

1222-2022  
800  
ANNI



UNIVERSITÀ  
DEGLI STUDI  
DI PADOVA

ICEA

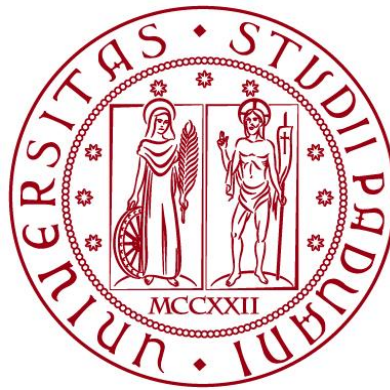


**UNIVERSITÀ DEGLI STUDI DI PADOVA**

**DIPARTIMENTO DI INGEGNERIA CIVILE, EDILE E AMBIENTALE**

*Department Of Civil, Environmental and Architectural Engineering*

International Master's Degree in Sustainable Territorial  
Development: Climate Change, Diversity and Cooperation



**Master Thesis**

**CLIMATE CHANGE IN MOUNTAIN REGIONS: ADAPTATION  
STRATEGIES AND FUTURE SUSTAINABLE DEVELOPMENT  
ALTERNATIVES. VALMALENCO CASE STUDY.**

Supervisor:

LANZAVECCHIA ALBERTO

Candidate: DEMATTEIS MARGHERITA

Registration number: 2034668

BATCH 1

**ACADEMIC YEAR 2022-2023**





## **THESIS APPROVAL**

[This document must be submitted by the student within the thesis document]

I, Lanzavecchia Alberto, as supervisor of the student DEMATTEIS MARGHERITA, hereby **APPROVE** the thesis entitled “*Climate change in mountain regions: adaptation strategies and future sustainable development alternatives. Valmalenco case study*”.

Padova, 06/09/2023

Signature \_\_\_\_\_ 

*Alla mia famiglia*

**As my grandfather Luigi wrote in October 1975...**

*“Nemico delle Alpi non è l’uomo, ma la sua mentalità odierna.  
L’idea di farne una palestra di consumi guida l’assalto dei novelli Unni.  
Per giustificare la conquista, l’alpe va resa spopolata e sterile,  
allontanandone gli abitanti con il miraggio di una civiltà più comoda.  
Così, gigantesca terra di morti fantasmi, sarà facile preda alla colonizzazione.  
Alpe diverrà sinonimo di pista, di arrampicata, di stazione alla moda.  
Ma l’Alpe, la vera Alpe resterà sotterrata per sempre.  
Può la nostra cultura permettere simile scempio?  
Non è dovere istruirci su quanto intendiamo salvaguardare,  
aiutare chi cerca di resistere?  
Non tocca forse agli organi politici, accollare alla collettività  
l’onere di un intervento finanziario, capace di modificare situazioni  
oggi non più sostenibili?  
E se dall’esterno, per incapacità o insensibilità,  
manca l’apporto fattivo, provveda la popolazione alpina,  
specie la giovane dalle nuove idee, a darsi un ordinamento adeguato.  
Autogestisca il proprio patrimonio di cui Natura è stata prodiga,  
rammodernizzi le proprie aziende, tenga fede alla propria cultura  
e rispetti le antiche tradizioni.  
Lotti la gente alpina per restare, nella terra degli avi,  
signora,  
non schiava, al servizio dell’altrui colonialismo.  
E, quale signora, sarà ben lieta di ospitare chi verrà a visitarla.”*

L. Dematteis. (1975). *Alpinia. Testimonianze di cultura alpina*. Priuli & Verlucca.

## **PREFACE**

Having been born and raised in a small mountain village (in the Varaita Valley), it has always been one of my greatest passions, inherited largely from my family. Ever since I was a child, between hiking in the mountains and transhumance with horses (bred by my parents), it has played a fundamental role in my life and I am convinced that it has also influenced my personality to a certain extent.

Over the years, my understanding of the mountains has changed: if as a child it meant a simple place of recreation and adventure, for me today it represents a 'way of being'. To be part of a community with ancient origins, which, with the advent of technology and globalisation, is slowly disappearing. I am now a child of this society, but thanks to the upbringing imparted to me by my parents, I am convinced that there is a large slice of this reality, unknown to most, that needs to be preserved and brought back into vogue. I am talking about the old trades, the work of the land, the return to the origins and to simple, authentic 'things'. Of course, it is necessary to think in terms of development, so going back to the mountains of the past is no longer possible or desirable. In my opinion, what will determine the future of these lands will be the ability to integrate all the ancient cultures and traditions with modernity and today's needs.

From a future perspective, to relaunch and revive the mountains, I think young people play a fundamentally important role. Indeed, they represent the meeting point between the values of an ancient world, which unfortunately they have not known directly, but have only heard about, and the society of today, in which they have grown up.

## ***ABSTRACT***

In the current context of climate change, mountain areas and tourist destinations in the Alps face common challenges. The impacts of climate change, resulting in a reduction in natural snow cover, changing tourist practices and demographic dynamics require strategies for the diversification of tourism supply and regional development. In response to these challenges, through a participatory and inclusive approach of local communities, the study aims at investigating and implementing new models of sustainable tourism, economic, social and environmental development. Through the analysis of the ski area of Chiesa in Valmalenco, we analyze the critical challenges facing the snow industry and aim at the development of forms of tourism alternative to the ski sector, with the aim of strengthening the mountain economy, the resilience of local communities and investigating possible strategies to adapt to climate change. Unfortunately, even today the winter ski industry is too large a lobby, it requires intensive use of resources and attracts an unsustainable type of tourism with a high environmental impact. Through the analysis of a number of case studies in various locations in the Alps, linked to positive experiences of alternative tourism development, concrete examples of active and innovative projects in the area are investigated. The expected final objectives include analyzing the vulnerability of the traditional tourism system, linked to the ski industry, promoting sustainable economic transition processes, assessing the replicability of these experiences in other Alpine contexts, and fostering concrete experiences of resilience and adaptation.

# **INDEX**

PREFACE

INTRODUCTION

## **1. CHAPTER I. CLIMATE CHANGE AND THE SKI INDUSTRY**

1.1. Climate change

1.1.1. Climate change on a global scale

1.1.2. Climate change in the mountain areas

1.2. The Alps

1.2.1. The Alps: a general overview

1.2.2. The Alps as a natural and cultural resource and heritage

1.2.3. Climate change and its impacts in the alpine region

1.3. Ski industry

1.3.1. History and development of skiing and ski areas

1.3.2. The establishment of the ski system as an industrial, Fordist economic model

1.3.3. The role of skiing in the Alpine economy and vulnerability of the current tourism model

1.3.4. The system of public contributions

1.3.5. Snowmaking today

1.3.6. Environmental impacts of the ski industry

## **2. CHAPTER II. METHODOLOGY & MATERIALS**

2.1. Research design

2.2. Choice of case study

2.3. Literature review

2.4. Data collection

2.4.1. Qualitative data and research tools used

2.4.1.1. Stakeholders mapping and analysis

2.4.1.2. Semi-structured interviews

2.4.2. Quantitative data and time-space frame of analysis

2.4.3. Geospatial data and geovisualisation of the territory

2.5. Data analysis

2.5.1. production and analysis of graphs and maps

2.5.2. production of SWOT analysis

2.6. Validity and Reliability

## **3. CHAPTER III: CONTEXT ANALYSIS AND STUDY AREA**

3.1. The Interreg Alpine Space TranStat project

3.2. The Valmalenco case study

3.2.1. Geography of the territory

3.2.2. Historical background and economic-social context

3.2.3. The ski resort of Chiesa in Valmalenco

3.2.3.1. History of the ski resort



3.2.3.2. The ski resort of Chiesa in Valmalenco today

3.2.3.3. Criticalities of the ski area and recent regional contributions

#### **4. CHAPTER IV: RESULTS & FINDINGS**

4.1. Production and processing of the SWOT analysis

4.2. Quantitative data results and findings

4.2.1. Demographic data

4.2.2. Environmental, meteorological and spatial data

4.2.3. Tourism data

4.2.4. Data on activities and services

4.2.5. Data on territorial governance

#### **5. CHAPTER VI: DISCUSSION**

5.1. Adaptation strategies and future development alternatives in the light of swot analysis and quantitative data

5.1.1. Analysis of the strengths and weaknesses of the territorial context

5.1.2. Analysis of quantitative data

5.1.3. Analysis of the opportunities and threats of the territorial context  
Increasing the resilience of local communities

5.1.4. Planning a strategic territorial promotion

## **6. CHAPTER V: POSITIVE EXAMPLES OF SUSTAINABLE DEVELOPMENT IN THE ITALIAN ALPS**

- 6.1. Valpelline (Aosta Valley)
- 6.2. Maira Valley (Piedmont)
- 6.3. Funes Valley (South Tyrol)

### **CONCLUSIONS**

### **BIBLIOGRAPHY**

### **SITOGRAPHY**

### **ANNEXES**

## **INTRODUCTION**

In the era of the current climate crisis, mountain areas and their related social, environmental and economic systems are facing common challenges and critical issues that have never been experienced before. In recent years, in fact, they have received increasing attention because it is not only the balance of Alpine ecosystems, biodiversity and the natural environment that are under threat, but also water resources, human activities related to the mountains, such as agriculture and livestock breeding, and the very survival of local communities. In particular, the impacts of climate change, which, as reported by numerous scientific studies, lead to a reduction in natural snow cover and a rise in average temperatures, are putting the ski industry sector, which for many years has been, and in some cases continues to be, the dominant and driving economic sector in many Alpine resorts, into crisis. This sector is also now strongly dependent on snowmaking, and since the current environmental conditions are no longer sufficient to guarantee the presence of snow resources for the entire ski season, the use of this practice over the years has increased strongly to the point where practically all ski resorts are dependent on it. Given the great weight that skiing had in the development of mountain resorts in the second half of the 20th century, in some cases allowing them to survive and limiting their depopulation, today attempts are being made to keep this system alive through significant funding from the public sector.

The current profound crisis in the ski sector, due in part to the impacts of climate change, in part to the increase in energy costs for the production of snowmaking and for the maintenance of the facilities, the socio-environmental conflicts that arise at the territorial level for the use of resources, both economic and natural, and the increasing economic contribution to support the sector by the public sector, require a rethinking of the economy and development model pursued to date, linked to downhill skiing and mountain areas in general. In a perspective of ever-increasing climate change and considering the unsustainability of the current ski industry, it is therefore essential to start thinking about an alternative development model, also in a post-ski perspective, oriented towards all-round sustainability, both from an environmental, economic and social point of view.

In response to these challenges, through the analysis of the case study of Valmalenco, taken as an example as an environmentally relevant mountain territory with a rather interesting history related to ski resorts, this research aims to investigate which possible climate change adaptation strategies and future development models can be implemented in order to allow the survival of the place and its population, with the artistic-cultural, historical and environmental heritage connected to it.

Through a careful search for documentation and review of existing literature and through the study of the ski resort of Chiesa in Valmalenco, we firstly analyse the challenges and criticalities that the ski industry is facing in the current climate crisis, linked to the production of artificial snow, the increase in energy costs and, as will be seen in the course of the study, to a more general crisis.

Secondly, through the adoption of a mixed methodology that sees the combination of qualitative and quantitative approaches in the collection of data, an analysis of the Valmalenco territory, its economic, social, historical, anthropological and environmental context and its current problems will be carried out.

Then, thanks to the use of a participatory and inclusive approach of local communities and their direct involvement through semi-structured interviews, the strengths, weaknesses, opportunities and threats of the territory as a whole will be investigated in order to outline which strategies, actions, directions and opportunities would need to be undertaken and promoted from the point of view of all-round sustainability, from the economic, social and environmental points of view.

Finally, in order to give concrete value to this contribution, three positive examples of sustainable mountain models in the Italian Alps will be analysed, based on development lines and territorial philosophies that are completely different from those pursued by the ski industry. Through their analysis, it will be confirmed that although still few in number, there are mountain resorts that have undertaken a change of course, basing their development on a model opposed to the industrial one, based on gentle and sustainable practices.

The results obtained from the analysis of the Valmalenco context are then to be considered valid and applicable to any other mountain area, always bearing in mind, however, that each reality and locality is unique on a naturalistic, social and

anthropological level, so that only the most general strategies can be taken as an example.

Although on a practical level the pursuit of the strategies, actions and opportunities identified in the final part of the paper may encounter complications and therefore be difficult to apply due to external dynamics unrelated to what is being analysed, this research intends to represent, at least on a theoretical level, a small contribution to the implementation of an alternative future development model for mountain areas that, contrary to the current one connected to the industrialisation of the ski sector, is more marked by sustainability, environmental protection and the preservation of the socio-anthropological structure of each territory.

It will therefore be up to the local communities, together with the territorial authorities, to decide which lines of territorial development to follow in the very near future. On the one hand, the questionable choices of those who continue to invest resources, social, economic, environmental and human, in support of a system such as skiing, which appears totally unsustainable in the current era, will be confronted, and on the other, virtuous policies, through a change of course, will attempt to implement and pursue those strategies, actions and lines of development, partly outlined in this study, with the aim of increasing the resilience of the population and preserving the mountains as a whole, both environmentally and humanly.

On the basis of the question "what future development is in store for mountain areas?", the absolute unsustainability from an environmental, social and economic point of view thus emerges and possible future development alternatives for the Alpine valleys are outlined in an era of unprecedented climate crisis and in a more long-term perspective.

# 1. CHAPTER I. CLIMATE CHANGE AND THE SI INDUSTRY

## 1.1. Climate change

### 1.1.1. Climate change on a global scale

Earth's climate has changed throughout history. As reported by NASA (n.d.):

“just in the last 800,000 years, there have been eight cycles of ice ages and warmer periods, with the end of the last ice age about 11,700 years ago marking the beginning of the modern climate era — and of human civilization. Most of these climate changes are attributed to very small variations in Earth’s orbit that change the amount of solar energy our planet receives”.

At the same time, however, it is undeniable that industrialisation and the massive development of human activities since the mid-1800s have accelerated this process, proceeding at a pace not seen in millennia (Intergovernmental Panel on Climate Change [IPCC], 2023). In particular, the sudden development of human activities increasingly dependent on the use of energy has gone hand in hand with an increase in the use of fossil fuels, such as coal, oil and natural gas. Starting with the Industrial Revolution and even more so following the Second World War in the United States and Europe, an economic boom unprecedented in history took place, which has recently become a global phenomenon with the advent of globalisation, dragging with it an increased demand for energy.

This disproportionate and massive exploitation and use of fossil fuels has caused a significant increase in the concentration of greenhouse gases in the atmosphere, which have trapped more solar energy in the Earth's system, leading to global warming. In fact, the additional energy has warmed not only the atmosphere, but also the oceans and land, generating rapid and widespread changes in the atmosphere, oceans, cryosphere and biosphere (NASA, n.d.).

As shown in figure 1, according to the NOAA<sup>1</sup> observatory at Mauna Loa<sup>2</sup> on the Hawaiian Islands (located in the middle of the Pacific Ocean, where there is no

---

<sup>1</sup> The National Oceanic and Atmospheric Administration (NOAA) is a Washington, D.C.-based scientific and regulatory agency within the United States Department of Commerce, a United States federal government department. The agency is charged with forecasting weather, monitoring oceanic and atmospheric conditions,

interference from polluting gases as it is far from factories and metropolises), the concentration of carbon dioxide in the atmosphere has risen from 290 ppm<sup>3</sup> in 1956 to over 420 ppm at present (NOAA Global Monitoring Laboratory, n.d.)<sup>4</sup>.

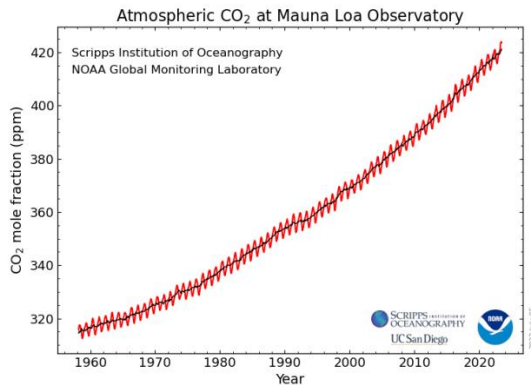


figure 1

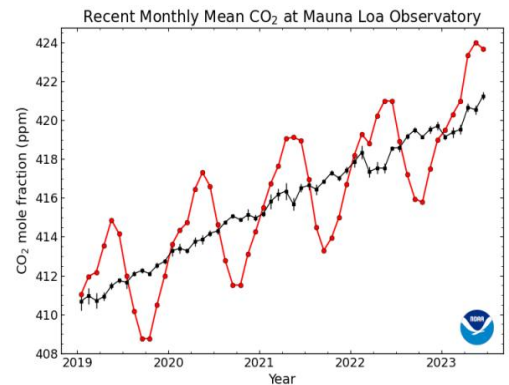


figure 2

Specifically, the graph in figure 2 shows the change in the amount of CO<sub>2</sub> in the atmosphere and its increase over the last four years, from 2015 to the present, again measured at the NOAA Mauna Loa Observatory (Hawaii) (ibid.).

Similar increases have also been recorded in the concentrations of other greenhouse gases such as methane, water vapour, nitrous oxide, and halocarbons including mainly chlorofluorocarbons (CFCs) and hydrofluorocarbons (HFCs) (ibid., n.d.). These gases are the main culprits of the notorious “greenhouse effect”, the acuity of which has led to a progressive increase in global temperatures and to highly impactful and significant consequences, which are now before everyone's eyes.

Indeed, as reported by Climate.gov (n.d.):

“according to NOAA’s 2021 Annual Climate Report, the combined land and ocean temperature has increased at an average rate of 0.14 degrees Fahrenheit (0.08 degrees Celsius) per decade since 1880; however, the average rate of

---

charting the seas, conducting deep sea exploration, and managing fishing and protection of marine mammals and endangered species in the U.S. exclusive economic zone.

<sup>2</sup> Mauna Loa Observatory (MLO): MLO stands for an atmospheric station of the National Oceanic and Atmospheric Administration Earth System Research Laboratory (NOAA ESRL). ESRL's mission is to measure the percentage changes of atmospheric components responsible for climate change on earth and those causing the destruction of the ozone layer. It is located on the volcanic island of Mauna Loa in the Hawaiian archipelago.

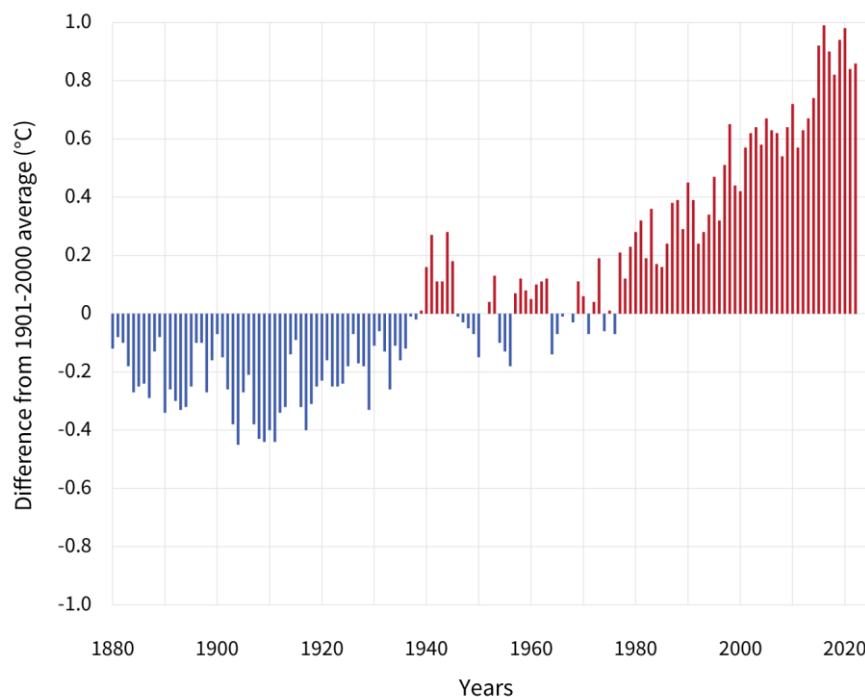
<sup>3</sup> Ppm: parts per million. It is a method used in science to express the concentration in a solution.

<sup>4</sup> <https://www.esrl.noaa.gov/gmd/ccgg/trends/>

increase since 1981 has been more than twice as fast: 0.32 °F (0.18 °C) per decade”.

At the same time, the NOAA National Centers for Environmental Information (2023) reports that “2022 was the sixth warmest year on record based on NOAA's temperature data in the 1880-2022 record, and the 10-warmest years on record have all occurred since 2010, with the last nine years (2014-2022) among the 10-warmest years”.

## GLOBAL AVERAGE SURFACE TEMPERATURE



**figure 3** Yearly surface temperature compared to the 20th-century average from 1880–2022. Blue bars indicate cooler-than-average years; red bars show warmer-than-average years. NOAA Climate.gov graph, based on data from the National Centers for Environmental Information. (Climate.gov, n.d.). From <https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature>

The IPCC's latest Summary for Policymakers (2023) starts like this:

“Human activities, principally through emissions of greenhouse gases, have unequivocally caused global warming, with global surface temperature reaching 1.1°C above 1850-1900 in 2011-2020. Global greenhouse gas emissions have continued to increase, with unequal historical and ongoing contributions arising from unsustainable energy use, land use and land-use



change, lifestyles and patterns of consumption and production across regions, between and within countries, and among individuals”.

As is well known, climate change and global warming have led and are still generating significant consequences: from melting glaciers to the reduction of the polar ice caps in Greenland and Antarctica, from the decrease in Arctic sea ice to a drastic reduction in snow cover, from an increase in the frequency of extreme weather events to an increased risk of desertification linked to changing atmospheric currents. Furthermore, NASA satellite observations have revealed that snow melts earlier and earlier in the spring season, altering the dynamics and balances associated with it (NASA, n.d.).



**figure 4** The Columbia is a large tidewater glacier, flowing directly into the sea. It is one of the most rapidly changing glaciers in the world. Since the 1980s, the terminus has retreated more than 20 kilometers (12 miles) to the north, moving past Terentiev Lake and Great Nunatak Peak. Since the 1980s, the glacier has lost more than half of its total thickness and volume.

NASA images by Jesse Allen and Robert Simmon, using Landsat 4, 5, 7, and 8 data from the USGS [Global Visualization Viewer](#). (NASA, n.d.).

As a consequence, there has been a rise in sea and ocean levels, which has increased by about 20 centimetres in the last century and the rate in the last two decades, however, is almost double that of the last century and continues to rise slightly every year (Nerem et al., 2018). This endangers many small islands and entire coastal areas of the world, like Bangladesh for example.

Finally, among the most visible evidence is the acidification of the oceans, which has increased by around 30% since the beginning of the Industrial Revolution (NASA, n.d.). This increase is due to humans emitting more carbon dioxide into the atmosphere and hence more being absorbed into the ocean.

### **1.1.1. Climate change in mountain areas**

Mountains are very diverse in terms of geographical extent, geological and climatic context, ecosystems and human activities. For this reason, Knight (2022) states that “mountain environments around the world are particularly sensitive to the effects of anthropogenic climate change (global warming) due to their unique heat-balance properties and the presence of snow, ice, permafrost and climate-sensitive ecosystems”.

Therefore, it is widely recognised that climate change has profound effects on various mountain systems, particularly cryospheric systems, with impacts on local, regional and global resources (Steiger et al., 2022). Mountains are very diverse in terms of geographical extent, geological and climatic context, ecosystems and human activities. As such, “mountain environments worldwide are particularly sensitive to the effects of anthropogenic climate change (global warming) as a result of their unique heat balance properties and the presence of climatically-sensitive snow, ice, permafrost and ecosystems” (Knight, 2022). Therefore, it is widely recognised that climate change has profound effects on various mountain systems, particularly cryospheric systems, with impacts on local, regional and global resources (Steiger et al., 2022).

Mountain ecosystems provide essential livelihoods, food security, well-being and cultural identity (Masson-Delmotte et al., 2021). However, they are currently facing increasing climate risks that create significant adaptation challenges and undergoing massive and unprecedented changes in the Anthropocene era, as a result of the adoption of the industrial capitalist model as the world's basic development system (ibid.). Almost certainly, mountain environments will face dramatic changes in the future with cascading impacts not only in high-altitude areas but also in downstream regions (Carrer et al., 2023).

Among the most widely recognised impacts of climate change in mountainous areas are the melting of glaciers and permafrost (at high altitudes and latitudes), the rise in snow depth (the limit at which the temperature remains below 0°C allows snow production) due to the decrease in snowfall, and the lack of water as precipitation is less abundant and glaciers have fewer and fewer reserves. This has an impact not only on the loss of biodiversity and ecosystems, but also on human activities such as agriculture and livestock breeding and more generally on the entire Alpine economic system, which is already extremely fragile and delicate.

## **1.2. THE ALPS**

After a brief introductory excursus on climate change in mountainous areas on a global level, the area of the Alps is specifically described, not only from a geographical point of view, but also as an artistic and cultural resource and heritage. Then, climate change in this specific area is analysed and a focus is placed on a specific valley in the central Alpine sector.

### **1.2.1. The Alps: a general overview**

The Alps are a mountain range spanning an arc of about 1200 km from the Ligurian Gulf to Slovenia and straddling five European states (France, Italy, Switzerland, Austria and Slovenia). For the Italian side, they are divided into Western, Central and Eastern Alps: the western sector is conventionally considered from the Mediterranean to the Valle d'Aosta, the central one to the Stelvio Pass and the eastern one to the Slovenian border. The Alps include massifs that reach very high altitudes, first and foremost Mont Blanc with its main peak at 4810 metres and Monte Rosa with Punta Dufour – 4634 metres, and represent the richest cradle of biodiversity in Europe with more than 30,000 animal species and 13,000 plant species (Abegg et al., 2007). The Alpine arc covers an area of about 190,912 square kilometres (CIPRA, 2018) and constitutes Europe's largest water resource as three of its most important rivers – the Rhine, the Rhone and the Po – originate in their mountains.

The geographical position of the Alps favours the concurrence of various atmospheric currents. They are conditioned by four climatic zones of influence: the Atlantic influence (and the Gulf Stream) with mild and humid air flowing in from the west; the Mediterranean influence with warm air blowing in from the south; the Central European influence with cold polar air flows from the north; and finally the Danubian-Carpathian influence that moves a continental air mass from the east, typically warm in summer and cold and dry in winter (L. Dematteis, 1994). In turn, the Alps exert considerable influence on weather patterns due to their altitude, vegetation and snow cover. In addition, the Alpine area is bordered on all sides by heavily anthropised and industrialised regions, which contribute to the aforementioned climatic variations.

According to the Alpine Convention, the Alps have a population of 14 million people, which is mainly concentrated in the valley bottoms, medium and low altitude areas (Angelini, 2015). It is the most inhabited mountain range in the world because of its easy accessibility and its strategic position in the centre of Europe makes it a very important part of the continent, at the centre of today's political and social development.

The Alpine landscape has been shaped by centuries of widespread human presence and the associated social, cultural and economic production. Human settlement in the Alps is very ancient and traces of it are visible even at the highest altitudes. Since the past, every Alpine valley with acceptable climatic conditions was inhabited and anthropised by populations whose main purpose was to maintain their living and working environment in safety and productivity (Permanent Secretariat of the Alpine Convention, 2015). Since the beginning of the 20th century large portions of the Alps have shown a strong tendency towards depopulation, which has made it more difficult to guarantee the maintenance of a constant preservation of the territory and the provision of basic services to the local population, putting their standard of living at risk (ibid.). In the Declaration "Population and Culture" of the Alpine Convention (Alpine Convention, 2006) emerges precisely this desire to “safeguard and preserve the presence of the local population in the Alpine region, to maintain the specifically Alpine characteristics of a man-made mountain environment and to implement an integrated policy that guarantees the protection and sustainable development of the Alps” (ibid.).

“The variety of the natural environments, the availability of water and the geological characteristics have constituted a set of resources of fundamental importance for the economy of the Alpine populations” (Treccani, n.d.). The anatomy of the Alpine economy is very complex as it is based on the interconnection between different sectors: tourism, services, industry, energy sources and agriculture (FAO, 2023). With their capital of biodiversity and reserves of water and wood, the Alps are a natural, cultural, living and working environment as well as an important tourist destination (Permanent Secretariat of the Alpine Convention, 2015). The Alpine territory as a whole is extremely heterogeneous both morphologically and culturally, with great disparities - especially in terms of population, employment and economic activities. The latter are very diversified: from mining, agricultural and silvopastoral activities (cattle breeding provides high quality meat and dairy products) to the tourist resource (summer and winter), concentrated in numerous towns throughout the Alpine arc (Treccani, n.d.).

### 1.2.2. The Alps as a natural and cultural resource and heritage

Quoting De Rossi (2014):

“paradoxical as it may seem at first sight, the Alps, as we know and perceive them today, have not always existed. They have been «*constructed*» through a dual process: that of the transformation of the Alpine territory and that of scientific and artistic knowledge, of the construction of an imaginary, a representation and staging of the mountains. Both these aspects have known and know a history”.

The Alps represent a cultural heritage of great value and an important resource for the country. As Morandini and Reolon (2010) reports:

“they constitute not only a geographical reality, but a human entity and a historical heritage. [...] A system that, if from the morphological point of view owes its formation to the Alpine orogenesis, from the socio-economic and cultural point of view it is the product of a myriad of drives that have their roots in the connections between the two slopes, in the integrations between the valley bottoms and the pastures of the higher areas and, above all, in the interchangeability of activities and permanent centres in relation to seasonal rhythms, with the development of its own unity in diversity”.

The Alps have a very long history behind them, which, quoting a phrase by Camanni (2017) in “*History of the Alps*”, “if it were a film could be told in twenty scenes, or chapters”. It starts from their birth, known as the Alpine orogenesis, and ends with the settlement of the “new mountaineers, [...] young people from the mountains who have come down to the city to study and return to the places of their fathers, or other young people from the city who choose to move to the mountains in search of economic opportunities and forms of life more respectful of sociality and natural rhythms” (ibid.). Meanwhile, their history unfolds through glacial phases, human settlement with the birth of the first Alpine villages and the artisan economy, the various historical phases of conquest by the Romans and the barbarian invasions, the climatic optimum phases at the end of the Middle Ages, passing through the economic and cultural crisis at the turn of the 17th century and seasonal emigration, pioneer mountaineering, the development of tourism, massive transformation and finally urban colonisation (ibid.).

Over the centuries, the Alps have been home to the crossroads of peoples, cultures and languages on the move: Provençal, Walser, Romansh, Ladin, Carinthian, Slovenian etc. Each new immigration has brought with it specific forms of production and different techniques for adapting to the mountainous nature (Camanni, 2016). This is why, even today, the Alps represent an interesting living space with distinct characteristics of an ethnographic laboratory, as the cradle of very important anthropological, cultural and social information. The differences are still clearly visible in the languages and territories, especially in the anthropological and economic distance separating the Roman-speaking Alpine region from the German-speaking one (ibid.). A close look at the multiple forms of the rural landscape reveals a mosaic of cultural traits closely linked to the settlement practices of the various valley communities, despite the profound changes in lifestyles over the last 50 years, which have led to homogenisation with western urban societies (Salsa, 2005).

Moreover, Corrado (2025) in “Popolazione e cultura alpine: le Alpi di oggi” states:

“the Alps, with their natural and cultural heritage, are an important tourist destination attracting around 120 million visitors each year. With the aim of promoting sustainable development and protecting the interests of the resident population, while taking into account the complex environmental, social, economic and cultural issues, the Convention on the Protection of the Alps, known as the 'Alpine Convention', was created in 1991 and signed by Austria, France, Germany, Italy, Switzerland, Liechtenstein and the EU. The socio-economic and socio-cultural aspects of the Alpine habitat are accorded central importance in the implementation of a comprehensive policy for the protection and sustainable development of the Alps”.

### **1.2.3. Climate change and its impacts in the Alps**

Climate change is readily observable in the Alps. Climatic conditions in Alpine areas vary along altitude gradients and define mountain regions and the species that inhabit them. Consequently, changes in climatic parameters have a strong impact on both the physical environment and the living world (CREA Mont Blanc, n.d.).

The Alps are particularly sensitive to climate change and “over the last 50 years, the Alps experienced a 5.6% reduction per decade in snow cover duration, which already affects a region where economy and culture revolve, to a large extent, around winter” (Carrer et al., 2023). Future projections from current climate models appear to be even more negative, in particular there will be a reduction in snow cover at low altitudes, glacier retreat (a process already strongly underway), thawing of permafrost at high altitudes, and changes in temperature and precipitation values.

Because rising temperatures result in a reduction in the amount of areas covered in ice and snow, which reflect sunlight, warming is exacerbated in mountainous locations (CREA Mont Blanc, n.d.). In their place, patches of black rock and later flora absorb the sun's heat, raising the temperature of the ground and causing additional melting (Carrer et al., 2023).

