Resilience of livestock farming systems: concepts, methods and insights from case studies on organic farming

Guillaume Martin, Maëlys Bouttes, Augustine Perrin

guillaume.martin@inra.fr

UMR 1248 INRA / INPT
AGroécologies - Innovations - Ruralités

Equipe MAGELLAN

Farmers' adaptive capacities are real but challenged

Examples

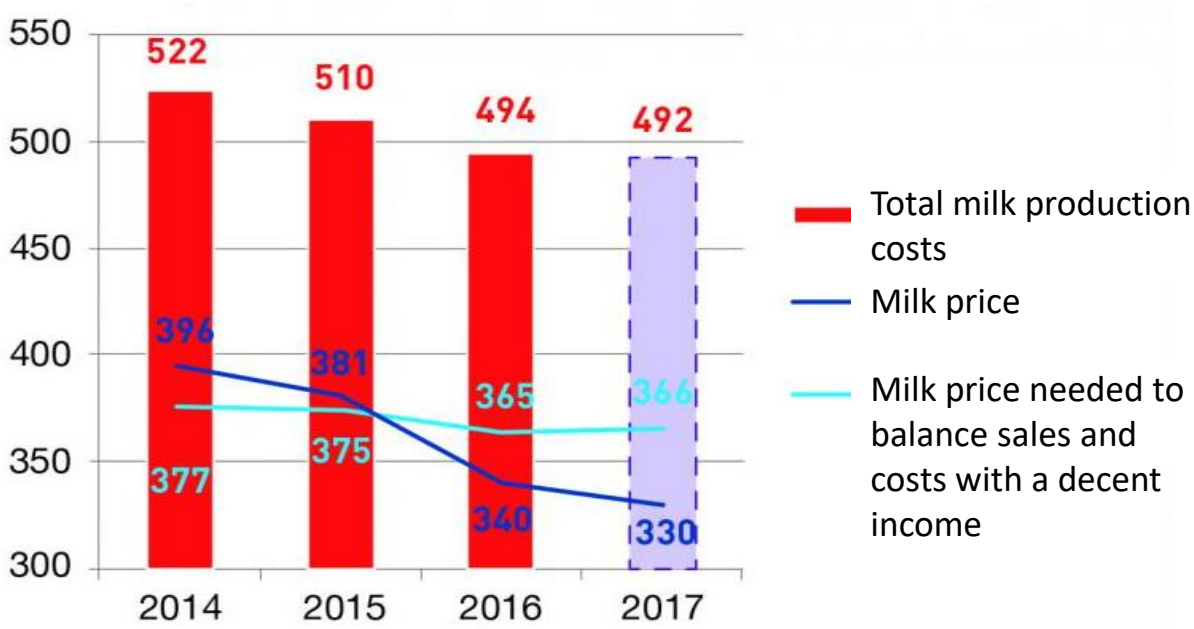
Milk crisis following the end of the quota system

→ In France, 10% of dairy farms close to bankrupcy (Le Foll, 2016)

Summer drought 2018

→ 30 to 60% of yield losses

→ 200-300 millions euros for pastures



Source : L'agriculteur Normand,
Data: Inosys réseaux d'élevage

Some hazards and changes are predictable
but many are not and their frequence and intensity tend to increase.
The resulting insecurity affects entire sectors, but also farms.

Resilience: emergence of the concept

- Resilience is a concept that addresses this new understanding of the world as being fundamentally unpredictable
- Resilience stems from the Latin resilire denoting the idea of 'bouncing back', i.e. rebounding or recoiling (Alexander, 2013).
- First used during the 19th century in mechanics to denote the ability of a material to resist the application of a force and absorbing it with deformation ➔ **resilience of what to what**
- Later in the 1950's in psychology
- And in the 1970's in ecology

Picture of the Wikipedia page for resilience in French

Ecosystems (2001) 4: 765–781
DOI: 10.1007/s10021-001-0045-9

ECOSYSTEMS

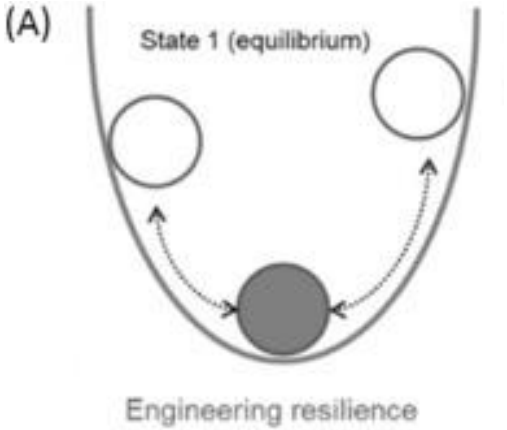
MINIREVIEW

From Metaphor to Measurement: Resilience of What to What?

Steve Carpenter,[1]* Brian Walker,[2] J. Marty Anderies,[2] and Nick Abel[2]

Resilience: definitions

Thoms et al., 2018



Buffering capacity
Ability of an ecosystem to remain within the critical thresholds of a given regime (Gunderson and Holling, 2002)

Adaptation/Transformational capacity as a core property of a resilient system (Darnhofer, 2014)

A management approach based on resilience "would emphasize the need to keep options open, (...) to devise systems that can absorb and accommodate future events in whatever unexpected form they may take" (Holling 1973: 21).

