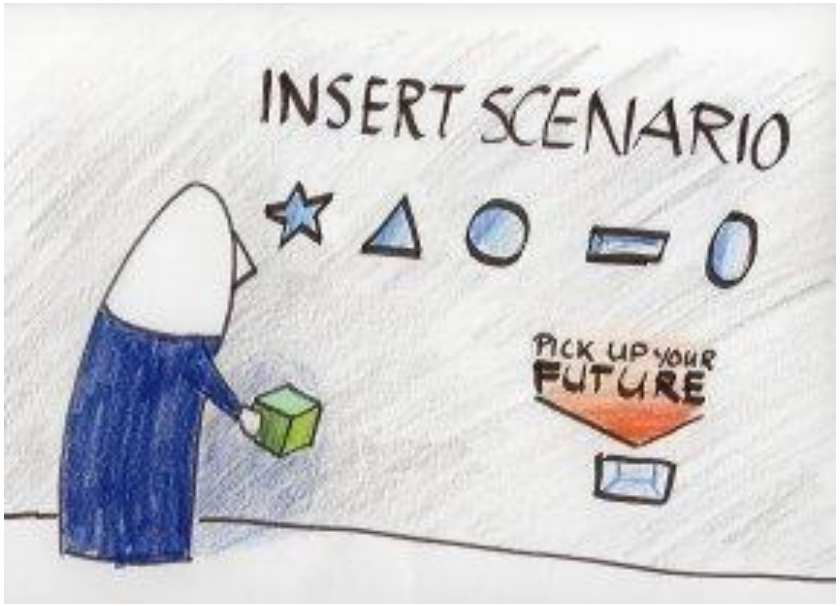
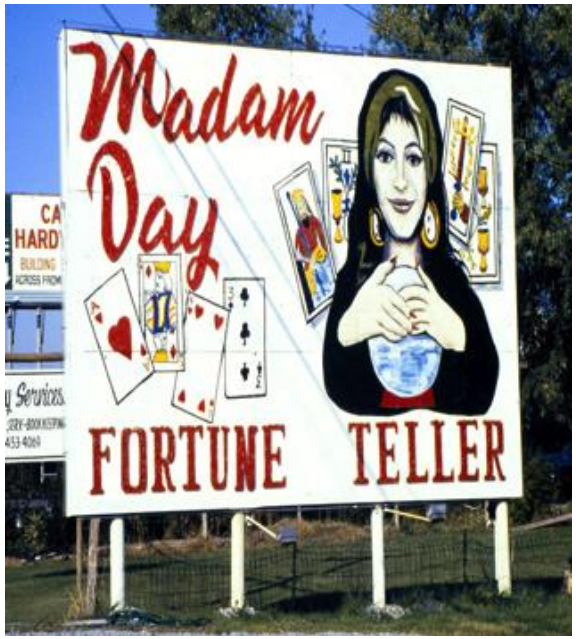
Scenarios as a tool to prepare for the future

Towards integrated scenarios for Serbia





Kasper Kok (Wageningen University)
Faculty of Civil Engineering, Belgrade

28 September 2017

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Content

- Personal background
- Current research focus: integrated scenarios
  - What are "integrated scenarios"?
  - Why?
  - How (stakeholder participation; mathematical models)?
- Plans for sabbatical stay
- An introduction to the CLUE modelling framework

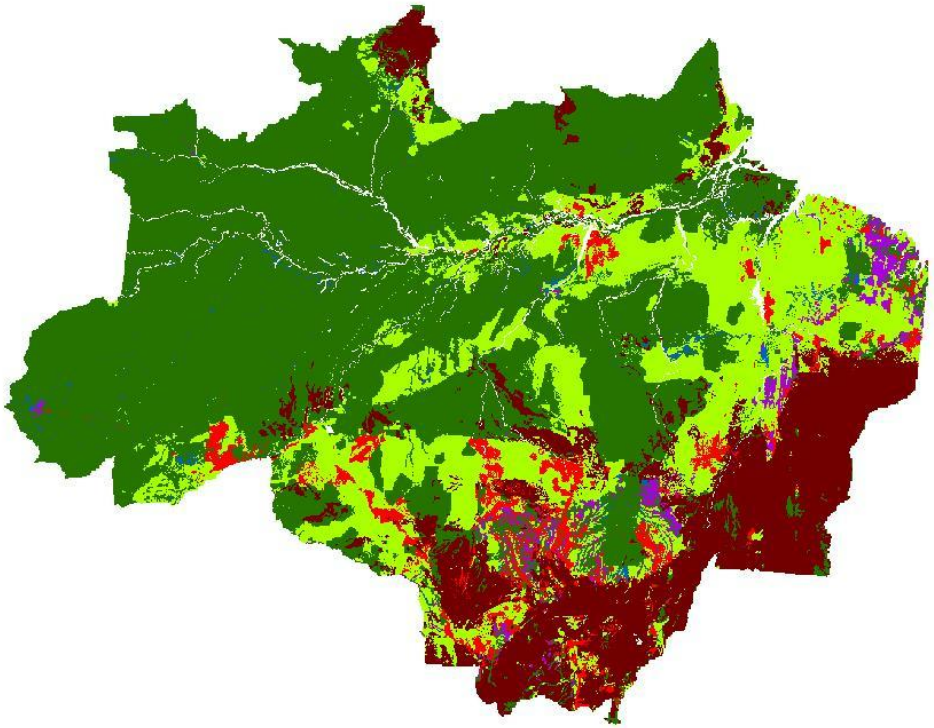
Personal background

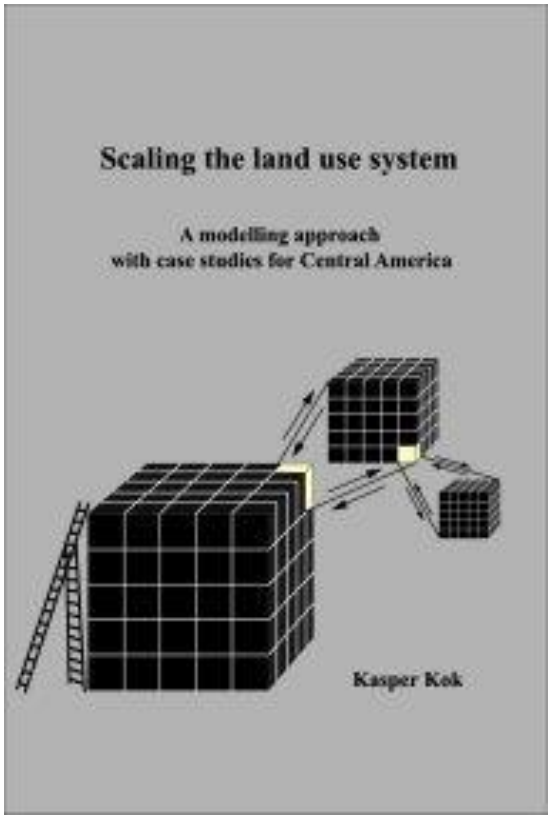
MSc in Tropical Ecology (Amsterdam)

- Population dynamics: Effects of burning and grazing on mountain ecosystems in Colombia

PhD in land use modelling (Wageningen)

- Land use change modelling: developing the CLUE modelling framework and applying it to case studies in Central America



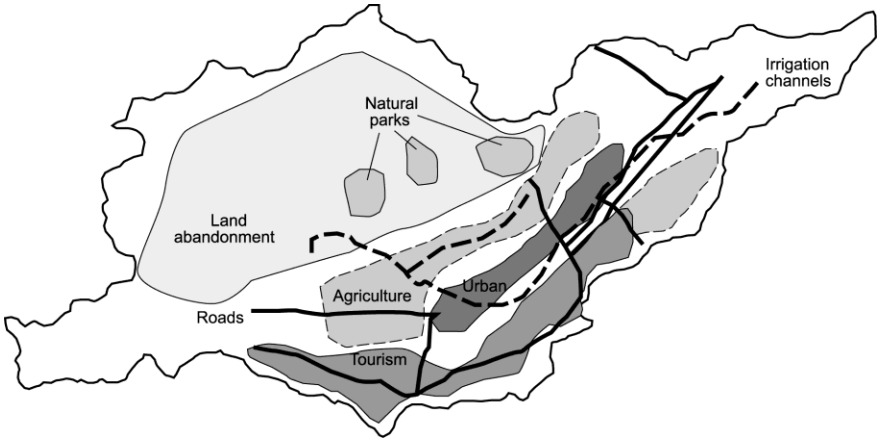


Senior researcher on participatory scenario development (Maastricht)

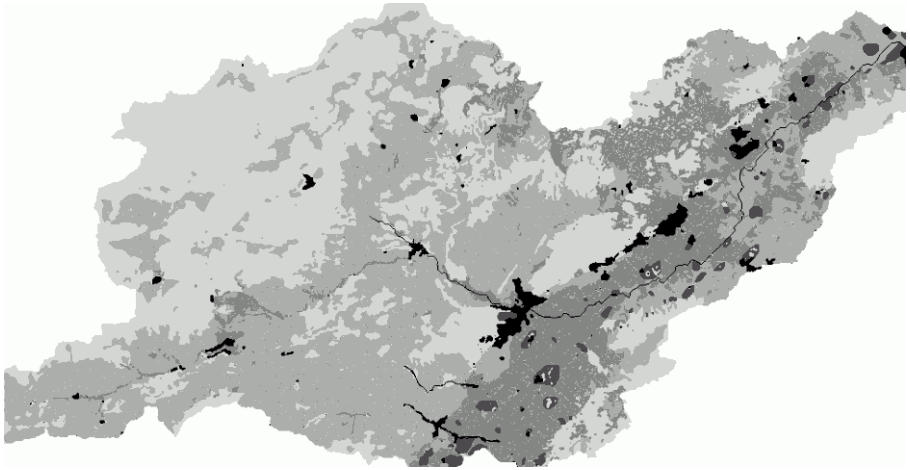
- Building qualitative scenarios based on perceptions of local stakeholders

Assistant professor (Wageningen)

- Soil Geography and Landscape Group
- Integrated scenarios for land and water
- Combining qualitative and quantitative approaches
- Developing novel tools that link narratives and models



stakeholders



model output

Current research focus:

Integrated Scenarios

Why: the overarching problem

"The world is now moving through a period of extraordinary turbulence; the speed and magnitude of global change, the increasing connectedness of social and natural systems at the planetary level, and the growing complexity of societies and their impacts upon the biosphere result in a high level of uncertainty and unpredictability"
(Gallopin, 2002)

- Fast changes
- Complex, connected human-environment systems
- Fundamental uncertainty

Methods and tools to tackle this overarching problem

Methods:

1. **Multi-scale** – Include more than one scale in the analysis
2. **Participation** – Co-production of knowledge, integration stakeholder perspectives
3. **Interdisciplinarity** – Integration of different scientific disciplines

Tools:

1. **Models** – Quantitative, spatially explicit future explorations
2. **Scenarios** – Qualitative future projections

What is a NOT scenario?

Scenarios are not **forecast** or **predictions**.

