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Diversification within rural areas and resilience – the TERESA agent-based model

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Content

General modelling approach in TERESA

What is resilience?

- Internal or external shocks and stresses

What is diversity?

- Variety, balance & disparity

The TERESA agent-based model

- Evolving agricultural supply chains

Evaluating resilience of pathways

- Function & structure

General modelling approach

AIM:

- Interactions between economic activity, environment and rural society between agricultural supply chains and rural region
- Investigate the role of diversity for the resilience of agricultural supply chains

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What is resilience?

Resilience can be characterized by three characteristics:

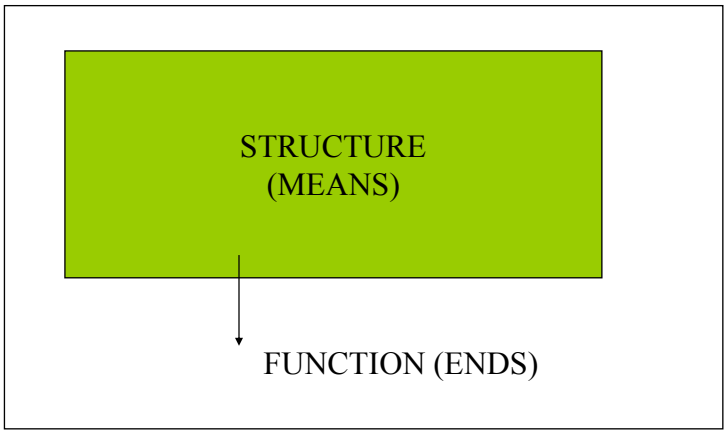
a) the amount of **disturbance** a system can absorb and still remain within the same state or domain of attraction,

b) the degree to which the system is capable of **self-organisation** (versus lack of organization, or organisation forced by external factors) and

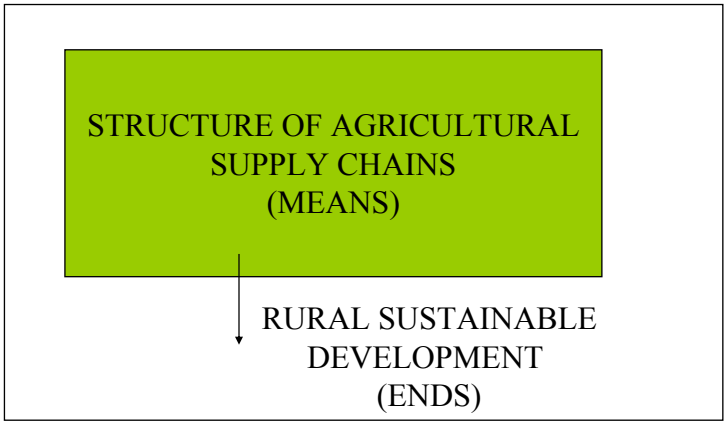
c) the degree to which the system can build and increase the **capacity for learning and adaptation**.

(Folke, Carpenter et al. 2002:4)

