LIFE PASTORALP

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Pastures vulnerability and adaptation strategies to climate change impacts in the Alps

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ACTION C.6: **Feasible adaptation strategies: identification and test on pilot areas**

Deliverable: Perception of climate change and adaptation strategies in the Écrins national park

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Executive Summary

This report has been elaborated in the framework of Action C.6: Feasible adaptation strategies: identification and test on pilot areas, so as to document and analyse the perception of climate change and adaptation strategies in the Écrins national park.

After mentioning the existence of different typologies of responses to climate change, it highlights a crucial difference between two main types of responses: coping, which consists of immediate or short-term responses to impacts and hazards, and adaptation itself, which refers to a transformative change in the medium and long-term. It then presents the two materials on which we relied: interviews with farmers, shepherds and experts, and "pasture diagnoses" specifically designed to address the issue of climate change. Interviews suggest that climate change on mountain pastures is considered a relatively minor issue, with a multifaceted impact. Our informants were able to identify a variety of coping and adaptation responses to climate change. It is interesting to note that shepherds were involved in the former rather than the latter. We used the pasture diagnoses to extract recommended adaptation strategies, again distinguishing between coping and adaptation strategies. Although these strategies have to be adjusted to the social-ecological characteristics of each mountain pasture and associated farming system and to remain flexible, we found some recurring strategies, such as limiting the total number of animals usually sent to the pasture, adapting the arrival date on the mountain pasture, increasing the consumption of coarse vegetation, and improving pastoral equipment. Finally, the comparison between the strategies mentioned in the interviews and in the pasture diagnoses showed a significant overlap, which suggests a widespread knowledge of these strategies among farmers, shepherds and experts.

1 How to read the document

The document consists of seven sections. Each section contains a complete description of a set of operations or processes or links to additional internal documents where the topic is developed in more detail.

The sections are organized as follows:

- Introduction (Section 3)
- Typologies of responses to climate change (Section 4)
- Material and methods (Section 5)
- Results (section 6)
- References (section 7)

2 List of acronyms

CERPAM	Centre d'Études et de Réalisations Pastorales Alpes-Méditerranée
DD	degree day
FAI	Fédération des Alpages de l'Isère
IPCC	Intergovernmental Panel on Climate Change
NUTS	Nomenclature of Territorial Units for Statistics
PNE	Parc national des Écrins

3 Introduction

The Alps are particularly vulnerable to climate change and its impacts. Especially in such areas, understanding how individual and collective responses to climate change, fostering the adoption of effective and feasible measures and avoiding their potential negative side effects and maladaptation[1] are crucial (Talanow et al., 2021). In the frame of PASTORALP, we focus on mountain pastures, which appear to be particularly affected by three types of climatic hazards: 1) summer droughts, 2) interannual variability of snowmelt dates in spring, 3) risk of frost after snowmelt (Brien, 2018). The Écrins national park already faces periodic summer droughts that affect grazing and farming practices, may impact the vegetation and soil erosion, and create tensions between the different types of actors involved in the management of mountain pastures (Dobremez et al., 2014; Nettier, 2016).

Our study of adaptation strategies to climate change in the Écrins national park aimed to address the following research questions: i) To what level are farmers and shepherds concerned over climate change? How do they perceive it? ii) Which adaptation strategies do they apply or consider applying in their grazing and farming practices, and in the management of mountain pastures?

An important specificity of mountain pastures is that they form a complex social-ecological system with the farms that use them, and therefore cannot be isolated from them (Nettier, 2016). Studying responses to climate change on mountain pastures requires taking into account the climatic hazards, the way these hazards are perceived and the measures that shepherds/farmers take or do not take, both on the mountain pastures and their associated farms.

1 The IPCC third assessment report defined maladaptation as "an adaptation that does not succeed in reducing vulnerability but increases it instead" (IPCC, 2001, p. 990). Barnett and O'Neill (2010: 211) defined it as "action taken ostensibly to avoid or reduce vulnerability to climate change that impacts adversely on, or increases the vulnerability of other systems, sectors or social groups".