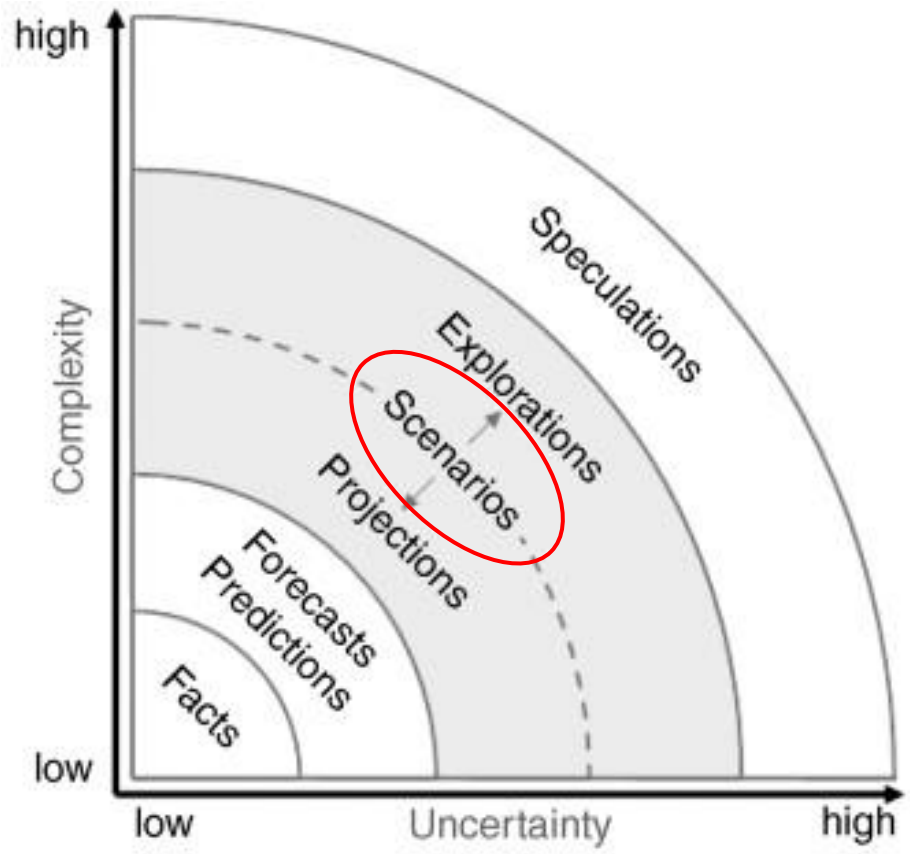
What is a scenario?

There are many definitions, with only partial agreement. Two important ones are:

- Scenarios are *plausible* descriptions of how the future may develop, based on a *coherent* and *internally consistent* set of assumptions about key relationships and driving forces. (focus on system description)
- Scenarios are *credible*, *challenging*, and *relevant* stories about how the future might unfold that can be told in both words and numbers. (focus on value for end users and other stakeholders)

Future explorations, outlooks, stories

Scenarios – when to use?



Scenarios – types (van Notten et al., 2003)

A Project goal - exploration vs decision support:

I. Inclusion of norms? : descriptive vs normative

II. Vantage point: forecasting vs backcasting

III. Subject: issue-based, area-based, institution-based

IV. Time scale: long term vs short term

V. Spatial scale: global/supranational vs national/local

B Process design – intuitive vs formal:

VI. Data: qualitative vs quantitative

VII. Method of data collection: participatory vs desk research

VIII. Resources: extensive vs limited

IX. Institutional conditions: open vs constrained

C Scenario content - complex vs simple:

X. Temporal nature: trend vs snapshot

XI. Variables: heterogeneous vs homogenous

XII. Dynamics: peripheral vs trend

XIII. Level of deviation: alternative vs conventional

XIV. Level of integration: high vs low

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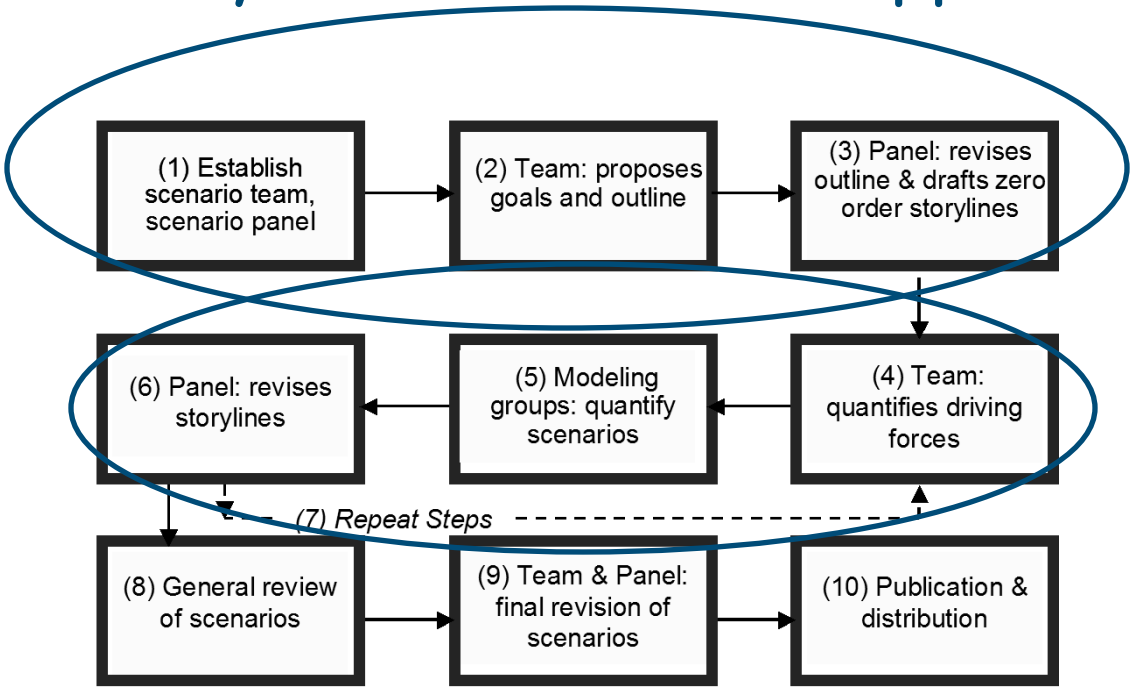
Integrated scenarios:

Story-And-Simulation approach



Narrative storylines

Model runs

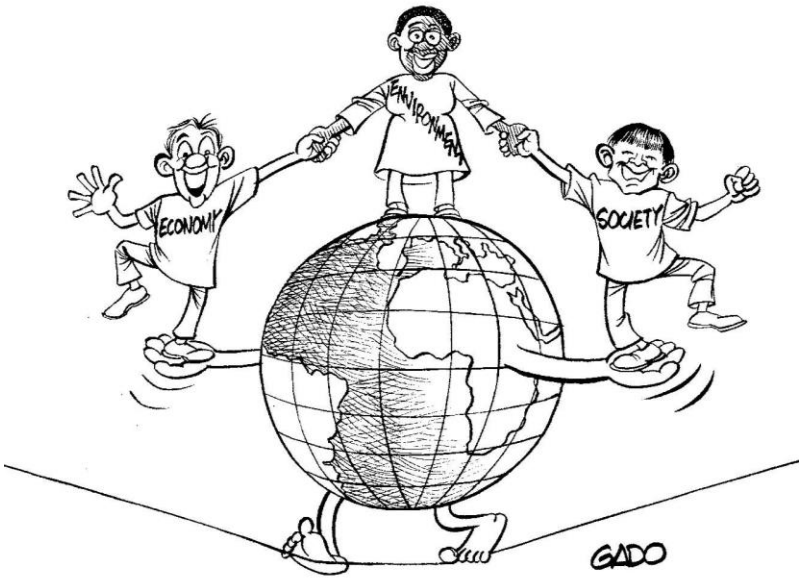
Scenarios – examples: qualitative

END
MARKET 1st 2023 → 2050

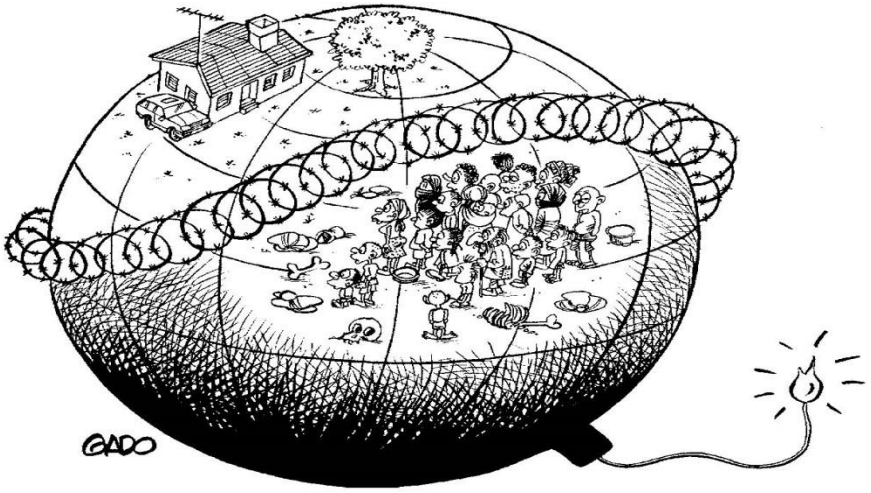
No subsidies for agriculture
Population movement to urban areas with abandonment of rural areas
Manufacturing - increasing scandals of water pollution
- reintervention of government.
Electricity - Continuing trend from middle period (+ some new innovations)
Widespread privatisation of water supply + treatment.
Agriculture - Entrenchment of industrial agriculture in Europe.
Pockets of high pressure on water resources
Locally agriculture out-competes other sectors
Increasing inter-basin water transfer (now economically viable)
Mass. low level treatment of ag wastes to make ecologically attractive products.
Domestic - Continuing increase in price of water.
Intensive local competition between domestic + agricultural sectors
Increasing economic incentives to improve water use efficiencies + new water saving technologies.

