



A sustainable integration of mining activity in a tourist mountain territory: The case of *Germanasca Valley*

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ABSTRACT

Every mining activity shows a footprint on the territory. The signs left by mining operations are physical, such as tunnels, extractive waste facilities, dressing plants, but also economic and social, due to job placement, income and knowledge connected to mining activity *sensu lato*. In the extraordinary context of the Germanasca Valley, mining has coexisted for hundreds of years with the mountain environment of the Alps and with the local population, and has become a fundamental part of local development, intimately connected with the territory and the local economic and social fabrics.

The progressive migration of mining crops at lower altitudes has left behind old mining structures that here, more than elsewhere, guaranteed new forms of industrial and geo-tourism. Similarly, the technological advance and the evolution of mining production, towards a higher quality product, with a consequent reduction in the quantities exploited, led over time to a progressive reduction in the number of employed miners. The resilience of the local population, however, balanced the contraction of work in the mine, transforming former miners in tourist guides and increasing the induced activities, passing from the previous “in house” model to an “outsourcing” model, characterized by external management of mine-related activities. The transformation of old mines into museums has certainly contributed to the development of the area, particularly considering a slow tourism that shows scarce attitude to a “fast and junk” tourism. The challenge is to understand if and how geotourism influence, in specific mining areas (such as Germanasca Valley), the attractiveness of a place.

1. Introduction

Raw materials (RM) are the basis for the development of every societies and have always influenced, directly or indirectly, every type of human activity. Their importance grew more and more over time, becoming fundamental for technologies related to energy and vehicle decarbonisation, robotics, consumer electronics, digital transition, civil and military high technology (Jones et al., 2020). Responsible management of the mineral resources are therefore fundamental for the realisation of the ecological transition and for the achievement of many of the sustainable development goals.

Thanks to its geological setting, Italy has numerous and diversified mineral deposits spread over the entire territory, which have been exploited over the past centuries, with the higher production from the beginning of the twentieth century.

Until the middle of the XX century, the trend in mining activity was

continuously increasing, except for a slight reversal at the end of the 1920s and the beginning of the 1930s (corresponding to the adoption of R.D. 1443/1927, which regulated mining activity in Italy), and then decreasing after the WWII. According to the census carried out by ISPRA (Patanè et al., 2023), since 1870 there have been 3016 mining sites operating on the national territory. At present, however, the activity is residual. In 2020, 94 mining concessions are still in force, of these 76 are actually in production, mainly in Sardinia, Piedmont and Tuscany regions. At Italian level, among the so-called industrial minerals that are still being mined, the most important is talc, whose deposits are located in Chisone and Germanasca Valleys (Piedmont Region, northern Italy), in the succession of gneisses and mica schists of the Dora Maira massif, and in Malenco Valley (not object of the present research) Talc is often associated with graphite, whose deposits present in the Pinerolo area were found within fine gneisses and sometimes granatiferous mica schists.

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The present paper focuses on the Germanasca Valley, which can be considered a replicable and widely recognised case study to investigate and validate the close connection between still operating mines, not operating mines and territorial development, both related to mineral production and to tourism (geotourism). The close link between economic, social and environmental impacts (pillars of Sustainability) concerning mining and touristic activities is here highlighted.

2. Geography and geological setting of Germanasca Valley case study

Germanasca Valley, known in the past as San Martino Valley or Valley of Saint Martin, is an alpine valley extended for about 200 km², pertaining to the Cottian Alps sector (Piedmont, NW Italy). It is a narrow valley placed between Pellice Valley, to the South, and Chisone Valley, to the North-East. It is as long as the river Germanasca, that runs through it and from which it takes its name. Moreover, Germanasca river is a tributary to the orographic right of the Chisone river (Fig. 1) (see Fig. 2).

The provincial road n. 169, which runs parallel to the Germanasca stream, ensures quick access to the valley, which can be reached in about 90 min from Torino, capital of Piedmont Region. The valley is also crossed by a large number of secondary roads that allow adequate access to the side valleys of Salza, Massello and Conca Cialancia. The main inhabited centres, in addition to Perosa Argentina, are Pomaretto, Perrero and Prali, all distributed along the main axis of the valley. From an economic point of view, the Valley was characterized by widespread mining activities, as stated in the present research. Currently, the valley has assumed a predominantly tourist vocation, centred on the ski facilities present in the municipality of Prali. Traditionally, the Germanasca Valley is part of the Waldensian Valleys, where the absolute majority of the population follows the Waldensian cult, linked to Pietro Valdo, persecuted as a heretic in the Middle Ages.

The Germanasca Valley contains two important geological units of the Western Alps, the Dora Maira Massif and the Piedmont Zone. The first represents a unit of continental crust metamorphosed under eclogitic conditions, while the second includes high pressure and low temperature metamorphic rocks (from blueschist to eclogitic) derived from original oceanic rocks of Jurassic-Cretaceous age. The Piedmont Zone is a composite system of oceanic units, made up of two main groups defined as the Internal Piedmont Zone and the External Piedmont Zone. The Dora Maira Massif (DM) in the area is composed of two main *tectonic*

units of continental basement characterized by different alpine metamorphic evolution (review and references in ((Sandrone et al., 1990; Nosenzo et al., 2022) and references therein): the Lower Monometamorphic Unit, also known as the Sanfront-Pinerolo Unit (Vialon, 1966); (Borghi et al. 1835; Henry et al. 1993) and the Upper Unit (Vialon, 1966; Borghi et al.,).

The Fontane talc deposit has been studied several times (reviewed in Sandrone et al., 1987) and (Cadoppi et al., 2016). It is generally recognised as a layer that conforms to the bedrock and has an uneven orientation and thickness. In terms of mining, it can be considered as a series of coplanar lenses. This complex geometry is confirmed by a detailed reconstruction and has been interpreted by (Sandrone et al., 1987) and (Vialon, 1966; Sandrone and Zucchetti, 1989) as the result of a series of folding events. The Fontane talc deposit is the most important in Italy and one of the most important in Europe, due to the quality and quantity of the mineral extracted. For further data and a description of the geological setting of the area, see Supplementary Material part 1.