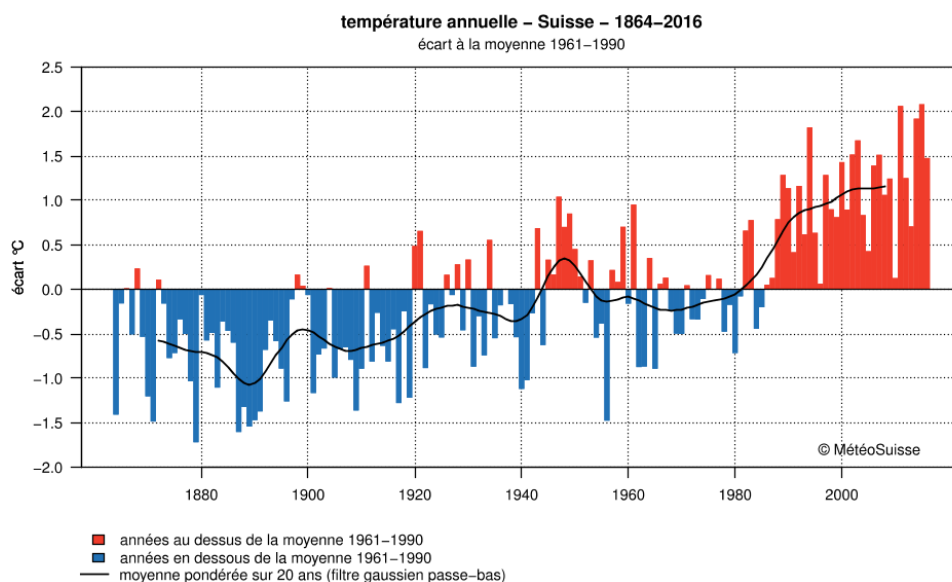


figure 5 Average annual temperatures in Switzerland: based on the 1961 to 1990 average, blue bars indicate years during which annual temperatures were below average and red bars indicate years above average. © Météo Suisse. From <https://creamontblanc.org/en/climate-change-and-its-impacts-alps/>

As CREA Mont Blanc (n.d.) reports on its website<sup>5</sup>:

“at the scale of the European Alps, over the course of the 20th century, temperatures have risen by 2°C (3.6°F). This rise is greater than the French average of +1.4°C (2.5°F) and double the increase recorded in the northern

<sup>5</sup> <https://creamontblanc.org/en/climate-change-and-its-impacts-alps/>

hemisphere. The rate of this warming, observed since the beginning of the Industrial Revolution, has increased since the 1980s to 0.5°C (0.9°F) per decade. In terms of temperature conditions, 0.5°C represents about a 100 m (328 ft) difference in elevation. That means that, in order for species be able to stay in the same temperature conditions, they would need to move 100 m upslope.”

Furthermore, Matiu et al. (2021) report that “in the Alps seasonal (November–May) mean snow depth, recorded in several hundreds of in-situ snow depth observations, experienced an 8.4% decline per decade between 1971 and 2019”. With regard to the melting of Alpine glaciers, the Copernicus Climate Change service (n.d.) reports that on average, over a series of observations of Alpine glaciers taken as “reference”, they lost more than 24 m in thickness between 1997 and 2017, which corresponds to an average annual mass loss of 1.2 kg per m<sup>2</sup>.

The consequences of changes in temperature and precipitation are already clearly visible in the mountains: significant retreat of glaciers, reduction of snow cover at mid-altitudes, increase in altitude of the seasonal snow line, more frequent soil water shortages, increase in permafrost elevation, shortening of the duration of the winter season, and prevalence of rainy events over snowy ones.

Snow cover in high and very high altitude regions has strong effects on the Earth's climate, environmental processes and socio-economic activities: some snow-dependent or cold-adapted species are facing a decline in abundance or a reduction in reproductive fitness (Hock et al, 2019), while winter tourism and related recreation activities have been negatively impacted by the space and time reduction of the snow cover (Niittyinen et al, 2018).

In particular, in the following paragraphs we will analyse how an economic giant such as the ski industry, which is dependent on increasingly less abundant snow cover, is therefore in the midst of an unprecedented crisis and is at a crossroads: continue to invest in infrastructure and ski facilities or try to initiate a sustainable transition not only of the ski resort, but of the entire territory.



## 1.3. SKY INDUSTRY

### 1.3.1. History and development of skiing and ski areas

Alpine skiing is the consequence of two cultural steps that had the effect of two revolutions. The first step is the 'discovery' of winter, which is historically considered the dead season of mountaineers, a time of endurance and waiting, and the second is the emergence of tourism as a mass phenomenon, which profoundly overturns the mountain paradigm.

Although the history of skiing is thousands of years old, alpine skiing in the modern sense only began to develop from the mid-19th century, when equipment was introduced to facilitate the execution of downhill turns (Fis, n.d.). De Rossi (2014) reports that “it was precisely the decades between the 19th and 20th centuries that saw the emergence of a totally new phenomenon, that of snow sports and winter tourism, which began to change the uses and geographies, times and spatialities of the mountains”.

In the Alps, in particular, the debut of skiing as a sporting activity came from Sankt-Moritz, which at the beginning of the 19th century was just a small village in the Upper Engadine in Switzerland (ibid.). In the winter of 1864-1865, the hotelier Johannes Badrutt started a pioneering first phase by opening his accommodation in winter as well, inviting his regular English guests, who until then had only been summer holidaymakers, and betting that they would find the winter activities in the resort as enjoyable as the summer ones (ibid.). The 1st Yearbook of Tourism and Winter Sports published by the Italian Touring Club in 1911 gives a glimpse of an articulation far removed from the later *monoculture of skiing* that would permeate the mentality of the second half of the 20th century (Touring Club Italiano, 1911). De Rossi (2024) writes in reference to the early years of the 20th century:

"the snow and the cold months are experienced, compared to the traditional summer mountain of holidays and outings, first and foremost as an extension of seasonality and activity, in which the playful dimension and the discovery of an almost unheard of universe of sensations prevail. The radical transformation, with the gradual disappearance of the summer season and the

coercion of the monoculture of skiing, would only occur some time later, with the mechanisation of the mountains and mass tourism”.

While skis were already widespread in Norway and other Nordic countries, they literally took their first steps in Italy with the Swiss engineer Adolfo Kind, who brought two pairs of ash 'planks' to Turin in 1896: the Norwegian “*skis*” (AltriSpazi, 2020). As Camanni (2005) reports in “L’alpinismo e lo sci, in Torino e lo sport. Storia e immagini”:

“Kind first showed these tools to some friends in the living room of his villa that he had built in the Nordic style, not far from the Po and the Valentino park. «He invited some acquaintances and showed them his skis. The friends, rather incredulous and curious, put on their skis and started imitating his movements, as if they were really skiing», wrote the Italian Emilio Santi some years later. The first skiing then took place in the hills, on some meadows, and on the hillsides inside the Valentino park, while the descent took place on sunken roads”.

Camanni (ibid.) goes on to report that:

“Kind was won over by skiing because it perfectly matched that combination of enlightened ingenuity and visionary energy that pointed the way to progress at the beginning of the 20th century. He conquered the austere children of the Italian Alpine Club with extraordinary skill and ease by preaching the elegance of gesture and the intoxication of speed, and in December 1901, following the example of the Austrian and Swiss clubs, the Turin Ski Club, the first Italian ski club, was founded by him. Skiing was fully wedded to the mountaineering tradition and was welcomed as an extraordinary means in the subalpine salons as it provided them with two answers to two needs: it helped them to reach and climb mountains in winter and it unconsciously freed them from the burden of the summit by allowing them to play on the snow fields, trying to fly like birds”.

On 6 January 1906, in Oulx, the 'first Italian alpine station' was inaugurated with considerable participation by skiers and the public, while in February, in Sauze d'Oulx, the first 'ski' course was organised, aimed not only at Ski Club members but also at officers of the Alpine regiments (ibid.).

Alpine skiing at the turn of the century was, however, still a very elitist sport and very much connected to the 'religion' of the mountains. During the 20-year Fascist period, the popularity of skiing increased enormously as it became a popular pastime and its spread marked the loosening of the link with mountaineering (ibid.). It was precisely during this

period that “entrepreneurs with good financial resources, intoxicated by the promise of a future of development and ever more advanced technology, began to make major investments in the construction of cable cars in the mountains” (Dematteis & Nardelli, 2022). In this period there was a change in the way of understanding the mountains and the creation of Sestriere (in the Western Alps) is an emblematic case of this. Here since 1931 Giovanni Agnelli built, within the space of a few years, six cable cars and initiated the experience of building a new alpine city between 2000 and 2800 metres above sea level (ibid.). Concerning this period Camanni (2005) writes:

“Behind the profound transformation driven by the regime there is a completely revolutionary interpretation of the mountain, no longer an outpost isolated from modernity, but, on the contrary, an urban invention equipped with the same infrastructure as the city, in places generally created ex novo for tourist and speculative purposes. [...] With Sestriere, cars and skiing become an inseparable pair and symbol of modernity, sweeping away the age-old mythology of the uncomfortable and silent alps”.

In the same years, other «Snow towns» developed in the Alps, including Foppolo in Lombardy, Breuil Cervinia and Courmayeur Mont Blanc in Valle d'Aosta and Cortina d'Ampezzo in Veneto.

### **1.3.2. The establishment of the ski system as an industrial, Fordist, economic model**

After World War II, associated with the season of quantitative growth, the expansion or birth of a whole galaxy of small and medium-sized ski resorts began, both in the Alps and the Apennines, which colonised entire valleys and transformed them into colourful urban appendages. This boom brought with it a great transformation, of culture, custom and style, which profoundly changed the socio-cultural and anthropological structure of places. The concept of the '*alpine picturesque*' that had permeated the entire 19th century, “based on the idea of space founded on the movement of the journey and the relational characteristics of the landscape, rather than on the idea of being settled and

residing fixed in a place as was the case with 20th century modernisation” (De Rossi, 2014), is left behind.

Dematteis and Nardelli (2022) report:

“in the post-World War II urban-industrial development, part of the profits generated by industrialisation in search of profitability were diverted to the highlands, weakened by the crisis of the old agro-sylvo-pastoral model which had become, for exogenous reasons, socially unsustainable. These investments found in the snow industry, i.e. in the creation of ski resorts, an engine capable of generating very interesting returns, thanks to the simultaneous emergence of mass tourism, a by-product of welfare and social struggles to obtain paid leisure time, which ensured flows of new skiing enthusiasts” (p. 7).

In the 1970s, with the beginning of the economic boom, skiing went from being an elitist activity to a mass sport (ibid.). As a result, ski resorts in the Alps and Apennines became more and more numerous, competition grew and it began to be realised that the operation of ski lifts alone could not sustain the local economy. Mass skiing is inextricably linked to the building cycle, because the lifts add value to real estate, especially in the construction of second homes (ibid.). Macchiavelli (2017) in his book emphasises how the growth in family income, induced by the economic boom, progressively developed a propensity to purchase property in resorts with a good ski offer, initially with 'tourist' objectives, and then increasingly with investment purposes. Since the 1970s, almost all the resorts easily accessible from the plains have seen an enormous tourist-residential real estate development and “since environmental sensitivity was almost non-existent, there are quite a few Alpine resorts marked by urban and real estate disfigurements that have today greatly reduced their attractiveness” (ibid.). Within a few years, the building cycle will itself become the real driving force behind the production of wealth and the object of enormous speculation (Dematteis & Nardelli, 2022).

Between the 1980s and 1990s, mass skiing, by then inseparably linked to the construction cycle, established itself as a Fordist-type economic model of tourist industrialisation of the mountains (ibid.). Each ski resort has its own investor behind it, usually representing urban-based industry (Turin and Milan in primis), which recasts

local communities on Fordist bases, distributing job opportunities and commercial induced activities, as well as manufacturing linked to the production of equipment, clothing, etc. (ibid.).

On page 8 of their book Dematteis and Nardelli (2022) write thus:

“the territory understood as landscape, as social construction and as cultural expression is subjected to the basic logic of mass consumption that brings to the places an unprecedentedly rapid and irresistible growth of widespread wealth that will deeply mark the peasant anthropology of mountain people recruited as workers in ski lifts in winter and construction workers in summer”.

They go on to report that “this is the model of limitless growth applied to the highlands, of the unfolding of tourism as heavy industry, of the total domination of human technical intelligence over the most rugged nature, tamed and reduced to a productive factor” (ibid.). The mountain thus became within a few years 'a "double" of the Fordist city, characterised by the season of quantitative growth and the parallel dissolution of traditional ways of life (De Rossi, 2014).

### **1.3.3. The role of skiing in the Alpine economy and vulnerability of the current tourism model**

In the 1980s, there were a few less snowy years, which were a kind of precursor to the current warming phase of the climate, and to compensate for the then scarce snowfall in the late 1980s and early 1990s, the first artificial snowmaking systems began to develop (Dematteis & Nardelli, 2022). Over the years, these systems grew more and more in quantity and quality and both technology and effectiveness were perfected.

Snowmaking proved to be the best adaptation strategy to climate change from the outset, and over the years, dependence on artificial snow has become increasingly important in the ski sector (Legambiente, 2023). In fact, while in the 1980s in Italy artificial snow was only used to supplement natural precipitation, today it is considered an indispensable element for slope preparation, even in high-altitude ski resorts.

In order to support this development model and to cope with the increasingly high energy costs for snow production and the operation of the facilities, “since the early 2000s, the Alpine regions and the Italian state have responded and still continue to intervene with robust injections of public money to the crisis in the sector, which goes hand in hand with the rise in temperatures at altitude” (ibid.).

As is well known, today this sector is going through a major crisis due firstly to climate change and secondly to the rising cost of energy. In recent years, according to Dematteis & Nardelli (2022), “efforts are being made to avert the *spectre of the end* of a mass tourism system linked to winter skiing in order to move forward the break-even point of the ski resorts that are still holding out”.

Dematteis & Nardelli (ibid.) then go on:

“The mountain tourism industrialisation model built around mass skiing is now in its twilight years. Because downhill skiing needs heavy and impactful infrastructures, not at all adaptable to the changes that the mountains have always been subject to. In our country, there are hundreds of them, small and medium-sized disused ski resorts, built at 1,000 metres or so, that have resisted as long as they could and then were forced to throw in the towel. Years of battles in the pursuit of an unsustainable chimera of development that was getting further and further away, amidst diminishing snow days, rising expenses and vanishing skiers. Efforts to find public subsidies, low bids and costly maintenance pushed the debts of lift operators to the point of insolvency. Because it is precisely these realities, daughters of a lesser god, that today are the first to bear the brunt of the 'cultural-economic-environmental' change, often leaving behind the rubble of a time gone by. They are the symbol of a system of infinite growth that is now in its twilight years, an interrupted dream that lulled and deluded the communities in the highlands”.

### **1.3.3. The system of public contributions**

Given the significant role that the ski industry has played in the economy of the Alpine valleys, undoubtedly representing in the past decades an important factor in the economic growth of mountain areas and partly containing the massive depopulation that occurred in those territories in the post-war period, today attempts are being made to maintain and support this economy with massive public financial intervention.

A great deal of funding comes from the European Union, which “from 2014 to 2020 has planned to invest more than 44.6 billion in structural funds in Italy, which will partly finance the upgrading and creation of new ski resorts, and partly the artificial snowmaking” underlines Legambiente (2023).

In Italy, more than in the rest of European countries, dependence on snowmaking is very high and the competitiveness of the ski sector has now created a sort of vicious circle that requires ever greater investment in new technologies and continuous expansion of the area to be covered to keep up with other European countries. To support this, the state has been intervening in this sector for several years now, but in recent times with the worsening impacts of climate change, with the forced closure due to Covid-19 and with the increase in energy costs due to the political instability between Russia and Ukraine, the incentives have grown and become even greater. The contributions are almost always non-repayable and concern the construction of new facilities and infrastructures, the modernisation or decommissioning of old ones, the renovation and maintenance of systems for snow-making on the slopes such as basins or water supply basins, the production costs of snow-making, the implementation of innovative snow-farming projects, and the obtaining of any landscape authorisations necessary for the implementation of the eligible projects.

As an example, the two latest financial interventions in the area of ski facilities by the Italian government for the year 2023 are listed below. The first is promoted by the Ministry of Tourism and is a “Fondo per l’ammmodernamento, la sicurezza e la dismissione degli impianti di risalita e di innevamento artificial”, whose notice was published on 27 June 2023 on the official website (Ministero Italiano del Turismo, 2023). The fund will have a multi-year validity over the four-year period 2023-2026 and a total endowment of 200 million euros, 30 million of which for the year 2023 (ibid). The official website of the Ministry of Tourism (ibid.) states:

“the measure aims to promote tourist attractiveness and stimulate tourist flows in mountain areas and ski resorts by carrying out renovation, modernisation and maintenance work on cableway and snowmaking facilities.”

The second intervention is the “Fondo per lo sviluppo delle montagne italiane – Energia in vetta”, whose notice was published on the official website on 24 May 2023 (Dipartimento per gli Affari Regionali e le Autonomie). This is a non-repayable

contribution with a total budget of 10.8 million euro, promoted by the Department for Regional Affairs and Autonomies (DARA) of the Presidency of the Council of Ministers and managed by Invitalia, which aims to support the operation of sports infrastructures for the higher costs incurred in the 2022/2023 winter season compared to the previous winter season (ibid.). The planned incentives are intended to cover the operating costs of electricity and water supply for the planned snow production (ibid.).

#### **1.3.4. Snowmaking today**

For many alpine areas, winter sports have been and still are the most important source of income, so the security of snow is one of the key elements for maintaining winter tourism. It must, however, be taken into consideration that in the last 100 years the average temperature of the planet has increased by about 0.6-1°C. Hence, planned artificial snow production has become a necessity, in connection with the scarcity of snowfall and, indeed, rising global temperatures (Ludovici et al., 2006).

Technical/planned snowmaking, often also referred to as artificial snowmaking, continues to be the main adaptation strategy identified by the industry to respond to climate change (Dematteis & Nardelli, 2022). Without snowmaking, in fact, ski areas would not be able to cope with the growing needs of the sector. In contrast to the irregularity of snowfall, there is a need for an adequate amount of snow in order to guarantee the opening of ski slopes and the continuity of alpine skiing throughout the winter season. Rising temperatures reduce snowmaking potential, as high temperatures and/or high relative humidity inhibit snow production (Willibald et al., 2021).

In Europe, the dependence on artificial snow is now very high. Legambiente (2023) reports that Italy is the Alpine country where artificial snow is most widespread, with 90% of slopes artificially covered with snow, followed by Austria with 70%, Switzerland with 50%, France with 39% and finally Germany, with 25%, the lowest percentage.

In addition, Legambiente (ibid.) mentions the production costs of scheduled snow per cubic metre, reporting that they have risen from around 2 euro per cubic metre in the



2021-2022 season, to 3-7 euro per cubic metre in the 2022-2023 season, an increase due to higher energy prices and inflation in recent periods.

According to a Hamberger and Doering (2015) in their German study on artificial snowmaking in the Alps, the total energy consumption in the Alpine region, just for the production of the first minimum layer of artificial snow, i.e. 30 cm, corresponds to about 1400 GWh per season. However, with subsequent snowmaking operations, the total consumption would reach 2100 GWh and could increase significantly as temperatures rise (ibid). The same study reports estimated data on the volume of water consumption for snow production, which ranges between 2000-6000 m<sup>3</sup> per hectare of slope, taking into account the various snowmaking operations required during a season (ibid.). Legambiente (2023) reports in that “considering an average of about 4000 m<sup>3</sup> of water per hectare, it can be deduced that if the 70000 hectares of slopes in the European Alps were completely covered with snow, the volume needed would be in the order of 280,000,000 m<sup>3</sup> of water per year”. To the consumption for shot snow must be added that for the mechanical snow groomers, who each use up to 30 litres/h of fuel for an average of 1200 h per season (Reinboth, 2019).

According to a 2023 estimate by Legambiente (2023), every year in Italy to snow the 24,000 hectares of slopes, 96,840,000 m<sup>3</sup> and 720 gigawatt-hours of energy are used, which corresponds to the annual water consumption of about a city of one million inhabitants, for an expenditure that fluctuates, based on the 2022-2023 season, for a thickness of about 30 cm between 242 and 565 million euro, if all snow cannons were in operation.

Legambiente (2023) also reports that there are still many supporters that artificial snow is still the best adaptation response. It is often overlooked, however, that with worsening climate change, if temperatures rise above a certain threshold, “snowmaking will simply be practicable only in very restricted areas at high altitudes, in places where the already high costs of snow and sport will increase substantially, so much so that only a small elite will be able to access Alpine skiing, as was the case in the past” (ibid.).

### **1.3.5. Environmental impacts of the ski industry**

In an already very critical climatic context, it is worth analysing the various impacts that the ski industry and related mass tourism have on mountain environments. It must be agreed that existing ski resorts have produced and continue to produce numerous highly negative effects on the environment, ecosystems and species. In fact, the 'occupation' of a given mountain area by a ski resort causes significant disturbances to habitats, species and soil, which have been widely documented for a long time (CAI, 2020). On the one hand, one has to consider the impact of the construction and infrastructure of snowmaking facilities, on the other hand, the consequences of this practice, which do not only affect the areas covered by artificial snow, and on the other hand, the environmental costs of snow production (Legambiente, 2023).

First of all, as always Legambiente (ibid.) reports, the implementation of artificial snowmaking systems leads to significant consumption of water, energy and soil in highly valuable areas. It also points out that "artificial snowmaking in Europe requires the use of billions of litres of water, a quantity that is difficult to calculate exactly because it varies from year to year and because not all consumption is declared" (ibid.) and for the next few years the demand for water for snowmaking in the Alps is expected to increase significantly, from 50% to 110% according to Steiger et al. (2019). This need for water already interferes with the demand for other water uses in other sectors, "creating not only social but also environmental conflicts, which will be exacerbated in the coming years with an even warmer climate: from the water needed for the production of electricity, to that for agriculture and livestock breeding, to domestic uses in general, to that for tourism" (Legambiente, 2023). Of particular concern is the use of water to feed reservoirs, to the detriment of mountain water resources that are increasingly reduced as the climate crisis deepens. Reservoirs are now numerous and increasing in number, and are currently seen by the ski industry as optimal solutions for storing water for the production of artificial snow. Unfortunately, however, these reservoirs create many environmental problems due to their very high energy requirements, altering the hydrological cycle, exacerbating the foreseeable competition for water resources and reducing the flow rate of watercourses, thus making them particularly fragile (ibid.).

Furthermore, artificial snow compared to natural snow has a high liquid water content, approximately 15-20% compared to 7-10% of natural snow, and consequently has a higher weight and lower thermal insulation capacity than dry snow would have between the soil and the atmosphere (Brenna, 2015). These factors cause the soil to freeze, preventing the passage of oxygen and causing the underlying vegetation cover to asphyxiate, which is then subject to death and decay (ibid.). In locations subject to artificial snow cover, a delay in the start of vegetative activity of up to 20-25 days compared to the average has been observed (ibid.). The deterioration of the vegetation cover makes slopes more prone to erosion and alters the ecology and biodiversity of mountain slopes (ibid). Moreover, slope working tends to compact the snow, causing delayed melting, with considerable consequences on soil quality and species, which already enjoy a very limited vegetative and reproductive period in the mountains, and causing an impoverishment of biodiversity (Hahn, 2004).

In addition, district construction sites immediately cause several serious environmental problems, such as earthworks, erosive phenomena, alteration of the soil and ecosystem dynamics, destruction of habitats and species, degradation of landscape values, in turn compromising other land uses (CAI, 2020). In fact, the enlargement of an area or the construction of a new plantation often entails the cutting of important forest strips, altering historical forest associations and thus destroying the ecosystem of a specific territory and impoverishing its plant and animal biodiversity (Casanova, 2020). The unity and compactness of a slope is often altered, the fragmentation of the territory is favoured, a recognised factor in the loss of biodiversity (CAI, 2020), corridors are built that facilitate the penetration of winds, thus imposing significant and irrecoverable microclimatic changes, and the spread of parasites that generate from the cut edges of slopes is facilitated (Casanova, 2020). Before nature recovers what has been destroyed, many years pass as a specific environment is totally deprived of its naturalness, as a consequence of major human intervention and subsequent abandonment (ibid.). Added to all this is the continuous anthropic disturbance caused by winter and summer tourism and winter working of the slopes, both during the day and at night, which causes disturbance to wildlife, due to both the presence, noise and lights (CAI, 2020).

Finally, the growth of a ski resort has over the years caused and still causes significant environmental impacts due to the massive development of the construction-urbanisation

sector linked to the construction of second homes, buildings, infrastructures, shops and all those services that that world has attracted to it. One of the biggest problems we are facing today is precisely related to the 'end of life' of both ski resorts and this enormous building speculation that developed between the 1980s and 1990s, eventually running out and leaving major disasters in most resorts (CAI, 2020). According to Legambiente (2023), there will be 249 disused facilities between the Alps and the Apennines in 2023, 15 more than in 2022. They have been completely abandoned, leaving relative ruins, disused buildings and uncommissioned ski lifts that continue to burden the mountains.

## **2. CHAPTER II: METHODOLOGY AND MATERIALS**

### **2.1. Research design**

In the present study, a mixed methodology was adopted that combined qualitative and quantitative approaches in order to obtain an in-depth understanding of the research topic. The research was structured in several stages that included literature review, data collection, graph and map making, data analysis and the production of a final SWOT that was then analysed in order to outline possible future developments.

In the following paragraphs, the design of the research is explained in detail, outlining how the data collection was organised, which sources, sampling procedures and data collection tools were used and over what timeframe. It is then reported which data analysis methods and procedures were adopted to evaluate the results.

In addition, three case studies were analysed as positive examples of locations in the Alps that have found sustainable development and transition alternatives. They show that there are places that have successfully emerged from an unsustainable situation, reviving an economy and a community. They are analysed in the research in order to highlight good practices and to outline possible strategies, alternatives and future scenarios also for the case study considered.

### **2.2. Choice of case study**

During my internship at the Mountain University in Edolo, a branch of the University of Milan, I worked on the international Interreg - TranStat project, which I will discuss in detail in the next chapter. The project identified Valmalenco as a living laboratory on Italian territory, a territory that was therefore taken as a case study for this research to be analysed in detail. The Valmalenco presents itself as a very important valley both from a naturalistic-environmental point of view, given the great landscape value that makes it one of the most interesting valleys in the Alpine arc, and from a historical point of view, and it has ski-lift facilities of a certain importance. Just in recent years, the entire territory and the related ski industry have been going through a serious economic crisis, certainly linked on the one hand to climate change and the lack of snow, and on the other to the increase in energy prices for the maintenance of facilities and the production of artificial snow, but also to a more general crisis, unrelated to the ski

sector. The case study is in line with the literature analysed above and therefore seemed appropriate in order to assess possible adaptation strategies and future development alternatives in a mountain resort that has built its economy around the ski industry.

### **2.3. Literature review**

With regard to the literature review, a systematic search of academic publications, books and literature resources (also online) relevant to the topic was conducted. In the first instance, documents related to climate change were analysed in depth, starting on a global scale and then arriving at the specific local level of the Alps. Then the Alps were described as a territorial entity of great value and relevance for the role they play on a social and environmental level. Next, the context of skiing and ski resorts in the Alpine mountains was analysed, investigating in depth its history, its development over the years as an industrial model and the social and environmental impacts that the ski industry has caused on the environment and Alpine communities; finally, the current crisis linked to climate change and high energy costs was analysed.

Subsequently, the focus was on documents related to the specific case study. Bibliographic sources and a number of documents provided by the various municipalities, the tourism consortium and the Lombardy Region were consulted, including the Territorial Government Plans. This topic will be discussed in more detail in the section on quantitative data.

The literature review provided a comprehensive overview of previous theories and studies related to the research topic, providing a solid theoretical framework for subsequent research, which is based on sources.

### **2.4. Data collection**

For data collection, various research tools were used and both quantitative and qualitative data were collected. The choice of this approach was guided by the aim to examine both objective and subjective aspects of the phenomenon under investigation and to obtain a more detailed overview.

### **2.4.1. Qualitative data and research tools used**

The research was conducted through the development of several phases. A first phase of the work involved the review of existing literature and studies on the research topic under analysis. A second phase, on the other hand, concerned the design of the most appropriate research methodology and techniques in order to conduct qualitative research on the area under investigation. In this phase of the project, two complementary researches were therefore conducted in parallel: on the one hand, stakeholder mapping was undertaken in order to identify the important actors and 'interesting' people in the area, and on the other hand, work was done on the formulation of a semi-structured interview to be administered to the identified stakeholders. A third phase then involved the collection of quantitative data from the various portals, with subsequent analysis and graphical processing through the use of the Excel programme. Thanks to the data obtained from the various interviews, compared with the quantitative data, we then moved on to the final phase and the elaboration of a SWOT analysis of the area, which allowed us to analyse possible future scenarios for the case study in question. The following paragraphs look in detail at each phase.

#### **2.4.1.1. Stakeholder mapping and analysis**

First of all, together with a specialised work team, the mapping and analysis of stakeholders was carried out, with the aim of identifying those persons relevant to the area, community stakeholders, and whom it is necessary to involve in the project in order to obtain a general overview of the context under analysis. Since one of the objectives of the project was to use as inclusive and participatory an approach as possible, based on a bottom-up design<sup>6</sup>, it was decided to involve as many people as possible from different categories (divided into groups, professions, etc.), external to and disconnected from the world of ski facilities, in the project and in the interview.

Analysing specifically and from a theoretical point of view what stakeholder mapping is, Lavazza (2017) reports:

“it is a design activity used to analyse and visualise all the stakeholders in a given project. It is fundamental for understanding the context, relationships and

---

<sup>6</sup> The bottom-up approach, as opposed to the top-down model, is characteristic of bottom-up planning and is a management style that aims to involve a wider network of people to actively participate in the decision-making processes and strategies of a project.

internal dynamics of the project, it serves to identify in a participatory manner all those who must necessarily be involved within the project and aims to do so in the most correct way.”

The mapping process helps to prevent problems that could be created in the development of the project: it allows to know the scenario, the actors, the relationships and, last but not least, the frictions that exist on certain issues in a specific territory (ibid.). Stakeholder mapping is also “one of the many participatory tools of human-centred design and design thinking because it not only puts people at the centre of the project from the outset, but also identifies their relationships and connections by enhancing the value of dynamic eco-sustainability” (ibid.).

In the specific case of the study under examination, stakeholder mapping was carried out by means of the Venn model, which is the best known and most widely used stakeholder map and analysis model and is presented in concentric circles within which the various targets are placed, subdivided according to their role, relevance and knowledge with respect to the ski resort issue into internal stakeholders, which are those most at the centre, and then gradually direct external stakeholders and indirect external stakeholders (ibid.). The central object or key-target of the model in the case of the research under consideration was identified in the ski resort system, and around it the human ecosystem of the various stakeholders identified and interested in the project at various levels.

Stakeholder mapping comprised several stages. The first step was to identify the different categories of territorial stakeholders. As a decision shared by the working group, the categories were identified as follows on the one hand, internal or direct external stakeholders were selected, i.e. those potentially relevant subjects to be interviewed, bearers of interest in the issues touched upon by the project and connoisseurs of the specific context of the ski facilities, such as ski instructors, mountain guides, president of the facility management company; on the other hand, it was decided to also involve in the mapping some subjects far from the world of skiing, “casual” inhabitants of the territory, so as to understand in depth their opinion, as indirect external subjects and therefore theoretically neutral, on the specific ski sector.



Below, in table no. 1, are reported the categories of stakeholders that were chosen for the semi-structured interview and the relative number of people in each category.

categories	number of stakeholders
mountain guides	3
institutions (mayors)	3
accommodation/hospitality services (refuge management, b&b,...)	3
owner/president of ski resort	1
tourism/sports associations (ski/mountain bike instructors, CAI)	2
agriculture/breeding/crafts	2
consulting society	1
tourism consortium	1
<b>TOTAL</b>	<b>16</b>

table 1

Next, each stakeholder was specifically identified and analysed, assessing its role within the society and project context and its relevance at territorial level. Each "actor" was then placed in a specific category according to its role. Thanks to the presence within the working team of a person from Valmalenco itself, it was easier to identify some key actors of the territory and fill in the various categories that had been pre-set.

In total, around forty subjects were identified as stakeholders, including individuals, public bodies, consortia, administrations, etc. Of these, 16 were then interviewed. The remainder will then be involved in the subsequent phases of the project, in workshops, debates and focus groups in the area.

#### 2.4.1.2. Semi-structured interviews

Parallel to the stakeholder analysis, a semi-structured interview was designed to collect qualitative data from a representative sample of participants. To begin the collection of qualitative data, this type of approach was chosen as it appears to be the most suitable to provide a general understanding of the opinions and thoughts of the interviewees and consequently to obtain an in-depth knowledge of the territory and context as a whole.

From a theoretical point of view, the semi-structured interview is a qualitative data collection method that combines elements of both structure and flexibility (Compilatio,

2023). In contrast to fully structured interviews, in which questions are fixed and predefined, and unstructured interviews, in which questions are very open and left to spontaneous conversation, the interviewer uses an interview guide with pre-determined questions, but at the same time allows open-ended questions, new directions and insights into certain topics based on the answers and reactions of the interviewee (ibid.). This freer scheme thus allows the interviewer to obtain specific information and new insights.

After choosing the type of interview to be administered, the objectives of the interview and the results to be obtained from it were defined. The main objective was to obtain a general overview of the area and the inhabitants' perceptions of that specific place initially on various general topics, from climate change, to future developments in the valley, to the social fabric, etc., until reaching the heart of the interview, which focused on mapping opinions and visions (often divergent) on the subject of ski facilities and the related investments and future developments in this sector.

We then proceeded with the formulation of the interview, which was structured into 10 very different macro-questions, each concerning a specific topic. The first questions were more related to the territory as a physical entity, others more to the social context, others more to the development of the valley over the years, the hypothesised future scenarios, and finally the investments in the ski resort (for the complete interview see annex no. 1). The interview was carried out anonymously and in two ways depending on the availability of people to the sixteen stakeholders selected in the stakeholder mapping and analysis phase. Most of the interviews were conducted face-to-face, while a small part was administered online, via Zoom. The interviews were all recorded and transcribed in order to be analysed at a later stage. The transcription was done manually for each of them.