Scenarios – examples: qualitative

Scenarios: Cartoons



Sustainability First



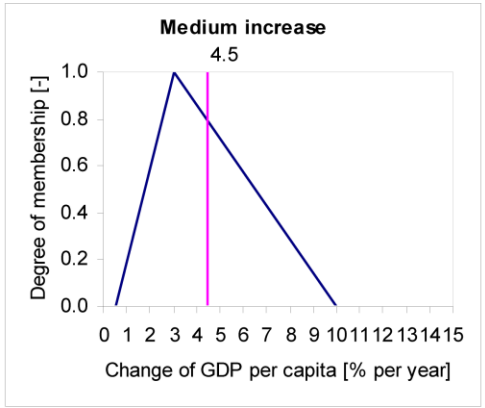
Security First

Economy First

Scenarios – examples: from qualitative to quantitative

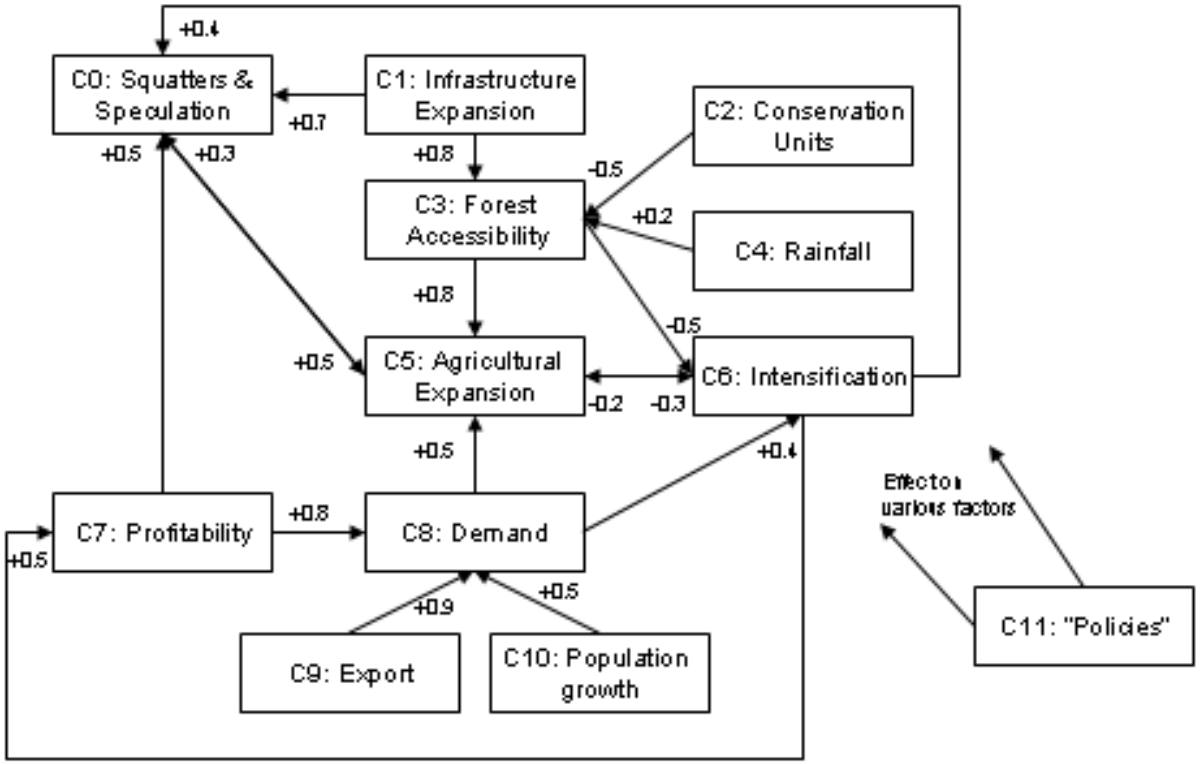
Fuzzy Sets translation keys

Region	Markets First	
	2005-2025	2025-2050
WE	Medium increase	Low increase
CE	Medium increase	Low increase
EE	Medium increase	Medium to high increase

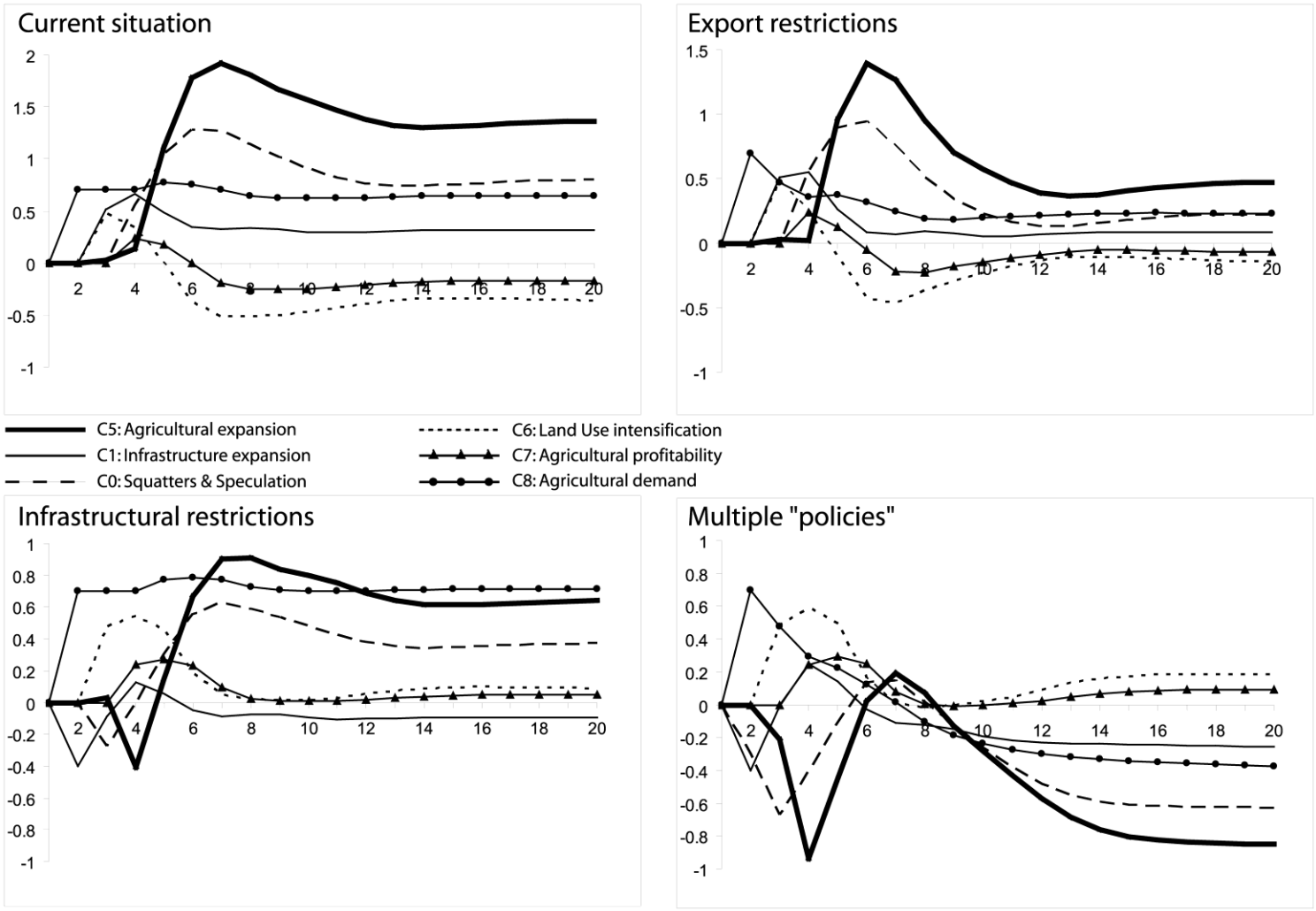


Region	Markets First	
	2005 - 2025	2025 - 2050
WE	+ 4.5	+ 2.3
CE	+ 4.5	+ 2.3
EE	+ 4.5	+ 2.3 -4.5

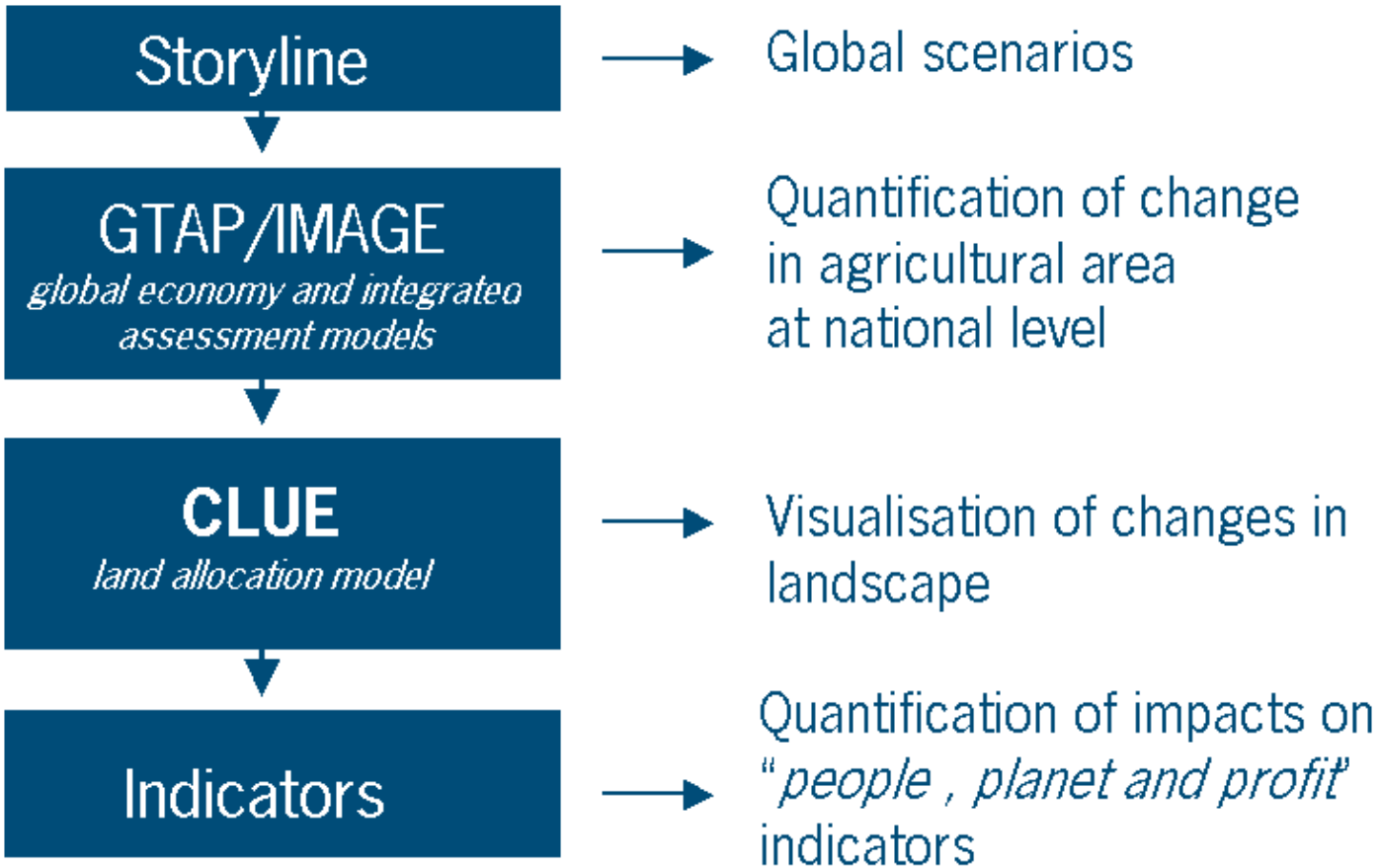
Scenarios – examples: semi-quantitative (FCMs)