3. Industrial evolution and history of talc mining

Dating back to at least the 18th century, local inhabitants engaged in artisanal talc extraction from open-air mines, harvesting flakes from surface outcrops. The talc exploited in the area, known as "craie de Briançon," gained recognition across Europe for its purity, and its trade as tailor stone fuelled regional economies. Regulations governing talc extraction were established as early as 1780, signifying its economic value (Barelli, 1835).

Industrial exploitation burgeoned in the latter half of the 19th century, spearheaded by pioneers such as Mrs. Rostagno di Sagne, who initiated tunnel excavations and established processing facilities. The legal classification of talc as a second-class mineral in 1859 spurred further interest, leading to a rush for exploitable land.

Soon, a race for the ownership of potentially exploitable land took place, with the landowners also becoming the masters of the subsoil's riches. In the years that followed, several entrepreneurs, such as Count Enrico Brayda, initiated a range of small enterprises to extract the mineral. Subsequently, the **Société Franco-Italienne des mines de Talc du Piémont** and the **Anglo-Italian Talc and Plumbago Mining Company** also ventured into this domain. Talc was obtained from Prali, Salza, and Perrero municipalities in Val Germanasca, and Roure, Feneestrelle, Usseaux, and Prigelato in Val Chisone. The primary centre of

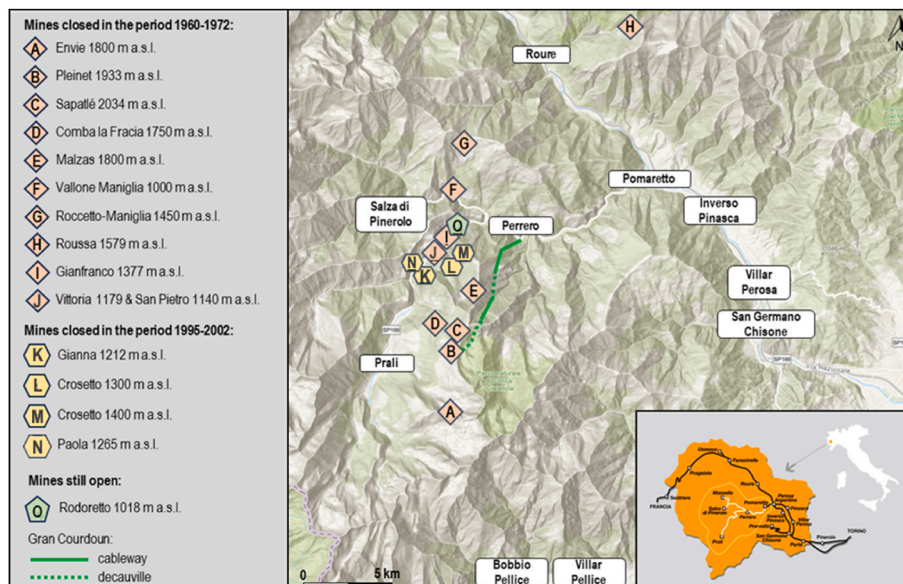


Fig. 1. Location of main mines in the Germanasca Valley.

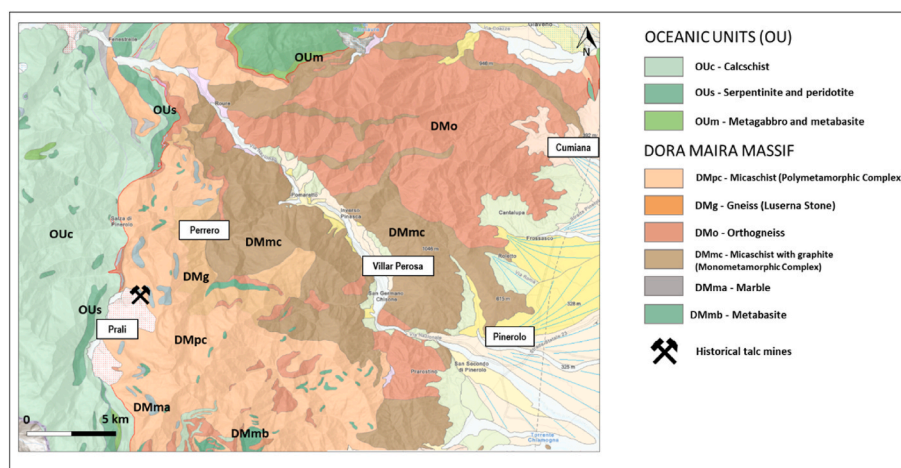


Fig. 2. Geolithological map of Germanasca Valley (Barale et al., 2020, Modified).

extraction was naturally Germanasca Valley, where several mining sites were established. Up until 1880, all small companies traded both talc and the associated pyrite to Briancon.

In 1907, the **Talco e Grafite Val Chisone Company** was established in Pinerolo, taking over the operations of the Talc and Plumbago Mining Company and several other mines in the Germanasca Valley. It also acquired all the Roussa concessions in the upper Val Chisone, becoming the exclusive enterprise for talc extraction in the Pinerolo valleys. Prior to 1927, mining companies were required to compensate landowners for permission to exploit the mineral deposits. This amount was a substantial source of revenue for both municipalities and private persons. The law of July 29, 1927 also implemented the mining scheme for talc, resulting in the soil becoming state-owned and the compensation paid to asset holders being substituted with a concession tax remitted to the State.

In the 1930s, mines at high altitude progressively became exhausted, and excavations began at Gianfranco (1377 m a.s.l.), Gianna (1212 m a.s.l.), Paola (1265 m a.s.l.), Vittoria (1179 m a.s.l.) and San Pietro (1140 m a.s.l.) mining yards, in what was to become the Fontane - Crosetto mining complex (Fig. 1).

The mining industry initiated a phase of decline in the 1960s. Initially, the peripheral mining sites (Maniglia, Malzas, Envie and Sapatlè) were abandoned, followed by mechanization of the extraction process. Mining operations were focused on the Fontane-Crosetto complex from 1967, producing about 40,000 tonnes a year. In 1990, the **Talco e Grafite Val Chisone Company** was acquired by RTZ and Talc de Luzenac SA taking the name of **Luzenac Val Chisone S.p.A.** then moved to **Rio Tinto Minerals** in 2006. In 2011 the company was acquired by the Imerys group and became **Imerys Talc Italy S.p.A.** The deposits of the Gianna/Paola mining complex were declared exhausted in 1995 and those of Crosetto in 2002.

