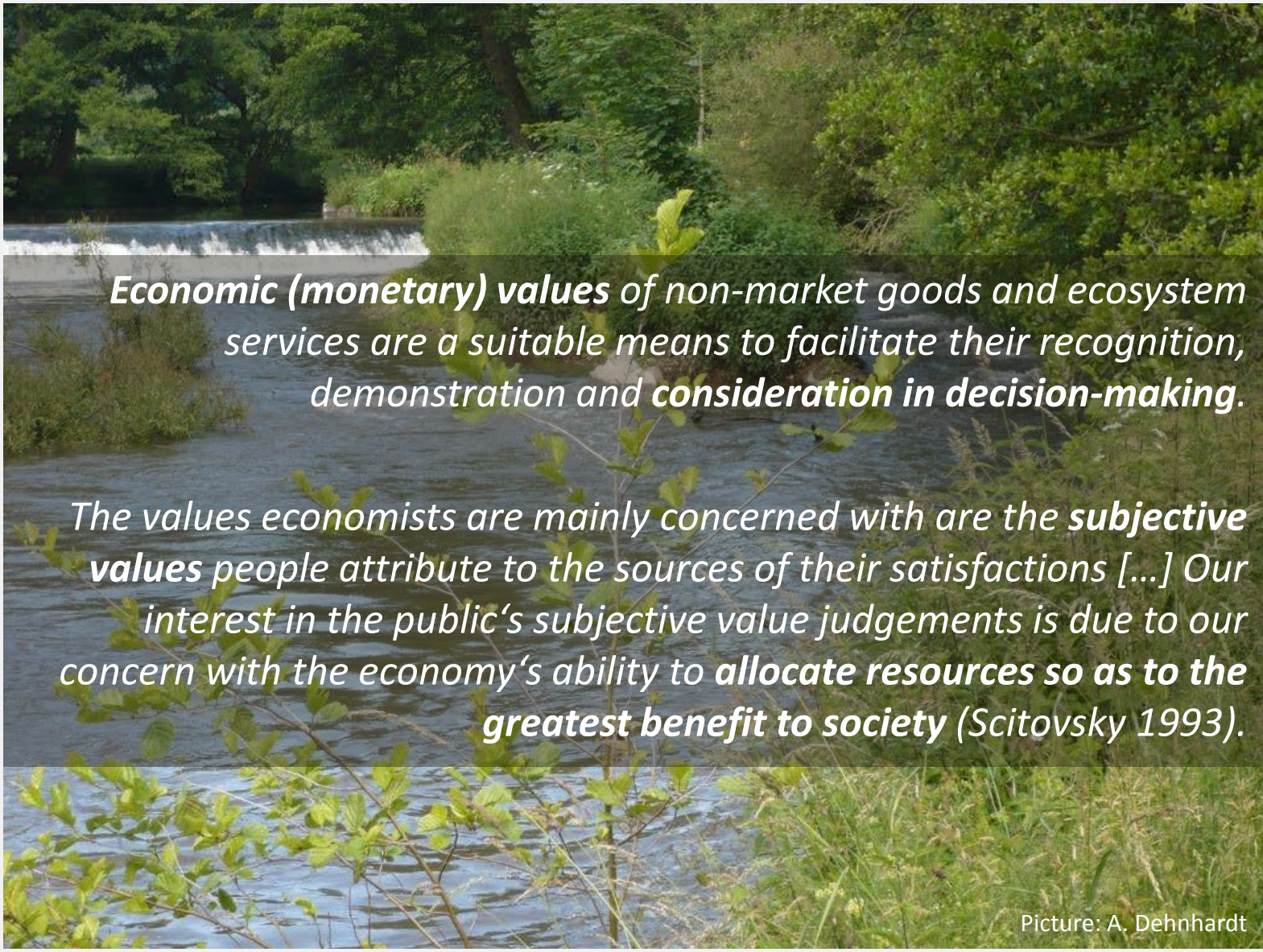

Economic (monetary) values *of non-market goods and ecosystem services are a suitable means to facilitate their recognition, demonstration and* ***consideration in decision-making****.*

The values economists are mainly concerned with are the ***subjective values*** *people attribute to the sources of their satisfactions […] Our interest in the public's subjective value judgements is due to our concern with the economy's ability to* ***allocate resources so as to the greatest benefit to society*** *(Scitovsky 1993).*

Picture: A. Dehnhardt

Outline

The **value of water quality (improvements)**….

1. Why do we need an economic perspective in water management
2. What is the (economic) benefit of water quality and how it contributes to human well-being
3. How economists conceptualize value and how the value can be measured
4. How to apply valuation methods in practice
5. What an economic valuation can contribute to societal and political decision-making processes

The problem

Clean fresh water is a scarce resource

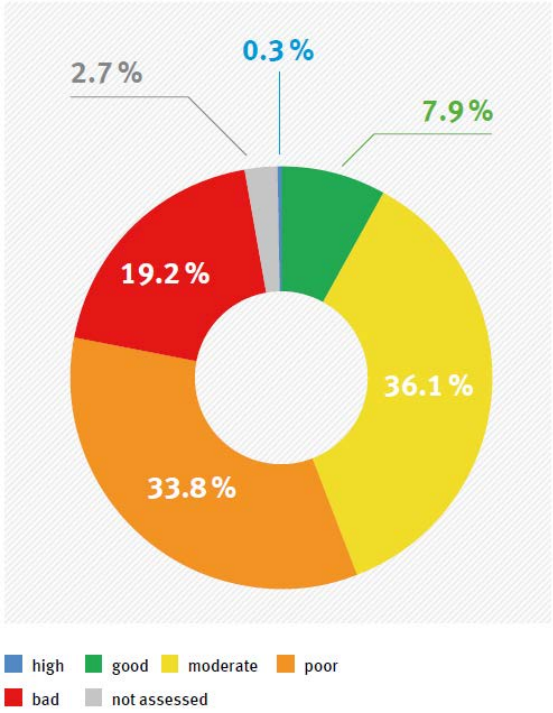
- Overconsumption aggravates scarcity
- Pollution deteriorates water quality

Given scarcity, use of water is characterized by resource use conflicts

- Input for production and consumption purposes
- Absorption of pollutants
- Shipping, flood protection, irrigation
- Recreational use of riverine landscapes

⇒ Need to make choices among available alternatives

Ecological status of Germany's surface water bodies.



Source: Berichtsportal WasserBLICK/BfG; last updated 23 March 2016. Adaptation/editing: Umweltbundesamt, based on Bund/Länder-Arbeitsgemeinschaft Wasser (LAWA) data.

