NATURANCE

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Assessing benefits of NbS: Implications for financing schemes

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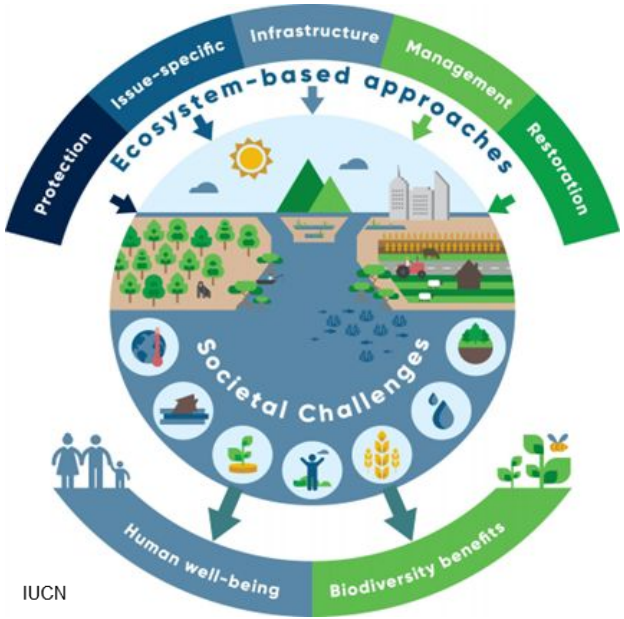
Nature-based Solutions



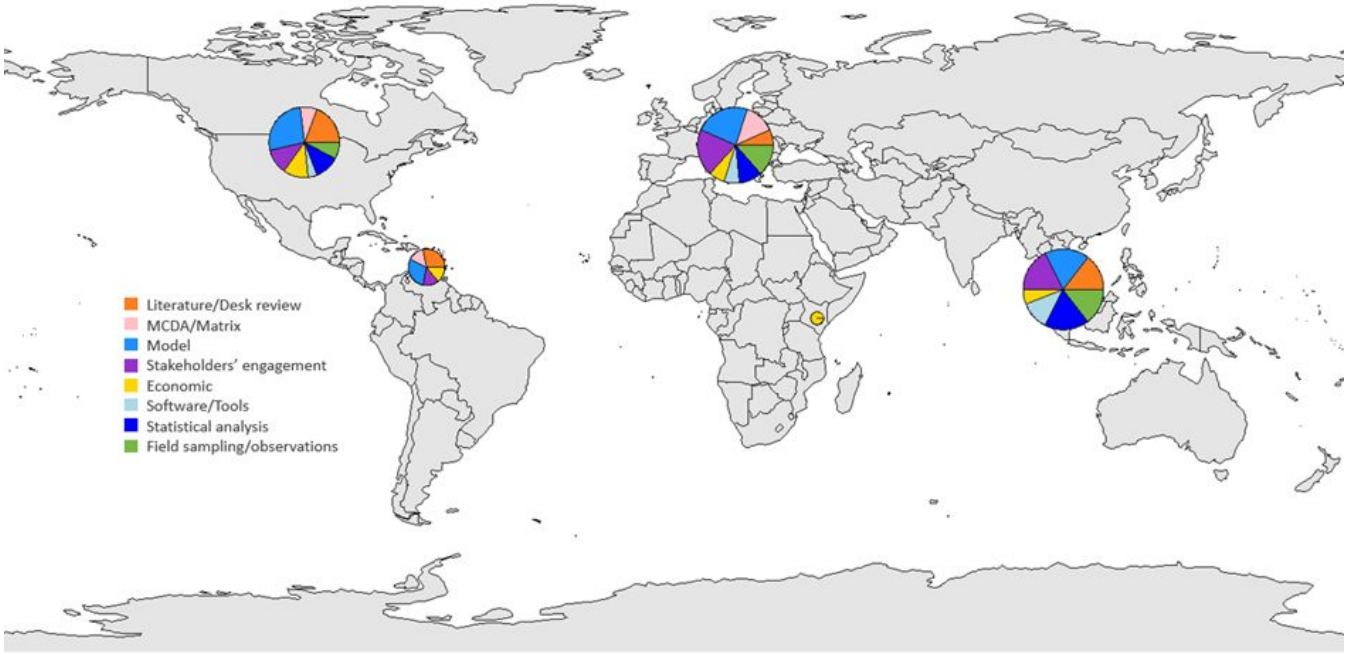
"Solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience" (EC)

