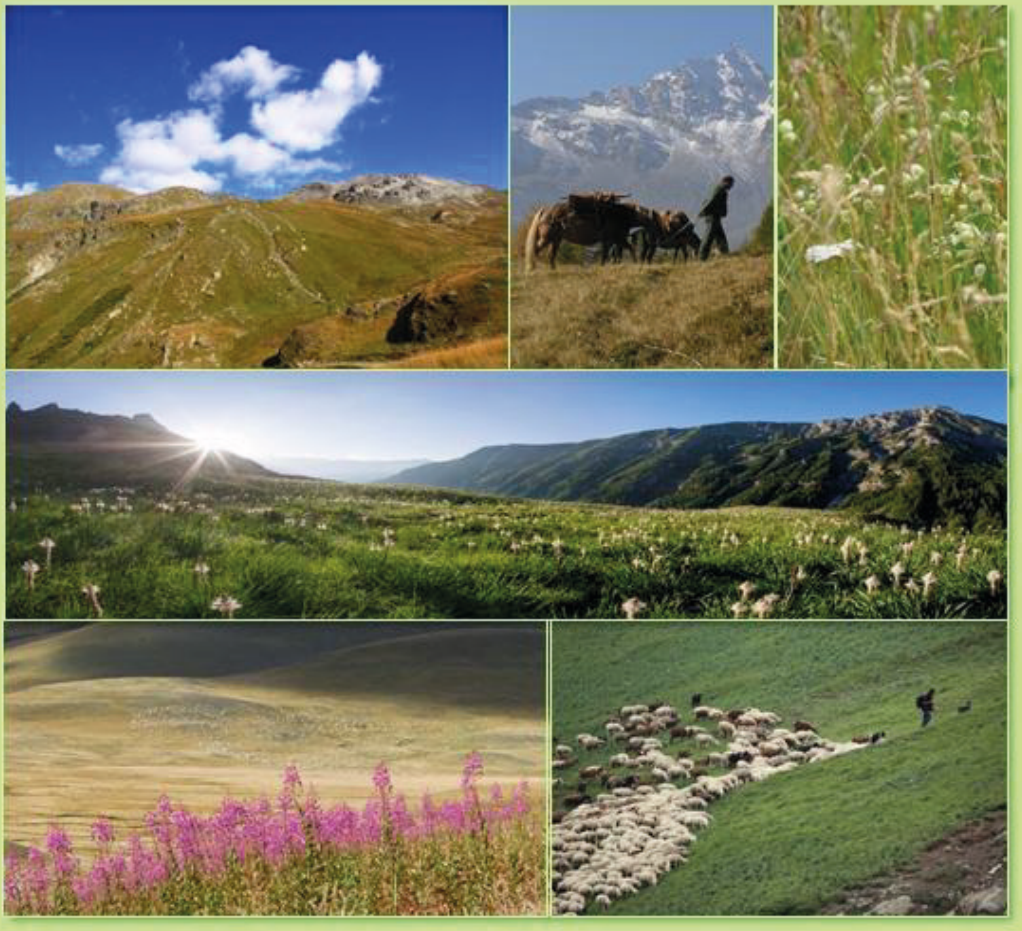
LIFE PASTORALP



LIFE16 CCA/IT/000060

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

Deliverable C.8

Integrated Adaptation Strategy plan and policy recommendations of alpine pastures to climate change impacts

March, 2023

LIFE PASTORALP

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INRAE (FR)

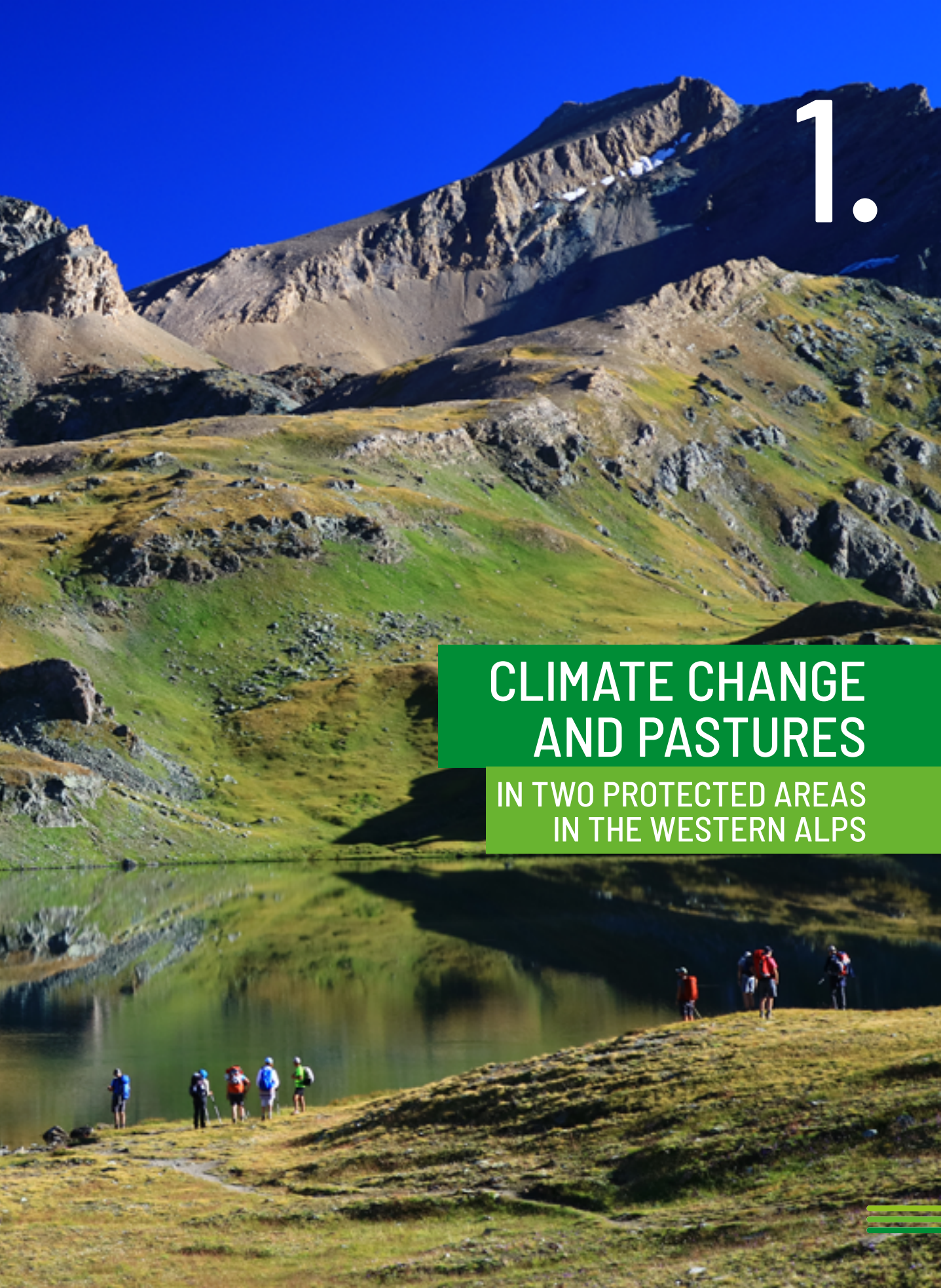
Parc National des Écrins
PNE (FR)

Parco Nazionale Gran Paradiso
PNGP (IT)

SUMMARY

GLOSSARY

24 hours grazing time	Night and day grazing with no return to the barn.
Climbing or Amontagnage	Seasonal, vertical transhumance that takes place in the period of late spring/early summer when cattle and flocks are transferred from the lowlands to the summer mountain pastures.
Coarse vegetation	Graminoid vegetation that is poorly consumed by animals (*Patzkea paniculata, Brachypodium gr. pinnatum, Helictotrichon spp., Deschampsia caespitosa, Calamagrostis spp.*, etc).
Downclimbing or *Demontagnage*	Descent of cattle and flocks from the alpage to the lowlands at the end of summer or in autumn.
Forests suitable for sylvo-pastoral use	Forests suitable for silvo-pastoral use: these are generally even-aged woods characterized by a herbaceous understory, likely rich in grasses and/or legumes and/or a shrub layer having a mid-pastoral value. The main tree species larch forests, secondary broadleaf forests (birch, poplar, invasive maple and ash forests, etc.), swiss scots pine and oak forests rich in grasses and legumes, sometimes fir woods. This category does not entail forests directly protected, stands under regeneration or transformation processes as well as uneven-aged stands at any stage of growth. Beech forests, fir forests, oak-hornbeam forests do not have a particular forestry vocation. In suitable stands, the conditions of the sward, light on the ground and availability for grazing can be improved by thinning, also through the transformation of irregular stands, without any particular management and without any other particular vocations.
High altitude pastoral paddock	Pastures at higher altitudes, usually grazed in August.
Mayen	Mid-mountain pasture, grazed on the way up or down from the summer mountain pasture, thus at the beginning (spring) and end of the grazing period (autumn).
Minor species	Wild minor species – complex of small size species ("minor" doesn't have a biological or systematic meaning) like: amphibians, reptiles, small mammals, fish and insects. Some "minor species" are listed in The Bird (2009/147/EC) and Habitat Directive (92/43/CEE). Directives define the protection level.
Summer mountain pastures or *Alpage*	The alpage is a high-altitude pastoral unit used in summer by herds and flocks belonging to one or several farmers. Usually the alpine pasture consists of a variable number of pasture areas and huts (remue or tramuto), where the herd and its shepherds stop for the time necessary to consume the surrounding pastures.



1.

CLIMATE CHANGE AND PASTURES

IN TWO PROTECTED AREAS IN THE WESTERN ALPS

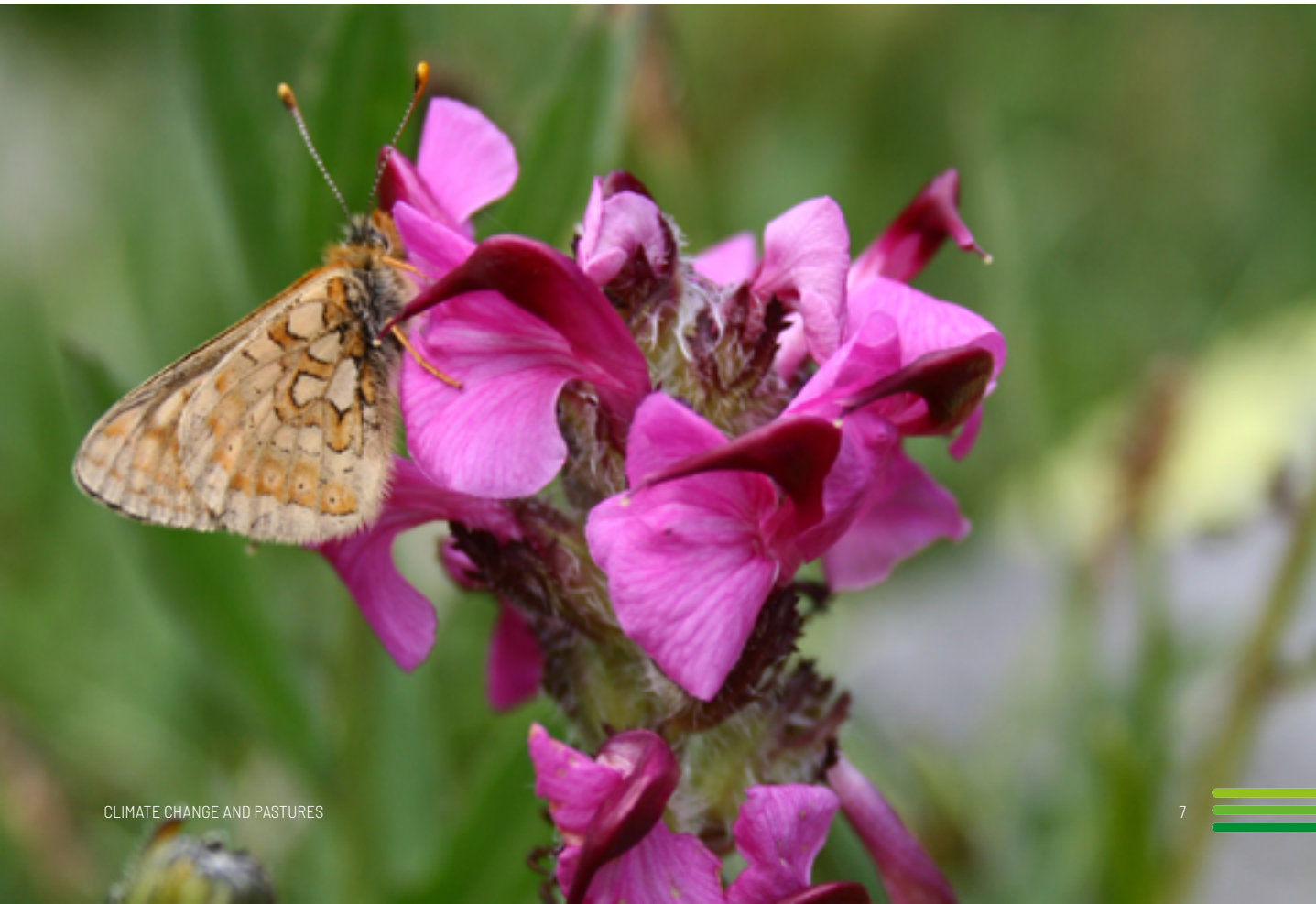
1. BACKGROUND: CLIMATE CHANGE AND PASTURES IN TWO PROTECTED AREAS IN THE WESTERN ALPS

A. The climate is changing-particularly in the Alps

In the last century, alpine ecosystems have experienced a global warming of about 2°C (+1.8°C in the 1979-2018), nearly two times higher than the global average *(Auer et al., 2005; 2007)*. The increase in surface air temperature is expected in a range of 3-5°C in the next decades, depending on the climatic scenarios analysed *(Dibari et al., 2015; Petriccione and Bricca, 2019)*. An air temperature distribution shift to warmer values is projected to occur in all seasons, especially for the minimum temperature, while the maximum temperature shows a more intense warming and a pronounced peak during summer *(Tomozeiu et al., 2018; Gobiet et al., 2014)*. Additionally, the altitude gradients of warming were found to significantly change, with a higher increase of temperature at higher elevations in all seasons *(Gobiet et al., 2014)*. Along with seasonal mean values, the extremes changed significantly with an extension of the summer period characterized by an increasing occurrence of intense heat waves *(Zampieri et al., 2016)*. Over the last decades, warming has been associated with variations in precipitation which in turn depends on the area (e.g. increases in the north-west and decreases in the south-east) and the seasonal pattern, with overall decreases in summer *(Schmidli and Frei, 2005; Auer et al., 2007; Brunetti et al., 2009; Chelli et al., 2017)*. Future projections, even if affected by uncertainties depending on the regional and global models considered, indicate the same trend: i.e. decreases in summer precipitation (especially in the southern Alps) and slight increases in winter by the end of the century *(Gobiet et al., 2014)*. Such precipitation decline, embedded in a structural warming trend, will alter significantly the hydrological cycle with an increasing trend of drought length and intensity and further accumulation of water deficits under all different levels of future warming *(Naumann et al., 2018)*. In addition to these trends, intense and frequent extreme climatic events (e.g. heavy rainfall, drought periods, heat waves and possibly also storms) are foreseen. Consequently, the snow mass of the Italian Alps is expected to reduce in the future, with uneven heavy snowfall events in winters, though likely to decrease in occurrence in the next future *(Soncini and Bocchiola, 2011)*, and leading to water scarcity in summer periods. In particular, the synchronous effect of drought and heatwaves in the Alpine areas, during summer, increases the forest evapotranspiration, which is essentially sustained by water availability in the soil. Thus, such increased evapotranspiration reduces the water runoff fraction that feeds streams and rivers from valleys to plains. The resulting water deficit is consequently transferred to remote plains even far away from the Alpine region *(Zampieri et al., 2016; Mastrotheodoros et al., 2020)*.

