How would Farmers in the French Alps Adapt their Systems to Different Drought and Socio-economic Context Scenarios?

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Abstract

The French Alps are considered as an area that is particularly vulnerable to climate change. Several droughts have already occurred since 2003. In order to assess the ability of farming systems to adapt to future drought events, we developed prospective scenarios combining different climatic and socio-economic contexts. Four scenarios were defined based on (i) prospective studies conducted at national and international levels, and (ii) a participatory approach with various stakeholders to transcribe these scenarios at a local level. Farmers and shepherds in the Vercors and Oisans massifs were surveyed in order to understand how they had reacted to previous droughts, and how they would plan to react to our scenarios. Results show first that the farmers would strive to continue their activity in each scenario, taking advantage of the flexibility of their farming systems, as in previous years. However, in the most pessimistic climatic scenario, they would also decrease the size of their herds. Depending on the socio-economic hypothesis, they would adopt farm structural changes (farm processing activities, direct selling, etc.), or look for part-time non-agricultural jobs. Three types of strategies were identified, depending on the farmers' objectives and adjustments. Finally, public policies to accompany these changes are considered.

1. Introduction

Reports of the Intergovernmental Panel on Climate Change (IPCC) identify mountain ecosystems as highly vulnerable to global climate changes. Climate change scenarios not only highlight the continued warming observed in the Alps, but also an increase in climatic extremes, in particular drought phenomena in areas subject to Mediterranean influences. Alpine ecosystems are considered especially sensitive to these changes, which are likely to lead to losses in biodiversity and landscape modifications (Thuiller et al., 2005).

The SECALP research project (2009-2011), which brought together agricultural scientists, foresters and ecologists, aimed to analyse the ability of Alpine farming and forestry stakeholders to adapt to increasing droughts. In this paper, we propose to characterise the way livestock farmers have adapted to the droughts to which they have been subject over the last ten years and identify the solutions they have implemented to counter these events (Nettier et al., 2010). We shall then describe the prospective phase of our research: based on scenarios combining both an increase in droughts and socio-economic contextual changes, we shall analyse farmers' reactions and the adaptive behaviour they would implement. Finally, we shall discuss the scope of the lessons learnt from our field studies and describe possible policies to support farmers in their efforts to adapt.

2. Material and Methods

The research work was carried out on the two 'Zone Atelier Alpes' sites, one in the Vercors (a regional natural park covering 85 municipalities), and the other in the Oisans (Villar d'Arène municipality) where the economy is based on agriculture and tourism. Both sites are located on critical climatic limits and are subject to oceanic and Mediterranean influences. Over the last two decades, the predominance of the Mediterranean influence has increased: for example, the Vercors pre-Alpine massif is now experiencing a significant increase in drought events (Bigot and Rome, 2010).

Farm surveys following droughts

To characterise the methods employed to adapt to the droughts experienced since 2003 (year of an exceptional summer drought and heat wave in France), we conducted farms surveys using semi-directive interviews. We identified the way the forage system worked (Fleury et al., 1996) together with (i) changes operated within this system, (ii) how consistency between the forage system and the livestock system (Dedieu et al., 2008) was maintained, and (iii) changes to all farm household activities. For the Villar d'Arène site, we decided to make the research work by interviewing every farm (9 livestock farmers and one transhumant shepherd), who used the municipality's farming areas, in order to take into account possible interactions between farms. On the Vercors massif, it was impossible to apply the same exhaustive approach. Classified as Natura 2000 sites and of great heritage value, the Alpine pastures in this area are considered important for their biodiversity. We therefore decided to take a sample of the various Alpine pastures (according to type of summer grazing animal and shepherding mode) and of the farms using these pastures during the summer period (farms located on the Vercors plateau or in the foothills and transhumant herds from the south of France). In all, 27 farms and 18 alpine pastures generally kept by shepherds were included in the survey.