The 1990s saw the exhaustion of several mining complexes, but innovation persisted with the inauguration of the Rodoretto section in Pomeifrè. Today, with modern infrastructure and a multinational workforce, talc production remains a cornerstone of the region's economy, continuing legacy centuries in the making.

For more data and information concerning mining of the area see Supplementary material part 2.

4. Employment in the mining industry

The Germanasca Valley talc is still being exploited for over than 250 years. Clearly, the industrial demand, the purity and quality of the mineral are the major reasons for its longevity. The historical development of the mine has been possible thanks to the wide availability of local and cheap labour. The extraction of talc has represented for the

Germanasca Valley the greatest job opportunity alternative to emigration for over 150 years and, in particular, for the whole of the XX century (Rochon, 1986). From 1907 to 1921, the maintenance of low wages is due to the monopoly held by the **Talco & Grafite Val Chisone** company, the only one operating in the valley. The mountain people, used to a pastoralist and agricultural occupation that, placed in front of to the emigration/mining alternative, choose the second one, are intensively adapted to a hard and poorly paid industrial work. Immediately before the First World War the economic crisis and the installation of the cableway at the Roussa mine, just outside the geographical boundaries of the Germanasca valley, but where many miners from the valley worked, result in less need for labour, especially for the talc transport; for this reason, several miners were fired. Every technical innovation introduced in mining technology has changed working conditions, but it has also had social consequences. In general, the main technical innovations have allowed greater productivity or the maintenance of previous productions, but with less need for workers. In the first case there has been an expansion of industrial activity, in the second case there have been redundancies and hard social struggles. Not considering the health problems caused, an example of the first case is the introduction of compressed air and the use of air drills from 1920s. This innovation, in combination with the law of 1927 that attributed to talc the mining regime, gave a remarkable impulse to the mining development and the production of mineral, reaching the maximum expansion in 1960, with 1580 employees and a talc production of 60.000 tons.

Other innovation factors that contributed to this astonishing expansion were the beginning of the transport of ore by truck from 1932 and the adoption of hydraulic injections drills from the late 1950s.

After the peak of 1960, there were difficulties linked to competition from other producing countries and production costs, despite the fact that miners were paid less than workers in industries. A long phase of trade union struggle had begun with repeated strikes (1954, 1957, 1962) to raise wages and production premiums.

Starting in 1965, the company began a major restructuring, with the progressive closure of high-altitude mines, depleted and/or less convenient and concentrated the production in the Crosetto-Fontane sector, at lower altitudes.

A part of the investment was directed to research and development of new uses for talc, allowing to present the talc of Pinerolo as "one of the purest talc and particularly suitable for pharmaceutical and cosmetics production" (Rochon, 1986).

In 1995, the new Rodoretto section was inaugurated in Pomeifrè, and production began in March 1999 after four years of work contracted to the Negroni company in Bergamo, which included 13,000 m of boreholes. A 5-m-diameter tunnel that spans 2 km allows the trucks to reach the cultivation fronts directly, while more than thirty miners (some of

these are Polish) ensure, still in our days, an annual production of about 30,000 tons of high-purity talc.

In this way the production of talc was directed towards niche markets, with a high quality of the product offered and a higher selling price, reducing production and the number of workers, but allowing the mining activity to survive permanently until today. Graphic of talc production and mine employees over the years, in relation to major events and technological advances is shown in Fig. 3.

5. Sustainability of mining activity

What do we mean by sustainable mining? According to (Kirsch, 2010) this term has involved over time with a progressive redefinition. In particular, the concept has emptied out of its only original reference to the environment, in favour of a more complex concept that considers not only environmental aspects, but also social and economic considerations. More concretely, (Laurence, 2011) argues that operators can improve the sustainability of their mine sites by ensuring that leading practices are implemented in five areas: Environment, Economic, Community, Safety and Resource Efficiency. (Rajaram et al., 2005) state that mining is sustainable when it is conducted in a manner that balances economic, environmental and social considerations, often referred to as the ‘triple bottom-line’, and that sustainable mining practices are those that promote this balance. Finally (MacPhail et al., 2023) observe that a mine needs a “social licence to operate”: the success of mining operations depends not only on legal licenses, but also on local community acceptance (Cooney, 2017).

The case of the Val Germanasca talc mine could be intended as an example of “sustainable mining”, being remarkable from an environmental, economic and social point of view.

From an environmental perspective, it has to be stated that from the end of ‘800, with the introduction of the upwards method, mining from bottom to top. the extractive waste has been used, for the most part, for filling mining voids (backfilling operation). The use of extractive waste for backfilling has been continued also with the change of cultivation method in downwards in the 80s, from top to bottom and still, up to this day, with the use of cemented backfill. It is therefore not surprising that

the extractive waste facilities are very limited, mostly concentrated on the right orographic side of the Germanasca valley, or at the entrances of older tunnels at higher altitudes. For this reasons, extractive waste facilities present in the surface level are limited and there have never been any stability problems connected to extractive waste management and deposits.

From a production perspective, in the last 30 years the production of talc has been settled on values of 30–40.000 tons/year, that represents the current point of economic equilibrium, allowing the continuation of the mining activity. In addition to this, it should be noted that reduced production shows other additional benefits.

- the useful life of the deposit is extended;
- the production of extractive waste is reduced;
- the impacts on the territory are reduced.

The transport of the mineral in Val Germanasca has always represented a substantial part of the mining activity, both in terms of human resources employed and as important part of the cost of producing talc. Since 1932, with the access of the trucks to the entrance of the mine Gianna, the transport of the mineral is carried out by road. Nowadays the trucks reach directly the underground exploitation, but the reduced production means that the road transport, first to the sorting and then to the treatment plant is limited to an average of about 5 trucks/day. The impact on road traffic and the transport footprint have therefore become very limited.

To these aspects must be added the phenomena of industrial tourism and geotourism, which have affected the area in recent years, directly or indirectly involving the local population. These will be discussed in detail in section 6.