B. Expected impacts on pastures areas

The main climatic variables driving the impacts on pastures are: increases in temperatures, variability in precipitation patterns and higher frequencies of extreme events (droughts, heat waves and dry spells). These climatic trends will likely affect high-mountain grassland ecosystems considered as hot spots of climate and land use changes *(Beniston 2003; Tasser 2005)* also due to their importance to provide associated services in the Alps. Agriculture drop-out and global warming interact to close open spaces by encroachment of wooden species towards higher altitudes. This likely determines a serious risk of biodiversity loss, missing a connectivity approach in landscape management and in the absence of agro-environmental measures allowing connections between subalpine and alpine grasslands. In alpine pasture environments, the start of the growing season is strictly dependent on the melting of snow. Since temperatures are increasing due to climate change, snow is melted earlier, leading to an anticipation of the start of the growing season that may result in cold spring, which in turn may determine damages to grassland vegetation in its beginning of the vegetative period. These forage resources, as observed, can be further damaged by the higher drought in summer periods that don't allow for an adequate storage of water in soil making it difficult for grassland to survive and leading to remarkable effects on productivity and forage quality. This can, in turn, create problems for animal health or can affect animals' feeding performances. Moreover, the socio-economic changes that occurred in the past decades have caused several modifications in the land-use intensity determining reductions on biomass production, quality of the forage, botanical composition and biodiversity issues (at resource and landscape level). Besides the importance of the productive aspects, preservation of pastures in mountain areas is also crucial for many other ecosystem services provided by these resources, i.e. biodiversity protection, defense from soil erosion, landscape maintenance, conservation of open spaces useful for touristic activities, carbon sequestration.



C. Consequences for pasture management

In this context, pastoralism, whose tradition in the Alps dates back to 6000 years BP *(Lichtenberger, 1994)*, has encountered an increased vulnerability associated with grassland abandonment and tourism economy development that became a convenient alternative to agricultural activities.

Natural pastures derive from a combined influence of local environmental characteristics (mainly climate and soil properties) and centuries of human-managed livestock grazing: in this way Alpine grasslands represent at the same time a traditional landscape element and the basis of the local farming systems *(Targetti et al., 2010)* and their management represent both the way of their conservation and exploitation. Appropriate management can preserve grassland biodiversity, maintain ecosystem services and counteract climate change impacts *(Nori and Gemini, 2011; Felber et al., 2016)*. Often, in the alpine valleys, current management practices are far from being "best practices" and pasture management fails to be sustainable, due to the concurrence of several causes: reduction of the presence of local herders; pasture abandonment and/or stocking rate reduction; increased presence of external shepherds, coming from the lowland, with a limited knowledge of alpine grassland management. Good pasture management practices and tools still need to be disseminated and promoted. Moreover, climate and socio-economic changes modify the parameters to which farmers were accustomed and impose the definition of resilient strategies and new solutions to adapt pastoral practices to the new framework. Hence, it is important to create the conditions for the occurrence of cooperation between involved parts that may have to face similar problems. It is known that significant climate change impacts are already visible globally, but they are expected to become more pronounced in the future. Thus, related problems like depopulation of alpine areas, abandonment of mountain grasslands and shrub encroachment could be hampered having negative consequences on grasslands ecosystems and pasture management. A more sophisticated assessment of adaptation decisions resulting from combined environmental and socio-economic analyses is relevant and critical for the development of pastoral systems facing climate changes.

D. From awareness to action: counteracting measures nowadays applied in alpine areas against climate change

Many studies *(e.g. Nori and Gemini, 2011, European Environment Agency, 2010)* report on the positive effects of appropriate pastoral resource management for maintaining the ecosystem services of the so-called 'Europe's ecological backbone'. In many Alpine regions specific measures to manage pastures coping with climate change are still not implemented, and this despite the adoption of ad hoc policies *(e.g. European Agricultural Policy, Dir. 2001/41/EU, Reg. 2003/1782/EU and 2005/1698/EU)*.

2.

AIM OF THE PLAN:

HOW WE CAN ADAPT TO FUTURE CLIMATE CHANGES

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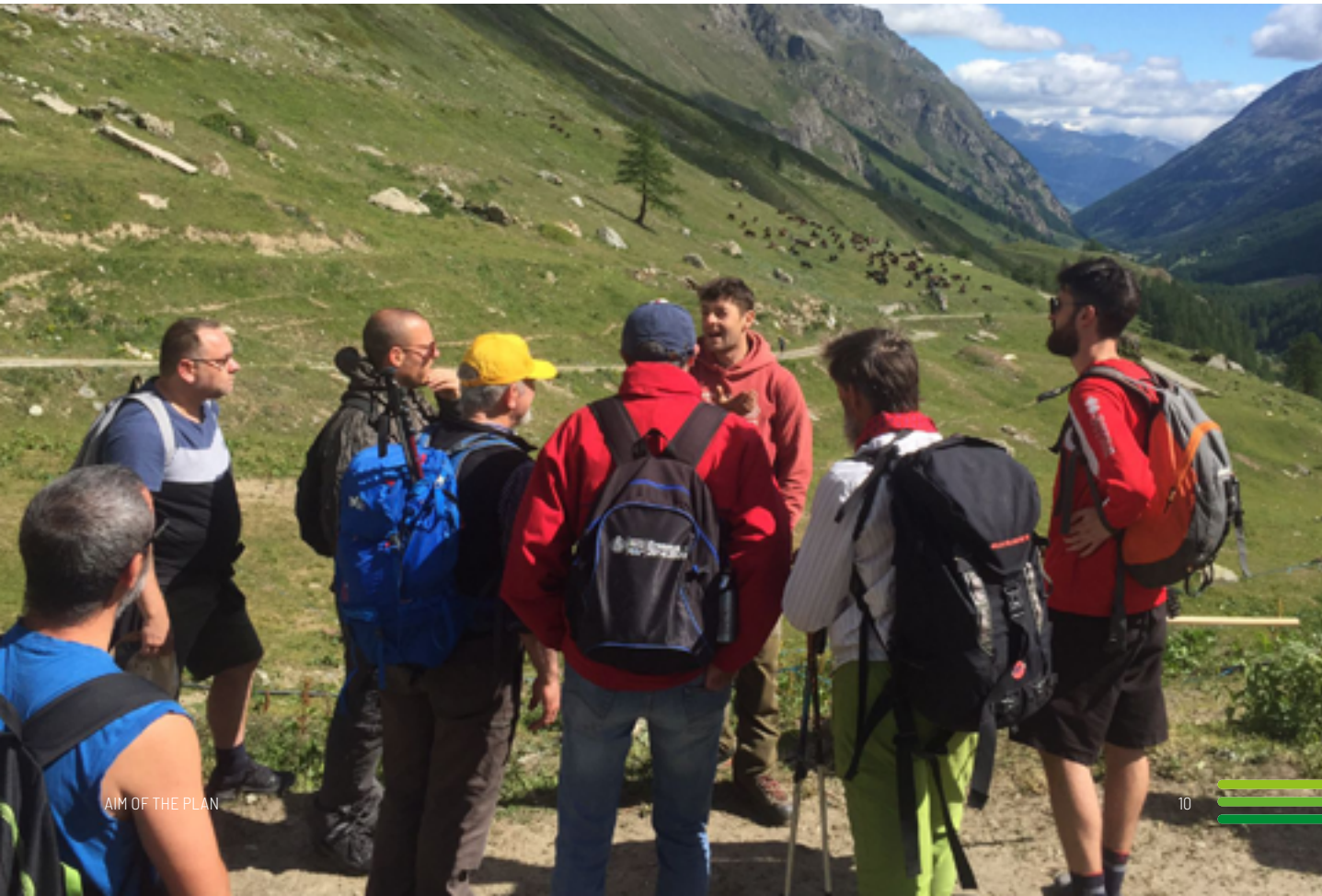
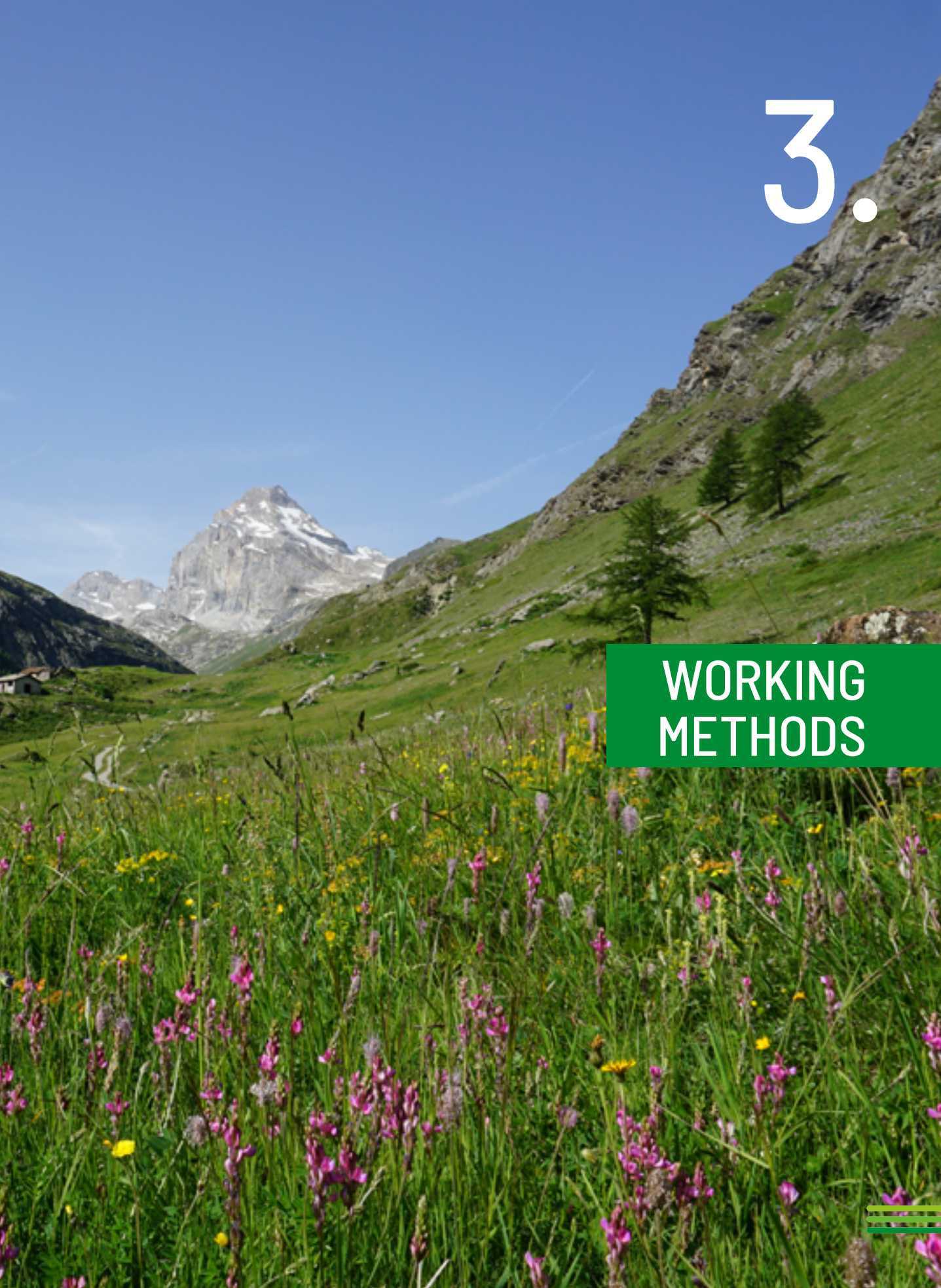
The Plan aims at reducing the vulnerability and increasing the resilience of alpine pasture agriculture by spreading tested adaptation measures, enhancing capacity building and developing improved management strategies for climate change adaptation. The achievement of this goal is based upon a solid science-based knowledge of future climate change impacts on pastoral communities located in two national parks (Parc National des Écrins and Parco Nazionale Gran Paradiso) in the Western Alps (Italy and France) taken as examples of the alpine environment. Vulnerability of alpine natural pastures is addressed by combining biophysical and socio-economic characteristics with the final aim of providing instruments to reduce it as well as deploying outcomes for facilitating climate change adaptation strategies adoption in order to propose reliable management practices options able to face the foreseen impacts and mitigate negative effects.

The phases to establish the adaptation measures reported in this plan were:

- assessment of the **impacts of climate change** on different pastures characteristics (production, occurrence, forage quality, biodiversity, etc.), and **analysis of their vulnerability** by different methodological approach, such as modelling, remote sensing, climate scenarios analysis, etc.;
- outline and discussion on the perception of climate change on agropastoral systems in mountain areas by local **stakeholders** to validate obtained results of previous phase;
- drafting of **guidelines for shepherds and decision makers** for a more efficient pasture management to face future climatic conditions.





3.

WORKING METHODS

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Different methodologies were applied in a rational framework for the realisation of this plan.

The first step dealt with the collection and acquisition of data concerning pasture areas and their management, in order to analyse the best adaptation strategies to be applied in each site. Specifically, data acquired were as follow, according to different actions of the project:

ACTION A1

A Communication, Dissemination and Stakeholder engagement plan (CDSp) was developed. The CDSp formalizes stakeholder engagement strategy, that includes a stakeholder analysis and engagement plan and a stakeholder platform. This list was further increased through the participation to the launching events and to workshops.

ACTION A2

The analysis has focused on Common Agricultural Policy, mainly with the assessment of the Rural Development Programmes of Regions involved in the project. Other European regulations and technical reports that directly and indirectly refer to pastures management have also been reviewed. At the same time, a list of feasible adaptation strategies was reported including pros and cons of each. All information was stored in a specific database.

ACTION C1

Aimed at collecting and harmonizing data as well as at providing future climatic data according to models protocols. A geo-database containing meteorological data, pasture management and soil parameters has been created for six relevant sites (three in PNE and three in PNGP).

ACTION C2

Mapping of pastoral distribution across the two study areas under an harmonised legend was performed. In this mapping activity, based on field data collection, remote sensing and modelling application, presence and absence of pastoral resources, vegetation macrotypes and pastoral productiveness classes were mapped.

