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Social, Economic and Ecological Impacts of Customaci

Marble Sector

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ABSTRACT

This research seeks to analyse and interpret the marble-rich territory of Custonaci to gain a deep understanding of the transformations occurring at social, economic, and environmental levels. Intensive extractive practices have, over time, markedly reshaped the region's natural, cultural, and economic dimensions, leading to substantial and increasingly ingrained alterations in its morphological and ecological profile. The primary objective of this research is to analyse the reasons that contribute to make the marble sector, in Italy and more specifically in Sicily and in Custonaci (TP), a sector with major problems.

To comprehensively capture the perspectives of various stakeholders, this study gathered testimonies from residents, including those employed within the marble industry across different roles, as well as individuals in other professional sectors. Laws regulating the sectors, in an environmental level and workers' rights have an important impact on this research, allowing an even more completed comprehension of the different layers that regulate the sector. Furthermore, an alternative use of abandoned quarries is outlined. The comparison with other case studies has allowed the identification of weaknesses and strengths in order to design a project that can be truly applied in the Custonaci area.

The overall objective is to reconceptualise the extractive landscapes of Custonaci in order to achieve sustainable development based on a harmonious integration of social, economic and environmental priorities.

Key words: Impacts – Interviews – Marble – Environment – Custonaci

INTRODUCTION

Marble is one of the world's most popular indoor and outdoor materials, celebrated for its versatility as well as its timeless beauty in the architectural and artistic spheres. Paradigmatic of this is the fact that it is used extensively in interior and exterior architectural projects. “According to the XXXIII World Marble and Stones Report 2021, the quarry production in the global stone industry reached 155 million tons in 2020, marking a 0.32% increase compared to 154.5 million tons in 2019.” (Chen Zhaofeng, 2024, p. 1). Extracting marble is a process that requires precision cutting and drilling in specific mountain sections to obtain blocks of varying sizes. Once extracted, the blocks undergo quality controls by the same workers who carried out the drilling to assess their commercial value.

However, despite these rigorous processes, marble production generates considerable waste, often exceeding the quantity deemed fit for further processing. Countries engaged in dimension stone production extracted approximately 318 million tons of raw stone material in 2020. Out of this, 163 million tons were classified as quarrying waste, leaving only 155 million tons suitable for transportation to processing facilities. Moreover, these produced an additional 63.5 million tons of sludge waste, reducing the final product to only 91.5 million tons (Chen Zhaofeng, 2024, p. 24). Following Italian regulations these discarded products, after being processed, must be deposited in special landfills, the locations of which are problematic at regional level both because of the economic consequences for the company and the environmental impact caused by their transport.

Moreover, although the global marble and stone industry continues to expand, the Italian marble sector has faced notable challenges. In particular, in Sicily the Custonaci marble basin, historically important for the production of marble known and exported worldwide, earning a reputation as Italy's second-largest marble basin after the Carrara's one, has experienced a prolonged crisis that has deeply affected the local economy and its inhabitants. By 2001, the majority of Sicily's quarrying operations were concentrated in the provinces of Messina, Trapani, and Caltanissetta, together accounting for roughly 64% of the island's manufacturing enterprises (Corriere F., 28, 2001).

Custonaci, a small town in the west coast of Sicily and at the centre of this research, is a locality in Sicily that, although known to all Sicilians, remains scarcely visited and recommended when visitors from other regions or countries turn to regional residents for advice on places worth visiting. The town itself, set on a small rise, offers few cultural-historical attractions but has at its feet splendid coastlines and beaches, which, although they cannot be considered pristine (since it is extremely difficult to find a place on the globe that bears no trace of human passage), maintain the ecological relationships proper to marine ecosystems, attracting those who appreciate more isolated places with few services. The Custonacese, proud local residents, experience with regret and disillusionment the change that the decline of the marble industry is bringing to the town. Some, despite sadly acknowledging that change is taking place, are working to better manage the most likely path to the town's future, tourism, by setting up facilities they own along the coasts for tourist use. Others, however, are passively living through this transformation, without understanding what the future will be for themselves and their families.

