

# Transfers of vulnerability in farming system adaptation within complex systems

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# Agriculture facing Climate Change

- Flood
- Sea level rise, coastal erosion
- Drought
- Pest management
- Changing energy access
- Development of infrastructures



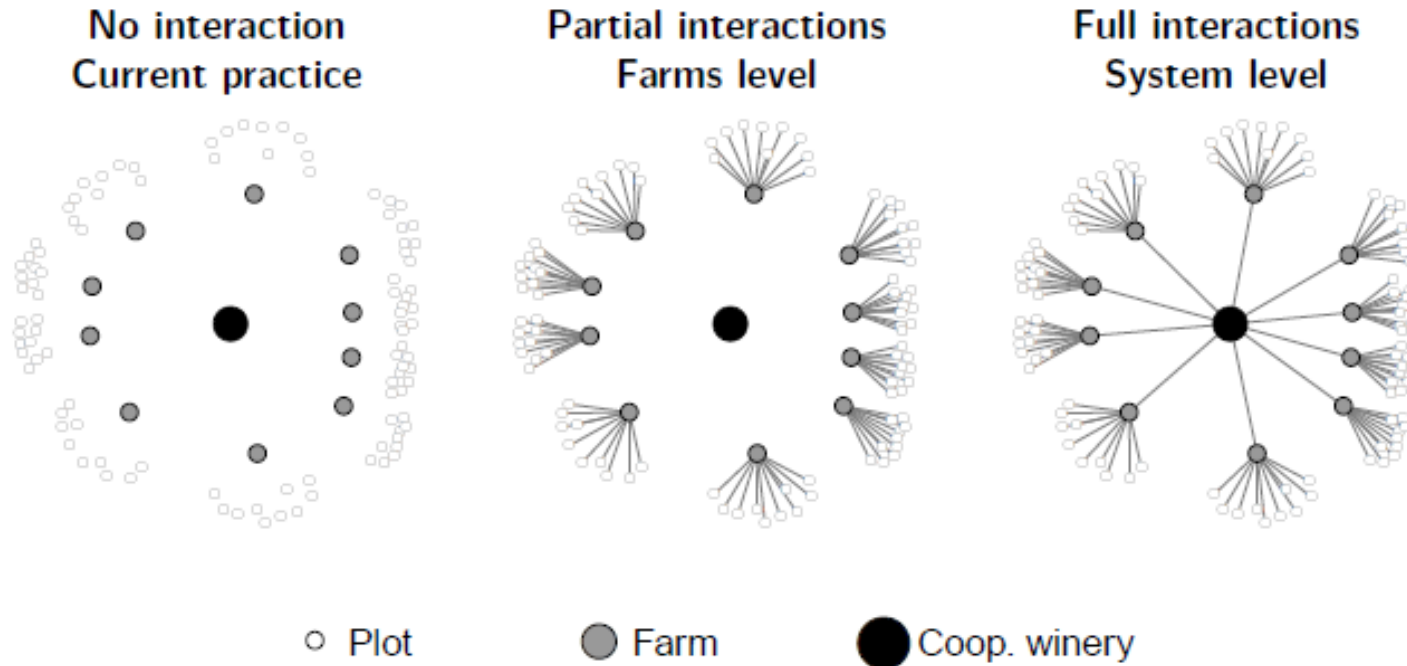
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# Adaptation to flood: cascade effects