ACTION C3

A set of environmental and socio-economic indicators has been set by literature scanning, indicator classification, and local stakeholders' contribution to identify interconnections between pastoral production and surrounding environment, as a basis for assessing the vulnerability of pastures located in the study areas under current and future conditions.

ACTIONS C4 AND C5

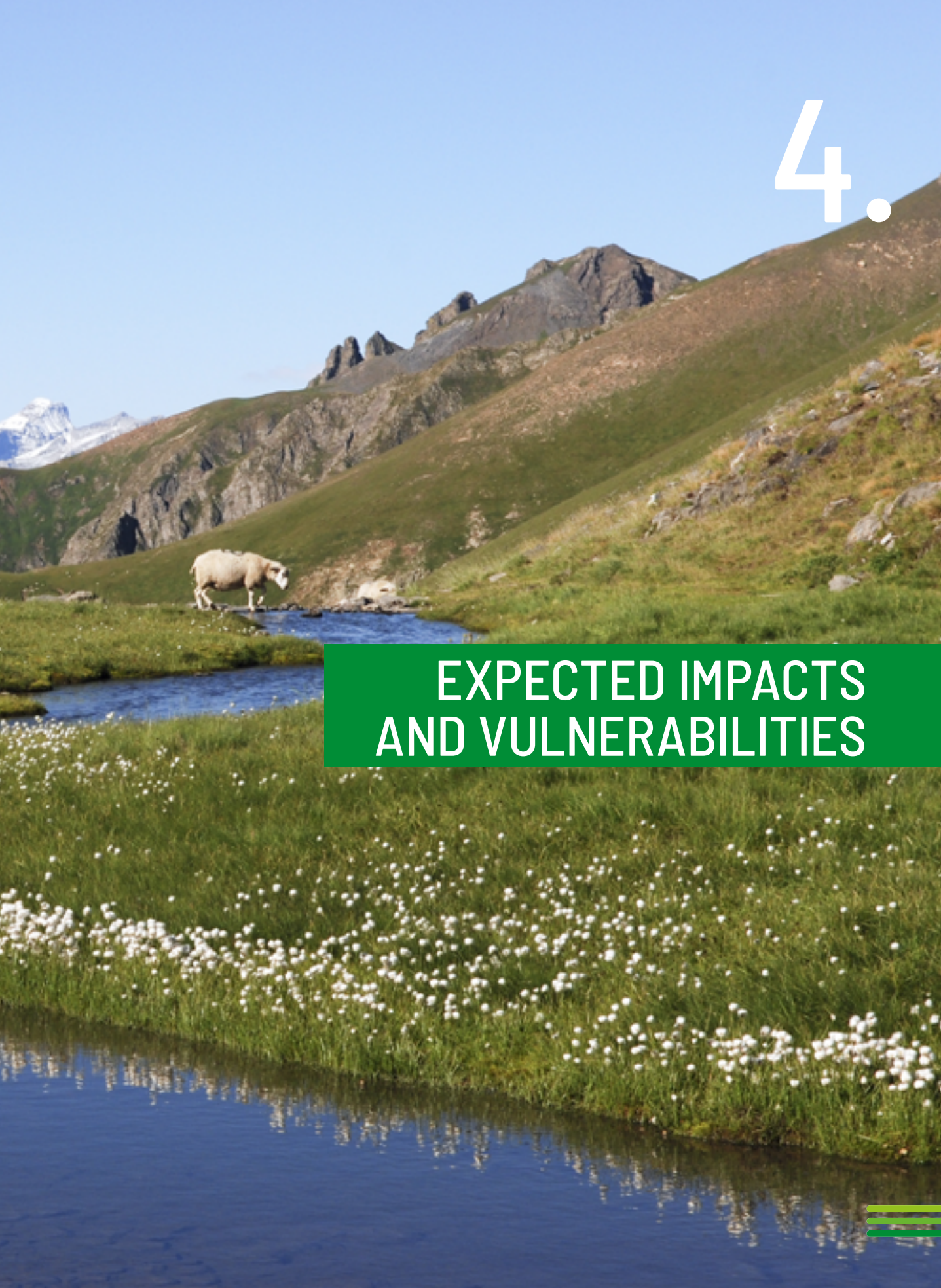
Assessment of the vulnerability of pastures in the Western Alps was performed by means of modelling approaches. Two models (DayCent, PaSim) were calibrated on data gathered from different areas of the two parks. The results allowed for the prediction of major expected changes on these ecosystems. The modelling procedure was also addressed by exchanges with local stakeholders that have confirmed the relevance of considering direct and indirect feedback that may exist between adaptation capacity and sensitivity to changes.

ACTION C6

Adaptation strategies, as derived from data acquired by bibliographic research previously described, were tested in a set of experimental sites located in the two parks, in order to test their feasibility. Outcomes have been progressively refined and integrated with results obtained by modelling framework and stakeholders' feedbacks.

Preliminary results of the abovementioned actions have been shared and discussed with relevant stakeholders by means of workshops, interviews, questionnaires, meetings and round tables both at PNE and PNGP. Results and outcomes obtained by the project have been presented at each event in order to activate participative discussions on feasible adaptation strategies as well as socio-economic impacts deriving from climate change. Socioeconomic drivers of the local pastoral systems affecting the sensitivity to climate changes were obtained according to the stakeholders' opinion and were compared with results of references analyses. The first step focused on exploiting the acquired data (subsection 3.a) to provide a descriptive socio-economic analysis related to pasture management. Using a participatory process, based on a stakeholder questionnaire, a set of indicators were selected and considered the most suitable to describe the sustainability and adaptation capacity of pastoral systems in PNE and PNGP. The indicator review has been analysed to provide for evaluating different potential trends according to different possible scenarios. Diachronic NDVI-based maps were produced to identify areas of recent land abandonment in PNE and PNGP and shared with stakeholders.

Moreover, a survey was conducted on a relevant sample of shepherds who regularly utilise the summer pastures of the Gran Paradiso National Park, following a questionnaire in order to deepen the main topics related to Pastoralp (perception of climate change and its effects on animals and vegetation), but also other socio-economic aspects and problems specific to these alpine areas. From the interviews it is evident that climate change is not what worries most the breeders so far, even if in the last few years they have already had to face extreme weather conditions or frequent long periods of drought. The current problems reported by farmers are mainly three: I) damages caused by wildlife (e.g. wolves); II) infrastructural deficiencies and lack of roads; III) bureaucracy.



4.

EXPECTED IMPACTS AND VULNERABILITIES

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Simulated pastoral outputs were obtained by forcing two grassland models - DayCent and PaSim - with daily downscaled weather data, which were selected to map a broad range of climate outcomes for impact modelling. Climate scenarios from three Regional Climate Models (RCMs) from Med-CORDEX - CNRM-ALADIN (0.11° × 0.11°), ICTP-RGCM4 (0.44° × 0.44°), and CMCC-CCLM4 (0.44° × 0.44°) - with radiative forcing for the medium RCP4.5 and the high RCP8.5 (Representative Concentration Pathways 4.5 and 8.5), were used for the reference period 1981-2010 (near past with 400 ppmv) and for two future time-slices: 2011-2040 (near future with 450 and 470 ppmv CO^2) and 2041-2070 (mid future with 540 and 670 ppmv CO^2). The delta-change approach was applied as a downscaling procedure, where the observed daily weather data available for each given site were modified using the forcing factors obtained from the RCM simulations. These were calculated as the mean absolute monthly differences between the RCM baseline (1981-2010) and the future RCM periods selected for simulations (2041-2070, 2071-2100) for minimum and maximum air temperatures and the percentage variation in monthly cumulated rainfall, wind speed and solar radiation. These differences were then added, month by month, to the observed daily meteorological data from PNE and PNGP to derive future weather data that were used to feed model simulations for future periods. The three daily datasets deriving from RCMs downscaling were finally merged into a single dataset reproducing the mean change in climate conditions for each single site in RCP4.5 and 8.5 for 2031-2040, 2041-2070 and 2071-2100 time-slices.

Meteorological observations and satellite-derived normalised difference vegetation index (NDVI) trajectories, determined in areas representative of three pasture macro-type classes (high, medium and low productivity along an altitudinal productivity gradient) in two study areas - the *Parc National des Écrins* (PNE) in France and the *Parco Nazionale del Gran Paradiso* (PNGP) in Italy - were used as a basis for the modelling work. Although no clear upward/decreasing trend in projected precipitation was observed in both parks in the progression from near to mid-future, climate models showed a general increase in temperature towards the mid-future, similar for both parks, with the largest increases in summer and the smallest in autumn-winter. For both parks, we assessed the multi-year response of two grassland models to these projected climate changes (as reflected by the RCP4.5 and RCP8.5 scenarios for the near and far future) under business-as-usual (BaU) and alternative management scenarios (14-day grazing advance and grazing intensity of ±20%).

The calibration process showed a satisfactory performance of both models in reproducing macro-type pasture production (r^2=0.52 to 0.83), and the changes in pasture dynamics under climate scenarios and adaptation options were evaluated for: I) the length of the snow season; II) the length of the growing season; III) fluctuations in soil water content; IV) the impact of adaptation options on biomass production at the peak.

The length of the snow season is expected to decrease in both parks and for all three macro-types due to earlier spring melt and later snowpack accumulation, and warmer scenarios are likely to exacerbate this situation.

In contrast, the length of the growing season can be strongly affected by the change in snow-cover pattern, resulting in an early start and a late end in both parks. Under climate change scenarios, for the high productivity (HP) macro-type, the growing season was found to start earlier, between 11 and 37 days, and end later, between 6 and 49 days. For the medium (MP) and low (LP) productivity macro-types, the growing season pattern was similar to that observed for the HP macro-type, with the growing season extending from 20 to 60 days in total. Adaptation options can partly affect the length of the growing season, as higher livestock densities could enhance grassland regrowth, resulting in a higher biomass level at the beginning of the growing season. However, no major changes are expected when different adaptation options are applied.

Under climate-change scenarios, both grassland models indicate an anticipated decrease in soil water content close to or below the permanent wilting point, especially during the warm season in all three macro-types in both parks, while no change in soil water content is expected with the different simulated adaptation options. Overall, PaSim showed less pronounced oscillations in soil water content compared to DayCent. In the HP macro-type, PaSim report variations of ~0.30-0.40 m^3 m^{-3} in the PNE and ~0.15-0.25 m^3 m^{-3} in the PNGP, whereas DayCent amplifies seasonal differences with ~0.15-0.60 m^3 m^{-3} in the PNE and ~0.05-0.35 m^3 m^{-3} in the PNGP (with similar patterns in the MP and LP macro-types). In the MP macro-type, the simulated soil water content by DayCent varied in a range of ~0.20-0.65 m^3 m^{-3} in the PNE and ~0.05-0.40 m^3 m^{-3} in the PNGP, while using PaSim the soil water content was in a range of ~0.30-0.45 m^3 m^{-3} in the PNE and ~0.12-0.24 m^3 m^{-3} in the PNGP. In the LP macro-type, the soil water content simulated by DayCent ranged by ~0.20-0.65 m^3 m^{-3} in the PNE and ~0.05-0.40 m^3 m^{-3} in the PNGP, while using PaSim the soil water content ranged by ~0.32-0.48 m^3 m^{-3} in the PNE and ~0.12-0.22 m^3 m^{-3} in the PNGP.

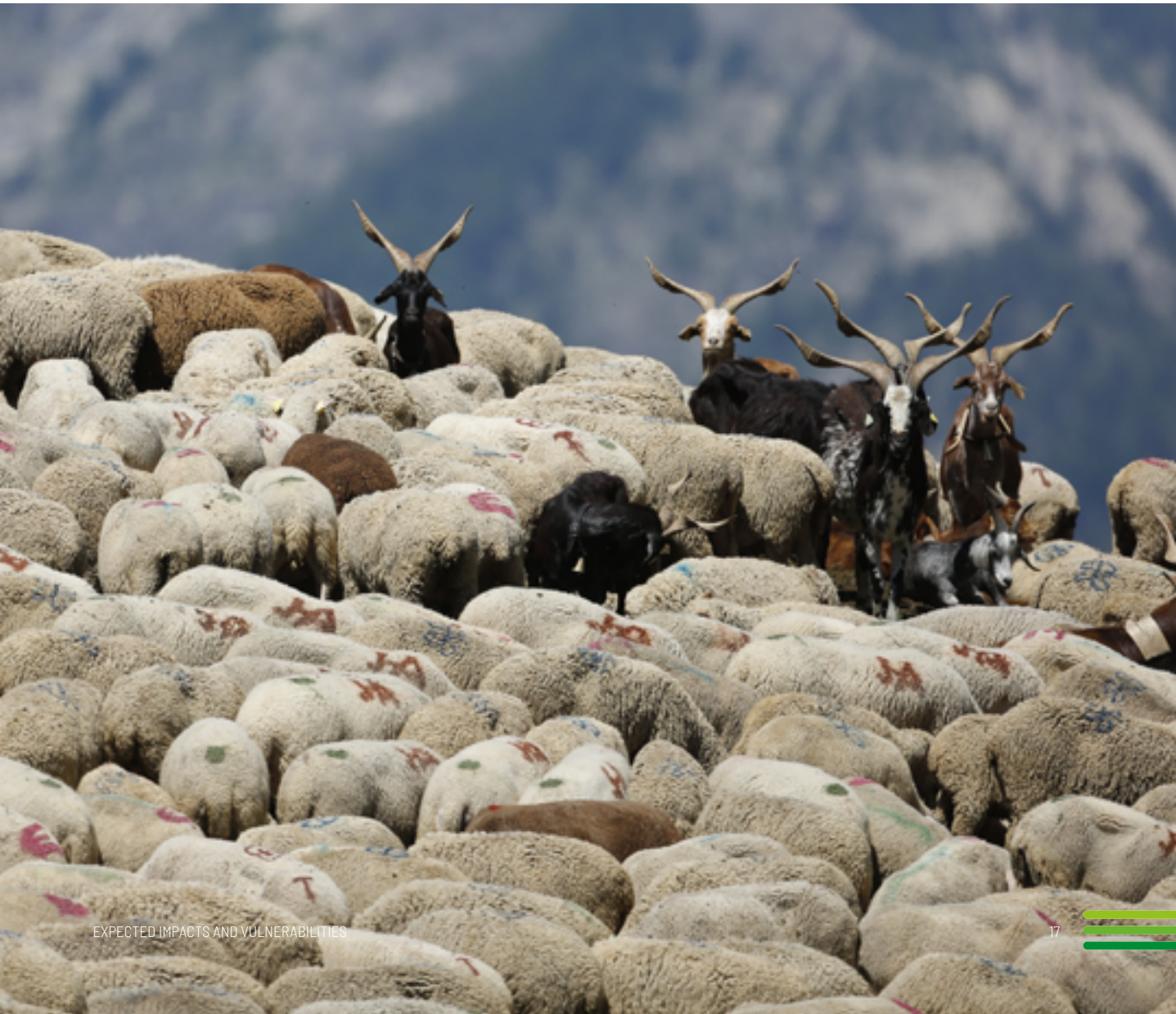
With drier summer conditions, grassland growth can be water-limited in summer, while pasture growth may continue throughout the year. Model simulations with the projected climatic conditions indicate a slight overall reduction in pasture suitability for all future periods and scenarios, particularly for the period 2041-2070, where pasturelands are expected to be reduced by between -8% to -5% compared to the present in both RCP 4.5 and 8.5 scenarios. Among the areas studied, the greatest losses are expected in the PNGP with RCP4.5 in the far future, while the PNE is expected to be affected by lower losses of pastoral suitability (-2%) compared to the present in both RCPs.