Nature-based solutions (NbS) and nature restoration are considered ***key actions to required to transform our relationship with nature and enhance our resilience to the global challenges.***

- The ***total value generated by NbS is often underestimated*** due to limited understanding of both the risk reduction potential and co-benefit generation.
- In particular, ***co-benefits are often not considered*** when NbS are compared to traditional measures (such as grey infrastructure), leading to underinvestment in NbS.

Evidence and methods: what NATURANCE did?

Overview and *mapping of methods used to assess the environmental, social, and economic co-benefits of NbS* in the scientific literature, examining their potential usability in a wider context.



Several studies across the world, using a variety of methods applied to different NbS project to assess diverse co-benefits in the context of risk reduction

The reviewed methods

Field sampling/observation	Pre/post-NbS monitoring/comparison of environmental and biophysical conditions
Model	Model physical and ecological process and the effect of NbS; comparison of NbS vs grey infrastructure.
Software/tools	Support analysis of ecosystem services, trophic interactions, biodiversity, population health and social cohesion delivered by NbS.
Statistical analysis	Link ecological parameters and benefits provided; support sample and biodiversity analyses; validate model results; compare data and outcomes.
Stakeholder engagement	Identify cultural and socio-economic co-benefits, perceived effectiveness, needs and preferences, NbS willingness-to-pay and monetary valuation of services provided.
MCDA/matrix	Support trade-off analysis, ranking of NbS options, structured decision-making reflecting community perspectives.
Literature/desk review	Define baseline conditions and scenarios based on historical information, value and knowledge transfer of NbS projects; support for participatory processes and modelling
Economic valuation	Assign monetary value to NbS co-benefits, such as energy savings, carbon sequestration, natural resource quality, temperature regulation, tourism, recreation, biodiversity.

Overall results and take home messages

Evidence confirms the effectiveness of NbS in reducing climate risks and providing co-benefits such as cultural services, biodiversity, and carbon sequestration.

A range of methods have previously been used to assess the co-benefits of NbS, but ***there is no single standardised approach and they are often used in combination***. A lack of data and indicators limits the comparability and scalability of these approaches.

Standardised, transparent approaches are vital to monetising NbS co-benefits and thereby supporting greater use of NbS through credibility and comparability.

Stakeholder engagement and participation of both the private and public sectors are key to showing the true value of NbS co-benefits and unlocking their financing.

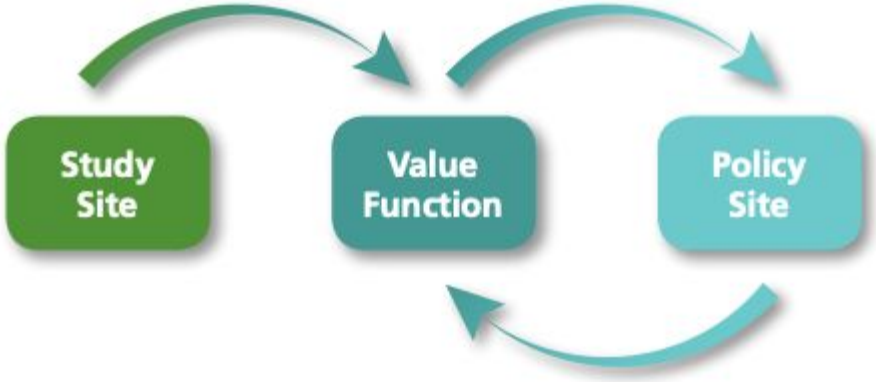
Consideration of the risks of future climate impacts is necessary for more accurate valuation of NbS derived co-benefits in the long-term.

