

Interdependencies between Land use and Climate Change

Strategies for sustainable land use management in Germany

Socioeconomic Assessment of Ecosystem Services in agricultural landscapes



**Meeting
Ecosystem Services, Human Values
and Global Change**

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 **NACHHALTIGES
LANDMANAGEMENT**

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Overview



- **Introduction**
 - Aims of the project
 - Research approach
- **Ecosystem Services of Agricultural landscapes**
- **Climate mitigation and adaptation options**
- **Subproject Socio-economic valuation of Ecosystem Services in favor of climate mitigated and adapted land use strategies**
- **Discussion**



Foto: Juliane Specht

Introduction



- Land surface in Germany is used intensively
- Land (-scape) fulfils many societal requirements including the production of food, energy and wood, it provides area for settlement and infrastructure as well as recreation
- Global changes such as climate change and globalisation of economic systems will increase the competition for the limited land resources
- Changes in land use have effects on biodiversity, GHG-emissions, water cycling and waste treatment
- Research focus: How to integrate these aspects of preserving an intact environment, climate mitigation & adaptation, and sustainable resource management

Agriculture & climate change



- **Agriculture produces 13% of GHG in Germany**
- **Main emission sources:**
 - Agricultural use of drained/former wet soils
 - livestock
 - Mineral fertilizer
- **Agriculture produces 6% of CO₂-emissions**
- **54% of nitrous oxide, 51% of methane**
- **93% of methane from cattle farming**
- **Over 70% of agricultural land in Germany is used for production of forage**

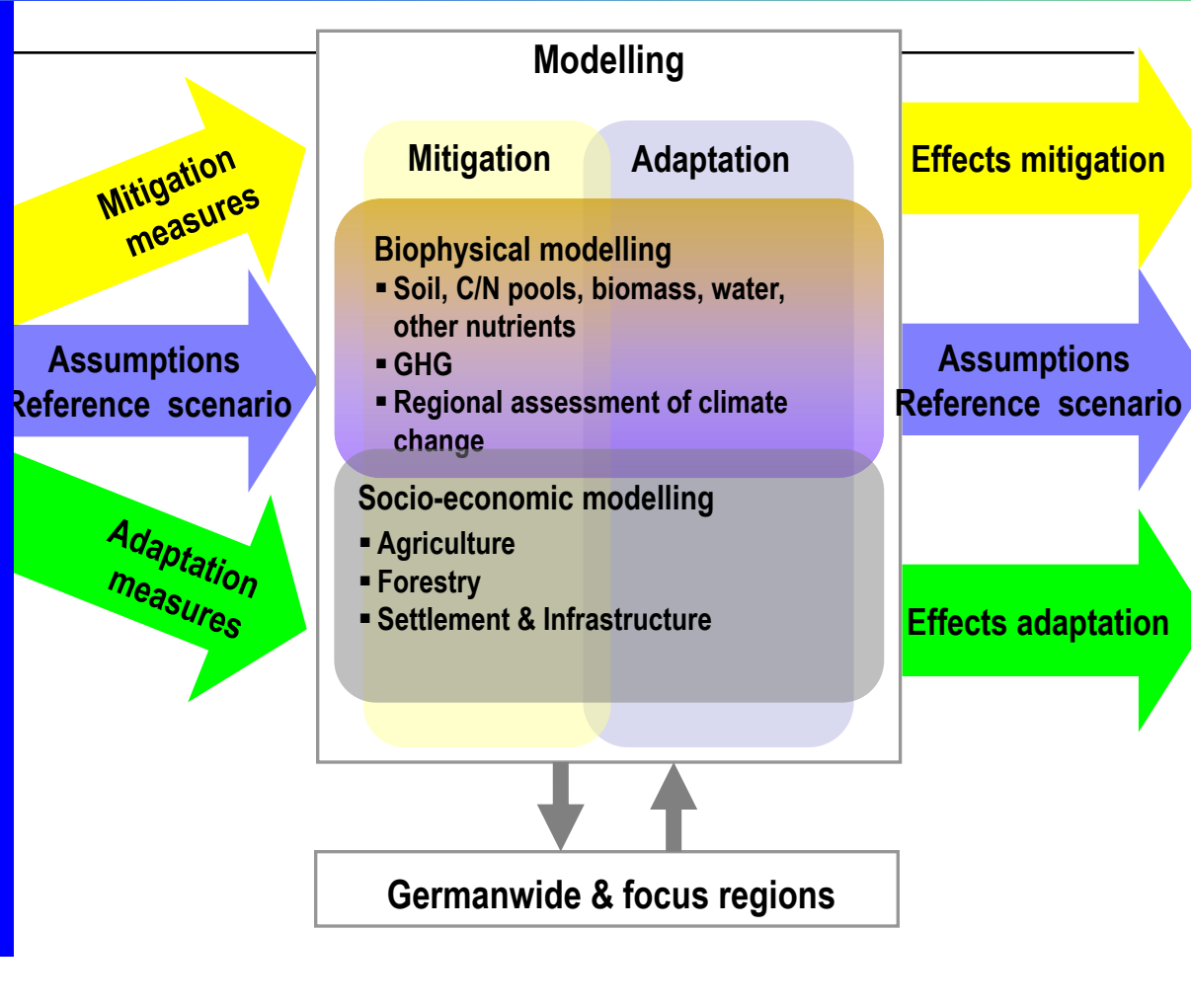
CC-LandStraD: Interdependencies between Land use and Climate Change