#### **2.4.2. Quantitative data and time-space frame of analysis**

Turning now to the analysis of the quantitative data, the specific area of analysis and the time span considered for data collection is described in detail. Together with the work team, the Upper Valmalenco Valley was chosen as the territory to be analysed specifically, i.e. the territory comprising the municipalities of Chiesa in Valmalenco,

Caspoggio and Lanzada, leaving out the two lower ones of Spriana and Torre Santa Maria as they are not affected by the ski resort and its related induced activities.

Quantitative data were collected and divided into the following categories: geographic and demographic data, tourism data, activities and services, environment and territory, governance and specific data relating to the ski area. They were collected individually for each municipality and were then correlated and analysed as a whole.

Various online Open Data portals were used for their collection: the geoportal of the Lombardy Region, the ISTAT portal, the geoportal of PoliS Lombardia, the geoportal of Arpa Lombardia (Regional Agency for Environmental Protection) and of the nivo-meteorological centre of Bormio (SO), the website of the Inland Revenue Agency, the Regional Statistical Yearbook (ASR) of the Lombardy Region and the Territorial Government Plans of each municipality. In addition to the online portals, some data were provided by the Sondrio and Valmalenco tourist consortium, the company managing the ski lifts in Chiesa in Valmalenco called 'Funivie al Bernina' (F.A.B. S.r.L.), the Lombardy Region and the various municipalities analysed.

The collection and analysis of nivo-metereological and environmental data followed several steps. First of all, a specific consultation was organised with a geologist and engineer from Arpa Lombardia in order to understand the most significant data to be collected and analysed for research purposes and in order to understand the variation in snow depth from year to year, which turned out to be the real discriminating factor in demonstrating whether climate change is active or not. The three most relevant parameters turned out to be snow depth on the ground, precipitation and average temperatures. The data were almost all collected over a 30-year period, from 1992 to 2022, with some exceptions depending on data availability, and for each ski season, during the time period considered as the start and end date of the season, from 1 December to 30 April. “30 years” was chosen as the analysis timeframe because, as reported by experts in the field in the consultancy with Arpa Lombardia, this is the minimum time period to be analysed for nivo-metereological data in order for them to have statistical value and be meaningful. At the same time, the nivo-metereological stations of Arpa Lombardia in the upper Valmalenco area that had this data available were mapped. The decision to collect data in several locations was made in order to be able to compare the data at a later date and to verify the generality of certain

phenomena. Finally, the data were requested via the Arpa portal and, once transformed from raw data to readable data, were processed using the Excel programme. Thanks to the statistical tools inherent in descriptive analysis, such as the processing of graphs, it was easier and more immediate to analyse the data and understand the trends of each parameter taken into consideration. The chapter “Results and findings” will detail which data were collected specifically and which weather stations were considered.

The other data were collected on the other portals in order to obtain a more complete overview of the territory under analysis, at demographic, economic, social and administrative levels. In general, they were all analysed over a time span of 10-12 years, from 2010 to 2020/2022, depending on data availability. The Covid period from 2020 to 2022 was analysed in order to make the data as current as possible, but was not considered relevant for the research due to the multiplicity of variables and parameters to be taken into account. The collection of this data was used to compare the objective and quantitative data with the subjective and qualitative data obtained from the interviews, which were filtered by each interviewee's perception of their own area.

Finally, the quantitative and qualitative results were integrated in the data interpretation phase. Significant connections, discrepancies and patterns were identified between the collected data and the existing literature. The discussion of the results enabled the research questions to be answered and the implications of the results for the field of study to be explored.

### **2.4.3. Geospatial data and geovisualisation of the territory**

In addition to qualitative and quantitative data, a geographical map of the territory was drawn up together with the working group based on the Geographic Information System (GIS) instrumentation. The data was acquired through the Sondrio province's webgis geoportal, a tool for monitoring and managing the territory, in which it is possible to obtain all the information concerning territorial urban planning<sup>7</sup>. The map was produced using the layers within the portal in order to visualise the territory, the skiable areas, both the disused area of Caspoggio and the current one of Chiesa in Valmalenco, to see the orography of the territory and to identify the anthropised areas from the natural ones. In the map, the surface area of the above-mentioned three municipalities of Alta

---

<sup>7</sup> <https://webgis.provinciasondrio.it/map/?mapset=geoportale>

Valmalenco was analysed. After selecting the relevant layers and data, the legend, scale and orientation arrow were added.

Specifically, in addition to the territorial boundaries and the basic cartography supplied directly by the Lombardy Region, including the road network and the various land uses distinguished by colour, the current path network with the associated system of bivouacs and refuges, the altimetry with contour lines, the inhabited centres and the main road network and the area relative to the ski resorts (both Chiesa and Caspoggio) were highlighted. It will be explained in more detail later that the ski facilities in Caspoggio are no longer active today; therefore, only those in Chiesa in Valmalenco remain open.

The other territorial maps already produced, which are to be found within the Territorial Government Plans, were then analysed to obtain more detailed information.

## **2.5. Data analysis**

Data analysis took place in several distinct stages. Quantitative data was analysed through the production of graphs, which allowed trends and data to be evaluated over a period of time and the changes in a given parameter over time to be understood. Qualitative data, on the other hand, were extrapolated through interviews and a SWOT analysis was finally produced. The map produced by the work team through the Province of Sondrio's geoportal and various other maps found in the Territorial Government Plans (PGT) of the three municipalities analysed were then analysed. The phases are analysed in detail below.

### **2.5.1. Production and analysis of graphs and maps**

In order to simplify and subsequently analyse the collected data, various graphs were drawn up using the Excel programme. Graphical visualisation made it possible to identify trends, patterns and relationships between data and thus to analyse the collected data. The graphs were produced by relating the data collected individually in the three analysed municipalities; this made it possible to compare them and visualise divergences or concordances between them more immediately. In some cases, trend

lines were included in order to understand the trend of certain parameters over time and thus draw considerations.

The map produced by the work team via the Sondrio province portal provided a geographical overview of the territory and made it possible to understand which surface area is currently anthropised, which is natural and which is considered skiable domain. At the same time, various maps present in the Piano di Governo del Territorio (PGT) of the various municipalities were analysed.

The production and use of graphs and maps were fundamental in the analysis phase as they simplified and made readable raw data that was highly difficult to understand. The results obtained will be analysed in detail in the chapter "Results and findings".

### **2.5.2. Production of SWOT**

Parallel to the analysis of the quantitative data and the elaboration of graphs and maps, work was carried out on the analysis of the qualitative data obtained from the semi-structured interviews and a SWOT analysis was drawn up from the interviews administered. The main objectives of the territorial SWOT analysis were to assess the current situation of the geographical area under analysis, to obtain a more in-depth overview of the territory as a whole (in the three areas of economy, society, environment) and to assess the various current and future development strategies of the valley. Furthermore, this tool was fundamental in order to understand the potential of the area under analysis, to understand which directions can be taken for the most sustainable development of the territory, from the social, environmental and economic points of view, and to develop the possible strategies and action plans needed to improve the quality of life, economic development and other specific aspects of the area analysed.

From a theoretical point of view, the Dipartimento della funzione pubblica (n.d.) reports:

“the SWOT analysis is a simple and effective strategic planning tool that serves to highlight the characteristics of a project, a programme, an organisation and its consequent relations with the operational environment in which it is located, offering a framework for the definition of strategic orientations aimed at

achieving an objective. SWOT analysis allows one to reason with respect to the objective to be achieved while simultaneously taking into account both internal and external variables. The internal variables are those that are part of the system and on which it is possible to intervene; the external ones, on the other hand, since they do not depend on the organisation, can only be kept under control, so as to exploit the positive factors and limit the factors that instead risk compromising the achievement of the set objectives”.<sup>8</sup>

The SWOT Analysis is constructed by means of a matrix divided into four fields in which there are: Strengths, Weaknesses, Opportunities and Threats, as shown in the figure 6 below.

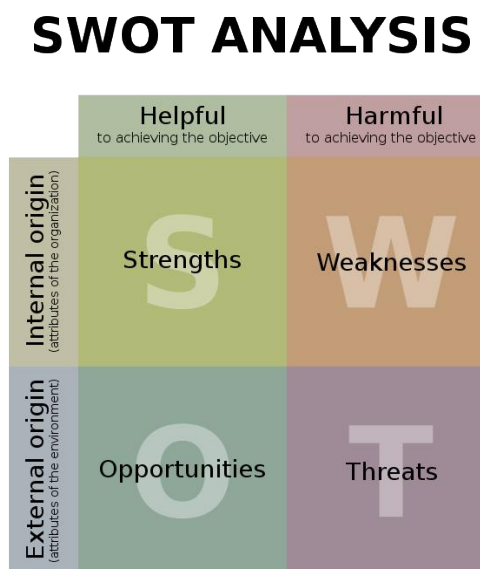


figure 6

In the upper part, the first two quadrants highlight the 'internal', 'proper', material and immaterial aspects characterising positively and negatively a given object of analysis (community, territory, sector, organisation, etc.). In the lower part of the space, on the other hand, forces, trends and factors - external to the object of analysis - that may offer support and opportunities for development, opportunities in fact, and those that could worsen and make the existing situation critical or limit future possibilities: risks, threats.

<sup>8</sup> <http://qualitapa.gov.it/sitoarcheologico/relazioni-con-i-cittadini/utilizzare-gli-strumenti/analisi-swot/index.html>

In the case of the present study, the concept of SWOT analysis was applied to a specific geographical area, namely that of Valmalenco, rather than to an organisation or a company. Thus, the four variables referring to the specific territory were analysed. For the analysis to be successful, a specific methodology for obtaining the final SWOT was discussed among all team members and then designed. The following turned out to be the most effective.

First of all, since several macro-topics were analysed in the interview, it was decided to subdivide each quadrant and parameter of the SWOT into sub-categories so that the strengths, weaknesses, opportunities and threats of a specific sector could be reported in each of them. The chosen macro-topics were subdivided into sectors reported in the table no. 2 below:

<b>Macrotopics SWOT</b>
Economy - resources
Environment & territory (Climate change)
Governance
Ski industry
Alternative forms of tourism
Services & social aspects (local needs)
Culture/aggregation/identity

**table 2**

Thus, the strengths of the economic sphere, the environment and territory from a geographical/natural point of view, governance, the ski sector, alternative forms of tourism already present in the area, services and social aspects, and the sphere concerning territorial identity and the cultural sphere were analysed. Likewise, the weaknesses, opportunities and threats of each of the above-mentioned sectors were analysed.

In addition, it was decided to draw up an individual SWOT for each stakeholder interviewed in order to gather as much information as possible. Each subject's SWOT analysis was double-checked by all team members through cross-reading in order to avoid or minimise possible subjectivity errors. The SWOT analysis was carried out according to the above methodology and information was gathered on the strengths, weaknesses, opportunities and threats for each area of analysis.



Finally, the final and definitive SWOT was elaborated, relating to the territory as a whole. All the SWOT's were put together and each piece of information was merged into a broader, recurring concept. The criterion chosen in order to deem a specific piece of information relevant or not was recurrence. If the same concept was mentioned by at least a quarter of the stakeholders (four out of sixteen) it was considered as valid and significant; otherwise it was not considered in the final SWOT. In the following chapters, the overall SWOT obtained will be specifically analysed.

## **2.6. Validity and Reliability**

To ensure the validity and reliability of the research, several measures were taken. First, a thorough literature review was conducted to inform the research design and ensure a sound theoretical basis. In addition, the confidentiality and anonymity of participants was ensured during data collection. Data triangulation was used to compare and integrate the results obtained from the different research instruments, confirming the consistency and reliability of the results and thus minimising the possibility of error during the course of the research.

### 3. CHAPTER III. CONTEXT ANALYSIS AND STUDY AREA

#### 3.1. The Interreg Alpine Space TranStat programme

The Interreg Alpine Space TranStat project (TranStat stands for *Transitions to Sustainable Ski Tourism in the Alps of Tomorrow*) is an international, multidisciplinary project with a duration of three years – from 2023 to 2025. The project involves five European nations (the five nations around the Alps: France, Switzerland, Italy, Austria and Slovenia), 11 partners from the Alpine arc, including universities, research centres, regions, public bodies and sustainable development agencies and nine ski resorts (two for each of the countries mentioned, with the exception of Switzerland, where there is only one) that were identified during the project's drafting and development phase as pilots and living laboratories on the ground.

The TranStat project does not aim at the sustainable transition of the ski area itself, but of the entire resort as a socio-economic territorial entity and as a mountain resort. It therefore aims to unite the ski area, the ski resort and the various activities that revolve around it (such as ski rentals, ski schools, restaurants, chalets, etc.) and the other sectors that determine the characteristics of a place such as non-ski-related economic activities, the agricultural sector, the forestry system, the collective management system, etc.

Reporting what is written on the official website of Transtat, “the TranStat project aims to facilitate the adoption of co-constructed transition processes in Mountain Resorts (MR), understood as ski resorts and their territory. Based on a participatory & inclusive approach, TranStat aims at elaborating scenarios and co-constructed solutions able to respond to the challenges identified in the MRs. The main challenge is to promote new models of economic, social and environmental development in order to support a lively future in the Alpine mountain areas, with a view to sustainability. TranStat will address this overall issue through the creation of a physical & digital network of resorts in transition to share knowledge and experiences about the future”<sup>9</sup>.

TranStat and its network of ski resorts territories aims to be a place for experimenting with applicable solutions for transitions, to be developed at local level but shared and disseminated at the alpine level. Based on participatory approaches, direct data availability for use on local level, facilitated by local decision-makers and experts will

---

<sup>9</sup> <https://www.alpine-space.eu/project/transtat/>

allow a real multisectoral, evidence-based cooperation (ibid.). This project aims to co-develop, in a bottom-up participatory process with inhabitants, visitors, actors and policy-makers relevant policy frameworks for the establishment of new transition sustainable practices across European ski mountain areas (ibid.).

## **3.2. The Valmalenco case study**

### **3.2.1. Geography of the territory**

The Valmalenco, located in the Italian Central Alps and specifically in the Province of Sondrio (Lombardy Region), is an Alpine valley characterised by high mountain massifs, a remarkable landscape diversity and a rich artistic and cultural heritage. The valley begins at the Valdone bridge, just above the city of Sondrio, and heads north towards Pizzo Bernina for a length in the valley floor of about 15 km (Wikipedia, n.d.).

The Valmalenco, which covers a territory of 256.86 km<sup>2</sup>, is organised into five municipalities (Spriana, Torre S. Maria, Caspoggio, Chiesa in Valmalenco, Lanzada) and has a total population of about six thousand people (ibid.). The administrative management of the five Valmalenco municipalities is delegated to the unions of municipalities (local authorities recognised by Law 142-90) (Ecomuseo della Valmalenco, n.d.). There are two in particular in Valmalenco: the first is the Unione dei Comuni Lombarda della Valmalenco, which includes the three highest municipalities in the valley, namely Chiesa, Caspoggio and Lanzada, established in 2001, and the other is the Union of the two lowest municipalities in the valley, namely Spriana and Torre di S. Maria, established in 2002 (ibid.). On the website of the Ecomuseo della Valmalenco (ibid.) is reported:

“the unions of the Valmalenco municipalities were born as a recognised form of collaboration between the various municipalities, a joint exercise of specific functions that has led, over time, to a real administrative reorganisation and to the entrusting of the provision of municipal services to the unions themselves”.

The Valmalenco is the main one of the right-hand tributary valleys of the Adda River in the Rhaetian side of Valtellina and is surrounded by mountains over 4,000 metres above sea level, including Pizzo Scalino, Pizzo Bernina and Monte Disgrazia (Ferlinghetti,

2022). Orographically, it is wedged into the western Rhaetian Alps and in particular divides the Bernina Alps into the Val Bregaglia Mountains to the west and the Scalino Group and Bernina Massif to the east. It borders Val Masino to the west, Engadin in Switzerland to the north and Val Poschiavo (also in Switzerland) to the east.

The orography of an Alpine valley such as the Valmalenco is the factor that most influences landscape types. In particular, the altitudinal gradient, which determines a climatic gradient, means that, travelling through the valley from the lower altitudes to the peaks, one encounters in succession: broadleaf forests, coniferous forests, natural pastures and meadows, alpine-nival environments (Ecomuseo della Valmalenco, n.d.). Specifically, in the initial part and at lower latitudes, the Valmalenco is narrow, characterised by steep slopes planted with chestnut and ash trees; it then opens into a wide basin of larch woods that branches off into the valleys of Chiareggio and the Lanterna stream, at the foot of the Disgrazia and Bernina mountain massifs (ibid.). The Upper Valley is very impervious and is characterised by unique environments and landscapes, with a very rich geodiversity, a quality that underpins and integrates biodiversity within ecosystems, with different morphological characteristics and a great alternation of pasture areas, areas with spontaneous vegetation and rocky areas devoid of vegetation typical of high latitude mountain environments (Ferlinghetti, 2022).

The valley is characterised by glacial valleys, alpine lakes and numerous streams, which make this area unique. There are numerous glaciers that unfortunately, like those in many other Alpine regions, are suffering the impacts of climate change, including a significant reduction in their volume. The main ones to date are the Fellaria Glacier, which develops in the municipality of Lanzada and is located on the south-west slope of Pizzo Scalino, and the Ventina Glacier, which descends instead from Monte Disgrazia and Picco Cassandra. Thanks to the presence of mountain massifs and glaciers that, although suffering, still resist climate change, the Valmalenco is very rich in water. The river that flows through it and then becomes a tributary of the Adda River downstream is the Mallero, which runs through the entire valley.

Ferlinghetti (2022) reports:

“the current landscape of the valley is the result of a historical sequence of mutual interactions between natural factors – geology, topography, climate, original biodiversity – and human activities, and it is therefore through the

study of the dynamics of the environment that the spectacular diversity of the Valmalenco's landscapes and the extraordinary peculiarities of the valley's history can be interpreted”.

In fact, in the nature-culture dialectic in Valmalenco, two factors must be considered of primary importance (ibid.). The first concerns the ultramafic rocks that characterise the valley, i.e. the large outcrop area of serpentinite and gabbro (ibid.). Ferlinghetti (2022) also writes in his book:

“in the mountainous areas where these ultramafic magmatic rocks of basaltic-peridotitic composition outcrop, [...] soils, ecosystems, and peculiar mining and agro-pastoral activities develop, which in Valmalenco take on a pervasive connotation, determining the environment and traditional activities in many municipalities of the valley”.

The other fundamental element to be taken into consideration that characterises the valley and has determined its development is the massive presence of forest vegetation and in particular larch. In fact, larch groves represent the most widespread forest formation in the Sondrio Valtellina mountain community, with 29% of the entire vegetation cover, but in Valmalenco the proportion of larch groves even exceeds 50% (Comunità Montana Valtellina di Sondrio (CMVS), 2011). According to documentary, historical and archaeological sources, the larch was a significant economic resource for the timber trade and for the production of coal for metal reduction in furnaces (Ferlinghetti, 2022).

### **3.2.2. Historical background and economic-social context**

From a socio-anthropological point of view, the Valmalenco has a very interesting history. In Malenco culture, know-how and work activities have developed since the earliest centuries, maintaining a close link both with the typically Alpine economy, based on the agriculture-livestock combination, and expanding towards some specific craft professions linked, for example, to seasonal emigration and stone quarrying and working (Ecomuseo della Valmalenco, n.d.). The economic benefits were considerable, thanks to the flourishing trade in handicrafts and dairy products that the area was able to develop and the export of seasonal labour, especially until the valley represented a direct connection corridor with Switzerland via the Muletto pass (ibid.).

The economy of Valmalenco has for many years been based on its natural resources and in particular on the mining of its rocks. The origin of serpentine and rock mining in Valmalenco is very ancient and, as reported on the Ecomuseo della Valmalenco website<sup>10</sup>, its history can be summarised as follows (Ecomuseo della Valmalenco, n.d.):

“At the height of Chiesa Valmalenco, the landscape that would have presented itself to a visitor a few centuries ago would have been quite different from what it is today, and not only from an urbanistic point of view (an aspect common to many towns in the Alpine valleys), but specifically from a strictly morphological aspect. In fact, a natural rock wall used to separate the fertile basin of Chiesa from the upper area of the alpine pastures. And on that wall climbed the 'cavallera' road of the Muretto: a wall made like a yoke (1140 m) and now almost completely demolished, later called Giovello (small yoke). It was probably in the first centuries after the year 1000 that someone, stopping during the strenuous ascent or lingering on the descent, observed the layers of serpentine rock that emerged there and that were markedly foliated, so much so that in some places they even seemed to have been reduced to lamellae.

Soon, the men from Chiesa, who were already experts in digging the local iron mines, tried to cut through those layers, realising how easily they split into slabs that could be used for some good purpose: to pave the huts, or better still for their roofing, replacing straw and shingles, materials with a very limited lifespan. They were in fact, those slabs, not only of considerable surface area and characteristic appearance, but also flat, thin, light, easily transportable, waterproof and therefore resistant both to the lowest temperatures and to shocks and atmospheric agents.

The experience gained in the extraction of ferrous material, through the use of special tools and the fire induced in the rock that caused the cracks then used to dislodge it, led to the birth and evolution of serpentine mining and processing techniques.”<sup>11</sup>



**picture 1** Mine hole preparation in a serpentine quarry.

---

<sup>10</sup> <https://www.ecomuseovalmalenco.it/>

In the first decades of the 20th century in Valmalenco, with the development also of the first motorised vehicles, the trade in serpentine slabs called '*piode*' in the local dialect grew and a real economy began to develop around it (Consorzio Artigiani Cavatori Valmalenco, 2002). Starting in the 1930s, the first serpentine quarrying and processing companies developed, such as Serpentino d'Italia, but it was in the 1980s that there was a boom in the development of this sector, thanks also to the introduction of modern means and technologies (ibid.). It is therefore clear from the above history that for many years the quarrying, quarrying and stone-processing sector was the mainstay of Valmalenco's economy.

Together with this sector, the driving sector of the economy since the mid 19th century has been tourism. Initially, it developed in connection with the exploration of Alpine peaks and high-altitude mountaineering (Ecomuseo della Valmalenco, n.d.). The expedition of 24 August 1862 to Mount Disgrazia by some British explorers definitively sanctioned the birth of mountaineering as we know it today and, in fact, of alpine tourism in the entire region (ibid.). But it was from the 1960s that another type of tourism began to develop, which arose following the birth of the first ski lifts for alpine skiing in Caspoggio.

E. Canetta and N. Canetta (2006) report:

“Caspoggio had already started planning its chairlift in 1952; between '57 and '60 it was completed, leaving behind the rest of the valley, not to mention much of the province of Sondrio itself. Within a very short time, Caspoggio became one of the most important skiing centres in Valtellina. The village, until then somewhat marginal compared to other Malencian centres in terms of tourism, leapt to the attention of the winter sports world”.

Caspoggio in the 1970s and 1980s became a major tourist destination when it hosted important international competitions and high-level athletes on its famous Vanoni track (Montagna.tv., 2010). Starting with the economic boom of those years, which led to a significant development of tourism, especially winter sports, the local economy began to change significantly. In Caspoggio, in fact, it was precisely the skiing sector and its related induced activities that revived the economy, which had been damaged by the massive depopulation following the Second World War.

A few years later, the ski resort of Chiesa in Valmalenco also developed in parallel, whose history and structure will be described in detail in the following section. In the following years, with the construction of new ski lifts in Chiesa and the increase of those in the municipality of Caspoggio, there was a rapid development of accommodation, commercial and leisure facilities, as well as a massive growth in construction, which led to a transformation that, in the space of a few decades, profoundly changed the landscape and socio-anthropological face of the entire Valley (Masa, 2023).

Due to climate change and the lack of snow, the Caspoggio ski lifts were permanently closed in 2013. As confirmed by the lift operator, the budget had been 'at a loss' for more than 10 years due to the huge costs incurred for snowmaking (Calufetti, 2013).

In the following section, the ski area of Chiesa in Valmalenco and the problems it is facing are examined in detail.

### **3.2.3. The ski resort of Chiesa in Valmalenco**

#### **3.2.3.1. History of the ski resort**

Until 1960, Chiesa had mainly summer tourism, but from the 1960s, with the construction of the first ski lifts, it also became a winter tourist resort (Valmalenco ski resort, n.d.).

The ski resort of Chiesa was born on paper in 1961 with the foundation of the company managing the Funivia Al Bernina (F.A.B. S.p.a.) lift facilities, which was subscribed to by some 700 locals and non-locals with the aim of bringing winter tourism also to Chiesa in Valmalenco, as was already happening in nearby Caspoggio (Dovesciare.it, 2021). However, after a series of ups and downs that brought the company to the brink of bankruptcy, it soon passed into the hands of Cavaliere Francesco Vismara, who managed to complete the construction of the plants and steer the company to safer shores through great financial efforts. F.A.B. S.p.A. thus went from being a public company to a practically family-run company, as 93% of the share capital was subscribed by Vismara himself.



The company started off with an ambitious lift programme. The ski resort went into action in 1964 with the construction of the Chiesa in Valmalenco - Alpe Palù cable car, which started at an altitude of 1,000 metres in Chiesa in Valmalenco and led to the 2,000 metres of Alpe Palù (Associazione Funivie, n.d.). The 24 ore news official website (n.d.) writes:

“subsequently an ultra-modern cable car with automatic coupling, an absolute novelty for those times, and three modern ski lifts with a total capacity of about 3,000 persons were built, a respectable capacity for those times and allowing skiing from the 1,800 metres of the Barchi to the 2,370 metres of Monte Motta. At the same time, two modern high-altitude restaurants were built along with the lifts. In the 1970s, a two-seater chair lift was added, which also allowed skiers to reach the ski slopes from San Giuseppe, and a fourth ski lift on a more challenging slope requested by customers.”

Within a few years, Chiesa became a favourite destination for the Milanese, also due to its proximity to the city. The ski slopes of the Alpe Palù brought prosperity to the Valmalenco, allowing the development of flourishing entrepreneurial activities both in the hotel and restaurant sector, and especially in the building sector, thus enabling the population to remain in their own land without having to emigrate in search of work (ibid.).

Over the years, the Funivia al Bernina F.A.B., under the leadership of Franco Vismara, Francesco's son and a lawyer with a flair for entrepreneurship, developed further and at the end of the 1990s launched a programme of renovation of the facilities, which once again made it one of the most modern stations in the Alps (ibid.). In 1999, the Chiesa - Alpe Palù cable car was replaced by a more modern cable car called the Snow Eagle, which, with its cabins seating 160 people each and a difference in altitude of 1,000 metres overcome in a single leap, could boast the record for the largest cable car in the world (ibid.).

Over the next ten years, there was a further development of the ski resort: on the one hand, new facilities were built, and on the other, almost all of the pistes were equipped with artificial snowmaking systems, so that even in the scarcest snow years there was excellent snow cover (ibid.). In 2006, the F.A.B., in a generous attempt to restart

sporting activities in nearby Caspoggio, also took over that company, thus becoming the only plant operator in Valmalenco (ibid.).

### **3.2.3.2. The ski resort of Chiesa in Valmalenco today**

As of today, the ski area of Chiesa in Valmalenco, called Valmalenco Bernina ski resort, offers about 60 km of slopes, is located in the Alpe Palù area, and can be reached by the modern Snow Eagle cable car, which starts at about 980 metres in Chiesa and arrives at over 2000 metres. The two maps relating to the current ski area are shown in the annexes as annex number 1 and annex number 2 but from two different perspectives.

The ski resort includes both alpine and cross-country skiing tracks. In fact, out of the total number of kilometres of tracks, about 38 km are used for cross-country skiing and are divided into three different locations and tracks: the Alpe Lago Palù Nordic skiing track (which can be reached via the Snow Eagle), which is 7 km long, the San Giuseppe ring in Chiareggio, which is about 30 km long, and the Lanzada ring, which is about 1.5 km long (Valmalenco Ski Resort, n.d.).

As for the slopes used for alpine skiing, they cover a surface area of approximately 850 m<sup>2</sup> and a length of approximately 22 km, covering an altitude difference of between 1527 m and 2353 m (Ski resort, n.d.). The ski area offers 8 ski lifts and 2 treadmills, with 3 black slopes, 8 red slopes and 8 blue slopes.

The following data was provided directly for the purposes of the study by the plant operator F.A.B. S.r.l.

The tables below show the details of the equipment of the ski lifts and downhill slopes. The data shown were provided for research purposes by the company F.A.B., which operates the facilities, and were then processed and analysed.

The first table, table no. 3, shows the name of the lift with the year of construction, the hourly capacity, the number of seats, the length in metres, the departure and arrival altitude and the altitude difference that each lift covers.

PLANT CONSTRUCTION YEAR AND HOURLY CAPACITY							
name of the plant	year	hourly capacity	number of seats	Plant length in metres	Starting altitude mt. a.s.l.	Arrival altitude mt. a.s.l.	altitude difference
FUNIVIA BIFUNE A VA E VIENI CHIESA-ALPE PALÙ	28/12/1998	1400	160	1981,39	985,67	2078	1092,33
FUNIVIA VASSALINI-ALPE MOTTA	5/9/2001	800	40	400	2010,13	2078	67,87
SEGGIOVIA PEDRANA-BARCHI-ALPE PALÙ	30/11/2004	2400	4	2172,7	1527,5	2012	484,5
SEGGIOVIA PIANO BRAGNA-ALPE PALÙ	30/12/1996	2400	4	486,44	1971	2024	53
SEGGIOVIA PALÙ-DEL DOSSO	16/12/2004	1199	2	288,08	1999,6	2110,5	110,9
SEGGIOVIA ALPE PALÙ-CIMA MOTTA	2/12/2004	1700	4	1411,16	2002,8	2340,2	337,4
SEGGIOVIA SCERSCEN-SASSO ALTO	4/1/1995	1920	4	1521	1857	2334	477
SEGGIOVIA BOCHEL-DEL TORNO	8/11/2005	1800	4	1312,12	2017,2	2350,2	333
TAPPETO BABY 1 ALPE PALÙ		700		100	2010	2025	15
TAPPETO BABY 2 ALPE PALÙ		700		100	1990	2000	10

table 3

In the second table, table no. 4, on the other hand, there are details of the downhill slopes with the name, the class of difficulty divided into black, red and blue slopes, the size of each section, the area occupied and the slope exposure.

SLOPE EQUIPMENT					
ski slope name	Class of difficulty (blue/red/black)	length (Km)	width (m)	Area (m2)	Exposure
BARCHI-PRATI PEDRANA	RED	0,9	40	36	WEST-EAST
DIRETTISSIMA SASSO ALTO-PALÙ	BLACK	1,73	40	69,2	NORTH -WEST
DIRETTISSIMA PALÙ-BARCHI	RED	1,77	40	70,8	EAST-WEST
NORMALE SASSO ALTO-PALÙ-BARCHI	BLUE	4	40	160	EAST-WEST
DIRETTISSIMA DEL DOSSO	BLACK	0,35	50	17,5	NORTH -WEST
NORMALE DEL DOSSO	RED	0,55	35	19,25	EAST-WEST
PLATEAU	RED	0,7	40	28	NORTH -WEST
CAMPO SCUOLA ALLE BAITE	BLUE	0,1	40	4	OVEST-EAST
DIRETTISSIMA SASSO ALTO -DOSSO VETTI	RED	2	35	70	NORTH -WEST
NORMALE SASSO ALTO-DOSSO VETTI	BLUE	2,5	40	100	NORTH EAST
PRIMAVERA	BLUE	0,18	40	7,2	NORTH EAST
COLLEGANTE BLU MOTTA -SEGGIOVIA	BLUE	0,5	35	17,5	NORTH
COLLEGANTE VARIANTE 2	BLUE	0,25	35	8,75	NORTH
HALF-PIPE	BLUE	0,1	30	3	NORTH
CHICCHI-BOCCEL DEL TORNO	RED	1,6	40	64	EAST
RACCORDO CAMPOLUNGO-SCERSCEN	BLUE	0,42	40	16,8	EAST
MONTE MOTTA-PIANO CAMPOLUNGO	RED	0,8	40	32	NORTH
SASSO ALTO-SCERSCEN THOENI	BLACK	1,665	35	58,275	NORTH
BARCHI-PRATI PEDRANA SUD	RED	1,4	40	56	NORTH
<b>Total</b>		<b>21,515</b>	<b>735</b>	<b>838,275</b>	

table 4

Furthermore, the F.A.B. also provided data on the area of the territory covered by artificial snow in the analysis time frame from 2010 to 2022, as mentioned above in the chapter on methodology. As shown in the table below, it can be seen that from 2010 to the current date, the percentage of use of snowmaking as a strategy to make up for the lack of snow has almost doubled (see table 5).

<b>percentage of slopes with snowmaking</b>	From 2010 to 2015 = approximately 41.75% From 2015 to 2019 = approximately 73.12% From 2019 to present = approximately 77.54%
---	---

table 5

In addition, again on the data stage provided by the managing company, it is reported that the area of the territory covered by artificial snow from 2010 to 2015 was about 350 m<sup>2</sup>, becoming from 2015 to 2019 about 613,000 m<sup>2</sup>, and then arriving at the area covered by artificial snow from 2019 to the current date of about 650 m<sup>2</sup>. It is therefore once again evident how indispensable this adaptation strategy has been over the years.

The table 6 below, on the other hand, shows data, again provided by the F.A.B. for research purposes, on the number of snow cannons and water and energy consumption discounted to 2023.

<b>number of snow cannons</b>	No. 214 equipped pits No. 155 lances No. 6 mobile fans
<b>water consumption</b>	90 000 m <sup>3</sup> - 115 000 m <sup>3</sup>
<b>energy consumption</b>	900.000 Kw - 1.050.000 Kw

table 6

In order to have a complete overview of the district under consideration, the number of accommodation and catering activities that have been mapped within the district and thus benefit from the induced activities created and the users connected to them are shown in table 7.