Dealing with public goods

- Challenge
  - Water is mobile (upstream and downstream costs and benefits of water use)
  - Environmental goods are public goods

Rivalry	Excludability: Yes	Excludability: No
Yes	Private good	Common good
No	Club good	Public good

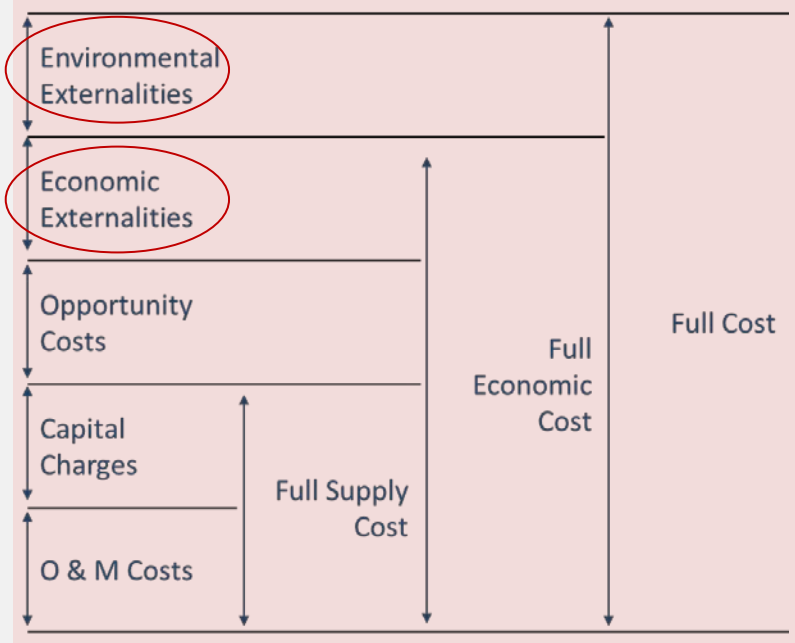
Economic benefits provided by (river) water quality

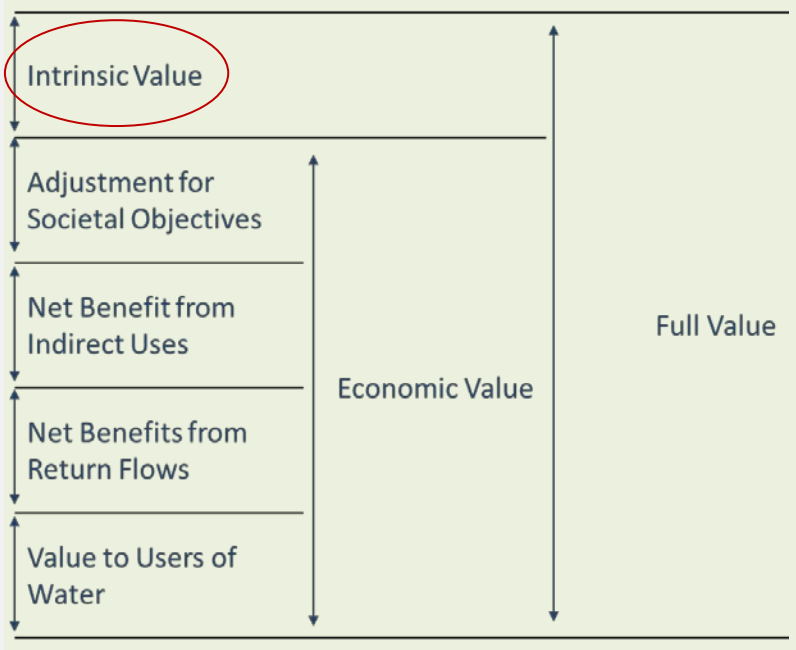
Off-stream uses: consumptive (household, industry, agriculture)

Instream uses: non-consumptive (hydropower, shipping, active or passive recreation, regulation)

The economic perspective on environmental problems

- Economic **value** is different than the market **price** of a good or service; market prices do not reflect the true value of a commodity
- Existence of **externalities** (positive or negative effects of economic activities, which do not impact market prices)
- Economics explains why **markets fail** and water-related problems occur





Source: Rogers et al. (2002)

