Forest and land use change based on socio-economic and physical drivers: examples from Africa and West Asia

Rüdiger Schaldach

Center for Environmental Systems Research
University Kassel, Germany

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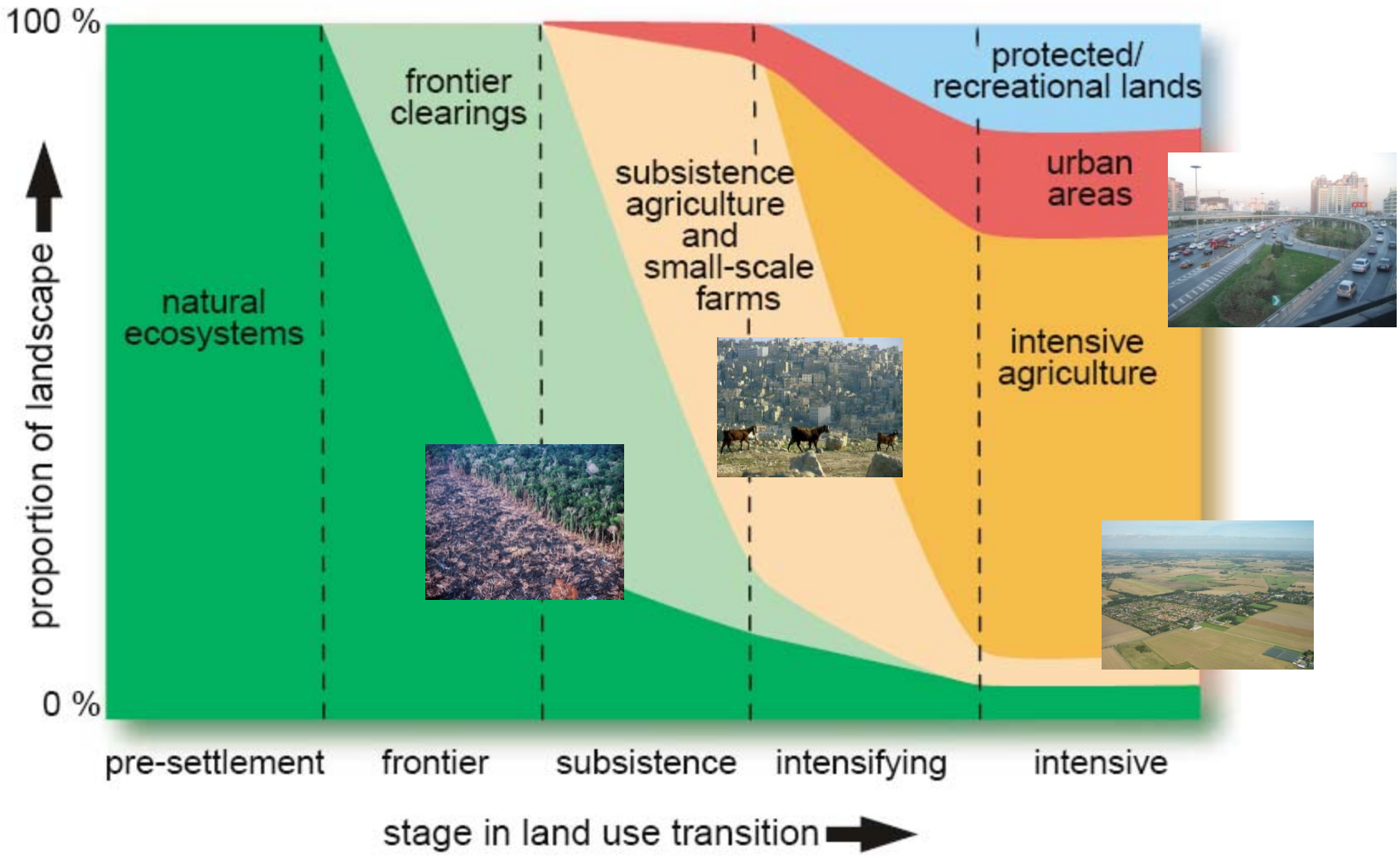
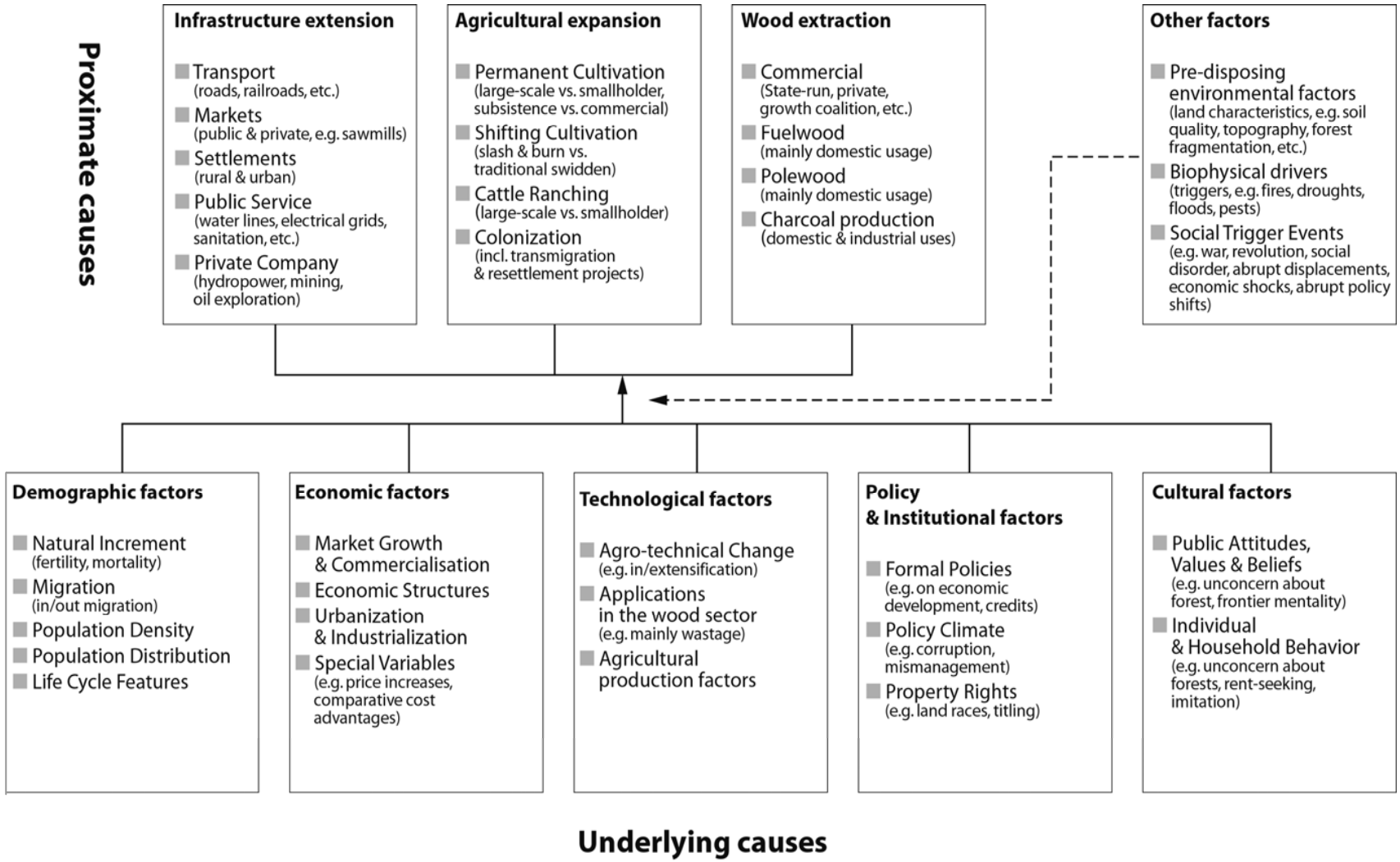
Land-use and land-cover change