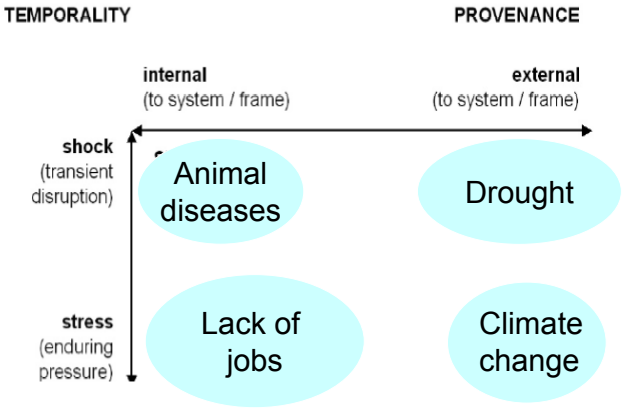
Conflating function and structure



The TERESA approach

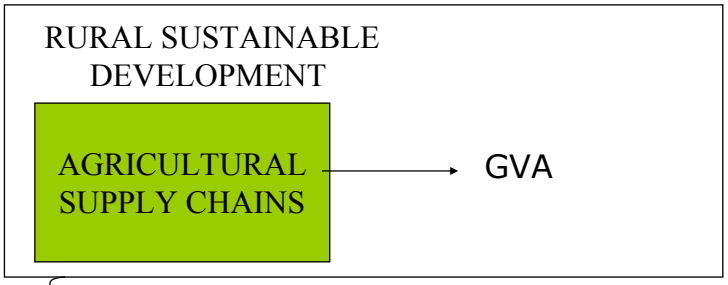


Evaluation of dynamic system properties



Ref: Stirling et al. (2007)

Application to TERESA



function
- How much is the GVA contribution?

structure
- How 'durable' is the GVA contribution?
- How 'stable' is the GVA contribution?
- How 'resilient' is the system contributing to GVA?
- How 'robust' is the system contributing to GVA?

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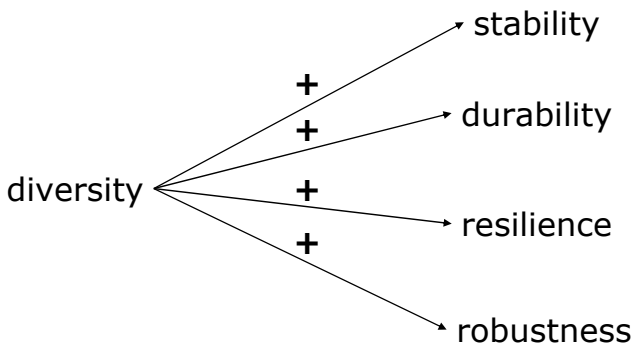
How to measure resilience?

- **Network theory**
  - Robustness, interconnectiveness, average path length
- **Process engineering**
  - Flexibility, redundancy
- **Ecology**
  - Length of time to recover versus the magnitude of the shock/stress, diversity

Why diversity?



What is diversity?

increasing diversity

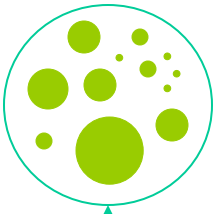
land use

comprising mix of options

eg: standard products, energy, forestry and unique products

What is diversity?

increasing diversity



variety

number of options in mix

eg: a region with five products vs. a region with ten products

balance

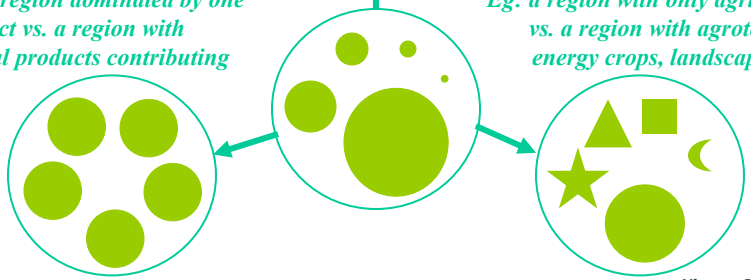
evenness in contributions

Eg: a region dominated by one product vs. a region with several products contributing

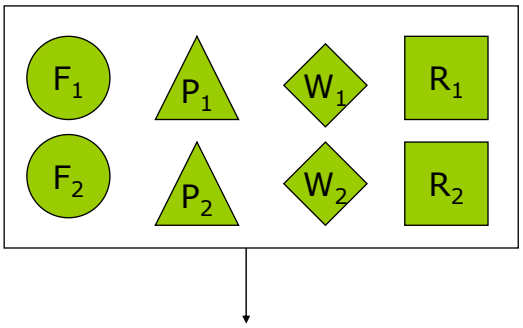
disparity

degree of differences

Eg: a region with only agriculture vs. a region with agrotourism, energy crops, landscape man.