6. Industrial tourism and geotourism

6.1. The mining heritage and the geotourism

The concept of “geotourism”, intended as a new form of sustainable tourism, refers to a relatively new line of research that has been gaining

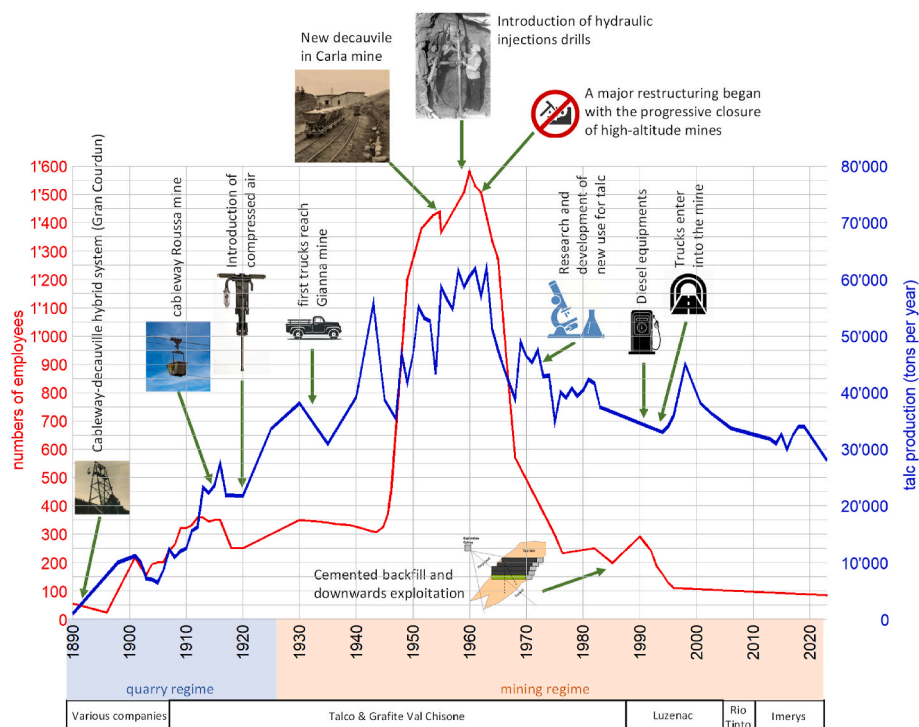


Fig. 3. Talc production and mine employees over the years, in relation to major events and technological advances.

momentum worldwide since the past two decades (Ólafsdóttir and Tverijonaite, 2018). Mines, whether active or inactive, are among the most important geotouristic sites, valued for their significant economic and social impact on nearby communities, as well as their important role in cultural and popular contexts.

The mining industry leaves behind a large number of tangible or intangible remains. Specific cultural or social values and meanings, which remind of the importance of mining in the past and today, are represented through this mining heritage (Jelen, 2018). These issues, in Germanasca Valley are intimately linked to the history and culture of the local area, particularly because the mining activity has existed for many years and has been the most local employer for a long time. The valorisation of this tangible “industrial/mining” heritage to future generations is the only way to preserve them.

Mining tourism can be considered as an important process that helps both to interpret the mining heritage and to serve as a subsequent source of employment and business activity following the end of mining. The old mining infrastructures are, today, commonly considered significant elements of local cultural heritage (Varriale et al., 2023), but they have been recovered for other purposes only in few cases.

When mining leaves a community, there are invariably negative impacts, most notably in terms of the decline in economic activity and the resultant loss of employment. Transforming mines into attractions will never replace the level of economic benefits created by mining or replace all the job lost, but in can contribute to the development of tourism as an alternate economic activity and can also preserve mining heritages for the benefits of communities (Conlin and Joliffe, 2010).

In the context of the Germanasca Valley, the development of geotourism activities related to the old disused mines has been developed over time, but what that need to be explored in order to understand how these activities fit into the context of the Valley, are the socio-economic and tourism aspects that specifically characterize the municipality of Prali, where two geotouristic projects developed (see Paragraph 6.2). Indeed, the understanding of these new types of tourism, require a careful analysis of the territory and the related socio-economic dynamics in which the centre of interest. For this reason, it is necessary to briefly sketch the socio-economic framework in which the reality of the Germanasca Valley fits. To proceed in this direction, a series of socio-economic and tourism data will be analyzed below that can help to have an overview of the trends that have characterized the area for the period 2017–2022, and a brief description will be offered. These data have been extracted from national and regional databases or are the result of specific requests aimed at the various actors operating in the territory of the Municipality of Prali.

6.2. Geotourism: ScopriMiniera e ScopriAlpi

The Germanasca valley represents a paradigm of the interaction between mining activities (active talc mine and Prali marble quarry site) and tourism. The area was and still is interested by extractive activities and its touristic vocation started extensively in the 1960-1970ies.

In order to guarantee a lively tourism and to spread awareness on the importance and uniqueness of local geology and mining activity, two museums were created: Scopriminiera (first in 1998) and ScopriAlpi (later in 2013). Both the museums guarantee a constant tourism (they are closed only in winter) thanks to the visits of schools (primary, secondary and universities), families, experts interested in geology, mining and industrial archaeology, curios fellows, etc ...

The presence of the museums, together with other touristic recreational activities (i.e. winter and summer sport activities, trekking, relaxing, gastronomic attractions, etc.), guarantees to tourists to have nice experiences, to replicate: we can say that it's not “an occasional tourism” but a “constant tourism” by people who appreciate and enjoy the time in the valley. Furthermore, the presence of infrastructures connected with winter and summer sports, guarantees a positive impact on the local community in term of positive social and economic returns.

Scopriminiera and ScopriAlpi (Fig. 4) are two touristic routes hosted in the former talc mines of Germanasca Valley. In the innovative spirit of the international museography at the end of 1900s, the project of preservation of Chisone and Germanasca valleys mining heritage found its place becoming subsequently the **Ecomuseo Regionale delle Miniere e della Val Germanasca**. Founded in 1993 and recognised of regional interest in 2003, it aims to preserve and enhance the unique local mining heritage that was left to abandon and deterioration. The mineral processing was the main economical source of the valley, shaping its landscape and view. At the end of the 80's, the talcum “cultivation” seemed to come to an end and the mineral heritage of the Germanasca valley community seemed to be lost: machineries got rusty, mining structures fell down, archives dissolved, memory faded. This is when the **Comunità Montana Valli Chisone e Germanasca**, following the example of other projects in Great Britain, France, Germany and Austria took up the challenge and started through an intense cross-border cooperation an ambitious cultural heritage tourism project to preserve and enhance the mining heritage.