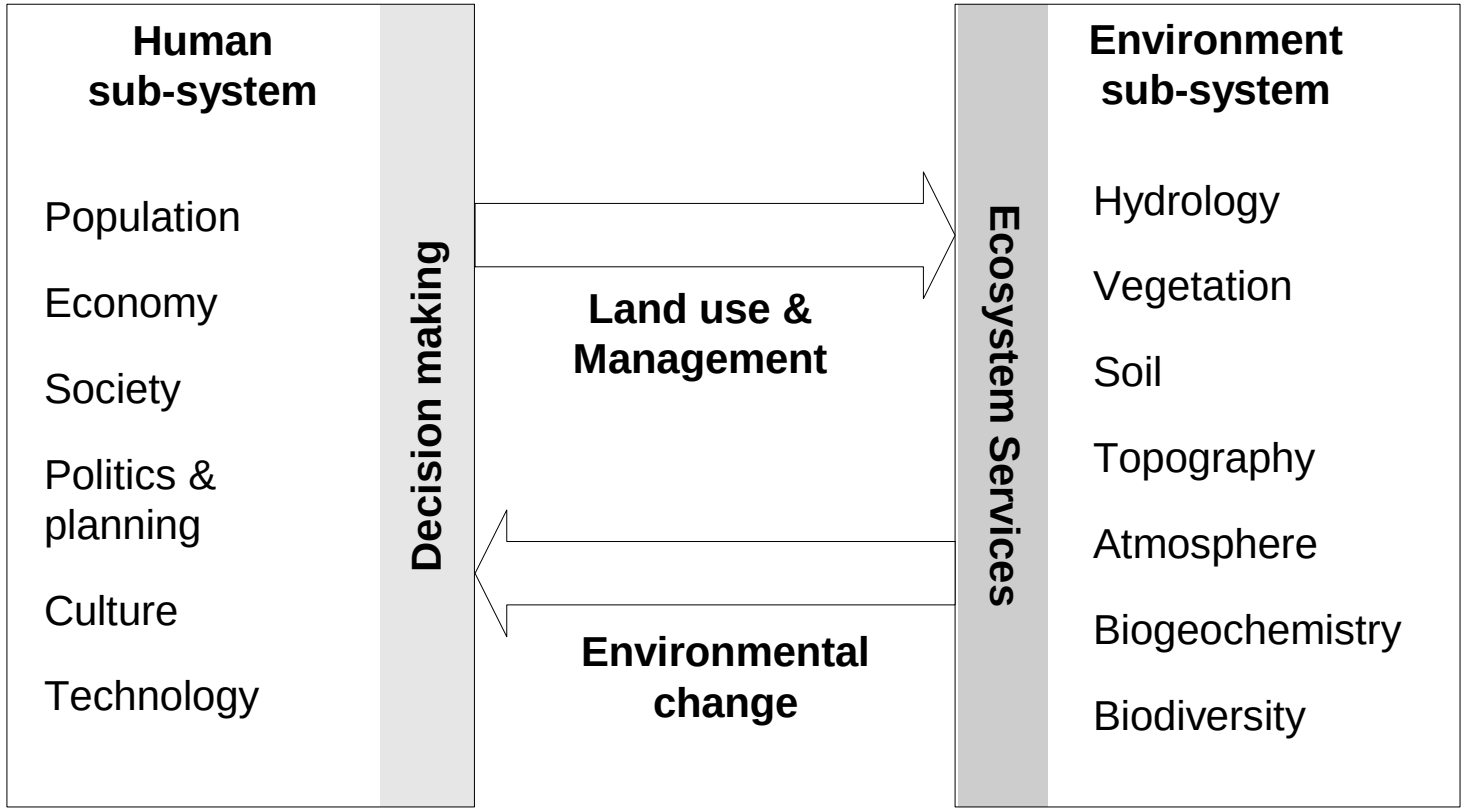
(Foly et al., 2005)

Drivers of land-use change



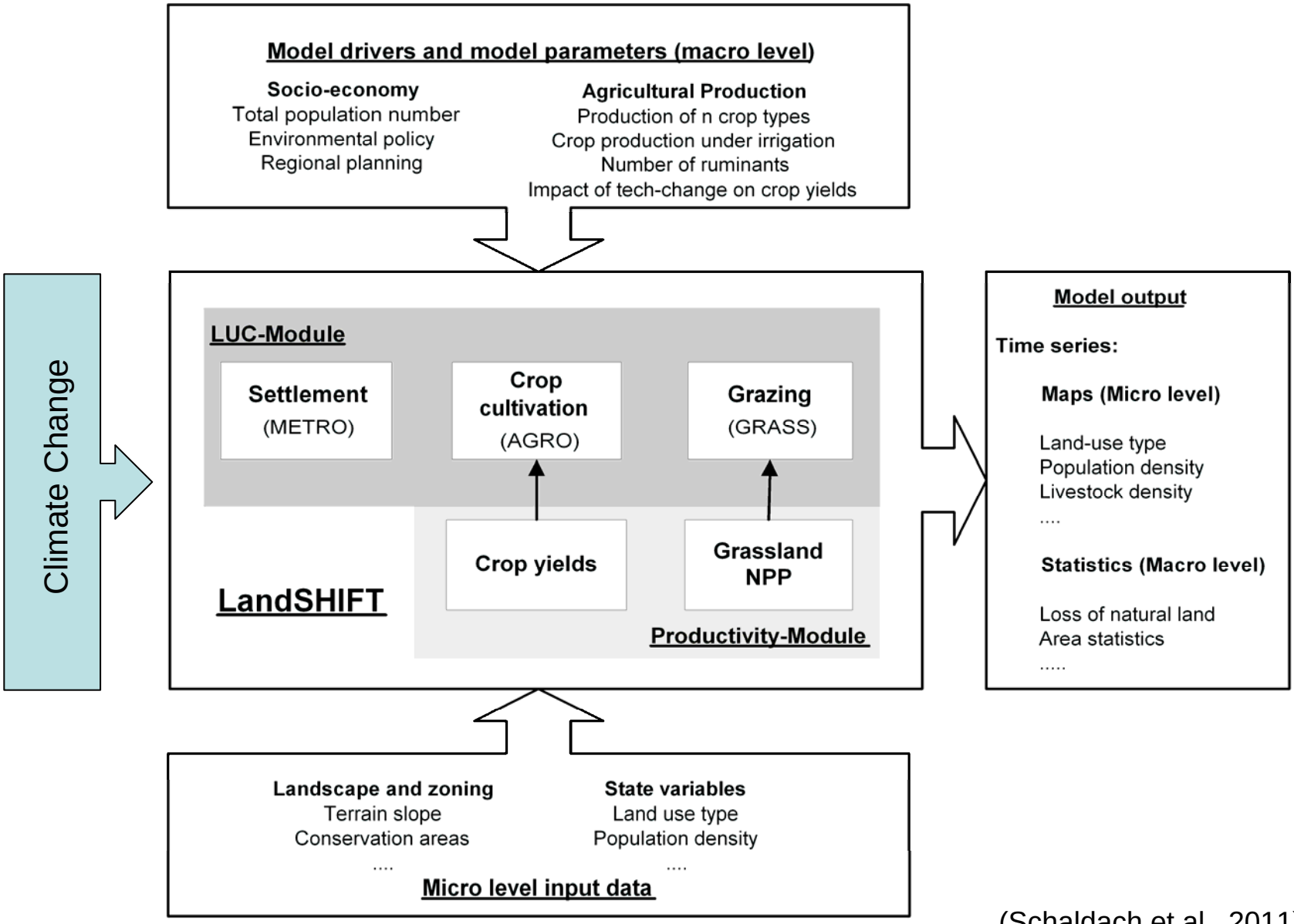
(Geist and Lambin, 2002)

The Land System perspective



Based on GLP (2005)

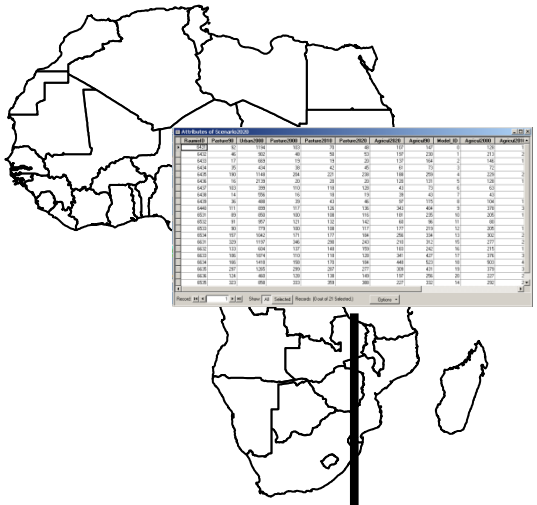
The LandSHIFT model



(Schaldach et al., 2011)

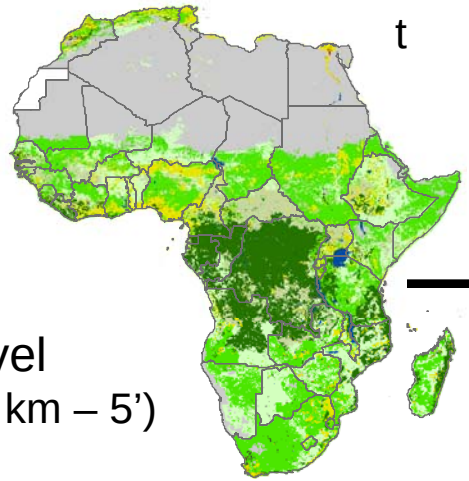
Spatial model integration

Macro level
(countries, districts)



Model drivers, e.g.
- Population
- Crop production

t



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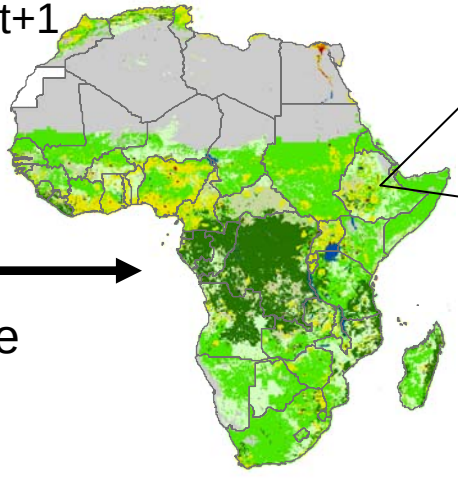
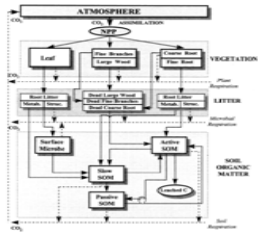