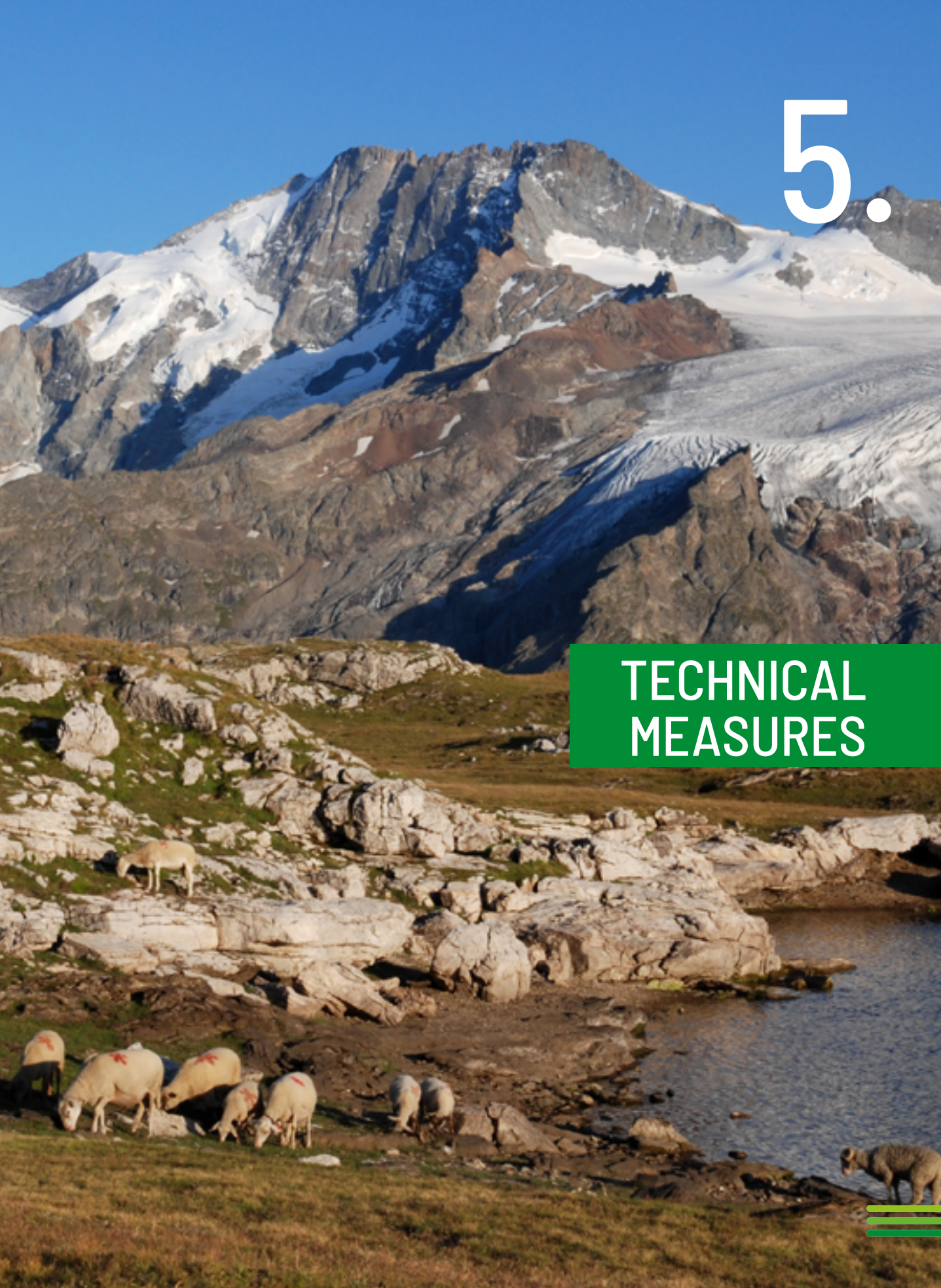
The pasture biomass profiles reflect two peaks in production, most evident in the high-productivity macro-type (low altitude), resulting in two seasonal grazing periods. A peak, the highest (at 5-6 tonnes of dry matter per hectare), occurs in June and the second in August. Both are expected to be maintained in the future, with the peak dates likely brought forward by about a week. Future patterns for the first peak of high productivity pasture production indicate an increase in biomass production of ~18% in the PNE and ~41% in the PNGP as warmer scenarios approach, while DayCent reported a decrease of ~20% in both study-areas. These results mainly reflect the calibration of the two models against observational patterns, with the PaSim production profile indicating faster plant growth in spring, with a distinct peak biomass, and rapid summer regrowth. This behaviour is much more evident in the climate-change scenarios, resulting in differences in biomass production that are about 38-45% higher at peak with PaSim than with DayCent, likely due to the absence of sensible water deficits in PaSim. For the medium and low productivity macro-types, the biomass peaks partly reflect the trends observed for the high productivity macro-type, with an indication of an increase in peak biomass production with warmer climate by ~25% in the low productivity (high altitude) macro-type in the PNE.

For the impact of adaptation strategies, the peak biomass value under usual management was compared to the peak biomass of alternative management practices under future scenarios, i.e. the stocking rate in the pasture was increased or decreased by 20%, and the grazing period was advanced by 14 days. In the HP macro-type, given the different modelling approaches in the simulation of soil water content, the simulated biomass under water limitation reflects complex patterns across parks, macro-types and models. Using DayCent, in the PNE an increase in stocking rate and an earlier grazing date were the better adaptation options (+13 to +18% of biomass), whilst in the PNGP a reduction in biomass was found regardless of the adaptation strategy adopted (-5.4% to -18%). Using PaSim, all management options showed an increase in peak biomass under all climate scenarios and time-slices (+11 to +50%). For the MP and LP macro-types, PaSim suggested a general increase in biomass production, more prominent (>50%) in the PNE than in the PNGP and macro-types. In

contrast, DayCent reported none or declining (-6%) production for the MP macro-type in both parks under all advanced grazing management, while for the LP macro-type it showed contrasting patterns. Specifically, a slight decrease in productivity (-4%) is expected in the PNGP approaching the warmest scenario under all managements, while an increase in productivity between +10 to +20% was found in the PNE approaching the warmest scenario at the current grazing date (business-as-usual) and at different livestock densities (±20%).

In conclusion, the alpine region is expected to become warmer and wetter, and higher yields can logically be expected, but how yields are affected in such areas depends largely on water availability. The lack of water in the soil in summer could become an increasing issue for alpine pastures. Reduced soil water availability and increased number of heat stress days (stomatal closure) may inhibit biomass production in summer, which should be taken into account in addition to the increase in plant photosynthetic rates with increasing CO2, while taking into account the possible degradation of grasslands due to severe summer drought events. For that, any excess water in winter can be used to reduce the water deficit when the soil is drier than the field capacity. Another message of this study is that the projected climate scenarios and the adaptation options considered are not expected to substantially worsen the GHG balance, although a caveat is that C sequestration by pasturelands may be reduced in a warmer climate.





5.

TECHNICAL MEASURES

5. RECOMMENDATIONS ON ADAPTATION POLICIES AND TECHNICAL MEASURES

Based on the expected future impacts of climate change and the vulnerability analysis, effective policies and adaptation measures were developed to cope with socio-economic and climate changes in the two study areas (Écrins National Park-FR, Gran Paradiso National Park-IT). In order to define the major climatic risks of the two territories and possible solutions, current regional, national and European policies were analysed and then participatory processes were launched with stakeholders, such as farmers, technicians, agricultural actors and local institution officials. Consultation workshops, interviews and round tables were held in the two parks to: I) gather opinions on perception of CC and its effects on pastures production and animals' performances; II) discuss current management and criticalities of mountain livestock farming and key drivers of socio-economic change; III) record adaptation measures already implemented in the project areas; and IV) collect suggestions from stakeholders. At the end of the participatory process, the identified strategies were assessed by stakeholders in terms of feasibility in mountain context, contribution to CC adaptation and economic viability. The exchange of knowledge and discussion between different stakeholders proved to be effective in raising awareness on climate change in Alpine mountain farming and promoting the adoption of adaptation measures by pastoral communities.

5.1 THE PASTORAL SYSTEM IN PNE AND PNGP

Permanent grasslands are a central element for the agro-pastoral livestock system in the territories of the two National Parks. Alpine pastures are complex and multifunctional systems, preserved by traditional and sustainable pastoral practices. They constitute a habitat for flora and fauna of high biodiversity value and represent a landscape of great cultural value. The extensively managed alpine pasture system provides multiple ecosystem services of support, supply, regulation (in particular carbon sequestration and prevention of flooding and soil erosion) and cultural (recreational spaces for tourists and local population). Summer mountain pastures play an important economic and social role in the development of rural areas and in the production and commercialisation of quality products linked to specific territories (e.g. dairy, meat, wool).

Cattle, sheep and goat breeding represent the most important and widespread form of agriculture in these mountain environments. The typical organisation of livestock farming involves the mounting of herds or flocks, from the farm at the bottom of the valley to the summer mountain pastures, sometimes moving through the *mayen*, the mid-mountain areas that are typically grazed in spring and autumn. This farm management, based on the practice of vertical transhumance, stems from the possibility of always being able to use fresh grass, first at the bottom of the valleys and and then going up to the *mayen* and the summer mountain pastures, and to be able to mow the meadows at the low-altitude zones to provide the fodder supply for the winter.

Because of the high altitude of the alpine pastures (approx. 1500-2700 m a.s.l.), the grazing period of the grasslands is limited to the summer season only. The *alpage* can have several huts in order to make better use of the seasonal growth of the grass at different altitudes. Some alpine pastures are equipped with buildings for housing staff and livestock, small dairies for milk processing and other facilities.

Mountain animal husbandry is characterised by predominantly family-run farms of small to medium size in terms of both managed surfaces and number of animals. In the Écrins National Park pastures are typically grazed by flocks of sheep for meat production, while in the Gran Paradiso National Park cattle breeding is the most widespread. In Valle d'Aosta, the management of alpine pastures with dairy cows is largely aimed at the production of Fontina PDO, a traditional cheese closely linked to the territory and the native cattle breeds, which are distinguished by their remarkable rusticity that allows them to adapt to the difficult mountain conditions and at the same time guarantee good productivity.

Agricultural activity is strongly influenced by the difficult geomorphologic and climatic characteristics typical of the mountain environment and by socio-economic changes. The trend in recent years is that of a gradual but constant decrease in the rural population and agricultural activities, resulting in the abandonment of agricultural land. Other critical issues include the shortage of manpower in the agricultural sector, the low value of dairy and meat products and, finally, the return of the wolf, which heavily affects the management of animals by breeders and shepherds.

5.2 WHAT ARE THE MOST COMMON NATURAL HAZARDS IN THE WESTERN ALPS ALPINE PASTURES?

In the Gran Paradiso National Park and Écrins National Park study areas, the main climate risks for high-mountain grasslands were identified by researchers and stakeholders. For each one, the possible consequences and impacts on the environment (soil, vegetation and water) or animals and on the pastoral system were described.

1. LACK OF SNOW WITH VERY DRY AND COLD WINTER; OR EARLY SNOWMELT FOLLOWED BY SPRING FROST; OR LATE OR COLD SPRING

Due to a lack of water or low temperatures or growth stop caused by frost, grass production at the beginning of the season may be low and/or with grass that is too tender. On low-altitude pastures, which are usually more productive, a poorer quantity of grass or a delayed start of the growing season will be observed. In addition to affecting grass production, this climatic condition can also impact grass quality and, over time, cause a degradation of vegetation composition.

2. EARLY SPRING

When the herd or flock arrives on the alpine pastures, the plant phenological stage may already be advanced compared to the normal situation. This implies the grazing of grass with lower nutritional quality and palatability.

3. SPRING DROUGHT AND VERY LITTLE SNOW COVER

Insufficient water stock in the soil at the start of vegetation growth can lead to a low resource in productive low-altitude pastures.

4. VERY MARKED DROUGHT IN EARLY SUMMER

The consequences on the pastoral resource may concern both quantity and quality. Low grass production may result in the need to restore complementary grazing areas and/or improve animal welfare.Grass may also dry up quickly with effects on nutritional quality and palatability, which may be reduced.

5. HEATWAVES AND WIND AT THE BEGINNING OF SUMMER

The grass reaches maturity at the same time over a large part of the pasture or even dries out. The nutritional quality and palatability of the grass will then be lower.

6. VERY HOT AND DRY SUMMER, HEATWAVE AND DROUGHT

The effects of this climate risk are manifold and may affect pastoral resources, water resources or the animals. Concerning source dry out, there could be problems for watering animals and irrigation, where present. With regard to the pastoral resource, the grass may dry up quickly, which may reduce the nutritional quality and palatability of the grass. On lower grasslands already grazed at the beginning of the season, there could be very little regrowth, leading to a shortage of grass at the end of the season.

In the medium and long term, possible deterioration of the vegetation composition could occur with relative worsening of the fodder resource.

Finally, negative effects of heat stress on animals could be observed with consequences on animal health, production and reproduction. For example, on very warm days, animals have very high water requirements and spend more time resting with a consequent reduction in grass consumption.

