UNIVERSITY OF TWENTE.

Deltares
Enabling Delta Life

Farmers' drought risk adaptation in the southwest Netherlands

-an agent-based approach-

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Drought adaptation

Increasing drought frequency and severity due to climate change

Deltaprogram: develop public strategies to secure future fresh water availability
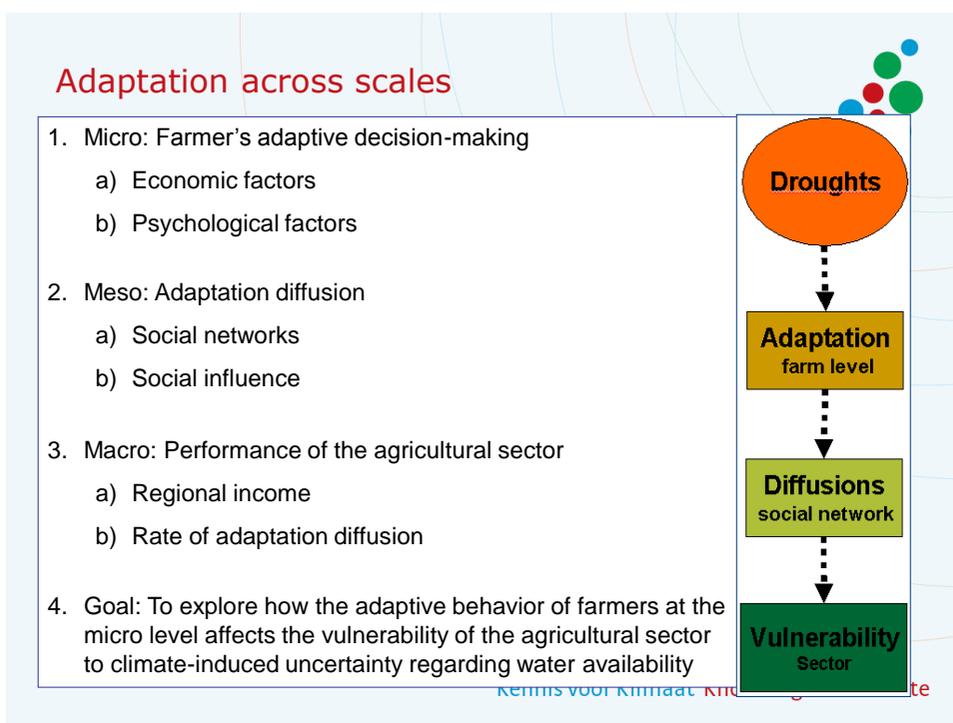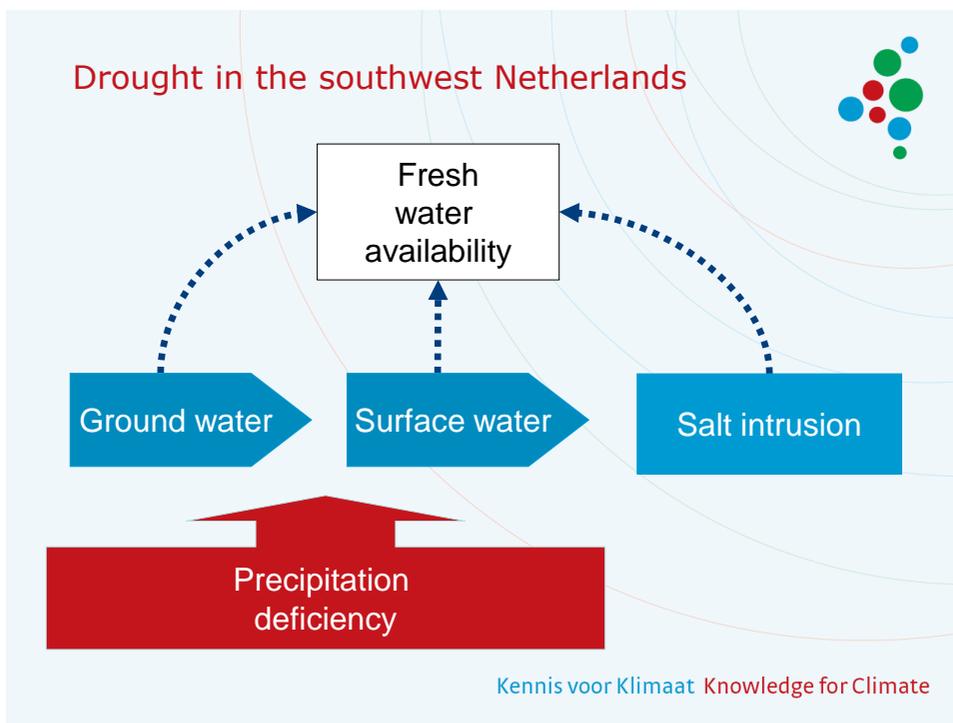
Understanding drought risk: hazard, exposure, sensitivity and <u>adaptive capacity</u>

Uncertainty on private adaptation: how will the sector respond to droughts and what are the consequences?