4 Typologies of responses to climate change

Different typologies have been used to explore how farmers/shepherds seek to adapt their activities to climate change. Picot et al. (2021) identify adaptation measures for the major climatic hazards in mountain pastures (very dry winter or late or cold spring, early spring, shallow snowpack, spring drought, heatwave and wind in June, very hot and dry summer, rainy summer). Another useful typology makes a distinction between two broad types of responses to climate change: coping, which consists of immediate or short-term responses to impacts and hazards, and adaptation itself, which refers to a transformative medium and long-term change (Fischer, 2019; Talanow et al., 2021), see Table 1.

Table 1: coping responses and adaptation responses to climate change (from Fischer, 2019 and Colloff et al., 2021)

Coping responses	Adaptation responses
Short-term process of temporary adjustments	Long term process of enduring adjustment
Associated with reactive responses that can be quickly implemented	Associated with action in anticipation of a threat
Incremental[2]	Incremental or transformative

2 Incremental adaptation consists of making small changes in current contexts to avoid disruptions and continue pursuing the same objectives, whereas transformative adaptation entails making changes at large scales that are new to a particular context and that fundamentally change the broader biophysical, social, or economic system (Fischer, 2019). Colloff et al. (2021: 165) consider that transformative adaptation necessarily involves a sequenced mix of incremental and radical adaptations which together result in transformed, adaptive social-ecological systems.

5 Material and methods

We based our study on i) interviews with farmers, shepherds and experts, and ii) "pasture diagnostics" specifically designed to address the issue of climate change.

5.1 Interviews with farmers, shepherds and experts

Interviews with sheep shepherds/farmers (n=10), and experts (n=7) were conducted between April and July 2018 by Pascaline Brien (2018) during a 6 month internship supervised by M. della Vedova (PNE). Most farmers and shepherds interviewed worked with sheep, both because sheep farming dominates in the Écrins range and because cattle farmers were overworked and unavailable for interviews. The average time spent by the shepherds on the mountain pasture they were using at the time of the study was 16 years, ranging from 1 to 27 years. 8 shepherds out of 10 worked on mountain pastures considered to be very vulnerable to drought (Deléglise, 2019), with a late growth of vegetation, a higher exposure to frost after snowmelt than the average for the Écrins national park, a long duration of spring[3] and a high interannual variability of this duration. This type of mountain pastures represents a bit more of 40% of all mountain pastures in the Écrins national park, and are thus overrepresented in our sample. The experts were employees of the Écrins national park or of pastoral or farming organizations, or were local elected representatives.

Farmers/shepherds were invited to express their views about climate change on the mountain pasture they were then using, its impacts on pastoral resources, their already in place as well as envisaged adaptation strategies, needs for equipment, their concerns over climate change and its impacts on the future of grazing activities and mountain pastures. They were in particular asked to explain the adaptation measures they had taken during the previous grazing season, characterized by a late summer drought at the scale of the Écrins national park, and then to extend the discussion to previous years. Experts did not focus on a specific mountain pasture and could express their views about climate change, its impact, and current and future strategies at a larger scale (from the local community to the "département" – NUTS3 level - or the "Région" – NUTS2 - depending on their function and occupation). Interviews were recorded and transcribed.

Finding shepherds having worked on the same mountain pasture long enough to have noticed climate change and its impact on pastoral resources and practices turned out to be a difficult task.

5.2 Analysis of "pasture diagnostics" designed to consider climate change issues

Pasture diagnostics carried out within the project include several dimensions and comprise:

i) a description of pasture characteristics (geomorphology, biodiversity),
ii) an analysis of vegetation types, including a map of main vegetation types over the pasture and a description of their characteristics,
iii) the description of existing pastoral equipment,
iv) an analysis of current management practices,

3 The duration of spring on a given mountain pasture corresponds to the spread of the period during which 600 degree days are reached (date when the last pixel reaches 600 DD - date when the first pixel reaches 600 DD) (Nettier, 2016: 174).

v) the identification of external constraints such as recreational uses,
vi) the climatic vulnerability of the pasture,
vii) a set of management recommendations for the pasture.