The decline of Custonaci's marble industry stems from a complex web of interrelated factors and their understanding is essential in order to devise strategies that can address current challenges without repeating the mistakes of the past. Insights gathered from stakeholders and residents suggest several key issues requiring attention: the lack of collaboration among local businesses, increasing competition from international producers, inadequate regional transportation infrastructure, and growing pressure to reconcile industrial activities with environmental concerns. These issues will be approached through a historical and cultural lens in order to discover the reasons for their persistence over the years. On the other hand, the national and regional legal context will be addressed in order to better understand some of the regulatory gaps of this sector, both with regard to mining and waste disposal, and with regard to worker safety, with a focus on the problem of high temperatures. However, the presence of numerous abandoned quarries requires that this issue be approached with a positive outlook through planning that looks to the future of Custonaci. If the community is undergoing a process of transformation, it is also necessary to understand towards which horizons it is facing and try to direct this transformation in a way that does not damage the places and people involved.

Tourism, in fact, a possible new outlet for the city and so far underdeveloped, has the power to change even radically the place in which it develops in an uncontrolled manner. The redevelopment of abandoned quarries could therefore have the objective of directing tourism towards less travelled routes, diversifying the local offer and revitalizing the community, creating new employment opportunities.

METHODOLOGY

The methodology adopted, in order to better understand the dynamics at play, integrate both qualitative and quantitative data. Qualitative data were obtained through a series of open-ended questions in interviews conducted with a diverse range of respondents, both in terms of age and employment. These interviews were complemented by quantitative data gathered through bibliographic searches.

QUALITATIVE DATA COLLECTION

The process of collecting qualitative data relied significantly on connections between citizens, allowing for the gradual establishment of relationships with a number of individuals in the Custonaci area. The social nature of Custonaci and neighbouring communities facilitated this process: being a small town, each respondent often provided the researcher with other contacts of people willing to contribute their time and insights to the research. Although the snowball sampling method is not always effective, it proved invaluable in capturing a wide range of perspectives, thus enriching the research findings.

The importance of these interviews cannot be underestimated, as the diversity of participants allowed for a comprehensive and multifaceted understanding of the phenomenon under investigation. Each interview, despite the participants' initial scepticism as to the usefulness of their contributions, yielded valuable details that were subsequently explored. The knowledge shared during these interactions was instrumental in uncovering critical insights that may not have been discernible through quantitative methods alone.

By incorporating both local perspectives and expert opinions, the interviews effectively addressed two primary areas of inquiry:

1. Local Impacts on Residents and Workers: Understanding the social and economic implications of the marble industry on Custonaci's population.
2. Industry-Specific Insights: Identifying the economic and logistical challenges facing the marble sector.

AIM OF THE RESEARCH QUESTIONS

In anthropological research, it is common for the formulation of initial hypotheses to evolve as the researcher becomes immersed in the field and interacts with participants. At the beginning, in fact, research addressed extractivism as a fundamentally destructive socio-ecological process, characterized by the depletion of natural resources, loss of biodiversity, and environmental degradation, all driven by the imperative of capital accumulation. Scholars such as Eduardo Gudynas (62, 2018) have described extractivism as the large-scale appropriation of natural resources, whose extracted materials are predominantly exported in raw or minimally processed forms. Similarly, Ye et al. (155, 2019) highlighted the ecological consequences of such practices, including soil degradation and the disruption of critical ecological connections. Further perspectives have contributed to enrich the reflection on extractivism. For instance, as Kelam (2016) said in the review of Klein (2014), Klein has connoted extractivism in terms of "sacrifice zones", i.e. regions subjected to exploitative and one-sided relationships of humanity with the land, defined solely by the act of extraction. Willow (2019, p. 2) added another dimension, framing extractivism as a "mode of being in the world" that reflects the relationship humanity has with the natural environment. This conceptualization sheds light on why, in certain cases, resource extraction is not only tolerated but actively supported by local communities.

In the context of Custonaci, a unique perspective emerged: a poeticization of extractivism, in which landscapes disrupted by mining were appreciated and preserved by local residents. This wholly unexpected reality led to a change in the researcher's initial viewpoint, but a critical question emerged: why do residents often prefer quarries to unaltered mountains, or landscapes scarred by mining to those left undisturbed? This investigation sought to understand the cultural, economic and emotional ties that bind the community to the marble industry, revealing a multifaceted relationship between human activity and the natural environment.

The questions posed to the respondents aimed to understand how mountains per se and those used for resource extraction, as well as nature in general around them, has an effect on their perception of where they live and how they experience it. The questions asked did not always have the desired effect, receiving answers that were either misdirected or did not match the researcher's idea. What emerged was a general perspective of the inhabitants, for

whom mountain quarrying does not turn out to be a problem either on a landscape level or as an idea of environmental justice. The marble quarries provided jobs and prosperity for the city and its citizens, and this seems to be the crux of their thinking. These highly utilitarian views glorify extractivism but allow for an understanding of why the excavated mountains are looked at with different eyes, with gratitude and beauty. There are voices that come out of the chorus, pointing to the quarries as aesthetic ugliness, but nevertheless extolling the utility of extractivism in the local context of Custonaci.