Scenarios

Influence factors on land use:

- Societal change
 - Migration
 - Demand
- Economic development
 - Economic structure
 - Production
 - Consumption, markets, prices
- Climate change
 - Temperature
 - Water
- Political frame & implications
 - Climate policy
 - Environmental policy
 - Agricultural policy
 - Energy policy
 - Spatial planning

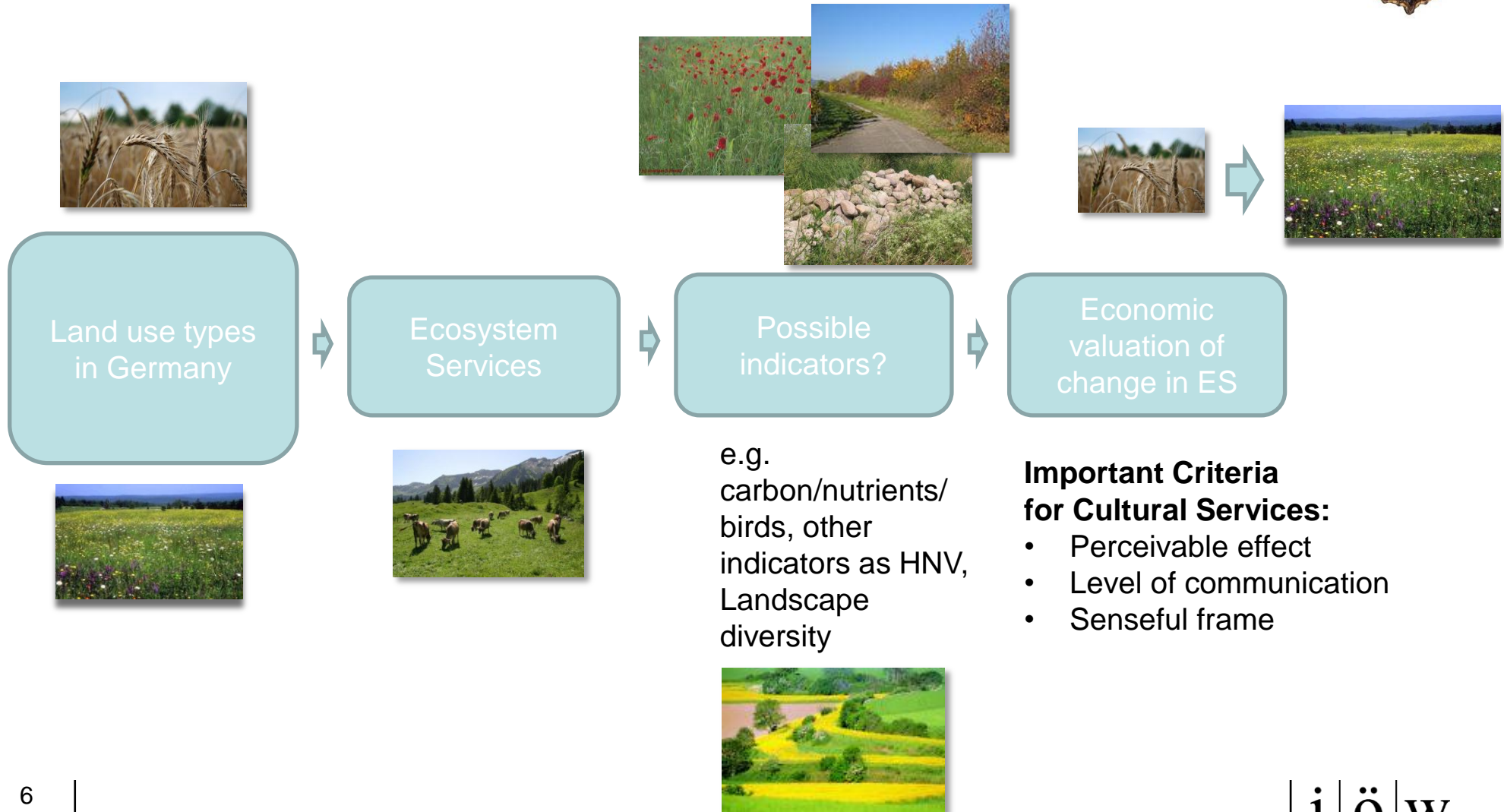


Valuation

Agriculture & forestry

- Socio-economic consequences of land use change
- Especially non-market goods and services
- Provisioning, regulating and cultural services
- Benefits versus costs
- Implementation potential
 - Suitability with regional framework
 - Societal demand and acceptance

Research approach of subproject



Ecosystem Services in agricultural landscapes



Regulating services:

- Climate regulation/moderation of extreme events through wetlands, grassland and cropland
- Regulation of water flows/flood control
- Waste treatment/water purification in and around wetlands/grassland/cropland
- Erosion prevention/control through vegetation/land cover/structural elements in agricultural landscapes (e.g. hedgerows)
- Nutrient cycling and maintenance of soil fertility

Ecosystem Services in agricultural landscapes

Provisioning services:

- Production of food
- Production of forage
- Production of energy plants
- Water availability/fresh water supply