How can we value NBS co-benefits when there is no primary evidence?

Collecting local evidence is key to assess the co-benefits of NBS.

However…

…conducting primary valuation studies is not always possible (cost, expertise, etc.)



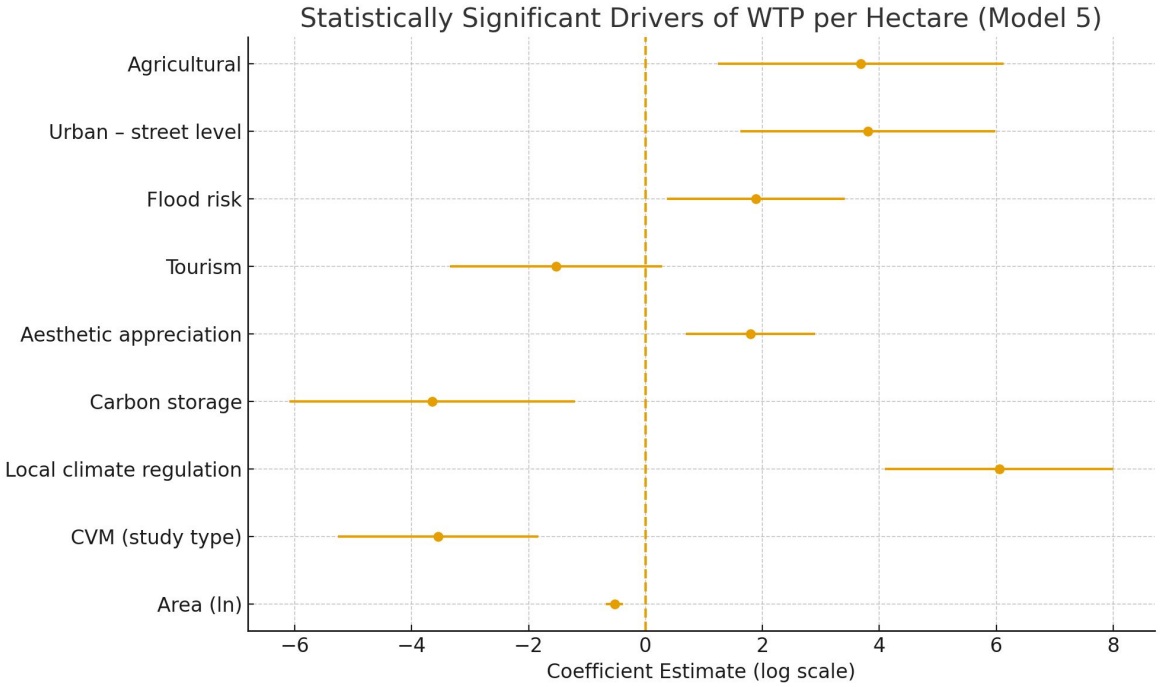
How can researchers inform policy making when there is no primary evidence?

$$Value\ (ha/yr) = \beta 0 + \beta(size) + \beta(gdp\ per\ capita) + \beta(population\ density)\ldots$$

The Meta-analysis Value Transfer Function for co-benefits

- **The meta-regression showed that respondents value more short-term co-benefits of NBS.**
- **The value per hectare decreases as NBS increase in size.**
- **Urban NBS located in highly populated areas are more valued on average.**

The VT function uses the results of the meta-analysis to value co-benefits in policy sites.