<b>Accommodation and catering activities</b>	Mountain refuges	5	Rifugio Malga Rundai, Rifugio Motta, Rifugio Palù, Rifugio la Grusa, Rifugio ai Barchi
	Other accommodation	1	Alloggi ai Barchi
	Restaurants	3	Campanacci Alpe Motta, Bar Polo Nord, SNow food Mini Campanacci, Campanacci Alpe Palù, Bar Penna Bianca, Bar Mountain Room, Ristorante Taragna e Champagne, Ristorante Sasso Nero

table 7

To conclude, the number of workers employed each year in the ski resort is again reported. According to data from the F.A.B., updated to the year 2023, between 10 and 15 people are employed each year for the winter and summer season with a permanent contract. As far as temporary employees are concerned, 50 to 70 seasonal employees are employed each year, of whom approximately 25 to 30 work in the operation, maintenance, and management of the facilities, approximately 20 to 25 in the on-piste

catering, and approximately 15 to 20 are employed in the accommodation and hospitality facilities (hotels, etc.) (table 8).

<b>Number of employees</b>	with a permanent contract	10 to 15
	with seasonal contract	50 to 70 total divided as follows: 25-30 for ski resorts + approximately 20-25 for on-piste catering + approximately 15-20 for hotels (starting in 2018)

table 8

### 3.2.3.3. Criticalities of the ski area and recent regional contributions

From the data collected through the interviews that will be analysed below, it emerged that the ski resort of Chiesa in Valmalenco is now in a moment of serious crisis. In the face of the crisis in the ski sector that is being felt on a global scale due to climate change and the related problems already listed in the literature review, this ski resort too was not unscathed by its impacts. In particular, as will be seen later on from the nivo-metereological data collected and analysed, despite the fact that the ski area is located at rather high altitudes and is equipped to date with an efficient snowmaking system, snowfall has gradually decreased and the snow quota has risen. This therefore leads to a higher utilisation of the snowmaking system and consequently to a higher expenditure for production costs. Added to this is the increase in energy and utility costs in recent periods due to the political instability between Ukraine and Russia and the difficulties associated with the forced closure during the Covid-19 period.

The public sector, and specifically the Lombardy Region, has intervened to support the ski sector in Valmalenco as well. In particular, as reported on the Region's website (Regione Lombardia, n.d.), “on 2 March 2022, the Municipality of Chiesa in Valmalenco, in its capacity as lead partner, presented the proposal of the “*Patto Territoriale per la valorizzazione della ski Area Valmalenco*” pursuant to art. 2 L.R. no. 40 of 28 December 2017 and the determinations established by d.g.r. no. 2792 of 31 January 2020”.

The Territorial Pact proposal includes 'a programme of interventions whose main objective is to maintain and relaunch the competitiveness of the Valmalenco Bernina Ski Resort in Chiesa in Valmalenco in order to increase the economic and social growth

of the area, enhancing local resources, protecting the environmental characteristics of the Valley and laying the foundations for sustainable development' (ibid.).

The pact pursues three main lines of development and envisages three different types of intervention: enhancement of facilities and slopes (including the construction of new facilities within the skiable area and the modernisation of existing ones), enhancement of the area's accessibility (through structural improvement and modernisation of parking areas near the accesses), and an increase in services (with the need to improve and increase the offer of services to users both in winter and in summer, also through complementary proposals to skiing) (ibid.).

The Territorial Pact, which was signed by the municipalities of Chiesa, Caspoggio and Lanzada, with the adhesion of the company F.A.B., envisages a total cost of the proposed interventions of €22,081,545.34 against a regional contribution of €14,473,390.81, and envisages the realisation of seven interventions by the end of 2025, described in detail on the Lombardy Region website (see references at the end).

In the end, data was collected on the contributions provided by the Lombardy Region to support the ski sector from 2018 to 2021. Below in the table 9 are the contributions granted for snowmaking in the Valmalenco Bernina ski area (the data were provided by the Lombardy Region).

2018	2019	2020	2021
71.591,00 €	61.882,00 €	58.639,00 €	84.756,00 €

table 9

## **4. CHAPTER IV. RESULTS AND FINDINGS**

After having analysed in detail the case study of the research, identified with the Valmalenco territory in its entirety and the Chiesa ski resort, this chapter proceeds with the illustration and presentation of all the qualitative and quantitative data collected, analysed and processed, which will then be discussed in detail in the following chapter. The results were obtained through the application of the methodology.

The order of presentation of the data will follow the approach already used for the methodology. First, the results obtained from the qualitative data will be presented, followed by the quantitative data.

### **4.1. Production and processing of the SWOT analysis**

Starting from the analysis of the qualitative data obtained through the semi-structured interviews and through the application of the above methodology, a SWOT analysis of the Valmalenco territory was elaborated. It is the result of the analysis of the various semi-structured interviews administered to the stakeholders. In the following chapter, each parameter will be analysed in detail.

Below are the results, considering each parameter of the SWOT analysis individually. In order, the strengths, weaknesses, opportunities and threats of the Valmalenco territory are reported.

<b>STRENGTHS</b>	
<b>Economy and resources</b>	
importance of the tourism sector, particularly winter tourism related to skiing, and of the mining industry for the local economy	
emergence of a lighter receptivity, with more sustainable philosophies, aiming to accommodate slower, greener forms of tourism development - contrasting depopulation	
emergence of new activities and enterprising small businesses, with a desire to invest in the area	
<b>Environment &amp; territory (Climate change)</b>	
Landscape, geomorphological and environmental richness. Enormous biodiversity of the territory.	
Territory offering a wide range of opportunities and outdoor activities - many opportunities already active in the territory: rich network of refuges, ski area, small hotel network, dense network of trails,...	
<b>Governance</b>	
Financial contributions from institutions to support activities in the area, on different scales	
Easy communication and good relations between municipality and local population due to the small size of the territory	
<b>Ski industry</b>	
Importance of the winter tourism industry	
Awareness of the current climate situation on the part of both ordinary people and lift operators/owners and openness on the part of the latter to listen to innovative ideas and strategies for a sustainable transition and willingness to work together to find alternatives	
<b>Alternative forms of tourism</b>	
Development of diversified and alternative activities to skiing (snowshoeing, mountaineering, trekking, ski mountaineering) and activation of different diversification and deseasonalisation strategies.	
Caspoggio's resourcefulness and adaptation to the closure of the ski lifts for the relaunch of the local economy through the development of alternative forms of tourism and activities	
Entrepreneurship and interest on the part of local people in the area of sustainable territorial development and deseasonalisation/diversification	
<b>Services &amp; social aspects</b>	
Efficient public transport to and from Sondrio - proximity to Sondrio	
Presence of essential services for residents, including a reception service for the elderly and dependent persons	
Sports facilities widespread in the area (swimming pool, climbing wall..)	
<b>Culture/aggregation/identity</b>	
Maintenance of a cultural and historical identity over the years, and preservation of knowledge (agriculture and crafts).	
Strong attachment to the territory and its origins (strong desire to live there and to give something back to the territory) - The local population is attached to the territory and to being "Malenchi	
Sense of welcome and authenticity perceived by tourists	



<b>WEAKNESSES</b>
<b>Economy and resources</b>
lack of opportunities and diversity in job offers, often seasonal and concentrated work (due to the Italian holiday system)
lack of labour and funds to invest in the area (lack of generational change leading to closure of activities)
decline of the mining sector/ agricultural work is unprofitable
<b>Environment &amp; territory (Climate change)</b>
Significant environmental impacts and alteration of the landscape by the ski and mining sector
Climate change leads to a lack of snow and water (Lake Palu), melting glaciers and landslides
Climate change has a direct impact on agriculture and animal husbandry, the length of the ski season and mountaineering activities.
<b>Governance</b>
Lack of a network of actors working together to create shared planning and actions; and lack of participatory approaches
<b>Ski industry</b>
High consumption of water and energy for snowmaking and increasing costs for maintenance of facilities.
Due to the closure of the Caspoggio ski resort, many services and activities had to be discontinued.
<b>Alternative forms of tourism</b>
Lack of promotion of the upper valley by the Sondrio-Valmalenco consortium, lack of events and signposting, and presence only of an info point in Chiesa
Focus on mass tourism and skiing, without aiming at the deseasonalisation of tourist services and differentiation of activities
tour operators lack specific training (e.g. knowledge of English)
<b>Services &amp; social aspects</b>
Lack of medical services; and presence of a small campsite only in Lanzada
Heterogeneity of tourist flows: on the one hand there is oversaturation during the high season of Christmas and August with consequent traffic jams, crowded car parks, and excess demand for catering services; on the other hand during the winter some accommodation facilities close due to lack of tourists
Few buses connecting the various hamlets, lack of buses to Chiareggio early in the morning in summer; buses that are not equipped to transport bicycles and lack of skibus
Dated hotel facilities lacking modern services
<b>Culture/aggregation/identity</b>
Lack of awareness of the valley's riches

<b>OPPORTUNITIES</b>	
<b>Economy &amp; resources</b>	
	renovation and recovery of abandoned hamlets and old buildings in traditional mountain style
	creating a network of hospitality services of higher quality and with more sustainable philosophies that attract a slower and more conscious tourism
	enhancing what already exists in the area, both from an environmental and infrastructural point of view
	stimulating the development of digital nomadism and new communities
<b>Environment &amp; territory (Climate change)</b>	
	incentivising investments to support agriculture by stimulating a simple type of farming
	preserving the aesthetic-environmental part of the valley by minimising infrastructure. Aiming at maintaining and recovering, instead of adding, building.
	Enhancing the area's natural resources by creating a nature park with reduced access
	exploiting environmental and landscape diversity to expand the activities possible in the area (canyoning, climbing crags,...)
<b>Governance</b>	
	more efficient, structured spatial planning with a longer-term perspective.
	development of a common territorial vision between municipalities, citizens and local authorities - more bottom-up planning - more focus on sustainability
	balancing tourism investments in different sectors (not only giving money to the area but also for the development of other activities)
	enhancing the valley's unique/speculiar points, without copying other models
	focus on slower, more sensitive and less consumerist tourism. improving services and quality.
<b>Ski industry</b>	
	implement a sustainable transition of the ski area and the resort as a whole, encouraging the development of alternative activities
<b>Alternative forms of tourism</b>	
	development of alternative forms of tourism, which is more tied to the place - proposing and promoting experiential, more authentic forms of tourism
	better structured promotion and tourism planning and greater economic support from local institutions and the consortium to support alternative activities to skiing
	focusing on a tourist offer of quality rather than quantity, on foreign tourism, on hospitality and taking care of host/owner relations
<b>Services &amp; social aspects</b>	
	revaluing the ancient roots and artistic and cultural heritage of the place through the promotion of cultural/sporting/environmental events
	developing and implementing the transport system
	fostering partnerships with schools, involving universities in territorial projects
<b>Culture/aggregation/identity</b>	
	maintaining the authenticity of the area, maintaining the structural elements of the country and exploiting the characteristics of the country
	increasing the resilience of local people through awareness and knowledge of climate change issues
	aiming for non-perfection - preserving authenticity

TREATHS
<b>Economy &amp; resources</b>
difficulty in finding activities that are profitable for the local economy such as skiing
Depopulation of the valley due to the inability to continue skiing, better opportunities in Switzerland, increased cost of living.
<b>Environment &amp; territory (Climate change)</b>
Exacerbation of climate change impacts and problems in skiing: lack of water in Lake Palù for artificial snowmaking, rising temperatures, lack of snow, shrinking glaciers, weakening of ecosystems
Exacerbation of climate change impacts on the territory - both on the agricultural and skiing sectors
<b>Governance</b>
difficulties in cooperation between local authorities, citizens and administrations for the success of shared projects
enormous speculation and waste of money behind large projects, which then turn out to be unfeasible, useless and unsustainable
applying territorial development models of other morphologically and socially different realities to the Valmalenco context
prevalence of economic interests over environmental protection
lack of foresight in decision-making processes (also in tourism) and lack of courage to invest in alternatives
<b>Ski industry</b>
Rising energy costs and lack of water in relation to the ski industry
<b>Alternative forms of tourism</b>
Persistence in focusing on hit-and-run and mass tourism: risk of standardisation and destruction of wilderness areas due to excessive frequency
<b>Services &amp; social aspects</b>
ageing and depopulation for reasons of work and study, but also for attraction to the urban lifestyle
<b>Culture/aggregation/identity</b>
feeling of inability to cope with the dynamics of climate change
risk of losing the identity and essence of this area

## 4.2. Quantitative data results and findings

As already reported in the chapter "Methodology and materials", the quantitative data collection was carried out by dividing the data into various categories: demographic data, environment and territory, tourism data, activities and services, governance and specific data related to the ski resort (already reported in the previous chapter). Below are the results and findings for each category.

In the table below (table no 10), there are general data for each municipality, such as the ISTAT identification code, the postal code, the area of the municipality (in km<sup>2</sup>/ha), the average altitude of the municipality, and the current resident population.

data	Chiesa	Caspoggio	Lanzada
ISTAT code	14019	14013	14036
Postal code	23023	23020	23020
area of municipality (in km <sup>2</sup> /ha)	107,6	7,31	117,17
altitude of municipality	Altitude: 960 m a.s.l.	Altitude: 1.098 m a.s.l.	Altitude: 983 m a.s.l.
current population	2314	1346	1260

table 10

### 4.2.1. Demographic data

In order to have a fairly accurate demographic picture of the territory under examination, together with the work team, it was decided to analyse as demographic data the resident population, the percentage variation of the resident population, the average age of the population, the number of young residents (understood as people under 35 years of age), the distribution of the population by age group, the education rate as of 2011 and the number of employed people by economic sector as of 2011.

The data were collected in the three municipalities of Chiesa in Valmalenco, Caspoggio and Lanzada because, as explained in the methodology, they are the most relevant for the purposes of the research. The data were almost all collected from 2010 to 2022, with some exceptions that will be reported later.

Below are the graphs obtained from the processing of the data listed above, which will be commented on in the next chapter "discussion".

Graph 1 shows the data on the resident population in the three municipalities<sup>12</sup>.

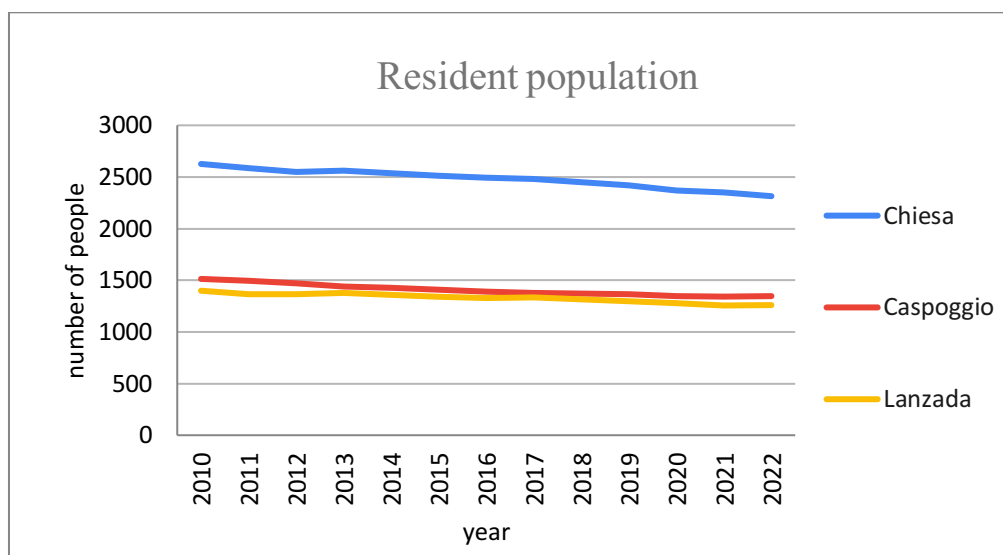


chart 1

The following chart, chart number 2, shows the data on the percentage change in the resident population, which indicates how much the resident population has changed in percentage terms over the year, due to births, deaths, immigrations and emigrations<sup>13</sup>. Chart number 3, on the other hand, shows the average age of the resident population over the time period considered<sup>14</sup>.

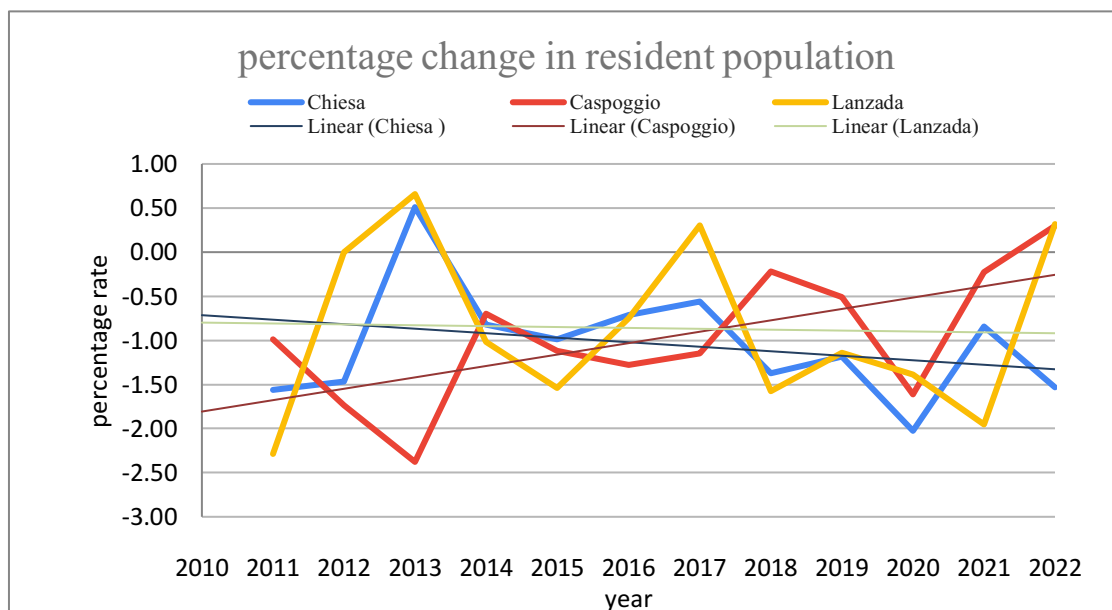


chart 2

<sup>12</sup> <https://www.tuttitalia.it/lombardia/24-chiesa-in-valmalenco/statistiche/popolazione-andamento-demografico/>

<sup>13</sup> Same source as before

<sup>14</sup> <https://www.tuttitalia.it/lombardia/85-collio/statistiche/indici-demografici-struttura-popolazione/>

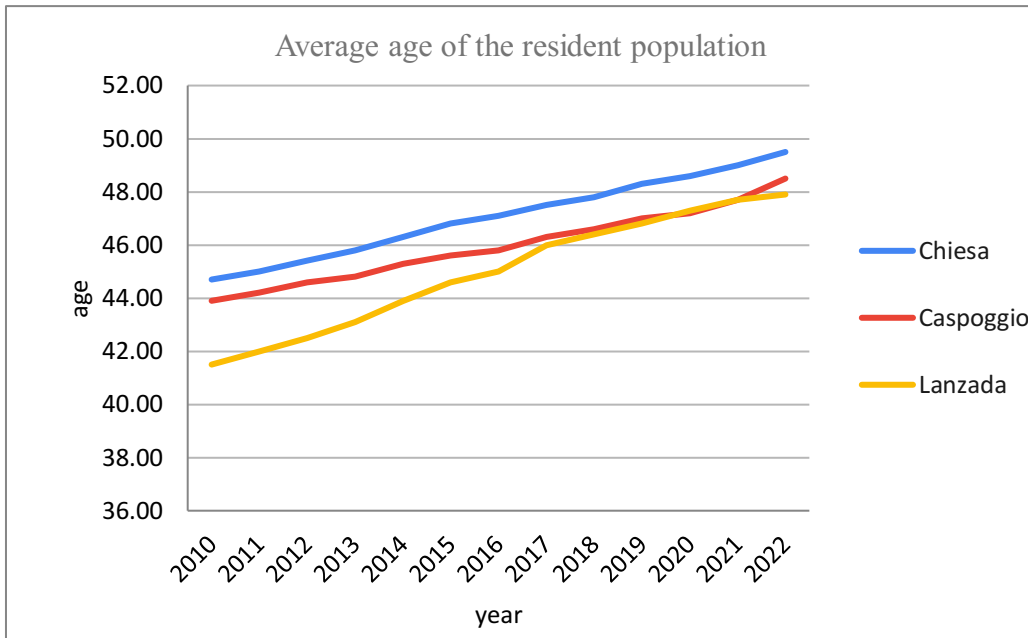


chart 3

Chart 4, on the other hand, shows the change in the number of young residents, considered to be those under 35 years of age, over the past 13 years<sup>15</sup>. At the same time, data were collected on the distribution of the population by age group in the three municipalities and its change over time (Charts 5-6-7)<sup>16</sup>. Data in 2010, 2016 and 2022 were analysed and compared.

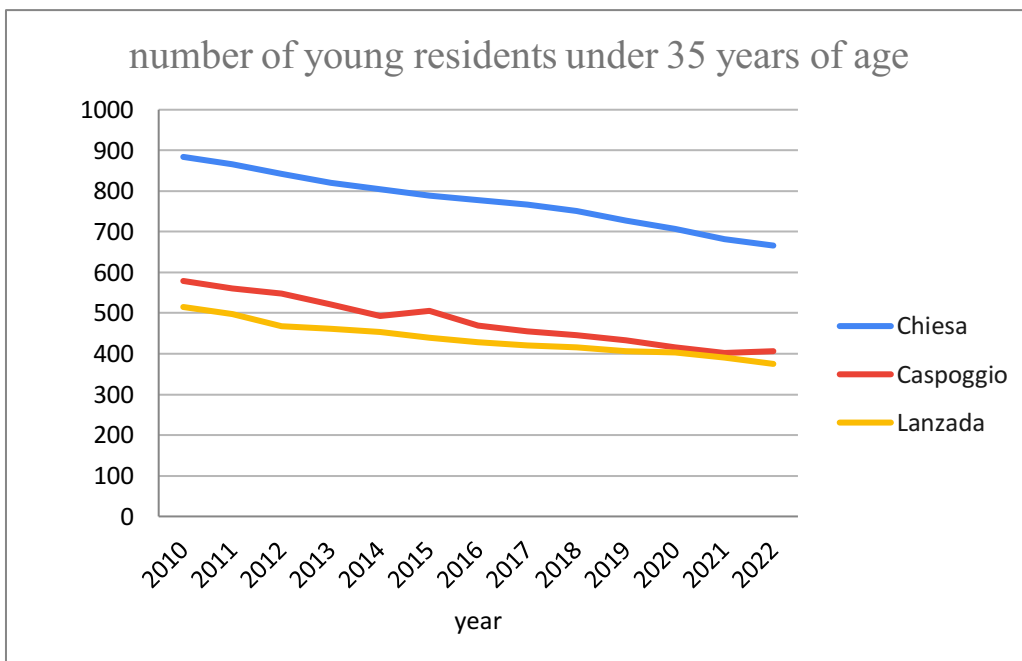


chart 4

<sup>15</sup> <https://www.tuttitalia.it/lombardia/24-chiesa-in-valmalenco/statistiche/popolazione-eta-sesso-stato-civile-2022/>

<sup>16</sup> Source: ISTAT website

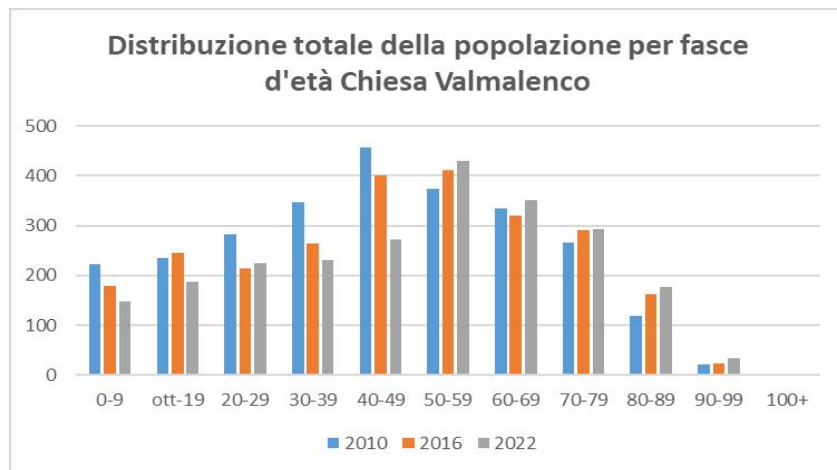


chart 5

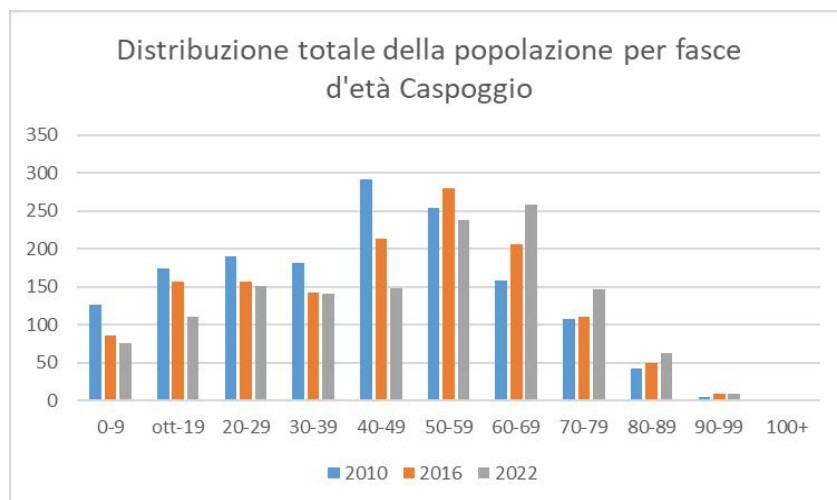


chart 6

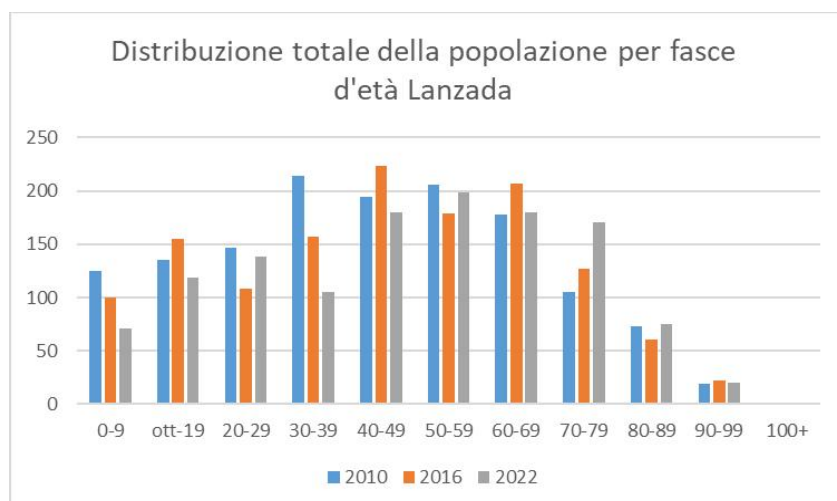


chart 7

Then, in order to obtain information on both the economic and social context of the location, the number of employees per economic sector and the education rate in the three municipalities were analysed. The data are owned by ISTAT (National Institute of

Statistics) and were collected on its online platform called 8 thousand Census. The data in the following two graphs (no 9 and 10) refer to 2011, the year in which the last general population and housing census was conducted by ISTAT (which used to take place on a decennial basis). More recent data are not available, but these are nevertheless useful to give an idea of the situation.

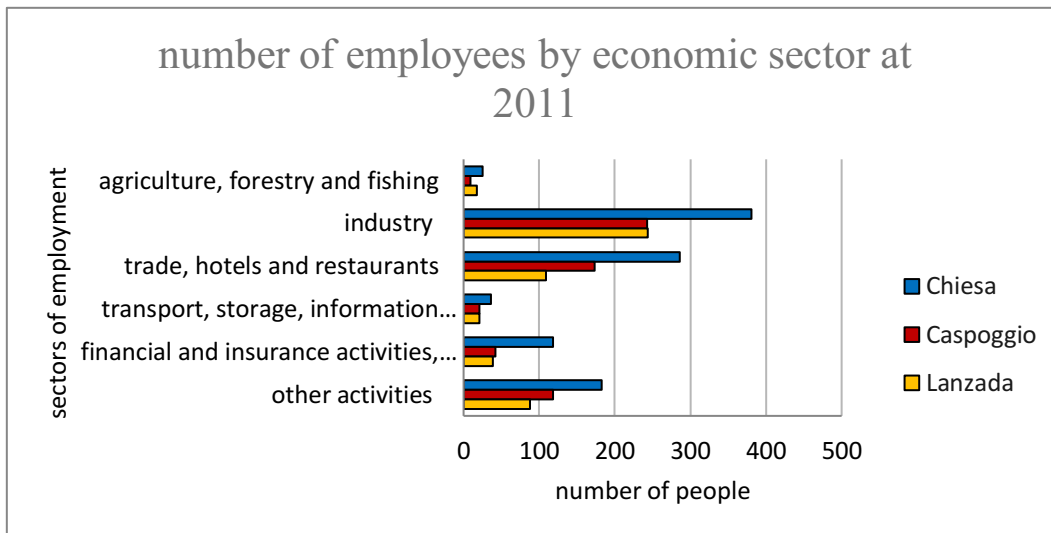


chart 8

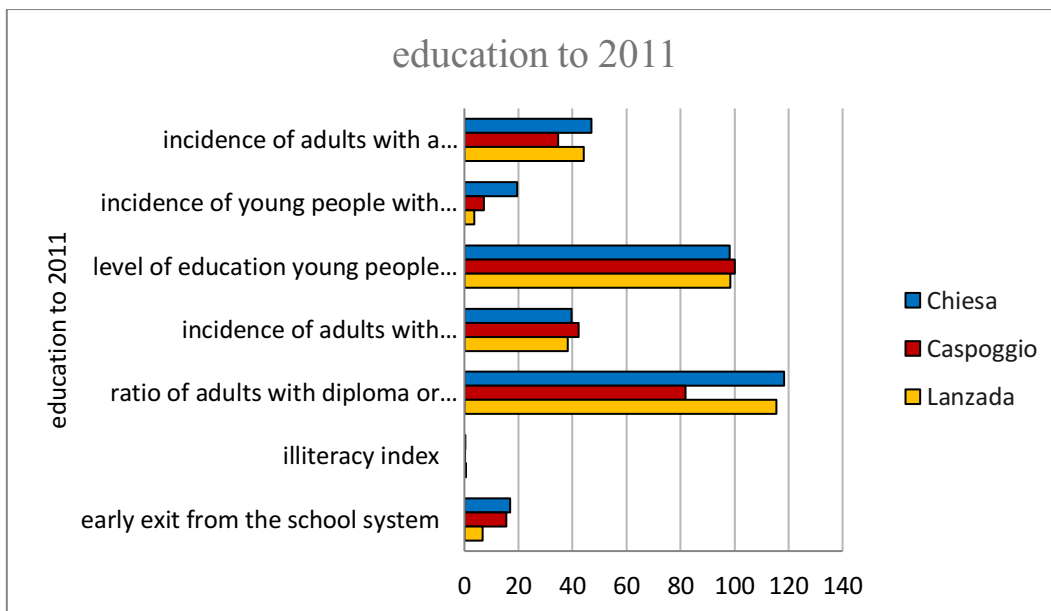


chart 9

#### 4.2.2. Environmental, meteorological and spatial data

As far as the analysis of environmental and meteorological data is concerned, through the use of the methodology reported in the chapter “Methodology and materials” and in order to understand the variation of the snow quota from year to year, the following



three variables were analysed: the height of snow on the ground, precipitation and the average seasonal temperature.

The data relating to these parameters were recorded and collected by the Arpa Lombardia meteorological stations present on the territory and in particular in the areas closest to the Valmalenco Bernina ski resort. In particular, on the basis of the type of data available at each meteorological station, the Caspoggio Piazzo Cavalli, Lanzada Ganda and Lanzada Palù stations, located at different altitudes, were selected for the temperature analysis; the Val Masino - San Martino station was selected for the precipitation; and the Lanzada Palù meteorological station was selected for the snow height on the ground. Anomalies and variability have not been calculated due to the lack of data.

Below are the Arpa Lombardia meteorological stations where the data were collected, which were considered relevant as they are the closest to the ski resort of Chiesa in Valmalenco. On the side you can see the station timeframe availability, the altitude at which the station is located and the station identification code.

01/12 to 30/04	Station Timeframe Availability	Altitude	Id station
Temperature			
Caspoggio Piazzo Cavalli	from 27/10/1989 to 25/05/2023	1719 m	35
Lanzada Ganda	from 10/11/1989 to 25/05/2023	988 m	33
Lanzada Palù	from 01/01/1992 to 25/05/2023	2151 m	832
Precipitation			
Val Masino - San Martino	from 21/02/2000 to 25/05/2023	943 m	1238
Snow			
Lanzada Palù	from 01/01/1992 to 25/05/2023	2151 m	832

table 11

Once the raw data had been obtained from the Arpa Lombardia geoportal<sup>17</sup>, using the aforementioned methodology, we moved on to the processing of graphs in order to understand the trend of the selected variables over time.

First of all, data were processed on the average temperatures per winter season in each of the ARPA stations with available data for this parameter. Below are the processed graphs of average daily temperatures in °C per winter season, maximum temperatures

<sup>17</sup> <https://www.arpalombardia.it/temi-ambientali/meteo-e-clima/form-richiesta-dati/>

and minimum temperatures at the three weather stations analysed. For each of them, the linear trend line with reference to the average temperature over the years has been highlighted. The lack of data at the Caspoggio and Lanzada Ganda stations from 1993 to 2003 and at the Lanzada Palù station from 1991 to 1993 and from 2005 to 2010 is highlighted.