Important to address this issue:
- To align public and private adaptation initiatives
- For policy formulation: which factors are potentially able to enhance the adaptive capacity

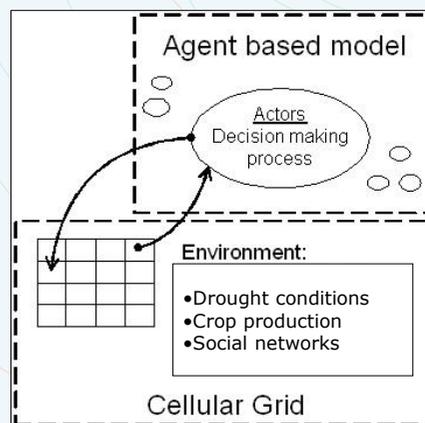Kennis voor Klimaat Knowledge for Climate

Drought in the southwest Netherlands

Fresh water availability

Ground water → Surface water → Salt intrusion

Precipitation deficiency

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Adaptation across scales

1. Micro: Farmer's adaptive decision-making
   a) Economic factors
   b) Psychological factors

2. Meso: Adaptation diffusion
   a) Social networks
   b) Social influence

3. Macro: Performance of the agricultural sector
   a) Regional income
   b) Rate of adaptation diffusion

4. Goal: To explore how the adaptive behavior of farmers at the micro level affects the vulnerability of the agricultural sector to climate-induced uncertainty regarding water availability

Droughts → Adaptation farm level → Diffusions social network → Vulnerability Sector

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Agent-based modeling

Typically, ABMs consist of two components:
1. The environment:
    a) Bio-physical environment
        1. Drought conditions
        2. Crop production
    b) Social environment
        1. Social network
        2. Social influence

2. The agents:
    2. Characteristics (farm. crops. network)
    3. Behavioral rules

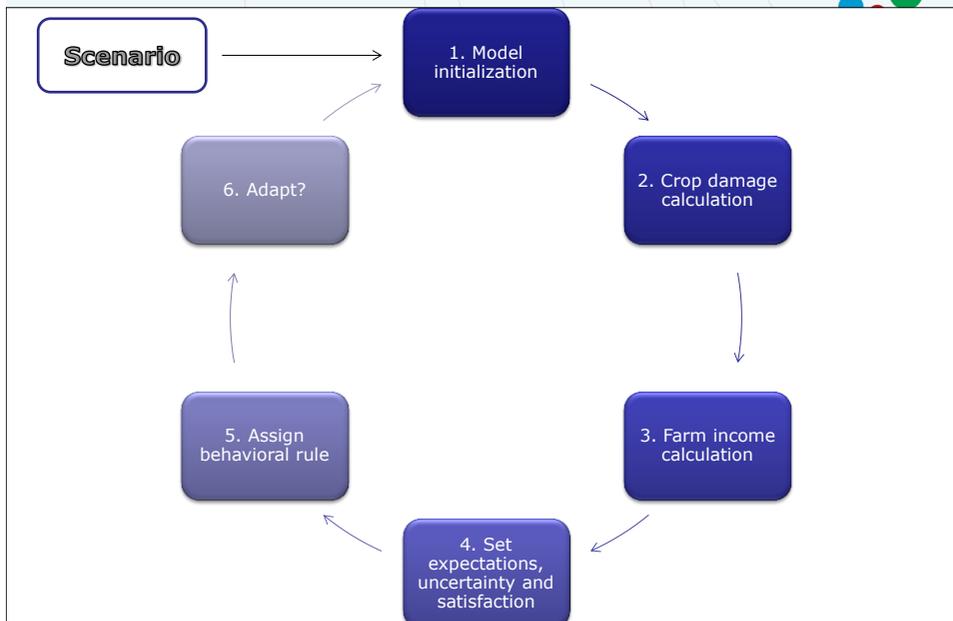→ Many micro-level decision give rise to macro phenomena

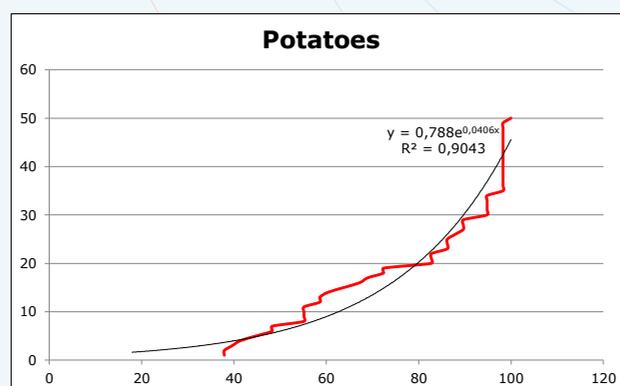Kennis voor Klimaat Knowledge for Climate