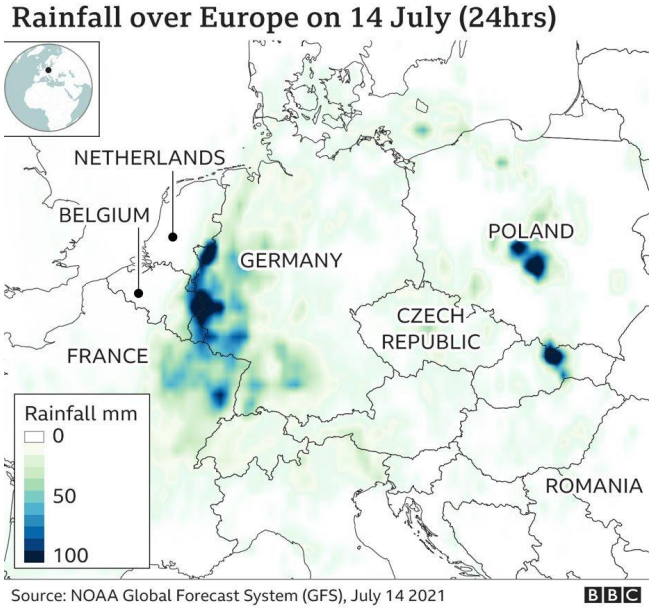
Model 5: N = 219 observations, Adjusted R^2 = 0.768

Application of the value transfer function

Attribute	Essen's transition from grey to green
Type	Urban
Continent	Europe
Risk addressed	Flooding
Area (ha)	230
Population density	2,715
GDP per capita (USD 2022)	50,070
Type of NBS	Park
Previous land use	Urban (former factory site)
Value per ha per year (USD 2022)	533,870
Total annual value (USD 2022)	**122.7 million**

Combine with risk-reduction estimates (EAD) from physical modelling into decision-making tools such as CBA.

Case study: The European floods of 2021

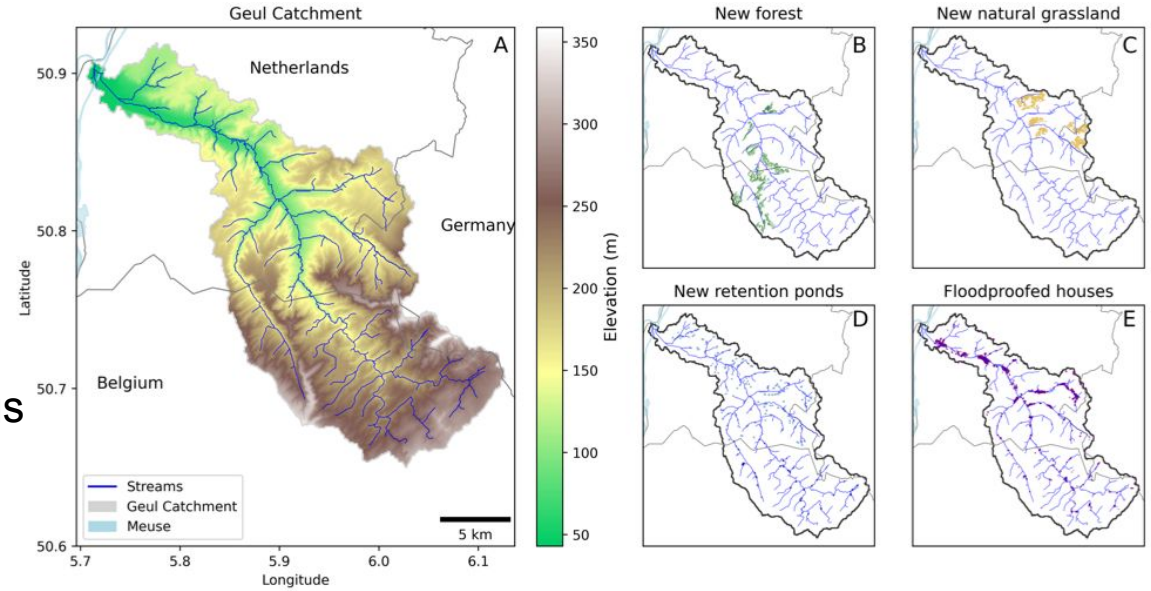


Analysis plan: We perform a societal CBA for different NBS scenarios, including risk reduction estimates, co-benefits and insurance analysis.