QUANTITATIVE DATA COLLECTION

Regarding the quantitative component of the research, an analysis of research that has studied marble extraction from different perspectives has been carried out. The importance of marble worldwide is reported, with the quantities of material that are extracted, exported and imported. Following a brief introduction in which the various steps for the production of marble are analyzed, Section 1.1 discusses the various regulations governing the marble industry in Italy and Sicily, with particular emphasis on those concerning waste. This issue is also highlighted in section 1.2, reporting some data on the environmental and social impact of transporting dewatered quarry dust to special landfills. The analysis showed that in Sicily there is a shortage of landfills suitable for the containment of this waste, lengthening the distance to be traveled to collection sites. Although marble waste is not considered hazardous, it must be disposed of by a specific process, thus in suitable landfills.

Chapter 2 opens with a section on regional transportation, attempting to highlight how Sicily's specific history has resulted in regional underdevelopment, which also impacts the ways in which companies must manage their activities. In fact, it is not feasible, because it is not economically and time-effective, to manage their exports with the public transportation system. Rail connections are extremely limited, increasing the cost of transporting the products of Sicilian companies. While the paragraph 2.1 focuses on the perspectives of workers and it is mainly based on interviews, the Chapter 3 starts the dissemination of information on Custonaci's decline. The paragraphs in the third chapter are mostly devoted to the various problems that companies face, particularly globalization and competition among

companies and the lack of synergy that does not allow effective collaboration, limiting the possibilities of the industry.

Instead, Chapter 4 reviews the difficulty of discerning between the terms Ecological Restoration, Reclamation and Rehabilitation. The differences between the terms are not marked, creating confusion in both the scientific literature and international regulations regarding projects of this kind. One term is often used by one entity to indicate what another entity uses to indicate different type of planning. The same thing happens in Italy. Examples are given for each of these Ecological Restoration, Reclamation and Rehabilitation projects. One has been more carefully addressed, because while the other examples have been completed, the one planned in Campania in 2006 did not see the light. The extreme complexity of the project under consideration, provided inspiration for the design of a much simpler idea that could be implemented in one and more quarries in Custonaci for the conception of abandoned quarry sites into areas of social and economic value.

This research, though complex and far-reaching, touching on many points, from the local to the global, aims to understand the world that gravitates around marble, to understand the problems that Custonaci is facing, and to find a solution, however minimal and simple, for the society and the natural environment around it. The complexity of the case study does not allow for there to be a one-size-fits-all solution for its resolution, which is precisely why the project devised at the end of the research is only meant to be food for thought to increase transformational thinking in Custonacian and Sicilian society, not a point of arrival.

A POEM ON MARBLE

This poem, written in 1986 by Filippo Majorana represents the glory of Custonaci's past and the value this stone had to society. The stone under the sun is described as solemn. It has not only an economic value, but represents the hope, industriousness and desire for redemption of this people.

It is an ancient poem that the people of Custonaci today seem to no longer identify with, but it represents the past of a people and the pride of its history.

Sicilian

E spacca e zappa

rumpi la vina

Canta e la vuci

Va pi la chiana

Nfila u fiorettu

serru lu filu

L'arganu è pronto

Curri licchettu

Supra la cava

Lu sulì splenni

La petra luci

Muta e sulenni

O cava, cava

Ricchizza granni

Tu'ntra li visciri

Oru nascunni

Quannu lu sulì

Tracodda e scura

a la Maronna

Sta nostra priera

Matri amurusa di Custunaci

Varda sti figghi e dunaci paci.¹

¹ Filippo Majorana's poem, written in Custonaci the year 1986. Poem set to music in Sicilian dialect, that opens Antonio

Torre's book "Omini 'n Cava" 2010, translated from Sicilian into English by the researcher.