Prospective scenarios

To develop our prospective approach (de Jouvenel, 2002), we opted for 4 scenarios coupling two different climatic contexts and two different socio-economic contexts. This coupling was notably the result of the lessons learnt from the surveys performed in the first stage of our research. These pointed to drought events as being only one of the factors influencing the decisions of farmers, who were also found to consider the socio-economic context. The difficulty entailed in developing these scenarios lay mostly in the choice of contrasting but plausible conditions and the way to apply these locally so that they included characteristics specific to the field of study and hence were meaningful for the farmers. We therefore co-built these scenarios with a group of local experts. These scenarios were applied locally through discussions between the SECALP project group of researchers and the group of experts.

The "*intermittent*" climate context was based on an increase in spring and summer drought periods alternating between wetter years to reflect the recent situation in some sectors of the Alps. The "*shock*" climate context was based on four consecutive years of springtime drought. With the help of the ecologists involved in the SECALP project and agricultural experts, the climatic contexts were translated into consequences for the areas studied, particularly seasonal production losses in a drought year (table 1). Moreover, using the observations relating to the recent droughts and experimental drought simulations, the ecology researchers demonstrated that the Alpine vegetation was highly resilient (Lavorel, 2011): these results were included in the "intermittent" context.

Climate context	Intermittent	Shock
Drought periodicity	Droughts (spring or summer) alternating with wetter years	4 consecutive spring drought years
Consequences on vegetation after a 4-year cycle: Hay meadows Rangelands and alpine pastures	Species' resilience In a drought year: 1st cut yields = 60% of a wet year	rangelands: deterioration of herbaceous plants 40% loss in fodder resource for long term

Table 1. Main provisions in the two climate contexts selected.

Two socio-economic contexts were chosen from national and international prospective studies: Millenium Ecosystem Assessment (MEA) (Carpenter et al., 2005), Les Nouvelles Ruralités (NR) (Mora, 2008), Agrimonde (2009). The first one, called "global" socio-economic context, was based on continued globalisation in a free economy and a process of urban concentration (cf. MEA 'Global orchestration' scenario, Agrimonde G0 and NR Scenario 1); the second one – "territorial" context - was inspired by the emergence of the "territorial fact" (cf. MEA 'Adapting mosaic' and NR Scenario 4). In the "*global*" socio-economic context, the areas and their stakeholders were confronted with continued globalisation and urban concentration with agriculture being supported only for its role as a producer of global environmental services (e.g. carbon storage). In the "*territorial*" context, citizens showed a growing interest in their geographic area and its activities while mountain farming was supported so that it continued to act as a producer of quality food in line with strict environmental requirements (table 2).

Socio-economic context	Global	territorial
Roles of agriculture	Attractive landscape for city dwellers maintained; carbon storage	Local quality products; hospitality; landscape and biodiversity
Product prices paid to producer in relation to the survey year	meat -15%; milk -20%; except organic -10%	meat -15%; milk -20%; except organic, PDO label: maintained
CAP pillar 1 support	-20%: subsidies generally decoupled but minimum guaranteed (1 yearly minimum wage)	-20%: no minimum guaranteed
Agri-environmental measures (AEM)	Bonus for maintaining grasslands; bonus for planting trees on farming land	Bonus for biodiversity with commitment to results (e.g. maintain floral wealth of meadows)
Alpine pastures equipments	No public subsidy	Possible support from municipalities

Table 2. Main provisions in the two socio-economic contexts selected.

The two climatic contexts and the two socio-economic contexts were combined in pairs to form the four scenarios. The four scenarios were then transcribed into storylines before being submitted to the group of experts for validation.

Return to the farms

To help the interviewees understand and appropriate the various aspects of the scenarios, illustrative documents were prepared in addition to storylines: drawings (showing landscape changes), graphs showing changes to fodder productivity according to different types of vegetation, changes to aid in line with the CAP reform (pillars 1 and 2), and changes to farming product prices. We interviewed all of the farmers from Villar d'Arène and 8 farmers from the Vercors. These farmers were selected for their receptiveness during the previous phase and so that the sample would reflect the diversity of situations. In all, 17 interviews were performed with livestock farmers. As the shepherds work on a seasonal basis and are unable to influence strategic changes to livestock systems, they were not interviewed in this prospective phase.