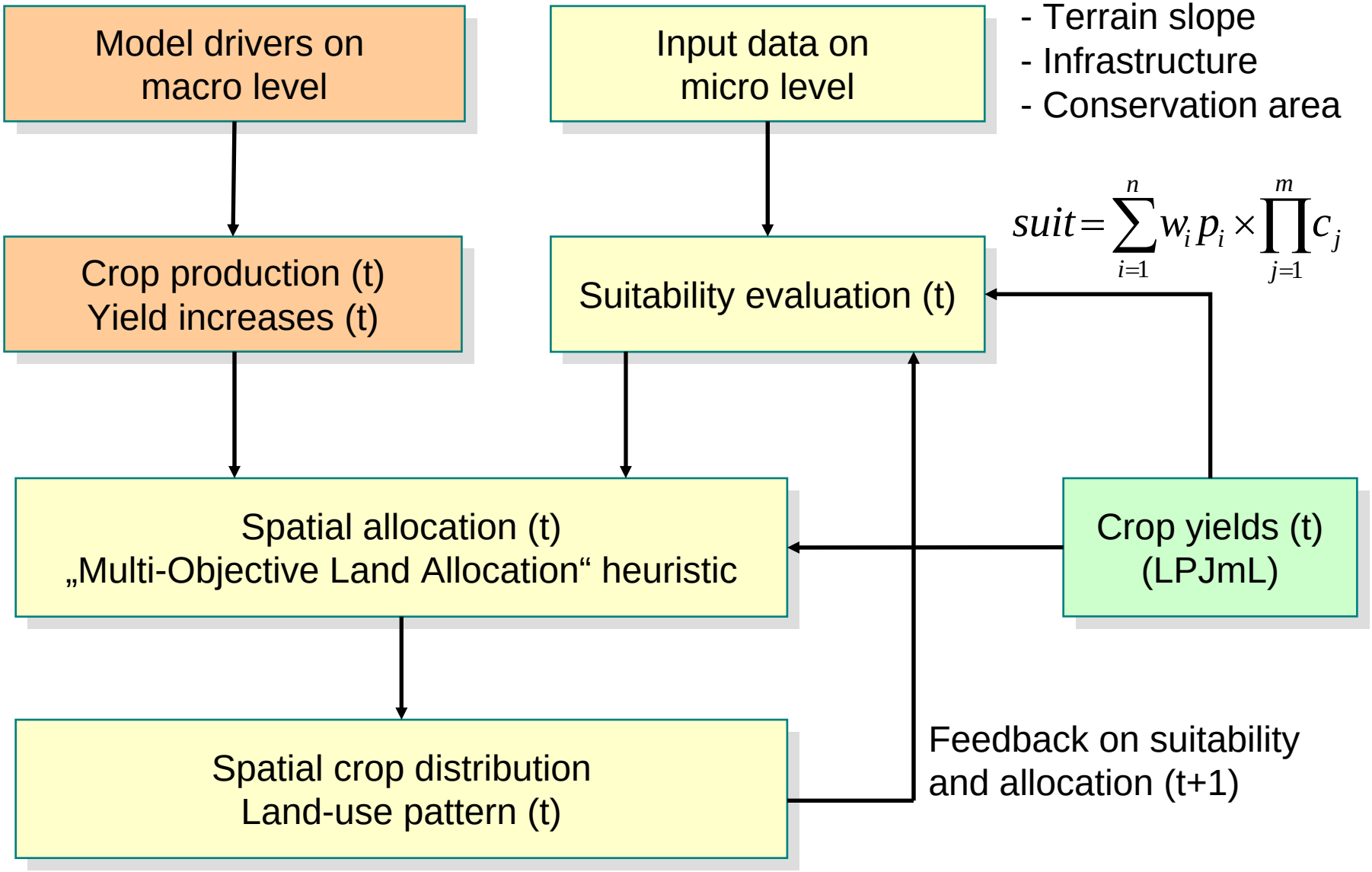


Ecosystem processes

Micro level
(Raster 1 km – 5')

Land-use change

Land-use activity „Crop cultivation“



Scenario analysis Africa

Plausible descriptions of how the future may unfold… scenarios until 2050 from the UNEP Global Environmental Outlook 4

Markets First

Faith in markets and their advances for economy but also for social and environmental improvements.

Population: 800 Mio - 1900 Mio

GDP/cap: 702 $ - 3300 $

Food availability: 2460 kcal/day - 3476 kcal/day

Climate: dT = 2.2 K; CO_2 = 563 ppmv

Sustainability First

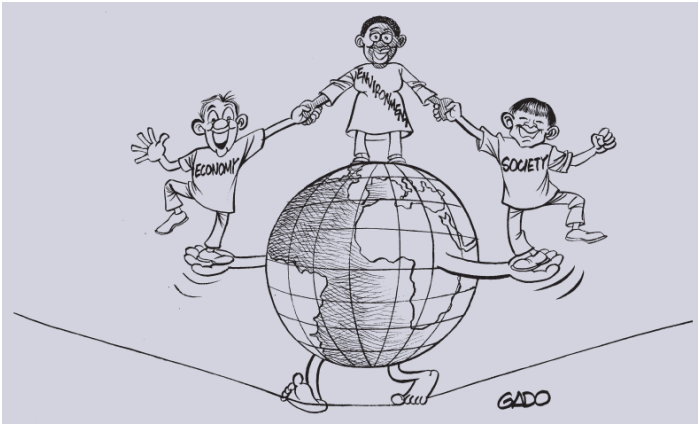
Emphasis on environmental and social concerns.

Population: 800 Mio - 1400 Mio

GDP/cap: 702 $ - 4300 $

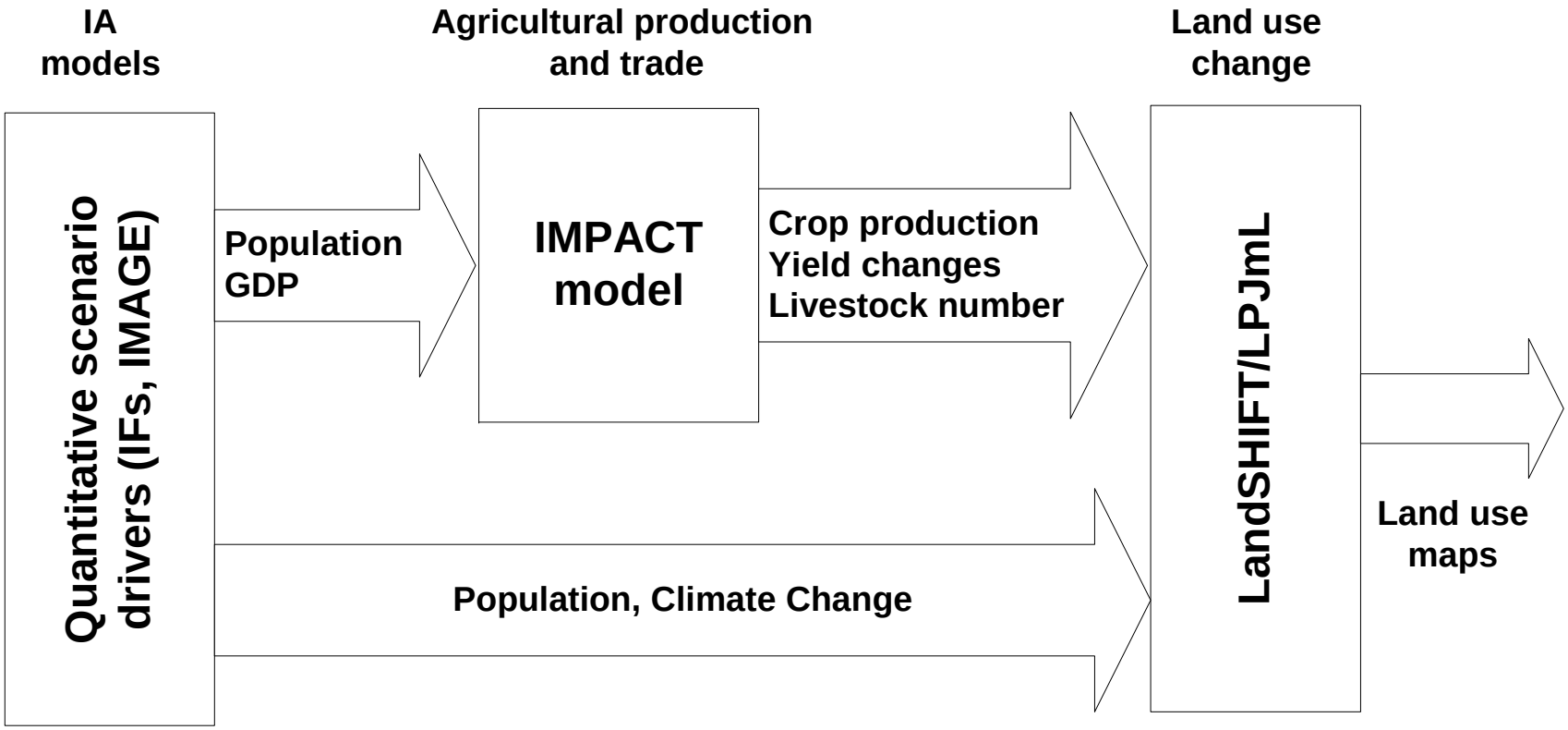
Food availability: 2460 kcal/day - 4108 kcal/day