Application to agricultural systems

European Review of Agricultural Economics Vol **41** (**3**) (2014) pp. 461–484
doi:10.1093/erae/jbu012
Advance Access Publication 11 June 2014

Resilience and why it matters for farm management

Ika Darnhofer*

SURE Farm

Meuwissen et al., 2018

Farm resilience relates to the ability of the farm to address sudden shocks, unpredictable 'surprises' as well as slow-onset changes

Resilience covers **buffer, adaptive and transformative capabilities**

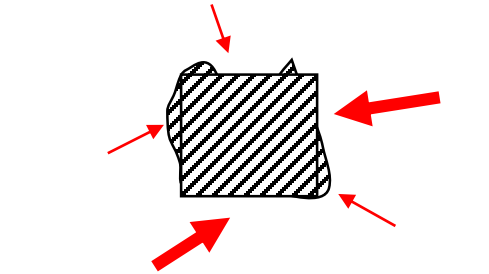
Capability: ability to identify opportunities, to mobilise resources, to implement options, to develop processes, to learn as part of an iterative, reflexive process.

Farm resilience relates to the ability to maintain its essential functions in the face of increasingly complex and volatile challenges

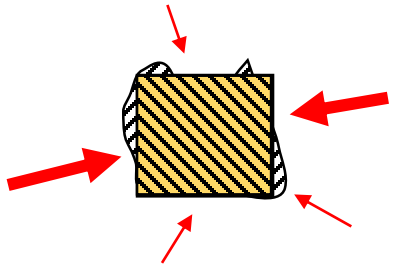
Resilience does not reflect separate properties of a system, but describes the dynamics of its sustainable performance.

Resilience types include **robustness, adaptive capacity** (adaptability) and **capacity to transform** (transformability).

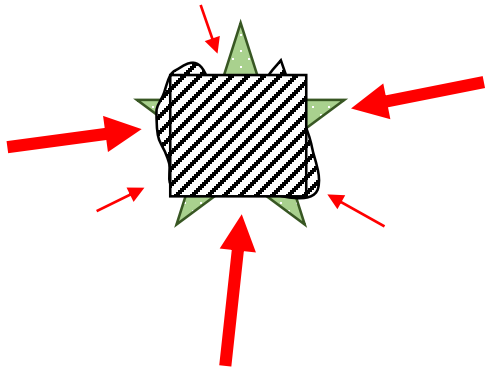
Buffer, adaptive and transformative capabilities



Buffer capability:
ability to assimilate a perturbation without a change in structure or function



Adaptive capability:
ability of a system to adjust in the face of changing external drivers and internal processes, thereby allowing for development while staying within the current stability domain



Transformative capability:

ability to implement radical changes. A transformation implies a transition to a new system, where a different suite of factors becomes important in the design and implementation of response strategies.

(Darnhofer, 2014)

Assessing and explaining farm resilience: quantitative methods

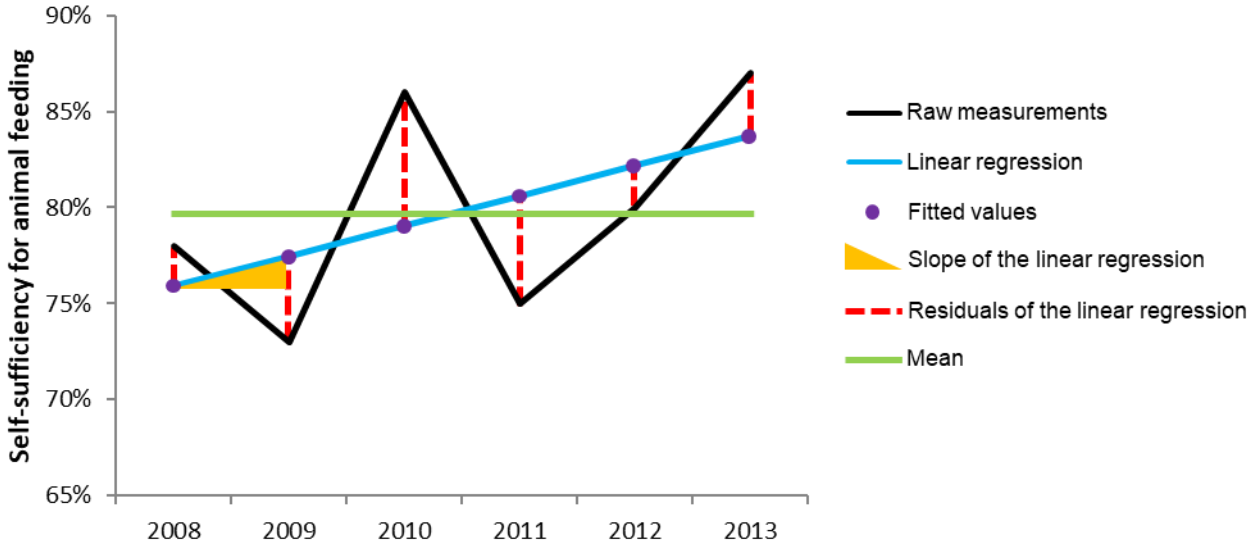
Martin et al., 2017

Step 1: Choosing resilience and explanatory variables	*Expert knowledge*
Step 2: Calculating farm-specific resilience and explanatory variables	*Mixed linear regression of vulnerability variables*
Step 3: Characterizing the diversity of farm resilience patterns	*Principal Component Analysis of resilience variables*
Step 4: Explaining farm resilience from explanatory variables	*Partial Least Squares regression of resilience and explanatory variables*