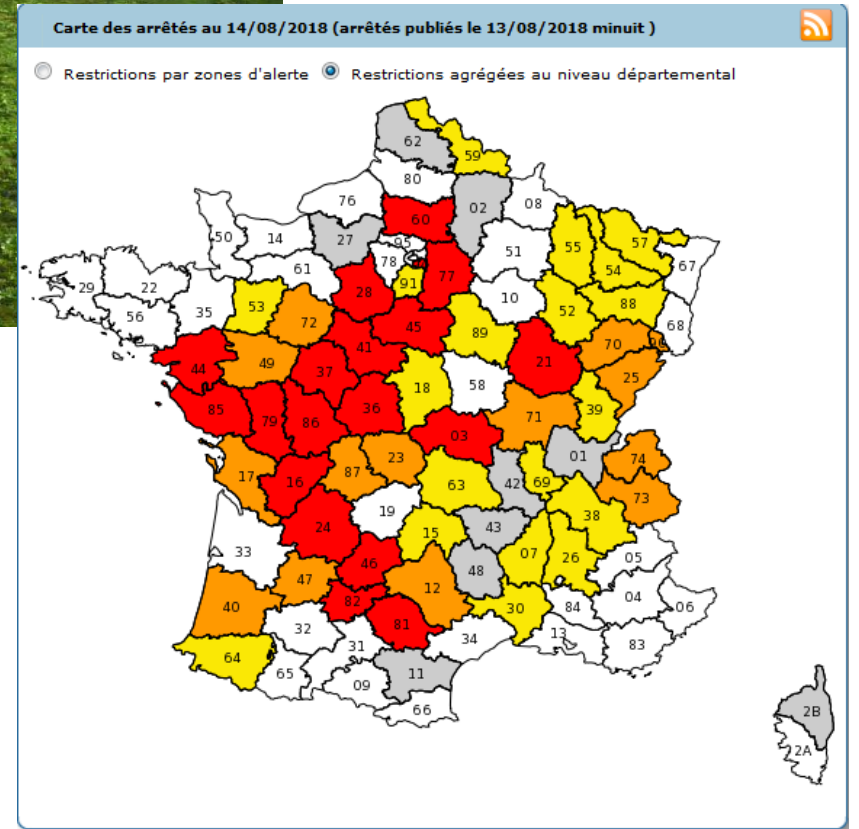


- ❖ Consequences of others' adaptation
  - Overflooding agricultural land
  - Sharing land in case of strategic retreat

*Nortes Martinez, D. « Prise en compte de la multiscalarité dans la modélisation économique de la vulnérabilité aux inondations. Apport d'un modèle multi-agent appliqué aux systèmes coopératifs viticoles », Université de Montpellier, 2019*



# Adaptation to drought: a complex issue





# With a diversity of propositions



ENVIRONNEMENT

60 actions pour lutter  
contre le changement climatique



# Plan Climat

» [laRegion.fr](http://laRegion.fr)



# And a diversity of framings: social hydrological systems



- Open Systems with blurred boundaries
  - Ambiguity in policy arenas
- Multiple interests
  - Ambiguity in evaluation criteria
- Need for:
  - consistent tools to monitor/ pilot/ explore
  - Robust participatory settings



# Challenged by intensification of global changes



- Climate, Urbanization
- New demand for food, energy...
  - Quantity, quality
- Technical changes
  - Practices, varieties
- Change in access to resources
  - Interconnections, treated waste water reuse
- New information availability
  - Big data, connected objects
- Exploring new institutional tools
  - Insurance systems; protected origin



# Innovation in drip irrigation in Maghreb

- Strong expectations for water saving
  - Lower consumption to avoid groundwater depletion
  - Issue of efficiency: farmers and their objectives & practices
  - Suitability of outscaling from the lab to the agricultural region
- No conclusive evidence of benefits
  - Use of surplus water for intensification, continued decline of water tables
  - Water saving at field level, not at regional level
  - Allocation of « saved » water to be handled



*Van der Kooij S., Zwarteveen M., Boesveld H., Kuper M., 2013: The efficiency of drip irrigation unpacked. Agricultural Water Management, 123, 103-110*