The current evolution of the project involves municipalities of the valley, private partners (ski lift operators, hotels, etc.) and the holding company **Finpiemonte Partecipazioni S.p.A.** of the Piedmont region. Scopriminiera and ScopriAlpi are now the core of a more articulated and modern territorial museum proposal that attracts an average of 15.000 visitors per year, with peaks of 27.000 in the recent past. The initiative also offers new job opportunities to the local communities which, at least in part, compensates for the reduction in work in the mines. It involves about 20 people, for the most part guides; among whom there are many sons of former miners.

Scopriminiera forms the main part of the eco-museum, and includes 3.5 km of tunnels and galleries from the Paola and Gianna former mines and a network of excursions outside. It offers the visitor an extraordinary journey back in time, with the chance to explore the life of the farmer-cum-miner, and see the evidence of talc extraction still left in the valley. The tour begins with a trip aboard the little miners' train (Fig. 5a), after which visitors continue on foot through the tunnels and to former work sites (Fig. 5b): a real plunge into the past.

As well as the underground visit, and tours of the surrounding area and the industrial buildings close to the entrance to Paola Mine, there is also a permanent museum exhibition to explore. Additional facilities include a video room, an archive of the history of the mines, workshops for educational activities, a reception centre for the Regional Ecomuseum, a book-shop and a bar-restaurant called “Il Ristoro del Minatore” (Miner's Refreshment).

The Scopriminiera Educational Department offers workshops and study trails for schools of all types and levels. Scopriminiera therefore provides a space in which to encounter history, culture, geology, knowledge and experimentation.



Fig. 4. Guided tours (courtesy of Scopriminiera).

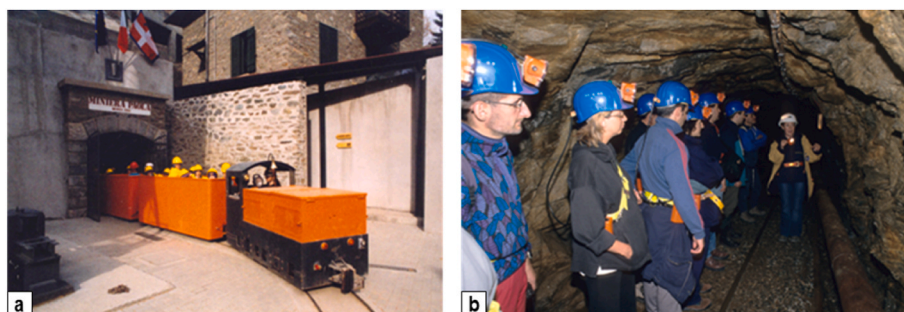


Fig. 5. a Little miners' train of Scopriminiera (courtesy of Scopriminiera) b visit to Scopriminiera (courtesy of Scopriminiera).

ScopriAlpi develops among clefts, galleries and structures of a mine opened more than 60 years ago (Fig. 6a and b). The mine worked until 1995 to transport the finest white talc to the light from underground. The presence of a major tectonic contact, along the tunnel, separating layers of rock belonging to the paleo- African and European continents allows visitors to experience a real “scientific expedition” to discover still visible signs of Alpine orogeny.

6.3. Socio-economic local setting

6.3.1. Social data

The social data for the municipality of Prali were collected from ISTAT's national socio-demographic database, which provides very accurate information on what are the Italian demographic aspects. The numbers in this first table show a very restrained reality that has almost remained unchanged over the observed time series (Table 1).

6.3.2. Residential data

Residential data were collected thanks to questions addressed directly to the municipality of Prali (Table 2). These data could show hypothetical increase or decrease in the urbanization of this area and in this case, they show a slight rise in the number of first houses, while the number of second houses remains almost unchanged.

6.3.3. Economic data

Economic data are inherent to the employment situation in the municipality of Prali and they were collected from both regional (Rupar Piemonte) and national databases (ASC.Istat and MES) (Table 3). Unfortunately, the available information stops at 2019, so it is not possible to understand the impact of Covid-19 restrictions on the workers' situation, even if the Gross Regional Product suggests an economic growth until 2019 and then a slight decrease in 2020. It could be useful to know the data related to 2021, that would better explain the path across the pandemic period.

6.3.4. Touristic information

The origin of the tourism data under consideration is heterogeneous; in fact, this table encompasses information either from different types of

documents and databases or were requested directly from the managers of the various activities (specifically ScopriMiniera and Nuova 13 Laghi – ski lift company) (Table 4). The databases consulted are derived from regional and local sources, such as Visit Piemonte and Rupar Piemonte, and show useful information to better understand tourist flows within the municipality of Prali. A drastic decline in tourism flows can be seen between the pre-Covid period (2017–2018) and the post-Covid period (2020–2021), while data for 2019 are not shown. This trend can also be confirmed by what emerges from the number of visitors going to the ScopriMiniera website; in fact, it is possible to notice a significant decrease in the post-Covid period. Between 2020 and 2021, however, there was a significant increase in visits to the mining reality, so we could glimpse in this growth an, albeit weak, return to normality.

On the other hand, regarding the data offered by Nuova 13 Laghi, the situation appears different from that photographed by the reality of mining tourism: Between 2018 and 2019, for example, the number of first-time entrances to the lifts saw a significant increase, which was maintained over the following year. However, the figure for 2021 is missing, so it cannot confirm or disconfirm the trend under consideration. The Prali ski area has no connections with other ski resorts. This means that transit entrances belong to the same people who make the first entrances.

Another point to note is that the ski resort remains open in both summer and winter. In fact, people use the ski facilities in summer to practice sports on foot or by bicycle.

It tends to be the case that tourism recovery in the municipality of Prali appears slow and laborious.

Generally, the number of visitors to ScopriMiniera has been declining over the years, although there are many who come to Prali for skiing. This decline is because visitors tend to return, but the catchment area is still the same, so those who visit the museum once are unlikely to repeat their visit. From the picture that emerges, the most useful and interesting data in relation to the analysis being conducted are the tourism ones, related to the number of visits and admissions for ScopriMiniera and Nuova 13 Laghi. These are raw data that could be analyzed in more detail, to better understand how tourist flows to the Valley are characterized and which target visitors have the most incentive to visit the attractions present. In the case of ScopriMiniera, for



Fig. 6. a Gallery of ScopriAlpi (courtesy of ScopriAlpi) b Gallery with panels of ScopriAlpi (courtesy of ScopriAlpi).

