HydroServ NRP61

Water-related Ecosystem Services

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Valuation of water-related ecosystem services integrating spatial trade-offs and risks

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Valuation of ecosystem services

Land use in catchment areas strongly influences water storage, quality and discharge. Well regulated discharge in the upland supports flood prevention in the lowland, helps shortening periods of water scarcity, and increases water quality due to enhanced soil filtration. Knowledge about interactions among water-related ecosystem services (WRES) is crucial to avoid unintended trade-offs between ecosystem services (Tilman et al. 2002; Walker et al. 2002).

People's preferences for public goods which lack a surrogate market can be measured with stated preference methods. Among these, choice experiments are particularly suited to deal with situations where changes are multidimensional and trade-offs are of interest. This includes the possibility of accounting for risk by including it as a choice attribute. Visualizations help to convey realistic change scenarios, reduce reliance upon response heuristics and thereby allow underlying preferences to be more effectively measured.

Taking into account people's preferences for WRES and risk, while also considering spatial trade-offs, provides an important step towards sustainable integrated water management.

Landscape functions and risk

People have inherent preferences for landscapes, e.g. most people prefer a structured cultural landscape to a dense forest.

In order to help people separate scenic beauty from landscape function (e.g. water-holding capacity), we integrate both into the choice experiment and explain the relationships between landscape and function in an extensive learning task.

By combining damage potential and frequency of occurrence we are able to derive preferences in regard to risk of flood events.

Landscape scenarios in upland

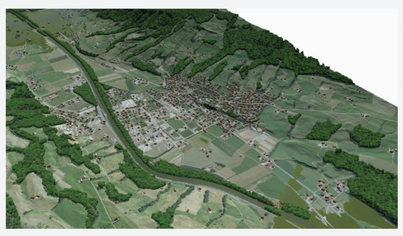
Attribute levels

a) Forest and pastures
b) Cultural landscape with forest, pastures and moorland
c) Regrowth of forest

Denotation

- Scenic beauty
- Protection function
  - a) low
  - b) medium
  - c) high

Landscape scenarios in lowland

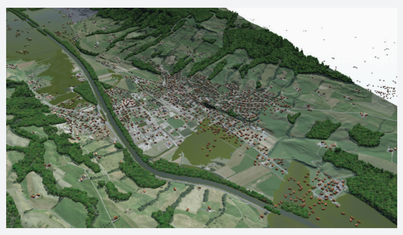


Attribute levels

a) Renaturation, planned protection measures
b) Renaturation, planned protection measures, additional settelment area
c) Renaturation only

Denotation

- Scenic beauty
- Vulnerability
  - a) low
  - b) medium
  - c) high



Integrating risk

Risk = intensity x frequency

Risk = damage potential x frequency of occurrence

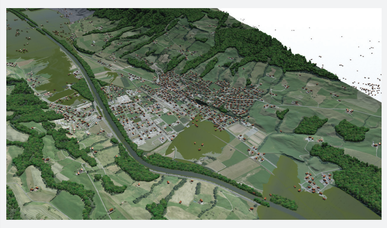
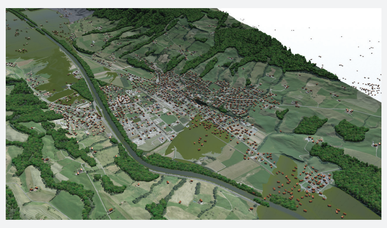
a) low	a) Every 30 years
b) medium	b) Every 100 years
c) high	c) Every 300 years

Damage potential = protection function x vulnerability x frequency of occurrence

Risk = protection function x vulnerability x frequency of occurrence

Integrating risk into choice experiments

Choice task example: choosing the preferred scenario

Attribute	Scenario A	Scenario B	
Landscape in upland			= Damage potential
Landscape in lowland			
Damage potential	Medium	Medium	= Risk of damage event
Frequency	Every 300 years	Every 100 years	
Recreation in lowland	Additional fireplaces	None	
Recreation in upland	Additional hiking paths	Additional hiking paths	
Cost / year	3% of income	1% of income	
I choose	☐ Scenario A	☐ Scenario B	

Research Questions

- What is the economic value of key water-related ecosystem services provided in the downstream area of the Kleine Emme?
- What are people willing to pay for mitigating risks of losing water-related ESS originating from climate and land use change?
- How can knowledge about the provision of water-related ESS and their dependence on land use and climate change be integrated into management of land use in upstream and downstream areas?

Expected Results

- Identification and spatially explicit quantification of all key water-related ecosystem services (WRES) in the catchment area of the Kleine Emme
- Market based valuation of key WRES where surrogate markets exist
- People's preferences for key WRES where market based valuation is not possible
- Representation of uncertainties in the relationships and feedbacks between land use change, key hydrologic attributes and the provision of WRES to expected climatic and socio-economic impacts in a multi-period Bayesian Network

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