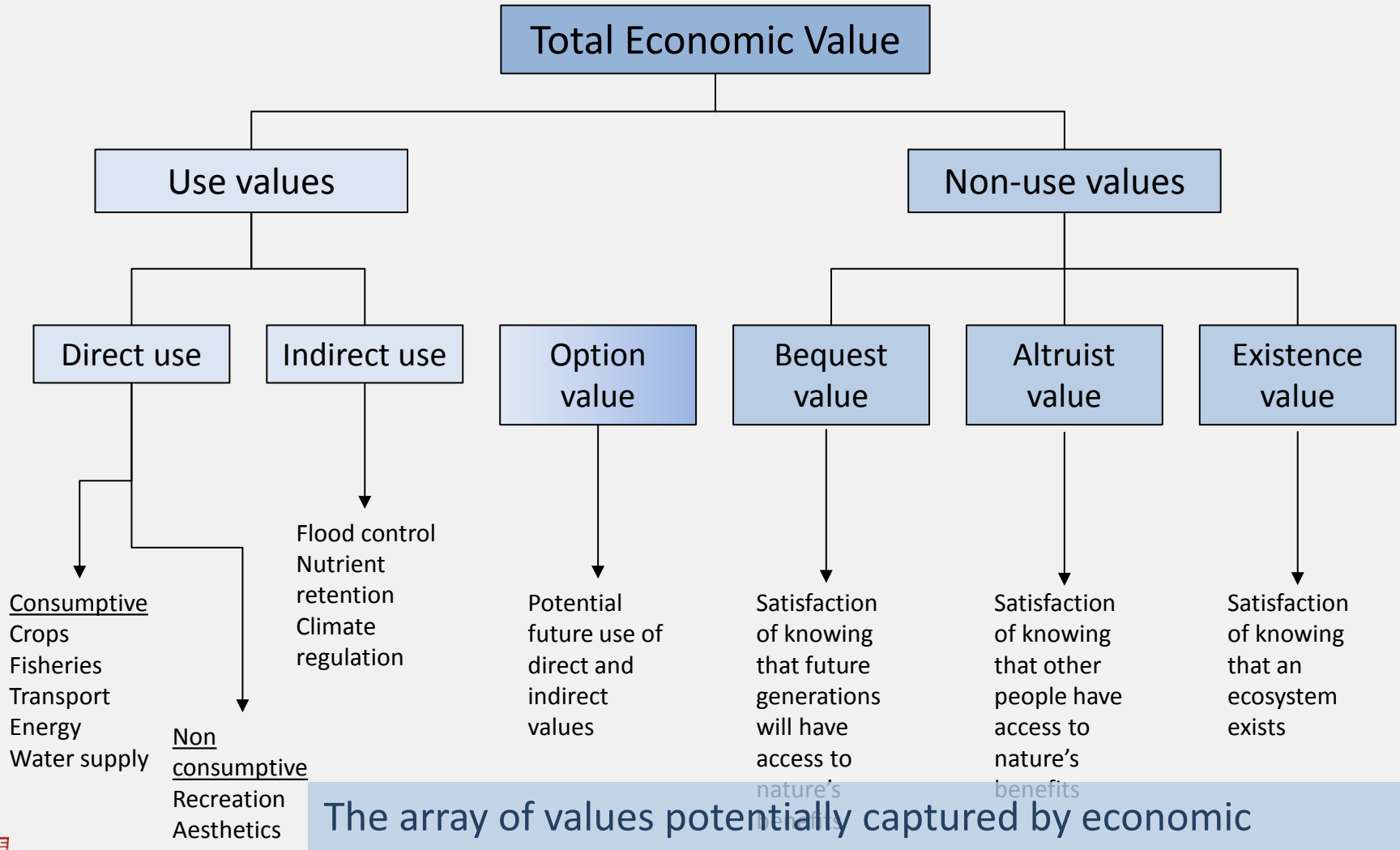
The economic conception of value

- All humans assign certain values to objects; not always explicitly
- Value judgements vary according to peoples' interests, attitudes, knowledge and use; according to their **individual preferences**
- Paradox: value in exchange ⇔ value in use

The value in use (utility) of water obviously differs from its value in exchange (price) => modern economics focus on the value in use

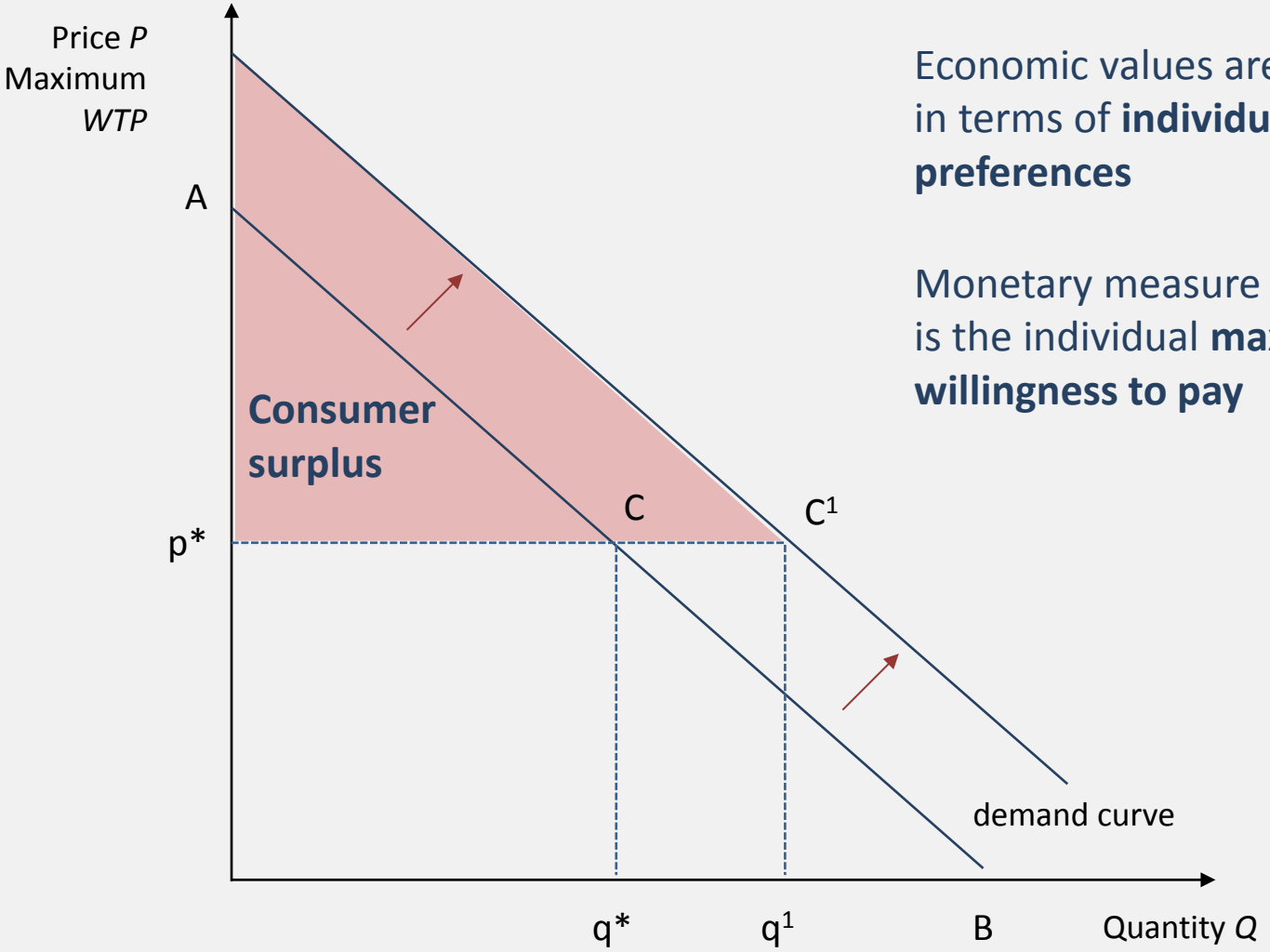
- Meaning of **economic value**
  - Importance, worth, usefulness ⇔ held values, principles, moral duties
  - Self-interested values ⇔ (?) social values
  - Use and non-use values

Total Economic Value (TEV)



The array of values potentially captured by economic valuation is broader than often assumed by non-economists.