Some examples



Variety: 8

$Balance_{F1:R2}$: 0.125

$Disparity_{F-F}$: 0

$Disparity_{F-P}$: 1

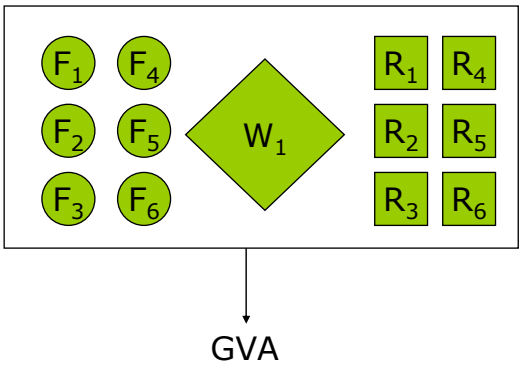
$Disparity_{F-W}$: 1

$Disparity_{F-R}$: 1

Etc.

F = farmers
P = producers
W = wholesalers
R = retailers

Some examples



Variety: 13

$Balance_{F1:F6}$: 1/18

$Balance_{W}$: 6/18

$Balance_{R1:R6}$: 1/18

$Disparity_{F-F}$: 0

$Disparity_{F-W}$: 1

$Disparity_{F-R}$: 1

F = farmers
P = producers
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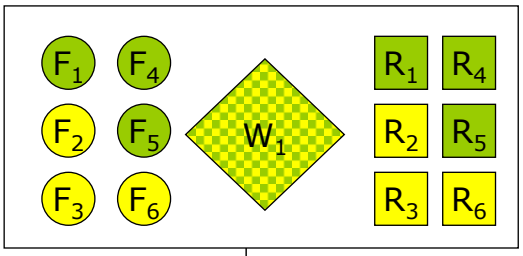
Some examples



GVA

Variety: 13

Balance$_{F1:F6}$: 1/18

Balance$_{W1}$: 6/18

Balance$_{R1:R6}$: 1/18

Disparity$_{F1-F6}$: 0.5

Disparity$_{F-W}$: 1

Disparity$_{R1-R6}$: 0.1

F = farmers
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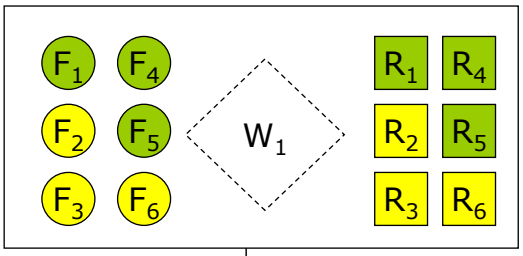
R = retailers

Some examples



Cultural value

Variety: 12

Balance$_{F1:F6}$: 1/12

Balance$_{W1}$: 6/18

Balance$_{R1:R6}$: 1/12

Disparity$_{F1-F6}$: 0.5

Disparity$_{F-W}$: 1

Disparity$_{R1-R6}$: 0.5

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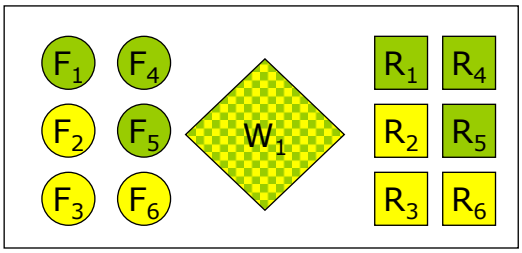
Heuristics for measuring diversity



i = actor

p_i = provision $actor_i$

D_{ij}= disparity between $actor_i$ and $actor_j$

$$D = \sum_{ij(i \neq j)} d_{ij} p_i p_j$$

F = farmers
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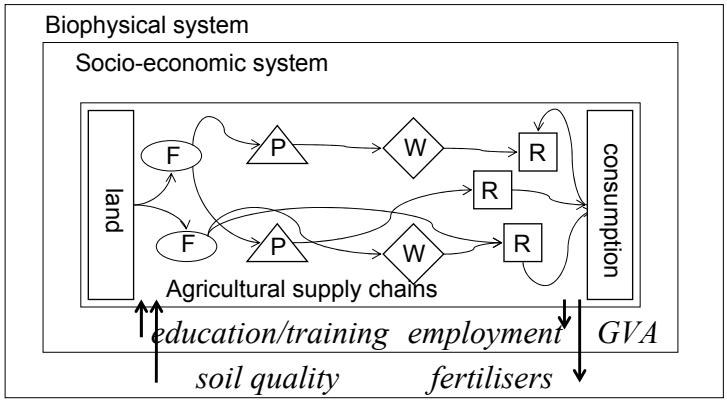