Farm resilience maximized by combining

- high initial values (i.e. indicating "good" initial performances),
- a stable or increasing trend (i.e. indicating stability or improvement)
- And low residuals (i.e. indicating robustness) or high residuals (i.e. indicating adaptive or transformative capabilities)

for all considered resilience variables



Assessing and explaining farm resilience: qualitative methods

CONSERVATION ECOLOGY

Report

Organic Farming and Social-Ecological Resilience: the Alpine Valleys of Sölktäler, Austria

Rebecka Milestad and Sonja Hadatsch

- People managing a natural resource, e.g. farmers, are knowledgeable about their agro-ecosystem, continuously learn about the system, and adapt to change
- Explore their perspectives to find out whether they support social-ecological resilience or not

Interviews + participatory workshops to learn about farmers' "desired system state"

Features of farmers' desired system:

- ❖ Persistence of farms
- ❖ Social cohesion
- ❖ Farming identity
- ❖ Economic sustainability
- ❖ Nature conservation
- ❖ Cultural landscape management

Assessing and explaining farm resilience: qualitative methods

A relational approach (Darnhofer et al., 2016)

Fig. 4. In the relational perspective, the emphasis is on the interactions that create ever-evolving situations. However, unlike a card game, the aim is less to win a specific round than to build relations that allow to keep playing.
Illustration by Simon Kneebone for the authors.

- Overcoming ecological/social dichotomies and the focus on states and stability
- Focusing on relations to enable a closer analysis of how ecological and social processes interact to undermine or strengthen resilience
- Considers farms' resilience as a on-going process: the farm 'is' not resilient, but farming resilience is continuously remade in interaction
- Emphasizing that relations could always be otherwise
- Providing new insights into farmers' experiments that are central to learning about shifting relations

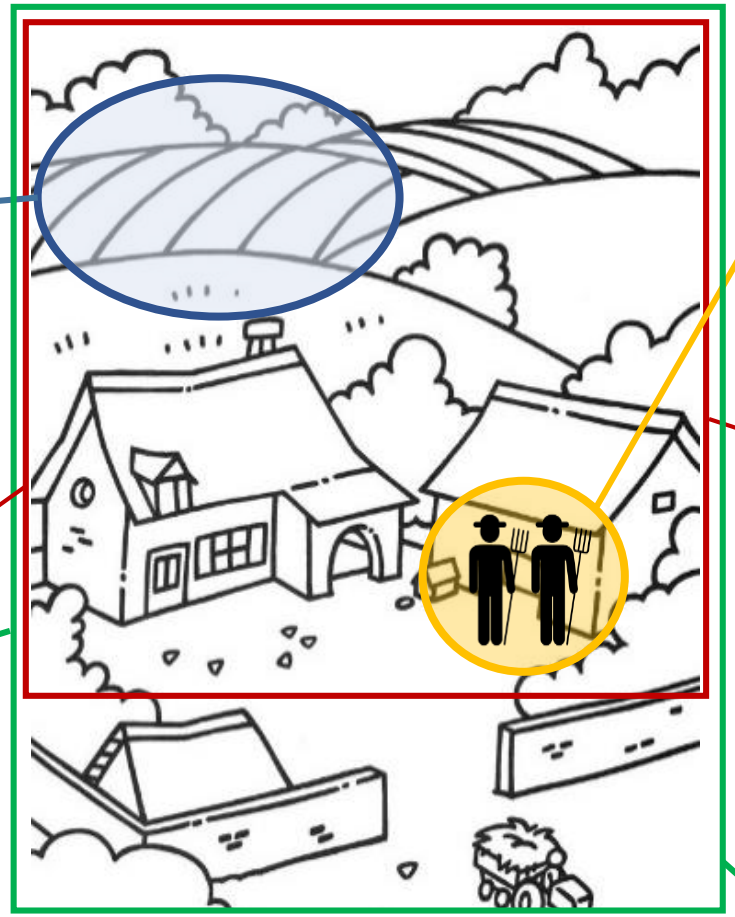
Examples of resilience factors suggested by scientists

Plant diversity at the cropping system level

BioOne RESEARCH EVOLVED

Resilience in Agriculture through Crop Diversification: Adaptive Management for Environmental Change

Author(s): Brenda B. Lin
Source: BioScience, 61(3):183-193. 2011.
Published By: American Institute of Biological Sciences
URL: http://www.bioone.org/doi/full/10.1525/bio.2011.61.3.4



Learning/sharing of knowledge and know-how

Sustainable Agriculture Research; Vol. 1, No. 2; 2012
ISSN 1927-050X E-ISSN 1927-0518
Published by Canadian Center of Science and Education

Building Resilience through Farmers' Experiments in Organic Agriculture: Examples from Eastern Austria

Susanne Kummer[1,*], Rebecka Milestad[2,*], Friedrich Leitgeb[1] & Christian R. Vogl[1]

[1] Division of Organic Farming, Department of Sustainable Agricultural Systems, University of Natural Resources and Life Sciences, Vienna, Austria

[2] Department of Urban and Rural Development, Swedish University of Agricultural Sciences, Uppsala, Sweden & Division of Environmental Strategies Research, Royal Institute of Technology, Stockholm, Sweden

Correspondence: Susanne Kummer, Department of Sustainable Agricultural Systems, University of Natural Resources and Life Sciences, Vienna, Austria. E-mail: susanne.kummer@boku.ac.at

* Equally contributing authors

Plant/Livestock diversity at the farm level

Sustainability **2011**, *3*, 238-253; doi:10.3390/su3010238

OPEN ACCESS

sustainability

ISSN 2071-1050

www.mdpi.com/journal/sustainability

Article

Agricultural Biodiversity Is Essential for a Sustainable Improvement in Food and Nutrition Security

Emile A. Frison *, Jeremy Cherfas and Toby Hodgkin

Bioversity International, via dei Tre Denari 472a, 00057, Maccarese, Rome, Italy; E-Mails: j.cherfas@cgiar.org (J.C.); t.hodgkin@cgiar.org (T.H.)

