Methodological challenges for designing resilient household farming systems in dryland areas -forecasted trajectories, risks and provision of ecosystem services-

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« Resilience framework » to test the diversity-Resilience hypotheses.

- Market chocks
  - Prices, subsidies
  - Resilience to what?
    - Frequency
    - Duration
    - Intensity

- Climate chocks
  - Agro-system
  - Adaptation strategies
  - Economic incentives
  - Technical innovation to improve agsys. diversity.

- Territory
  - Aggregate global impact

- Agro-ecosystem/household
  - Limiting factors /access resources
  - Resilience of what?
  - Resources allocation
  - Area affectation

- Local actors
  - Time horizon
  - Time step
  - Threshold

- Resilience of which characteristics?
  - Functional: Food production, revenue, labor....
  - Structural: farm size, irrigated area,....
  - Functional: Input use efficiency, production
  - Structural: crop association, agroforestry,
Modelling chain for Resilience analysis

- Indicator calculator
- Regional model
- Household farm model
- Database
- Cropping systems model

- Territory
- Agro-ecosystem/household
- Agro-system

- Aggregate global impact
- Limiting factors/access resources
- Joint production
- Resources allocation/Area affectation

- Area affectation
- Access/resources
Determinants for model and data selection and evaluation

Data
- Calibration Evaluation

Cropping/farming systems
- Activity concept

Biophysical x bio-economic models
- Evaluation using expert indicators
- Errors acceptability

Scenarios
- Existing model

Players
- Ad Hoc model

Existing model (Belhouchette et al., 2011)

Ad Hoc model (Adam et al., 2013)

Biophysical x bio-economic models (Adam et al., 2012)

Evaluation using expert indicators (Faisal et al., 2018)

Errors acceptability (Therond et al., 2009)

Calibration Evaluation (Belhouchette et al., 2011; Flichman et al., 2018)

Activity concept (Hammouda et al, 2018)

Ad Hoc model (Therond et al., 2011)

Existing model (Belhouchette et al., 2011; Flichman et al., 2018)

Determinants for model and data selection and evaluation

El Ansari et al., 2021
Resilience analysis framework

Truly resilient farming systems (A)
- Revenu
- Terre
- Labour

Better than resilient farming systems (B)
- Revenu
- Land
- Labour

Evolutive resilient farming systems (C)
- Revenu
- Land
- Labour

Non-resilient farming systems (E)
- Revenu
- Land
- Labour

Poorly resilient farming systems (D)
- Revenu
- Land
- Labour
Example of results: Cereal based-production area

- Truly resilient farming systems (A)
  Diversified annual crops and livestock – small perennial trees

- Non-resilient farming systems (E)
  Orchards or orchards and rain-fed cereals

- Poorly resilient farming systems (D)
  Less mixed farming systems

- Group 1
- Group 2
- Group 3
Resilience of the dominant farming systems in the South Mediterranean area, by considering both their structure, their dominant activities irrigation levels, and their potential trajectories under climate change

Souissi et al., 2018
Design of Resilient Farming Systems

(Irrigated mixed farms (including Bovine and ovine livestock))

Farm income

Cheeps

Cows

Sheeps

Cereal/fallow farms (only ovine livestock)

Sheeps

Irrigation

Investment

Labour

In Chenoune et al. (2022), the design of resilient farming systems is illustrated through various graphs showing trends in farm income, rented area, irrigation, and investment over time. The systems are categorized into irrigated mixed farms (including Bovine and ovine livestock) and cereal/fallow farms (only ovine livestock).