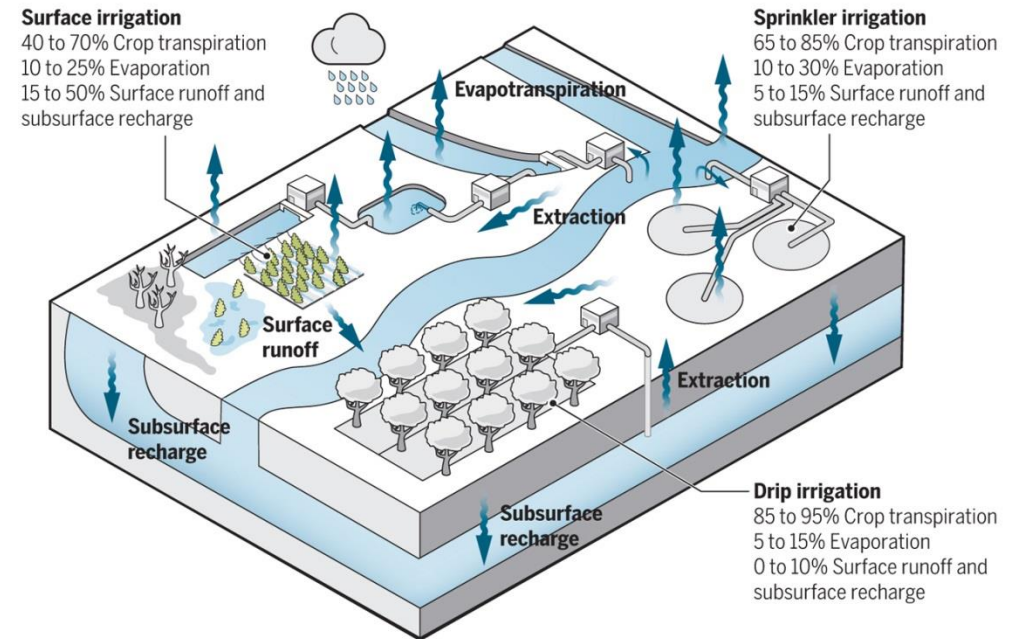


# Transferring farm vulnerability to basin vulnerability: *Taking in account return flows*

- Egypt (Perry et al. 2017)
  - All return flows contribute to resource
  - Increase of on farm irrigation efficiency does not mean water saving
  - Need to address destination of excess flows
- Australia (Perry et al. 2017)
  - Assumption of zero return flows in Murray Darling
  - Subsidies for on-farm water savings
  - Increase of on-farm water consumption

## Accounting for water

The paradox of irrigation efficiency (surface, sprinkler, and drip) and the water inflows and outflows can be seen in a watershed example. Ranges of crop transpiration, evaporation, runoff, and recharge are authors' judgment of possible values. These values depend on crop and soil types, weather, and other factors.



R. Q. Grafton et al. 2018

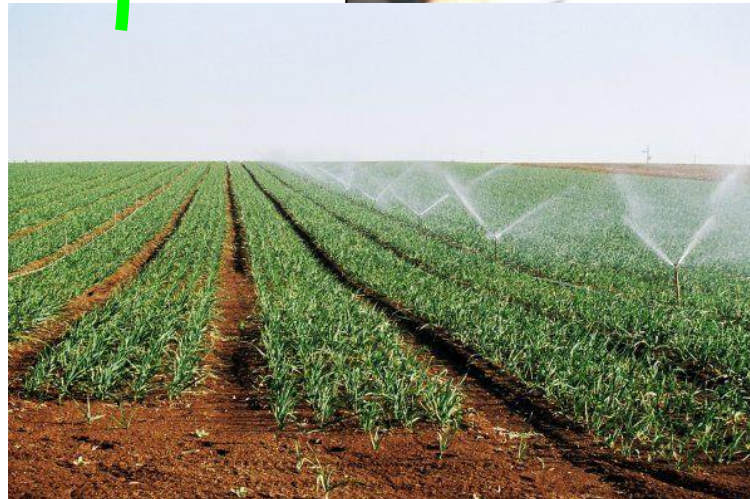


Grafton R. Q. et al. 2018. *The paradox of irrigation efficiency.*  
*Science*, 361 (6404): 748-750

Perry C.J. et al. 2017. *Does improved irrigation technology save water. A review of the evidence.* FAO, Cairo, 42p.