7. RAINY SUMMER

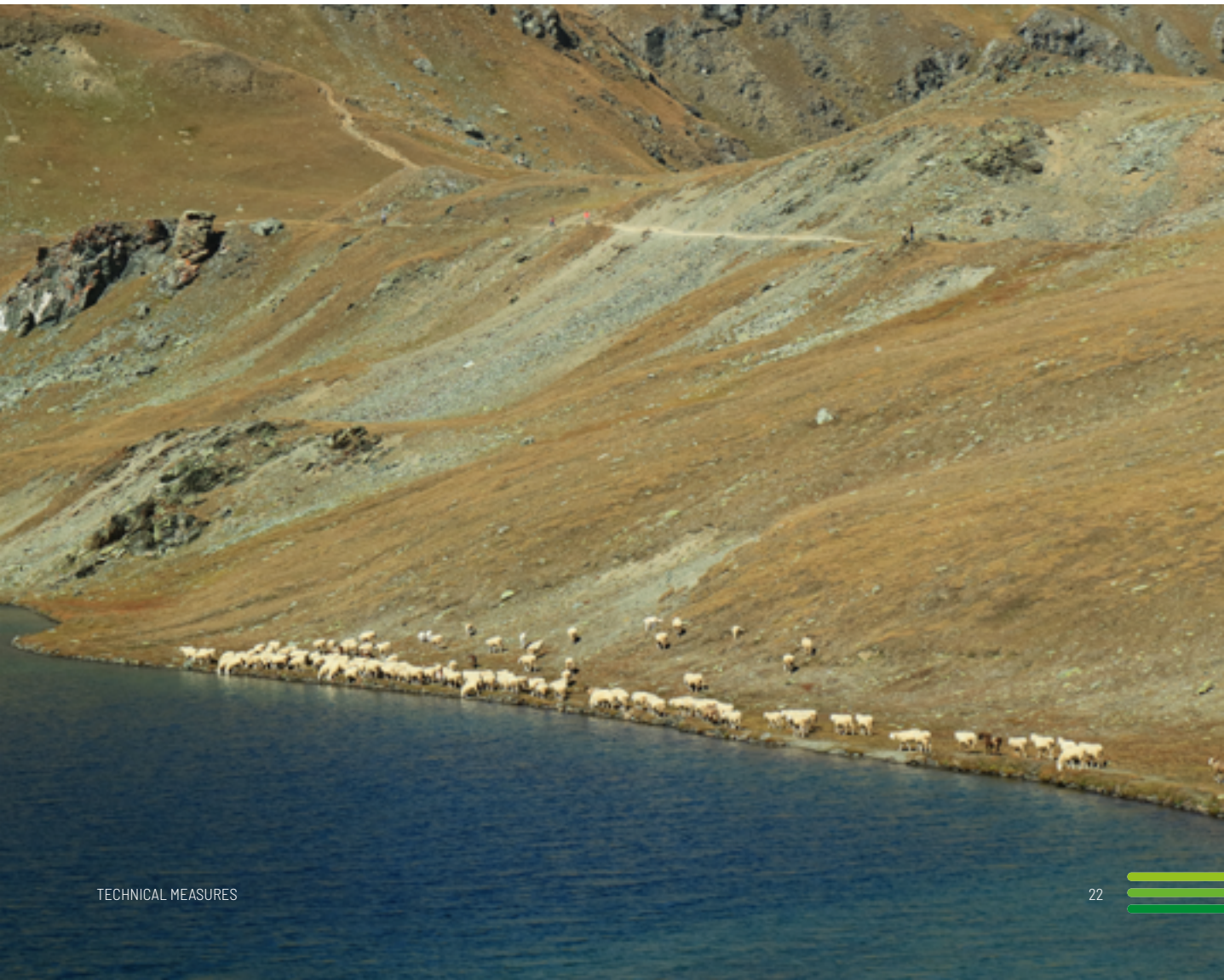
Although it is not a common and widespread risk in the two study areas, rainfall can have negative consequences for the soil and animals, which, due to the wet soils, can develop paw diseases.

8. HEAVY RAINFALL

In the event of heavy rain, damage can be expected to the pasture, especially where vegetation is sparse, due to run-off and soil loss.

9. VERY MILD AUTUMN

Pasture conditions at the end of the grazing season are good so it is possible to extend the grazing period if grass is still present.



5.3 TECHNICAL MEASURES

For each climate hazard, suitable adaptation measures were identified, taking into account their potential impacts on the natural environment and the pastoral system. Particular attention was focused on technical difficulties, factors of failure or success, management aspects on the side of the farmer and the shepherd, and finally the conservation of floristic and faunal biodiversity.

Concerning biodiversity conservation, some species and habitats need special protection because they are included in the annexes of the Habitats Directive 92/43/EEC or the Birds Directive 2009/147/EC. The Directives have nature conservation as their primary objective and provide for the adoption of a whole series of measures and assessments to be implemented when carrying out management actions in order to ensure the maintenance or improvement of the conservation status of species and habitats. There are still habitats and species, both animal and plant, that, although they are not included in specific laws protecting them, have a high naturalistic value because they are extremely localised, with a discontinuous distribution or because they are endemic to an area. For this reason, especially in protected areas, it is always advisable to carry out punctual and preventive assessments regarding the application of identified adaptation strategies, in order to take into account the complexity of ecological dynamics and apply the best pastoral adaptation strategies for that context.

In general, in open habitats such as grasslands, it is positive to maintain a good environmental heterogeneity, also evaluating the adoption of multiple strategies in synergy with each other in order to decrease the impact and maintain the landscape mosaic.

Description of technical measures

The proposed adaptations mainly concern:

THE FORAGE RESOURCES

THE WATER RESOURCES

PASTORAL MANAGEMENT PRACTICES

STRUCTURAL ADJUSTMENTS

Based on the temporal and spatial scale of application, the technical adaptation measures were grouped as follows:

SHORT-TERM ADAPTATIONS	LONG-TERM ADAPTATIONS	FARM/ALPAGE SYSTEM
Adjustments to extreme weather events at the alpage scale.	Structural actions and strategies implemented at the alpage scale in the medium and long term.	Adaptations affecting not only the alpage but the whole farm organisation.

SHORT-TERM ADAPTATIONS

Adjustments to extreme weather events during the grazing season at the *alpage* scale.

Extreme weather phenomena can cause immediate effects on the pastoral system, e.g. on grass production or water availability. The proposed adaptations include feasible solutions that the farmer can implement right away during the *alpage* season.

1. Exploration of new pasture areas, including wooded or shrubby areas

WHEN

Low grass production in low-altitude productive pastures due to spring and summer drought

ADAPTATION

Searching new grazing zones in case of grass shortage or reducing grazing pressure on lowest grasslands. In low-elevation mountain pastures, it is possible the pastoral utilization of forests suitable for grazing (in particular fodder trees, larch woods). Attention must be paid to the presence of predators and to whether grazing in the forest is allowed.

BIODIVERSITY CONSERVATION

Grazing in the wood could directly impact on some forest species or animals who nest on the ground, in the bushes or use clearings (for example: hazel dormouse, Chiroptera, black grouse, woodpeckers, owls). Moreover, guardian dogs could prey on chicks or young ungulates. In order to protect flora, grazing in the wood must be practiced on graminoid herbaceous undergrowth. Caution! Absolutely avoid grazing in the presence of swiss stone pine regrowth.

2. Increase the consumable coarse vegetation grazing

WHEN

Poor grass production in spring (lack of snow, cold winter) or when grass dries quickly in summer (heatwaves) or there is no regrowth at the end of the grazing season (hot and dry summer)

ADAPTATION

This graminoid vegetation, poorly consumed by animals (*Patzkea paniculata, Brachypodium gr. pinnatum, Helictotrichon spp., Deschampsia caespitosa, Calamagrostis spp.*, etc), can be grazed at the start of the season in order to save grass for the season or when there is shortage of pastoral resources on lower grasslands. It is recommended supplementary feeding for lactating cows in order to keep the same milk production. The measure is applied with guided grazing or setting up of fenced corrals. If the herd is not used to consuming this type of vegetation, the shepherd's job will be complicated: it is therefore important to provide technical support and focus on farmers and shepherds training.

BIODIVERSITY CONSERVATION

Grazing on shrubs could impact on black grouse, hazel dormouse and bush or ground nesting birds, if it is applied in spring season. The risk for the vegetation is the over-selection performed by livestock.

3. Preserve lower pastures for grazing at the end of the season

WHEN

Grass shortage and no regrowth on lower grasslands already grazed at the beginning of the season due to hot and dry summer.

ADAPTATION

Delaying the grazing of grasslands that dry out less quickly on lower areas in order to preserve grass for the end of the season.

4. Tight herding in productive grassland

WHEN

Lower nutritional quality and palatability of the grass because of plant phenological stage already advanced at the arrival on the *alpage* in spring or grass reaching maturity at the same time (heatwaves and wind at the beginning of summer).

ADAPTATION

Forcing the herd to consume a non-optimal resource through guided grazing or setting up of fenced corrals. Supplementary feeding for lactating cows in order to keep the same milk production is recommended.

BIODIVERSITY CONSERVATION

Beware of overgrazing, risk of excessive nitrogen return to the soil and permanent damage on pasture.

5. Fodder supply in *alpage*

WHEN

Low fodder resource because of very marked drought in summer.

ADAPTATION

Transfer of hay and cattle feed from the valley in *alpage* for lactating cows, if there are roads to *alpages* or compensation for helicopter use.

BIODIVERSITY CONSERVATION

Pay attention to means of transport impacts (for example helicopter).

6. Change grazing timetables

WHEN

Negative impact of heatwaves and drought on animals.

ADAPTATION

On very warm days, animals have a high water requirement and increase their resting time, which reduces grass consumption. It is recommended grazing during the cooler hours of the day or at night (predators permitting - supplementary helpers like herders and livestock guardian-dogs).

7. Adapt grazing tracks for watering the animals

WHEN

Watering problem for source dry out in very hot and dry summer.

ADAPTATION

Adaptation of grazing usually set on vegetation for watering the animals.

BIODIVERSITY CONSERVATION

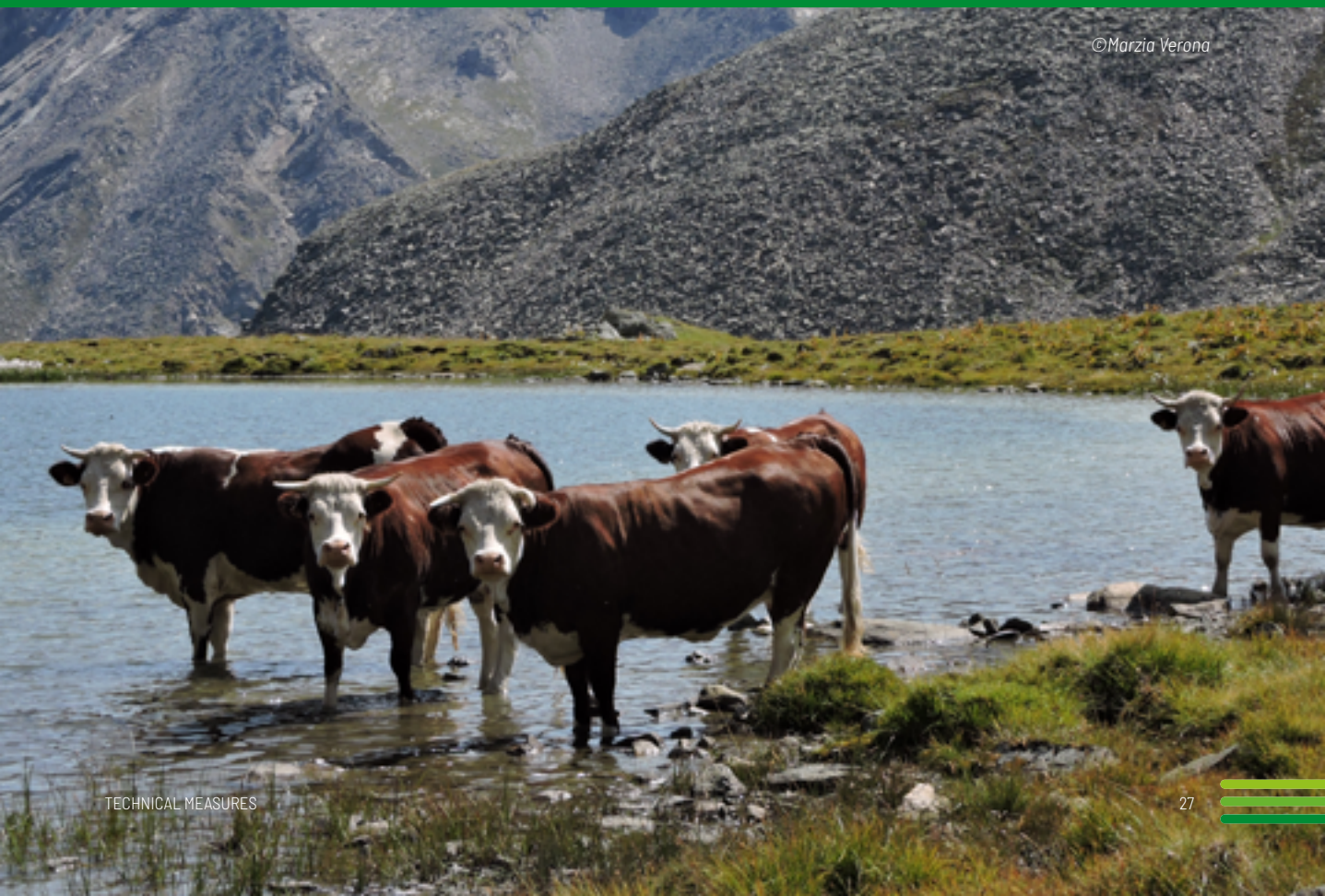
Watching out for possible deterioration of vegetation and soil related to additional animal movements.

FAILURE OR SUCCESS DRIVERS

How the measures can be applied and promoted by local communities.

In order to counteract the direct and immediate effects of adverse weather conditions, excellent knowledge of the *alpage* and herd management are crucial. For example, the search for new grazing areas and water sources or careful utilisation of pastures and guided grazing requires strong shepherd training. The shepherd's skills will be helpful, for example, in accustoming the herd to using grass that is not usually grazed (e.g. coarse vegetation), or in implementing tight grazing or grazing at other times of the day e.g. early morning, late evening or at night (flexibility depends on production orientation and husbandry system). The shepherd must pay particular attention to identifying when grazing has too much impact on the environment and with overgrazing of fragile grasslands and the phenology of early flowering plant species of EU interest (e.g. orchids).

The skills of farmers and shepherds can be enhanced by technical support from institutions, research centres or protected area management bodies; this leads to a sustainable and rational management of the pastoral resource and conservation of biodiversity. Collaboration with local authorities can overcome certain difficulties that can make adaptation to climate change difficult: searching for new pastures, fragmentation of properties and land management are often complex, and grazing in forests is not always allowed.



LONG-TERM STRUCTURAL ADAPTATIONS

Structural actions and strategies implemented at the *alpage* scale in the medium and long term.

Recurring weather events and climate change may have permanent consequences on the environment and the pastoral system in the medium and long term. In response to climatic trends, livestock farmers, pastoralists, alpine owners and institutions can undertake broader strategies concerning pastures, buildings, equipment, facilities and infrastructure.

1. Search for additional pastures and/or brush clearing on the lower areas of the *alpage*

WHEN

Low production of grass in spring due to lack of water or low temperatures or growth stop caused by frost.

ADAPTATION

Recovering new grazing areas for use at the beginning of the *alpage* season. Funding must be found for works and brush clearing.

BIODIVERSITY CONSERVATION

Subtraction of habitat and food resources for early season fauna (for example: nesting places for birds, nectar sources for pollinators, refuge areas for reptiles).

2. Recovery and construction of *alpage* buildings, infrastructures and facilities

WHEN

Low production of grass in spring due to lack of water or low temperatures or growth stop caused by frost and very marked drought in early summer.

ADAPTATION

Need to restore complementary, mid-mountain (*mayen*) or abandoned or underutilized pasture areas. This may require the construction or renovation of buildings and infrastructures to serve the pasture or to improve animal welfare.

BIODIVERSITY CONSERVATION

Positive effect on meadows thanks to stoking-rate distribution.

3. Inclusion of trees and appropriate management of forest suitable for grazing

WHEN

Heatwaves in summer.

ADAPTATION

Inclusion of trees and appropriate management of forests providing shaded areas in mid- and low-elevation pastures in order to contrast the negative effects of heat on animal health, production and reproduction.