* Author to whom correspondence should be addressed; E-Mail: e.frison@cgiar.org; Tel.: +39-06-6118-1; Fax: +39-06-6118-405.

Agroecological practices

Agron. Sustain. Dev.
DOI 10.1007/s13593-015-0285-2

REVIEW ARTICLE

Agroecology and the design of climate change-resilient farming systems

Miguel A. Altieri · Clara I. Nicholls · Alejandro Henao · Marcos A. Lana

Insurance

Income Insurance in European Agriculture

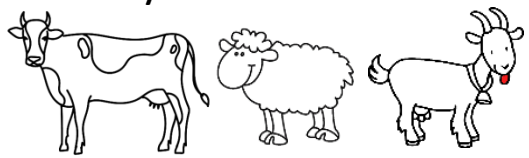
L'Assurance – Revenu dans L'Agriculture Européenne
Einkommenversicherung in der Europäischen Landwirtschaft

by Miranda P. M. Meuwissen, Ruud B. M. Huirne and Jerry R. Skees

Farmers' perceptions of resilience factors

Perrin, 2019

According to 151 organic dairy cattle, sheep and goat farmers surveyed in France



Improve

Measure

Resilience of dairy farms

FACTORS

INDICATORS

- Stable and remunerative milk price
- **Cost control**
- Livestock and soil health
- Work satisfaction

- **Give a prominent role to pastures**
- Balance land and livestock
- Decrease the workload

- Diversify (productions, crops, livestock)

- Be curious and observant
- Be reactive and opportunistic
- Know how to anticipate

Self-sufficiency

Economic viability

Overall consistency of the farming project

Ability to remain / be transfered

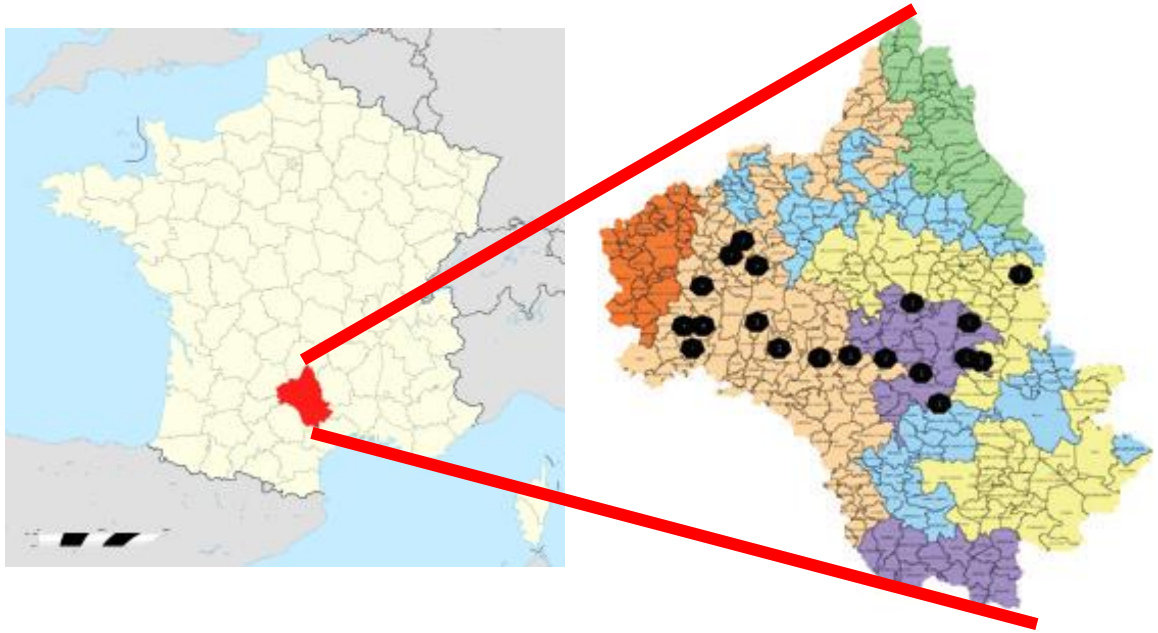
My farm is sustainable, Resilience is improved transferable and thus by the price of products resilient