Following the IPCC framework, diagnostics characterize climatic vulnerability through three components (Deléglise et al. 2019), namely:

- the exposure of the pasture to climatic constraints,
- the sensitivity of pastoral resources to these constraints,
- the feasible adaptation strategies taking into account the characteristics, objectives and constraints of the farming systems using the pasture.

Pasture diagnostics were led and realized by local experts from pastoral organizations (FAI: J. Vilmant, H. Dodier, CERPAM: A. Silhol, S. Vieux), with inputs from relevant stakeholders in each case (herder, shepherd …). Eight diagnostics have been produced between 2018 and 2021 over the following pastures: Chantelouve, Lanchâtra, la Grande Cabane de Faravel, Jas La Croix, Saut du Laire, Tramouillon, la Vieille Selle and les Selles (Figure 1). Sheep flocks graze on all pastures and donkeys and cows are additionally grazing on one of the pastures. Importantly, the diagnostics should not be interpreted as an in-depth analysis of one specific pastoral season (i.e. they do not concern a specific year only); rather, they provide a comprehensive vision of the system intended to be valid over a medium-term period (~10 years).

In this report, we synthetize the feasible adaptation strategies identified for the different pastures along the coping - adaptation typology (Table 1) and we comment on the main associated enabling or constraining factors.

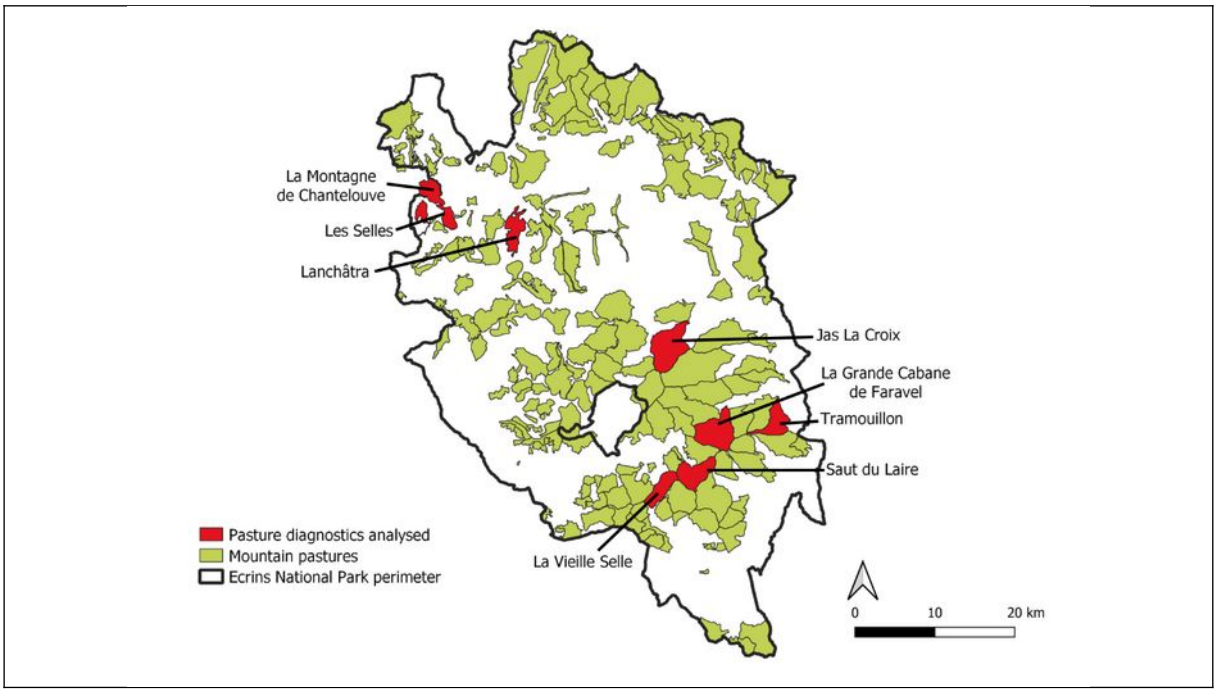


Figure 1: Mountain pastures of the Écrins National Park. Eight pasture diagnostics considering climatic vulnerability have been produced in the context of PASTORALP project and analysed in this report.