English

*And smash and hoe
break the vein
sings and the voice
goes across the plain
'Slip the foil
Thread the string
the tool is set
running smoothly
Above the quarry
the sun shines
the stone glistens
mute and solemn*

*Oh quarry, quarry
great treasure
in your entrails
you hide gold
When the sun
falls and darkens
to the Virgin
this prayer of ours
loving Mother of Custonaci
Look on these children and give us peace.*

CHAPTER 1. CHALLENGES IN THE MARBLE SECTOR

Introduction

Marble production has grown enormously worldwide in the last twenty years, but the marble that is processed is only a fraction of what is extracted. In 2003, gross extraction amounted to 153 million tonnes and of this, discarded material amounted to 78 million tonnes. In 2019, 316 million tonnes were extracted of which 161 million tonnes were discarded.

YEAR	GROSS QUARRYING	QUARRYING WASTE ¹	RAW PRODUCTION	PROCESSING WASTE ¹	PROCESSED PRODUCTION
2003	153.750	78.750	75.000	30.750	44.250
2004	166.500	85.250	81.250	33.300	47.950
2005	174.750	89.500	85.250	34.950	50.300
2006	190.250	87.500	92.750	38.000	54.750
2007	212.000	108.500	103.500	42.500	61.000
2008	215.000	110.000	105.000	43.000	62.000
2009	213.750	100.250	104.500	42.850	61.650
2010	228.000	116.500	111.500	45.715	65.785
2011	237.200	121.200	116.000	47.560	68.440
2012	252.500	129.000	123.500	50.630	72.870
2013	265.800	135.800	130.000	53.300	76.700
2014	279.000	142.500	136.500	56.000	80.500
2015	286.200	146.200	140.000	57.400	82.600
2016	296.400	151.400	145.000	59.400	85.600
2017	310.700	158.700	152.000	62.300	89.700
2018	313.000	160.000	153.000	62.750	90.250
2019	316.000	161.500	154.500	63.350	91.150

Table 1. World stone industry: Processed and Waste Comparison from 2003 to 2019 ²

² Table from Chen, 5, 2024.

It is possible to highlight the unsustainability of these rhythms, not only in terms of the exploitation and related degradation of the mountains from which the material is extracted, but also in terms of the resulting waste production. This intensive production is allowed by the technological avant-garde that has accelerated and made the various processes more and more precise, of which there are three main ones: exploration, excavation and processing, and all of which have undergone decisive changes in both the tools used and the techniques (Chen, 11).

If the exploration process is carried out carefully and accurately, retrieving quality geological data, the excavation of materials that is not considered valuable can be avoided, thus limiting the loss of time and the amount of waste. A particularly promising and non-destructive method (others, such as Drilling Core Analysis are classified as destructive) is GPR (Ground Penetrating Radar) “which has found extensive application in detecting fractures within rock masses in quarries. The fundamental principle of GPR involves emitting radio waves into the soil and utilising the waves that bounce back to generate a visual representation of fractures, joints, faults, and other underground structural attributes”. (Chen, 12). In the extraction process, DWC (Diamond Wire Cutting) is the most widely used method and is also the one that generates the least waste, employing extreme speed and good block yield (Chen, 14).

Following the transport of the blocks to the processing plant, the next step involves the transformation of the blocks into regular shapes of different thicknesses suitable for final sale. This process is called sawing, which is then followed by polishing and smoothing. The last process is the final cutting into slabs of various sizes. The waste material therefore does not only originate from the extraction stage, despite the fact that this is the step where the largest blocks and great quantities of powder are produced, but also in all other processing stages.

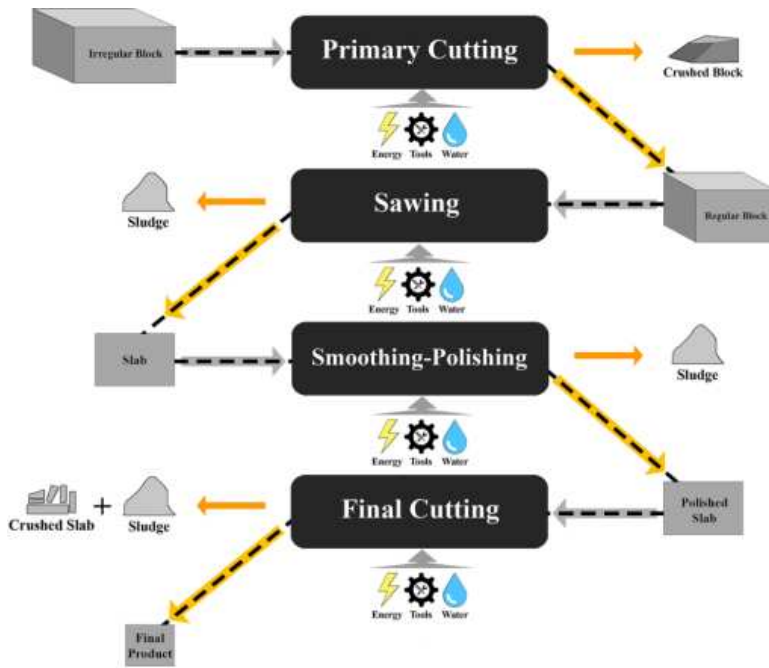


Figure 1: Schematic representation outlining the dimension stone processing sequence³