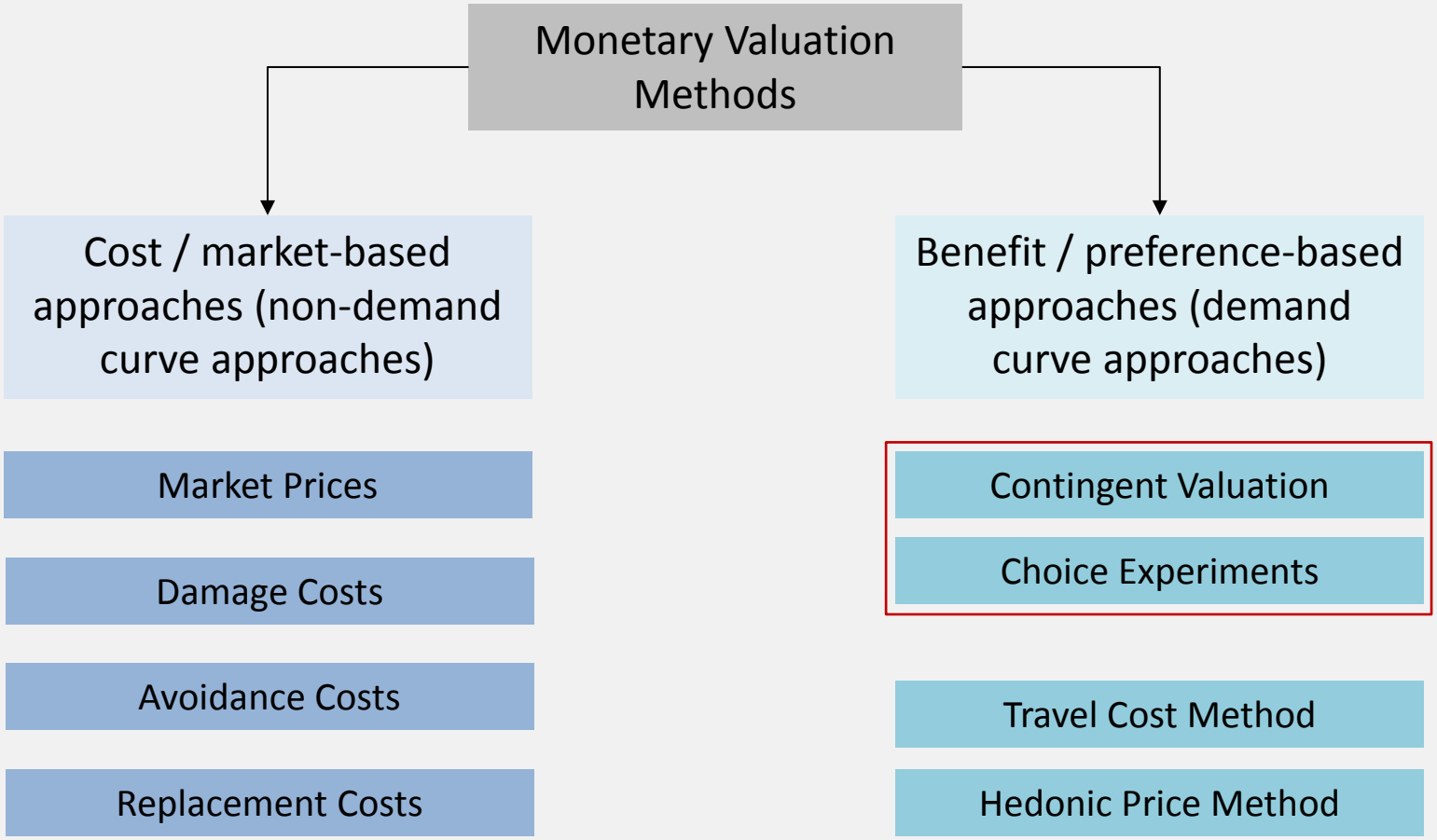
Economic theory and conceptual basis



Economic values are expressed in terms of **individual preferences**

Monetary measure of benefits is the individual **maximum willingness to pay**

Economic Valuation methods



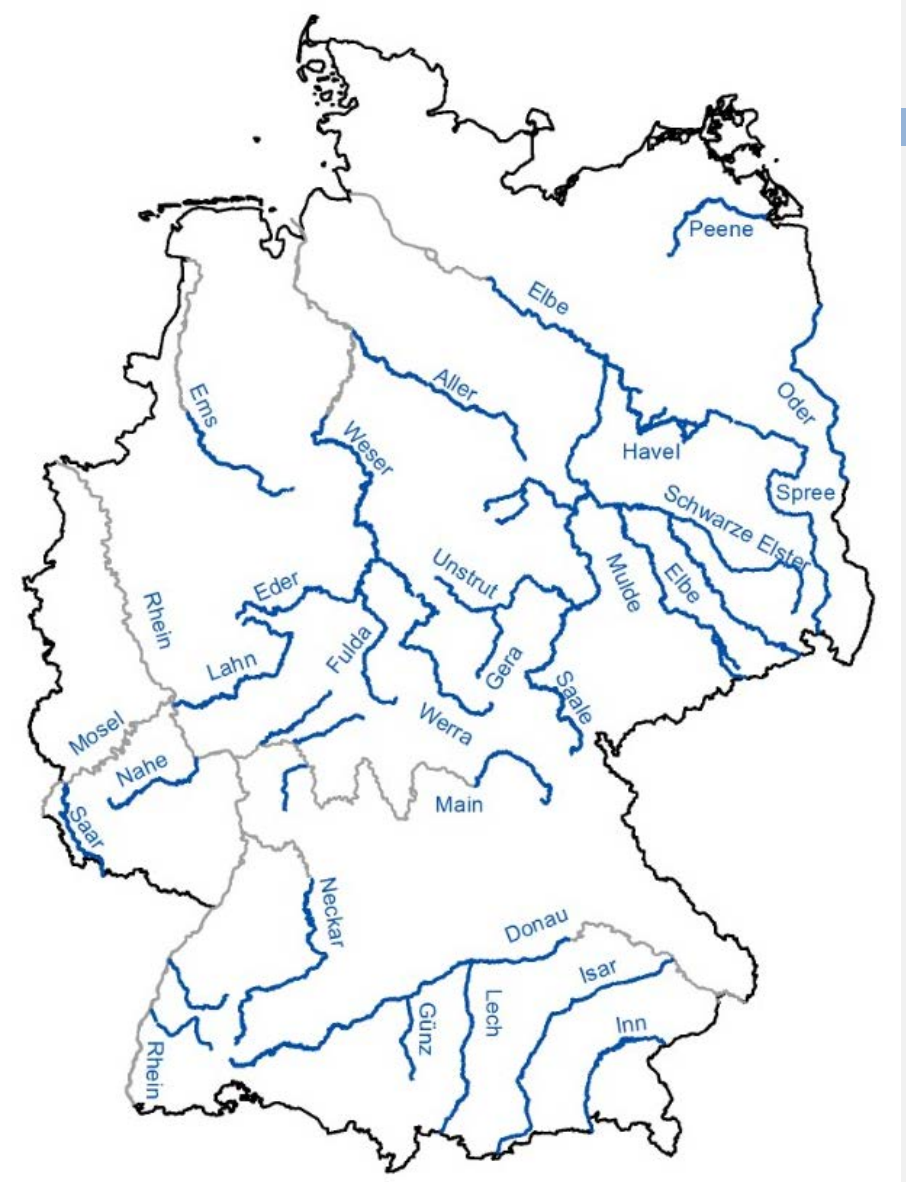
⇒ No true welfare measure
⇒ But useful information for policy-makers