6 Results

6.1 Interviews with farmers, shepherds and experts

1. Perception of climate change on mountain pastures: a relatively minor issue

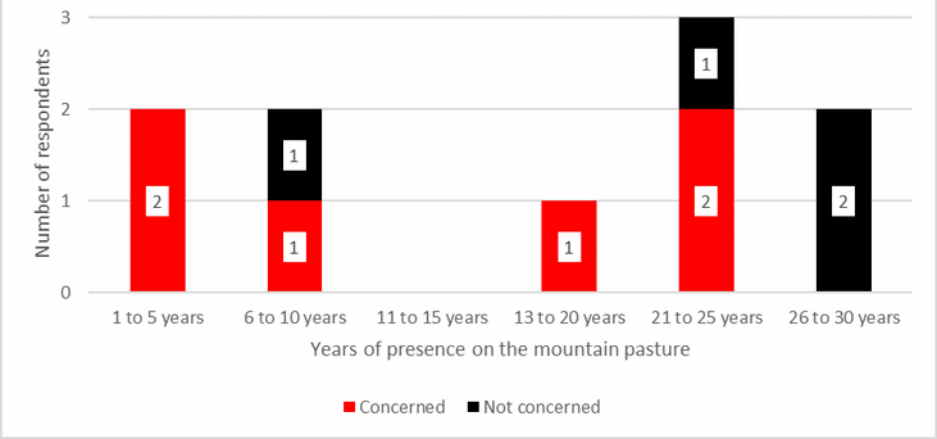
The shepherds/farmers' observations of climate change were contrasted: 2 did not indicate any changes, 3 stressed increased unpredictability and variability (*I'm scared, nowadays anything can happen*), 1 more extreme events, 4 fewer water and fodder resources, 2 less snow, 1 increased risks (avalanches, rock falls), 1 colder springs, 1 more wind. One informant pointed to potential positive effects of climate change. This suggests a high diversity of local perceptions of climate change on the mountain pastures, possibly related to:

i) the distinct exposure of each mountain pasture to climatic events;
ii) the specific sensitivity of water and fodder resources locally, making some climatic events more visible than others;
iii) individual factors leading informants to pay more or less attention to climate change on their pastures.

Overall, shepherds/farmers considered climate change to be a minor issue. 4 out of 10 did not feel concerned about climate change.

Both experts and shepherds/farmers considered climate change to be a much less important factor for current and future pastoral activities and mountain pastures than public policies and economic factors, and predation, respectively. Interestingly, shepherds who had long worked on the same mountain pasture did not seem to consider climate change to be a more important issue than shepherds who had recently arrived on a mountain pasture (Figure 2; for Fig. 2B. Wilcoxon test is non significant).

A.



B.

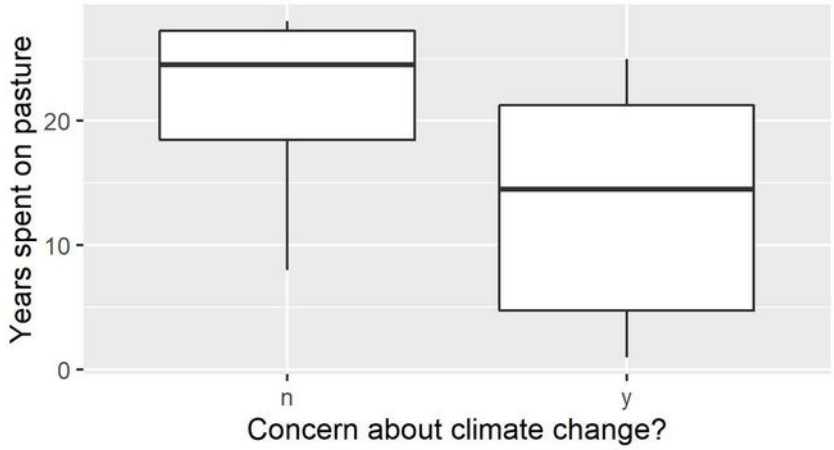


Figure 2: Shepherds' concern about climate change (results from P. Brien)

Farmers considered that farms are more exposed to climate change than mountain pastures, which appeared as a relatively preserved place and resource.