# Need for specific arenas

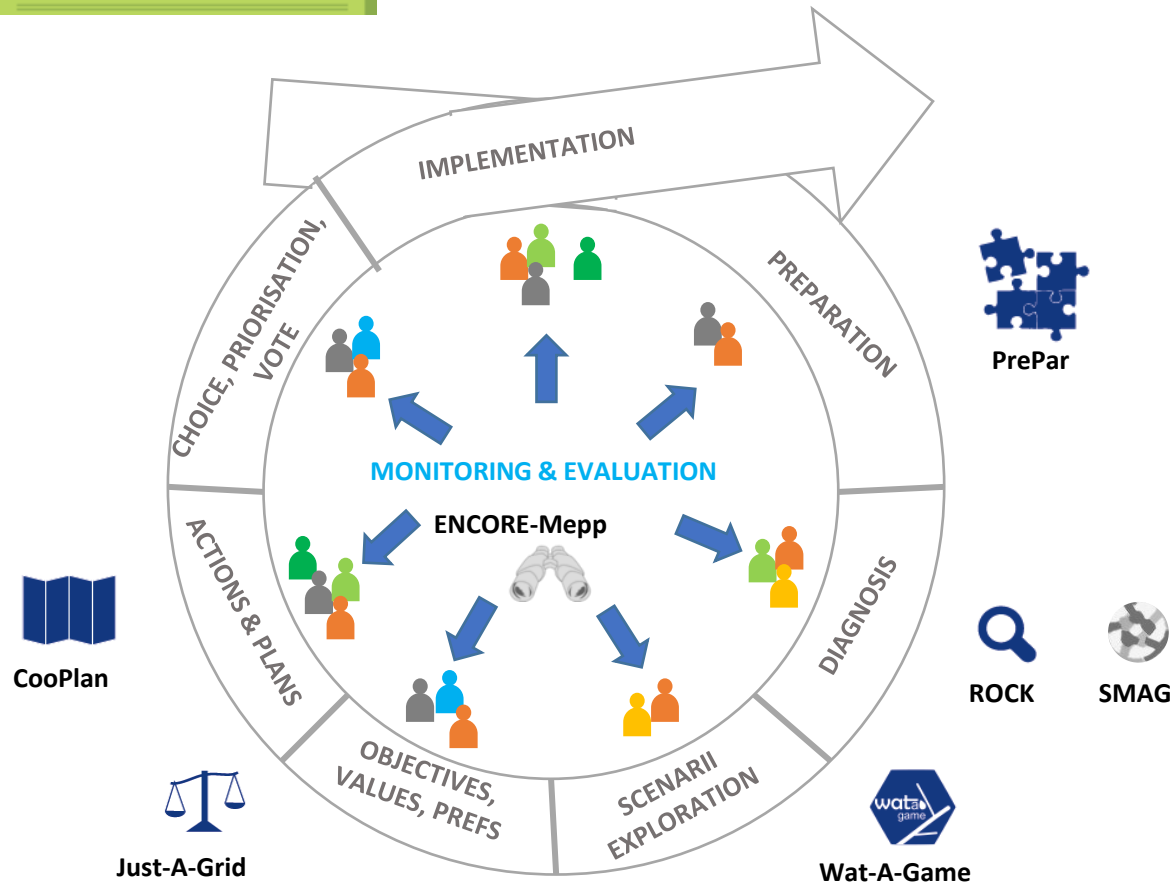
- Gathering suitable people
- Meaningful multiple scales and viewpoints
- With flexibility regarding stakes introduced and related flows
- And tools to explore scenarios