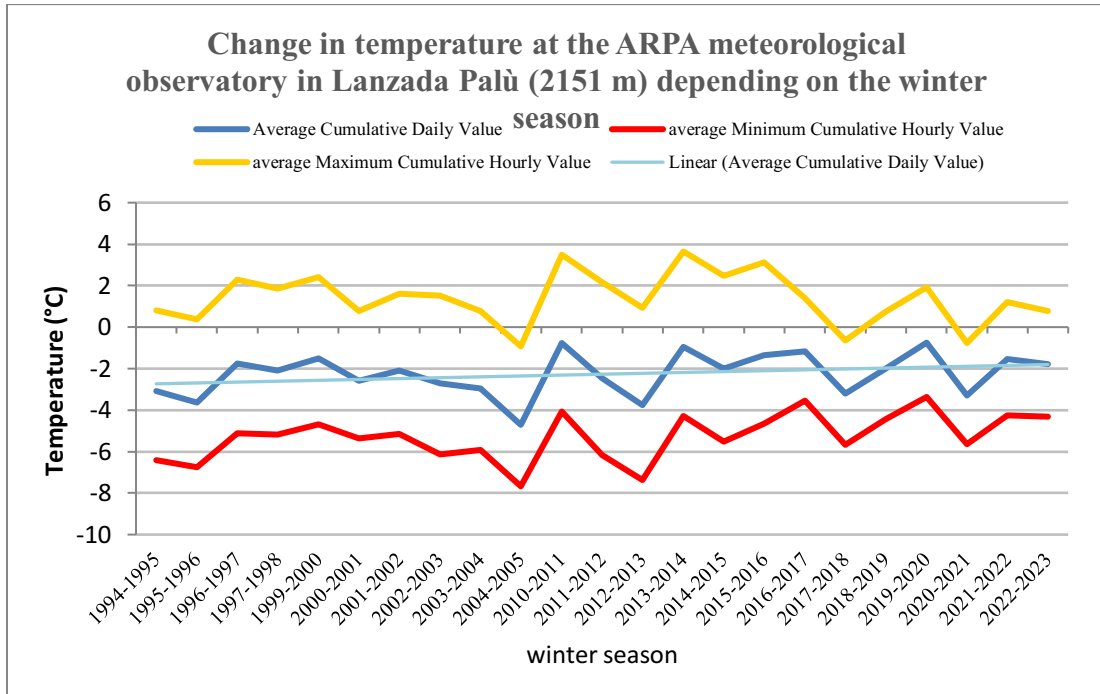


chart 10

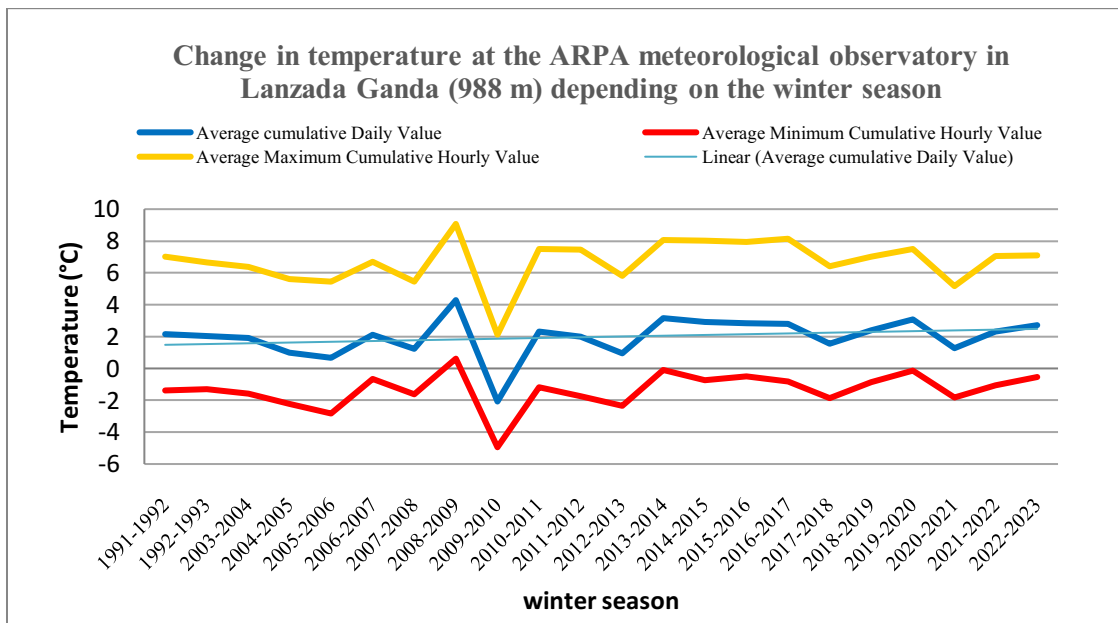


chart 11

## Change in temperature at the ARPA meteorological observatory in Caspoggio (1719 m) depending on the winter season

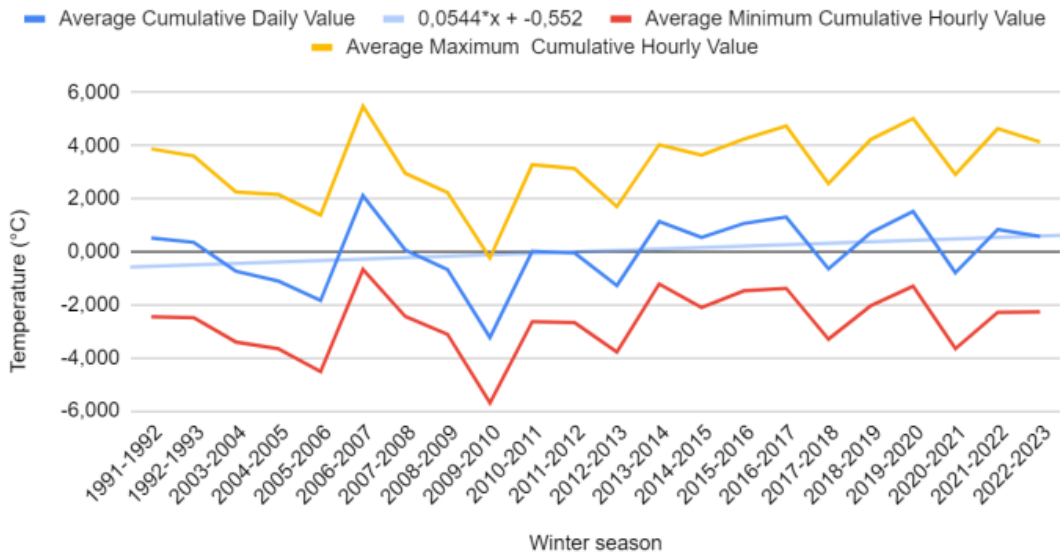


chart 12

The graph of temperature variation at the Arpa meteorological observatory in Caspoggio as a function of the winter season will be discussed in detail in the next chapter and will serve to demonstrate the alteration of the climate in this locality and in general throughout the valley.

Subsequently, the average temperature values of each weather station over the reference time span were put together and compared. For this purpose, a unified graph was drawn up, showing the evolution of the average temperature according to the winter season in the three localities of Caspoggio Piazza Cavalli, Lanzada Ganda and Lanzada Palù, with the relative trend line over time.

Evolution of the average temperature depending on winter season

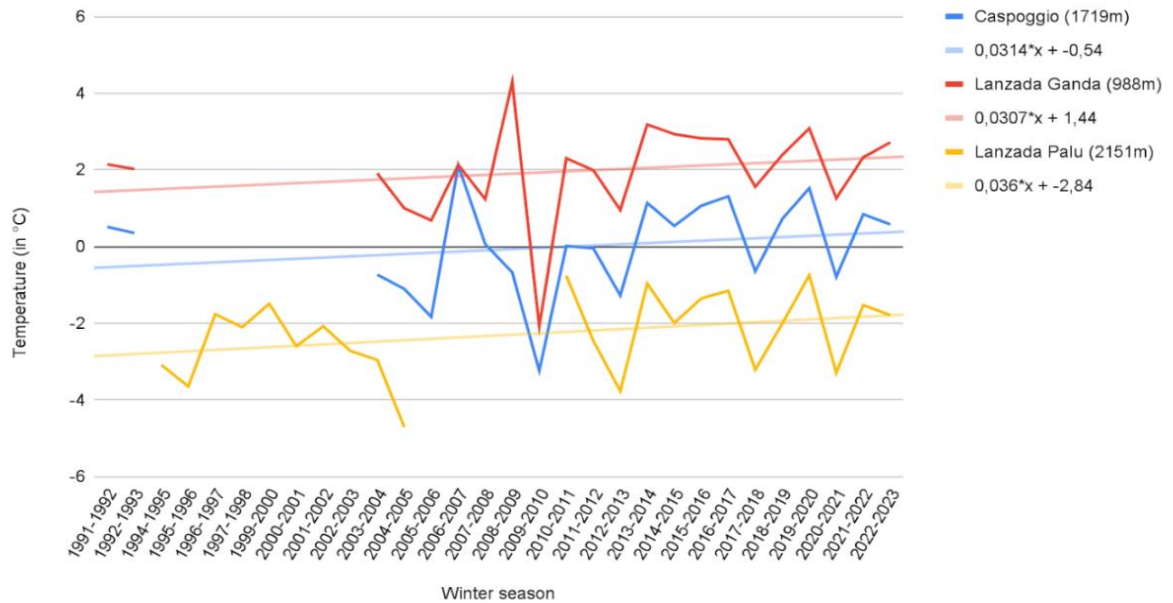


chart 13

Turning now to the analysis of the precipitation parameter, here too a graph was drawn up following the described methodology. Collections were analysed in the Val Masino - San Martino station which, although not so close to the Valmalenco Bernina ski resort as it is located in the parallel valley (the Val Masino), is the only station in the area equipped with a heated rain gauge. In fact, through an internal heating system, it allows the water to be kept in a liquid state, preventing the snow from freezing, a phenomenon that could lead to errors in the measurement of precipitation as ice takes up more space than liquid water. The heated rain gauge therefore allows more accurate measurements to be obtained and is therefore the best way to get the most accurate picture possible of the situation. Furthermore, the Val Masino - San Martino station is located at the same latitude and altitude as Chiesa in Valmalenco and the weather conditions can therefore be considered similar.

Change in precipitation at the ARPA meteorological observatory in Val Masino depending on the winter season

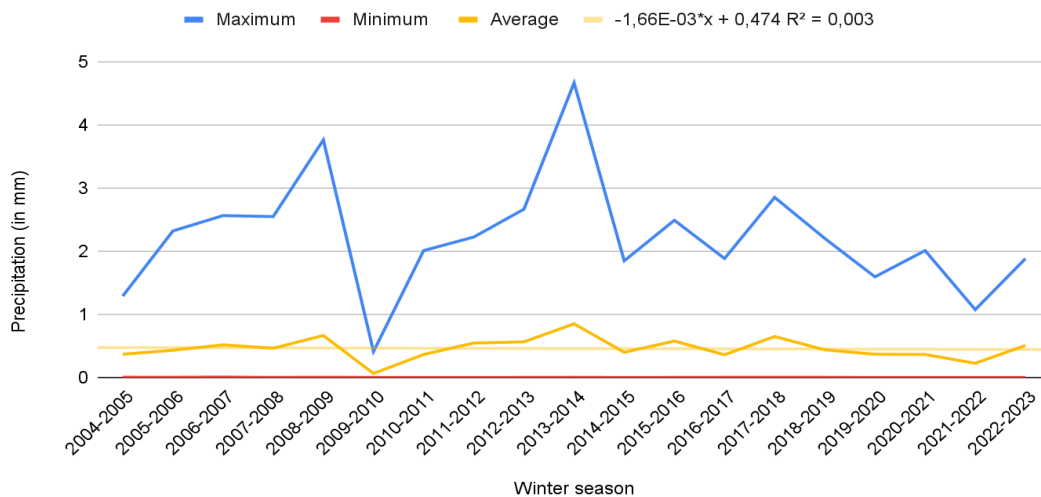


chart 14

Finally, with regard to the variable 'snow depth on the ground', data from the Lanzada Palù station located at an altitude of 2151 metres near the ski resort were processed in the following graph. They were collected in order to understand whether there have been variations over time at that altitude.

Change in snow height at the ARPA meteorological observatory in Lanzada Palù depending on the winter season.

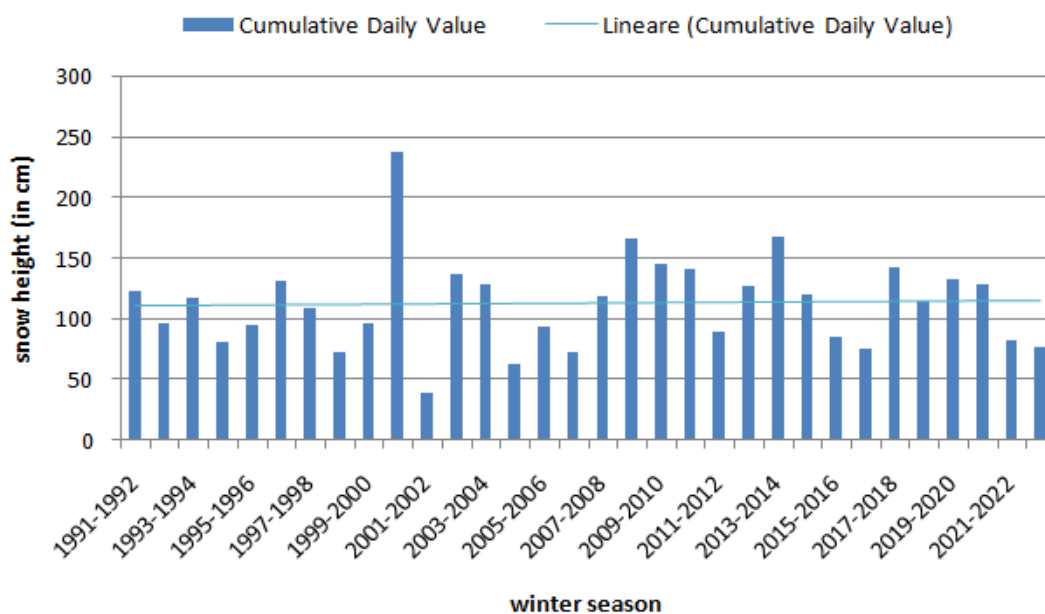


chart 15

Finally, other interesting environmental and spatial data were mapped, which are reported below and concern the number of lakes, rivers, reservoirs, areas of nature interest and wildlife trails present (table 12).

<b>Parks and wildlife/nature trails</b>	Chiareggio Marmot Park; thousand-year-old larch trail
<b>Areas of natural interest</b>	Alpe Palù peat bog, Geological Park of Chiareggio and Campo Frasca; Alta Via della Valmalenco
<b>Lakes</b>	Lake Palù, Lake Pirola
<b>Rivers</b>	Torrente Mallero; Torrente Lanterna
<b>Reservoirs</b>	Campo Moro Basin, Alpe Gera Basin, Campagneda Lakes

table 12

#### 4.2.3. Tourism data

For tourism data, data and flows were collected in parallel both within the three municipalities and within the ski area. The data was also analysed by dividing the winter and summer seasons, and in many cases the graphs were processed on a monthly scale.

Before illustrating what has been found with regard to tourist flows, it is necessary to make a clarification. According to the ISTAT online glossary (2010), the term ‘arrivals’ refers to the number of customers, both Italian and foreign, hosted in accommodation establishments during the period considered. ‘Presences’, on the other hand, are the number of nights spent by customers, both Italian and foreign, in accommodation establishments (ibid.).

Summer and winter arrivals (chart 16) and presences (chart 17) by municipality from 2016 to 2022 are shown respectively. The data were provided by PoliS Lombardia, the regional institute for policy support in Lombardy.

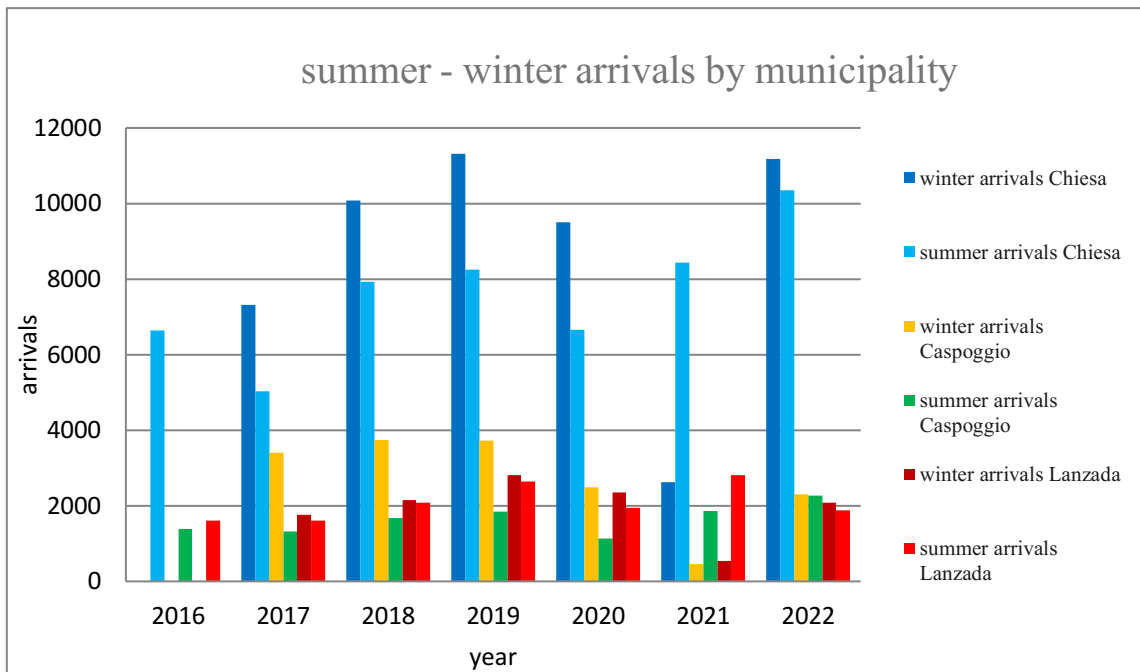


chart 16

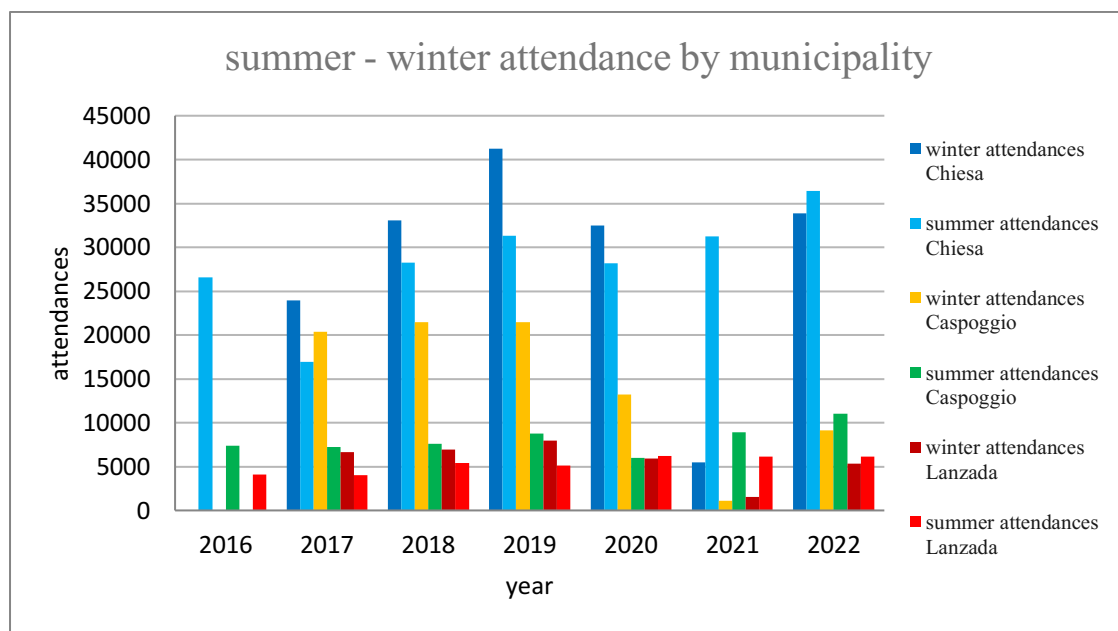


chart 17

As far as the ski area is concerned, the data was provided directly by the company that operates the facilities, F.A.B. S.p.A. They made it possible to draw up the following three charts.

The first, chart number 18, relates to the presences in the ski area in the winter season, subdivided by months, while the second, chart number 19, refers to the presences in the ski area in the summer season, again subdivided by months.

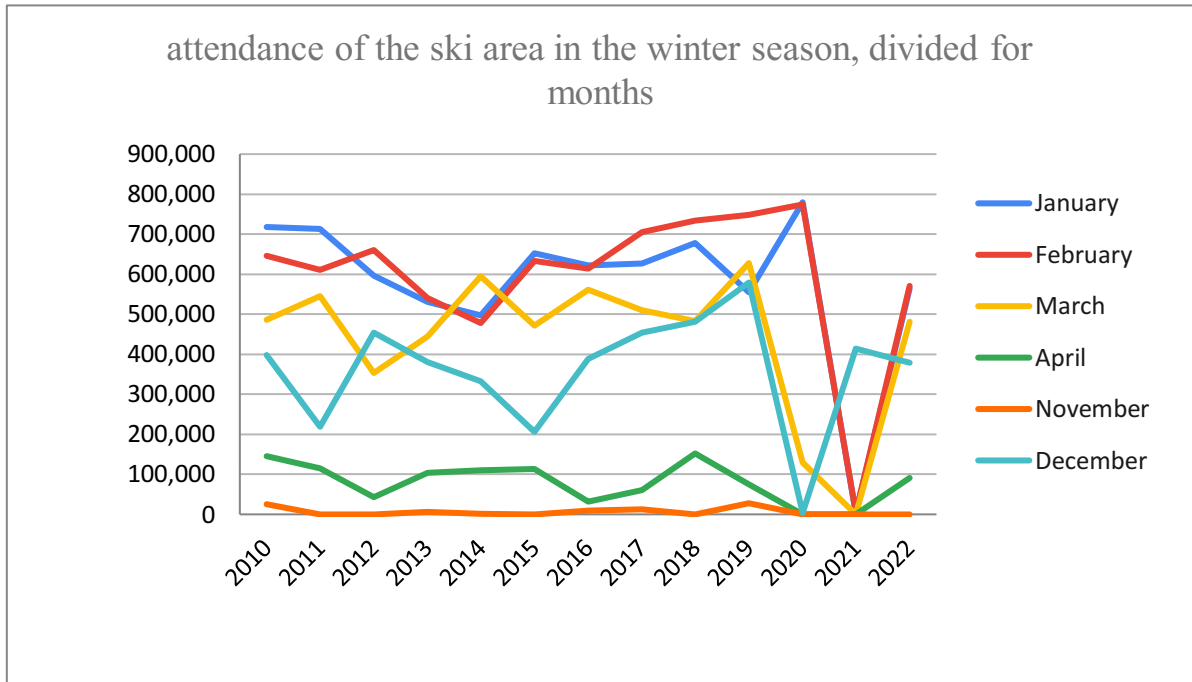


chart 18

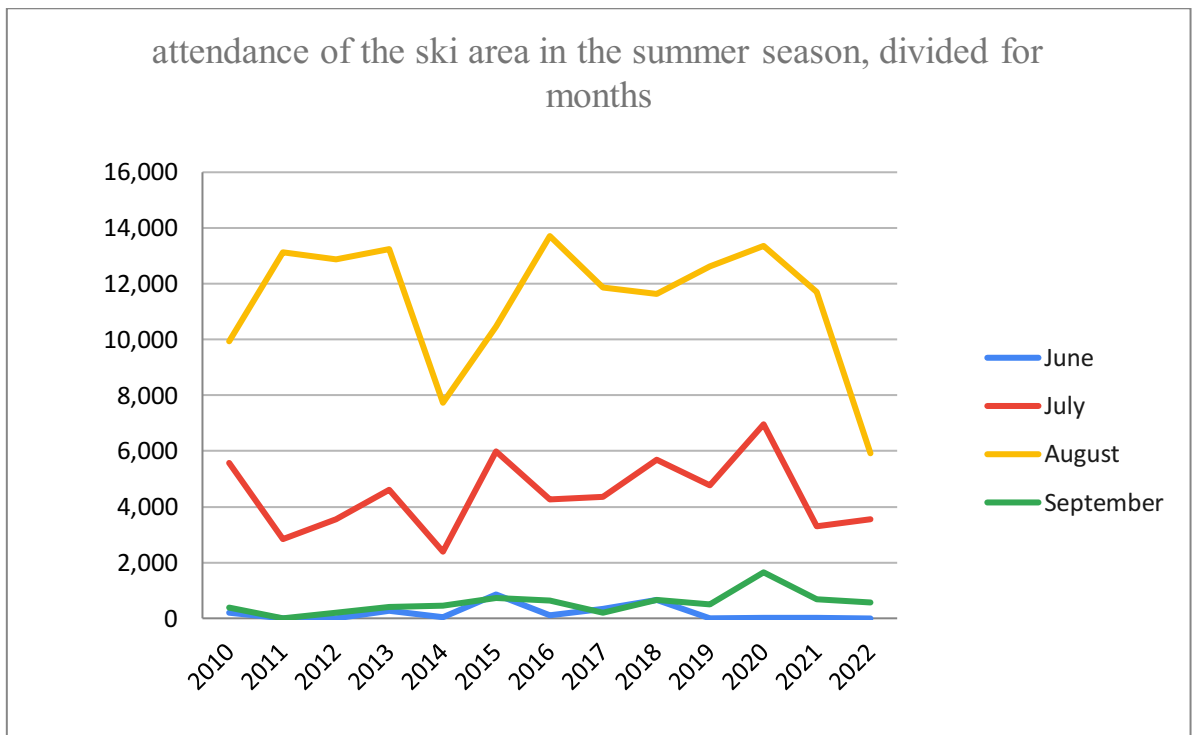


chart 19

In the graph below (chart 20), one can instead see the total admissions within the ski resort over the years, broken down by months.



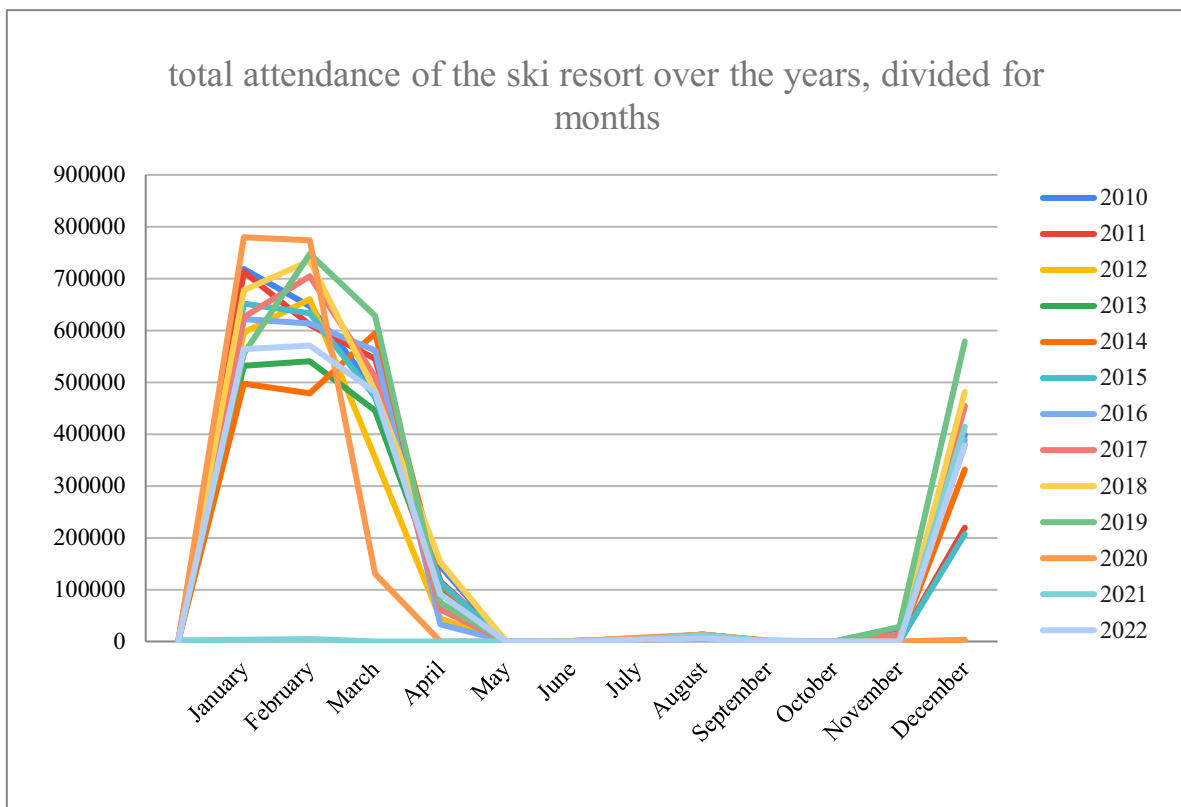


chart 20

In addition, the Sondrio – Valmalenco tourism consortium provided data on the district's target users in percentage terms (see table 13) and on the total annual presences in the district area from 2008 to 2022, broken down by years (see chart no. 21 below).

<b>Target users ski area winter 2016 -2022</b>	<b>2016:</b> 30.89% Italians - 69.11% foreigners <b>2022:</b> 84% Italians - 16% foreigners
<b>Target ski area users summer 2016 -2022</b>	<b>2016:</b> 85.28% Italians - 14.72% foreigners <b>2022:</b> 82.30% Italians - 17.7% foreigners

table 13

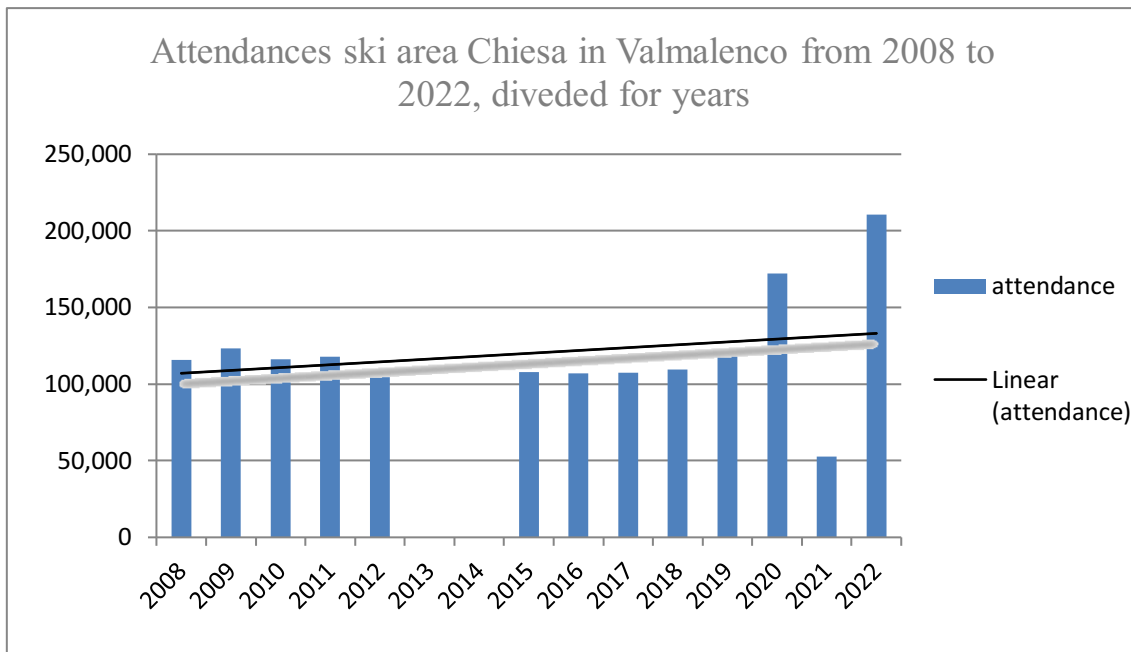


chart 21

#### 4.2.4. Data on activities and services

For the part on activity and services, together with the team, it was decided to map the total number of accommodation and hospitality services broken down by municipality and the number of businesses active in the area by municipality and by sector of interest.

The chart 22 shows the total number of accommodation and hospitality services in the three municipalities from 2010 to 2022 and the growth/decrease trend for each municipality. The data were provided by PoliS Lombardia and accommodation establishments are to be considered as the sum of hotel establishments (hotels of several stars) + non-hotel establishments (campsites, tourist villages/residences, entrepreneurial rental accommodation, agritourisms, holiday homes, youth hostels, bed and breakfast, airbnb, other private accommodation).<sup>18</sup> The next two graphs, number 23 and 24, show respectively the number of extra-hotel and hotel establishments per municipality in the last 13 years.