2. Summary of three key issues from the analysis of interviews

- What is a good year?

Rather dry than wet: shepherds/farmers preferred dry years, as their work was easier and they had fewer stock health problems such as foot rot. However, this is only true to a certain extent: lack of water requires urgent solutions.

They considered that early/late springs have both advantages and drawbacks, depending notably on the water and fodder resources available on the farms. They reported that the variability of the date of arrival on the mountain pasture requires adjusting the beginning of contracts for shepherds at the last minute.

Informants expressed no views or contrasted views regarding the impact of frost following early snowmelt (some noted that it usually occurs before their arrival on mountain pastures).

- A multifaceted impact

Although farmers/shepherds considered climate change on their mountain pasture as a minor issue, they mentioned several types of impact of climate change: lack of water and fodder resources; increased workload for shepherds; decreased weight gain of animals.

- Responses to climate change

Following the typology exposed in Deléglise et al. (2019), responses to climate change reflect the need to consider that mountain pastures are part of a larger social-ecological system, including their associated farms, and to distinguish between coping and adaptation (Table 2). We therefore organized the mentioned adaptation strategies based on two criteria: i) whether the responses concern the mountain pasture only or the link between the farm and the mountain pasture; ii) whether it is a short-term response consisting of adjusting grazing practices (coping) or a long term response consisting of transforming the structure of the mountain pasture (adaptation).

Table 2: Typology of responses to climate change in the Écrins range

	Short-term responses consisting of adjusting grazing practices (coping)	**Long-term responses consisting of transforming the structure of the mountain pasture (adaptation)**
Responses concerning the mountain pasture	Increase consumption of coarse vegetation Early morning and late evening grazing, to avoid heat and take advantage of the dew in the morning Adapt grazing circuits to water the sheep Conserve areas little exposed to drought for the end of the grazing season	Extend the pasture downwards to include neighbouring forest areas Improve pastoral equipment (huts, water tanks and troughs)
Responses concerning the link between the mountain pasture and its associated farm(s)	Search for new grazing areas Decrease the number of animals during the whole grazing season or part of it Exceptionally advance or delay arrival on the mountain pasture Exceptionally advance or delay end of season departure from the mountain pasture	Change usual date arrivals on the mountain pasture Search for new grazing areas at the bottom of the mountain pasture or on the farm(s) Decrease number of animals usually sent to the mountain pasture Change lambing dates

Interestingly, adaptation measures included both incremental adaptation (e.g., Improve pastoral equipment) and transformational adaptation (e.g., Extend the pasture downwards to include neighbouring forest areas).

Informants suggested that more adaptation strategies were available on mountain pastures with a high diversity of habitats.

The use of notebooks to record weather events and grazing practices was also mentioned as a tool to improve adaptation responses.

Some informants stressed that, although shepherds were the ones who had to make decisions on the spot to adjust grazing practices to whatever happened on the mountain pastures, they did not participate in making the decisions about their long-term equipment and management. In other terms, they were involved in coping rather than in adaptation.

The need to raise awareness of grazing activities among the general public and local communities was also mentioned (not specifically in relation to climate change) as a means of avoiding conflicts and facilitating multiple use of mountain pastures. This could also help avoid maladaptation, which can occur if measures aimed at adaptation to climate change, e.g. irrigation of mountain pastures, are taken without considering other issues such as biodiversity conservation or lead to an increase in herd size potentially increasing the pressure on resources.