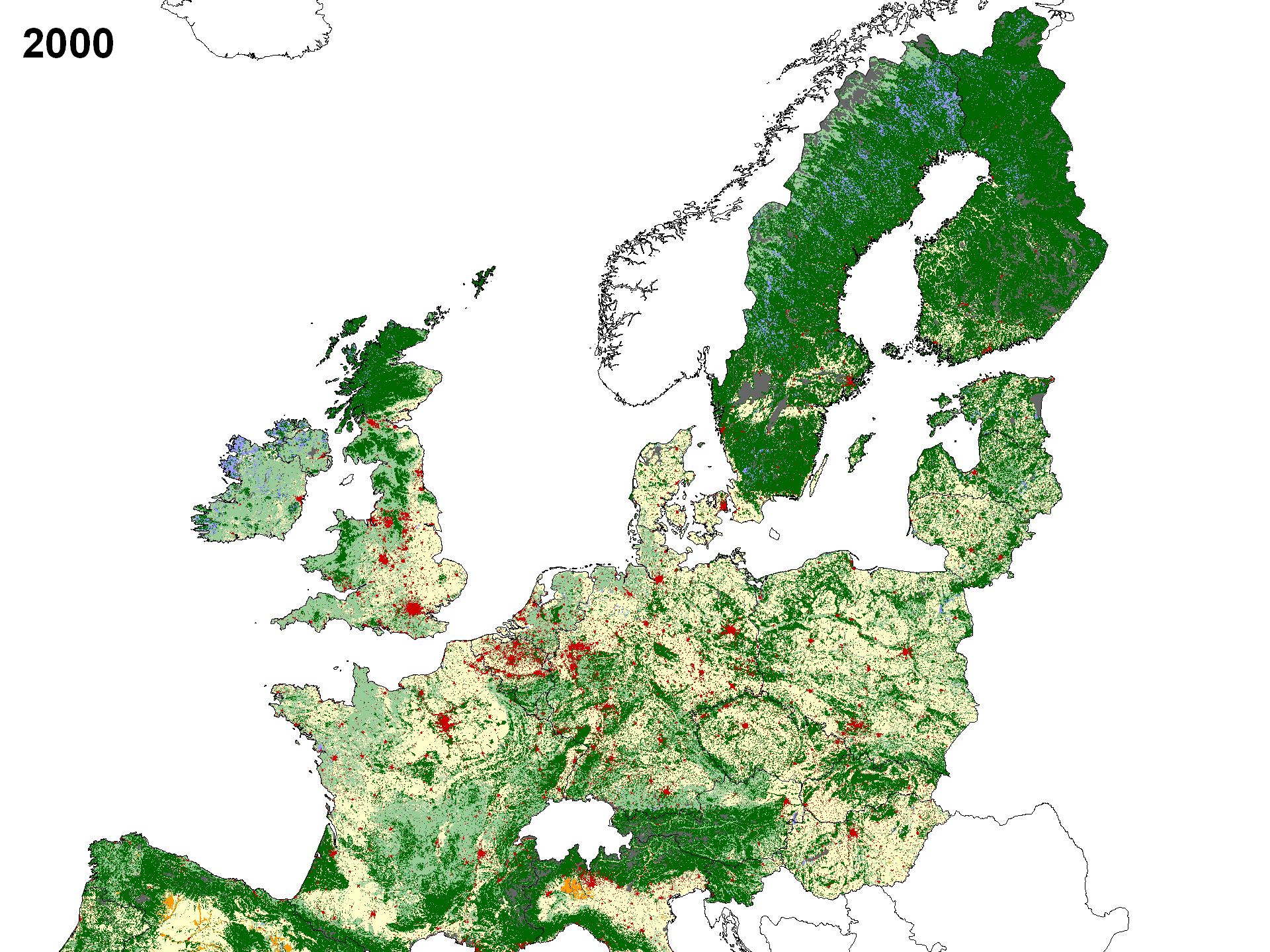


Scenarios – examples: semi-quantitative (FCMs)



Scenarios – examples: quantitative spatial models




2000

Plans for sabbatical stay

Develop integrated scenarios for Serbia

How:

- Using the Story-And-Simulation approach
- Building on existing data, knowledge, and scenarios

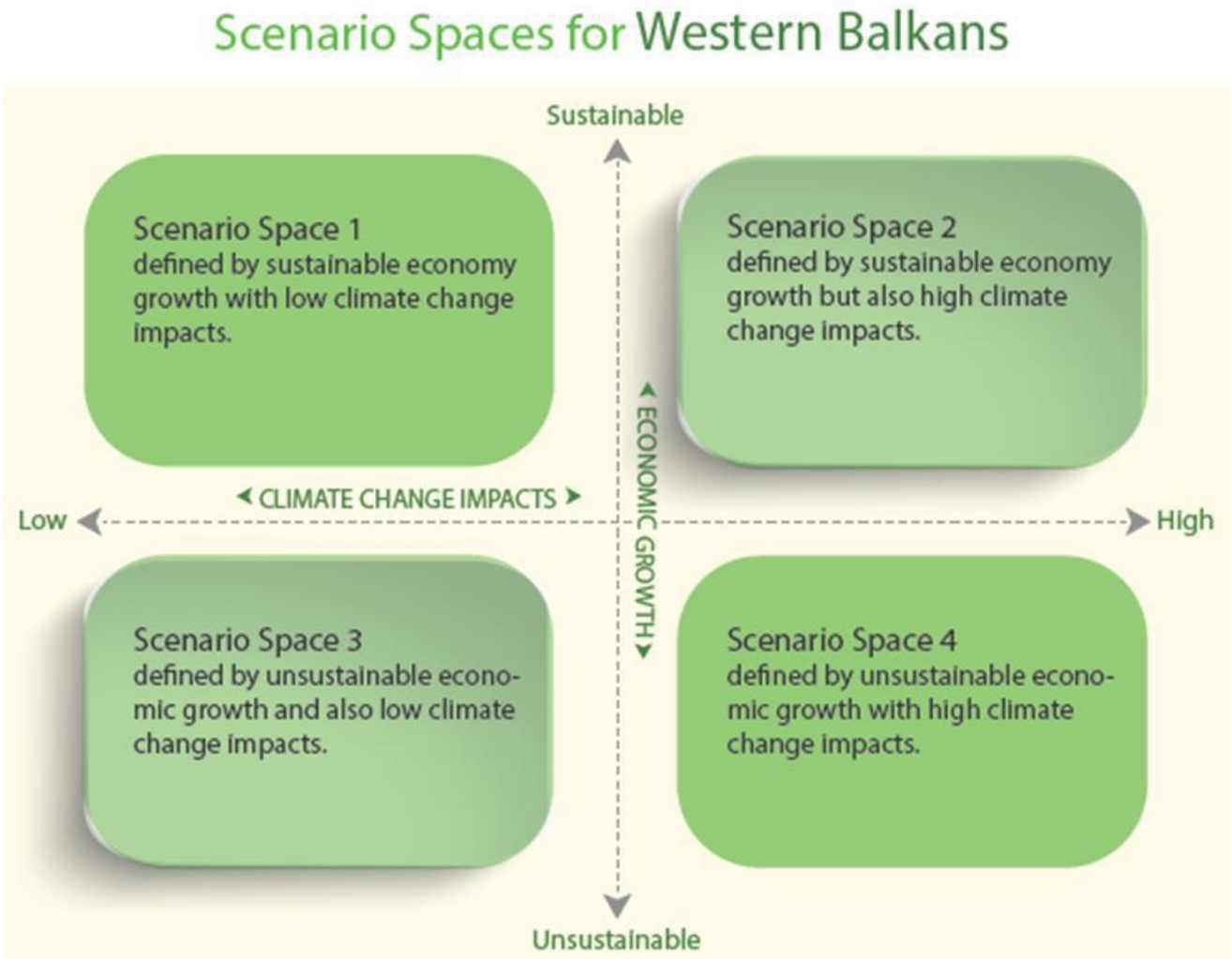
What type:

- Qualitative narratives on future developments
- Quantitative model application (CLUE)

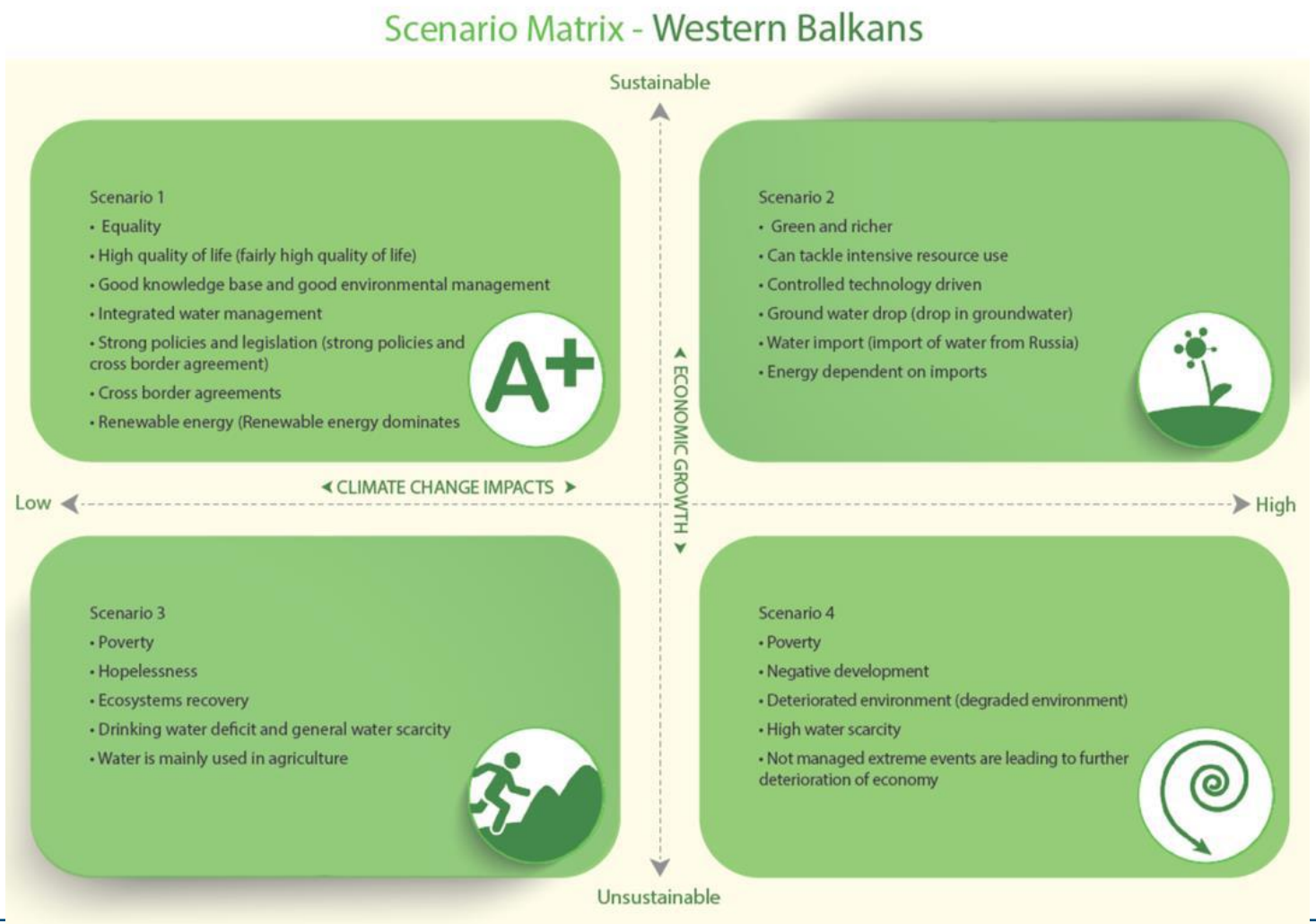
What characteristics:

- For Serbia
- Long-term (possibly 2100)
- Land use change

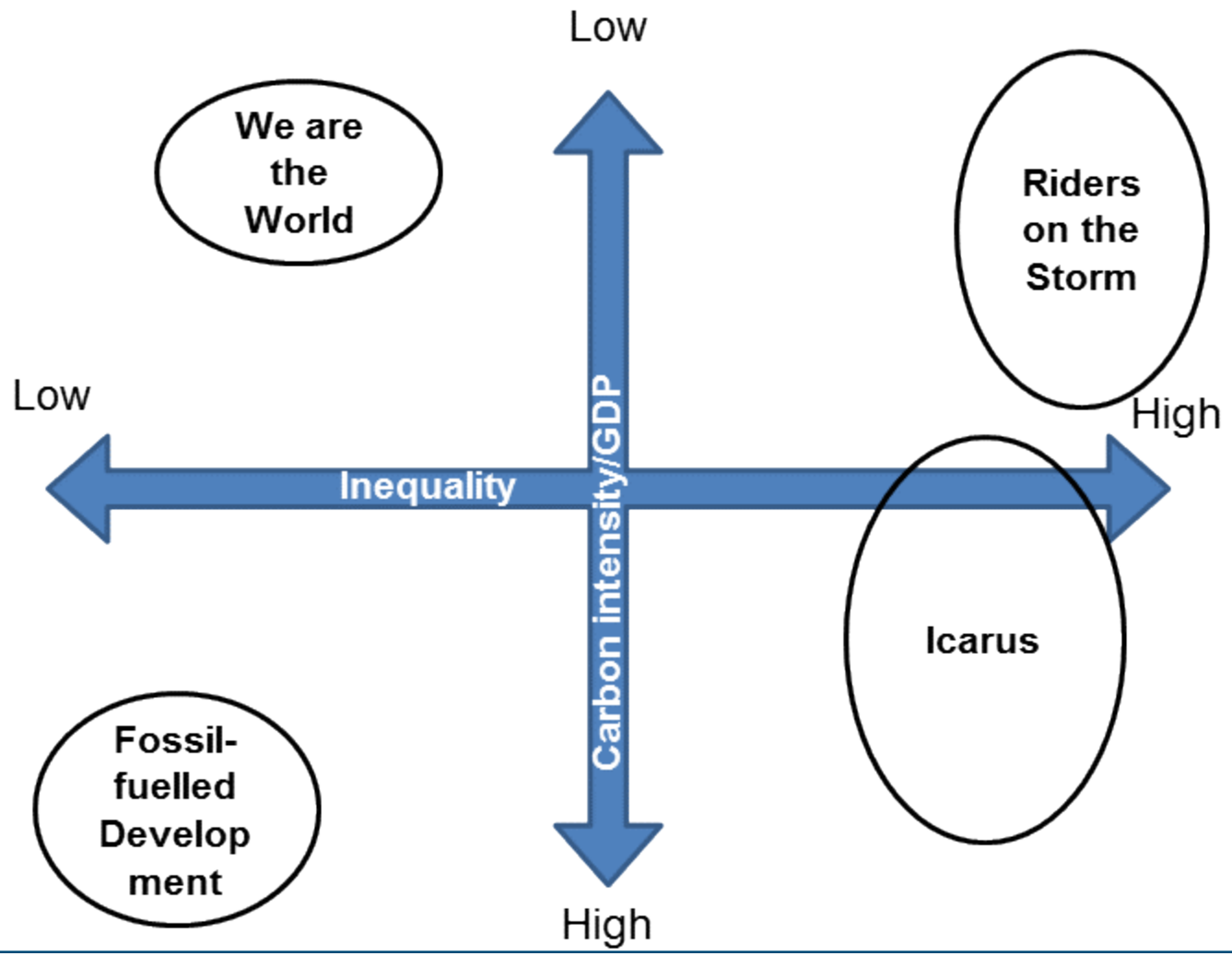
Scenario archetypes – Western Balkans (EEA)



Scenarios for Western Balkans (EEA)



Scenarios for Europe



Developing qualitative scenarios for Serbia

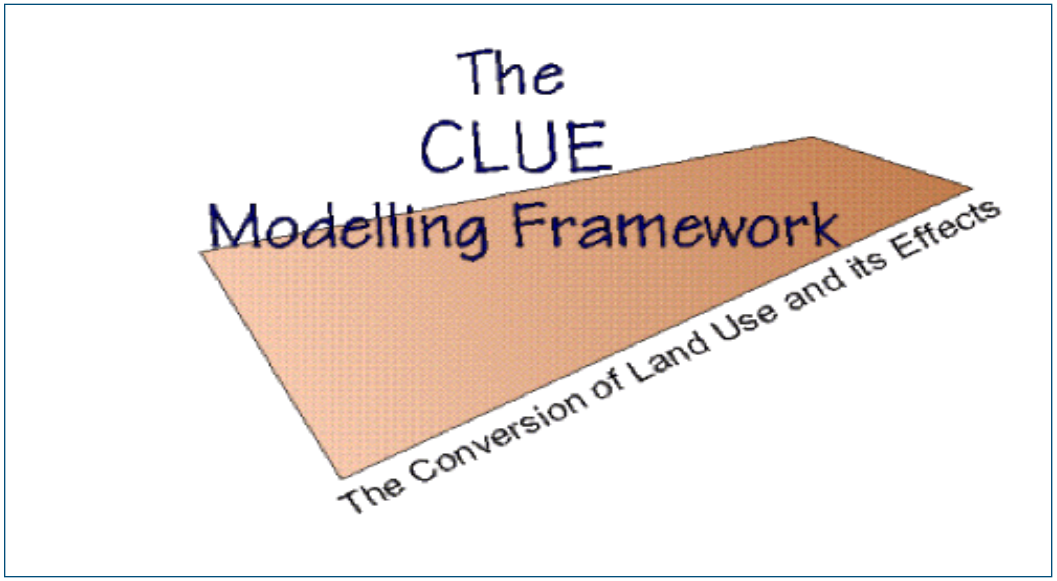
What:

- Covering aspects that are important but more difficult to quantify
- Socio-economic scenarios:
  - Political System, Governance, European policies, etc.
  - Urban/rural planning
  - Social changes, behaviour, (diet) preferences, etc.
  - Economic development

How:

- Discussions/interviews with different disciplines/aspects
- Using existing scenarios or scenario archetypes

CLUE – an introduction

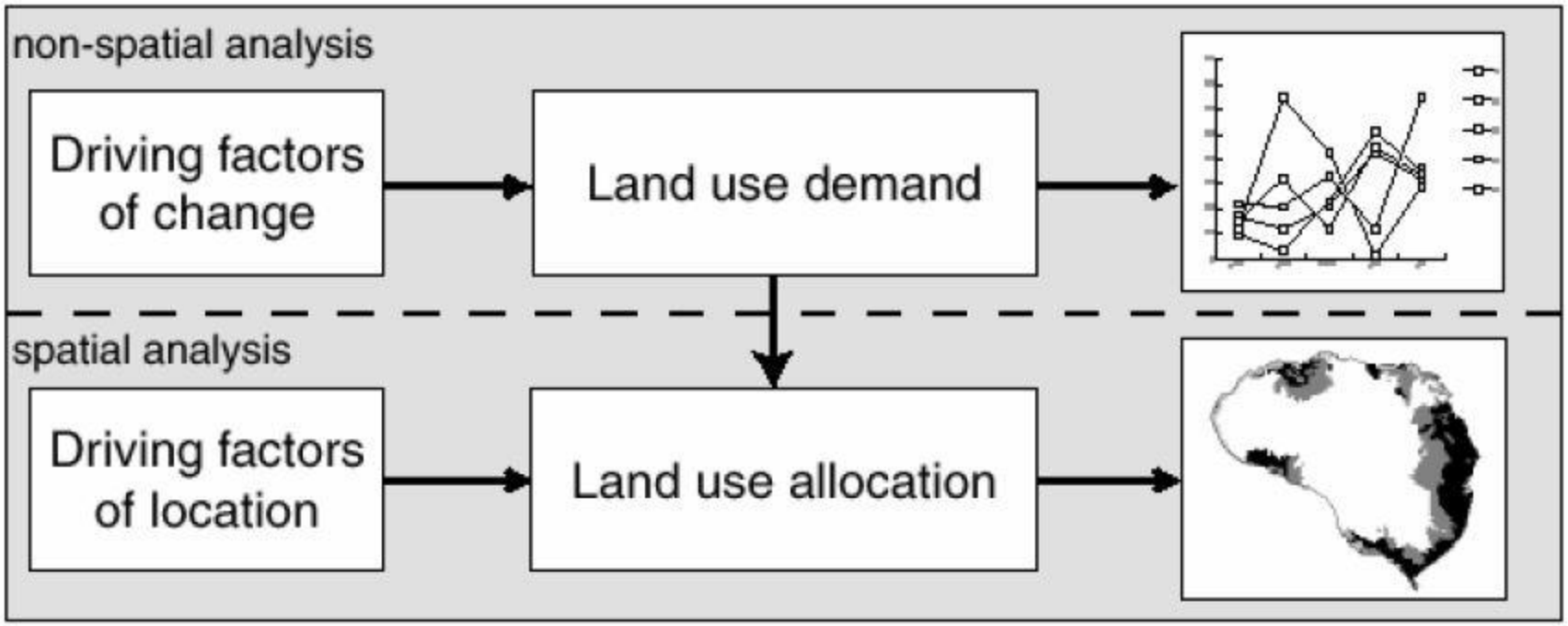


Characteristics of CLUE

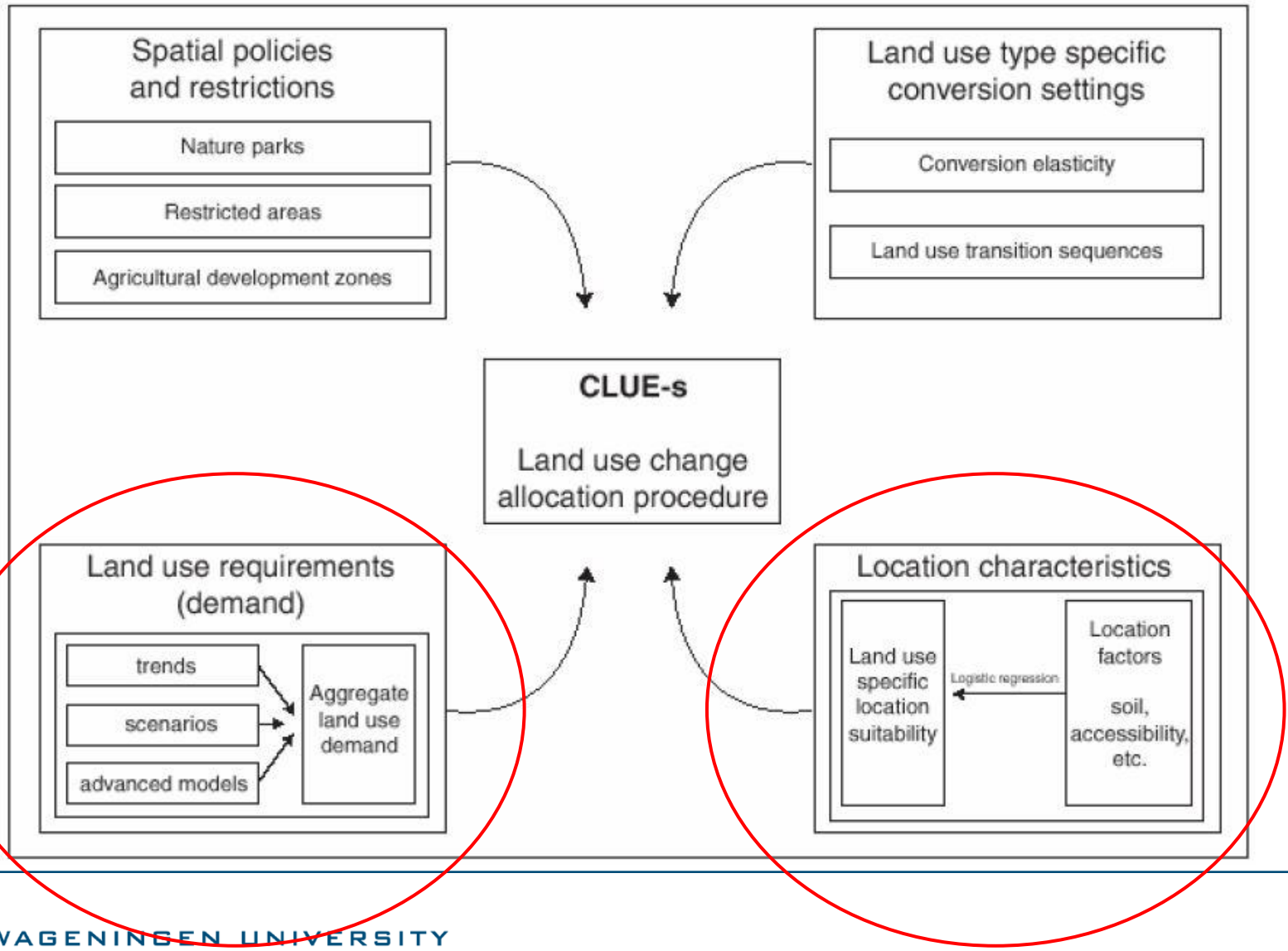
- **Spatially explicit (GIS-based)**
  - ✓ identification hot-spots of **land-use change**
- **Dynamic model**
  - ✓ structural analysis of **system** dynamics
  - ✓ future **projections**
  - ✓ based on "what if…" **scenarios**
- **Multi-purpose, multi-scale applicability**
- **Principles comparable to Cellular Automata**