⇒ Welfare measure
⇒ Non-market goods and services

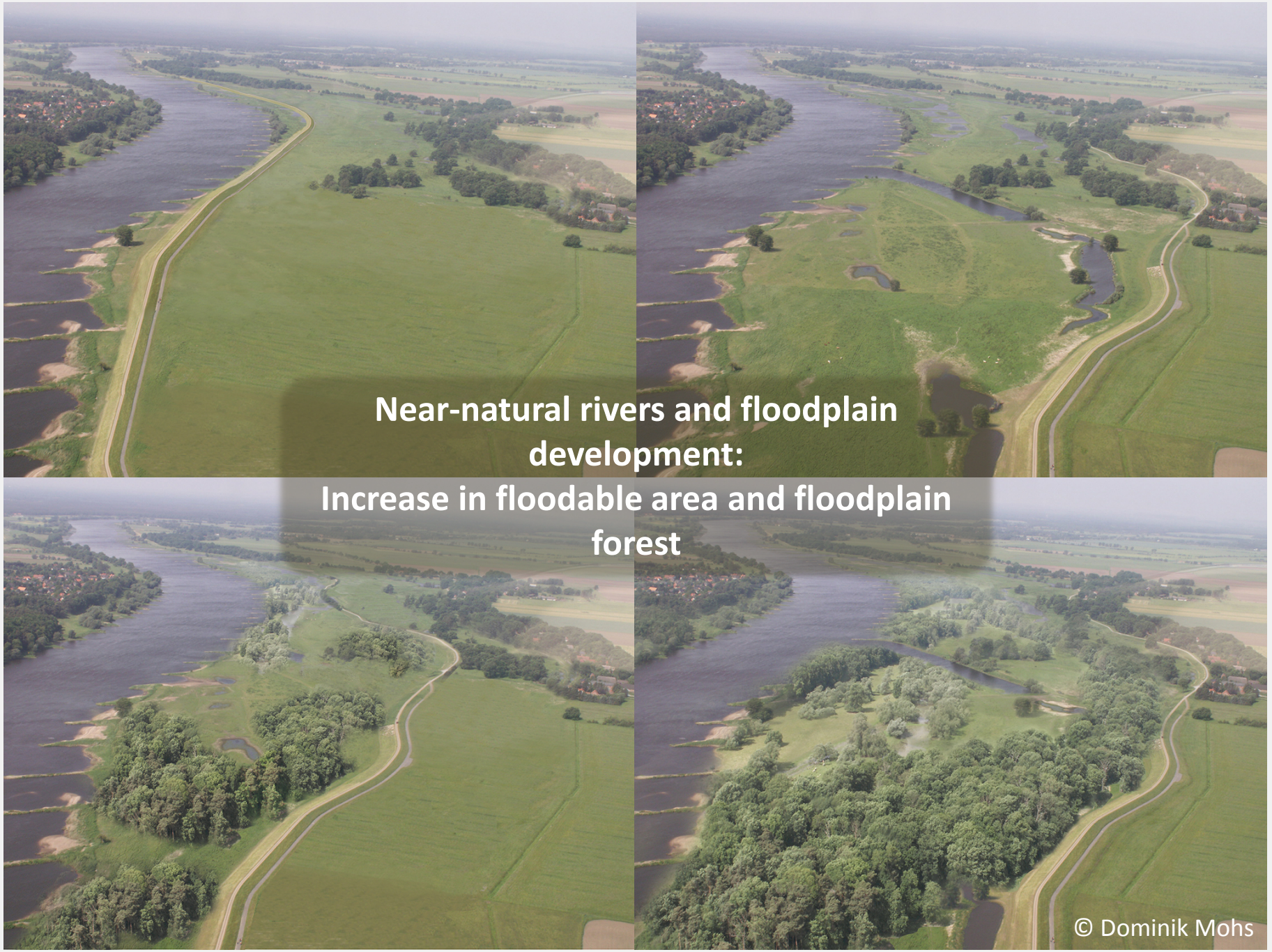
Case study: the ‚Blue rivers' in Germany

The ‚Blue Rivers‘

- Survey part of the last environmental awareness study (2,023 interviews)
- Near-natural development of selected rivers until 2030 (total lengths ca. 6,300 km)
- Survey included a *stated preference* study to estimate the economic benefits of river quality improvement
- CE: direct method of elicitating preferences: stated willingness-to-pay on hypothetical market



Source: Horbat, A.; Dehnhardt, A.; Meyerhoff, J.: *Der Wert naturnaher Flüsse und Auen in Deutschland* (in Vorbereitung)


Near-natural rivers and floodplain development:
Increase in floodable area and floodplain forest
© Dominik Mohs

Attributes and choice cards

Attributes vary systematically between different alternatives

Status Quo Option

Alternatives are characterized by attributes with different levels

	Option A	Option B	Option C
Floodable area	25,000 ha	10,000 ha	10,000 ha
Near-natural riverbanks	1,000 km lengths	3,000 km lengths	1,000 km lengths
Floodplain forest	50% of floodable area	50% of floodable area	10% of floodable area
Longitudinal connectivity (fish migration)	100% connectivity	50% connectivity	50% connectivity
Bathing	Good (suitable for bathing)	Bad (not suitable for bathing)	Bad (not suitable for bathing)
Payment for river development	50 €	100 €	0 €
I choose:	☑	○	○

Respondents choose most preferred alternative

The results

Willingness to pay for renaturation measures in Germany (*40.188.000 households)		WTP (€ / hh) (change to SQ)	Mio. € / year*
Floodable Area	25.000 ha	25.77	944
	50.000 ha	51.54	1.887
Floodplain Forest	30 % of floodable area	20.96	990
	50 % of floodable area	41.92	1.980
Near-natural riverbanks	2.000 km of the rivers	24.01	778
	3.000 km of the rivers	48.02	1.557
Connectivity for fish migration	75 % connectivity	35.87	1.394
	100 % connectivity	71.74	2.787
Bathing	Moderate suitable	41.01	1.579
	Suitable	82.02	3.157