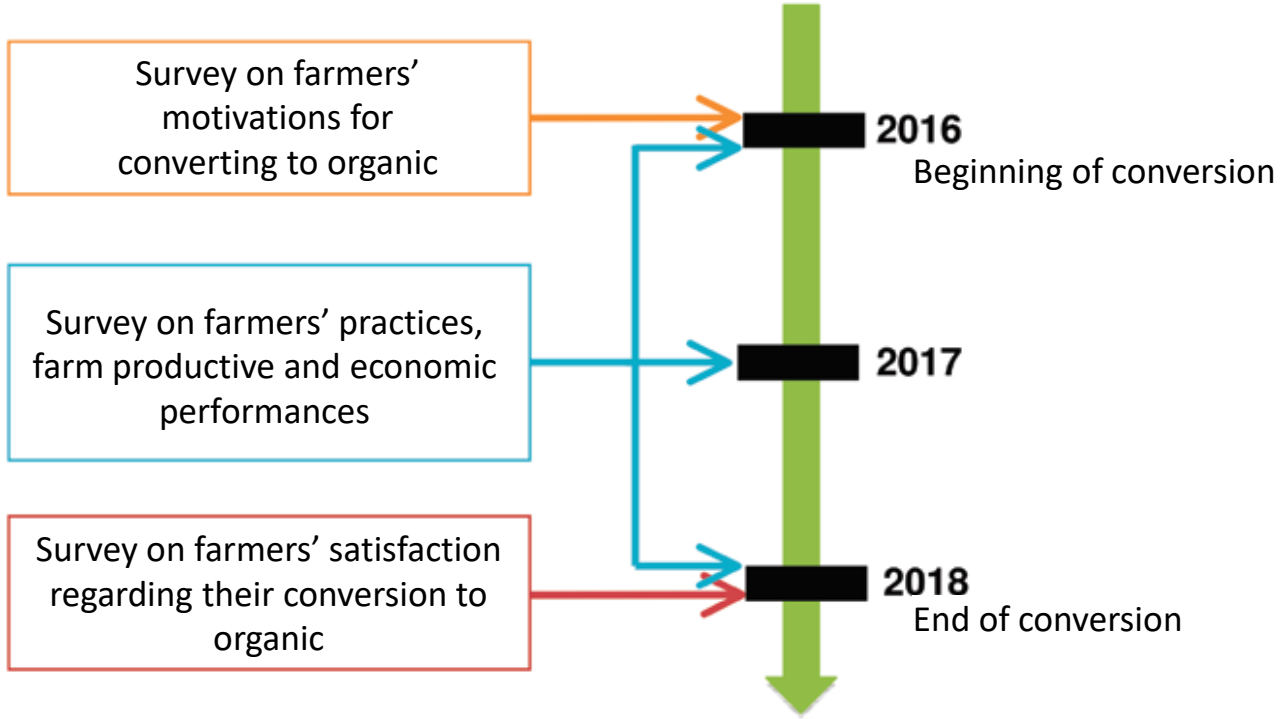
Grazing is essential on a resilient farm

A typology of resilience factors with examples

	Livestock management	Crop/pasture management	Farm management	Collective action
Buffering capability	Prefer rustic breeds			
Adaptive capability	Lengthen prod. lifetime			
Transformational capability	Diversify the species bred			

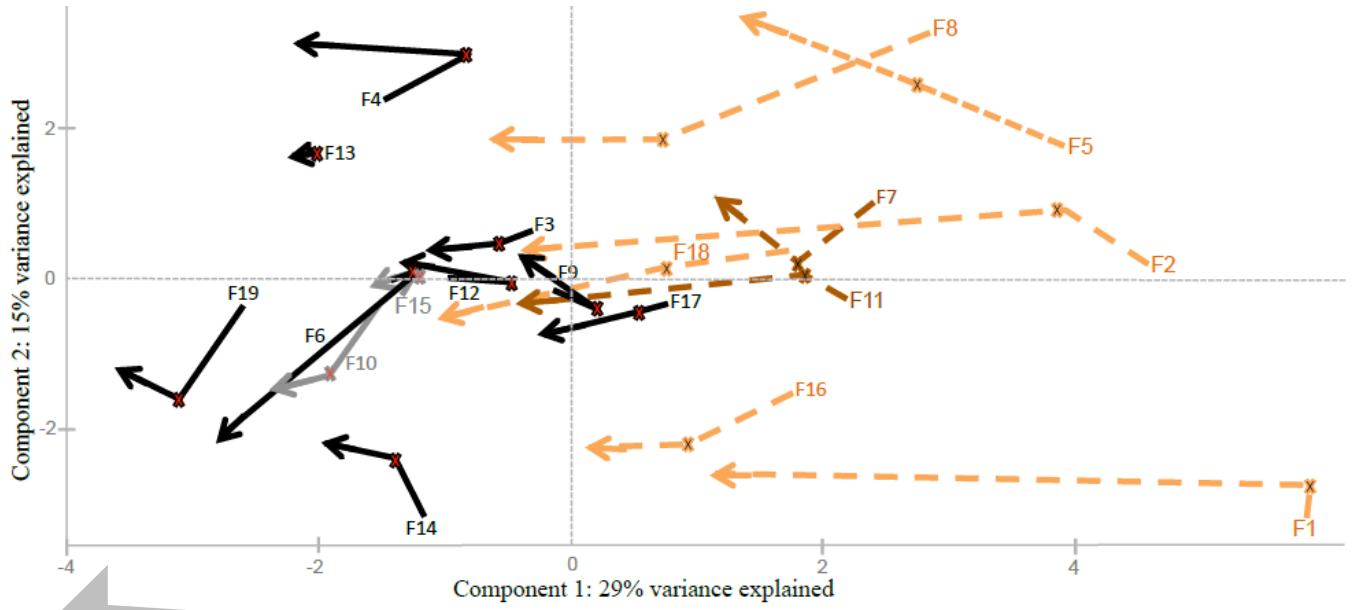
Conversion to organic dairy farming to promote resilience





- 2016: dairy crisis; many farms facing bankrupcy

Conversion to organic dairy farming to promote resilience



Self-sufficient pasture-based grazing systems with lower stocking rate

Systems based on highly productive cows fed silage maize and soya with high stocking rate