In the next section, the European directives and Italian laws pertaining to the stone waste sector will be explained, as well as the regulatory gaps and the consequences of these inefficiencies.

Section 1.2 analyses the work of Nicoletti, who makes a comparison between the Life Cycle Assessment of ceramics and marble, but only the work done on marble will be considered. Due to the lack of data on transport, considerations on the environmental, economic and social impact of transport will be implemented.

³ Figure from Chen, 22, 2024

1.1 How Legislations Shape Quarry Operations

In Italy, Royal Decree No. 1443 of 07/29/1927 differentiated the terms “quarry” and “mine” according to the material extracted, classifying mineral substances into first and second category materials, continuing to influence resource extraction practices to this day. Quarrying activities were delineated as the removal of construction materials for industrial use and ornamental stones considered to be of local importance, while mining activities were characterized by the extraction of high-value materials considered to be of strategic importance, such as metallic ores and fuel resources. This differentiation reflects the distinct economic and industrial roles played by mining and quarrying within the broader framework of natural resource management.

Through Decreto Presidente della Repubblica (DPR) N° 616 Article 83 of 24/07/1977, administrative control over mining and quarrying activities, previously managed at national level, was devolved to regional authorities. This delegation allowed each region to regulate such activities autonomously, albeit within the overarching boundaries of national guidelines, whose regulation of quarries and peat bogs is mainly in Decreto Legislativo N° 152 of 03/04/2006 of the Environmental Code.

The first significant legislative measure addressing quarrying and mining activities in Sicily was Legge Regionale (Regional Law) N° 127, 9/12/1980. Comprising 68 articles, this law established a foundational regulatory framework for the region. Updated as of 2023, the law seeks to manage extraction activities effectively, defining the fundamental lines regulating the exploitation of quarries, through the approval of the Piani Regionali dei Materiali da Cava e dei Materiali Lapidei di Pregio (Regional Plans for Quarry Materials and Valuable Stone Materials). For the purposes of this research, it is necessary to emphasise that this law generically refers to Article 27-bis of Decreto Legislativo (Legislative Decree) N° 152 of 3/04/2006, stipulating that the exercise of quarry activities is subject to the issuance of a single authorisation by the mining district competent for the territory. EIA (Environmental Impact Assessment) or VIA (Valutazione Impatto Ambientale) however, according to state law cannot be waived to the regions, thus the mandatory assessment prior to quarry activity must be submitted by state agencies.

For these aspects, and others cited subsequently, it is widely considered incomplete in several respects, also following the amendments made by Legge Regionale N° 19 of 01/03/1995, Legge Regionale N° 10 of 05/07/ 2004 and N° 9 of 07/05/2015.

One of the big problems in the marble sector is that of waste and its storage. According to the Italian National Institute of Statistics (ISTAT), nearly 65% of the materials extracted from quarries are classified as waste. This includes irregular blocks, fine dust, and the marble slurry known as *marmettola*, which poses a serious environmental hazard. Marmettola, when improperly managed, contaminates soil and groundwater systems, particularly when left exposed to rainwater at sawmill sites (Famoso, 279, 2024). Article 1 subsection 4 of Legge Regionale n. 9 del 07/05/2015 allowed a company with quarry activities to manage the storage of materials, including from other quarries, inert materials from the use, recycling and recovery of waste or from other alternative sources. However, this rule seemed illegitimate since the management of excavated materials is subject to the discipline dictated by the Environmental Code (art.183, paragraph 1, letter a), as elucidated by the ARS in May 2023 (7) in the “Riordino normativa dei materiali da cave e materiali lapidei – documento 6” (Regulatory reorganization of materials from quarries and stone materials - document 6).