- Ornamental resources



Ecosystem Services in agricultural landscapes



Cultural services:

- Aesthetic information: Diverse landscapes with their specific characteristics, landscape elements, landscape mosaic composed of different land use types and structural elements (linear/punctual), orchards
- Species richness or habitat diversity as experience/ opportunities for recreation and tourism
- Identity/Existence value/bequest value
- Invasive species?



Climate mitigation and adaptation options in agricultural landscapes



Main problems:

**Increase of extreme weather events and rising temperature,
water scarcity in some regions**

Climate mitigation:

- **Preservation of grasslands**
- **Conversion of cropland into grassland**
- **Restoration of wetlands/marshlands**
- **Reduce**
 - N_2O from the use of fertilizers
 - Methane emissions from digestion of cattle

Climate mitigation and adaptation options in agricultural landscapes



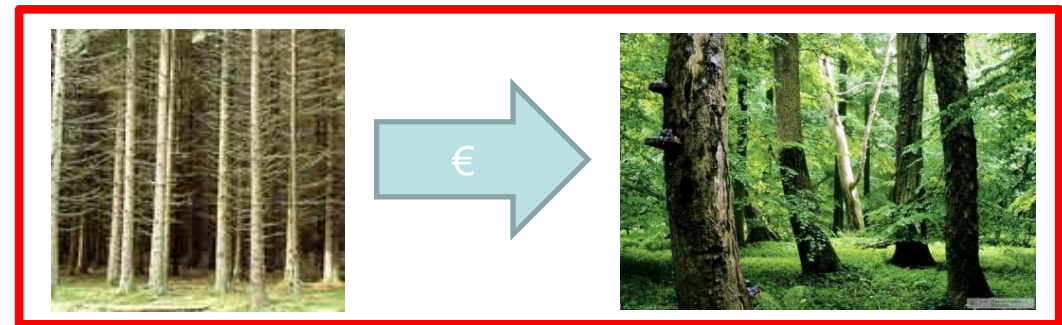
Climate adaptation:

- **Adaptation in plant/crop production/plant breeding**
 - Diversification of cultivation/crops, treatment of soil, irrigation; heat resistant traditional cultural plants, resistance towards pests
- **Adaptation in livestock husbandry**
 - Reduction of cattle, less consumption of meat, heat tolerant cattle
- **Ecological/organic farming/regional products**