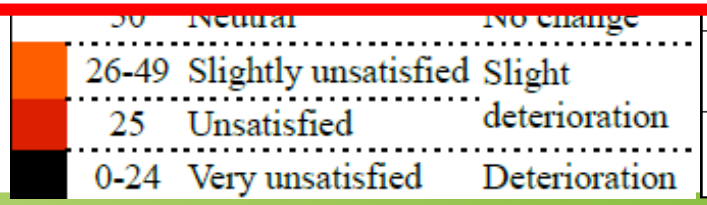
Within 2 years

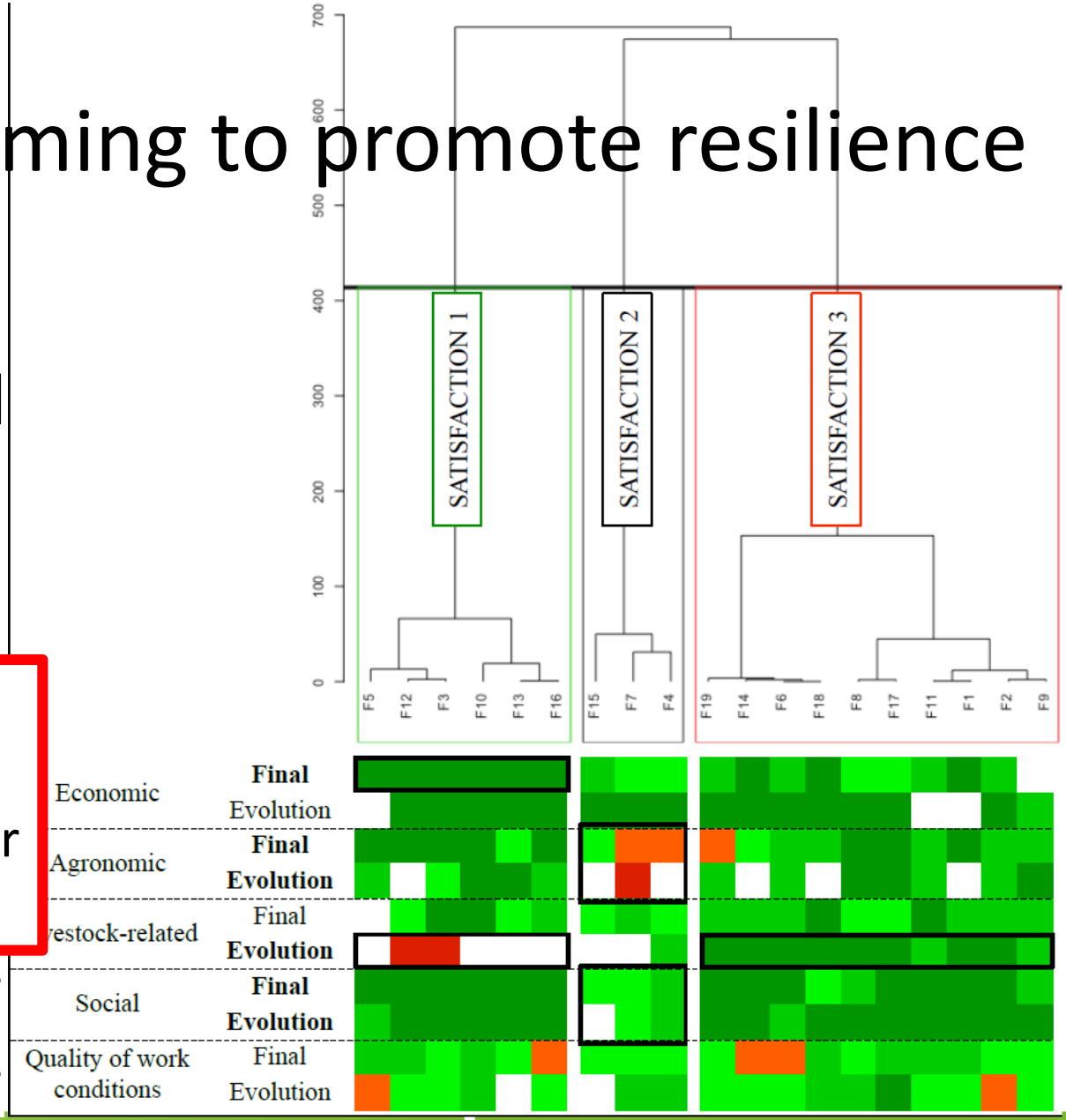
Bouttes et al., submitted

Conversion to organic dairy farming to promote resilience

- In the end
- 94% of positive assessments in total
- 100% of positive assessments for economic and social satisfaction

Mean change in operating costs
From 1068 €/cow to 977 €/cow
Mean change in gross operating profit per worker
From 42 K€/yr to 55 K€/yr