The choice of time horizon raised another difficulty: set at 25-30 years to reflect forest development cycles and climatic impacts, but we also had to precise the scenarios in concrete outcomes for the next 4 to 5 years and apply the 2013 CAP reform to this period because it is very hard for farmers to plan projects on a longer time horizon, due to a context of great uncertainty.

3. Results

After presenting the reactions to the recent droughts, we shall describe the adaptations envisaged by the farmers.

3.1. Farmers' reactions to the recent droughts

The means of leverage activated by the farmers and shepherds aimed to offset the drop in forage resources as well as prevent or limit damage to alpine vegetation (which could undermine the renewal of pastoral resource over several years). On the Alpine pastures, it was found that the farmers generally managed to overcome the dry summers by making contextual adjustments: the shepherds' know-how made it possible to optimise use of the grazing resource (exploration of new sectors, better use of plant phenological differences, etc.). In 7 cases out of 18 alpine pastures, a structural decrease in the stocking rate was nevertheless decided upon in order to face possible future droughts.

Farm types	**High mountain**	**"fodder"**	**"pastoral"**
Number of farms	9 (Villar d'Arène)	7 (plateau and foothills of the Vercors)	11 (Diois to the south of the Vercors and transhumants in the Mediterranean region)
Livestock farming systems	ewes, cattle	suckler ewes and cows dairy cows	suckler ewes
System characteristics	Long winter (more than 6 months) and limited mechanised surfaces. Oversized grazing land.	Higher proportion of surface areas suitable for machines. Variable level of fodder autonomy. Few grazing surfaces.	Many grazing surfaces. Shorter wintering period. Surfaces to be cut sometimes limited in relation to livestock's winter needs.

Table 3. Main characteristics of the surveyed farming systems.

To really understand the farmers' reactions, it seemed essential to reposition the farms in their pedo-climatic context. This context conditions adaptation possibilities as well as the functioning of forage systems and their sensitivity to drought. Three main types of farming contexts were identified on the sites studied (table 3). The farms displayed considerably different reactions in the face of droughts:

- Due to long winters and limited surface areas on which machines could be used, "high-mountain" livestock systems were highly sensitive to a drop in hay production. But thanks to oversized grazing land in relation to herd needs, they had few problems during grazing season. Purchasing of hay is generally the unique reaction. Some of the farmers also made some "relocations" on small surfaces (e.g. making hay in the valley, making it also possible to extend the vegetation period and spread out harvesting).
- "Fodder" type farms have a higher proportion of surface areas suitable for machines, but generally few grazing surfaces. They reacted to droughts with grazing of meadows initially to be mowed, or distribution of hay during grazing period, and consequently a drop in hay stocks. Most autonomous farms carried over hay stocks from one year to the next, whereas some others have to purchase hay.
- In the "pastoral" type systems (with a shorter wintering period and hence less need for stock), the farmers used the flexibility of their rangelands and "adjustment" pastoral areas: grazing of young cereal crops, undergrowth, acorns, etc. Hay purchasing are also observed, but with small needs. On contrary to the two other types, structural changes to grazing systems were observed (surface area extensions, woodland surface grazing agreements, or herd livestock reductions).

Many of these farms were found to be run by households with multiple off-farm activities and were therefore able to cope with hard times. It was thought that hay purchases would undermine the viability of the system if they were repeated year after year. No diversification activities on the farms surveyed were observed.