Conceptual model
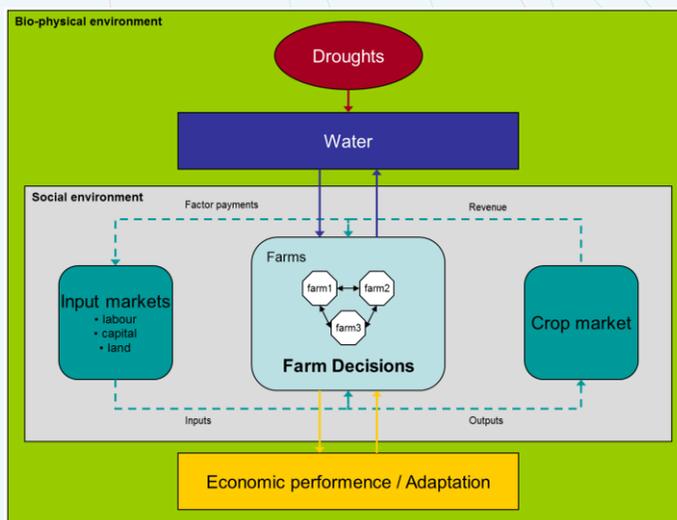
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Model sequence

Step 1. Model initialization

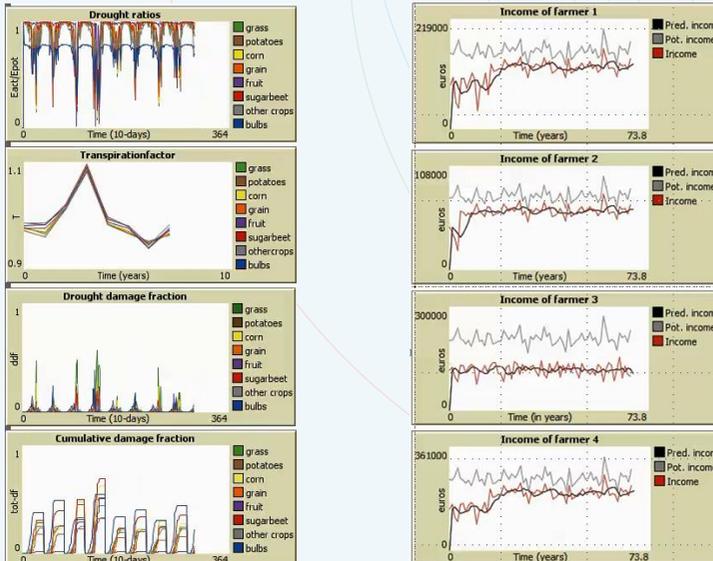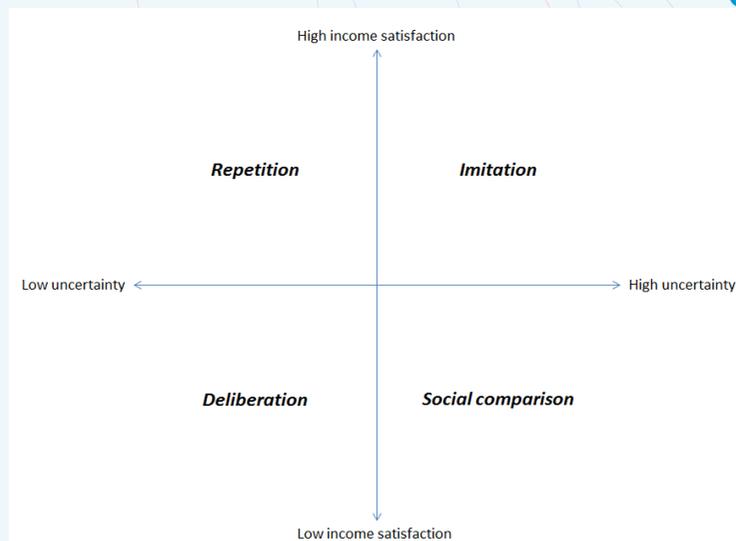| Environment	Agents	Social Network	Climate scenario
GIS grid 100m * 100m	Location	Number of connection	Current climate
Owner	Number of fields	Social influence	Warm/dry climate
Crop	Cropping pattern	Social susceptibility	
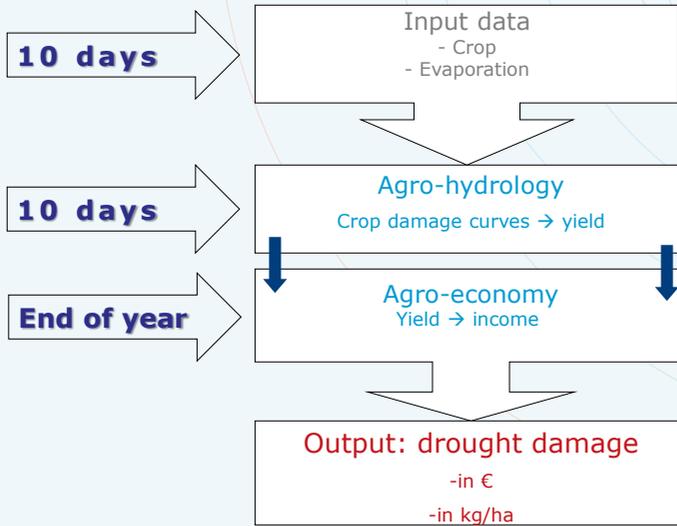
Step 2 & 3: Crop damage and Income calculation