Flood risk model

Four adaptation scenarios:

- Additional capacity of flood retention ponds
- Reforestation (10km2)
- Conversion of agricultural land to natural grassland (10km2)
- Wet- and dry-proofing all buildings that were flooded in 2021

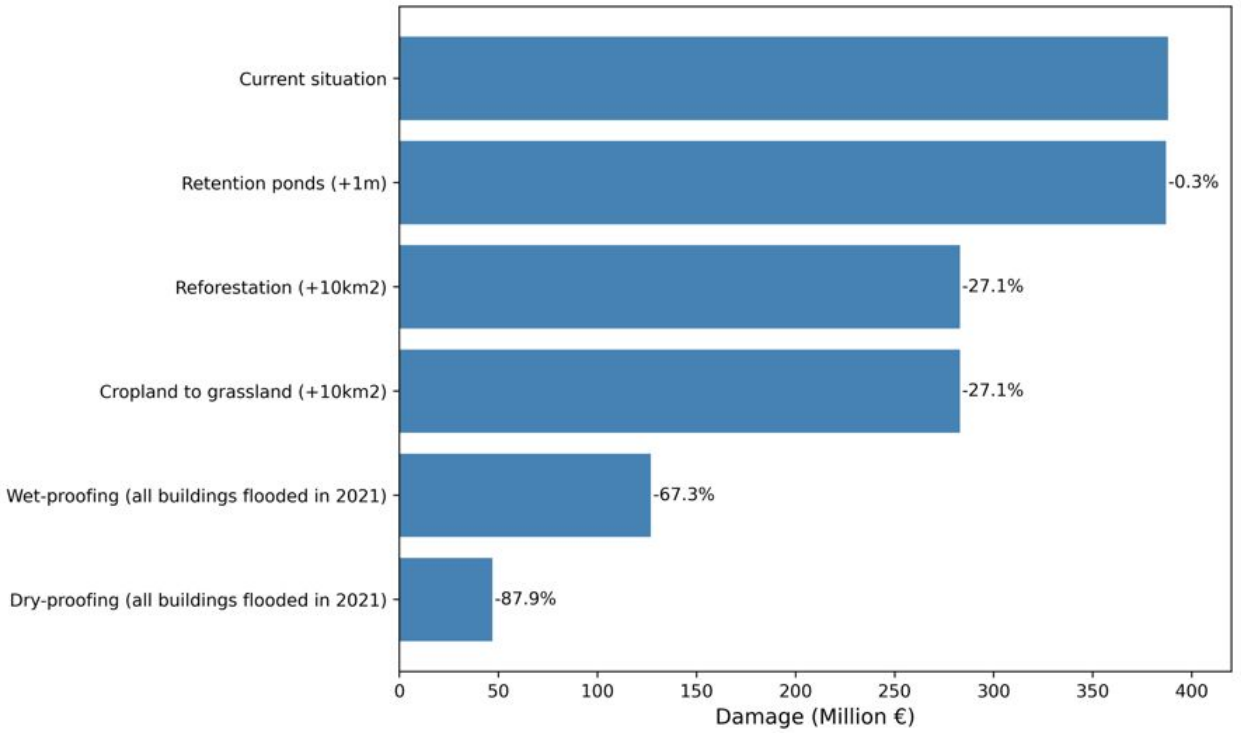


Application of NbS in flood model

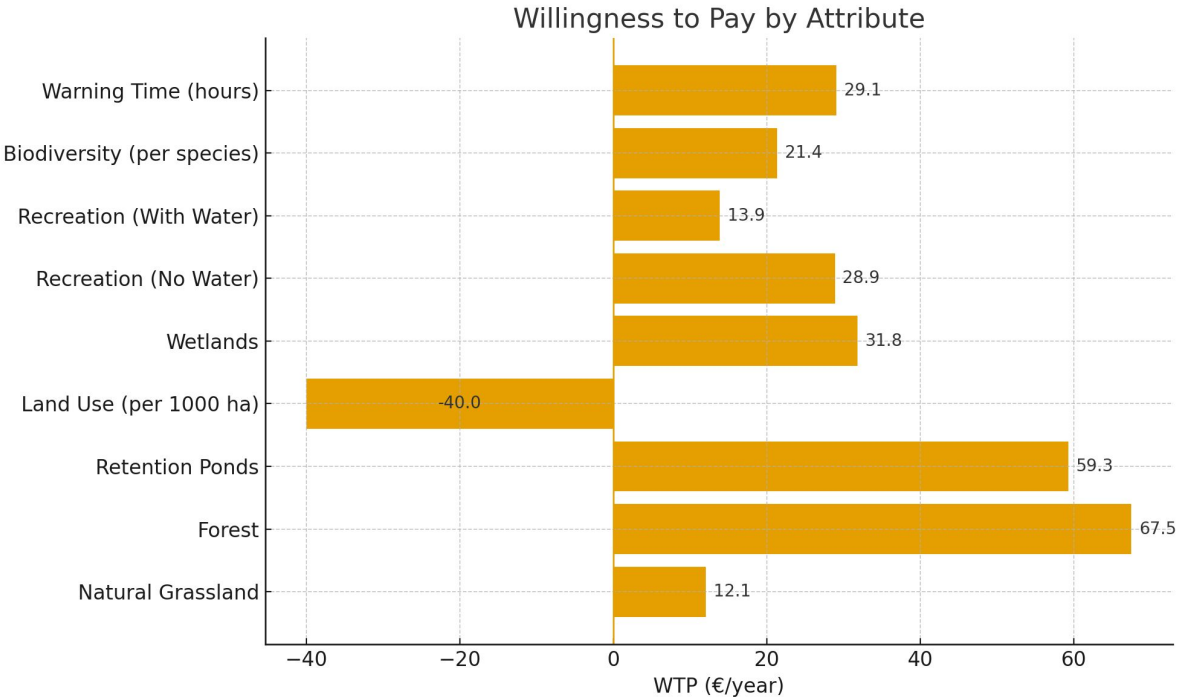
- SFINCS: hydrological - hydrodynamic flood simulation
- Retention ponds increase storage capacity, reducing flood volume downstream
- Reforestation and natural grasslands increase infiltration and reduces speed overland flow
- Object-based analysis of exposure
- Tailored flood vulnerability curves based on regional survey results

Results flood risk model

- Increasing capacity of retention ponds have limited effectiveness at reducing flood risk
- More natural landscapes (forests and grasslands) are more effective
- Wet- and dry-proofing are most effective at reducing flood risk