Table 1
Social data for the Municipality of Prali (ISTAT).

Data variables	Source	N year	2017	2018	2019	2020	2021
n. of tot. residents	ISTAT	5	242	243	252	252	251
n. of female residents	ISTAT	5	113	113	118	117	119
n. of male residents	ISTAT	5	129	130	134	135	132
n. of employed residents	ISTAT	2		102	107		
n. of unemployed residents	ISTAT	2		121	124		
average income from self-employment (€)	ISTAT	1	12.542				
average salary as an employee (€)	ISTAT	3	25.483	14.994	15.927		
n. of residents without educational qualifications	ISTAT	3			3	3	
n. of residents with primary school license	ISTAT	3		54	52	45	
n. of residents with secondary school license	ISTAT	3		84	87	71	
n. of residents with high school license	ISTAT	3		83	85	104	
n. of residents with a degree	ISTAT	3		6	10	14	

Table 2
Residential data for the Municipality of Prali.

Data variables	Source	N year	2017	2018	2019	2020	2021
n. of local business units (no accommodations)	Comune di Prali	5	124	125	134	133	131
n. of farms	Comune di Prali	5	131	133	126	132	133
n. of tot. workers	Comune di Prali		negligible data				
n. of employees	ACI	4	284	281	289	299	
Gross regional product (€)	ACI	4	219	217	223	228	

Table 3
Economic data for the Municipality of Prali (Rupar Piemonte, ASC.Istat and MES).

Data variables	Source	N year	2017	2018	2019	2020	2021
n. of local business units (no accommodations)	Visit Piemonte; Rupar Piemonte; ISTAT	3	26	29	33		
n. of farms	Rupar Piemonte; ISTAT	1	6				
n. of tot. workers	Scoprimeria	3	88	98	104		
n. of employees	Visit Piemonte	3	28	31	32		
Gross regional product (€)	Visit Piemonte	4	2.650.648	2.752.116	3.039.098	2.953.471	

Table 4
Touristic information for the Municipality of Prali.

Data variables	Source	N year	2017	2018	2019	2020	2021
n. of accommodation facilities	Visit Piemonte; Rupar Piemonte; ISTAT	5	4	3	7	12	11
n. of catering activities	Rupar Piemonte; ISTAT	3	9	11	12		
n. of Scopriminiera's visitors	Scoprimeria	6	17.200	14.180	13.920	5.734	7.099
touristic flows (total overnight stays)	Visit Piemonte	4	22.545	18.344		12.586	9.532
average stay	Visit Piemonte	4	7,77	7,13		5,19	4,46
n. of buses	ACI	4	0	0	0	0	
bus tickets	Nuova 13 Laghi srl						
parking data	Nuova 13 Laghi srl						
ski slope metric development (km)	Skiinfo.it	25					
n. of skipass (first entries)	Nuova 13 Laghi srl	4		43.480	60.631	61.619	
n. of skipass (transit entrances)	Nuova 13 Laghi srl	3			672.636	682.050	
n. of ropeways	ARPIET	4	0	0	0	0	
n. of chairlifts	ARPIET	4	2	2	2	2	
n. of skillifts	ARPIET	4	2	2	2	2	

example, visitor attendance (about 15.000 per year) has halved in 20 years but varies greatly throughout the months. Half of the visitors come from schools from the provinces of Turin and Cuneo.

It should be noted, however, that as far as the mining sector is concerned, tourism activity is concentrated in the Prali context, only on the disused mines managed by Scopriminiera. On the other hand, no type of tourism activity is thought or carried out in the context of the active mine, even if there are important synergies between Scopriminiera and the operative mine of **Imerys**. Indeed, **Imerys** is involved both from an economic and cultural point of view. The cooperation between the two actors is represented mainly by reciprocal visits. Furthermore, Imerys welcomes the existence of a site like Scopriminiera, who shows to the public the work of the miner and approaches civil society to their

activities, decreasing the eventual conflicts.

As can be seen from the data, the location taken into consideration is small but can host precisely the type of "slow" tourism that has taken hold as opposed to mass tourism (Serdane et al., 2020). The slow tourism (Mavric et al., 2021) concept derived from that of "slow food" (Petrini, 1986), has developed a lot during the COVID period. The impossibility of moving to distant areas, but not only that, has pushed tourists to explore nearby areas with a different spirit based on the desire to reconnect with the surrounding environment. Slow tourism becomes a way of practicing tourism that seeks to discover the identity of a territory through the rediscovery of natural and cultural values of the territory (Fusté-Forné, 2023).

7. Discussion and future perspectives

The geomorphological history of the area and the activities that this conformation allows to develop, lead to the growth of productions that were previously active and of cultural appeal when they ceased. The constant number of tourists and students who, although not increasing, continue to visit the museum represents an indicator to set up reasoning different from what mountain tourism, understood in the traditional sense of the term, proposes or, at least, to complement conventional activities.

By attempting to set up an analysis to answer the questions proposed in the introduction, it can start by noting that the elements taken into consideration (mining activities, museums derived from mining activities, industrial tourism, and particularly, slow tourism) in this paper are interconnected, and the case under consideration of the Germanasca Valley confirms this fact (Fig. 7).

On the basis of information and results arising both from the mining and the touristic contexts, it can be highlighted indeed how these two different realities are closely linked in the Germanasca Valley. ScopriAlpi and Scopriminiera are two peculiar “recreational and study” activities for the investigated area, and, even if they are closed during the winter period (when winter sports are at the top), and even if the visits to these two realities decreased after the Covid-19 pandemic crisis, they show positive impacts on the tourism in the area. In general, it can be stated that the visit to ScopriAlpi and Scopriminiera are more intense in the week during the school period (from September to June – a part for the winter break) and during the weekend during the Easter and Summer holiday. The close link of these two realities with the social and economic local development is also represented by the staff enrolled as museum’s managers and touristic guides, who often are represented by people living in Germanasca Valley (and mainly in Prali municipality) or by students who spent summer period in Prali, renting apartments and benefiting from local shops and recreational activities.