BIODIVERSITY CONSERVATION

Grazing in the wood could directly impact on some forest species or animals who nest on the ground, in the bushes or use clearings (for example: hazel dormouse, Chiroptera, black grouse, woodpeckers, owls). Moreover, guardian dogs could prey on chicks or young ungulates. In order to protect flora, grazing in the wood must be practiced on graminoid herbaceous undergrowth. Caution! Absolutely avoid grazing in the presence of swiss stone pine regrowth.

4. Improving herd management and pasture quality

WHEN

Possible deterioration of vegetation composition in the medium and long term following hot and dry summers.

ADAPTATION

Improvement of grazing efficiency (rotational grazing) and pasture quality through optimal manure management and/or elimination of undesirable species and/or 24 hours grazing time.

BIODIVERSITY CONSERVATION

In order to protect livestock and avoid interaction with wild predators, if present, 24 hours grazing time is feasible only with supplementary helpers (livestock guardian dogs or herders).

5. Rational management of water points on pastures

WHEN

Watering and irrigation problem for source dry out in very hot and dry summer.

ADAPTATION

Create a water distribution network and a rational positioning of water points on the *alpage* in order to have a water supply.

BIODIVERSITY CONSERVATION

Be careful about direct impact from trampling and pathways on vegetation and minor species (passerine birds, micromammals, reptiles, invertebrates).

6. Search for long-lasting supply solutions (impluviums, catchments, cisterns, drinkers, etc.)

WHEN

Watering and irrigation problem for source dry out in very hot and dry summer.

ADAPTATION

Implementing and maintaining long-lasting equipments to increase water availability for pasture management (livestock watering, water for human use, for dairy processing, washing, etc.) and pasture irrigation.

BIODIVERSITY CONSERVATION

Habitats: direct impacts on wetland habitats served by freshwater springs and on the springs themselves. Fauna: direct impacts on aquatic invertebrates and amphibians. Caution! Creation of temporary habitats that may act as ecological traps.

7. Restore traditional irrigation systems and improve irrigation efficiency by sprinkling

WHEN

Pasture irrigation problem for source dry out in very hot and dry summer.

ADAPTATION

Restore traditional flow irrigation systems (e.g. the 'ru', small canals used to irrigate crops and grasslands in Aosta Valley) or implement sprinkler irrigation systems or improve their efficiency.

BIODIVERSITY CONSERVATION

This strategy could lead to habitat changes, decrease species number due to increased soil moisture. Be careful of the direct impact of mechanical means.

8. Careful and continuous maintenance of drainage channels and the road network

WHEN

Heavy rainfall.

ADAPTATION

Careful and continuous maintenance of drainage channels and the road network in order to prevent damage to pastures. If vegetation is sparse, run-off and soil loss are increased.

BIODIVERSITY CONSERVATION

Managing direct impacts of mechanical means.

FAILURE OR SUCCESS DRIVERS

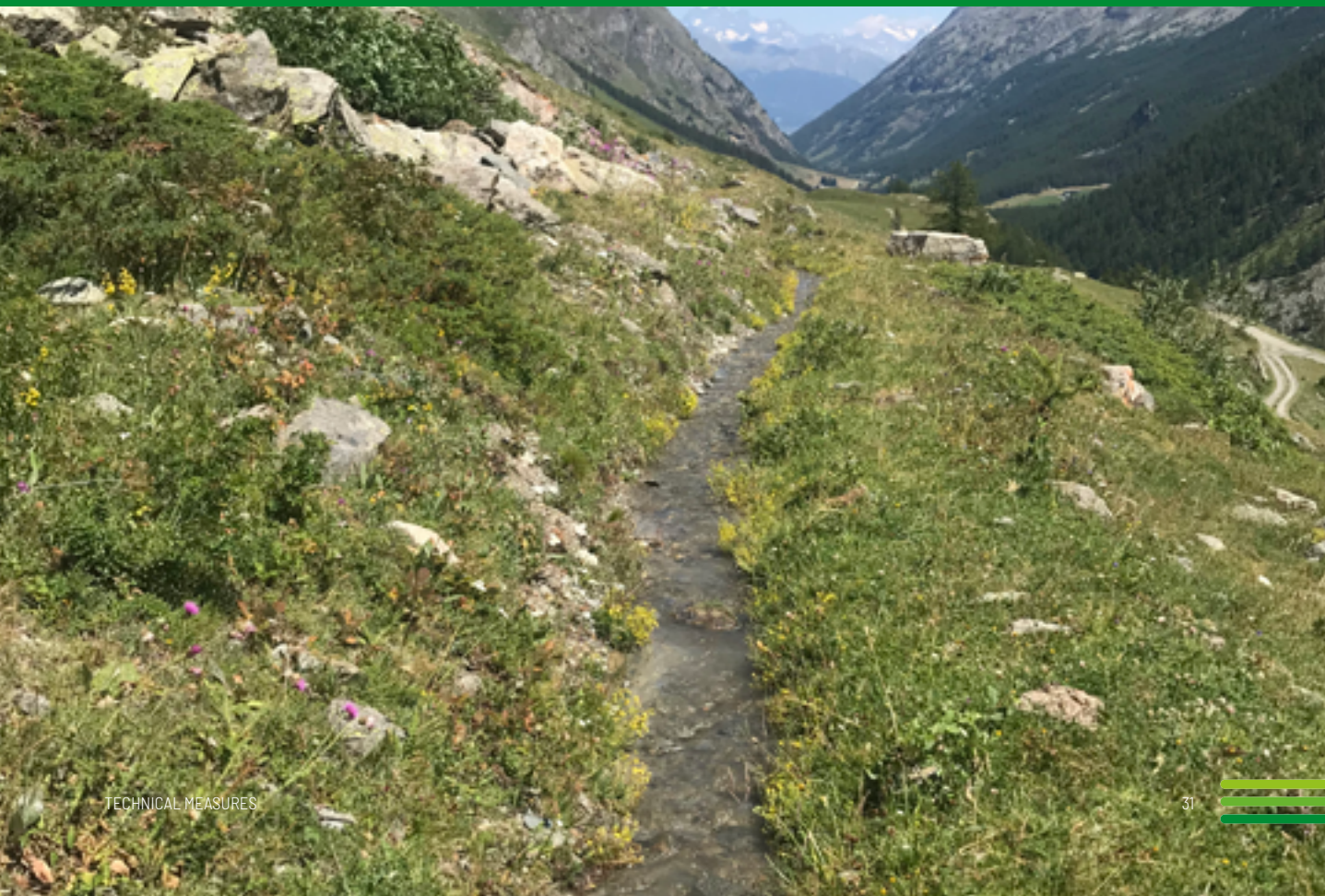
How the measures can be applied and promoted by local communities.

The proposed adaptations concern actions to be undertaken over the years on both grazing areas and alpine pasture structures and infrastructure.

Concerning the availability of additional grazing land, the strategies identified concern the purchase of new grazing areas, to be used regularly or as buffer areas in times of emergency, or the restoration of poorly productive areas. In order to improve the quality and productivity of the pasture, correct grazing and management techniques can be applied or pasture clearing such as brush-cutting can be carried out.

The need to restore abandoned or under-utilised complementary pasture, mid-mountain (*mayen*) or *alpage* areas may require the construction or renovation of buildings, roads, and water and irrigation systems. It should also be considered that these works require ordinary and extraordinary maintenance over time. The proposed interventions are considerable works that require an important financial investment and the availability of manpower.

The farmer who wants to carry out some work in *alpage* finds it difficult to obtain the consent of all parties involved and especially the will of the owners (often numerous given the fragmentation of properties).



FARM/ALPAGE SYSTEM

Adaptations affecting not only the *alpage* but the whole farm organization.

The grazing schedule, the movements to the *alpage*, the livestock stocking rate and the farm organisation and flexibility depend on the valley floor/*alpage* system. The adaptations proposed in *alpage* therefore take into account the indissoluble link between *alpage*, valley floor and low-altitude zones (where livestock are stabled in winter) and, if present, intermediate areas called *mayen* (grazed in spring and autumn).

1. Reduction of the stocking rate

WHEN

Poor production on low-altitude productive pastures or delayed start of the growing season due to late or cold spring and dry winter or drought in summer causing reduced quality and palatability of the resource.

ADAPTATION

Reduce the number of animals in *alpage* or delay the amontagnage (exceptional for one year or all years).

BIODIVERSITY CONSERVATION

Positive effect of grazing pressure reduction.

2. Advanced grazing period

WHEN

Plant phenological stage already advanced at the usual arrival date on the *alpage* in spring.

ADAPTATION

Advanced grazing period (exceptional for one year or all years) to consume the grass when the nutritional quality and palatability are optimal.

BIODIVERSITY CONSERVATION

Pay attention to the application of this strategy. Advanced grazing period could cause: direct impacts on ground nesting birds; stress to pregnant wild ungulates or to females with cubs, subtraction of nectar resources to early pollinators. Beware of guardian dogs: impacts on marmots (just out of hibernation).

3. Early *démontagnage* of animals

WHEN

It can occur in several scenarios: I) grass dries quickly due to drought in summer; II) low production due to late or cold spring and dry winter; III) source dry out due to heatwaves and drought in summer.

ADAPTATION

Early *démontagnage* of livestock (exceptional for one year or all years) because nutritional quality and palatability of grass are reduced, the pastoral resource is poor, and there is water shortage.

BIODIVERSITY CONSERVATION

Positive effect of grazing pressure reduction.

4. Late *démontagnage*

WHEN

Very mild autumn.

ADAPTATION

Possible extension of the grazing period if pastures are in good conditions (exceptional for one year or all years).

BIODIVERSITY CONSERVATION

Extension of grazing period could impact on vegetation (overgrazing of fragile grasslands) and increase the competition with animals preparing for migration (avifauna), ungulates descending in altitude and marmots preparing for hibernation.

5. Search for buffer zones outside the *alpage*

WHEN

Lack of available grass due to late or cold spring or due to drought in summer.

ADAPTATION

Search for buffer grazing areas on the farm or on mid-mountain pastures (*mayen*) (exceptional for one year or all years).

BIODIVERSITY CONSERVATION

Subtraction of habitat and food resources to, for example, birds, pollinators and reptile refuge areas, and competition with wild ungulates.

6. Modification of yeaning dates

WHEN

Reduction in quantity and quality of grass in dry winter, late or cold spring.

ADAPTATION

Modification of yeaning dates.

7. Change livestock category, breed or species

WHEN

Degradation of vegetation composition.

ADAPTATION

Radical modification in the productive orientation by changing livestock category, breed or species.

8. Storage of forage resources in lowland farm

WHEN

Low grass production due to drought in summer.

ADAPTATION

Storage of forage resources in lowland farm by increasing hay making in marginal areas or by hay purchasing.

9. Preparaction degli animali al pascolo in alpeggio

WHEN

Every year but especially in rainy summer.

ADAPTATION

Preliminary training of grazing animals, which should be carried out systematically every year to prevent the development of paw diseases (hooves cutting, footbaths). Care and isolation of sick animals.

BIODIVERSITY CONSERVATION

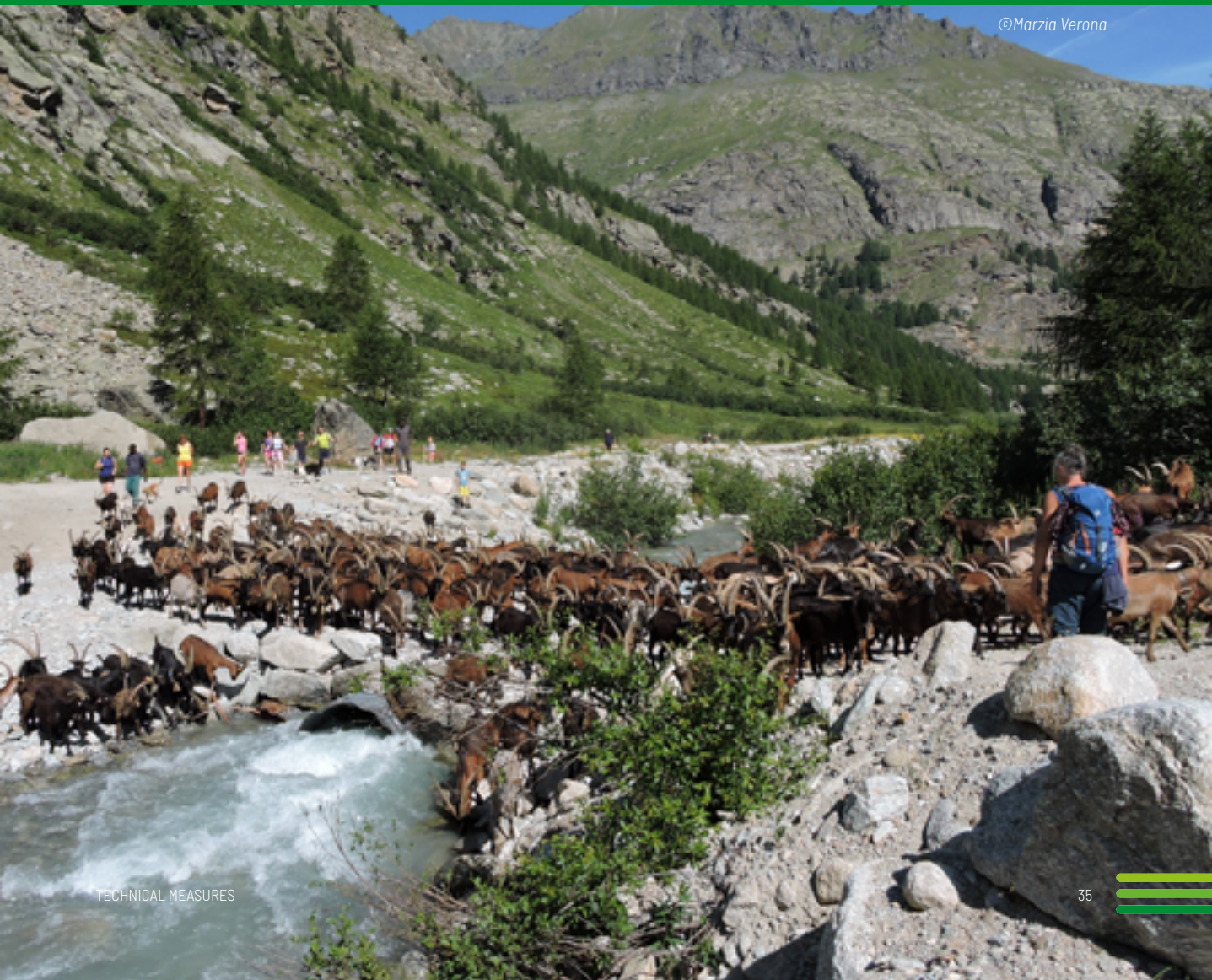
Pay attention to possible sick transfer to wildlife.

FAILURE OR SUCCESS DRIVERS

How the measures can be applied and promoted by local communities.