Subproject Socio-economic valuation of Ecosystem Services



- Valuation of land use strategies = bundle of land use options in favor of climate mitigation and adaptation
- These options have different effects on ecosystem services which can be valued from societal perspective
- Valuation of changed landscape and species richness resp. ES



Preference based socio-economic valuation

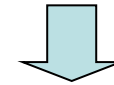


Market data



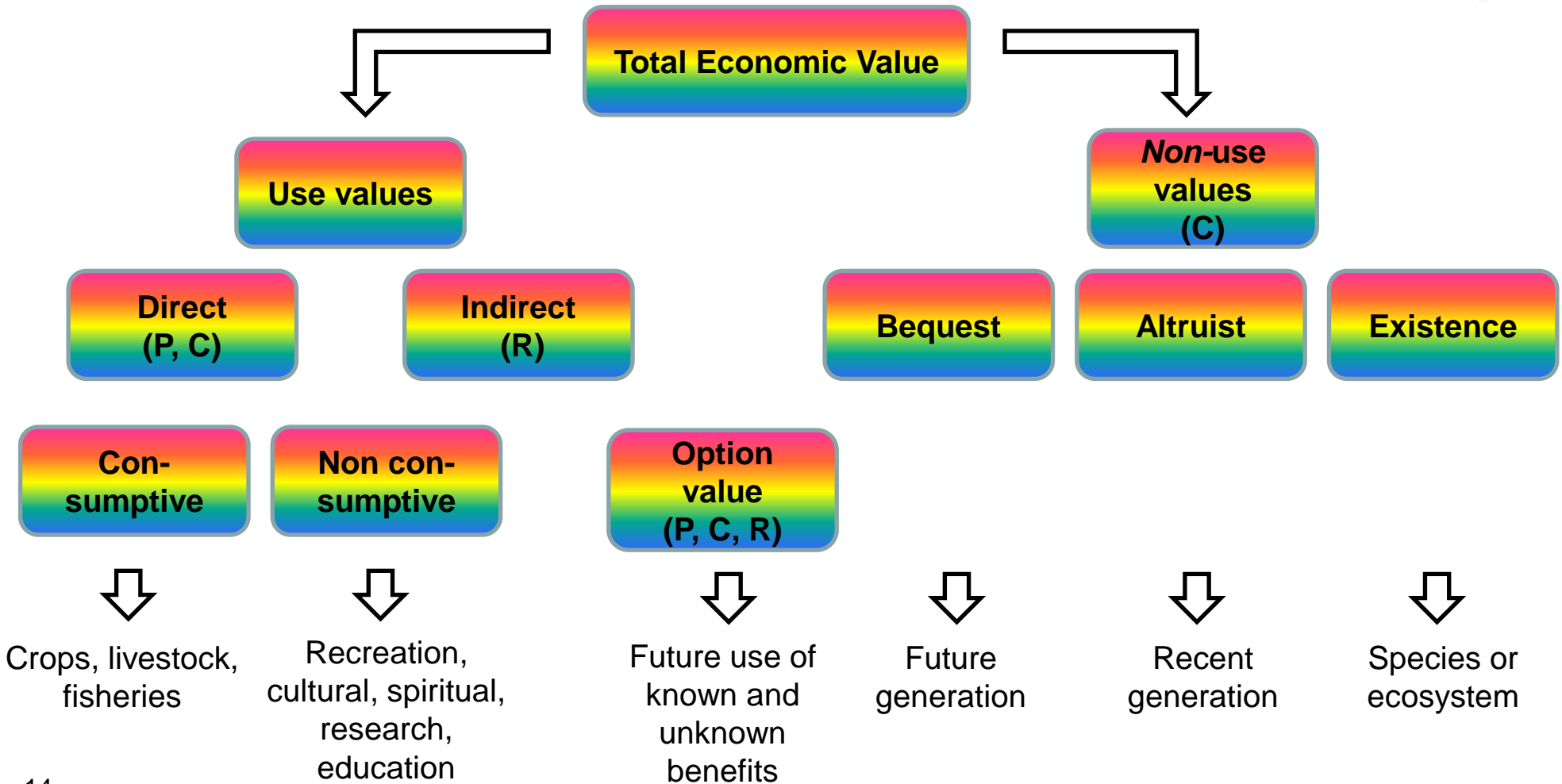
Demand behavior towards goods traded at markets allows for estimation of value of these goods

No market data available



A sample of population is being interviewed = Willingness to pay for **change** in ecosystem services

The Total Economic Value concept as valuation frame for ES



Socio-economic valuation of ES in CC-LandStraD – how?



