Exploring green agricultural water policy scenarios with a spatially explicit agent-based model

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Presentation Outline

- Introduction
- Why using an agent-based modelling approach?
- Model overview: SERA
- Example Case study areas Winterswijk and Noord Oost Groningen
- Results
- Conclusion
- Future work

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Triggering CAP 1/3

- Environmental issues increasingly need to be addressed at the landscape or catchment scale, whereas so far policy addresses mainly individual farmers
- Implications of “CAP towards 2020”-reform (e.g. priority on water use and water quality)
- In the Netherlands, farmer groups get an official role in Agri-environment-climate schemes (AES), both as client and beneficiary

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Triggering CAP 2/3

- Farmer groups may play a role in greening the CAP (1st pillar)
- Implementation of rule: 2016
- Question: (partly) collectively EFA and/or agri-environment-climate measures
- Role for waterboards?

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Triggering CAP 3/3

- Lack of knowledge assessment institutional aspect water schemes
- Quantitative tools needed that relate spatial conditions of water related goals
- Dynamics in land use and ownership

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Objective

‘The objective of this paper is to provide insight into the spatial, ecological and economic impact of applying collective approaches for both Pillar I greening measures and Pillar II agri-environment measures through experimentation with different scenarios using a spatially explicit agent-based model. ’

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Why agent-based modelling?

- To capture heterogeneity between farmers
- To better understand non-linear, stochastic dynamics between farmers and the environment (water system) within agricultural landscapes (more is needed)
- To include dynamics in spatial explicit way
- To assist in the identification, design and evaluation of policy interventions

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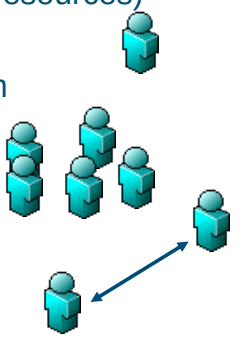
SERA: model overview 1/3

- A spatial explicit landscape represented by actual parcels containing several attributes: ownership, size, current land use, agricultural quality (including water resources)
- Decision rules farm agents following from
  - Keeping track of number of parcels in use
  - Age
  - Price expectations
  - Financial indicators
  - Nitrogen and feed production balances



- Calculate parcels contribution to farm income (land rent)

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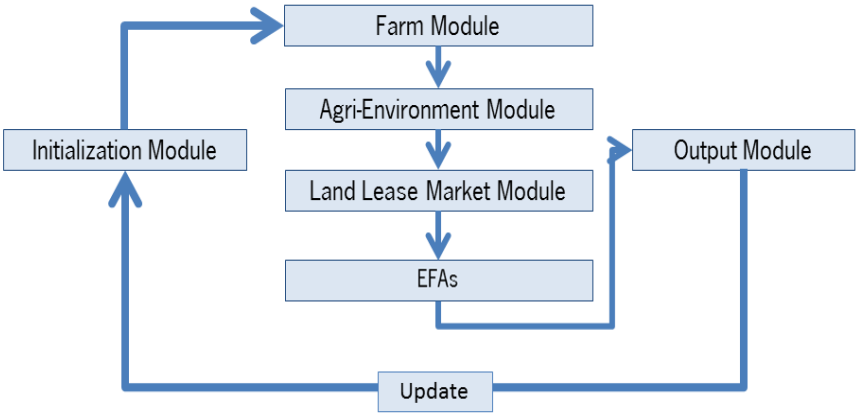
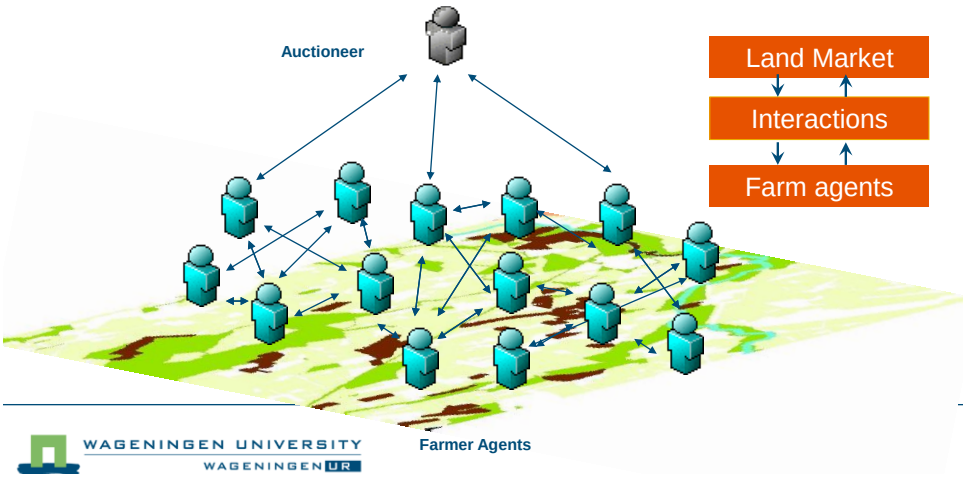
SERA: model overview 2/3



SERA: model overview 3/3

- A farm agent in SERA is an *'independently acting entity that decides autonomously on its organization and production to pursue a defined goal (e.g. to gain the highest profit)'.*
- A farm agent reacts to changes in its environment and its factor endowments