Climate: dT = 1.7 K; CO_2 = 478 ppmv

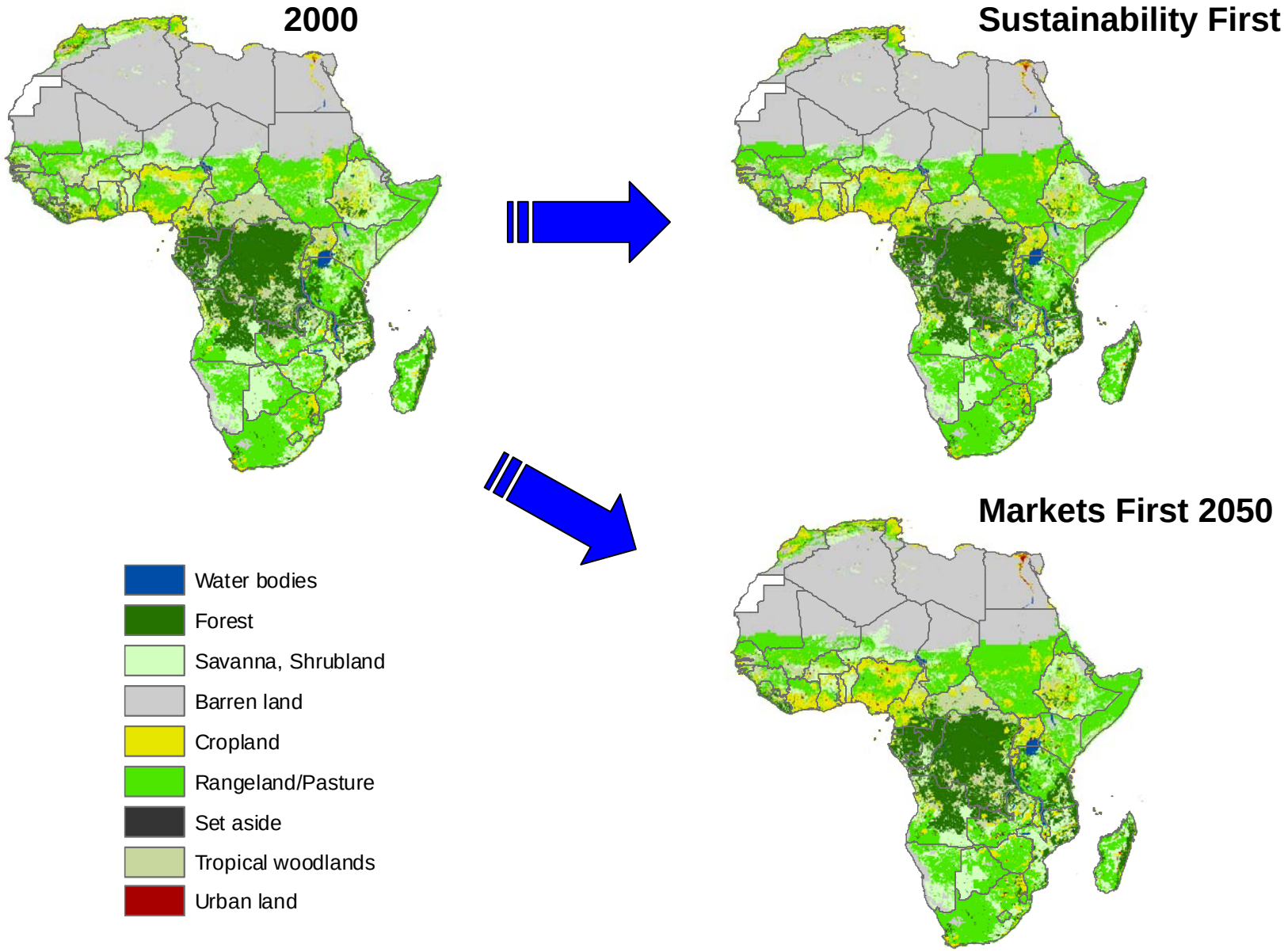


Quantitative scenarios

Sequence of different simulation models

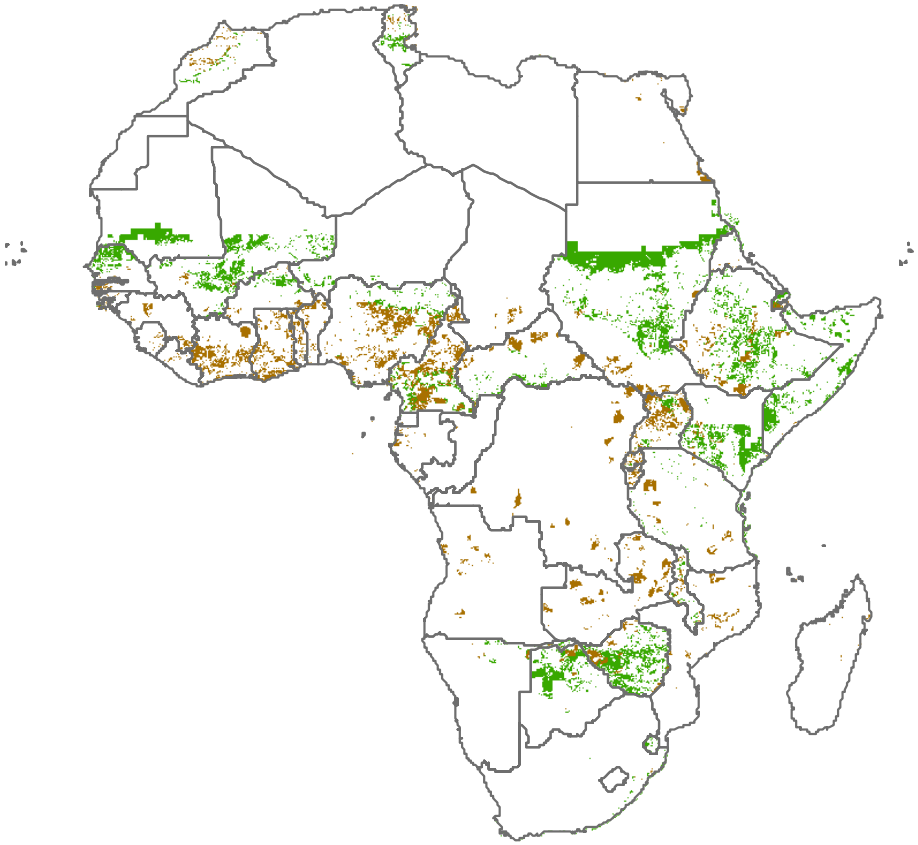


Land-use change

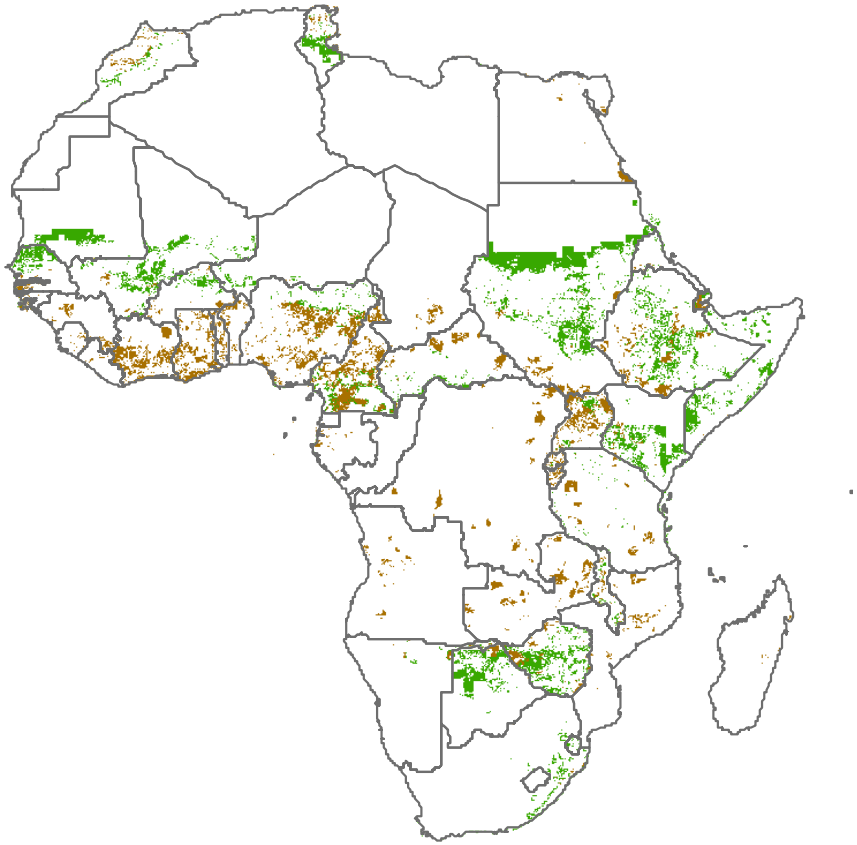


Expansion of agriculture

Markets First 2050



Sustainability First 2050



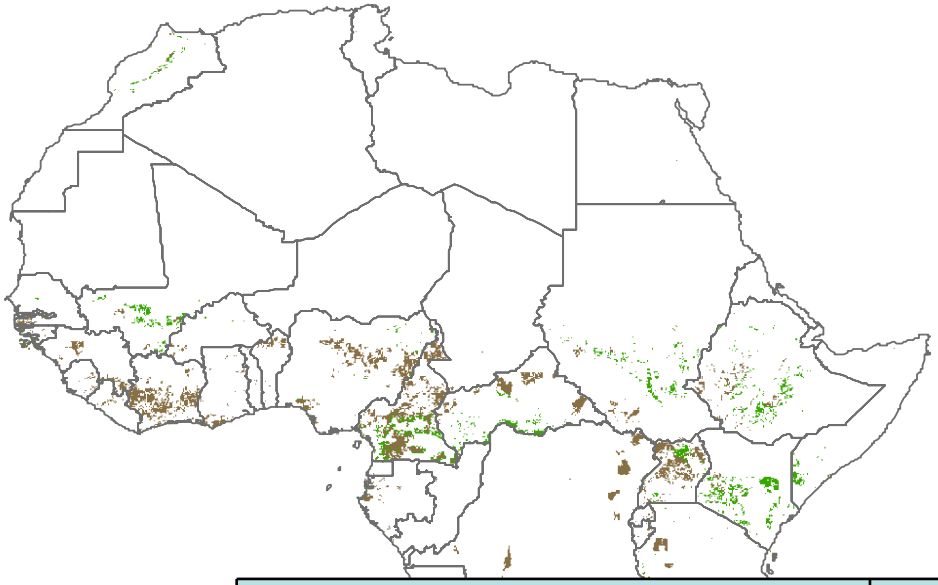
	2000	2050	
[1000 km²]		Markets First	Sustainability First
Cropland	2121	2855	2967
Grazing	7079	8231	8147