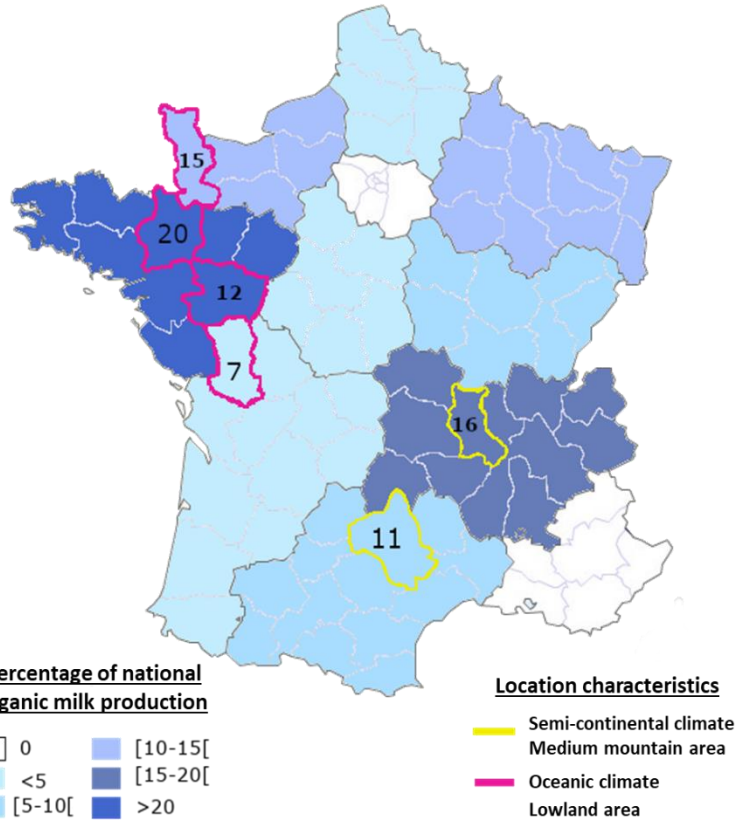


Bouttes et al., submitted

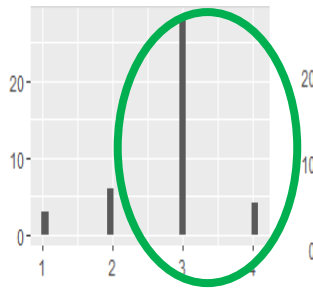
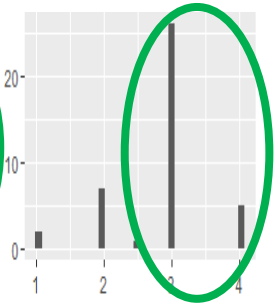
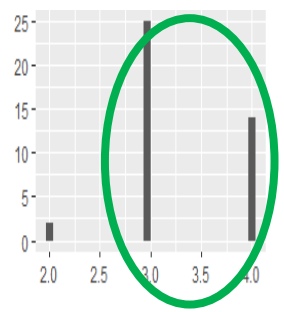
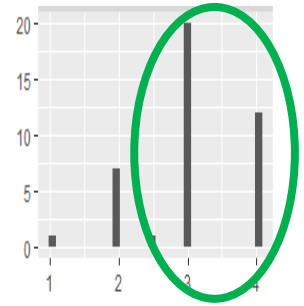
Resilience factors for already-converted organic dairy farms

Perrin et al., submitted

- 81 organic dairy cattle farms surveyed
- Converted to organic since 2012 at the latest