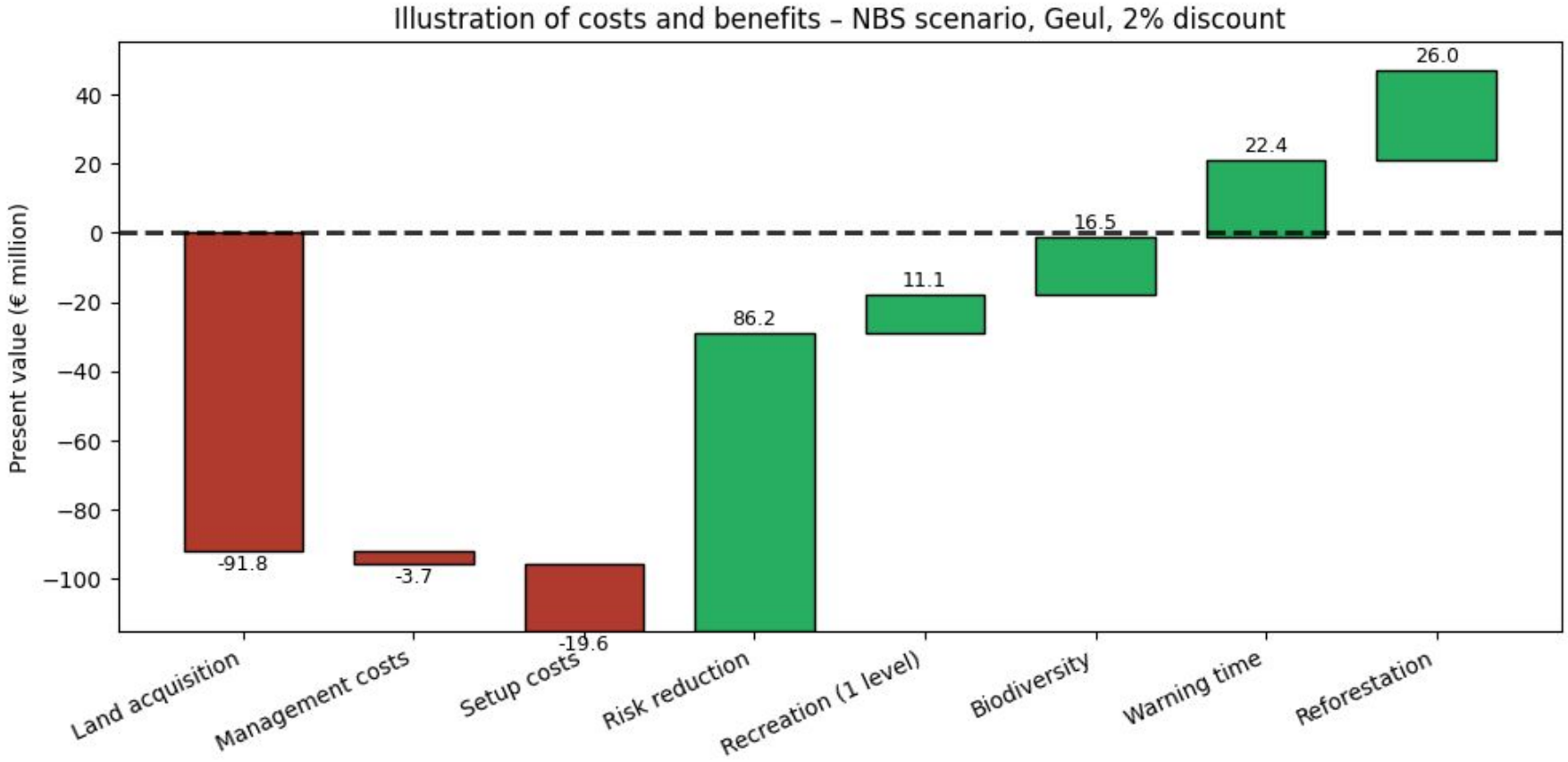


Co-benefit assessment survey results



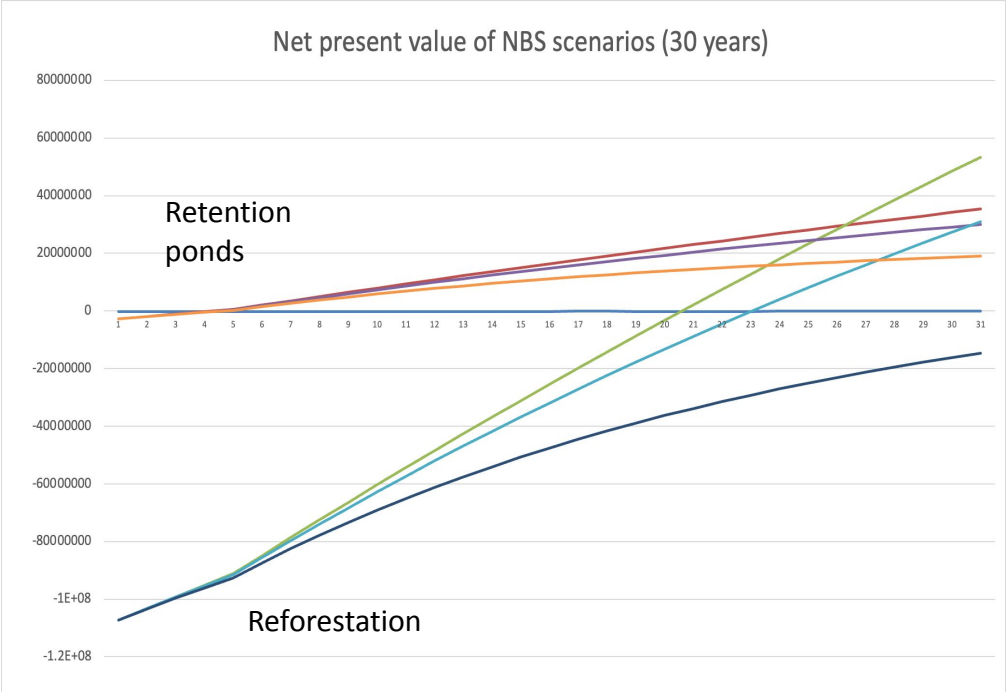
- Clear preferences for reforestation policies, and co-benefits such as recreation or biodiversity.
- Heterogeneous preferences: We find that 33% of our sample has strong disutility from converting agricultural land into NBS.

Cost-benefit Analysis: Results I



Cost-benefit Analysis: Results II

- Co-benefits are key to make an economic case for NBS investment.
- The amount of land that needs to be purchased is crucial for economic feasibility.
- Different approaches that combine agriculture and NBS, could address this challenge.



Insurance modelling - flood insurance premium results

Premium (mean)	Baseline	Retention ponds	Reforestation
Risk-based	€416	€364	€274
Flat-rate	€110	€100	€58
Risk-based (capped)	€100	€86	€50

Insurance system impacts who benefits from NbS investment

- For risk-based premiums, only high-risk households benefit
- For flat-rate premiums, everyone benefits equally
- For capped risk-based premiums, low-risk households benefit more

Insurance modelling - investment returns in river catchment

Investment-case:

If competition is restricted under a public-private insurance system, an insurer may invest in NbS proportional to the level of risk-reduction it generates.

The insurer's dividend is the reduced annual indemnity payments.

The return-on-investment (ROI) assumes the insurer funds half of the NbS investment

	Baseline	Retention ponds	Reforestation
Yearly dividend	-	€975.000	€5.22mln
Annual ROI*	-	20%	9.5%

Insurance modelling - coverage gap in a competitive voluntary insurance

	Baseline	Retention ponds	Reforestation
Penetration rate	35%	35%	32%
Unaffordability	15.5%	15.3%	14.5%
Coverage gap (uninsured risk)	€1.78mln	€1.6mln	€893.000

- The lower coverage gap reduces flood compensation required by the government

Recommendations for financing

- **The societal CBA shows that NBS are economically viable when the co-benefits are taken into account.**
- **Large land use changes not only can limit policy support, but considerably increase the costs, jeopardizing the financial viability of NBS.**
- **Integrate NBS in spatially detailed catastrophe models can provide actionable insights into risk reduction, premiums and insurability.**
- **Collaborations between the public and private sectors are likely needed to mainstream investment in NBS, potentially through PPPs.**
- **Stimulating private finance for NBS is dependent on the type of insurance system. In the case of a public-private insurance system, there is a business case for insurers to invest in NBS for risk reduction.**

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THANKS