<sup>18</sup> Source: PoliS Lombardia website

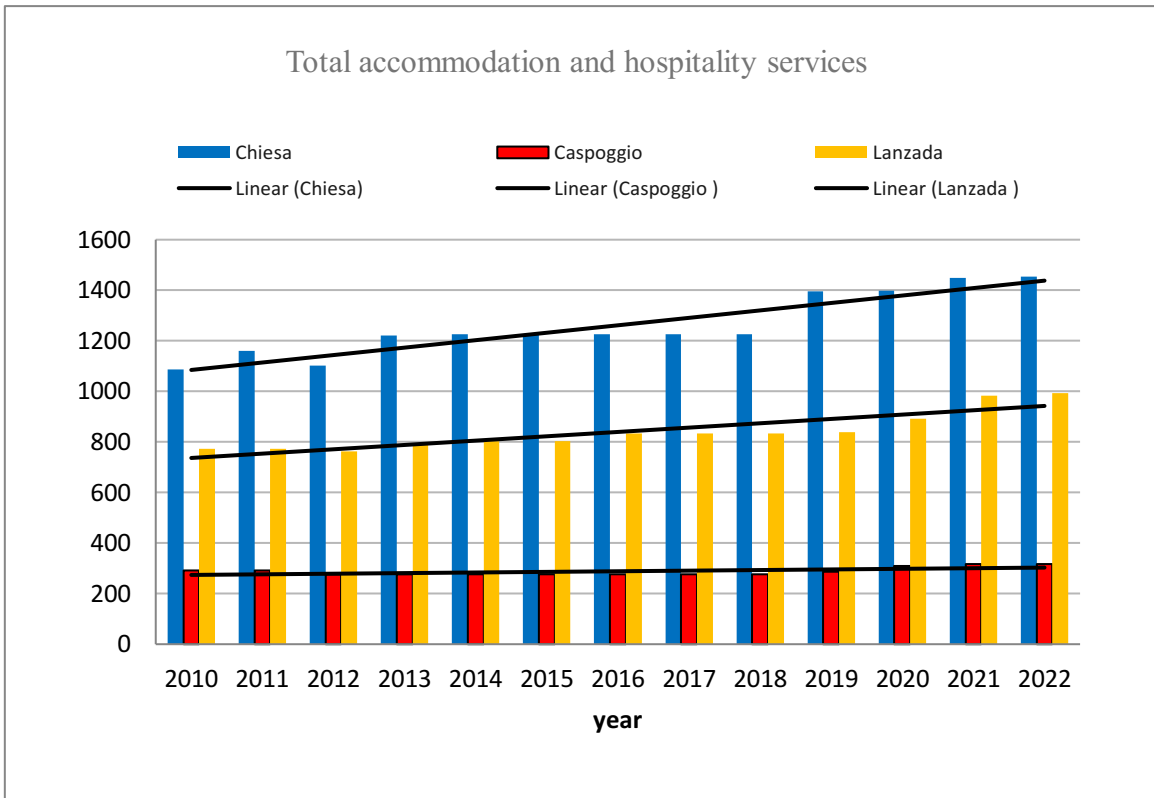


chart 22

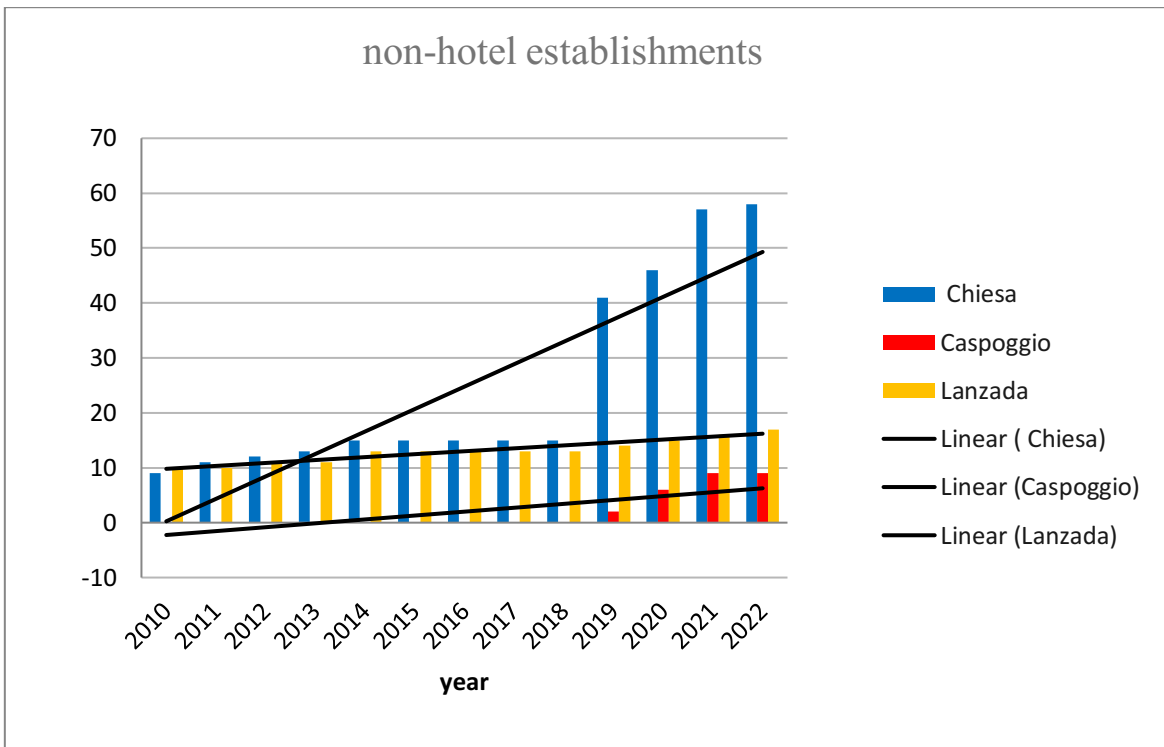


chart 23

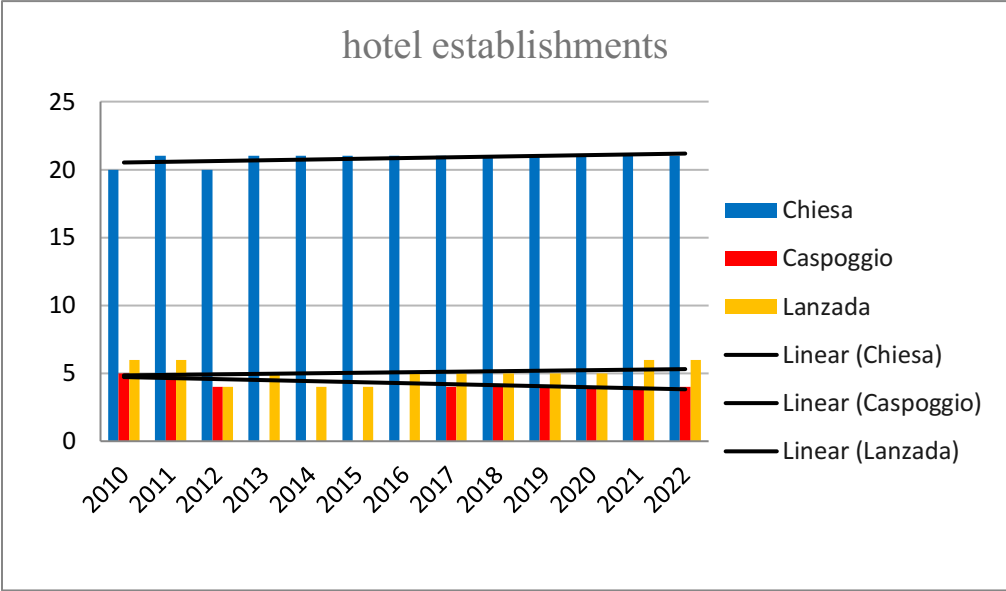


chart 24

Graph No. 25, on the other hand, shows the companies active in the area by municipality and their trend over time. Graph No. 18 finally shows us the economic sector in which the companies operate or have operated. The term 'enterprises' refers to both small and medium-sized as well as large enterprises.

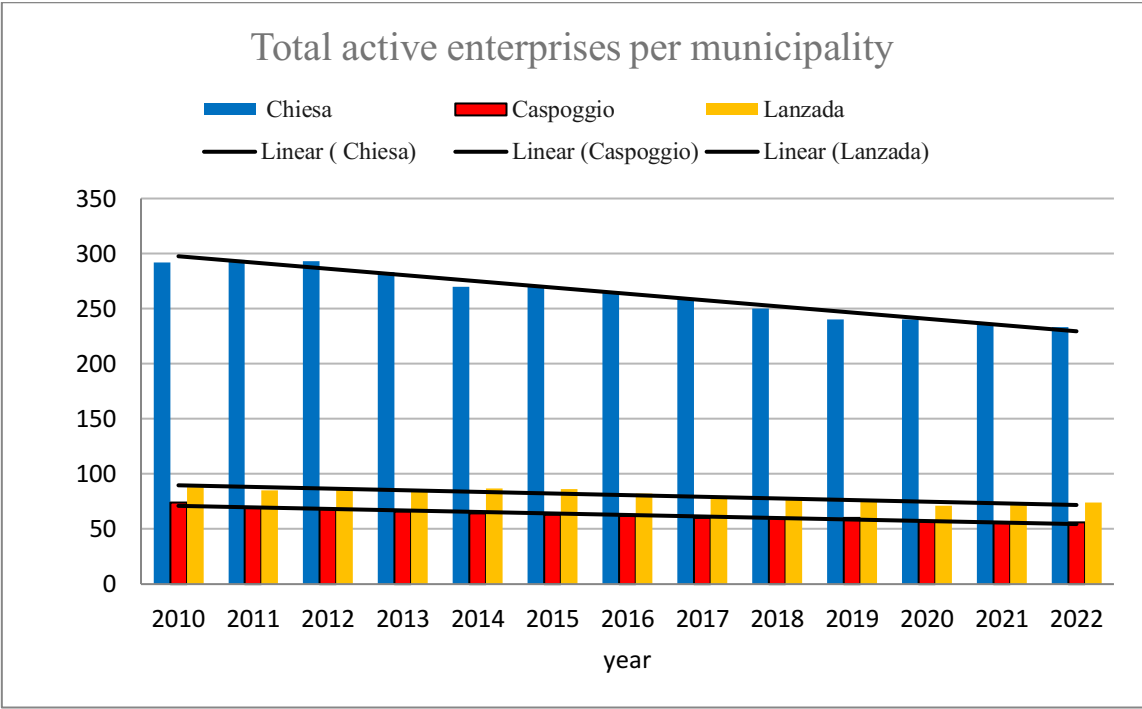


chart 25

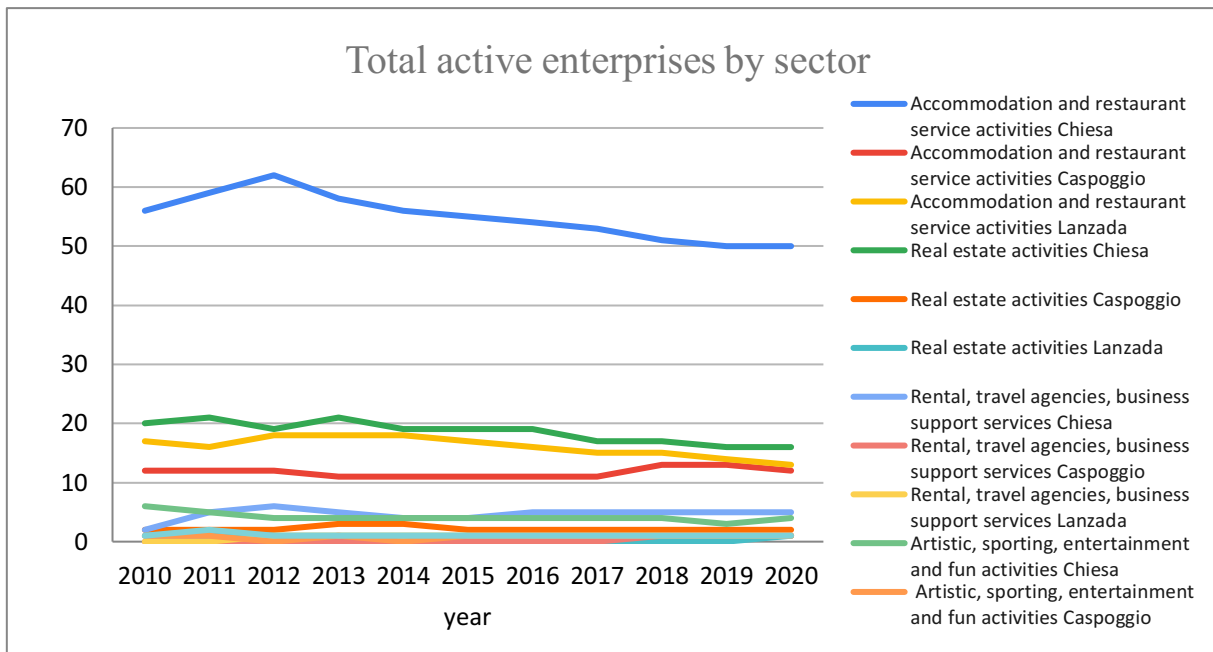


chart 26

#### 4.2.5. Data on territorial governance

As far as governance is concerned, in Valmalenco the Union of Valmalenco Municipalities and the Sondrio-based Comunità Montana Valtellina were found to be the territorial management bodies in addition to the municipalities.

As reported on the official website (Unione Valmalenco, n.d.), “the Unione dei Comuni della Valmalenco, the first in Valtellina, was established on 29 September 2001 by the mayors of the municipalities of Caspoggio, Chiesa in Valmalenco and Lanzada, and began operating in 2002 with the aim of rationalising, improving and enhancing the services provided to citizens and to implement projects of supra-municipal value in order to enhance the territory and plan the management of the landscape heritage in a more organic manner”.

The other territorial body operating in Valmalenco is the Sondrio Valtellina Mountain Community, which consists of 22 municipalities and has the city of Sondrio as its capital. A mountain community is an Italian local territorial body established by Law No 1102 of 3 December 1971 and now governed by Article 27 of Legislative Decree No 267 of 18 August 2000 (Testo Unico sugli enti locali): it is a public body with compulsory membership, set up by decree of the President of the Regional Council between mountain and foothill municipalities, with the aim of enhancing mountain

areas, for the exercise of its own functions, conferred functions and the associated exercise of municipal functions (Wikipedia, n.d.).

Finally, at the governance level, the presence of the Sondrio and Valmalenco tourism consortium should be emphasised. Generally speaking, consortia of tour operators are private organisations composed mainly of tourism enterprises, to which are added private subjects pursuing cultural and tourism interests (Regione Piemonte, n.d.). The Consorzio operates through programmes and projects oriented to the management, development and qualification of the tourism product and offer, for the purpose of the tourism marketing of the activities of their members, including the booking of tourist services (ibid.).

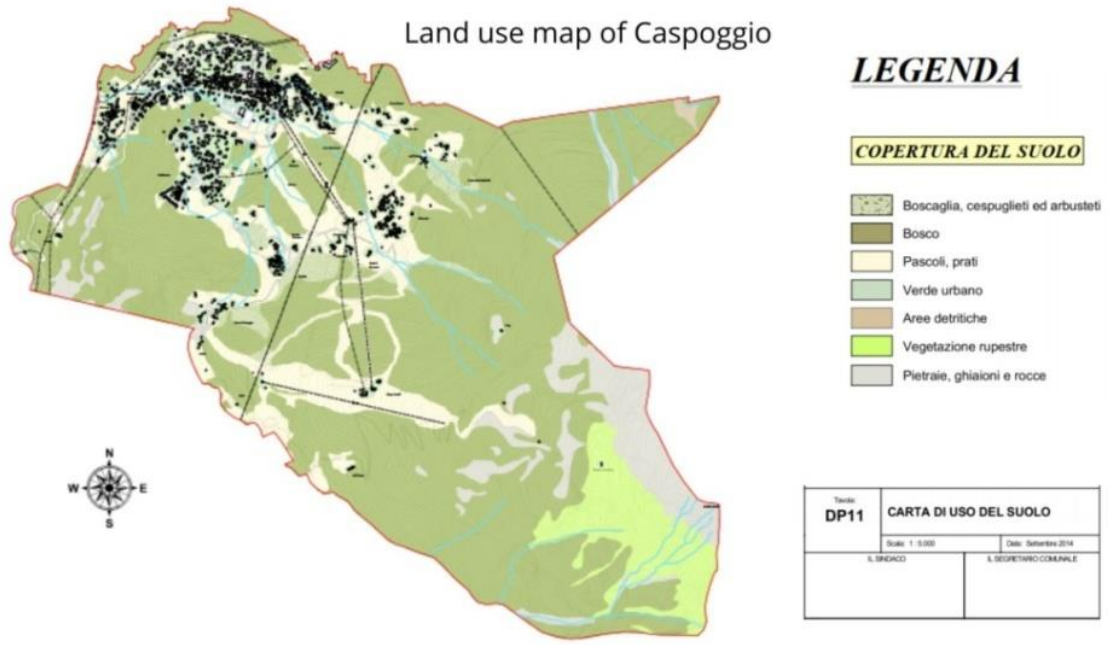
For the collection of territorial governance data, the Territorial Government Plans of each of the three municipalities were then analysed<sup>19</sup>. The Territorial Government Plan (abbreviated as PGT) is an urban planning tool introduced in the Lombardy Region by Lombardy Regional Law No. 12 of 11 March 2005 (Wikipedia, n.d.). The PGT replaced the General Regulatory Plan as the urban planning tool at municipal level and is intended to define the layout of the entire municipal territory (town planning, building, hydrogeological and earthquake protection, etc.) (ibid.).

The following maps were found within the plans and were selected as useful for analysing and visualising the territory in depth.

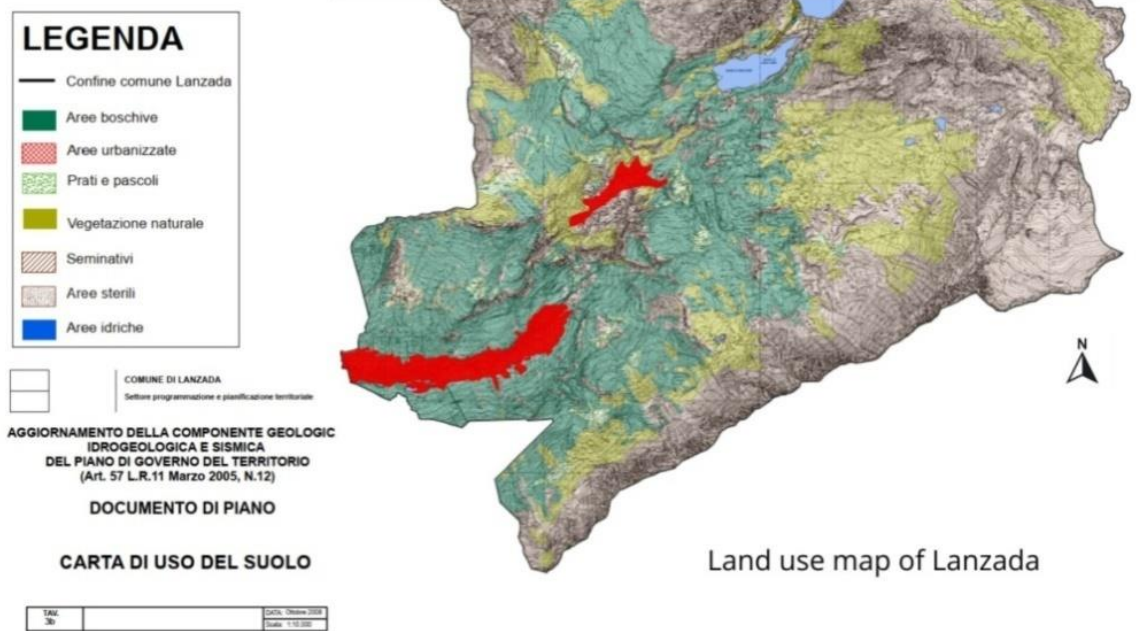
Below are the land use maps of the three municipalities analysed and in particular in order are that of Caspoggio, Lanzada and finally Chiesa in Valmalenco. The land use map is useful to understand how the territory is organised and to diversify the areas into wooded, agricultural, pastoral, rocky, barren areas, urbanised areas, etc.

---

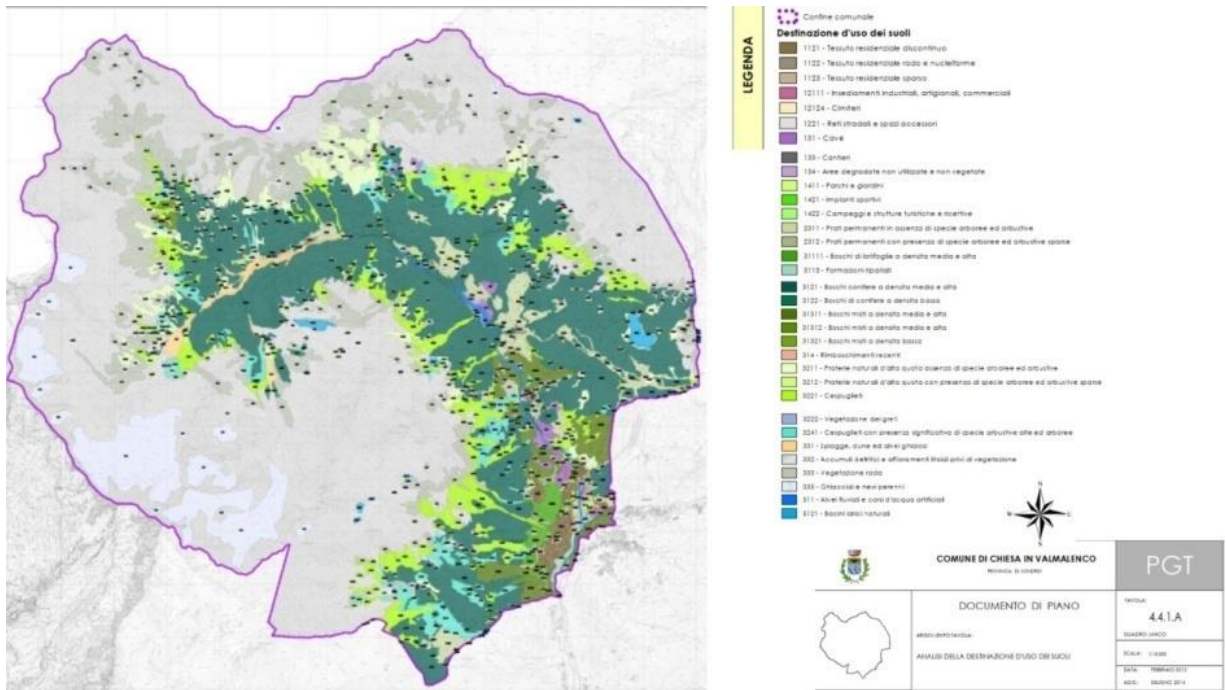
<sup>19</sup> <http://www.hlservizicloud.it/pgt/content/014019>



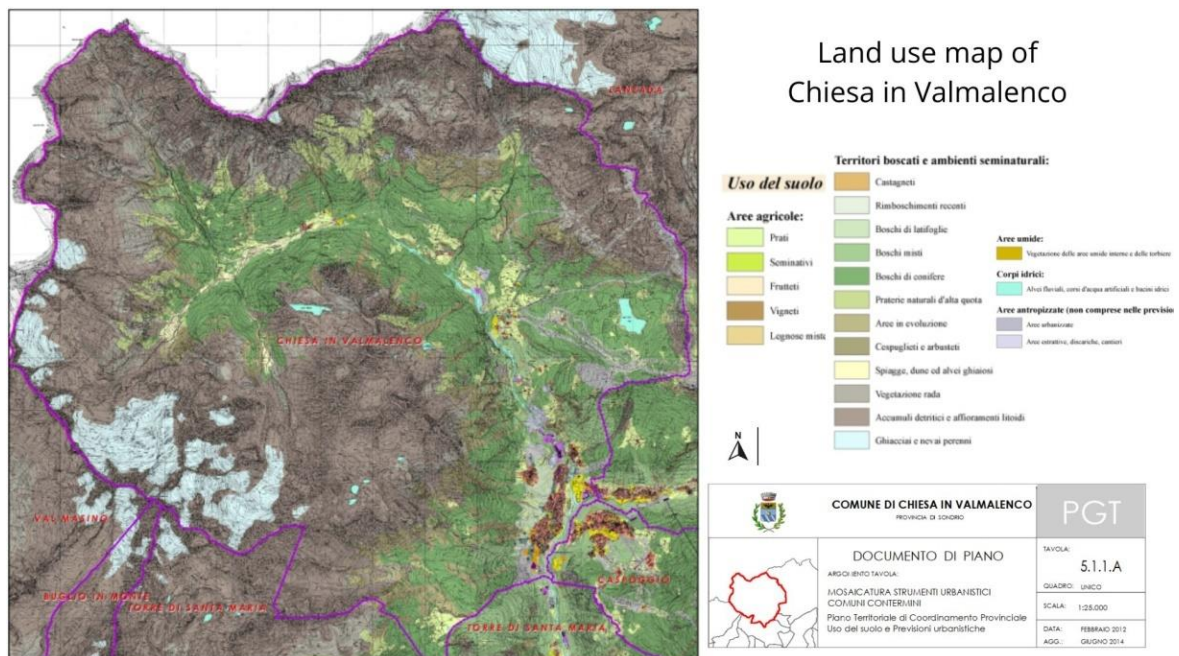
map 1 Land use map of Caspoggio



map 2 Land use map of Lanzada



map 3 Land use map of Chiesa in Valmalenco A

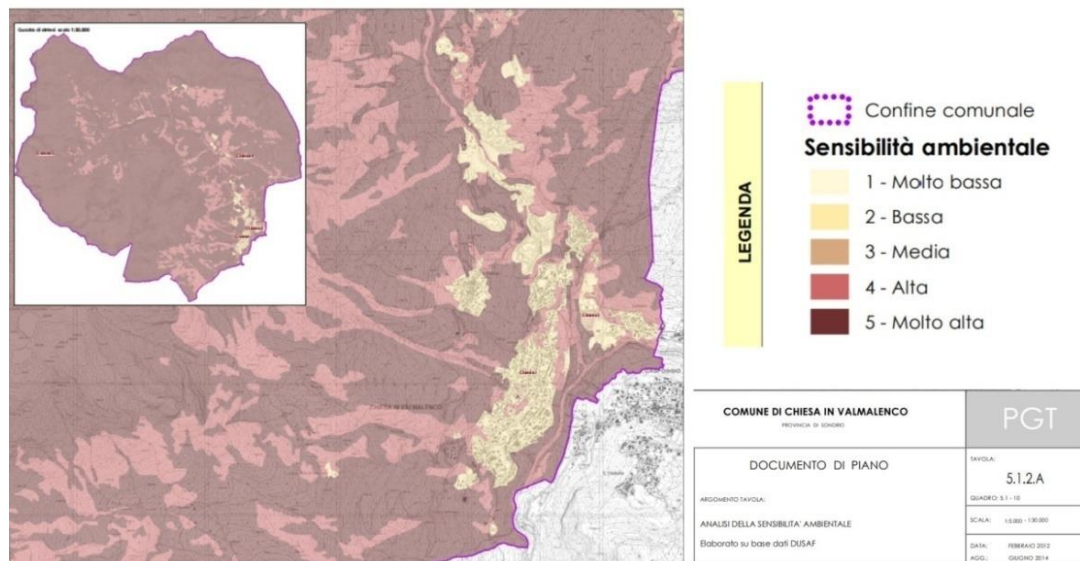


map 4 Land map use of Chiesa in Valmalenco B

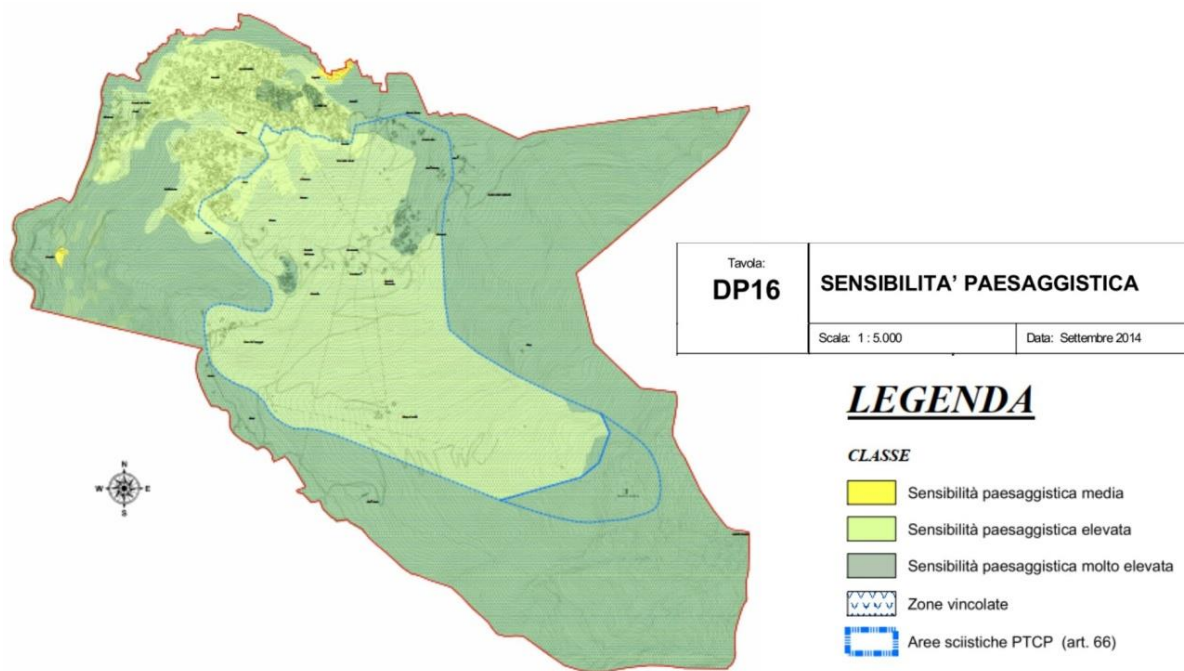
Furthermore, always within the PGT, the areas of environmental sensitivity were analysed, which are shown in the following maps.



Below (map 5) is the environmental sensitivity map of Chiesa in Valmalenco (PGT Chiesa, 2014) and that of Caspoggio (that of Lanzada is not shown due to the map's too low resolution).

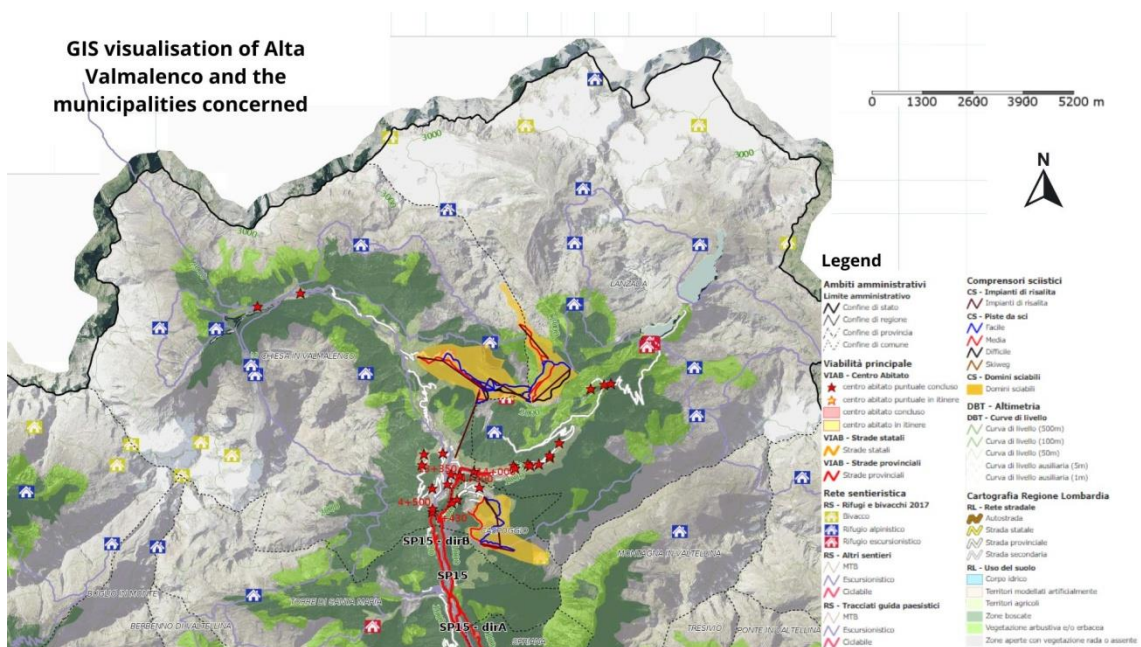


map 5 landscape sensitivity of Chiesa in Valmalenco



map 6 landscape sensitivity of Caspoggio

Finally, the following map, the number 7, was created showing Alta Valmalenco and the area of the three municipalities, the subject of this study. The dotted line indicates the municipal borders between Chiesa, Caspoggio and Lanzada, while the continuous black line indicates the border with Switzerland. The area occupied by the red stars highlights the built-up area and the anthropised area, while the red lines indicate the provincial roads, which become secondary as one ascends towards the upper valley (white lines). The skiable domains are highlighted in orange: in particular, the lower one indicates the Caspoggio area that was closed in 2013, while the upper one is the current Valmalenco Bernina ski area. The red/blue/yellow squares with a house icon inside show mountain huts (in red/blue) and bivouacs (in yellow). Finally, the areas on the map show different colours according to land use: water bodies are shown in blue, agricultural land in white, artificially modelled areas in beige, forested areas in dark green, shrub and/or herbaceous vegetation in light green and open rocky areas with sparse or absent vegetation in grey (the intensity of grey increases as the rocky areas increase). Finally, the presence of snow or glaciers is indicated in white.



map 7

## **5. CHAPTER VI: Discussion**

This chapter examines in detail the results obtained from the collection of qualitative and quantitative data, presenting what the current situation looks like at territorial level and evaluating the results in the light of the research questions.

