

Pyrenean mountain pastures: Modelling land-use change and ecosystem impacts under climate change

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Introduction and Approach

General Framework

The goal of this project is, to explore the anticipated **systemic feedbacks between**

- (1) **climate change,**
- (2) **land owner's decisions on land use,**
- (3) **Land use change, and**
- (4) **changes in ecosystems and biodiversity**

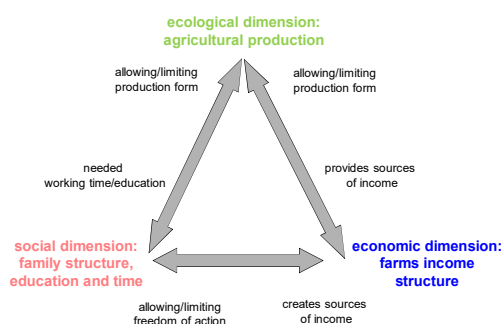
in the coming decades in mountain areas investigated in P³. The option space for future land management decisions depends on internal choices as well as on changes in the socioeconomic, socioecological and climatic framework conditions. Agent-based models are the best choice due to their ability to simulate aggregated outcomes resulting from decisions made by many individual actors. General applications of ABMs have proven their utility in analysing the dynamics of socioecological systems in which decisions of actors influence biophysical dynamics. The option space for future land management decisions depends on internal choices as well as on changes in the socioeconomic, socioecological and climatic framework conditions. Agent-based models are the best choice due to their ability to simulate aggregated outcomes resulting from decisions made by many individual actors. General applications of ABMs have proven their utility in analysing the dynamics of socioecological systems in which decisions of actors influence biophysical dynamics.



P³: Belmont Forum Project : People, Pollution and Pathogens - Mountain ecosystems in a human-altered world
<http://www.p3mountains.org/>

Method

Farm as a socio-ecological system



Stakeholder process

During summer 2018 we conducted 15 interviews with regional farmers and experts to gather qualitative information about the socio-ecological land system the Ariège, FR.

- Low thresholds for livestock density on grasslands due to subsidies and labor overload (part time farming) condition an extensive livestock production system
- Expansion of farm area is difficult (access to area and renting area shortage)
- Reduction of area only due to farm abandonment/ preparation for farm abandonment (important role of subsidies and cultural/traditional factors e.g. "guerre de mademoiselles").
- Use of mountain pastures "lived tradition", often based on ancient rights of usage
- Climate change is a present topic, farmers think about strategies to adapt to volatile yields (area expansion)
- Mountain pasture system is centrally organized and coordinated by the Fédération Pastorale de l'Ariège

Initialization

The initialization of the agent-based model based on agro-statistical data for land use (GIS map), farm economic data. Additionally, from the interviews, we integrated 4 farming styles (Schmitzberger et al., 2005) that represent the value system/ intrinsic motivation of farmers:

- **Optimizer:** optimizes the agricultural output (e.g. yields, land use)
- **Traditionalist:** follows the tradition (continues farming in the way of the parents/grandparents)
- **Innovative:** tries new things (new products, agro-tourism, direct marketing), diversifies income
- **Idealist:** less importance for income and workload, also cares about nature (biodiversity, ecosystem health) and work/life balance

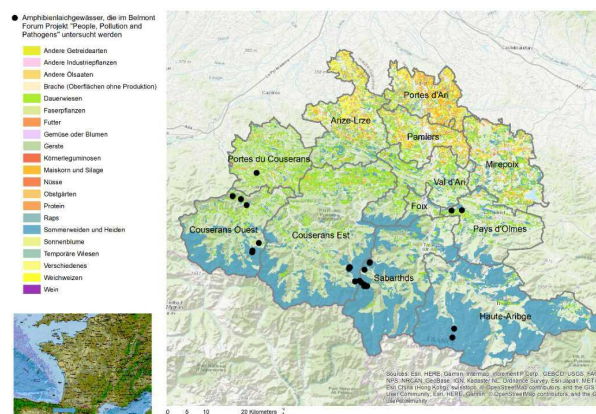
Results

- Ruminant livestock (cattle, sheep, goats) in the Ariège is dominated by meat production with minor shares of dairy farms (mainly cheese production). The livestock is mainly fed on a pasture based grassland system.
- The mountain pastures (*Estives*) play an important role in the farming system, as additional land is scarce mountain pastures can serve as additional pasture area.
- The Ariège is characterized by an extensive production system, with an above average (national) share of organic farms at about 20%.
- Néo-ruraux (new rurals): The Ariège attracts young people who flee the hectic city life and desire a live in nature. Conflicts with traditional Ariège inhabitants (e.g. farmers) exist

References

Schmitzberger, I., T. Wrba, B. Steurer, G. Aschenbrenner, J. Petersell, and H.G. Zechmeister. 2005. How farming styles influence biodiversity maintenance in Austrian agricultural landscapes. *Agriculture, Ecosystems & Environment* 108(3): 274–290.

Study site: Department Ariège, France



In the project we assess potential interactive effects of different societal and economic scenarios on regional plant diversity in the Department Ariège (French Pyrenes).

Scenarios:

Business as usual

The previous socio-economic development will continue. The demand for agricultural products, prices, subsidies and income from employment continues to develop linearly (index adjusted). Climate change takes place and causes an average increase in the harvest, at the same time there is a slight increase in the probability of an extreme weather event leading to a shortfall in the harvest.

Sustainability

Instead of economic growth, the focus is increasingly on human well-being. People appreciate leisure time and work less. Environmental awareness in societies is rising sharply and is increasing regional demand, the labour market is being strengthened and at the same time subsidies for extensive agriculture and organic production are on the rise. Climate change will be slowed down considerably and only slight changes will take place, crop yields will rise slightly due to the rise in temperature and extreme weather events will decrease.

Globalisation

Rapid growth of the global economy and technological progress dominate the development. Globalization and liberalization are lowering food prices and making earned incomes more unequal. Rising mechanization shortens time for agricultural production. Climate change is clearly noticeable and there is a strong warming, which ensures higher crop yields and makes it possible to cultivate arable crops even in higher altitudes. The weather is becoming more volatile and the probability of extreme weather conditions doubling.

The Agent-based Model: SECLAND