6.2 Analysis of the feasible adaptation strategies identified in pasture diagnostics

1. Overview of recommended adaptation strategies

Following the typology of adaptation strategies, we identified recommendation of all types from pasture diagnostics, namely both i) at short or long terms and ii) on the mountain pasture or at the link with their associated farms (Table 3).

Table 3: Recommended adaptation strategies to climate change in the Écrins range, extracted from the eight pasture diagnostics analysed

	Short-term responses consisting of adjusting grazing practices (coping)	**Long-term responses consisting of transforming the structure of the mountain pasture (adaptation)**
Responses concerning the mountain pasture	Increase consumption of coarse vegetation Implement specific herding practises (light or tight herding, adapted grazing period on sensitive vegetation types) Increase grazing pressure on forested lowland areas Conserve resources in low pasture areas for late grazing (e.g., following early autumn snow events)	Improve pastoral equipment to increase resource consumption, including in less accessible areas (huts, water tanks, troughs, walkways …)
Responses concerning the link between the mountain pasture and its associated farm(s)	Search for extra grazing areas outside the mountain pasture (temporary buffer zones) Decrease the number of animals during the whole grazing season or part of it Exceptionally advance or delay arrival on the mountain pasture Exceptionally advance departure from the mountain pasture	Adapt usual arrival / departure dates on the mountain pasture Secure new grazing areas at the bottom of the mountain pasture or on the farm(s) (buffer zones) Decrease number of animals usually sent to the mountain pasture

2. Adaptation strategies and feasibility

The feasibility of adaptation strategies depends simultaneously on the biophysical attributes of the pastures (altitudinal span, vegetation type diversity …) and on the characteristics of the associated farming systems (local or transhumant herder, know-how of the shepherd, type and experience of the animals, role of the mountain pasture in the farming system…). No silver bullet can therefore be expected to serve across all contexts. However, core principles based on the understanding of the linkages among resources, pastoral uses and climate might arise from a synthetic reading of the pasture diagnostics. Indeed, some strategies appeared repeatedly across the eight diagnostics while others appeared to be more specific.

Two strategies that concern the link between the mountain pasture and its associated farm(s) were almost systematically mentioned across the diagnostics.

- A first strategy consists in limiting the total number of animals usually sent to the pasture, which corresponds to a long-term response. This strategy aims at decreasing the total pressure on pastoral resources, which appears particularly high when the stocking density on the pasture equates or exceeds the availability of resources on average years, making it almost impossible to find flexibility and additional resources in case of e.g., drought event. However, this strategy implies a reorganisation at the farming system level, as either the size of the entire flock must be rethought or some feeding alternative must be found as a replacement for part of the herd. In addition, reports from the fields highlight the difficulty to determinate a precise and fixed number of animals that can sustainably graze on a given mountain pasture, as for instance the practises and expertise of herders and shepherds matter in this overall balance, i.e. a more experienced / skilled shepherd can make resources go further.
- A second recurrent strategy relates to adapting the arrival date on the mountain pasture depending on the resource available, which is a short-term response adapted on a yearly basis. Importantly, the fact that this measure was commonly advised across the diagnostics does not imply that it is always easy to implement. Indeed, the diagnostics mention that its feasibility depends on the flexibility for adapting transportation dates at the last minute according to vegetation phenology and development stages, which appears easier for local farms than for long distance transhumant farms. It also means finalising employment contracts with shepherds at a very late stage. Further, this strategy displaces the pressure from the mountain pasture to potential buffer zones for spring grazing around the farms, which might – or might not – be available. Finding extra buffer areas out of the mountain pastures was indeed mentioned in some diagnostics, both as a coping strategy for specific years marked by climatic hazards or as a permanent adaptation. A strategy related to managing arrival dates, which was frequently mentioned in the diagnostics although to a lesser extent, refers to advancing the departure date from the mountain pasture of all or part of the herd. Similar constraints can be associated to this measure than to the ones discussed for arrival dates, with in addition the constraints for herders of being repeatedly present on the mountain pasture with transportation facilities in case of spread departures. Interestingly, while adapting the arrival or departure dates on the mountain pasture was repeatedly mentioned as a short-term response to climatic events, changing usual arrival or departure dates was generally not advised as a persistent adaptation in the diagnostics – probably echoing the high variability in weather conditions from one year to the other.