### **5.1. Adaptation strategies and future development alternatives in the light of swot analysis and quantitative data**

The chapter is subdivided as follows: the first part analyses the strengths and weaknesses of the Valmalenco territory; the second part focuses on the presentation and explanation of the quantitative data and elaborated graphs; the third and last part concerns the analysis and investigation of the opportunities and threats gathered in the territorial swot analysis.

The opportunities are to be understood as that set of interventions, projects, actions, initiatives, choices, practices, strategies, activities, ideas, resources and lines of development that could be exploited, implemented and undertaken at a territorial level to initiate and enhance the sustainable development and transition of the area under analysis, including possible climate change adaptation strategies. They are primarily aimed at improving the quality of life and well-being of the local population and, more generally, the socio-anthropological, environmental and economic structure of the area. Threats, on the other hand, are to be understood as those phenomena, events or factors that are difficult to foresee and uncontrollable, which could hinder the development of opportunities as understood above.

In connection with what has just been said in the previous paragraph and before moving on to the actual discussion, it is also important to make a premise. In order to investigate possible future strategies for the sustainable development of a given mountain area, it is in fact fundamental to firstly take care of, protect and focus on the people who live there, listening to their ideas, opinions, interests and needs, and only secondly to consider the tourism sphere. In fact, although tourism is a very important sector and has a significant weight in the mountain economy, it is not fundamental to the survival of the population itself. For this reason, this research does not only focus on how to implement a type of tourism that is sustainable, but investigates which possible

development and adaptation strategies can be implemented in order to allow the survival of a territory and its population, with its associated artistic, cultural, historical and environmental heritage. As will be reported below, the implementation of a type of tourism that is sustainable is therefore not the objective of the research, but represents one of the possible future development strategies that are to be pursued.

Finally, the final chapter will summarise possible climate change adaptation strategies and future development alternatives for the entire Valmalenco territory and context, evaluating them in the light of the SWOT analysis and integrating them with more general concepts.

### **5.1.1. Analysis of the strengths and weaknesses of the territorial context**

Starting from the analysis of the qualitative data obtained and thus from the presentation of the territorial SWOT, the first two parameters are analysed in detail in order to understand the strengths and weaknesses of the territory as a whole, subdivided into the above-mentioned categories.

Starting from the strengths, as the relative table shows, as of today the Valmalenco territory still bases its economy on two main sectors: the tourism sector, especially in winter linked to skiing, and the mining and quarrying sector.

The sector linked to the ski industry, despite facing a deep crisis in recent years, is still very important for the Alta Valmalenco territory. In fact, in addition to creating jobs, it allows the survival of many other activities such as catering and tourist hospitality services. The current problem, however, reported by most stakeholders, relates to the huge economic-environmental cost that must be paid at the territorial level to maintain this sector: in fact, in addition to altering the morphology of the territory, it requires increasing costs for the maintenance of the facilities and a high consumption of water and energy for the production of artificial snow. At a time when, due to climate change, it is snowing less and less and at higher altitudes, the water resource is becoming an increasingly precious commodity and its use in the ski area interferes with the demand for water for domestic and other civic uses (such as livestock farming, agriculture, etc.), creating a rather relevant socio-environmental conflict.

On the other hand, as far as the mining sector is concerned, even though it has been decreasing in recent years (a characteristic that some stakeholders point out as a strong point due to the environmental impacts it produces), it still guarantees a good number of jobs, especially for young people, thus partially counteracting the depopulation that has affected Alpine areas in recent decades.

At the level of culture and identity, the results of the interviews revealed a strong attachment on the part of the people to their place of origin linked to the maintenance of a cultural and historical identity handed down from generation to generation. Generally speaking, the local population is proud to be 'Malenca', that is, an inhabitant of Valmalenco, and feels themselves to be the bearer of certain knowledge and know-how. This sense of authenticity and welcome is perceived by attentive tourists and represents a strength that must necessarily be preserved.

Despite this, depopulation (especially of young people) is still an active phenomenon in the area, representing a rather significant problem. In fact, according to the interviews, one of the major problems in the area is related to the lack of job opportunities and diversification. Jobs are often seasonal and concentrated, especially in the restaurant industry, very often there is no generational turnover and it is difficult to find the necessary labour. The tendency of young people is to leave and move to the big cities or towns in the valley bottom, partly for study reasons, partly for convenience of services, partly for better employment opportunities. Unfortunately, for some sectors of the economy, the lack of support and funds from local authorities do not allow them to subsist economically. An interview with a local farmer (also the owner and manager of a b&b and beekeeper) revealed that unfortunately in his area it would not be possible to survive solely on agriculture; this is why he decided to open complementary and more profitable activities.

On the other hand, however, according to what also emerged from the interviews and an interesting point of strength, a great spirit of initiative and enterprise on the part of some people can be seen in the valley context. Indeed, in recent years, as reported by many stakeholders, several new activities and realities have sprung up which, although small, seek to give a sign of change and represent a great desire on the part of local people to invest in the territory. Some activities are connected to the recovery of old trades, others arise from creativity and the idea of imagining new ones, and others are linked to a

passion, sporting or otherwise. Alongside this, an innovative network of hospitality services has also sprung up, based on more sustainable philosophies and aiming to welcome slower and greener forms of tourism, attentive to the environment and detached from the mass tourism that characterises, for example, the ski sector. However, in the area, there continues to be a prevalence of outdated facilities, lacking modern services and unattractive. These are the remnants of the building speculation that proliferated in the 1980s and 1990s and that today has left entire mountain areas with buildings in poor condition and abandoned. This is, according to stakeholders, a disadvantage and weakness of the location.

The territorial analysis carried out also revealed great interest and attention on the part of many local people to a more sustainable territorial development, which aims to deseasonalise tourism and diversify activities. The problem, however, which represents a major weakness of the area, is that, despite the fact that there are already many alternative activities to Alpine skiing, such as snowshoeing, mountaineering, ski touring, trekking, climbing, canyoning, etc., in general the focus continues to be on Alpine skiing, which at this juncture therefore represents an example of 'monoculture' and the prevalence of one activity over others. In fact, on the basis of stakeholders' perceptions detected through the interviews, it emerged that political choices, tourism promotion of the territory, investments and development strategies by territorial administrative bodies continue to be focused almost entirely on the ski sector. As a demonstration of this, if we analyse the contributions allocated that were reported in the previous chapter with reference to the Valmalenco Bernina ski area, the disproportion and the amount of funds allocated to support this sector by the public sector, both municipalities and the Lombardy Region, is evident. These funds do not go to the detriment of other territorial projects that aim at a more sustainable development (since they are already allocated in advance for that specific sector and could not finance other areas), but serve to give an idea of the line of development and of the tourism sector that continues to be supported and incentivised. In this regard, it should be noted that, at least at the municipal level, money is also allocated to support other sectors, e.g. to support the emergence of new activities, but at the level of larger investments, the ski sector continues to be favoured. In fact, in spite of the worsening climate change year after year, at the territorial level people continue to focus on mass tourism, in order to keep up the system that has developed since the 1960s without the environmental

conditions to support it. One stakeholder during the interview described the public investment policy and the Territorial Pact proposed by the Lombardy Region, which provides additional funds for the area's development, as 'the tail end of the dying dinosaur' created to support a system that is undeniably in crisis, but which is unable to change, partly due to laziness, partly due to inability, obtuseness, lack of ideas, and lack of foresight.

On the other hand, however, according to the interviews, many people are aware of the current climate situation and express the need for a paradigm shift in the land development system undertaken over the years. Among these people are also those who are directly interested in the future of the facilities as operators or owners. They have shown an enormous openness in listening and welcoming innovative ideas in order to initiate a sustainable transition of the territory and a great desire to collaborate in order to find alternatives to the current crisis situation. Through the contribution provided by the Lombardy Region contained in the Territorial Pact, an integrated attempt is being made to give a stimulus to this sector, which for years has been the fulcrum of the economy, but which certainly needs to start looking beyond the very near future.

Remaining on the subject of the 'ski industry', other interesting results emerged. If on the one hand there is a type of policy that is based on perseverance in investing in the ski industry (in the specific case in the ski resort of Chiesa in Valmalenco), with a series of supporters both locally and at a broader level, on the other hand a reality has emerged such as that of Caspoggio, which, at the level of territorial development, pursues completely different objectives and demonstrated this in 2013 following a very courageous political choice. In that year, in fact, after more than 50 years of activity, the Caspoggio ski lifts were closed as the balance sheet for the last 10 years had been continuously in the red. Initially, this decision had serious repercussions locally, as a certain target of tourists was missing, at least during the winter season, causing serious economic damage. In order to tackle this problem and relaunch the local economy, Caspoggio decided to radically change its line of development from then on, aiming at a more sustainable territorial planning through the valorisation of the artistic-cultural and environmental heritage of the place and the creation of a receptivity more of quality and less of quantity. In recent years, in fact, the recovery and restoration of old houses according to traditional architectural patterns has been encouraged. Many hotels have been converted into more sustainable b&b's and new family-run establishments have

sprung up. In addition, a project dedicated to the mountain area was launched, which saw the redevelopment of a managed municipal sports centre that has become a lively meeting point for the village. Through sport, recreational activities, family space, food and wine offerings, and cultural proposals linked to a research centre for anthropology, science and climate change, ideas and projects dedicated to new forms of tourist reception, to experiencing the territory, and to the enhancement and study of the mountain territory have been created (Centro della montagna, n.d.). The transformations and territorial investments of recent years have thus attracted a new type of tourism, more attentive to the territory, more interested in its history and in getting to know its cultural roots in depth. This has also been possible thanks to the presence of a community that is very attached to the area and to the perseverance of young people who have decided to stay and develop alternative activities that are not subordinate to skiing (such as sports associations and mountain biking schools).

Lanzada also presented itself as an interesting case. Here, in fact, no ski facilities have ever been built and economic resources have been invested in the development of sports (cross-country skiing, climbing crags), cultural (mineralogical museum) and natural (Bagnada Mine) activities. Also within the municipality of Lanzada are the Campo Moro dam and the Fellaria glacier, two famous tourist attractions in the area that attract many visitors each year, as well as a dense network of mountain huts and trails of all difficulties.

According to what emerged from the interviews, one of the most significant strengths of the entire area of the three municipalities is the valley's great scenic richness, its aesthetic-environmental value and its biological and geomorphological diversity. Indeed, it presents sites of environmental interest of enormous importance, partly represented by the peaks themselves and partly by very special natural spaces. Among them are Monte Disgrazia, Monte Bernina and Pizzo Scalino, the Chiareggio basin and Lake Palù (in the territory of Chiesa in Valmalenco), the Campo Moro and Campo Gera dams, the Fellaria and Scerscen glaciers with their associated glaciological trails, Val Poschiavina, etc.

Thanks to its natural beauty, the Valmalenco presents itself as a valley capable of welcoming various tourist targets as it offers a very wide range of opportunities for enjoyment and outdoor activities. From what is indicated in the SWOT, despite the fact



that political choices support the ski sector more, many opportunities are already present in the area: starting from the dense network of footpaths that starts just above the Sondrio terraces and reaches the upper valley, including the Alta Via della Valmalenco, which connects all the high-altitude refuges in the Bernina and Disgrazia areas, to mountain biking routes, climbing crags, canyoning activities, cross-country skiing routes, ski mountaineering and snowshoeing excursions, and the presence of multi-purpose sports centres. This indicates that many diversification and deseasonalisation strategies are already active in the area, but a paradigm shift in the system is still struggling to take place.

Furthermore, another important factor that emerges from the interviews relates to the lack of an integrated and inclusive system for planning, programming and promoting tourism in the area. Added to this is the lack of a common vision of territorial development, shared firstly by administrations and secondly by local people. In addition, very often, administrations, in decision-making processes on issues relating to the territory and affecting the entire community, adopt approaches that are not very inclusive and participatory, thus tending to monopolise policy choices.

One issue that emerged significantly from the interviews was related to the concentration of tourist flows at certain times of the year. On the one hand, this is due to the management of the Italian holiday system, which tends to concentrate tourist flows in certain weeks, over-saturating the tourist reception system; on the other hand, it is certainly attributable to the still clear prevalence of alpine skiing as a sporting activity compared to others. In particular, in recent years, the concentration of tourist flows in certain periods has increased sharply as, with the exacerbation of climate change that brings less and less snowfall in the mountains, the ski season has shortened considerably. This further exacerbates the problem of over-saturation during the high season, resulting in traffic jams, crowded car parks, and excess demand in the catering and hospitality industry. In contrast, in the low season many accommodation services, such as hotels, restaurants, mountain huts, are forced to remain closed due to lack of footfall and users.

Analysing climate change in the area, the interviews show that there is full awareness on the part of the interviewees of the problems and critical issues associated with it. In particular, the lack of snow and water, the melting of glaciers and the increase in the

amount of landslides are reported as evidence of the changes. They cause direct damage to various sectors of the economy, starting with agriculture and livestock farming and the ski sector, and ending with mountaineering. According to forecasts and studies on the subject, the problems caused by climate change will tend to worsen in the coming years and therefore represent both a weakness and a threat for the territory.

As far as services and social aspects are concerned, it emerged from the interviews that at least as far as essential services are concerned, the valley is fairly well provided for. In fact, in the area there are post offices, banks, a local doctor's surgery, two kindergartens in Chiesa, one in Lanzada and one in Caspoggio, a primary school for each of the three municipalities, a secondary school in Chiesa, while the high schools are in Sondrio. Due to its proximity to Sondrio, however, other services are easily accessible in the city centre. As far as the transport system is concerned, it is quite efficient during the year, while it should be strengthened during peak seasons when tourist flows are higher through the activation of more daily trips over a longer time span (starting early in the morning). Furthermore, it would be necessary to equip the means of transport with facilities to transport bicycles in order to boost activity and provide an additional service. Finally, many stakeholders pointed out the lack of an integrated transport system connecting and uniting the various hamlets and a lack of regulation of tourist flows and motorised vehicles in areas with unique landscape interest and value.

### **5.1.2. Analysis of quantitative data**

In order to verify the qualitative data obtained through the semi-structured interviews based on the territorial stakeholders' perceptions of certain issues and phenomena, the quantitative data for the territory under analysis, reported in the previous chapter, are analysed and explained below.

At the demographic level, the results obtained from the qualitative interviews align perfectly with the quantitative data. In particular, confirming the massive depopulation suffered in the territory, as visible in graph No. 1, the trend of the resident population shows a decreasing trend in all three analysed municipalities. In addition, analysing Graph No. 3 and Graph No. 4 respectively, it can be seen that the average age of the

population has increased over the last 12 years from 2010 to 2022 by almost 5 years in the three municipalities and that the number of young residents under 35 years of age, on the other hand, is clearly decreasing over the same time period. Graphs 5, 6 and 7 confirm the above, showing through the height of the columns a shift from the 40-49 age group towards the 50-59 age group, with a clear prevalence of the latter in all three municipalities analysed. This shows that emigration is a current and growing phenomenon and, in particular, that there are fewer and fewer young people in these areas.

The graph 8 about the number of employees by economic sector as of 2011 shows that the prevailing sector is industry, whether related to the construction-extraction and quarrying sector or to commuting to Sondrio and the valley floor. Second is the restaurant and hotel sector (especially in Chiesa), while the agricultural sector has few employees. In fact, as mapped through the qualitative interviews, it appears to be poorly incentivised by the administrations and not very profitable.

Graph No. 9 instead shows the educational level of the population in the three municipalities. In general, most people have a medium to good level of education, a small part has attended university and obtained a degree, but on the other hand there is a very small percentage of the population that left the school system prematurely. In the municipality of Caspoggio, the ratio of adults with a diploma or degree to those with a secondary school leaving certificate is lower, probably due to the fact that, as there are several farms in the area, people started working earlier to help the family work and left school early.

Turning now to the analysis of the environmental and meteorological data, these were useful to understand and see if there is any generalisation of certain phenomena and evidence of climate change in this area as well.

In Graphs 10, 11 and 12, temperature data were analysed in three values, average daily cumulative value, minimum average daily cumulative value and maximum average daily cumulative value, in the three ski resorts, located at different altitudes. Considering the trend line of the average daily cumulative value in the graphs, it can be seen that in all three weather stations analysed, it is increasing and the temperature is therefore an altitude-independent variable. The data from each station were then assembled together in graph No. 13, which confirms that the value of the winter season

average daily temperature is increasing, but shows another interesting fact. In fact, all three stations show an increasing trend, but each station is around a different average value: the average temperature in Lanzada Palù (highest altitude station) is around  $-2^{\circ}\text{C}$ , in Caspoggio (medium altitude station) around  $0^{\circ}\text{C}$  and in Lanzada Ganda (lowest altitude station) around  $2^{\circ}\text{C}$ . For snow to form, three conditions must be fulfilled: the temperature of the air mass (at all altitudes) must be very close to or below  $0^{\circ}\text{C}$ ; water vapour must be present in sufficient quantities in the atmosphere; small volatile particles (dust, sand, etc.) must be present in sufficient numbers in the atmosphere. For simplicity's sake, as the dominant factor, we only consider the temperature condition as a differentiator of the form of precipitation (snow or rain).

Carefully analysing the example of Caspoggio, it is evident that the station at this location represents the rain-snow boundary since, observing the linear trend of its average cumulative temperature represented by the blue straight line, it has gone from being below  $0^{\circ}\text{C}$  on average until the 2009-2010 season to exceeding it in recent years until the current season. It can therefore be assumed that in the last decade the rain-snow limit was more frequently below the Caspoggio altitude, i.e. around 1700 m, but that this limit is now more often above this altitude. In addition to the increase in temperature, which may be anomalous, the increase in the altitude of the rain-snow boundary over the long term is one of the most relevant illustrations of the climate alteration caused by human activity.

In Graph 14 concerning precipitation measurements, it is rather difficult to identify a stable trend. In fact, applying the coefficient of determination  $R^2$ , a statistical value for whether a linear regression model can be used to make predictions and which indicates how well the data fit the regression model, it is determined that the  $R^2$  value is very low, meaning that the linear equation cannot reveal a correlation between these values. There was no increase or decrease in average precipitation, which would be consistent with climate trends.

With regard to the ground snow depth data recorded at the Lanzada Palù station and shown in graph no. 15, identifying a stable trend is also complicated. Due to the absence of other nivo-meteorological stations and the scarcity of data from the analysed station, it is not possible to make a comparison. What is clear from the graph, however, is that, due to the rather high altitude of the weather station, the amount of snow appears to

have remained stable over the years. Since the Caspoggio station is probably the snowfall limit, i.e. the altitude at which the precipitation is composed in equal proportions of snowflakes and raindrops, if one were to measure the height of snow on the ground there over the years, one would notice changes. Unfortunately, due to a lack of nivo-metereological data from the station, it was not possible to carry out this analysis.

From the results obtained from the analysis of tourism data, it is evident that the greatest flows are concentrated in the winter season, as opposed to the summer season. This is confirmed in graph 16, where the trend is the same in Chiesa as in Lanzada and Caspoggio. In particular, the municipality with the greatest influx of people is Chiesa, followed by Caspoggio and finally Lanzada. During the winter season, this may be due in part to the presence of the ski resort, while in the summer season to the greater accommodation and hospitality offer, as well as the greater size of the town. There is a clear overall decline in 2021, due to the Covid-19 pandemic, and growth again from the following year.

Looking then at graph No. 17 on attendances, these are higher than arrivals, but show a very similar trend in all three villages. It should be noted that in Caspoggio, despite the closure of the ski resort in 2014, the flow of winter tourists is still high, probably due to the line of territorial development undertaken that aims at a more conscious and alternative type of tourism.

Turning then to the analysis of the ski area, graph 18 shows that, as regards the winter season (considered here from November to April), the greatest presences are recorded in the months of January and February, stabilising at an average of around 600,000, and are stable over time (with the exception of the 2020-2021 ski season in which there was the Covid-19 pandemic).

Comparing the results shown in graph 19 for the summer season (June to September), it is evident that the order of magnitude for summer attendance is much lower, and in the high season period represented by the month of August, attendance is around 12000. It should be emphasised that the Alpe Palù area is also used during the summer period, but as can be seen in the graphs, the flow of tourists in this season is much lower than the presences recorded in winter.

Graph No. 20 confirms this. Observing the orange line that refers to the 2019-2020 season, the last winter season before Covid-19, we can also deduce that people continue to prefer the winter season to the summer season and above all that during the summer the facilities are not used as much or at least are used by users in much smaller quantities (not having data on summer opening days and times it is difficult to draw further conclusions).

Finally, as graph No. 21 shows, in general, the annual presences within the ski area of Chiesa in Valmalenco show an upward trend over the last 15 years, rising from 115,000 in 2008 to over 21,000 in 2022.

Moving on to the analysis of the economic-social context of the Valmalenco and thus to the data on activities and services, non-hotel establishments such as b&b, rooms to let, agritourisms and the like (including greener and more sustainable hospitality services) are growing in all three localities (graph no. 23). On the other hand, the number of hotel establishments recorded in graph no. 24 remains stable in Chiesa and Lanzada, while it shows a decrease in Caspoggio. Confirming what has been reported on Caspoggio in graph no. 23, one notes the birth in the last four years of new hospitality services with more sustainable philosophies, a phenomenon that is perfectly in line with the development strategy that this locality is pursuing, while graph no. 24 shows a decrease in the number of more classic hotel establishments. This may be due to the conversion and transformation of hotels into more sustainable facilities such as room rentals, b&b, accommodation on airbnb etc.

On the whole, as shown in graph 22, most of the hospitality and accommodation services understood as hotel and non-hotel establishments are to be found in Chiesa, followed by Lanzada and finally Caspoggio.

Finally, in chart 25 it can be seen that the number of businesses active in the area, small, medium and large, has decreased over the years, in greater numbers in Chiesa. As can be seen in the next graph (no. 26), this may be due in part to the lack of generational turnover in the hotel/restaurant sector (confirming the findings of the interviews and reported in the SWOT), in part to emigration and depopulation that led to the closure of certain activities, and in part to the economic crisis.

Finally, with regard to governance data, partly already explained in the previous chapter, the maps show the land use of the three municipalities, thus providing a general picture of the territory, also from a geographical point of view. Even comparing the surface area of the three municipalities, it can be seen that the municipality of Chiesa in Valmalenco extends as far as the Chiareggio basin and Val Ventina, including the massif of Mount Disgrazia within the municipal boundaries, for a total surface area of 107.6 km<sup>2</sup>/ha; the municipality of Lanzada covers an area of 117.17 km<sup>2</sup>/ha, including the Campo Moro dams, the Val Poschiavina, a large part of the Bernina massif, the Fellaria and Scerscen glaciers, reaching as far as the border with Val Poschiavo in Switzerland; finally, the municipality of Caspoggio is the smallest of the three, occupying an area of 7.31 km<sup>2</sup>/ha. From the legend of the landscape sensitivity map, one can see the skiable domain of the old ski lifts.

### **5.2.3. Analysis of opportunities and threats of the territorial context**

After having first analysed the strengths and weaknesses, with an interlude on the explanation of the quantitative data, we now move on to the analysis of the opportunities and threats that emerged from the interviews concerning the Valmalenco territory.

First of all, starting from the analysis of opportunities, among the interventions at territorial level that could represent a possible strategy for future development there is the valorisation, from the environmental, infrastructural and historical-cultural points of view, of what is already present in the territory. In fact, what emerged most from the interviews is the awareness that in the current era it is no longer necessary to continue building new infrastructures and new facilities, thus increasing anthropisation and impacts on the environment and related ecosystems, which are already extremely fragile, but rather it is more important to recover and give new value to what already exists in the territory, adapting it to modern times.

In this regard, in order to partially counteract the depopulation taking place in the valley context and to enhance the area's resources, it is therefore important that renovation and recovery work on old hamlets and buildings be encouraged in accordance with the traditional style and local architectural model. Their recovery could turn out to be a

winning weapon from two points of view: firstly, it would mean giving light and life back to certain places, allowing the preservation of past cultural and architectural heritage; secondly, the recovery of old houses with a predefined objective could turn into a job opportunity not to be underestimated. Indeed, one could aim at the realisation of a diffuse hotel within an old hamlet or at the creation of a catering service. In this regard, based on what stakeholders have reported, catering in the valley has enormous potential due to the lack of restaurant services (many have closed with Covid-19 and have not reopened), so this could be a good opportunity to invest in the area. In addition, investment could be made in the creation and development of a network of hospitality services and accommodation facilities that favours quality over quantity, focuses on the development of the wellness sector, and is based on more sustainable and environmentally friendly philosophies. This could thus attract a slower and more conscious tourism. This is what, as reported above, has been initiated in Caspoggio, but is analysed here as an opportunity as it could be pursued throughout the valley and thus provide an incentive for the development of an alternative model of tourism.

On the other hand, however, it is important to emphasise that the renovation of old ruined hamlets may also turn out to be a negative intervention. In fact, very often, in the absence of a sensible design and a meaning and/or objective behind it, these projects can lead to the construction of dilapidated buildings, detached from the traditional patterns of the place, or 'cathedrals in the desert', abandoned during the construction phase or just starting up, thus making the situation much worse. It is therefore appropriate for governance to take the path of efficient and structured spatial planning, in which only projects aimed at enhancing and recovering ancient values and not at denaturalising places are developed. This concept can be applied to other contexts and not only specifically to the renovation of ancient hamlets. In fact, with a view to sustainable development, it is advisable that, before the implementation of a project of any kind, the territory, with its economic context and socio-anthropological dynamics, is studied and analysed in depth. Only in the second instance, once the feasibility conditions have been verified and it has been ascertained that they bring real benefits to the local people, can a project then be implemented in the area.

Secondly, according to the SWOT, in addition to revitalising old hamlets, it would also be important to encourage the modernisation and renovation, both in terms of management and aesthetics, of outdated accommodation facilities, making the villages



more attractive. In addition to this, at the territorial level, if the digitalisation and connectivity aspects of the valley were improved and enhanced, one could aim at attracting forms of digital nomadism, with the consequent possible development of new communities that, living directly in the area, would turn the local economy around, thus contributing in part to keeping it alive.

Moreover, a very relevant aspect concerns the encouragement and support by administrations for the creation of new activities in the area so that young people can stay, thus being a powerful strategy against depopulation. Especially in the area of agriculture, focusing more on the agricultural sector, exploiting the enormous hidden potential of this sector, which is often underestimated, could prove to be a winning strategy. A type of agriculture different from the industrial model, based on agroecology, sustainability and organic crops, could be supported, and projects related to the recovery of the valley's ancient crops, rediscovering ancient grains, or the cultivation of innovative crops such as saffron and genepi could be encouraged.

On the other hand, as far as the naturalistic aspect is concerned, according to stakeholders' opinions, the creation of a natural park and a related access regulation system is necessary in order to protect fragile ecosystems and areas of high environmental value. In fact, the main attractions in the area can almost always be reached by car or motor vehicle. At the same time, through the creation of 'protected zones' where access is only permitted on foot or by means of special shuttles, a connection and transport system should be designed ad hoc that can still make the area usable and accessible.

Furthermore, it would be desirable for local authorities and administrations to adopt a development line that is also shared with individual citizens so as to pool resources, funds, and energy, based on integrated territorial planning. First of all, by balancing funds and investments on various sectors, without focusing only on ski tourism, one could stimulate development and strengthen other models of tourism, based on completely different philosophies than mass tourism related to the ski industry. On the other hand, however, support from local and territorial authorities for this sector is clear, as it is the most profitable sector and the one that creates the greatest inducement in the local economy. It is indeed difficult to find alternative activities that move the same numbers as the ski sector, but diversification of activities can be a winning strategy.

According to stakeholders, environmental and landscape diversity should be exploited in order to expand or enhance alternative activities to skiing in the area, such as climbing, mountain biking, ski touring, and canyoning. The development, strengthening and promotion of these activities in the area should be economically supported by local institutions and the consortium, so as to expand the offer and target tourists as much as possible, lengthen the average stay and also attract foreign tourism. In fact, foreign tourists are much less pretentious than Italians, require less infrastructure and appreciate the natural and wild landscapes as they are, without too many demands. Secondly, greater care of the territory should be aimed at in several respects, starting with the maintenance, cleaning and efficient management of the trail network, mountain bike routes and climbing crags, and ending with the maintenance of territorial signposting.

From the governance point of view, based on the information obtained from the interviews, there is a need for a change of mentality, direction and paradigm within the territorial authorities that administer the territory. Through the development of a common vision among municipalities, citizens and territorial authorities and bottom-up, inclusive and participatory planning, also in order to prepare for the impacts of climate change, it is advisable to start developing and focusing on projects aimed at increasing the resilience of the local population and raising awareness of climate change and its impacts, also through awareness-raising actions on the issue. These projects must also aim at a slower type of tourism that is more sensitive and aware of the current climate situation, less consumerist and less impactful. To this end, it is necessary to focus on the quality of experiences and not on quantity. Forms of experiential tourism should be promoted and proposed, which allow travellers to get to know the mountains more closely in their most authentic and true form, in which both the history and culture of the place and the local food and wine are valued. For example, one could aim to organise a day in a mountain pasture, where one works together with the local people making cheese, cutting wood, milking, etc.

Another objective that would bring great benefits to the valley and that local authorities should focus on is the development of seasonal adjustment strategies. This term refers to a strategy that is used to shape tourist flows throughout the year and avoid them all being concentrated in a certain period, thus allowing activities to be maintained on an annual scale and bringing great benefits to both locals and tourists. Some deseasonalisation strategies that could be successful are related to the promotion of

activities during the week rather than weekends so that refuges can remain open all the time, to the proposal of tourist packages with discounts in the low season, and to the organisation of events in less frequented periods (to date there is the Valmalenco Ultra Trail, but it is an isolated event).

In addition, again with regard to governance, there is a wish for more efficient and structured territorial planning, aiming to give continuity to territorial investments. In fact, according to the interviews, a very relevant issue concerns the brevity of objectives. Many actions are undertaken during a five-year municipal administration and then abandoned, thus bringing no benefit to the territory. At the same time, there is also a need for an efficient and structured tourist promotion of the territory, which would make the valley attractive and aim at enhancing its uniqueness and peculiarities.

With regard to social, cultural and service aspects, in order to restore value to the ancient roots and cultural and social heritage of the place, very interesting actions could be planned, such as the recovery of old terraces where ancient crops were cultivated in the past, the maintenance of old mule tracks and dry stone walls. The interviews also show that it is not necessary to strive for perfection; on the contrary, it is better to maintain the identity of the place, not distorting it and preserving its authenticity.

On a social level, a very important aspect that emerged is the encouragement of collaboration between schools and activities in the area. According to the stakeholders, in fact, projects to raise awareness of environmental protection and outdoor education projects should be promoted to a greater extent, in collaboration with mountain guides or local realities, with the dual aim of having children acquire certain skills directly in the field and to make them more aware of the natural heritage that surrounds them. In addition, cultural/sports events could be promoted that focus on the environment and issues of climate change, mountains, and resources using innovative, inclusive, shared and non-frontal approaches. Lastly, university research centres on mountains, environmental issues and climate change could be created in the area, thus increasing the flow of people that feed the area's economy.

Finally, moving on to the analysis of opportunities related to the ski sector, with the development and implementation of the projects included in the Territorial Pact signed between the F.A.B., the Region of Lombardy and the three municipalities involved, there could be a relaunch of the ski sector for the next few years and of the related

tourist brand. In fact, the pact would allow for the realisation of several projects in the upper valley: in addition to the construction of new facilities or the modernisation and renovation of the old ones, it also envisages the renovation of the swimming pool in Chiesa, the renovation of the parking area at the start of the facilities, and the renovation/expansion of the service centre in Chiesa, thus bringing innovation in services with related benefits for the local people. The problem that arises is the following: while the expansion of the ski area may boost the economy and the ski sector, it also creates a lot of environmental damage. Moreover, the intervention is in any case a containment of the problem, as the climate crisis is bound to worsen and the related impacts to become more acute. From the interviews, there are in fact those who argue that, instead of continuing to build new infrastructures and facilities, we should focus on what already exists and therefore on better management of the current area. What is most appropriate in this area today is therefore to focus on implementing a sustainable transition of the ski area and the resort as a whole, encouraging the development of alternative activities and enhancing the Lake Palù area through the promotion of summer activities. It would therefore be necessary to adapt the ski lifts to transport bicycles, keep the trail network clean, and take care of signposting for both trekking and mountain biking routes in order to attract more people.

After a careful investigation of opportunities as possible lines of development to follow, we now move on to the analysis of possible threats to the projects and actions listed above.

One of the most significant threats is primarily the phenomenon of depopulation. As it stands at present, depopulation could either increase or slow down depending on whether the development of the above actions prove to be successful strategies or not. It is more likely to increase if the ski resort is closed, but this is an unassessable, uncontrollable and unpredictable factor at present.

Another phenomenon that could pose a threat is climate change. Based on the above studies, it is easy to foresee that the current effects it has on the environment will become more acute in the near future. These will include a further reduction in snow cover and a decrease in the amount of precipitation, retreat of glaciers, weakening of mountain ecosystems, and a further increase in temperature with significant impacts on mountain environments and the associated human system. In particular, the agricultural

and livestock sector will be most affected due to lack of water and changes in crops, and the ski sector. Added to this is the increase in snowmaking production costs due to higher energy prices. It would further burden the public system, which would intervene to support the sector through the provision of additional and more massive public funding.

At the governance level, among the greatest difficulties to be found in the implementation of territorial actions are the enormous risk of economic speculation and squandering of money connected to the implementation of large projects, which at the territorial level turn out to be unfeasible and unsustainable, also due to a lack of prior planning and context analysis.