Total benefit of different scenarios

		Scenarios for river development for the 'Blue Rivers'*		
		I Flood protection	II Biodiversity	III Bathing
Used attribute levels	Floodable area	50,000 ha	--	--
	Floodplain forest	--	50% of floodplain area	--
	Near-natural banks	--	3,000 km lengths	--
	Connectivity	--	100%	--
	Bathing water quality	--	--	Good
	Total Benefit (Mio. €/a)	**2,100**	**6,587**	**3,341**
	Net present value (billion €)**	**22**	**70**	**36**

*40.188.000 households in Germany
** 13 years, 3% discount rate

Investment **costs** for renaturation of 6,337 km river: approx. **11,2 billion €**

Economic values in the decision-making framework

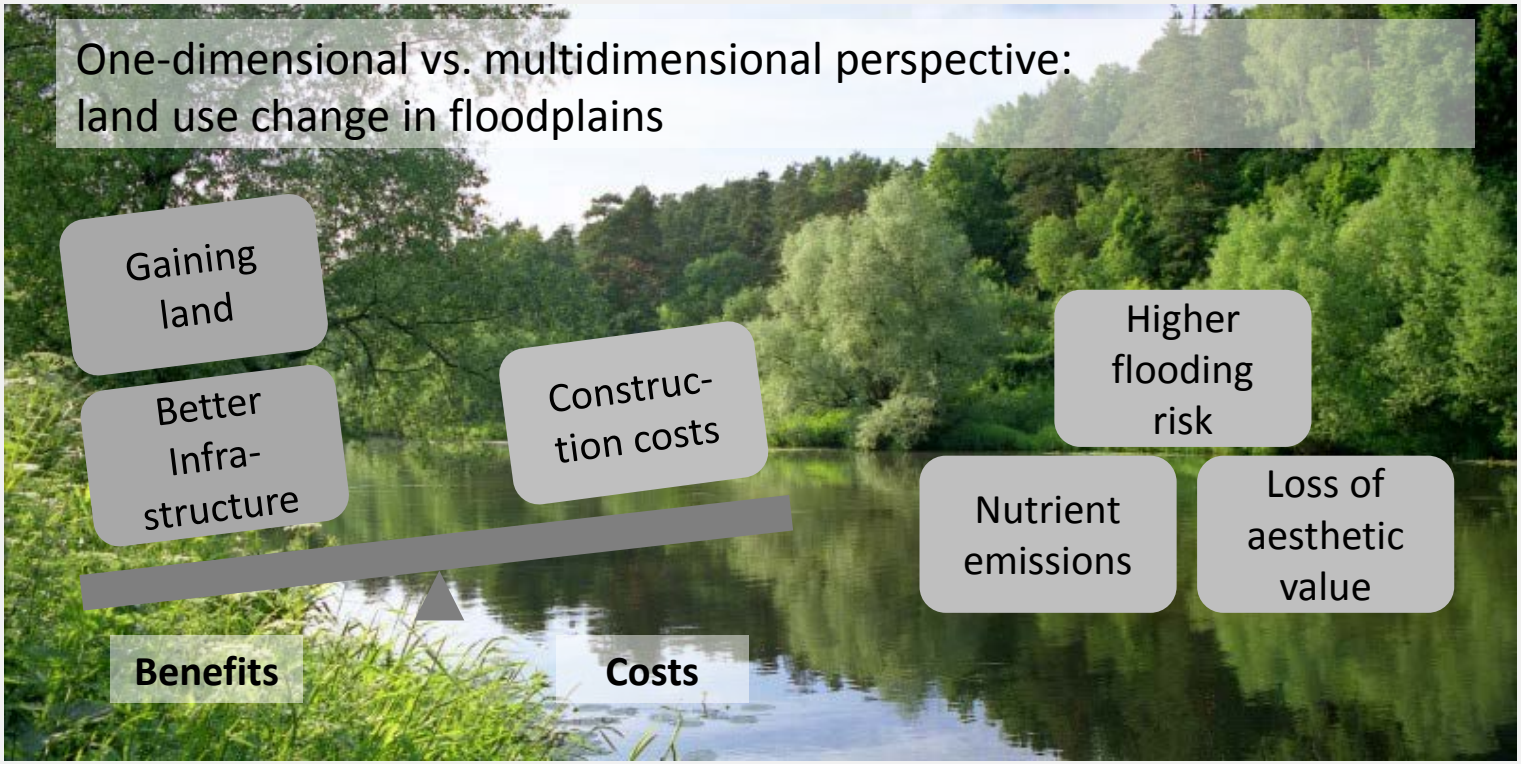
- Is it a good idea to estimate the economic values of environmental goods and make it the basis for political and societal decisions?
- Yes!
  - Providing additional information for policy-makers
  - Balancing costs and benefits for society
  - Identify winners and losers of alternative options
  - Addressing trade-offs and making them more obvious
  - Contributing to the efficiency of water-related policies
  - Part of cost-benefit analysis or multi-criteria analysis
- Creating awareness for the costs of using ecosystems and values of ES and their benefits for human well-being
- Applicable for a number of different decision contexts

Limits of the economic approach

- But…
  - Economic values as **one** decision criterion for policy-making: Economic efficiency next to other legal, ethical, political rules of weighting
  - Environmental policy frameworks (long-term, precautionary) still exist
- Boundaries
  - Non-substitutability of ecosystem services
  - Irreversible changes
  - Impact on future generations
  - Instrumental values ⇔ intrinsic values
- *Policy-related* challenge: acceptance of integrating economic thinking into policy-making (preference-based vs. expert-based judgements)