Moreover, it can be stated that, together with ScopriAlpi and ScopriMiniera, there are also other geotouristic “attractions”, such as:

- the “Vallone delle Miniere” (*valley of the mines*), a narrow valley just above Prali village, at about 3,5 h walking from it, in which it is possible to find traces of ancient mines and extractive waste facilities, in which it’s easy to find minerals (for collectors and precipitants).
- the “Cava dei Marmi” (*marble quarry*), a still active quarry but not continuously operating, at about 2 h walking from Prali village,

which can be visited and near which it is possible to spend amazing time in walking, resting and organizing pic-nic.

More in general, tourists who spend their holiday in Germanasca Valley have different chance for sports and recreational activities, from skiing to trekking, to open-air sports, to the already mentioned mining and geotouristic ones, and local economy (shops, bars, restaurants, hotels, rented apartments, camping, sky line, etc ...) benefit from the presence of tourists and of people “enrolled” in the touristic sector.

The types of recreation recalled seem to be closely related to a “slow” tourism, based on the landscape to appreciate and from which to learn (definition of geotourism): this takes us to consider tourism related to mining as an acceptance of an affection to territory with its characteristics and peculiarities. With these considerations it can be easily answered to the observation that questioned the possibility of matching the two terms (mining tourism and slow tourism).

However, the question remains: how much does mining tourism, intended as industrial tourism, weigh on the development of the territory?

More generally as a future development a framework could be created to assign a weight to the different components so that its sustainability in a broad sense (economic, environmental and social) can be assessed (Fig. 8).

Economic evaluation (mainly associated with tourism characteristics) and social evaluation (mainly associated with tourism types) are done for each stage. Environmental impacts are assessed in the totality of economic and social activities in the investigated area. Considering the three pillars of sustainability in an interactive and connected way, it could be assumed that each characteristic (e.g. slow tourism) or type (industrial tourism) has a numerical weight (derived from data collected directly on the territory) on each of the pillars of sustainability.

In this way, the sum of the different weights given to economic, social and environmental sustainability, e.g. of slow tourism, could give us a relative figure to compare with other similar data, allowing the construction of a taxonomy on which to base strategic policy choices. It is also true that some geographic and territorial situations do not allow the implementation of any type of tourism, but a basic indication could lead to valid reasoning for the development of the best strategy.

In addition, it is important to evaluate, with precise parameters, which factors influence the economic and social impacts. Fundamental is the evaluation of data connected to tourism year by year, to assess:

- the flotation of economic impacts connected to specific attractions, such as geotourism, slow tourism (which includes also eno-

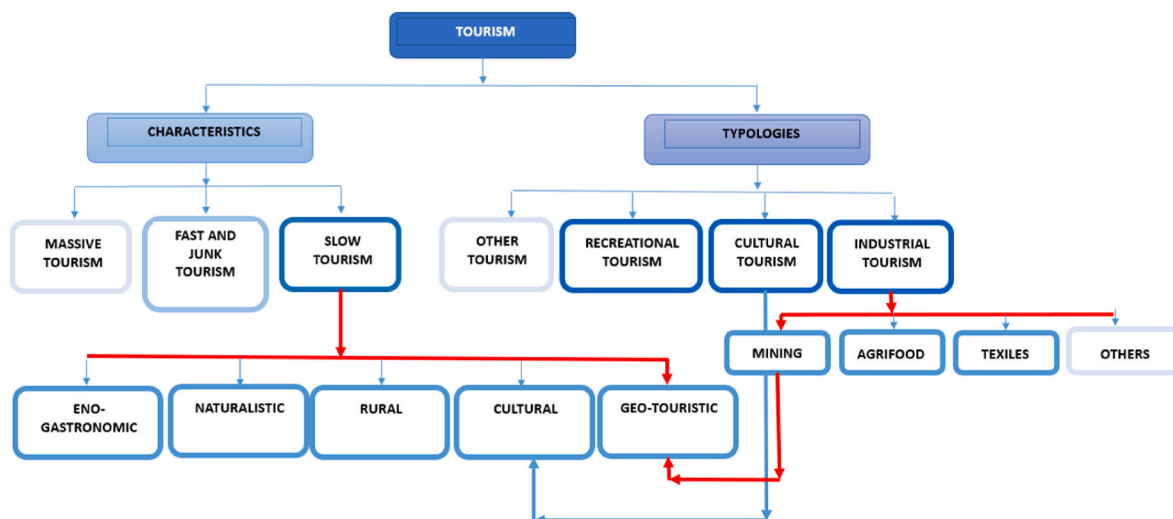


Fig. 7. Types and characteristics of tourism.

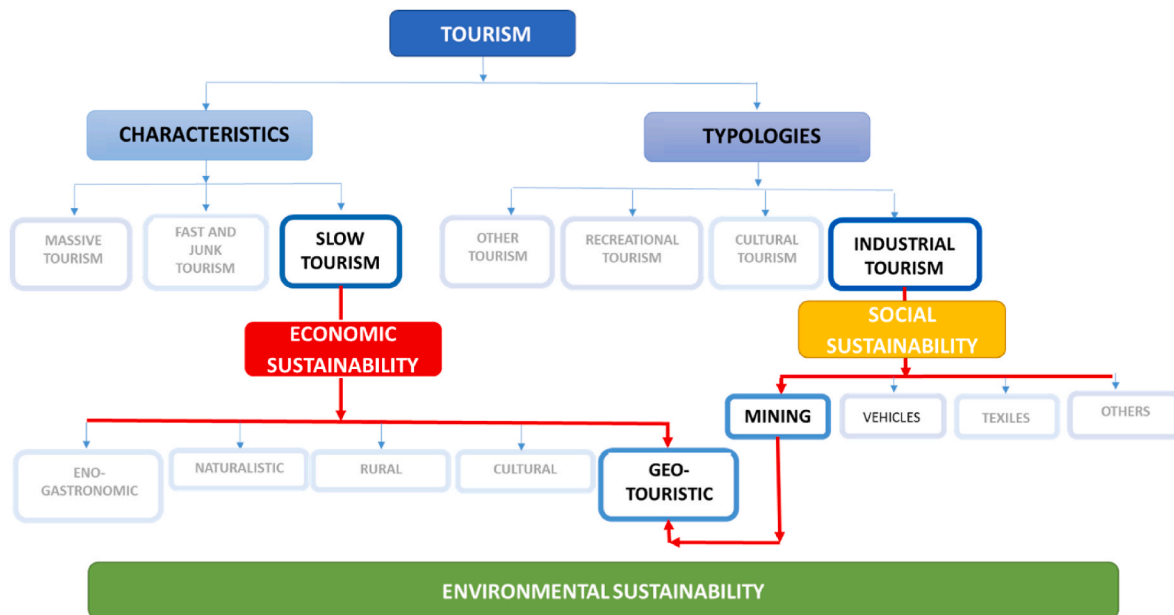


Fig. 8. Connection among slow-tourism, Geo-tourism and industrial (mining) tourism. Sustainable approach (economic, social and environmental perspectives) in managing geo-tourism.