Study Areas – CLUE & CLUE-s

General overview CLUE



General structure CLUE



Demand

National or regional analysis

Temporally detailed

Scenario-based future pathways of area development

Area development

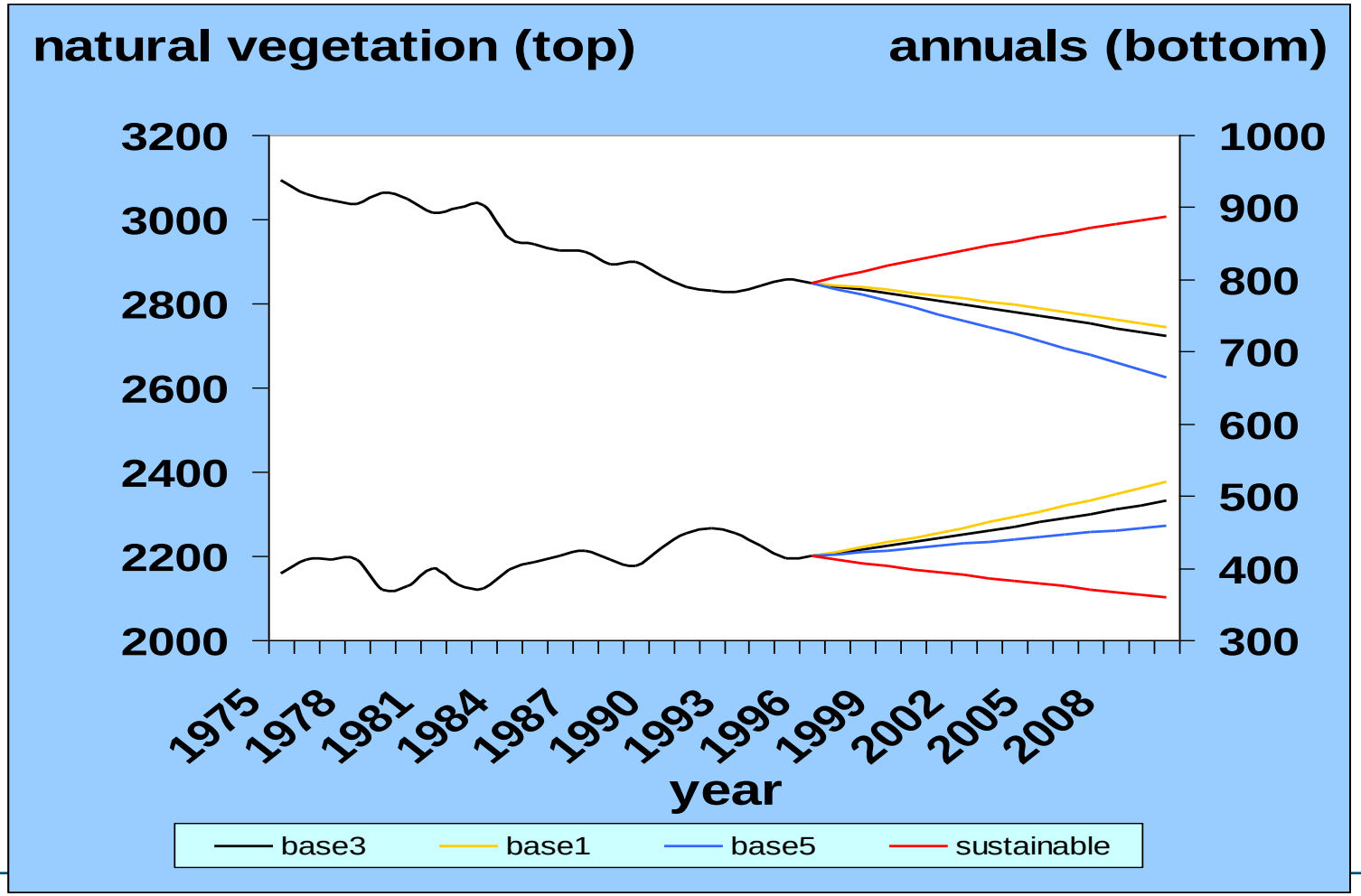
Area = Production × Yield

Production = (FOOD + EX - IM + PR + FE + OU) × (1 + FWA + FSE)

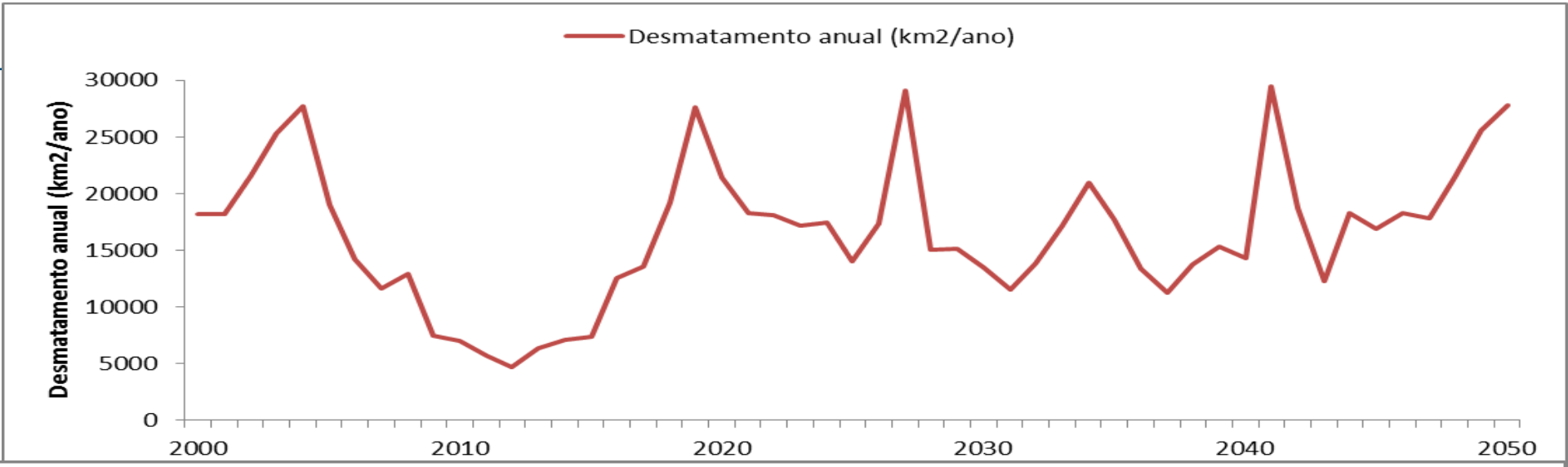
FOOD = CONSCAP × TOTPOP

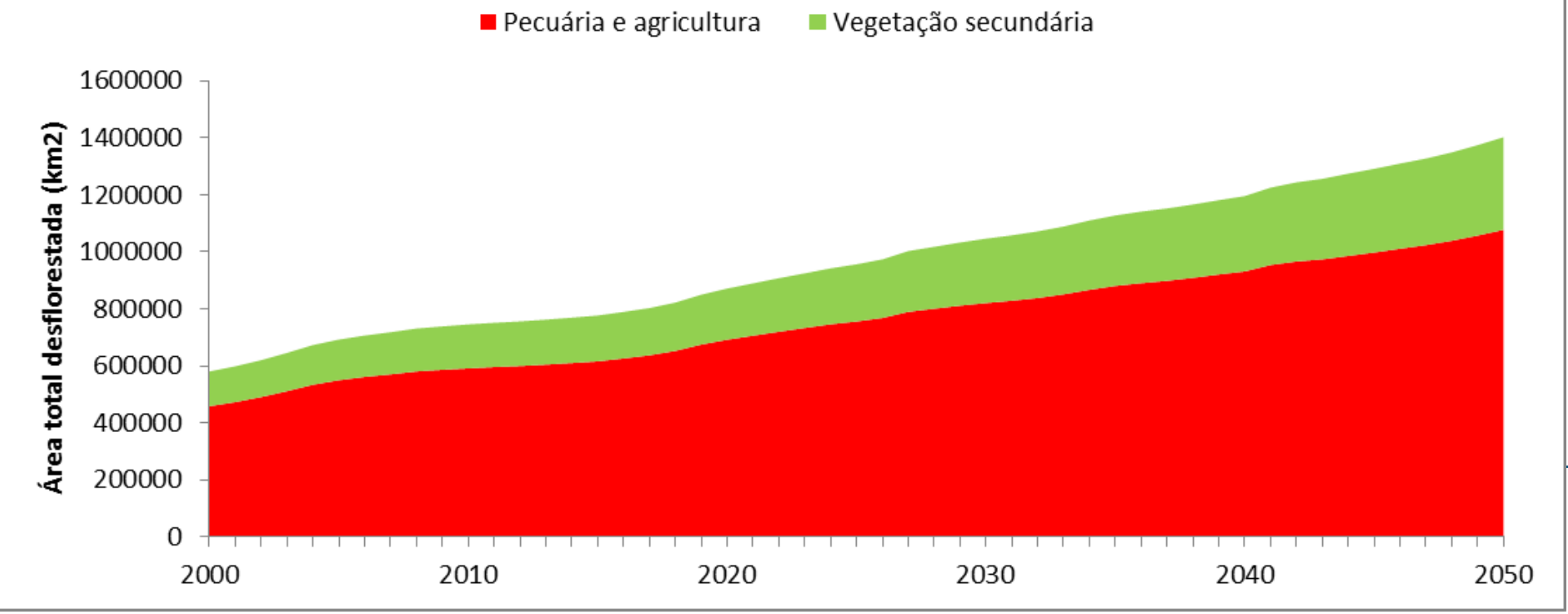
CONSCAP = f(GDP, %CONS, COUNTRY, TIME)

Actual and modelled area development of nature and annuals in Central America



Future scenarios – input for land use model (FRAG)





Allocation

1. System analysis
   identify the socioeconomic
   and biogeophysical drivers of LU
   and quantify relationships

2. Spatially explicit allocation using CLUE

Land use system analysis

Multiple regression analysis

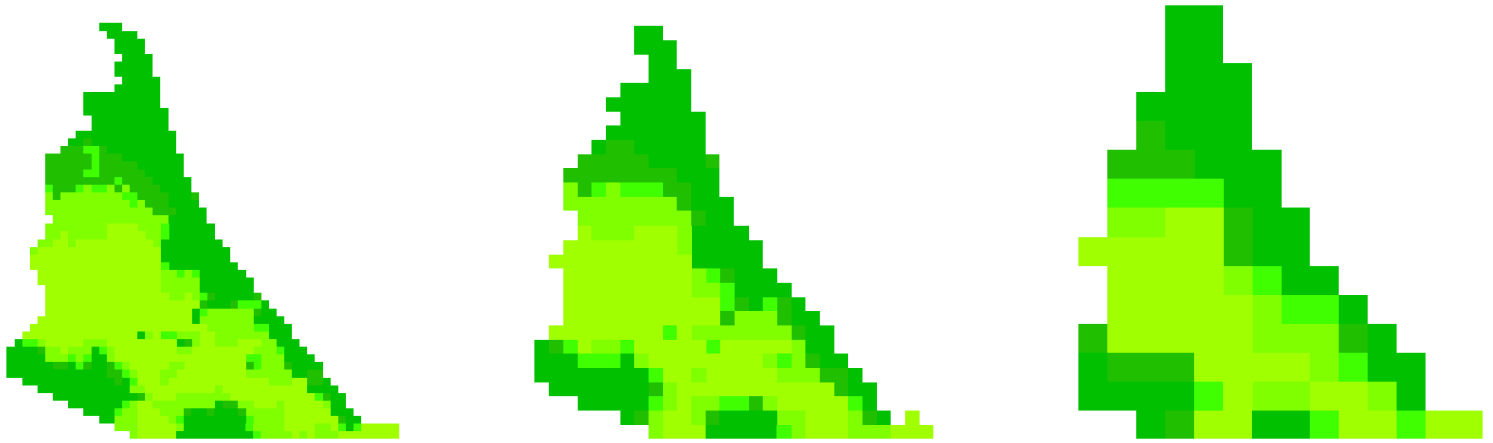
- identify potential important variables that could explain land use patterns

- quantify relationships

  %area = b0 + b1 * pop.dens + b2 * rainfall + ...