Added value of the economic perspective

- ‘Better’ environmental decision-making



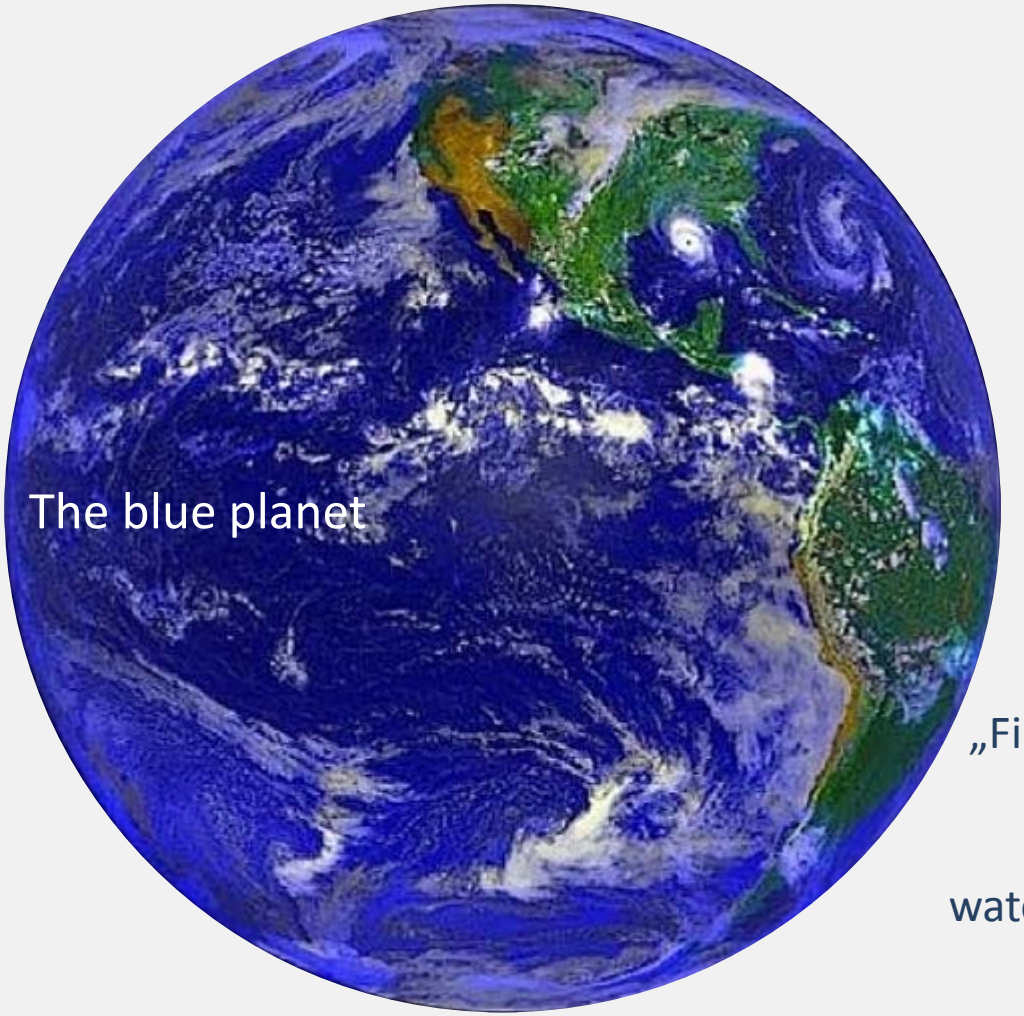
- *Science-related* challenge: still more attention needed for the quantification of the effects as well as for the benefit estimates => integration of social, ecological, economic, engineering disciplines

Actual impact on policy-making (limited?!)

- Cost-benefit analysis and water policy
  - History of CBA and non-market valuation in the USA intertwined with water projects: e.g. *Flood Control Act (*1936). "…the benefits to whosoever they may accrue are in excess of the estimated costs."
  - Paradigm change in the EU water policy (European Water Framework Directive): requires an integrated water resource management approach and cost-benefit analysis (disproportionate costs)
- Non-market valuation in the USA
  - Natural Resource Damage Assessment
  - Oil spill caused by the accident or Exxon Valdez (1989): non-use values were included in damage assessment by a CV study ($2.8 billion)
  - Controversial debate on reliability of CV estimates => guidelines
- Economic valuation of ecosystem services
  - Increased social and political awareness (TEEB)
  - Growing attention on institutional requirements and methodological soundness for applying economic valuation

Many thanks!

The value of water



The blue planet

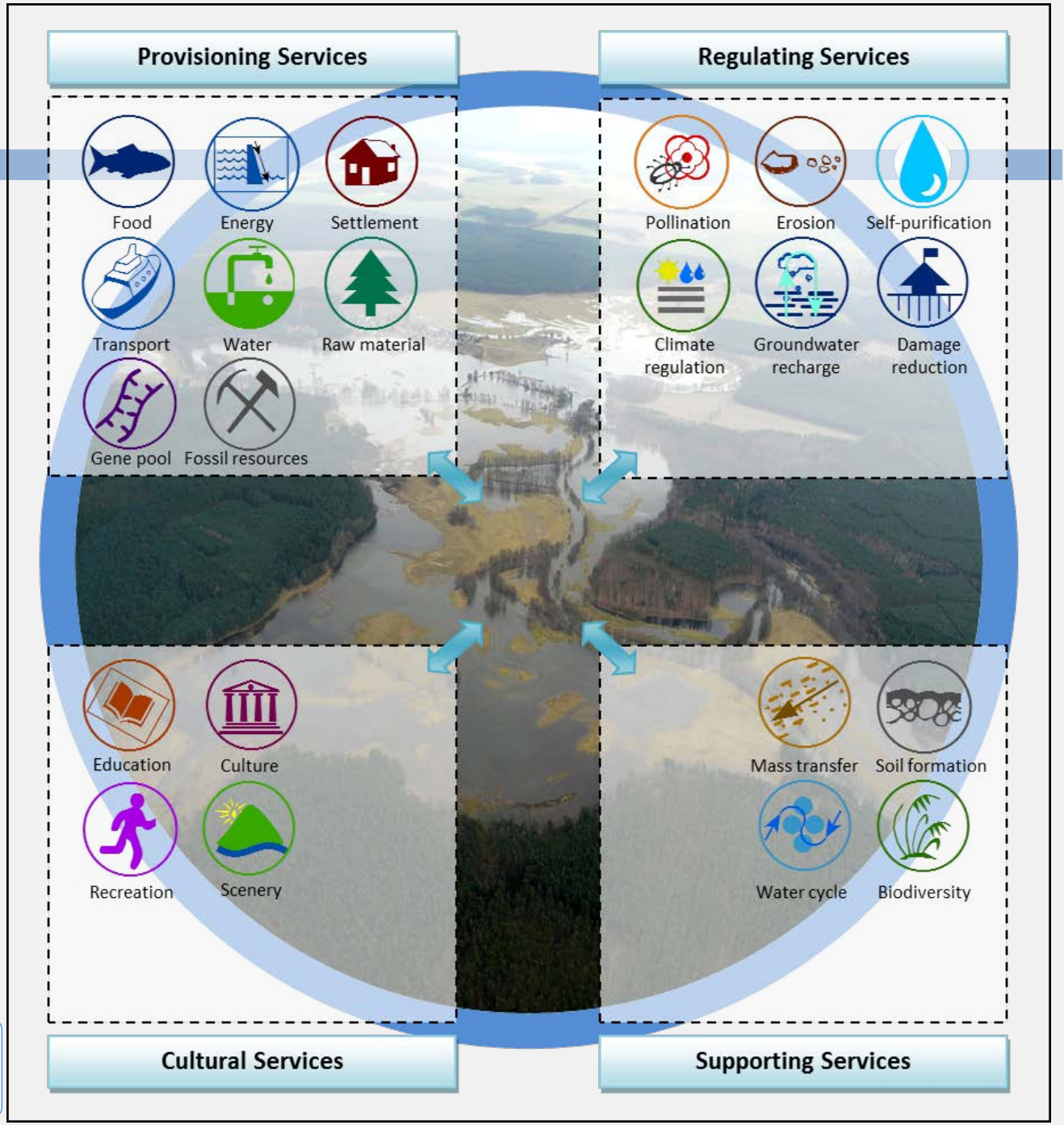
"When the well's dry, we know the worth of water."
(Benjamin Franklin (1706-1790), Poor Richard's Almanac, 1746)