gastronomic, naturalistic, rural attraction), and tourism in general (characterized by a strong presence of winter and summer sports and recreational activities in general). For example, Covid 19 pandemic crisis hugely affected geotourism, but didn't have strong impacts on resource industry present in the area (moreover, the tourism highly improved during summer period due to peculiar restrictions that brought people to migrate to place in which open-air activities were permitted);

- the social impacts in terms of new "green" and "cultural" jobs, of modern infrastructure for the territory, improvement of the welfare for the local community due earnings deriving both from tourism and resource industry.

Finally, together with social and economic impacts, mandatory is the evaluation of environmental impacts considering several possible scenarios:

- post-mining period, presence of only recreational tourism (winter and summer sports, eno-gastronomic tourism, etc.), with a consequent potential scarce monitoring on past mining activities, due to the absence of an operating industry;
- presence of mining industry (revenues linked only to the exploitation of local georesource – i.e. talc in Germanasca Valley);
- presence of mining and touristic activities that works "separately";
- presence of mining and touristic activities that have synergic strategies in the middle-long term, to guarantee the local sustainable development.

Basically, the question for further research seems to be: geotourism, and slow tourism at large, is sufficient to guarantee positive economic and social impacts at local level? How could it be improved thanks to the synergy with resource industry present in the area? Could external funds (i.e. public funds for rural area development) facilitate positive economic and social impacts on the territory?

8. Conclusion

Germanasca Valley area appears perfect for "slow geotourism" which seeks, alongside traditional mountain activities such as the possibility of practicing winter sports and summer excursions, the reason for moving

around, visiting, and rediscovering landscapes, territories tradition and activities strongly linked to the concept of place authenticity. From this perspective, the smaller size, the historical activities evidenced by museum activities, the traditional itineraries find space and foster loyalty in what, elsewhere, could be represented by hit-and-run tourism which is currently so widespread (especially during the winter season).

Comparing the data relating to tourism (number of rooms occupied and therefore not totally significant since it excludes daily tourists) with those relating to Scopriminiera entrances, it is highlighted that the majority of tourists staying in the area (over 70 %, with the sole exception of 2020, a particular year due to Covid-19 pandemic crisis) visit Scopriminiera and, consequently, take advantage both of sport recreational activities and touristic attractions (namely Scopriminiera). With these considerations, the Scopriminiera and ScopriAlpi tourist appeal appears even more relevant: as already mentioned, the mines seem to play a fundamental role as a tourist attraction, since some of the sites based on this can be defined as ecomuseums (Davis, 2011).

Moreover, geotourism associated to slow tourism can guarantee positive social and economic impacts: i.e., associating the visit to the local museums and geosites (including ScopriMiniera, ScopriAlpi, "Vallone delle Miniere", Rural life Museum, etc ...), to recreational activities present in the area (from winter and summer sport, to eno-gastronomic realities, such as local "agriturismi", in which people can appreciate local cheese, salami, raw meat, potatoes, vegetables, etc.).

An evaluation model would be useful in pushing the best resource and tourism enhancement strategy, however according to the bibliography by (Moyle et al. 2018) already now, the Valley could benefit from the closes cooperation and synergies of both main economic sectors (tourism and mining), which can be translated in.

- develop trust, communication and partnership within the two sectors;
- develop a joint long-term vision and strategy for both the sectors;
- developing a memorandum of understanding between the two sectors to implement the strategy in the long term;
- sharing experts and employees in both sectors in order to organize and promote joint activities, including the periodical visit to the active mining sites and processing plant, on the one side, to attract tourists, on the other, to facilitate social acceptance of mining industry (social acceptance is a pillar of the sustainable mining policy);

- more attention on environmental issues: an “alive valley”, can benefit from the constant monitoring of environmental impacts from mining staff and from common people. The monitoring has to be rigorous, transparent and correctly communicated, and the role of common people is to alert but, mainly, to prove that mining activity is working in a sustainable way;
- positive impacts on local infrastructures (roads, parking, recreational facilities, etc ...).

In general, three strategies can be developed to improve the coexistence of the two sectors (Moyle et al. 2018):

1. to **reduce the negative impacts of the coevolution process**, such as the negative impacts that mining sector could have on the touristic one (i.e. due to the traffic connected to trucks or to not correct management of extractive waste);
2. to **improve the “industrial” tourism** (mining tourism, but also geotourism and slow tourism – see Figs. 7 and 8), for example improving the number and typologies of tours for different kinds of tourists (from students, to families, to experts, etc ...);
3. to **develop and improve trust, partnership and joint vision** to promote and boost the local economy, mainly in rural areas (Buscher and Davidov, 2013).

CRedit authorship contribution statement

Marco Casale: Writing – review & editing, Writing – original draft, Resources, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Francesca Gambino:** Writing – review & editing, Writing – original draft, Validation, Data curation. **Alessandro Borghi:** Writing – review & editing, Writing – original draft, Supervision, Resources, Data curation. **Riccardo Beltramo:** Validation, Supervision, Formal analysis. **Enrica Vesce:** Writing – review & editing, Writing – original draft, Validation, Supervision, Data curation. **Cristina Vari:** Validation, Conceptualization. **Marco Giardino:** Resources, Project administration, Funding acquisition. **Giovanna Antonella Dino:** Writing – review & editing, Writing – original draft, Validation, Supervision, Methodology, Conceptualization.

Declaration of competing interest

None.

Data availability

Data will be made available on request.

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Appendix A. Supplementary data

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