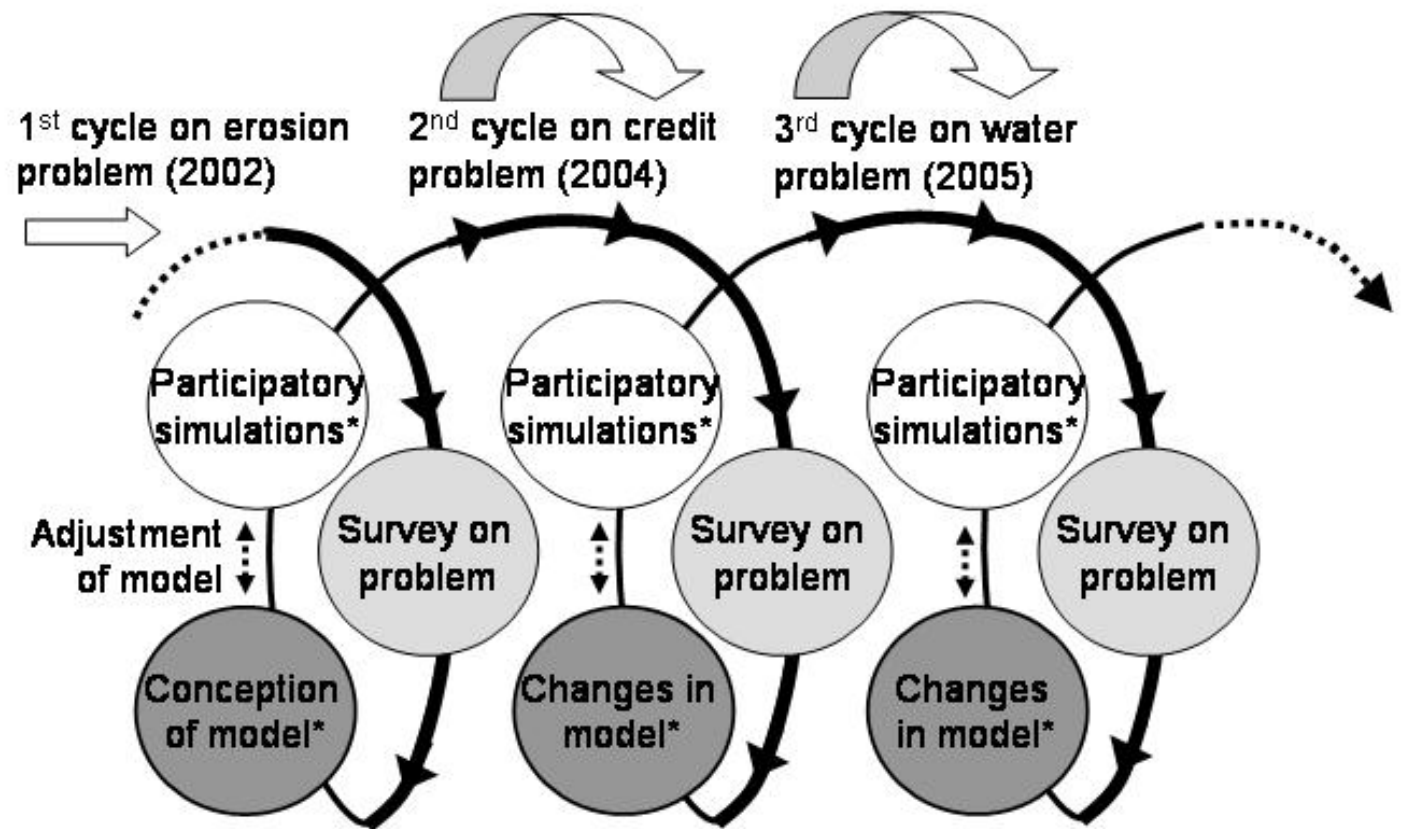
# Towards an open participatory platform

CoOPLAaGE



- Each step potential frame
  - Specific tool to involve stakeholders
- Need for continuous monitoring
  - Identify the evolution of the process
  - Reflexivity on its internal validity (= suit its principles)

# Sequence of cycles



\* 1 model, 2 forms : Role-Playing Game & Multi-Agent System

*Successive ComMod cycles conducted in Mae Salaep, Chiang Rai Province, 2002-2005 (Barnaud et al.)*



# Aména'jeu: Game with multi-scale interdependences

- 4 autonomous tables having to coordinate
- Focused on infrastructures
- Consequences of choices of other tables
- Dialogue arenas among table representatives