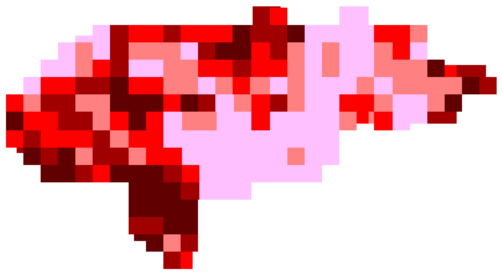
Spatial distribution of forest Atlantic Zone of Costa Rica 1984

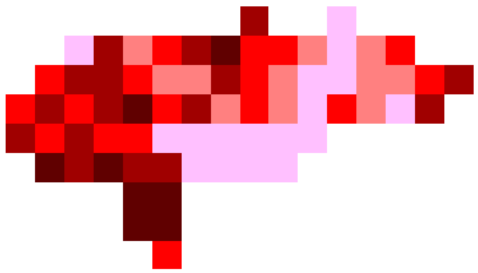
LEVEL 1 (2 * 2 km^2) R^2 = 0.83		LEVEL 2 (3.7 * 3.7 km^2) R^2 = 0.85		LEVEL 3 (7.5 * 7.5 km^2) R^2 = 0.90	
factor	*standardized beta*	*factor*	*standardized beta*	*factor*	*standardized beta*
bad drainage	0.32	bad drainage	0.36	shallow soils	0.69
precipitation	0.29	sandy texture	0.34	altitude	0.48
inside park	0.26	shallow soils	0.28	sandy texture	0.35
shallow soils	0.24	inside park	0.26	inside park	0.25



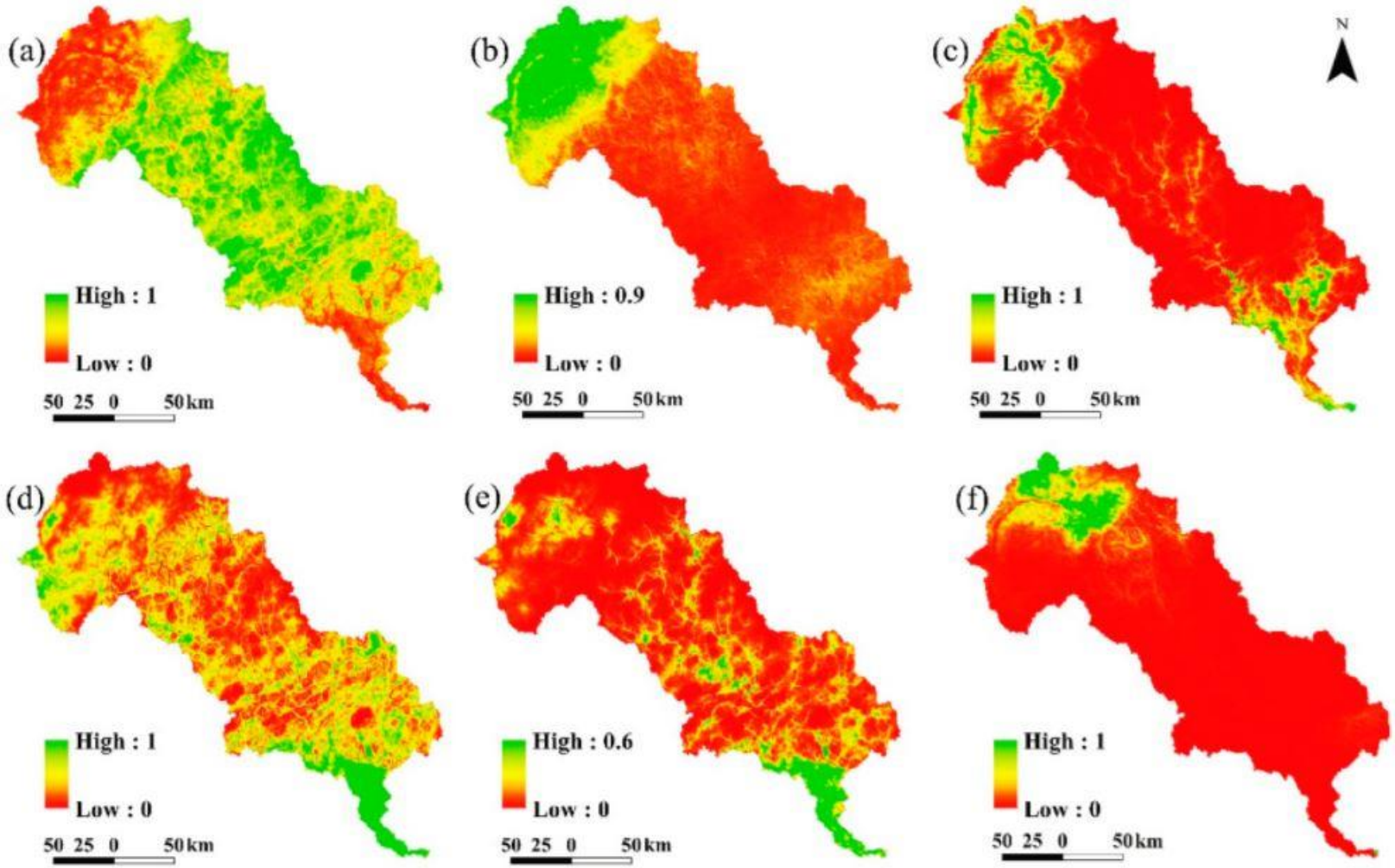
Spatial distribution of beans Honduras 1974

LEVEL 1 7.5 × 7.5 km^2 R^2 = 0.43		LEVEL 3 22.5 × 22.5 km^2 R^2 = 0.59		LEVEL 5 37.5 × 37.5 km^2 R^2 = 0.76	
factor	stb	factor	stb	factor	stb
DENRUR	0.38	DENRUR	0.34	DRYMONTH	0.52
FERTHIGH	-0.22	WORKER	0.18	FERTHIGH	-0.28
ROOTDEEP	-0.18	FERTLOW	0.17	DENTOT	0.25
WORKER	0.15	DRYMONTH	0.15		