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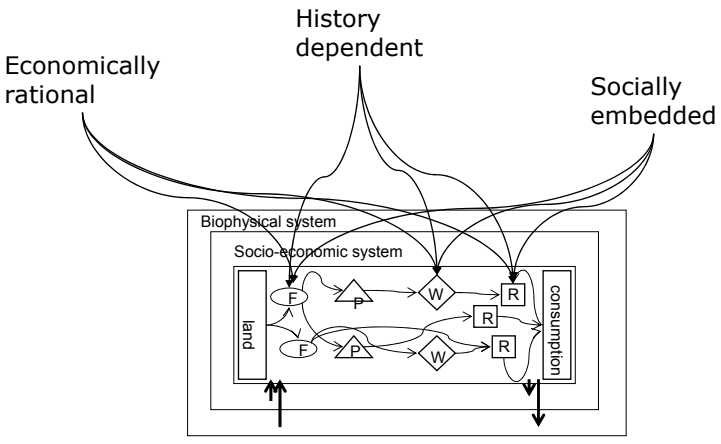

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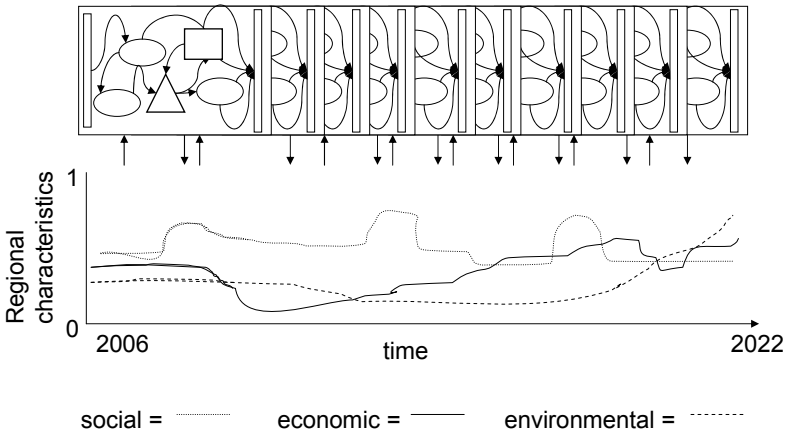

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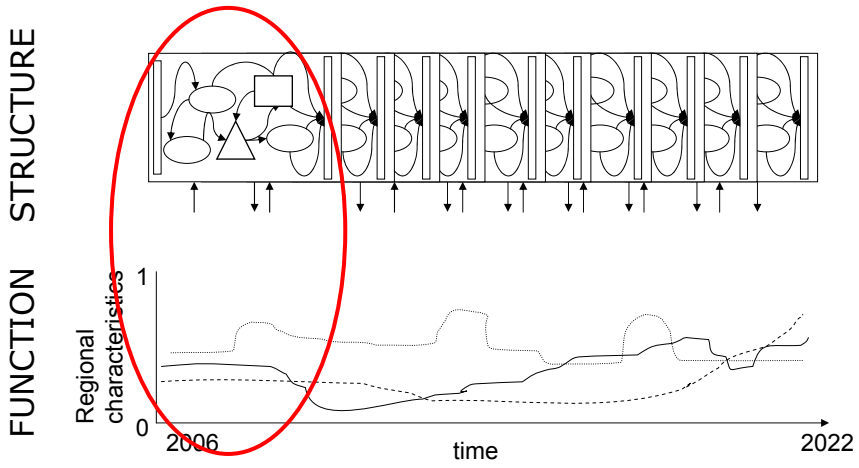
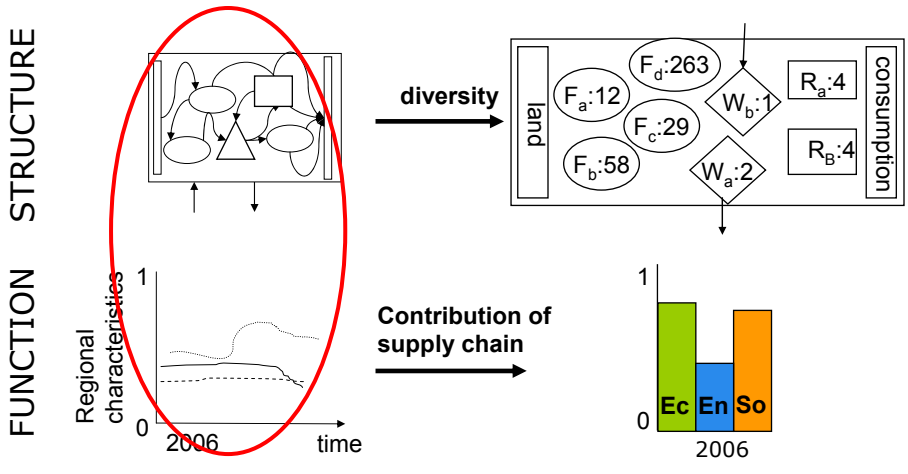
Modelling results