Two strategies that concern adaptations on the mountain pasture were mentioned by at least half of the diagnostics.

- One short-term strategy consists in increasing the consumption of coarse vegetation, which cover significant areas on many of the pastures diagnosed. Their grazing holds high potential for contributing to the feeding requirements of the herds, including in case of climatic hazards. However, the diagnostics acknowledge the possible difficulties for animals to graze and benefit from such coarse vegetation. Factors that were cited as enabling the implementation of this strategy include: the complementarity of vegetation types at the pasture level (and even at the scale of the daily grazing circuit); the possibility of an early grazing of some key species that get otherwise harder to graze; the possibility of regular and sufficient livestock watering; livestock ability to graze this type of vegetation; and shepherd know-how, essential for leading the flock at relevant times over these resources.

- Another reported strategy relates to improving pastoral equipment to allow for an increased resource consumption at the pasture level. In the diagnostics, this long-term response appears particularly relevant for areas presenting a low accessibility compared to most grazed areas or with uneven terrain that encourages limiting herd movement. Equipment mentioned include secondary huts, watering-related facilities (water tanks, troughs …) and access facilities such as walkways above mountain streams. Mentioned constraints mostly relate to regulations that the equipment needs to comply with and to economic costs that must be ensured.

Some diagnostics additionally mentioned some short-term responses that could be implemented on the mountain pasture. Specifically, they recommend i) implementing specific herding practises such as light or tight herding on specific areas of the pasture, ii) increasing grazing pressure on forested lowland areas, and iii) conserving resources in low pasture areas for late grazing (e.g., in case of early snow events). All these strategies rely on shepherds' expertise, required to anticipate the spatial and temporal distribution of resources over the grazing season as well as to adapt the grazing pressure to the distinct feeding capacities and sensitivities of the vegetation types composing the pastures.

Finally, although unevenly mentioned across diagnostics, we report here two points of attention that we believe to be important.

- First, a general recommendation was made in one diagnostic to keep the grazing dates over the different areas of the mountain pasture flexible. The rationale behind this strategy is to allow for on-the-ground adaptation to the sequence of climatic events along the grazing season on a yearly basis. Indeed, although a general overview of the feeding capacities of the different quarters serves the sustainable management of the pasture, a too rigid grazing calendar is conversely reported as limiting the adaptive capacity of shepherds on the mountain. One diagnostic mentions that even a one-day flexibility on arrival or departure dates might limit the risk of overgrazing vegetation types sensitive to given climatic contexts.

- Second, several diagnostics reported the uncertainties around water availability over the long term, even in contexts where the current situation appears satisfying. Elements discussed in the diagnostics seem rather specific to the local contexts of the pastures. However, they generally highlight the need for increasing knowledge about local water sources and their reliability over time, which is barely available.

6.3 Comparison of adaptation strategies mentioned in interviews and in pasture diagnostics

While our methodology does not allow for a direct comparison of results between data sources, it is interesting to note that most strategies reported here were cited both in the interviews and in the diagnostics. This suggests that knowledge about the possible relevance of such strategies is widespread among local stakeholders. However, this does not entail the actual implementation of these strategies on the ground, as a set of enabling conditions must be fulfilled in order to make them feasible as discussed in the previous sections.

Strategies implemented to adapt to climate change can rely on slight to profound changes in the current management practices. We notice that '*changing lambing dates*' was suggested as a possible strategy from the interviews but was not identified in the diagnostics. One reason might be that changing the reproduction cycles relates to a transformational change that induces a drastic re-organisation of the whole farming system. We hypothesize that such change might go beyond the purpose of a diagnostic carried out at the level of the mountain pasture itself and could be more easily considered when thinking generally about the system during the interviews.

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