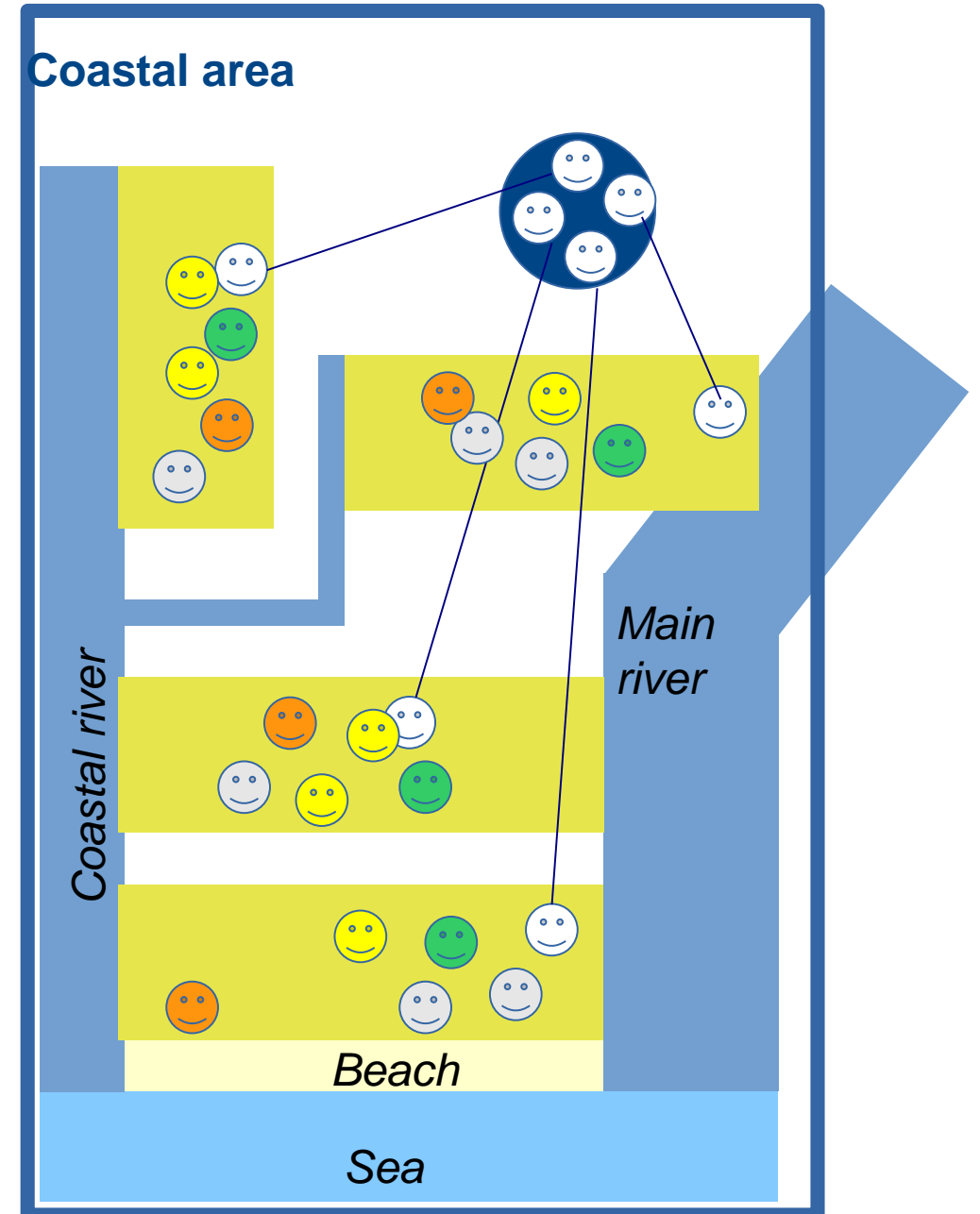
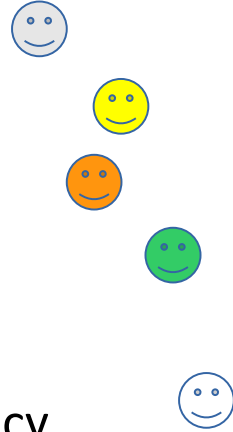
**MAGIC**  
**BELMONT**  
FORUM

*Bonté, B., Therville, C., Bousquet, F., Abrami, G., Dhenain, S., & Mathevet, R. (2019). Analyzing coastal coupled infrastructure systems through multi-scale serious games in Languedoc, France. Regional Environmental Change, 19(7), 1879-1889.*

# Setting in French case

## Participants' roles

- « aména-joueurs »
  - Urban
  - Agriculture
  - Tourism
  - Conservation
- « elected DM »
  - Planification/  
seeking consistency
- facilitators
- observers





# Take Home messages

- Diversity of sources of vulnerability of farming to climate change
  - Type of processes
  - Scales considered
  - Multiplicity of flows
- Context matters
  - Cascade effect
  - Feed back loops
- Tools are emerging: participatory settings, policy analytics
- Need for reflexivity
- Agricultural vulnerability management as a continuous open process