social = ····· economic = —— environmental = - - - -

Modelling results



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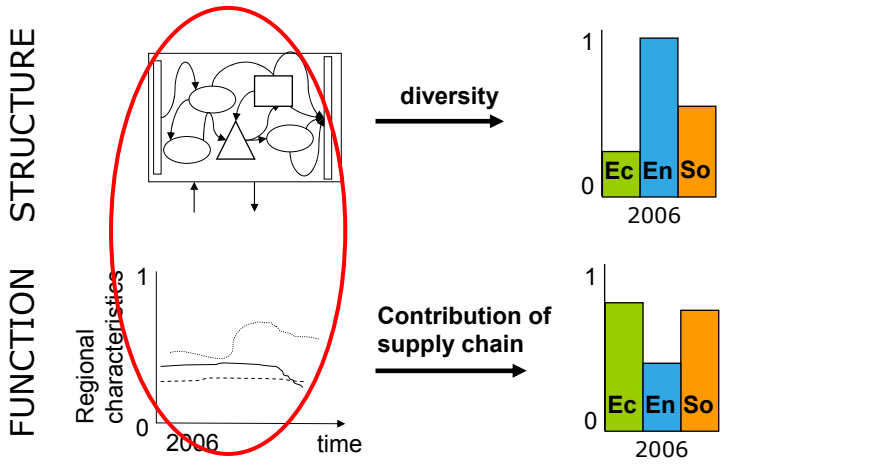
Modelling results



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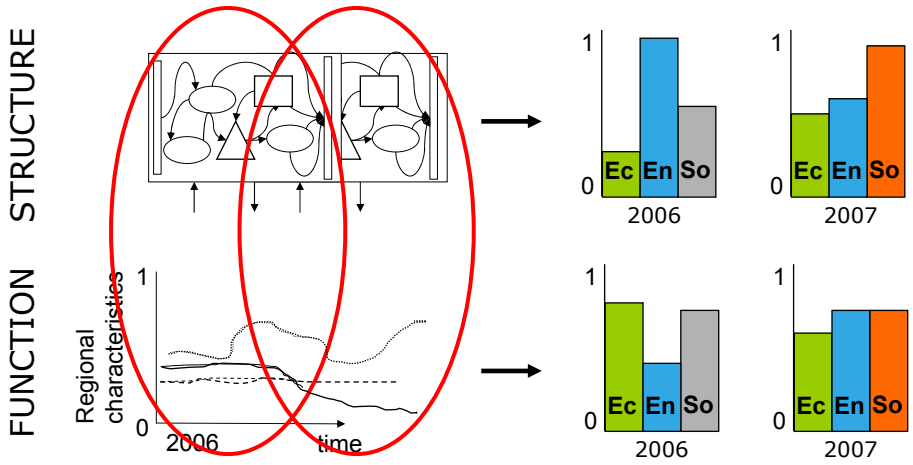
Modelling results