- **Cultural services**
 - Estimating benefits: Survey based (*Stated Preference* method)
- **Regulating services**
 - Estimating (hypothetical/real) costs: with cost based approaches
- **Provisiong services**
 - Calculating (real) costs: Based on market data (from subprojects)
- **Supporting/habitat services? What about concerns of double accounting?**

Socio-economic valuation of ES in CC-LandStraD – what?



- **Cultural services**

- Landscape aesthetics, species and habitat diversity, opportunities for recreation & tourism (overlap)

- **Regulating services**

- Climate regulation, nutrient retention/waste treatment (*possibly*: water cycling, erosion control etc.)

- **Provisiong services**

- Production of food, forage, meat, energy plants, wood, water (problem of double accounting with regulating services? Quality versus quantity?)

Valuation with Stated Preference methods



- Senseful frame: what is the measure/are the measures to reach an improvement of ecosystem services in agricultural landscapes?
 - Climate adaptation measures: preservation, maintenance or initial generation of field boundary strips fencerow edges or trees to separate fields/as landscape elements
- Valuation in terms of **change** of the particular ecosystem service
- **Perceivable effect:** e.g. increase of hedges, boundary strips, trees in the landscape, increased landscape diversity, increased biodiversity
- Willingness to pay for the perceivable **effect/consequence(s)**
- Choices of respondents between different options allow for estimation of benefits and unveils most preferred options

Possible topics for valuation with Stated Preference Method



- Proportion of land use (in %)
- Biodiversity/species/habitat diversity (e.g. birds, plants, High Nature Value Farmland (HNV))
- Recreation? Quality of recreation (dissection index; levels from „strong sounds from streets – no disturbance“ of distance of recreation area)
- Price for improvement of ES (e.g. higher tax per HH/ annum)

Example of choice cards



Card 1

Land use

50% crops & grassland
30 % forest
20% other (e.g. lakes,
streets, houses)

Species & habitat diversity

12,5% of grassland *with
high natural quality and
rare species*

Price

0 Euro (additional tax
payment)

☐

Card 2

Land use

48% crops & grassland
32 % forest
20% other (e.g. lakes,
streets, houses)

Species & habitat diversity

19% of grassland *with
high natural quality
and rare species*

Price

30 Euro (additional tax
payment)

☐

Card 3

Land use

45% crops & grassland
35 % forest
20% other (e.g. lakes,
streets, houses)

Species & habitat diversity

17% of grassland *with
high natural quality and
rare species*

Price

20 Euro (additional tax
payment)

☐

Please choose the card you prefer most!

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Conclusion



Economic valuation of ecosystem services in favor of climate mitigated and adapted land use strategies

- Enormous potential for identification of societal demanded/volitional options of land use/ e.g. effects on the landscape
- Benefits resp. costs of loss of ecosystem services for society
- Provides important information for policy makers
- Courses of actions can be formulated: economic incentives
- Make protection of ecosystem services and biodiversity politically and practically manageable

Criticism on Economic Valuation of Ecosystem Services



- **Ethical issues: debate about utilitarian arguments**
 - Ecologists: biocentric perspective based on *intrinsic* ecological values;
Economists: anthropocentric perspective that focuses on *instrumental* values
 - Question of access? *Degree* of complementarity and substitutability e.g. provisioning/cultural (e.g. induce societal changes (McCauley 2006), economic incentives to undermine moral motivation for conservation (Bowles 2008))
- **Uncertainty (delivery or supply of ES, preference, technical)**
- **TEEB (2010): New techniques and combinations of different methodological approaches (monetary, deliberative & multicriteria methods)?**
- **GAP between optimistic approach that dominates design of PES and what can be practically implemented (also connected to fairness)**

Thank you for your attention

.. and to Dr. Jesko Hirschfeld, Ulrich Petschow, Dr. Johanna Fick, Dr. Horst Gömann



Foto: Juliane Specht

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