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Farmers' decision-making: Consumat theory

High income satisfaction

Repetition   *Imitation*

Low uncertainty ← → High uncertainty

Deliberation   *Social comparison*

Low income satisfaction

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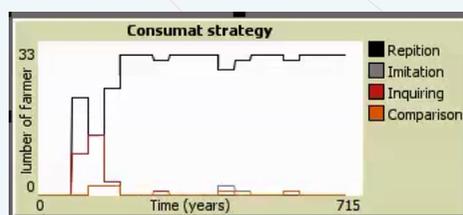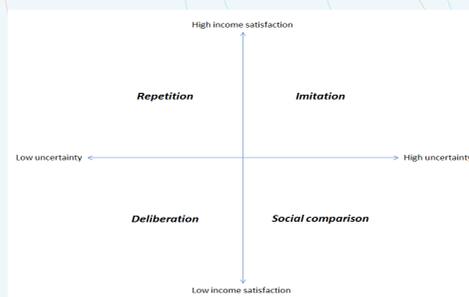
Step 4: Expectations, Uncertainty, Satisfaction

- Uncertainty: 1- (actual income / predicted income)

- Predicted income (expectations): N year moving average

- Uncertainty tolerance: standard normal distribution

- Satisfaction: actual income / potential income

- Aspiration level: standard normal distribution

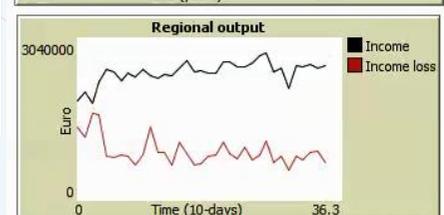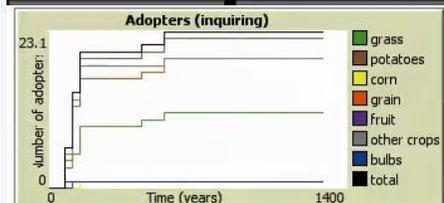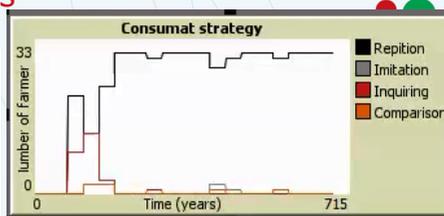Kenr   nate

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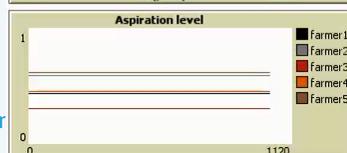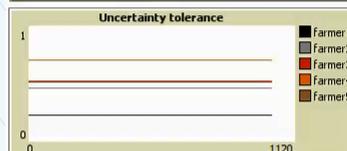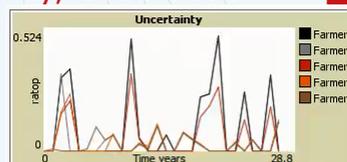
Step 5: Assign behavioral strategy

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Step 6: Emergent outcomes

- The model detect two feedback effects:
  - Behavioral strategy
  - Regional output

- Rate of adaptation is strongly dependent on the sequence of drought years

- Regional economic output increases with adaptation

Future work and experiments

1. Extend the adaptation options

2. Adaptation under different climate change scenarios
    1. Current
    2. W^+ – physical impact of CC
    3. W^+ – physical impact + price change

3. Rational (fixed) vs. consumat (adaptive) agents

4. Objective risk perceptions vs biased risk perceptions
    1. Objective RP
    2. Subjective static
    3. Subjective dynamic (risk experience)

5. Different topologies of social networks

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Thanks for your attention!

Questions?

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