In order to adapt to difficult years, it is essential that the farm is as flexible as possible in its organisation, grazing and *alpage* ascent/descent schedule, number of animals and fodder stocks on the farm. What are some factors that can help the farmer to adapt? Observing the meadows before the ascent to the *alpage*, having the farm close to the *alpage*, having the possibility to find other destinations for a part of the herd if there is not enough grass on the *alpage*. Among the areas to be enhanced, farmers mentioned above all the intermediate grasslands of *mayen*, which are often abandoned or under-utilised.

On the other hand, it is reported that among the most critical issues is the difficulty in finding free pastures and the fragmentation of properties: in this, the support in the search for pastures by municipalities and other bodies or the creation of AFP (pasture landowners associations) can help.



6.

POLICY RECOMMENDATIONS

6. POLICY RECOMMENDATIONS

Recommendations on the key project deliverables for decision-makers and politicians at every level – local, regional, national, and transnational – based upon identified adaptation strategies have been developed with the objective of promoting alpine pasture socio-ecological systems that are more resilient and fully implementable.

The objective of the political recommendations is to develop and improve the adaptation of the pastoral system to climate change, including the different segments composing the system: summer mountain pasture management; water management; biodiversity preservation; multifunctionality and pastoralism/tourism coexistence; cooperation and training.

6.1 SUMMER MOUNTAIN PASTURE MANAGEMENT

In a scenario of climate change and more frequent extreme weather events, the objective is to promote sustainable grazing management that preserves the quality and quantity of the fodder resource, taking into account its biodiversity.

Increase flexibility in the exploitation of summer mountain pastures

Supporting or not blocking specific adaptations that do not damage the environment and guarantee the feeding of the herds, such as:

- changes in the grazing calendar;
- changes in the number of animals;
- annual, marginal exchanges of pastures between neighbouring summer mountain pastures;
- movements of animals to other areas.

Prioritize an approach based on expected results

Encourage the implementation of result-oriented agri-environmental and climatic-environmental measures rather than restrictions and predetermined tasks, such as the number of animals, that make the system too rigid. Provide management tools – such as pasture management plans – that take into account the specificities of each summer mountain pasture. Promote measures based on the summer mountain pasture management unit and not only based on the surface criteria.

Promote an eco-pastoral approach of the territory

Include the mountain summer pastures in the wider strategies of land management. Encourage collective approaches (pastoral groups, land improvement consortia, collective ownership, associations, etc.) with a wider impact on the territory, promoting the creation of networks and supporting the owners in the mountain summer pastures management. Create a regulatory body for summer mountain pastures and regulatory tools to prevent and face the distorting effects on the market for summer mountain pasture leases.

Improve the exploitation of all grazing areas of the alpine pasture

Provide summer mountain pastures with equipment (e.g. construction and renovation of buildings, drinking facilities for the animals) to better distribute the number of animals on the mountain pastures. Give technical assistance to owners and/or lessees to improve buildings, infrastructures, and equipment. Improve access to summer mountain pastures and grazing land to be assessed on a case-by-case basis (renovation and/or construction of driveways, footpaths, helicopters, gondolas, monorails, etc.).

Extend the grazing areas of alpine pastures or the valley floor farms

Have procedures and tools to deal with land parceling (plots with multiple or unknown users, unused plots). Promote the use of buffer zones and the recovery of pastoral areas covered by shrubs and trees. Apply an integrated silvopastoral management to promote pasture in suitable forests, through the implementation of laws and plans of forest management. Create an obligation of consultation for the elaboration of the pans of forest management that take into account that pastoral activity.

Support adaptation

Develop and improve the tool analyzing climatic vulnerability in the summer mountain pastures. Have technical tools and human resources to support breeders (e.g. training, consultancy) in order to consider for them the recommendations on habitat management and conservation of the species. Encourage information transfer and creation of work groups (visits at the end of the season) between herders and other stakeholders of the territory. Facilitate the creation and the realization of projects through organized assistance. Strengthen technical support structures for pastoralism (research centers, associations).

POINTS OF ATTENTION AND PECULIARITIES OF THE PILOT SITES

[PNE - PNGP] *The territories are characterized by significant land parceling and frequent co-ownership of plots, which make the management of contracts difficult.*

[PNGP VdA] *The dissociation between mountain pastures ownership and management negatively affects the investments on mountain pastures structures.*

[PNGP] *The mechanisms of attribution of financial measures linked to the areas create distortive effects on the market of mountain pastures rentals.*

ALESSANDRO ROTA

Managing Authority of the Regional Complement of Rural Development of the CAP Strategic Plan 23/27 for Aosta Valley
Italy

Our action to implement the CAP in Valle d'Aosta between 2023-2027 is in line with the direction traced by these recommendations. Thanks to the participation and the discussion established with the PASTORALP project since 2019, we are planning to implement different tools shifting us from a transversal application of agro-climate-environmental measures to "tailor-made" solutions, designed to consider context specificities and promote goal-oriented reasoning. Specifically, we are working to introduce two tools for proper pasture management: the territorial Plan and the grazing Plans.

The first, thanks to a preliminary deliberation, will be the planning tool for meadow-pastures in the whole Region, will define the general framework, notwithstanding the national regulations, starting from the clear and unambiguous definition of "meadow" and "pasture", thus establishing the concepts of grazing turns, grazing period, type of animals, with the definition of the potential stocking rate by pastoral categories and the provision of guidelines for drafting the grazing Plans. Based upon this "macro" territorial planning framework, the grazing Plans will include at the "micro" level aspects such as: grazing areas actually used by the herds; tramuti half-way pastures (i.e. farmhouses and pastures used for a short period of time before going up to the actual pasture) and grazing areas; eligible areas; areas of interest that are not immediately usable; improvements to be implemented; species and categories of grazed livestock; optimal theoretical stocking rate resulting from the analysis of the potential productivity of the different areas; simulations and evolutionary scenarios, also adaptable to extreme weather events and ongoing climate changes.

This new approach is the result of the capitalization of the methodology for the main types of mountain pastures classification and mapping tested by the PASTORALP project in the Gran Paradiso National Park pilot area.

The extension of this methodology over the entire regional area, thanks to a dedicated agreement with ARPA VdA, is leading to the definition of the pasture Register, which provides data, with reference to altitude, slope, vegetation cover indexes, dry matter productivity, average annual stocking rate expressed in Uba, in a territorial grid of 20 meters by 20 meters.

This is a fundamental tool that, made available to everyone, constitutes the starting point for the definition of plans, reducing their complexity and processing costs. For us as a regional administration, this is an important milestone because it allows us to regain possession of our territorial reading and classifying tools, after years in which this classification was carried out and updated at a national level, with tools and methods which we could shape only marginally.

We are aware that this is a radical change: from area subsidies calculated automatically with transversal algorithms, we are moving towards measures planned on a case-by-case basis, aimed at preserving, recovering or improving production potential while respecting biodiversity and landscape and allowing a flexibility and adaptation that are today essential in the wake of increasingly extreme weather events and rapidly changing climate scenarios.

In order to make this transition effective, we are aware that we must provide adequate support, in terms of training (of farmers and experts) and back up; we are working in this direction with the new knowledge and innovation system in agriculture "AKIS - Agricultural Knowledge and Innovation System", promoted by the CAP for 2023 - 2027.

This challenge must be tackled together, in a continuous exchange between administration, farmers' representatives, field experts and scientific research.

www.regione.vda.it/agricoltura/nuova_pac_2023_2027_i.aspx

6.2 WATER MANAGEMENT

Climate change (more frequent droughts, reduction of snow coverage) has an impact on the availability of water resources and causes more tensions due to the limited access to water and the necessity to withstand different uses (drinking water, agriculture, hydropower, industrial, - artificial snowmaking). In this context the objective is to optimize the management of water resources in order to guarantee the mountain pastures production capacity.

Reinforce the knowledge on availability, needs and use of the water resources

Quantify the available resource and evaluate the real irrigation needs of the land. Develop systems to monitor the consumption. Promote research, studies and creation of databases in order to have the necessary knowledge to preemptively evaluate infrastructural interventions. Develop tools to calibrate infrastructural works and restrict their impact on biodiversity and landscape.

Promote infrastructural improvements to ensure storage, reduce consumption and improve water supply

Assess water storage on mountain pastures on a case-by-case basis according to the specific conditions, adjusting the interventions to restrict the impact on biodiversity and landscape. Create sprinkler irrigation systems to increase the production of pastures. Improve the water distribution network for watering animals in the different grazing areas. Maintain a network of channels sufficient to ensure water runoff during heavy rainfall and the ecological corridor function.

Pursue a comprehensive and reasoned management of water in order to reduce and prevent conflicts

Promote a shared approach based on the solidarity principle between stakeholders. Pursue a comprehensive and reasoned water management (drinking water, agricultural water, hydropower, industrial tourism and ski resort) by involving the various stakeholders at the river basin level. Provide technical support and consultation between stakeholders, develop decisional tools to define priorities for water management.

POINTS OF ATTENTION AND PECULIARITIES OF THE PILOT SITES

[PNGP VdA] *The Aosta Valley region is characterized by a historical canal network widespread for irrigation use (rûs).*

ANDREA MAMMOLITI MOCHET

Head of water, reclamation, and waste section of the Regional Environmental Protection Agency of Aosta Valley
Italy

As a preliminary remark, it should be emphasized that, in our territory, water has not been considered a limited and limiting resource, at least until now... Admittedly, even before 2022 there have been years with prolonged drought periods, such as in 2003, but society didn't change its approach to the management of water resources. Nowadays, it is objective and plain for all to see that the resource is decreasing, regardless – I would say – of what people believe to be the causes of the phenomenon.

I agree with the first recommendation on the necessity to begin by monitoring it: if you don't measure the resource, you can't manage it. Measuring is not only possible, but also necessary; it can be done through accurate assessment where it's impossible to actually quantify it, but it must be a shared starting point. Having measurements is the only way to overcome the logic of power relations (such as pre-existing rights of use) and the privileged positions of those upstream intercepting the resource first.

In this perspective, it is essential to recreate the map of the stakeholders who intervene in the different decision-making and operational processes for water management in various fields: from human usage to agriculture, from energy production to industry. We are faced with an extremely articulated and complex system; let's think for instance about the heritage of knowledge and procedures preserved by the irrigation consortia that operate on the individual water branches, as well as the many actors appointed by the Municipalities who manage the water networks, the drinking water and wastewater treatment plants and the companies using the resource to generate hydroelectric power. This context, in which the resource's environmental value is too often underrepresented, is extremely complex and conveys different points of view. These different perspectives must result from sharing data and knowledge that, today, are fragmented and unsystematic: a common framework that foreshadows changes that, in order to be effective, need to be systemic. Of course, specific actions, such as the mentioned reservoirs or the multifunctional use of existing basins, can be possible and useful under certain conditions, but the challenge awaiting us today is a radical change in perspective: the "software" of water usage in our society needs to be updated. It can be useful to check out other communities that have always faced water shortage, in order to influence our behaviors and management. In this direction, the projects addressing the issue from all angles, considering not only environmental and economic aspects, but also the anthropological and social ones, seem the most promising to lead us in this transition that can't be delayed anymore.

www.arpa.vda.it

6.3 BIODIVERSITY AND AGRO-ECOLOGY

A correct pastoral management ensures the protection of the flora and fauna biodiversity in the pastures, with a positive impact on the aesthetic value of the landscape.

Promote agriculture and agri-ecological practices related to High Nature Value agricultural areas

Have preliminary studies, technical, financial and monitoring tools for the application of agri-ecological practices that ensure the biodiversity conservation. Improve the transfer of knowledge to farmers. Promote payments for the ecosystem services for adaptation measures in pastoral activities.

Develop eco-pastoral management for some target species or endangered habitats

Enhance eco-pastoral management plans. Activate specific agri-climate-environment measures for some target species or habitats.

Promote the preservation of biodiversity hotspots and agroecological infrastructures in mountain pastures protected area and ecological corridors

Evaluate the role of mountain pastures on a regional and supra-regional scale on the strategies of the protection of biodiversity. Take into account the needs related to the creation and management of agri-ecological infrastructures (humid zones, peat bogs, green linear structures, etc.) that can also have a role of ecological corridor in all the interventions on mountain pastures.

Promote the cohabitation between wildlife and pastoral activities

Promote scientific research, training of the workers in the sector, divulgation and communication to the public. Have technical tools and human resources to guide breeders towards the correct cohabitation. Finance nonproductive investments (e.g. defense nets, guard dogs, surveillance systems, added personnel, etc.). Provide compensations for damages caused by wildlife.

DANIELE STELLIN

Director of the
Mont Avic Natural Park
Aosta Valley - Italy

Regarding the issue of biodiversity, as a Park we have a privileged position for several reasons: firstly, the deep knowledge of our territory, the binding nature of management tools and, finally, the available surveillance personnel dedicated to the implementation and monitoring of conservation measures.

Given its founding purpose, the Park inevitably focuses its action on conservation objectives, consequently allowing human activities, such as livestock farming, only if they are compatible with the maintenance of the protected environmental and landscape values. This entails a great degree of protection of the territory, which is shared with all Italian natural parks while it does not find immediate correspondence with the situations in other European countries, where natural parks have objectives and protection levels that are often quite different from each other.

Having said this, notwithstanding the high level of protection distinguishing us, we don't embrace an approach based on an "absolute ban" of anthropic activities, which in some cases can actually promote nature conservation objectives. For instance, we know that many habitats and species can be fostered by pastoralism if properly supervised and managed with suitable criteria. Above all, the experience in the Alpe di Prà Oursie, in the Chalamy stream valley, witnesses a collaboration between mountain pasture management and the Park, that results in good management practice, where agricultural activity and tourism add value to the territory in a way that is compatible with the conservation requirements. More complex situations can be found Instead in the Champorcher valley, an area of vast grazing surfaces, where the delimitation and respect of the perimeters of areas prohibited to domestic grazing is not always easy.

With regard to the management of pastures, having established that an absolute ban is not the solution, it is necessary, however, to specifically differentiate areas where grazing is allowed from areas where grazing is restricted, as well as identify the best measures to adopt in order to make management compatible with conservation aims. We therefore strongly support "tailor-made" tools that can be adapted to the specific needs of species and/or habitats. This is why we welcome the implementation of territorial plans and grazing plans in the region: an important step for the whole territory as well as essential and strategic for the protected areas. Thus, in this experimental phase, the Park, with its wealth of knowledge and human resources, can be an added value. Looking ahead, a system of this kind could also lead in the Park area to the prospect of organic certification of pastures, with obvious advantages for breeders. Essentially, regulations and constraints are largely already in compliance with organic rules; the further step to be taken concerns certifications and verifications, that could be concretely endorsed by our organisation, as well as granting the use of the quality label of the Park that is already available.

www.montavic.it

6.4 MULTIFUNCTIONALITY AND PASTORALISM/TOURISM COEXISTENCE

There are many challenges tied to the summer mountain pastures areas: the pasture is an important factor for the rentability and economic sustainability of the animal husbandry farms; these have an ecological, environmental and cultural value; they also have an important role for the recreational activities and tourism and, in wider terms, for the development of the local mountain economy.

Promote a systemic approach to mountain areas

Raise awareness on environmental, economic and social peculiarities of mountain areas. Increase the interactions and prerogatives of each user in order to improve the cohabitation between inhabitants, farmers and tourists. Develop a shared user code of the mountain. Have mediators for agriculture, create sensibilization tools and education in schools.