New grazing land

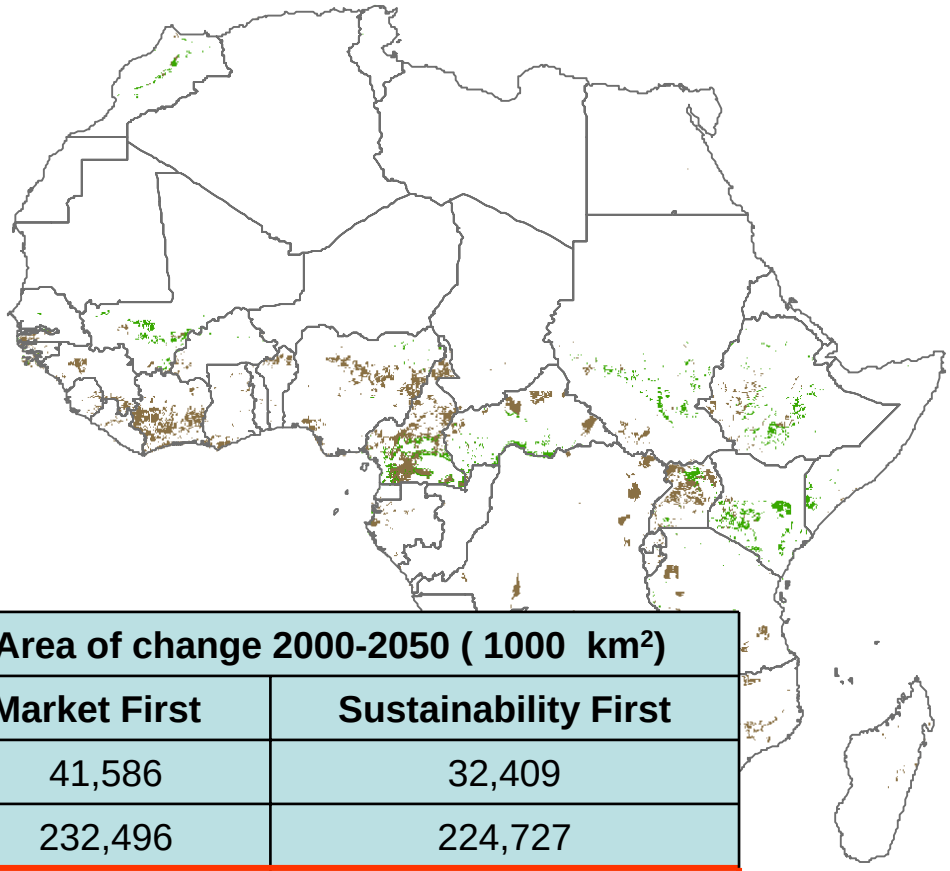
New cropland

Loss of forest habitat

Markets First 2050



Sustainability First 2050

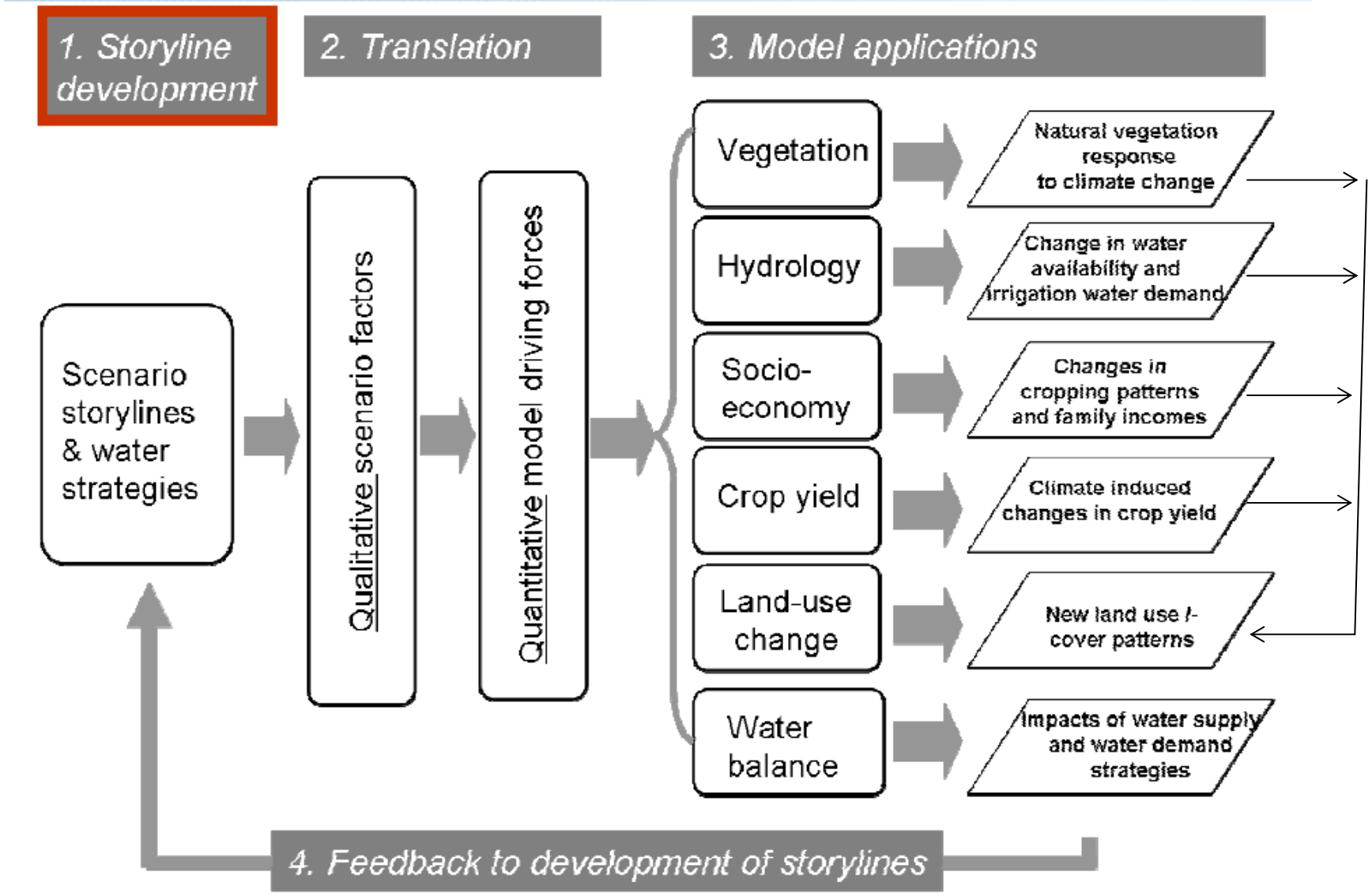


New land use on deforested cell	Area of change 2000-2050 (1000 km²)	
	Market First	Sustainability First
Urban	41,586	32,409
Grazing	232,496	224,727
Cropland	577,039	603,016
(Total deforested area)	851,121	860,152