Furthermore, the lack of foresight, planning and courage on the part of administrations and territorial authorities could prove to be a threat in the implementation of alternative development and adaptation strategies. On the basis of the SWOT analysis, the application of territorial development models copied from other realities, which are radically different from the Valmalenco, both from an environmental and morphological point of view and from a social point of view, could also prove to be a failure and cause greater damage to the territory.

Lastly, not to be underestimated as a threat is that of the persistence of investment in a single sector. The risk is that the system does not change, and at the level of the territorial development line, an unsustainable, 'mass' type of tourism continues to be nurtured, which brings with it enormous damage to the environment. This runs the risk of leading to the standardisation of natural environments in order to facilitate access and make the landscape attractive, and to the destruction of wilderness areas due to the excessive frequency and construction of infrastructure and new buildings.

## **6. CHAPTER VII: POSITIVE EXAMPLES OF SUSTAINABLE DEVELOPMENT IN THE ITALIAN ALPS**

Three positive and virtuous examples of alpine resorts that have found an alternative development path, oriented towards all-round sustainability, are analysed below, opposing the tourist industrialisation model linked to the ski industry. Different models that testify that there is no single correct development path, indeed it is right for each place to find the one best suited to itself, but all based on a shared and common ideal: to preserve and guarantee a future for the mountains and their people.

### **6.1. Valpelline (Valle d'Aosta)**

Devoid of famous mountains and ski-lifts, Valpelline, in the Aosta Valley, has in a decade become an example of how 'another snow' for the Alps can really exist. In fact, this valley is a laboratory where a new way of conceiving white tourism is being experimented. In 2012, the NaturaValp association was founded in this valley, which now has 35 members in the area, including accommodation facilities, refuges, farms, businesses, mountain and hiking guides (NaturaValp, n.d.). Valpelline has no ski-lifts, has refused heli-skiing, has only a small, technical cross-country loop of only 5 km, does not overlook the perfect pyramid of the Matterhorn, and does not contemplate the Mont Blanc massif. But the data speak for themselves. From the data collected prior to 2019, which can therefore be considered systematic and complete, winter presences in the valley have risen from 800 to 10000 in just five years, and from 30000 to 50000 overall (Balocco, 2022). But Valpelline has decided not to accept so-called 'mass' tourism and has established strategies that have proved successful.

The real key came from the NaturaValp operators who decided to propose and promote a slower and gentler type of tourism. Together with them, the local people followed them and encouraged their development.

Today, in winter, the valley offers not only snowshoe hikes and excursions, even at night, but also visits to local farms, craftsmen's workshops, walks along frozen streams, accompanied by mountain guides, and photographic walks (ibid.). In this way, one comes into contact with those who live, work and care for these places. The NaturaValp operators realised a few years ago that it was necessary to start from there, from both

the environmental and cultural roots of that land, from the cultural and human landscape behind it.

Today, many people come to Valpelline for long stays, generating a tourism that is different from the daily tourism linked to the ski facilities. Tourism of this kind generates ancillary income, but above all it is an engine of knowledge and awareness.

## **6.2. Valle Maira (Piedmont)**

As for the Maira Valley in Piedmont, it also has a very interesting history. Like Valpelline, the Maira Valley also lacks ski lifts and ski areas. During the boom years of the ski industry, there were studies on the feasibility of creating one, but thanks to the foresight of the president of the mountain community at the time, permission was not given for its construction (CAI, 2023). The valley thus remained completely intact, untouched by mass tourism and wild, also thanks to its geomorphologic and orographic characteristics that made access to the valley difficult. Precisely because it was not anthropised, the valley retained its purest and freest side, and it was this that decreed the success of the strategy and line of development pursued (ibid.).

In stark contrast to the neighbouring valleys, over the years the valley developed quality winter tourism, attracting many foreign (especially German) tourists. It has focused on the diversification of activities and the valorisation of territorial resources, both natural, historical and cultural, as well as enogastronomic, without building additional infrastructure or real estate. The first ski mountaineering weeks were born in this valley and it is precisely this activity that is most popular. In just a few years, it has thus become a popular destination for those who love wild nature, fresh uncontaminated air and a return to a real and simple dimension.

The long and popular trail network allows for numerous circuits and walks, ranging from those in the middle of the valley in the middle of the woods, which are generally shorter, to those in the high valley, on the rocky and wild peaks, which can last several days. Added to this are the cross-country skiing trails, climbing crags, via ferrata routes and delicious local, quality food.

Given the orographic conformation of the territory and its somewhat isolated and out-of-the-way location, the Maira Valley has attracted people who stay in the area even for weeks at a time, thus representing a nice return for the local economy.

### **6.3. Val di Funes (South Tyrol)**

Val di Funes lies at the foot of the Odle - Geislerspitzen massif and presents a landscape beauty of great rarity. The Unesco Dolomites Foundation describes it as 'a succession of incredible landscapes: from limestone plateaus to pastures, from peaks and majestic walls to deep gorges and fairytale forests' (Dematteis, 2022). On the one hand, therefore, it already possesses a certain intrinsic value of attraction, but on the other, it has managed to develop a model of tourism based more on relationships than on concrete. In fact, this valley, with its substantially intact environment and human activity dedicated to the forestry-pastoral economy, despite the mass tourism policies of the neighbouring valleys, 'has chosen to be itself, making this trait an element of tourist attraction, without, however, losing its own identity,' Dematteis reports (ibid.). It is outside, but not far from, the major ski resorts in the area and its choice is conscious, convinced and courageous. In fact, the valley has decided to reverse course with respect to the development models present in the area and to invest in a form of tourism based on the rediscovery of authenticity and simplicity. It now bases its hospitality on the valley's historic dwellings, the masi, rather than on large hotel structures. This attracts more discerning people, people who want to discover new worlds and connect with nature, places and the local community.

As Dematteis reports (ibid.), "the model developed in Val di Funes can be defined as sustainable and related to relational tourism; in this vision, all the subjects of the territory become protagonists of the tourism proposal, farmers and breeders, agritourists and hoteliers, artisans and custodians of history and memory". The concept of relational tourism is based on an idea of responsible tourism, where the heart of the welcome is people. It was then associated with the strategy of diffuse hospitality, which in Val di Funes has found a favourable context, the maso. The maso, reports Dematteis (ibid.) "represents 'a small ecosystem in which there is very little that is artificial and which invites you to a different relationship of time and space", allowing the tourist to interweave relationships, exchange experiences with the local people and learn ancient



knowledge and traditional practices that are now almost forgotten, such as milk processing, the production of cheese, fresh bread and butter and wool processing.

## CONCLUSIONS

To conclude what has been analysed and elaborated above, some reflections concerning the territorial context of the Valmalenco with the possible strategies of adaptation to climate change and the development alternatives that have been elaborated during the research thanks to the analysis tools and methodology reported are reported below. They take into account the territory in its complexity, analysing it from a social, environmental and economic point of view and try to be as applicable as possible also due to the fact that they are based on a participative and inclusive approach and therefore directly on the opinions, perceptions and ideas of the local people.

In this situation of stagnation in the ski market, strong international competition, ongoing climate change and socio-environmental conflicts between the protection of biodiversity and the exploitation of natural resources, it is necessary to outline a type of development of mountain areas that proposes an in-depth reflection on the downhill skiing economy and the model of 'mass' tourism and at the same time offers valid alternatives to mountain communities, wherever they reside and regardless of the presence of ski lifts.

First of all, it was confirmed by environmental and meteorological data that the ski sector is today in a moment of serious crisis, due to climate changes that alter atmospheric parameters and lead to a reduction in snow cover, an increase in the rain-snow limit, and a decrease in atmospheric precipitation. In the case of Chiesa in Valmalenco, since the ski resort is still located at rather high altitudes, the ski-related sector, even though it is now in a period of stagnation, still manages to survive. On the other hand, however, its survival is linked to the fact that it receives massive economic support from the public body to meet the costs of maintaining the facilities and producing snowmaking. Without considering the impacts it generates on the territory's environmental structure, the growth of the infrastructure and the expansion of the skiable area therefore represents a possibility to relaunch the local economy, but it must be considered as a temporary situation to buffer the environmental problems that make it a more fragile system day by day.

Indeed, different and contrasting opinions emerged from stakeholders regarding this sector and its development, thus revealing the extent to which it constitutes a socio-environmental conflict in the area. On the one hand, in fact, it embodies a model that

over the years has undoubtedly allowed Alpine development and contained depopulation in the area, and therefore its expansion could contribute to relaunching the local economy. On the other hand, in addition to the impacts it again generates on the mountain environment, it requires the use of large public economic resources and leaves no room for the development of alternative forms of tourism. The concept of a 'monoculture' of skiing therefore applies perfectly in this context. The subsidies provided by public bodies to support this sector are seen by many stakeholders as 'the tail end of the dying dinosaur' in which an attempt is made to maintain a system that is completely unsustainable in the current climate context. It would therefore be necessary to start planning a sustainable transition of the ski area, which could already partly take place through the enhancement of summer activities (adapting the ski lifts to the transport of bicycles, for example, maintenance of the network of trails and mountain bike routes...) and the valorisation and promotion of the area for the natural beauty it possesses.

In this regard, the interviews conducted with the territorial stakeholders that were selected for the purpose of the research revealed the need to start thinking about and designing alternative development models for the area under analysis, which would allow for the survival of the mountain area and its complex socio-anthropological structure. Although it has been pointed out that there is no alternative activity to skiing that can fully replace the scope and role that it has played in the mountain economy, it is essential to start thinking and practising a completely different development model that aims not only at enhancing territorial resources, but also at greater diversification of activities and a consequent deseasonalisation of tourist flows. With this in mind, it is not only important to aim for a more sustainable, conscious, slow and environmentally aware form of tourism, but also for a radical change in territorial planning and investment lines. Through more targeted attention and care for the territory, which would also allow the creation of new jobs for people specifically involved in the maintenance and cleaning of hiking trails, mountain bike trails, climbing crags, etc., it would be possible to give continuity to tourist flows, which would generate an induced activity in the local economy.

In addition, one of the objectives that can be pursued precisely at an integrated level is the development of greater attention to sustainability and the promotion of a tourist offer that focuses more on quality than on quantity, on hospitality, on the particularity of

the place and on taking care of it. It would therefore be necessary to focus and shift attention to a less consumerist and impactful development model than the 'mass' one linked to the ski sector, linked to slower, more responsible tourism, interested in the territory, its history, and its traditions. Connected to this, forms of experiential, rural and relational tourism could be promoted that emphasise the authenticity of the territory. The renovation and recovery of old hamlets in accordance with traditional architectural patterns could also prove in this context to be a great opportunity to create new job opportunities also related to the management of alternative and quality hospitality services.

In addition, this study shows the need for more efficient and sensible spatial planning on the part of local authorities, in which projects are evaluated in the light of the benefits they bring locally, and which have clearly defined objectives and meanings, without leading to the denaturalisation of places. For some large-scale territorial projects, it would then be desirable for them to have a longer-term vision and for it not to be limited to the duration of an administrative cycle. Still in the area of governance, in order to pursue and implement common objectives, it would be necessary to grow a shared vision between municipalities, citizens and territorial authorities on the lines to be taken at territorial level in the various areas. In this regard, it would be crucial to design a bottom-up methodology in decision-making processes, in which individual citizens can also express their opinions on different issues.

Again at the level of territorial governance, it is also necessary to start strengthening lesser-regarded sectors, such as those linked to mountain agriculture, livestock breeding, and handicrafts, a factor that could also prove successful in curbing depopulation somewhat. Through the promotion of the agro-ecological, sustainable and organic model, it would be possible to recover the ancient local crops, preserving some species of ancient grains and experimenting with new ones, such as saffron and genepì for example.

Subsequently, it is crucial that local authorities start working on targeted projects and emerging themes with the aim of raising awareness and knowledge about climate change and its problems, with a view to the future exacerbation of the climate crisis. To this end, events, debates, conferences, festivals, and meetings should be promoted at all levels, in which through the co-construction of knowledge, brought about by dialogue,

exchange of information, experiences among the actors involved, and the presentation of concrete examples of resilience, a structured planning can be achieved that outlines possible mitigation and adaptation actions to be undertaken to tackle climate change. Collaborations with schools and universities should also be encouraged in order to raise awareness or implement more sustainable and intelligent territorial projects.

In the light of the results of this study, it is therefore crucial that the adaptation and development strategies necessary to maintain the mountain system and its population are all oriented towards sustainability and the development of a more conscious and gentle tourism, and are implemented through the valorisation of territorial resources, the recovery and revitalisation of what is already present in the territory, the promotion of strategies that diversify activities and deseasonalisation, and the increase of local communities' resilience in the face of future challenges related to climate change.

Finally, the case studies presented as examples of positive development in the Alps show that there are realities that have developed and are still pursuing models based on completely different logics from those on which many mountain resorts still depend, still too closely linked to the ski industry. They show that a different type of tourism exists and is based on gentler philosophies, more connected to the environment, more attentive to the land and local communities, and completely detached from any plans to anthropise and cement the mountains. These three examples show us that we need to start again from the earth, from the deep roots of places, be they natural or socio-anthropological. We must focus on building relationships, rediscovering ancient trades and knowledge, and making the most of the human factor because, in a context of climate crisis such as the current one, along with nature, it is the local population that represents the real capital to be valued and protected.

To conclude, as Dematteis (2022) reports, “without a fertile community substratum, capable of interpreting the breakdown of flows, any development and work planned in purely technical-functional terms will absorb a lot of financial capital but will not produce the social capital necessary to make the Alpine mountains the place of a new spring after the long liquid winter”.

## BIBLIOGRAPHY

Abegg, B., Jetté-Nantel, S., Crick, F., & de Montfalcon, A. (2007). *Climate Change in the European Alps: Adapting Winter Tourism and Natural Hazards Management*. In S. Agrawala (Ed.), OECD Publishing.

Alpine Convention. (2006). *Declaration on Population and Culture*. Retrieved from [https://www.alpconv.org/fileadmin/user\\_upload/Convention/EN/Declaration\\_Population\\_and\\_Culture\\_EN.pdf](https://www.alpconv.org/fileadmin/user_upload/Convention/EN/Declaration_Population_and_Culture_EN.pdf)

AltriSpazi. (2020). *Adolfo Kind*. Retrieved from <https://www.sherpa-gate.com/altrispazi/adolfo-kind/>

Angelini, P., & Emma, M. (2015). La convenzione delle Alpi per la popolazione e la cultura alpine. In *Popolazione e cultura: le Alpi di oggi* (pp. 21). FrancoAngeli.

Balocco, F. (2022). *L'Onu premia "NaturaValp": Valpelline, un bell'esempio di turismo montano sostenibile*. Italia libera. Retrieved from <https://italialibera.online/primo-piano/interviste/lonu-premia-naturavalp-valpelline-un-bellesempio-di-turismo-sostenibile/>

Brenna, L. (2015). *L'impatto ambientale della neve artificiale*. LifeGate. Retrieved from <https://www.lifegate.it/sciare-tutti-costi-limpatto-ambientale-della-neve-artificiale>

CAI. (2020). *CAMBIAMENTI CLIMATICI, NEVE, INDUSTRIA DELLO SCI: Analisi del contesto, prospettive e proposte*. Retrieved from <https://www.cai.it/wp-content/uploads/2022/03/DOCU-NEVE-FINALE.pdf>

CAI. (2023). *L'altra neve. La Val Maira con la veste bianca*.

Calufetti, P. (2013). *Valmalenco, chiude la stazione sciistica di Caspoggio*. montagna.tv. Retrieved from <https://www.montagna.tv/44933/valmalenco-chiude-la-stazione-sciistica-di-caspoggio/>

Camanni, E. (2005). *L'alpinismo e lo sci*. In *Torino e lo sport. Storia e immagini*. Archivio Storico della Città.

Camanni, E. (2016). *Alpi ribelli. Storie di montagna, resistenza e utopia*. Editori Laterza.

- Camanni, E. (2017). *Storia delle Alpi. Le più belle montagne del mondo raccontate*. Edizioni Biblioteca dell'immagine.
- Canetta, E., & Canetta, N. (2006). *Le tracce dei secoli: conosciamo meglio il nostro territorio*. Comune di Caspoggio, Sondrio.
- Carrer, M., Dibona, R., Prendin, A. L., et al. (2023). Recent waning snowpack in the Alps is unprecedented in the last six centuries. *Nature Climate Change*, 13, 155–160. <https://doi.org/10.1038/s41558-022-01575-3>
- Casanova, L. (2020). *Gli impatti ambientali dell'industria dello sci*. Mountain Wilderness website. Retrieved from <https://www.mountainwilderness.it/editoriale/gli-impatti-ambientali-dellindustria-dello-sci/>
- Comunità Montana Valtellina di Sondrio (CMVS). (2011). *Piano di indirizzo forestale (periodo di validità 2011-2025). Relazione generale. Tavole di Piano*. Sondrio.
- Consorzio Artigiani Cavatori Valmalenco. (2002). *Serpentinoscisto della Valmalenco*. Torino.
- Corrado, F. (Ed.). (2015). *Popolazione e cultura: le Alpi di oggi*. FrancoAngeli. (p. 28).
- De Rossi, A. (2014). *La costruzione delle Alpi. Immagini e scenari del pittoresco alpino (1973 – 1914)*. Donzelli Editore.
- Dematteis, L. (1975). *Alpinia. Testimonianze di cultura alpina*. Ivrea. Priuli & Verlucca.
- Dematteis L. (1994). *Alpinia 2, le Alpi e la loro gente* (collana “Il tempo delle Alpi”). Priuli & Verlucca
- Dematteis, M., & Nardelli, M. (2022). *Inverno liquido. La crisi climatica, le terre alte e la stagione dello sci di massa*. DeriveApprodi Srl.
- Ferlinghetti, R. (Ed.). (2022). *Valmalenco. La trama sottile del paesaggio. Paesaggi minimi, invarianti strutturali e radici culturali della valle*. FrancoAngeli.
- Food and Agriculture Organization of the United Nations (FAO). (2023). *Why the Alps matter*. <https://www.fao.org/3/cc5419en/cc5419en.pdf>
- Hahn, F. (2004). *Künstliche Beschneigung im Alpenraum*. CIPRA-International.

Hamberger, S., Doering, A. (2015). *Der gekaufte Winter. Kurzfassung. Eine Bilanz der künstlichen Beschneigung in den Alpen*. Gesellschaft für ökologische Forschung und BUND Naturschutz in Bayern BN e.V. (BN)

History of Skiing. (n.d.). In FIS official website. Retrieved 10 July 2023, from <https://web.archive.org/web/20121204193649/http://history.fis-ski.com/>

Hock, R., et al. (2019). Title of the Chapter. In H. O. Pörtner et al. (Eds.), *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate* (pp. 131–202). Cambridge University Press.

Intergovernmental Panel on Climate Change [IPCC]. (2023). *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press. <https://doi.org/10.1017/9781009157896>

IPCC. (2023). *Summary for Policymakers*. In: *Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 1-34. <https://doi.org/10.59327/IPCC/AR6-9789291691647.001>

Istituto Nazionale di Statistica (ISTAT). (2010). *Glossario - MOVIMENTO DEI CLIENTI NEGLI ESERCIZI RICETTIVI* [Documento PDF]. <https://www.istat.it/it/files/2011/12/glossario1.pdf>

Knight, J. (2022). Scientists' warning of the impacts of climate change on mountains. *PeerJ*, 10, e14253. <https://doi.org/10.7717/peerj.14253>

Legambiente (Eds.; Bonardo, V., et al.). (2023). Dossier Nevediversa: Il turismo invernale nell'era della crisi climatica.

Legambiente. (2023). *Report Nevediversa 2023* [Documento PDF]. Legambiente. [https://www.legambiente.it/wp-content/uploads/2021/11/Report-Nevediversa\\_2023.pdf](https://www.legambiente.it/wp-content/uploads/2021/11/Report-Nevediversa_2023.pdf)

Ludovici, A. A., Bonardi, L., Daidola, G., Furlani, R., Macchiavelli, A., Minghetti, V., Scotti, R., Tonghini, C. (2006). *Alpi e turismo: trovare un punto di equilibrio*. WWF Italia.



Macchiavelli, A. (2017). *Il turismo della neve nelle Alpi italiane: nascita, sviluppo e cambiamento*. Histoires des Alpes.

Masa, S. (2023). *Uno sbocco sulla Rezia: la Valmalenco*. Distretto Culturale della Valtellina.

Masson-Delmotte, V., Zhai, P., Pirani, A., Connors, S. L., Pean, C., Berger, S., Caud, N., Chen, Y., Goldfarb, L., Gomis, M. I., Huang, M., Leitzell, K., Lonnoy, E., Matthews, J. B. R., Maycock, T. K., Waterfield, T., Yelekci, O., & Yu, R. (2021). *Climate change 2021: The physical science basis: Contribution of working group I to the Sixth Assessment Report of the IPCC* (B. Zhou, Ed.). Intergovernmental Panel on Climate Change (IPCC).

Matiu, M., et al. (2021). Observed snow depth trends in the European Alps: 1971 to 2019. *Cryosphere*, 15, 1343–1382.

Morandini, C., & Reolon, A. (2010). *Alpi Regione d'Europa, da area geografica a sistema politico*. Marsilio.

Nerem, R. S., Beckley, B. D., Fasullo, J. T., Hamlington, B. D., Masters, D., & Mitchum, G. T. (2018). Climate-change-driven accelerated sea-level rise detected in the altimeter era. *Proceedings of the National Academy of Sciences (PNAS)*, DOI: 10.1073/pnas.1717312115

Niittynen, P., Heikkinen, R. K., & Luoto, M. (2018). Snow cover is a neglected driver of Arctic biodiversity loss. *Nature Climate Change*, 8, 997–1001.

NOAA Global Monitoring Laboratory. (n.d.). Global Greenhouse Gas Reference Network: Trends in greenhouse gases. <https://gml.noaa.gov/ccgg/trends/> Assessed on 25 July, 2023.

NOAA National Centers for Environmental Information. (2023). Monthly Global Climate Report for Annual 2022. Published online January 2023. Retrieved on July 25, 2023, from <https://www.ncei.noaa.gov/access/monitoring/monthly-report/global/202213/>

Permanent Secretariat of the Alpine Convention. (2015). *Report on the state of the Alps - Alpine Signals – Special Edition 5* [Documento pdf]. Alpine Convention. [https://www.alpconv.org/fileadmin/user\\_upload/Publications/RSA/RSA5\\_EN.pdf](https://www.alpconv.org/fileadmin/user_upload/Publications/RSA/RSA5_EN.pdf)

Reinboth, C. (2019). *Die Zukunft der künstlichen Beschneigung in Mitteleuropa: Konzeptionierung eines Decision Support Systems* [Tesi di laurea magistrale, FernUniversität Hagen].

Salsa, A. (2005). *Popolazioni e cultura alpina*. CAI ligure, Genova.

Steiger, R., Knowles, N., Pöll, K., & Rutty, M. (2022). Impacts of climate change on mountain tourism: a review. *Journal of Sustainable Tourism*. <https://doi.org/10.1080/09669582.2022.2112204>

Steiger, R., Scott, D., Abegg, B., Pons, M., & Aall, C. (2019). A critical review of climate change risk for ski tourism. *Current Issues in Tourism*, 22(11), 1343-1379. DOI: 10.1080/13683500.2017.1410110

Touring Club Italiano. (1911). *1° Annuario di turismo e sports invernali*. TCI.

Willibald., F., Kotlarski, S., Ebner, P. P., Bavay, M., Marty, C., Trentini, F. B., Ludwig, R., Grêt-Regamey, A. (2021). Vulnerability of ski tourism towards internal climate variability and climate change in the Swiss Alps. *The Science of the total environment*. DOI: 10.1016/j.scitotenv.2021.147054

*Zusammenfassung Der gekaufte Winter* (2015). Retrieved from [https://www.bund-naturschutz.de/fileadmin/Bilder\\_und\\_Dokumente/Presse\\_und\\_Aktuelles/2015/PM\\_FA\\_27\\_15\\_Anlage\\_1\\_Zusammenfassung\\_Der\\_gekaufte\\_Winter\\_081215.pdf](https://www.bund-naturschutz.de/fileadmin/Bilder_und_Dokumente/Presse_und_Aktuelles/2015/PM_FA_27_15_Anlage_1_Zusammenfassung_Der_gekaufte_Winter_081215.pdf)

## SITOGRAPHY

Arpa Lombardia. (n.d.) <https://www.arpalombardia.it/temi-ambientali/meteo-e-clima/form-richiesta-dati/>

Associazione Funivie. (n.d.). *Chiesa in Valmalenco - Funivia Alpe Palù*. Retrieved from <https://www.funivie.org/web/chiesa-in-valmalenco-funivia-alpe-palu/>

Centro della montagna. (n.d.). <https://www.centrodellamontagna.com/>

CIPRA. (2018). *The Alps*. Retrieved from [https://www.cipra.org/en/topics/alpine-politics/alps#:~:text=The%20Alps%20as%20region%20of,3\)%20and%20about%206%2C200%20communities.](https://www.cipra.org/en/topics/alpine-politics/alps#:~:text=The%20Alps%20as%20region%20of,3)%20and%20about%206%2C200%20communities.)

Climate.gov. (n.d.). Climate Change: Global Temperature. Retrieved from <https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature/>

Copernicus Climate Change Service. (s.d.). *Alpine Glaciers*. <https://climate.copernicus.eu/alpine-glaciers/>

CREA Mont-Blanc. (s.d.). *Climate Change and Its Impacts - Alps*. <https://creamontblanc.org/en/climate-change-and-its-impacts-alps/>

Ecomuseo Valmalenco. (n.d.). Alpinismo. <https://www.ecomuseovalmalenco.it/percorsi/percorsi-del-turismo/alpinismo/>

Ecomuseo Valmalenco. (n.d.). Ambiente naturale. <https://www.ecomuseovalmalenco.it/la-valle/ambiente-naturale/>

Ecomuseo Valmalenco. (n.d.). Il serpentino e le piode. <https://www.ecomuseovalmalenco.it/percorsi/percorsi-del-lavoro/il-serpentino-e-le-piode/>

Ecomuseo Valmalenco. (n.d.). *Le unioni*. <https://www.ecomuseovalmalenco.it/la-valle/le-unioni/>

*Fondo per lo sviluppo delle montagne italiane: energia in vetta*. Dipartimento per gli Affari Regionali e le Autonomie (DARA)

<https://www.affariregionali.it/comunicazione/notizie/2023/maggio/fondo-per-lo-sviluppo-delle-montagne-italiane-energia-in-vetta/>

Geoportale Provincia di Sondrio. (n.d.).

<https://webgis.provinciasondrio.it/map/?mapset=geoportale>

Interreg Alpine Space TranStat. (n.d.). <https://www.alpine-space.eu/project/transtat/>

ISTAT. (n.d.). <https://www.istat.it/>

Lavazza, M. (2017). *Mappare gli stakeholders*.

[https://medium.com/@mc\\_lavazza/mappare-gli-stakeholder-51e1f175417b](https://medium.com/@mc_lavazza/mappare-gli-stakeholder-51e1f175417b)

*Metodo di Ricerca Accademica*. Compilatio.

<https://www.compilatio.net/it/blog/metodo-ricerca-accademica>

Ministero Italiano del Turismo. (2023). *Fondo per l'ammodernamento, la sicurezza e la dismissione degli impianti di risalita e di innevamento artificiale*.

<https://www.ministeroturismo.gov.it/fondo-per-lammodernamento-la-sicurezza-e-la-dismissione-degli-impianti-di-risalita-e-di-innevamento-artificiale/>

Montagna.tv. (2010). *Sciata d'Epoca in Valmalenco*.

<https://www.montagna.tv/26595/sciata-depoca-in-valmalenco/>

NASA. (n.d.). Climate Change: How Do We Know? Retrieved from

<https://climate.nasa.gov/evidence/>

NASA. (n.d.). World of Change: Columbia Glacier, Alaska. Retrieved from

<https://www.nasa.gov/image-feature/world-of-change-columbia-glacier-alaska>

NaturaValp. (n.d.). <https://www.naturavalp.it/>

NaturaValp. (n.d.). <https://youtu.be/bqx3vSOSc-Q>

*Patto Territoriale Valmalenco*. Regione Lombardia. (n.d.).

<https://www.regione.lombardia.it/wps/portal/istituzionale/HP/DettaglioRedazionale/servizi-e-informazioni/Enti-e-Operatori/territorio/montagna/patti-territoriali/patto-territoriale-valmalenco/patto-territoriale-valmalenco#:~:text=In%20data%20%20marzo%202022,2792%20del%2031%20gennaio%202020>

Polis Lombardia. (n.d.). <https://www.polis.lombardia.it/wps/portal/site/polis>

Redazione Dovesciare.it. (2021). *Chiesa Valmalenco: Funivia al Bernina compie 60 anni*. Dovesciare.it. <https://www.dovesciare.it/news/2021-11-17/chiesa-valmalenco-funivia-al-bernina-compie-60-anni>

Regione Piemonte. (n.d.). *Consorzi Operatori Turistici*.  
<https://www.regione.piemonte.it/web/temi/cultura-turismo-sport/turismo/sistema-turistico/consorzi-operatori-turistici#:~:text=I%20Consorzi%20operano%20attraverso%20programmi,la%20prenotazione%20di%20servizi%20turistici>.

Treccani. (s.d.). *Alpi*. Alpi, in Treccani.it - Enciclopedie on line, Istituto dell'Enciclopedia Italiana. <https://www.treccani.it/enciclopedia/alpi> . Accessed on July 12, 2023.

Tuttitalia (n.d.) <https://www.tuttitalia.it/lombardia/24-chiesa-in-valmalenco/statistiche/popolazione-eta-sesso-stato-civile-2022/>

Tuttitalia (n.d.) <https://www.tuttitalia.it/lombardia/24-chiesa-in-valmalenco/statistiche/indici-demografici-struttura-popolazione/>

Tuttitalia. (n.d.) <https://www.tuttitalia.it/lombardia/24-chiesa-in-valmalenco/statistiche/popolazione-andamento-demografico/>

Unione Valmalenco. (n.d.). *Servizi Aggiuntivi*.  
<http://www.unionevalmalenco.it/cuncbdvm/zf/index.php/servizi-aggiuntivi/index/index/idtesto/25>

*Utilizzare gli strumenti di Analisi SWOT*. qualitapa.gov.it. Dipartimento della funzione pubblica. (n.d.). <http://qualitapa.gov.it/sitoarcheologico/relazioni-con-i-cittadini/utilizzare-gli-strumenti/analisi-swot/index.html>

*Valmalenco Alpe Palù*. Ski Resort. <https://www.skiresort.it/comprendorio-sciistico/valmalenco-alpe-palu/>

Valmalenco Ski Resort. (n.d.) <https://valmalencoskiresort.com/it/attivita-inverno/sci-fondo-in-valmalenco/>

Valmalenco Ski Resort. <https://valmalencoskiresort.com/it/valmalenco-ski-resort/chi-siamo/>

*Valmalenco, F.A.B. spa, una storia lunga 50 anni.* 24 Ore News.

<https://www.24orenews.it/home/turismo/news/6367-lombardia-valmalenco-so-f-a-b-spa-una-storia-lunga-50-anni-16-e-17-dicembre>

Wikipedia. (n.d.). *Comunità montana.*

[https://it.wikipedia.org/wiki/Comunit%C3%A0\\_montana](https://it.wikipedia.org/wiki/Comunit%C3%A0_montana)

Wikipedia. (n.d.). *Piano di governo del territorio.*

[https://it.wikipedia.org/wiki/Piano\\_di\\_governo\\_del\\_territorio](https://it.wikipedia.org/wiki/Piano_di_governo_del_territorio)

Wikipedia. (n.d.). *Valmalenco.* <https://it.wikipedia.org/wiki/Valmalenco>

## ANNEXES

Annex no. 1.

### **Semi-structured interview administered to territorial stakeholders**

1. What is your relationship with your territory, (your valley)?
2. What are the most popular activities carried out by people working in the territory at the moment? Do people experience the territory where they live? Which sector is considered a driving force for the local economy?
3. What is the situation of young people in the valley? What are the opportunities for young people living here? Do you perceive a return/repopulation of the mountains in recent years? What do you think is essential to encourage a return of young people to live in these areas?
4. How is the transport system in the valley? What about services? What infrastructure/services are there for the local population? Are they guaranteed all year round or only at certain times?
5. In your opinion, what are the strengths/uniquenesses and weaknesses of the valley and the area as a whole? Which resources should be focused on more?
6. What line of territorial and tourism development has been taken in your area over the years and is currently being followed? What is your opinion on this? Are deseasonalisation strategies and alternative forms of development already in place? Do you think that for an improvement in the quality of life in the mountains, the tourism component is fundamental?
7. What is your opinion on winter tourism, linked to ski facilities? Do you think it has positively or negatively altered the socio-economic fabric and the environment? How much does ski tourism weigh on the local economy?
8. For institutions/administrations: What methodology do you use in tourism-territorial planning? Are the people who live in the area normally involved? If yes, in what way? What do you think they should be more involved in and what not?

For individuals: How are relations with institutions and local authorities related to the development of the territory? Have you ever been involved in the territorial development of your area, or do you feel excluded from it? If yes, what approach has been used and what have you been involved in?

9. In your opinion, what are the main issues already visible (also in relation to your work) and what are the main challenges that the local community will have to face in the coming decades to cope with climate change and its impacts? Have any initiatives already been taken by citizens and institutions to try to address these issues?
10. Imagine that you have both the decision-making power and the funds to operate in the area, what would you focus on for the future development of your area? What is your future vision for the mountains?

Annex no. 2.



Annex no. 3.