Improve living and working conditions in summer mountain pastures

Reduce isolation and bring workers closer to services at the bottom of the valley. Ensure digital accessibility (GSM network, internet connection, TV, etc.) Improve well-being and working conditions.

Enhance summer mountain pasture production

Support and promote the creation or the subscription to quality brands. Support the supply chain agreements. Promote new marketing tools thanks to new possibilities offered by informatization.

Supplement income through diversification of activities (transformation, direct sales of products, agrotourism, tourism and social activities, ...)

Promote regulatory frameworks tailored to the peculiarities of summer mountain pastures, with derogations and/or simplifications in order to enhance integration with other activities (welcome, offers for spare time, etc.). Technical and financial support to develop multifunctionality in summer mountain pastures.

POINTS OF ATTENTION AND PECULIARITIES OF THE PILOT SITES

[PNGP VdA] *In Aosta Valley, farmers have highlighted the restrictions resulting from regional legislation on agritourism activities.*

MARTA ANELLO

Aosta Valley
GAL coordinator
Italy

The Aosta Valley Local Action Group has focused its local development strategy on rural tourism. Towards this, within the framework of the Call 16.3.1 - Cooperation among small operators to organize joint work processes and share facilities and resources, we approved a project, presented by a network of producers, for the exploitation of Fontina cheese from mountain pasture, its dissemination and promotion on a national and international scale as a product of the highest quality, and an example of ethical and sustainable production.

In a mountain region like Valle d'Aosta, we believe it is crucial to enhance the value of mountain pasture products, recounting not only their properties and specificities linked to the grass and high-altitude water, but above all the commitment and effort that stand behind them.

The purpose implied by GAL local development strategy is precisely to strengthen synergies between tourism and agriculture; to raise awareness and promote the territory and its products in order to get a fair economic return for the farmers so that they can continue to work and take care of these areas, thus protecting the territory.

As GAL, we have noticed that those who visit our valleys show a keen interest in traditional mountain pasture products: promotional events in the area are always a great public success, but it needs to be consistent. In this regard, we stumble across the said difficulties in working in such particular high-altitude contexts, with regulations that are poorly adapted to the specific conditions and that in fact curb promotional activities such as tastings, direct sales, etc.

For less organized realities, it is also difficult to envisage that all phases can be guaranteed: animal care, processing, and marketing; thus, it could be useful to better promote synergies with other figures operating in mountain areas such as hiking and nature guides. These alliances could improve the knowledge and the awareness of the specific dimension of mountain pasture and its productions, without having an excessive impact on farmers' work.

www.gal.vda.it

6.5 COOPERATION AND TRAINING

The objective is to reinforce the competences of breeders and farmers to better manage the pastures, with particular attention to conservation of biodiversity and climate adaptation, make the job more appealing mostly to young people in order to encourage the creation of new businesses and the generational change.

Promote training courses for breeders and farmers

Strengthen the training: basic training at educational centers; field training through internship and shadowing expert professionals; training on specific topics (biodiversity, agri-environment, animal care, etc.). Guarantee the training of foreign personnel through internships and agreements with agricultural schools abroad.

Provide technical support, create a network between users

Build skills and competences in local communities. Introduce technical personnel specific to agriculture, forestry and nature conservation in local administrations (e.g. unions of municipalities) and in protected areas/parks in order to promote the collaboration and the flow of information between institutions, farmers, farmers and citizens. Promote the creation of public services with dedicated personnel to animate and create networks of farmers and other stakeholders.

POINTS OF ATTENTION AND PECULIARITIES OF THE PILOT SITES

[PNE] *Clarification of the status of apprentice or assistant shepherd needed. Difficulties in offering non-contractual training to shepherds (in France, training is provided for employees, but during the contract period, the shepherd cannot be absent for training due to animal husbandry commitments).*

[PNGP VDA] *The mountain pastures staff is mainly foreign*

FRÉDÉRIC LAURENT

Training center of Merle - Salon de Provence
France

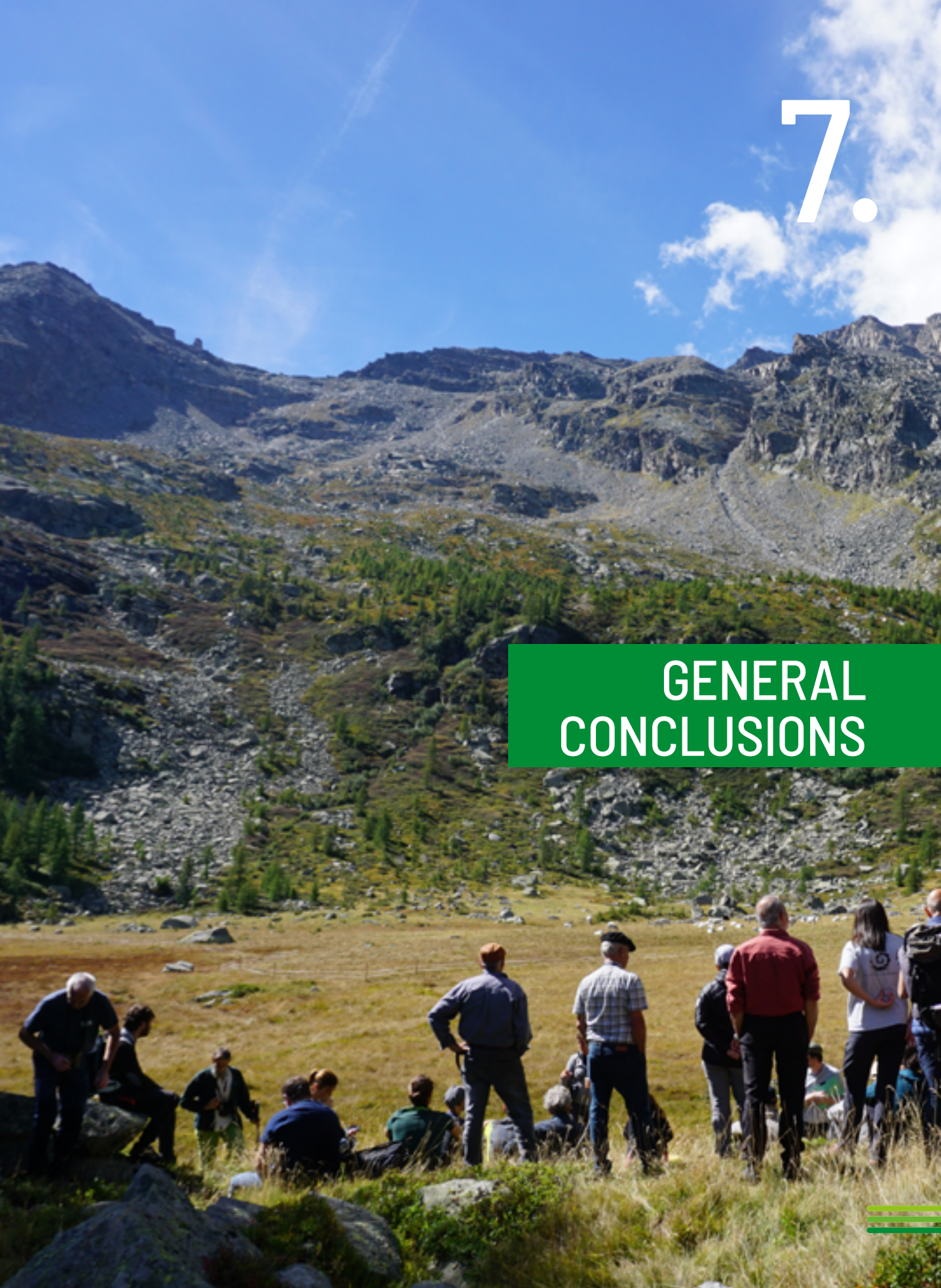
The training of transhumant shepherds offered by our center assigns a qualification and a diploma and is focused on the production cycle of transhumant sheep in the Southern Provence-Alpes-Côte d'Azur Region and the Alpine arc. This is a one-year professional training course, free of charge, being financed by the SUD Region. The trainees are of all ages and backgrounds. They will learn how to drive a flock, animal husbandry, pastoralism, how to train herding and guardian dogs, how to protect a flock against predatory animals, how to manage a flock in summer pastures... and they will do 3 training courses on lambing, guarding in the pastoral environment in mid-season and guarding in summer pastures. There are 18 places available each year.

As for the training of experienced shepherds, we are aware that there is this complex and targeted need. Employed shepherds could qualify for training with their specific training fund, but while they are working, they will find it difficult to leave their jobs. And when they are no longer employed, it is impossible for them to find funding opportunities. As it emerges, there are specific subventions from the SUD Region for training courses that do not fall into any framework, but this option needs to be looked into.

The other difficulty in training shepherds will be to find the right time to offer the courses. During the PASTORALP project workshops, some shepherds mentioned the idea of tutoring between experienced and novice shepherds, a system that doesn't exist today but it is indeed a great idea! I envisage asking my former trainees to take on some trainees when they have gained some experience.

Currently, the status of assistant shepherd can't meet this kind of demand: it is quite "dubious" since the assistant shepherd is not supposed to guard a flock alone. With a tutoring system, sometimes the trainee shepherd could, after spending some time with his tutor, guard the flock on his own in order to get used to it. Today, farmers and shepherds often ask to be two shepherds on a summer pasture rather than a shepherd/assistant-shepherd duo. For instance, there are more and more trainees from the Training center of Merle who propose to their employers to guard a summer pasture in pairs.

www.institut-agro-montpellier.fr/domaine-du-merle



7.

GENERAL CONCLUSIONS

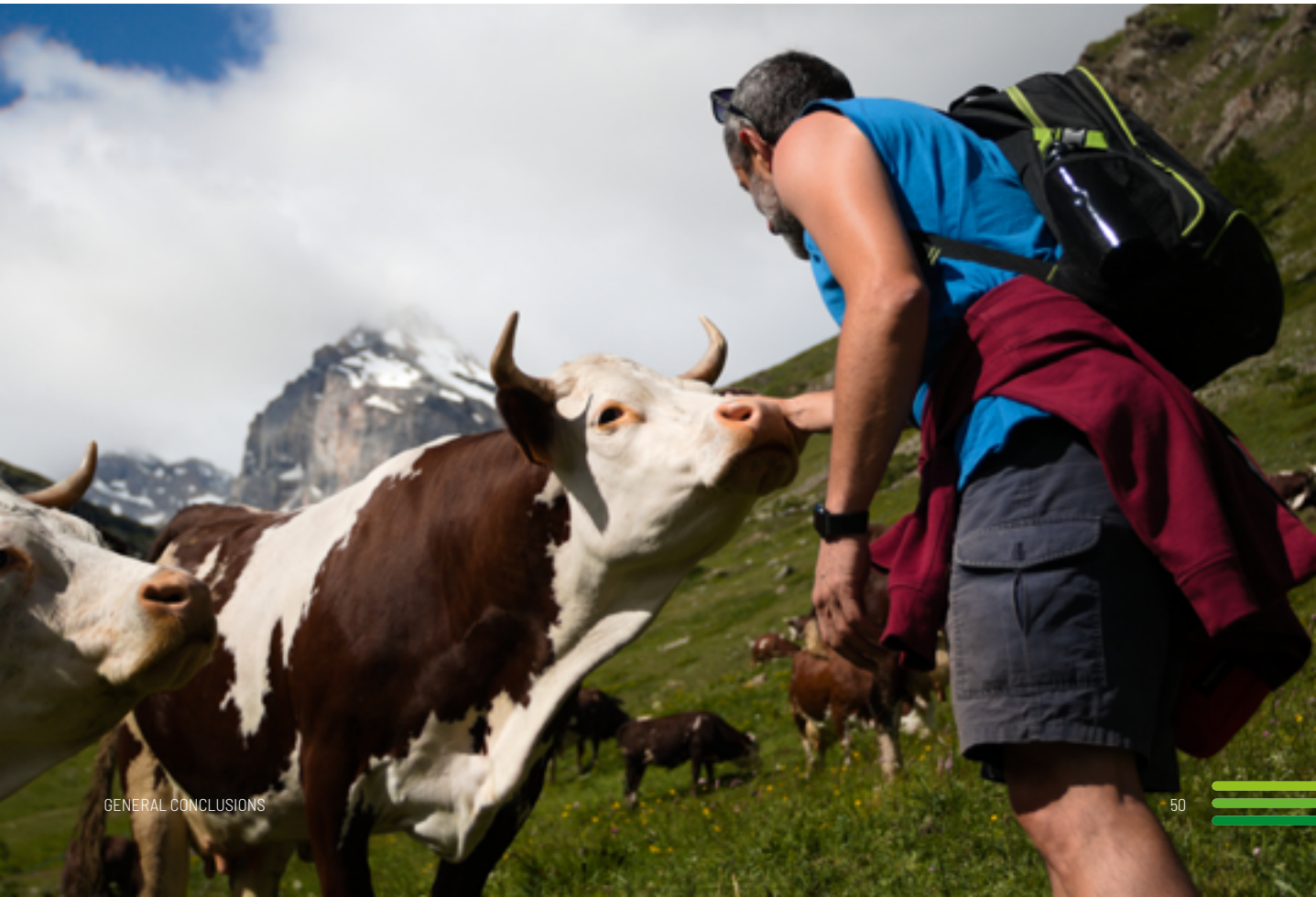
7. GENERAL CONCLUSIONS

The approach applied in C.8 action leverages on the outcomes deriving from other project actions (namely, A.2, C.1, C.2, C3, C.4, C.5, and C.6).

The definition of adaptation strategies, by combining traditional agro-pastoral activities with a rapidly changing climate, is the only viable response to medium and to long term adaptive capacity to cope with the climate emergency. Beyond the maintenance of pastoral productivity, animal welfare and rural economy, the adaptation plan developed within the project takes into account the preservation of biodiversity and mountain and alpine habitats.

Undoubtedly, traditional farming and grazing activities have shaped and influenced animal and plant communities over the centuries, thus any change in the governance and management has and will have an impact on the environment in the near future. At the same time, strategies that do not consider all the elements characterising mountain pastoral systems (e.g. climatic emergencies, technical-organisational difficulties on the farm, biodiversity, territorial peculiarities) may not be effective in maintaining pastoral resource and its ecosystem services for the future generations.

One of the peculiar and main strengths of the adaptation strategies (technical measures and policy recommendations) proposed by PASTORALP project is that they were conceived under participatory approaches which directly involved local actors throughout project duration, ensuring effective applicability and replicability. Thus, this plan has the ambition to provide practical guidance to farmers and policymakers in their activities to protect and maintain Alpine pastoral resources, ecosystems recognized among the most fragile and vulnerable in a context of climate change.



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CONTACTS

life.pastoralp

life_pastoralp

Platform

pastoralp.eu

Marco Bindi
marco.bindi@unifi.it

Giovanni Argenti
giovanni.argenti@unifi.it
+39 055 27 55 747

Camilla Dibari
camilla.dibari@unifi.it
+39 055 27 55 703

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