Land Market



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Including conservation cohesion in the ABM

- Adjusted Reilly index: to calculate the impact of surrounding water conservation areas (= NCA) on the potential for water conservation by sites with AESs

- Adjusted Reilly-index for AES site $_i$ =

$$\sum_{j=1}^{J} \frac{\text{Size of NCA j (within radius)} + \text{size AES site i}}{(\text{distance of site i to NCA})_{ij}^2}$$

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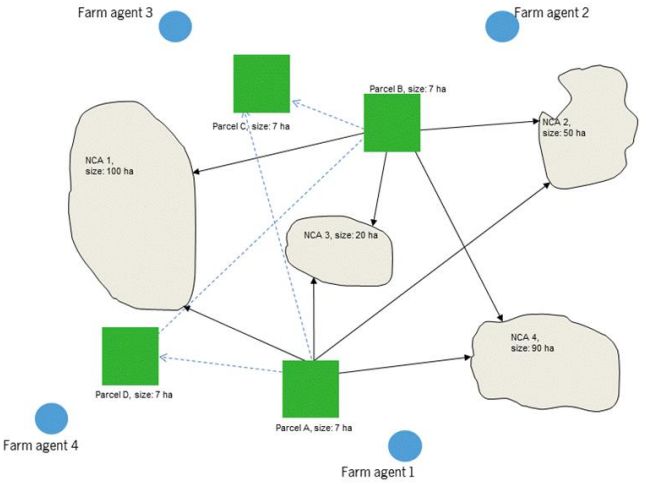
Example water measure

- 4 Farmers
- 100 ha/farm
- Area based measure



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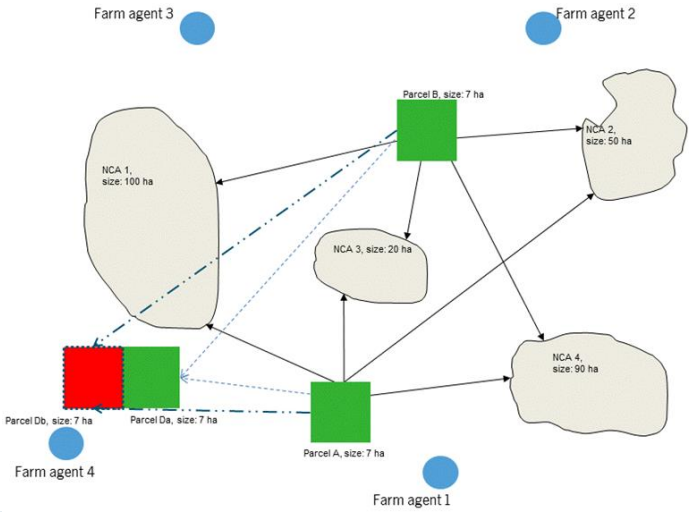
Example: exchange



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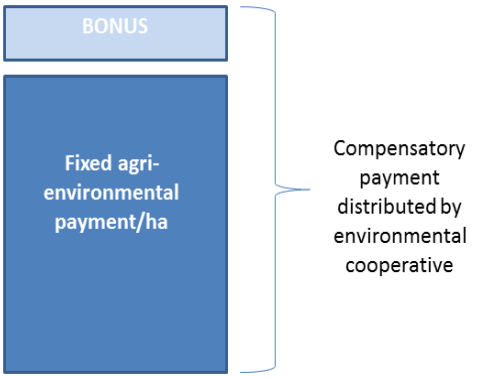
Exchange: mechanism

- Fixed payment per hectare in initial situation
- Limited budget
- Collectieve implementation:
  - Bonus to simulate convincing power of collective of famers



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Spatial representations case studies in ABM

- Winterswijk / North eastern part Groningen
- 206 specialized dairy farmers / 564 arable farmers
- Agricultural area 7.000 ha / 39.000 ha
- Grassland / field margin

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Results I

Area	Indicator	Unit of analysis	Scenarios		
			Base (no policies)	Current EC proposal	Collective approach
Oost-Groningen	Contracted points	%	0	32.4	31.7
	Operational Profit	%	100	92.8	93.2
Winterswijk	Contracted points	%	0	53.0	52.0
	Operational Profit	%	100	98.2	98.4

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Results II

Area	Indicator	Unit of analysis	Scenarios		
			Base (no policies)	Current EC proposal	Collective approach
Oost-Groningen	Contracted points	%	0	52	93
	Operational Profit	%	100	101	102
Winterswijk	Contracted points	%	0	21	48
	Operational profit	%	100	115	111

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Conclusions 1/2

- The approach is novel and holds promise as a way to explore the impact of environmental cooperative decision making on rural areas.
- Insight is gained
  - into the complex dynamics of rural areas
  - while imposing different types of policy instruments with different types of management regimes to the system.

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Conclusions 2/2

- Other means of coordination besides prices and hierarchy, such as reciprocity and trust will require further model development.
- Future developments of more sophisticated indicators could add to the informative use of the model for studying water system dynamics while different policy measures are implemented.

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Questions?

Thanks for your attention!

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