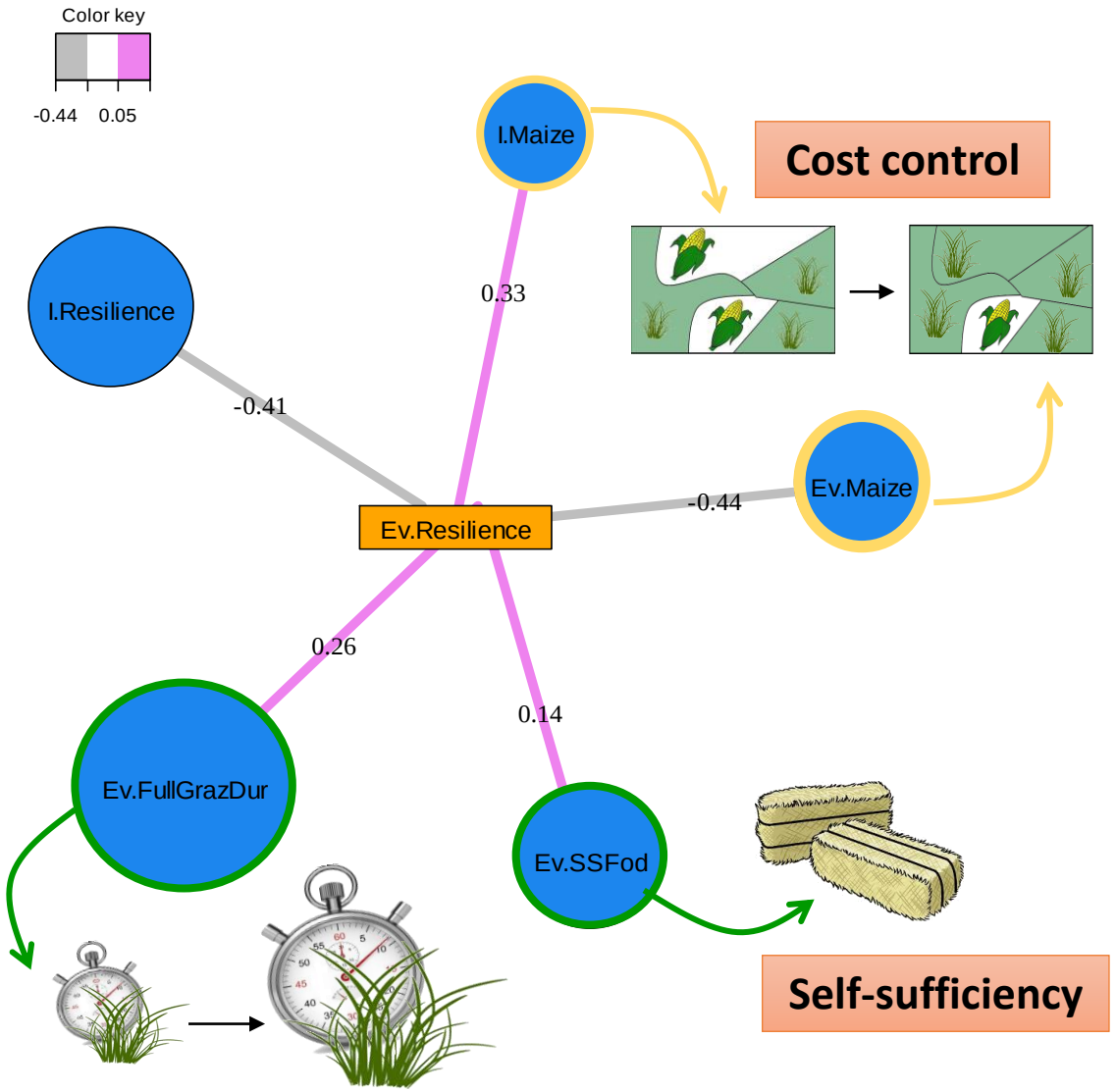


Percentage of farmers satisfied or very satisfied in 2018 (after at least 5 years under organic farming) regarding:

Soil, crop, and pasture conditions	Dairy herd conditions	Farm economics	Workload and social relations with relatives, neighbours, and society
			
85%	85%	96%	79%

Resilience factors for already-converted organic dairy farms

Resilience improved on average by 0.15 points (out of 16) each year

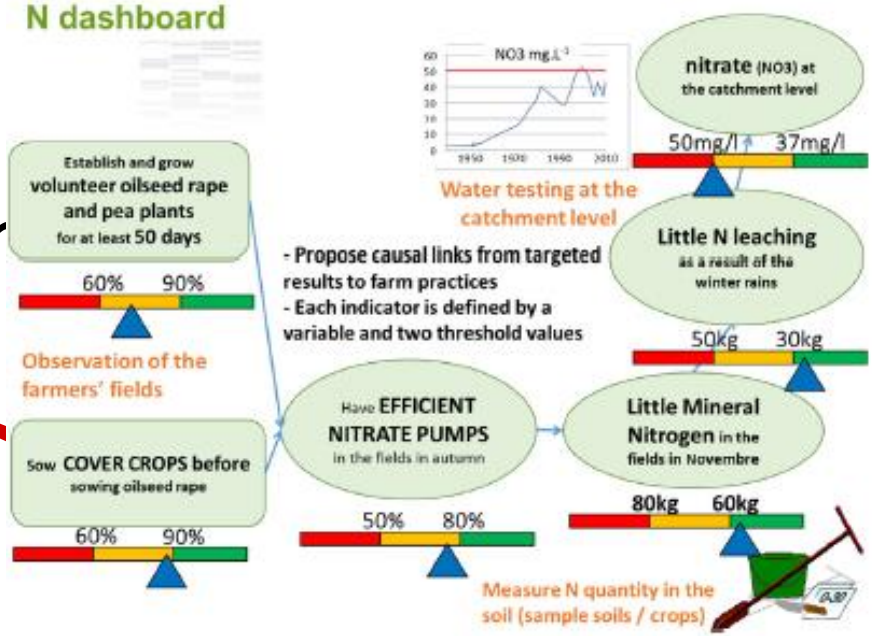


Perrin et al., submitted

	Livestock management	Crop/pasture management	Farm management	Collective action
Buffering	Prefer rustic	Prefer multi-	Keep fodder	Suscribe to

ns to support farm
lier

Focus groups relying on indicators
- Days of water shortage per year
- Input and output prices
- …



Assessment of exposure to hazards/changes

Assessment of sensitivity to hazards/changes

Design and assessment of alternative scenarios

Implementation and assessment of adaptations

Simulation-based design
- Forage Rummy (Martin et al., 2011)
- Farm modeling (Botz et al., 2006)

- Reflexive monitoring
- Dashboard (Prost et al., 2018)
- Unexpected effects (Allen, 2011)

On-farm diagnosis and farm visits relying on indicators
- Self-sufficiency for feed
- Income
- …

Next steps with farm resilience

- Refining/developing and further testing assessment methods
- Identifying resilience factors over a larger number of production systems (e.g. monogastrics)
- Improving our understanding of transformational capabilities and their potential to promote resilience
- Supporting farmers in developing their farms' resilience

« Que du positif ». Emmanuel Vernhet et Vincent Grès, GAEC des Tinarole, Aveyron.

Pour Emmanuel Vernhet et Vincent Grès, éleveurs de vaches laitières en Aveyron. Anglars-Saint-Félix en Aveyron, le premier changement a été sur les cultures : moins de céréales, moins de maïs, plus de prairies.

« Cultiver l'être ». Didier Larnaudie et Alain Beyer, GAEC des Fontanelles, Aveyron.

Motivés pour changer de pratiques et de rythme de vie, Didier Larnaudie et Alain Beyer, éleveurs de vaches laitières en Aveyron, mettent les aspects humains du métier d'agriculteur au cœur de leur témoignage sur leur conversion à l'AB.

Series of of 6-minute videos available on Youtube describing transition pathways towards resilience in the dairy farming sector

https://www.psdr-occitanie.fr/PSDR4-Occitanie/Le-projet-ATA-RI/Productions-operationnelles/Temoignages-d-eleveurs-en-conversion-a-l-AB

Thanks for your attention!

Results and reflections from several French- and EU-funded projects:

Casdar Résilait / PSDR ATARI / H2020 Core Organic MIX-ENABLE

AGIR UMR 1248 INRA / INPT
AGroécologies - Innovations - Ruralités

Equipe MAGELLAN