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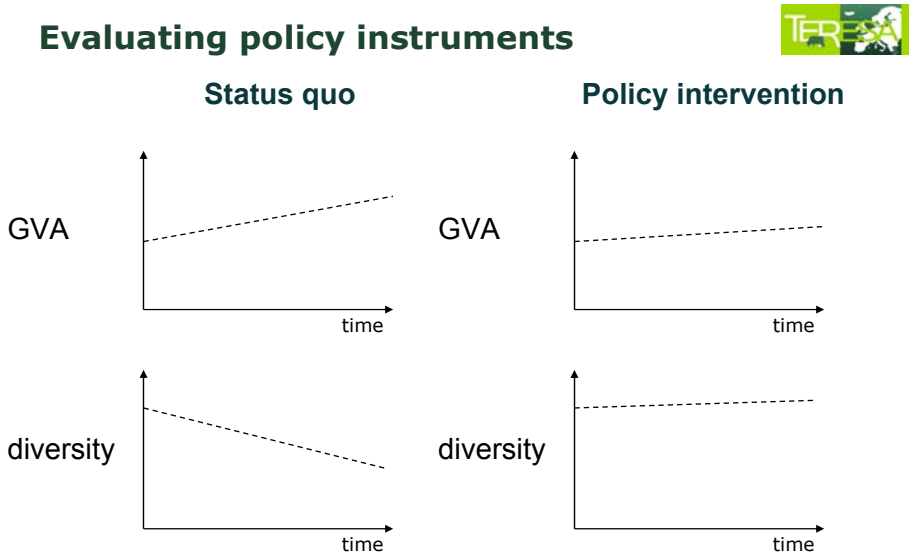
Evaluating policy instruments



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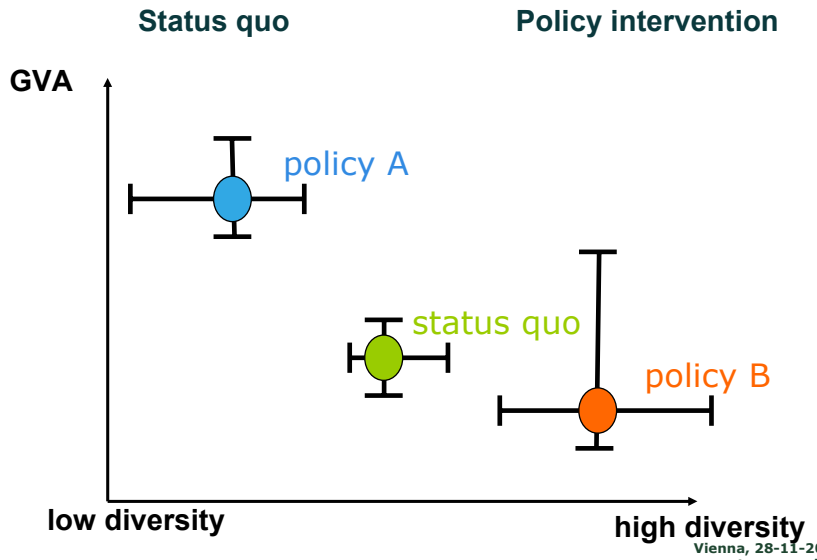

Pitfalls

1. Comparison within the same future scenarios
2. Comparison within the same region
3. Contributions measured in relative terms:

   - How efficient is the contribution provided? (ie GVA/capita)
   - How effective is the contribution provided? (ie GVA/soil quality)

Future questions

1. Augment analysis with qualitative interpretations
2. How to decide upon the level of analysis?
3. Incorporate the institutional actors within the region
4. Look at the relationships and behaviour between actors?
5. Is an increasing diversity always better? Or are there upper- and lower-threshold?
6. What's the relationship between 1) diversity, 2) redundancy and the 3)need to reward risks?