„We forget that the water cycle and the life cycle are one."
(Jacques Cousteau)

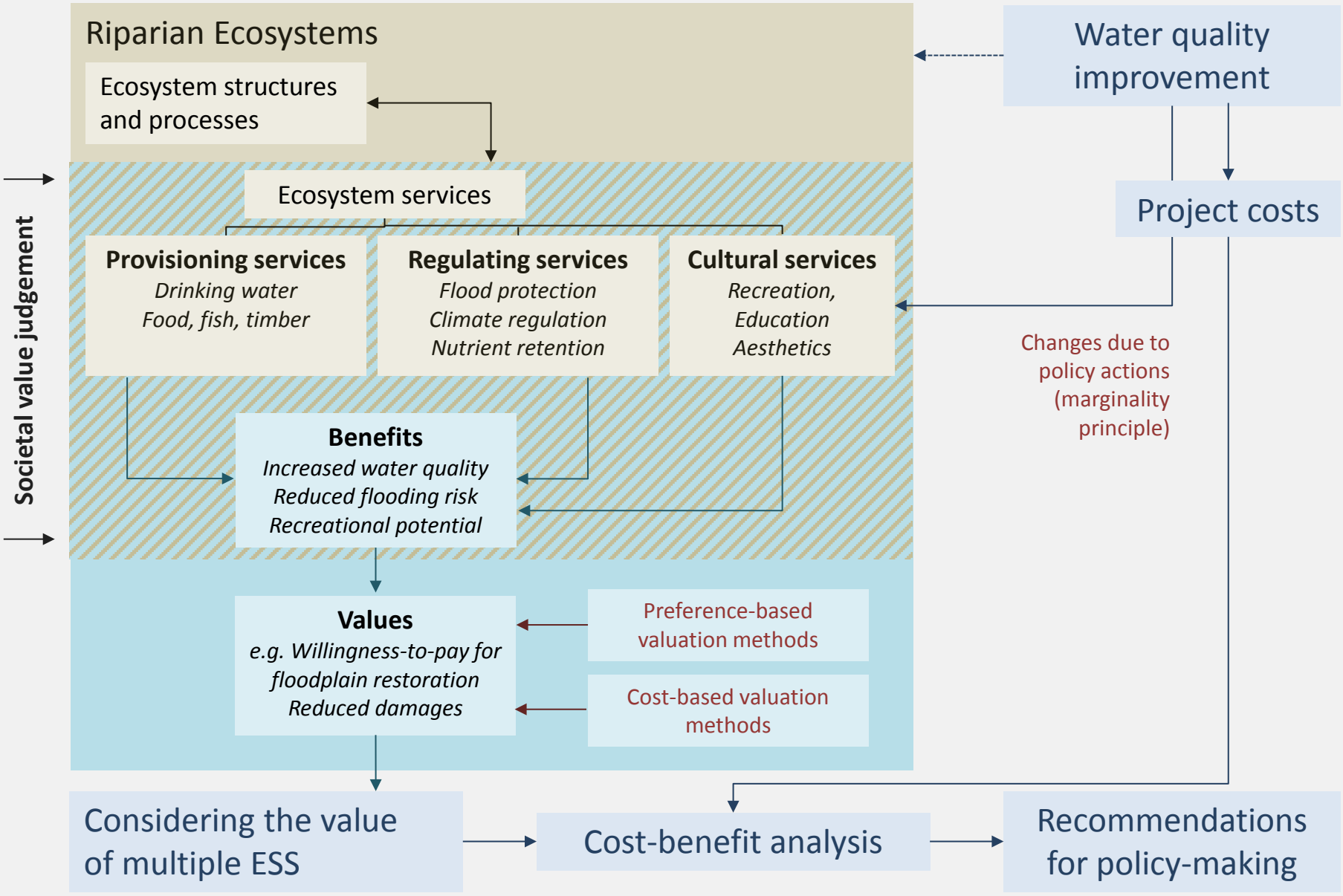
„Water is the driver of nature."
(Leonardo da Vinci)

„First Nations recognize the inherent value in water for water's sake rather than for what water can provide to humans. […] water management decisions need to value the inherent wealth in water."
(www.rethinkingwater.ca)

Aquatic ecosystem services



Value judgements in the decision framework



Economic terms and concepts

- Theoretical foundation: neo-classical **welfare economics**
  - Based on a conceptualization of human beings as rational actors that aim to satisfy their substitutable preferences and make choices that would maximize their **utility**, considering all **costs** and **benefits**
  - Changes in society's **welfare** due to marginal provision changes
  - Alternative with the highest benefit compared to the cost is preferable
- Methodological standard: Economic values are expressed in terms of **individual preferences**
- Monetary measure of benefits is the individual **maximum willingness to pay**

Attributes

Attributes	Shortcut	Level
Floodable area	FLOOD	**10.000 ha** 20.000 ha 50.000 ha
Near-natural banks	BANK	**1.000 km of the river** 2.000 km of the river 3.000 km of the river
Floodplain forest	FORR	**10 % of floodable area** 30 % of floodable area 50 % of floodable area
Longitudinal connectivity (fish migration)	FISH	**50 % consistency** 75 % consistency 100 % consistency
Swimming	SWIM	**bad: unsuitable for swimming** moderate: limited suitable for swimming good: suitable for swimming
Payment for river development (in € per household and year)	PAYM	**0** / 15 / 25 / 50 / 100 / 175 / 250