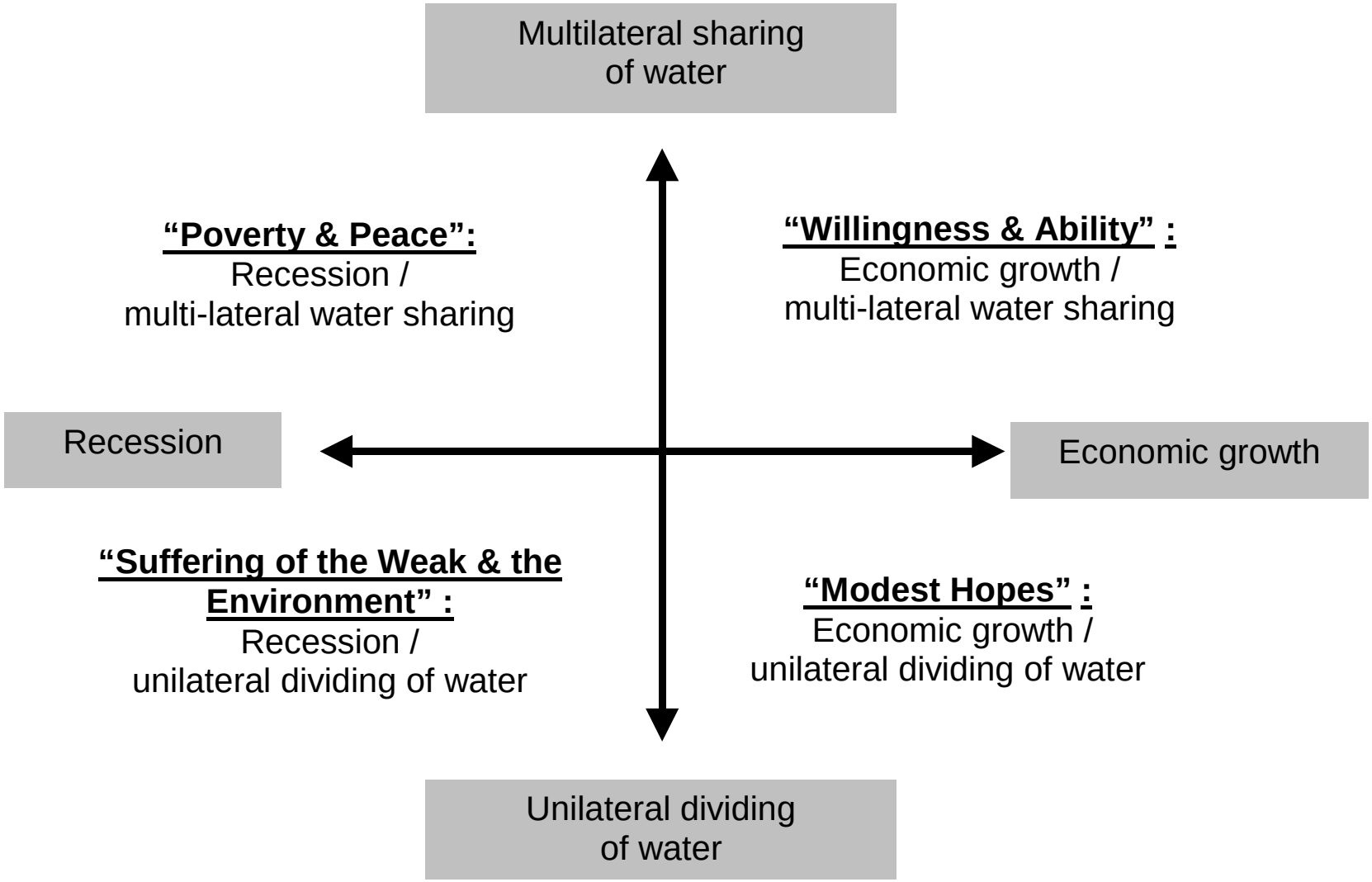
Scenario analysis Middle East

- GLOWA Jordan River Project
- Water scarce region
- Drylands with high degradation risk
- Strong population pressure
- Objective: Water management strategies under climate change

GLOWA Jordan River scenarios



GLOWA Jordan River scenarios

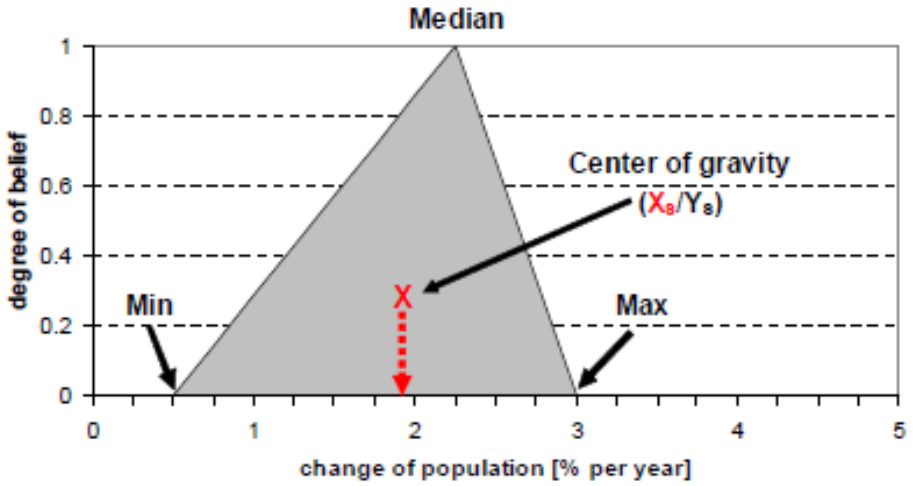


From storylines to models

"Population growth is *medium*"

"Fuzzy Sets"

Population growth = 2 % per year



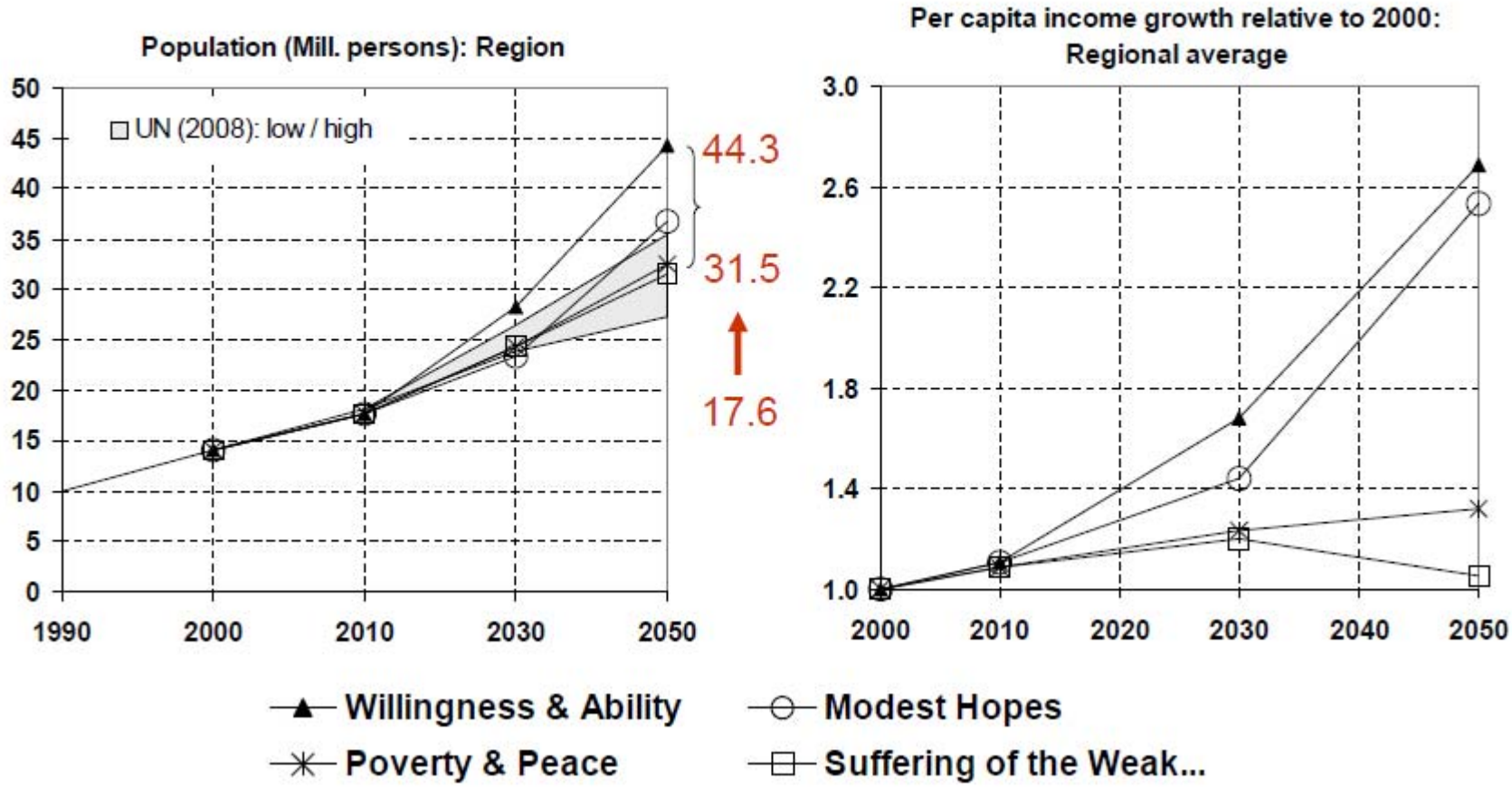
"Fuzzy membership function"

Objective translation:
linguistic statement "medium increase of population" → model input

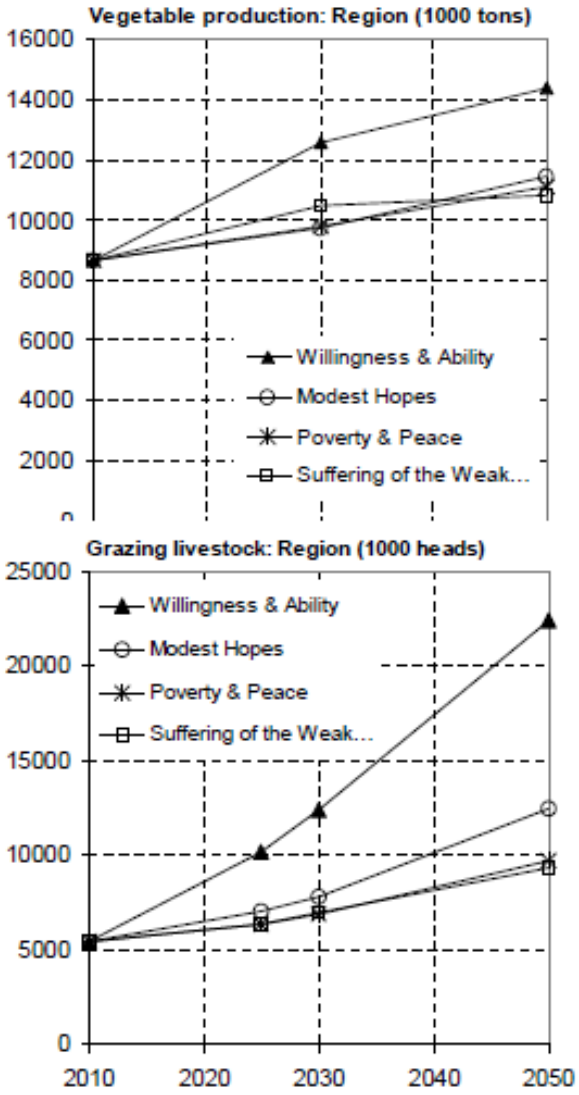
Alcamo (2008)