3.2. Possible adaptations envisaged by livestock farmers for the different scenarios

For the farmers in the Vercors, the intermittent climate context seemed to reflect the situation experienced over the last few years and to which they had been obliged to adapt. They therefore believed that they would be able to "bounce back" and that their forage system was adapted to face the situation. As was their habit, they intended to make the most of the flexibility of their forage system: adjust grazing or wintering dates, adjust dates for taking animals up to or down from the alpine pastures in relation to the pastoral resource available, use reserve sectors (rangelands outside of the farm parcel or grass regrowth in fields not grazed during normal years), alternate between the use of hay and grazing meadows during the pastoral period and, if possible, carry over hay stock from one year to the next by making the most of wet years or buying additional hay if fodder stocks were not sufficient to cover livestock needs. In a context of intermittent drought, structural changes would only be introduced in response to the socio-economic context. For the shock climate context where forage resources would be insufficient, they would reduce their herds to match the available resource and attempt to offset loss of income through off-farm work, in the case of the global socio-economic context, or through better use of the remaining animals (farm processing activities, short distribution channels, etc.), or even through additional tourist activities (farms open to the public) in the case of the territorial context for some farmers (Table 4).

<table>
<tr><td colspan="4">“Intermittent” climate context
Adapt to the situation as in the past = leveraging system flexibility to limit fodder purchases (increase surfaces, improve meadow productivity, set up carry-over stocks from one year to the next)</td></tr>
<tr><td rowspan="2">“Global” socio-economic context
Offset loss of income through an activity outside the farm, or even stop the farm</td><td>Scenario “Intermittent” + “Global”
Leverage system flexibility, increase surfaces, decrease livestock as a last resort</td><td>Scenario “Intermittent” + “Territorial”
Leverage system flexibility and increase surfaces + develop direct sales</td><td rowspan="2">“Territorial” socio-economic context
Farm processing activities + short distribution channels
Agri-tourism
Subscribe to agri-environmental contracts</td></tr>
<tr><td>Scenario “Shock” + “Global”
Decrease livestock and take on off-farm activity to offset the reduction; put a stop to the farm in some cases</td><td>Scenario “Shock” + “Territorial”
Decrease livestock, increase surfaces + develop direct sales + agri-tourism</td></tr>
<tr><td colspan="3">Decrease livestock to reduce sensitivity to drought
“Shock” climate context</td></tr>
</table>

Table 4. Summary of possible adaptations envisaged by livestock farmers in relation to the different scenarios and specific adaptations for each context.

According to the farmers, changes to the socio-economic context were also a determining factor, owing notably to the importance of public aid in the make-up of their income and to a concern for their work to be recognised by society. They considered agri-environmental measures (AEM) to be a concrete reflection of this recognition. This explains why the AEM provisions included in the “territorial” context were clearly preferred, in spite of the necessity to commit to results, than those envisaged in the “global” context (and based on a best practices obligation). The latter appeared to the farmers to work against their very profession (e.g. the bonus for planting trees on farming land was decried).

Although some main trends emerged for each scenario, the farmers did not apply the same reasoning to adaptation possibilities. While they all strove to think of ways to keep their livestock activity, three different adaptation strategies were identified: “*I would reduce the economic impact of droughts by diversifying my production and my activities*” (cereals, poultry workshops, agri-tourism and city work according to the case and socio-economic context); "*I would adapt but without diversifying my production because I want to keep my livestock farmer identity*” (possible direct sales of meat, even salaried work but in connection with breeding, shepherding work for instance, etc.); *"I wouldn’t change my system because it’s already robust enough”* (oversized haymaking surfaces or main source of income from an activity other than livestock).

The adaptations of the Villar d'Arène livestock farmers reflected this kind of reasoning. The intermittent context was considered part of the daily routine with which the farmers had had to cope for several years already. They said they would call on the same solutions as they had used for past droughts (mainly purchasing of hay). Breaks in their tradition were considered for the "shock + global" scenario: older farmers considered putting an early stop to their activity while others said they would stop cutting meadows to ensure animals had enough grazing and send the animals to winter in the valley. However, like the Vercors livestock farmers who preferred the second strategy and did not envisage giving up their animals, for most of the Villar d'Arène livestock farmers, meadow cutting seemed to be an essential component of their job conception. They did not wish to stop haymaking and considered this only as a last resort. The approach implemented at Villard d'Arène made it possible to take into account farmer interactions in the adaptation strategies. Thus, the eldest farmers who would put an end to their activity would free up mechanized land for their neighbours, hence limiting the purchasing of hay.