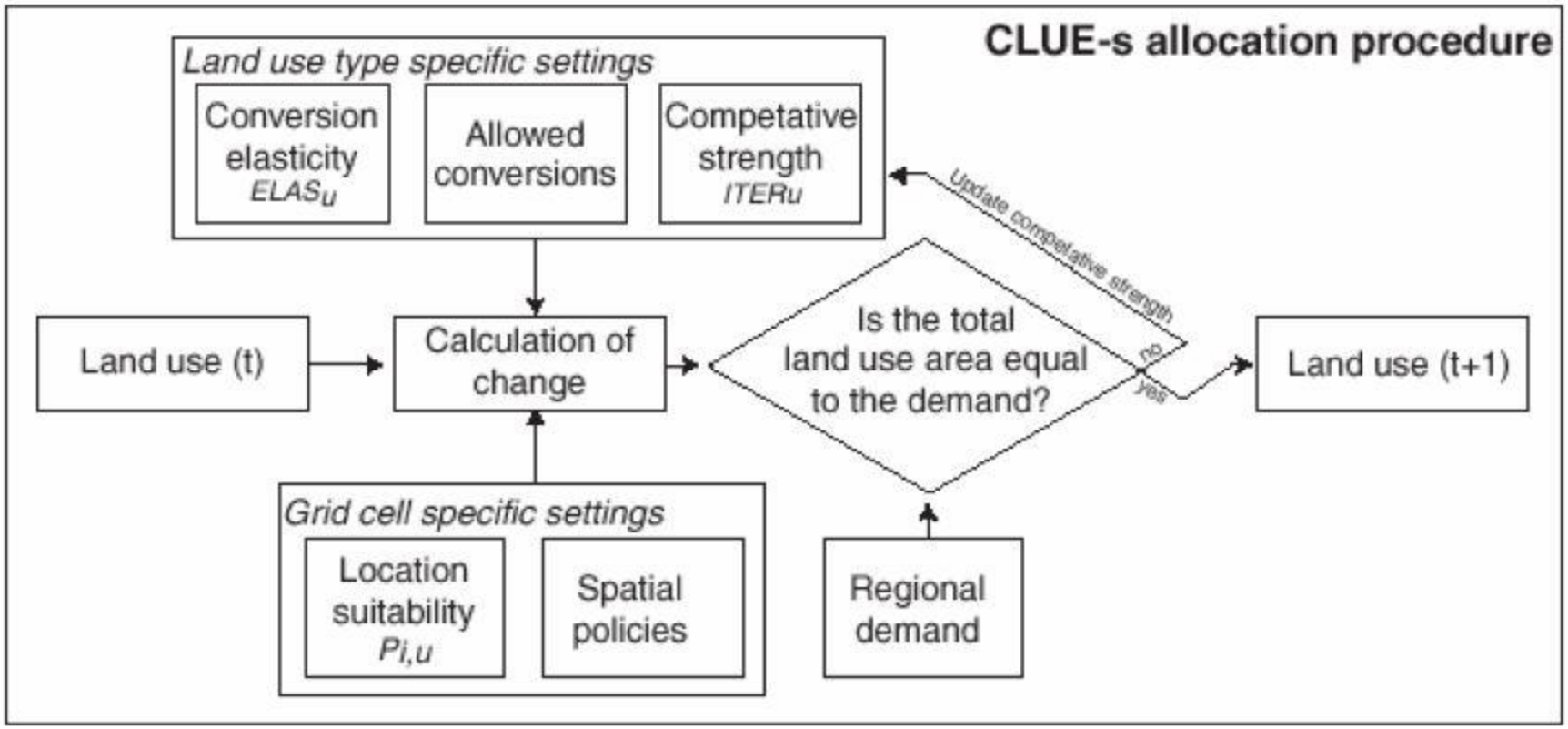




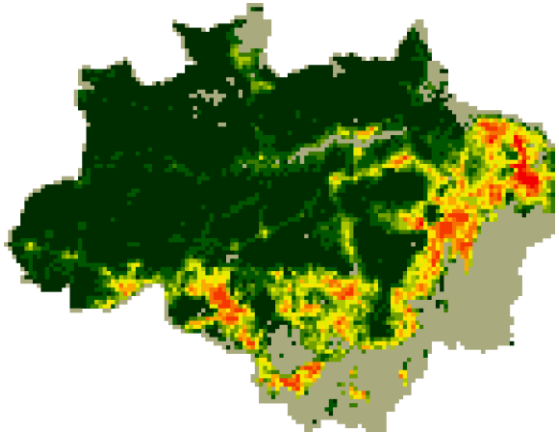
Suitability maps



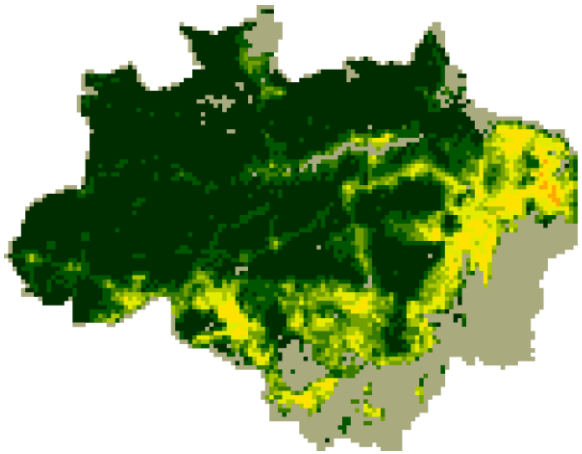
Allocation procedure



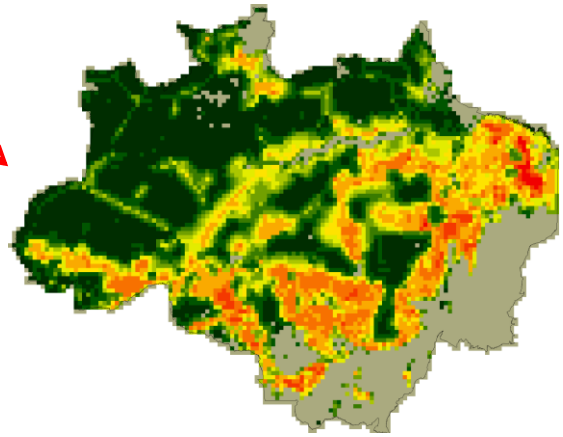
Future scenarios – output land use change model



2013

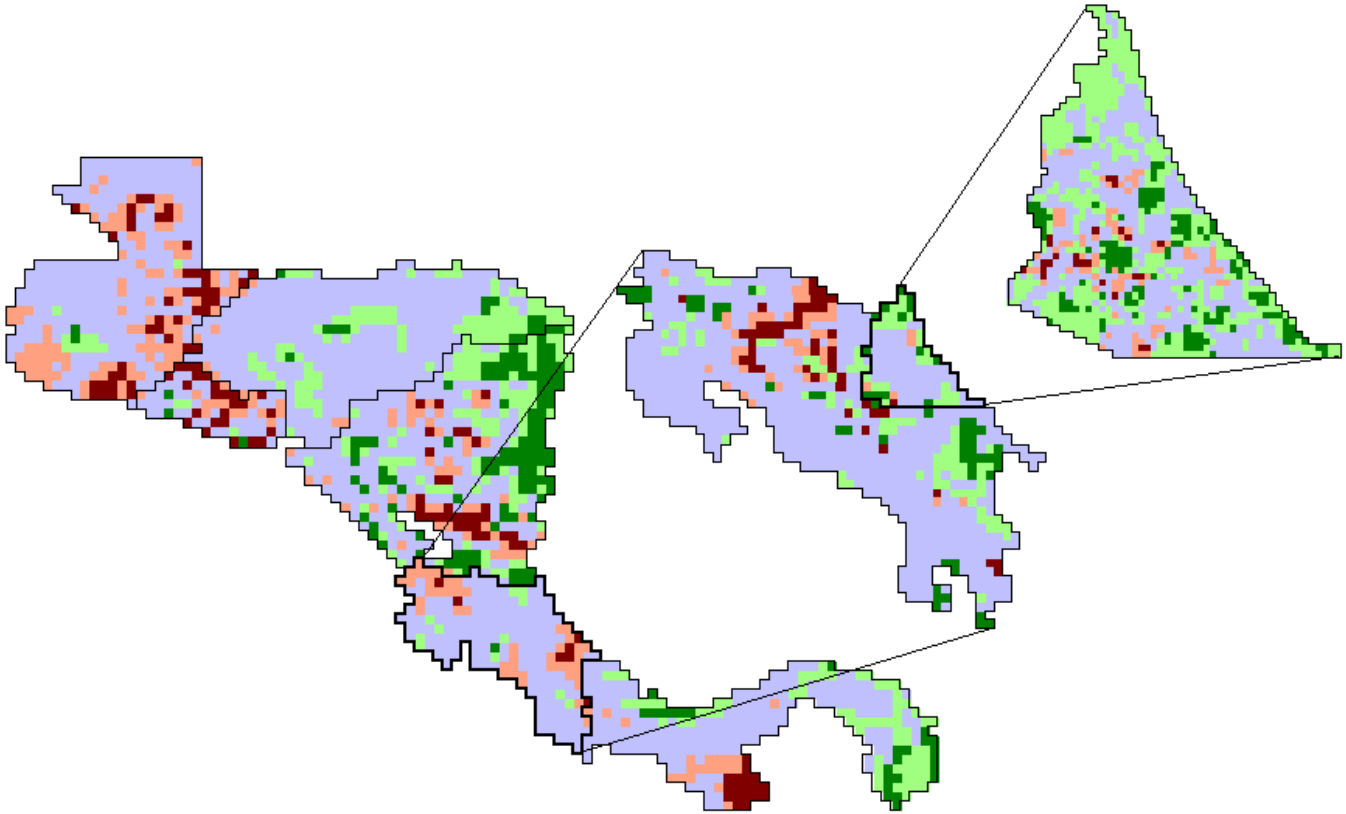


SUS



FRAG

Model results:
Hot-spots of land use change (pasture)



Developing quantitative scenarios for Serbia

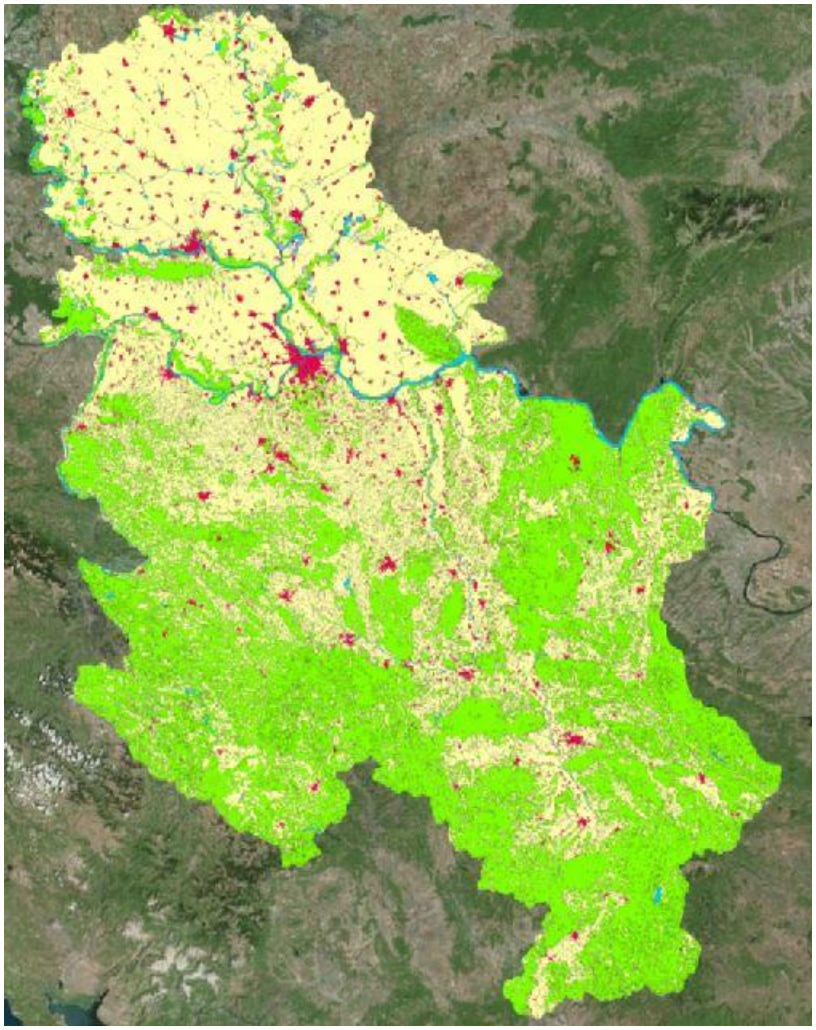
What:

- Current situation:
  - Land use (CORINE)
  - Soil characteristics
  - Digital Elevation Model
  - Population dynamics
  - Climate (current and future temperature and precipitation)
  - Spatial plans
  - Etc.
- Covering aspects that are important and can be quantified

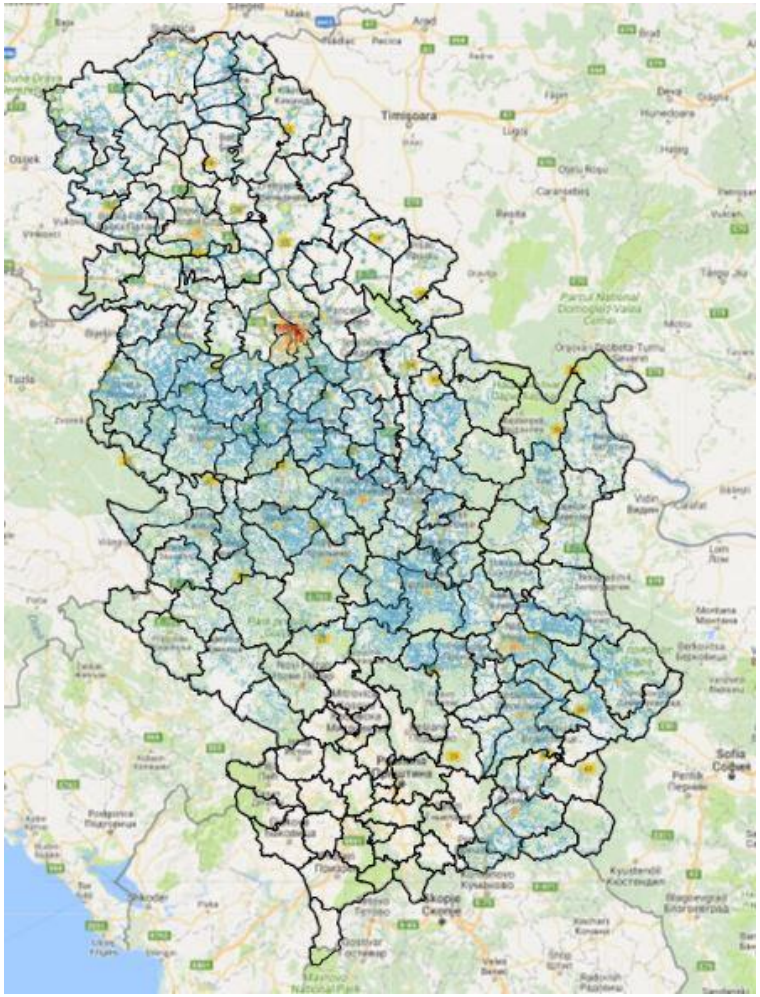
How:

- Contacting key dataholders and extract data on key variables
- Building georeferenced multi-disciplinary dataset

Current situation – land use



Current situation – population



Progress

In Serbia:

- Qualitative scenarios: interviews or short questionnaire will be prepared
- Quantitative scenarios: database will be constructed

Collaboration Wageningen/Belgrade:

- Developing qualitative scenarios
- Quantifying scenarios (model input)
- Quantitative maps of land use change for Serbia

Questions?