Numerical model input

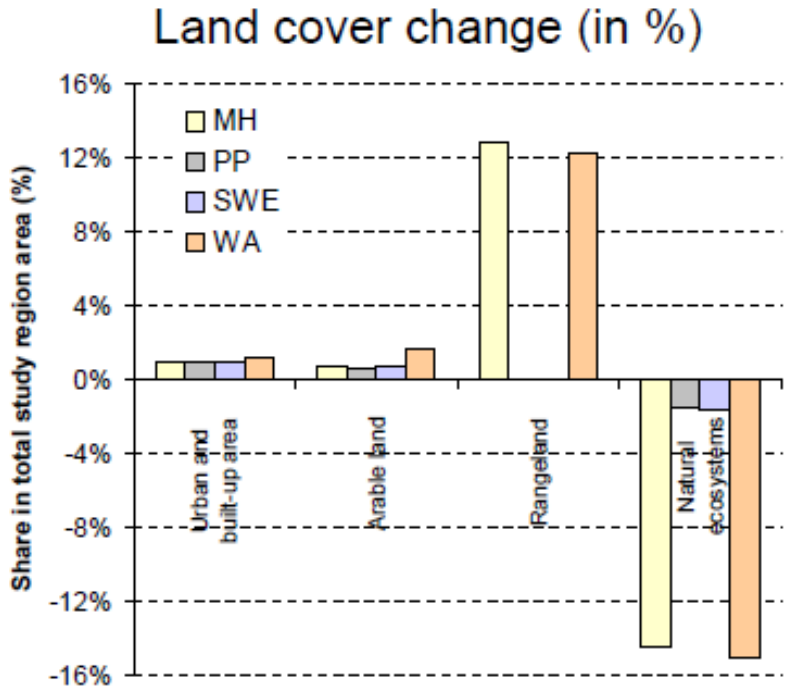
Population and income development up to 2050



Model input and land-use change

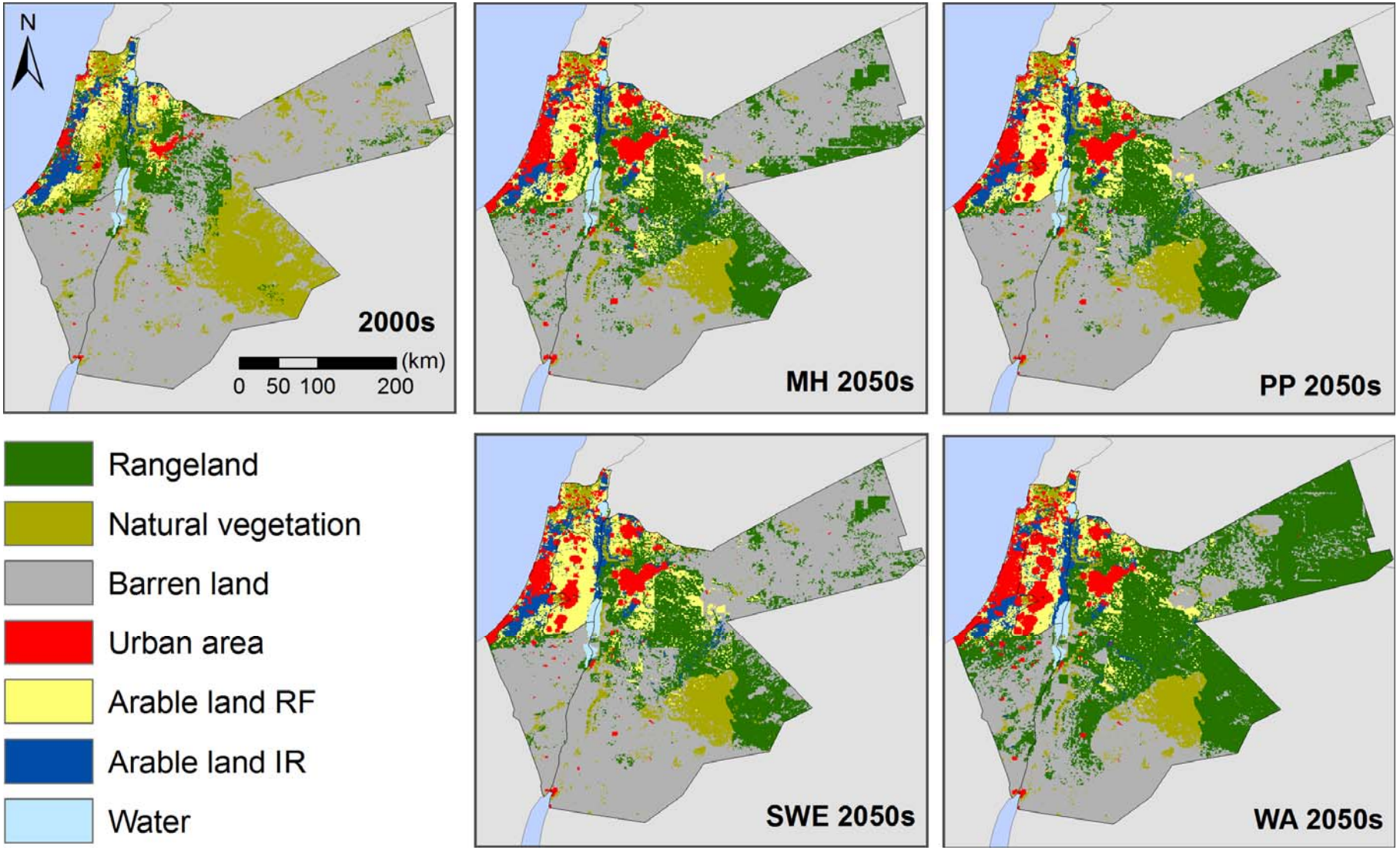


Production based on scenarios of Millenium Ecosystem Assessment + FAO data scaled with GLOWA JR population scenario



LandSHIFT.R results based on input from SAS, WADISCAPE, VALUE (Koch, 2010)