4. Discussion - Conclusion

Thanks to coherent storylines, illustrative drawings and graphs, farmers easily succeed to appropriate the four successive scenarios. When the scenarios were explained, some of the farmers did not agree with some of the assertions, which they nevertheless believed to be plausible. This was especially true for some of the global context measures. For example, one interviewee said, *"I like this one less than the other, that's for sure. But it's true that we might have to face such a scenario."* The high number of parameters to be considered, and which belonged to different registers, was found to be disturbing by some farmers. However, as some pointed out, this was also something they had to take into account.

The building of a participatory scenario approach combining factor-based climatic and socio-economic contexts highlighted the relative role of these two dimensions in farmers' adaptation methods. Generally speaking, their proposed adaptations reflected their response to the recent droughts or the forward thinking that these generated. More radical change possibilities underlined their attitude in the face of unexpected events but included other factors too, especially those relating to a changing socio-economic context.

Concerning the scope of the results, some of the adaptations envisaged may appear to be fairly specific to the sites studied, especially the idea to diversify activities and set up direct sales, drawing impetus from the high level of tourists in the area and the closeness of the cities. However, the whole French Alpine range, especially in the north, can be considered as an urbanised mountain area. We identified three main adaptation strategies in response to scenarios. Whereas reactions to past recent droughts were conditioned to pedoclimatic contexts, adaptation strategies depend more on sociological considerations. These can be compared with the logics highlighted by Lémery et al. (2008) in suckler farmers in Burgundy (France) when facing a situation of uncertainty (during the mad cow crisis), or by Girard (1995) concerning the attitudes of sheep farmers when confronted with unexpected climatic events. Thus, the first two strategies seem to exemplify the idea of *"making do"* described by Lémery et al. (2008), or that of *"mitigating the impacts of unexpected events"* described by Girard (1995), while the aim of the third strategy is to "*move outside of the range of impact of the climatic hazard*".

Many of the farmers interviewed were ready to take out further commitments in order to enhance the value of their livestock products (meat-cutting, cheese-making, setting up of short distribution channels, etc.). Observed across a small sample, this trend surprised the local experts who

nevertheless realised that such changes were in fact already emerging locally. While the farmers surveyed mentioned the limits of an approach based on individual interviews and the adjustments necessary according to local area and sector of activity (not everybody would be able to sell directly), the local experts believed that local authorities should look into the possibility of collective facilities in order to support the farmers: maintaining local abattoirs, creating meat-cutting rooms and sales outlets to support the development of farm processing activities and short distribution channels; equipments on Alpine pastures to facilitate and secure pastoral management.

Several public action frameworks could facilitate the preventive adaptation of the livestock farmers. A number of regulatory provisions would remove obstacles and provide leverage: facilitating the exercise of multiple activities, boosting access to land use, adjusting public subsidies criteria in relation to the actual potential and capacity of areas (e.g. recognition of the eligibility of all surfaces with grazing potential, including wooded areas, and adapting stocking rate criteria). Management and training measures could strengthen public action: coordination of farmers to improve access to resources, promotion of products, structuring of short distribution channels, technical advice (practices and production modes adapted to increasing drought periods), setting up of observation and warning systems to plan ahead for the adjustment of practices.

Intervention contexts differed substantially according to the scenario. For the “global” context, each crisis would necessitate the mobilisation of support on a case-by-case basis, as well as financial and social help with changes to area and livestock farmer orientation. The “territorial” context would appear to offer a better resistance thanks to adaptations reducing system vulnerability. The ability to adapt would be facilitated by the organisation of the profession, by local thinking about the multifunctional management of farming, forest and grazing areas, by the development of additional activities to reduce the dependence of livestock farmers on their main activity during drought periods, and by strengthening solidarity.

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