Calculated land-use change patterns



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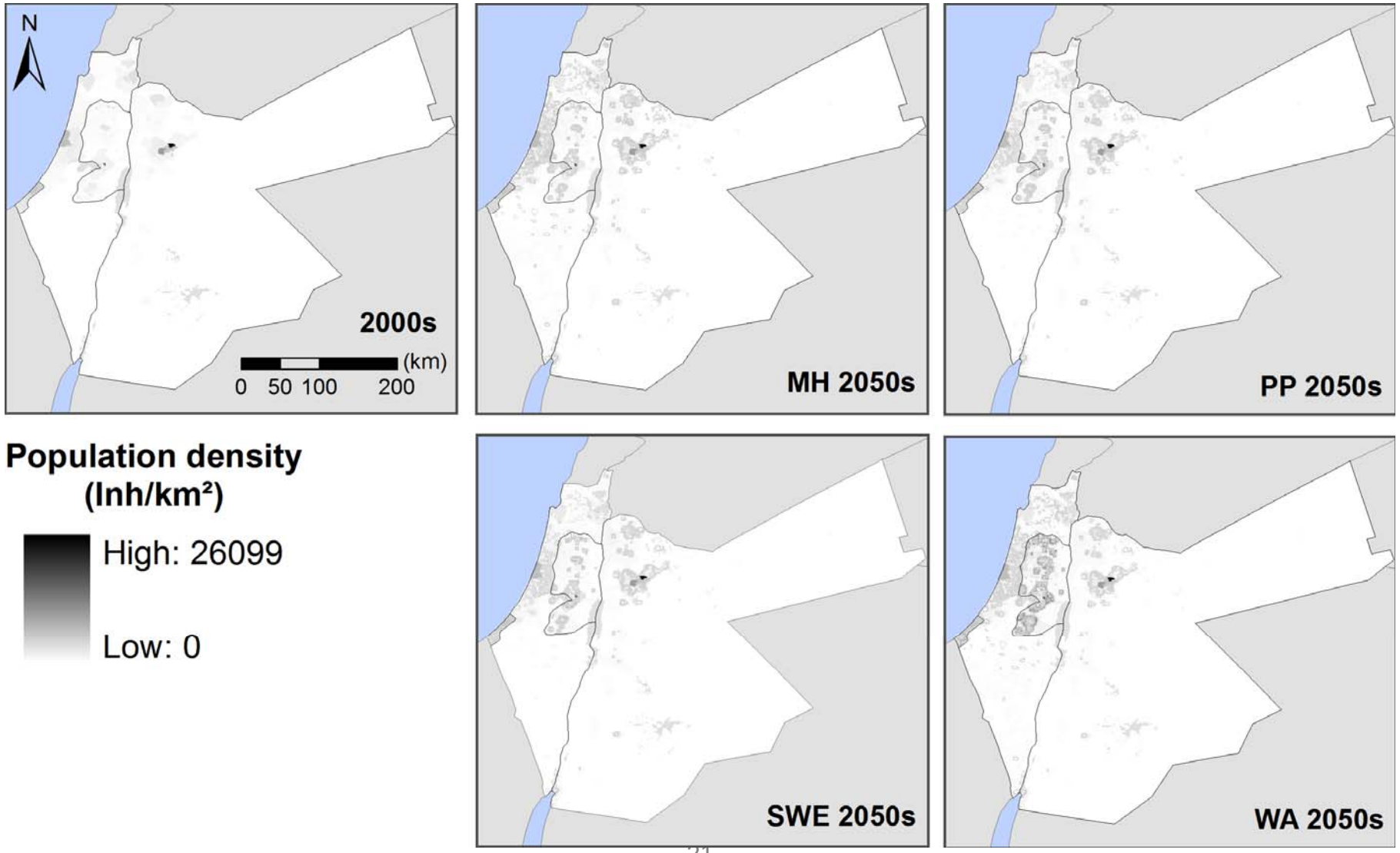
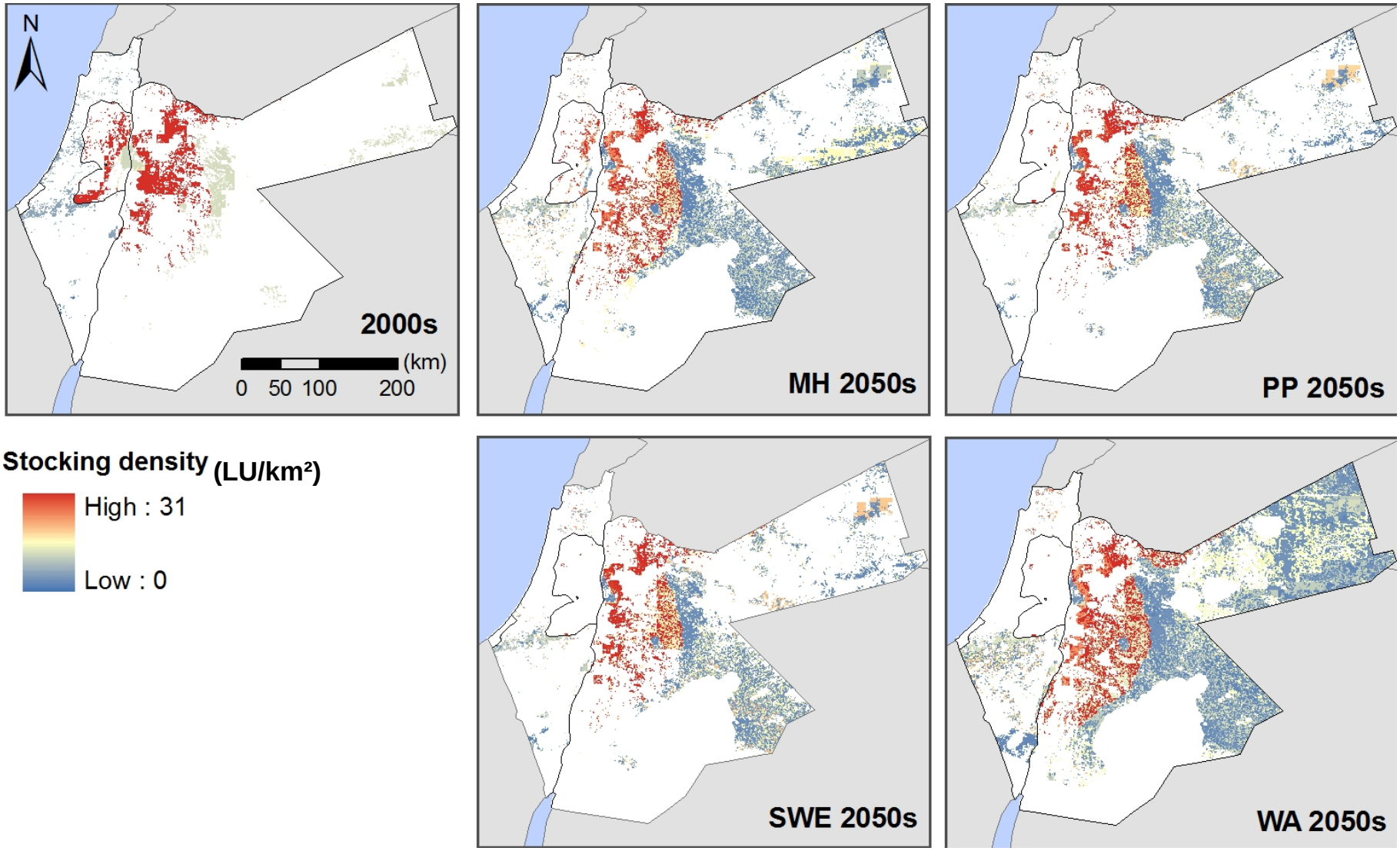
Population density



Stocking density



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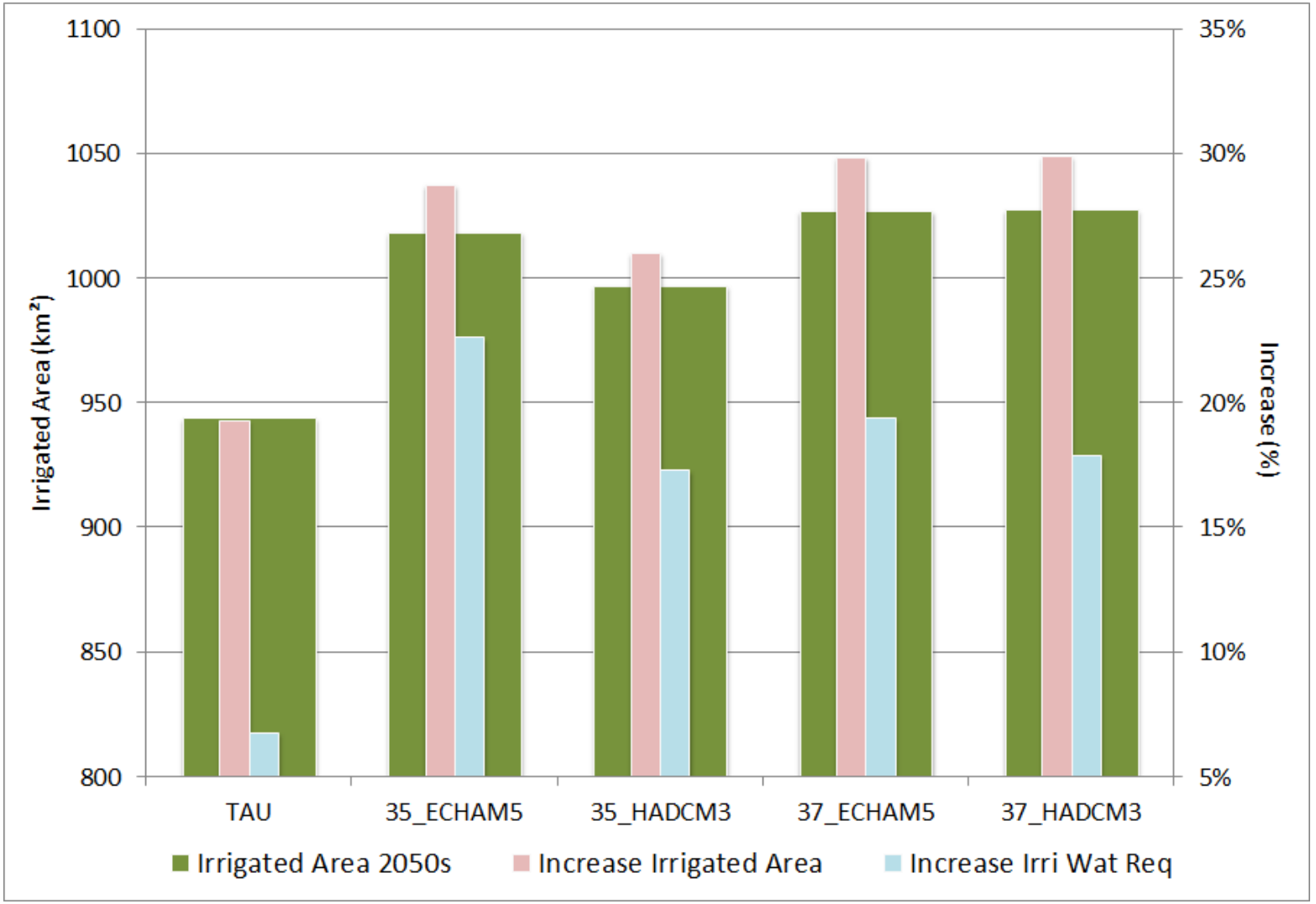
Climate Change – Impact on area and irrigation



Values only for Jordan and PA

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Summary and conclusion

- Deforestation is one aspect of land-use change and must be seen as the result of different drivers.
- Spatially explicit models such as LandSHIFT integrate socio-economic and environmental drivers to simulate land-use changes.
- The two examples illustrate how these models can be applied in context of a scenario analysis.
- Models might help to identify causes of deforestation and land-use change and are valuable tools to visualize effects of scenario assumptions.