To address waste management issues, Italy has implemented several legislative measures aligned with European Union regulations. Annex A of Decreto Legislativo N° 22 of 5/02/1997 and the Ministerial Directive of 9/04/2002, implement EU Regulation N° 2557/2001, which governs the classification and shipment of waste materials. Under this framework, marble waste is assigned the code CER 010413, classifying it as special non-hazardous waste generated from stone cutting and processing. If this waste cannot be reintegrated into the production cycle, it must be treated in accordance with Article 127 of Decreto Legislativo 152/2006, which outlines the proper methods for dehydrating sludge derived from wastewater treatment. As highlighted by Famoso and Corrao (285, 2022), the Sicilian Region in November 2023 published the update of the *Piano Regionale dei Materiali da Cava e dei Materiali Lapidari di Pregio* (Regional Plan of Quarry and Precious Stone Materials), which proposes a new method to monitor mining activity. Quarry operators are now required to report detailed data on the volumes of extracted, commercialised, and unusable materials to public authorities, using environmental indicators, grouped into three categories - context, process, and contribution - to enhance waste management practices and promote the reuse of by-products. This system is designed to improve efficiency and sustainability across the sector, outlining the quantity of waste produced and its reuse.

Despite these regulations, practical challenges persist due to the distance between extraction sites and authorized landfills, combined with transportation costs, a problem outlined in the next section. These factors often lead to the accumulation of marble sludge at the sawmill, indicating that the current regulations are insufficient to address logistical and economic barriers effectively. For instance, such sites must be located at least 300 meters away from watercourses and situated on geomorphologically stable terrain (Gisotti, 83, 2008). Additionally, areas protected under the Natura 2000 network—an EU initiative established by the 1992 Habitats Directive to preserve biodiversity—are off-limits for landfill development. In Sicily, key marble quarrying sites in Custonaci such as Monte Cofano and Monte Sparacio are part of this network, designated as Special Areas of Conservation (SAC) under the code ITA010029.

The *Piano Regionale dei Materiali da Cava e dei Materiali Lapidei di Pregio* emphasizes the potential for repurposing marble waste. According to this plan by-products such as *marmettola* and *cocciame* can undergo various recovery processes, turning them into valuable secondary materials, even if it is very difficult to deal with them, particularly with the *marmettola*. Their unique properties, including non-toxicity, resistance to water and abrasion, and pH stabilization capabilities, make them suitable for numerous applications. For example, marble waste can be used in the production of aggregates for cement-based materials such as concrete, mortar, and plaster. It is also utilized in the manufacturing of artificial stones, paper, and paving materials for road construction with a high level of permeability (Famoso, 283).

The lack of territorial development in line with the need to reuse this waste, does not allow companies to develop new market outlets, leading to the closure or suspension of activities. Under Legge Regionale N° 127 of 9/12/1980, Article 24, operators may request up to three temporary suspensions per year, provided they offer valid justifications. These suspensions allow operators to market pre-extracted materials without permanently shutting down their operations or declaring bankruptcy. In the Custonaci region, an increasing number of operators have requested temporary suspensions of extraction activities, but it does not seem this manoeuvre will help companies in the long term since, as can be seen from the Sicilian Region's List of Active Quarries because the number has fallen from 49 in 2009 to 31 in 2020. Similarly, the export value of ornamental stone decreased dramatically, from €61 million in 2013 to €31 million in 2021. This downturn has resulted in the loss of approximately 1,000 jobs, highlighting the precarious state of the industry.

Moreover, the area is not anymore subjected to the opening of new quarry sites, evidenced by the identification of the Sicilian Regional Government in 2023, of 63 new areas for quarrying and mining activities as part of its updated regional plans “with a total authorised volume of approximately 284 million cubic metres (corresponding, on average, to approximately one million cubic metres per mining activity”⁴. Of these, only three are designated for marble extraction, and none of them were located in Custonaci but all in the province of Messina. Moreover, these new sites are classified as update areas, meaning they expand upon existing quarry zones rather than establishing entirely new operations. This practice allows the reduction of costs for companies requesting the enlargement of the extraction area, without opening a new one and without implementing a new EIA (Environmental Impact Assessment) and SEA (Strategic Environmental Assessment) project, but “limited only to the significant effects on the environment that have not been previously considered by the superordinate regulatory instruments”.

⁴ Source: Regione Siciliana, 29 novembre 2023 [Piano Cave, Regione aggiorna mappa con 63 nuove Aree. Di Mauro: «Potenziamo attività» | Regione Siciliana](#)

1.2 Marble Extraction and Transport: Environmental and Social Implications in Custonaci

The impacts of extractive practices, regardless of their global context, are substantial and highly variable. The severity of these impacts often depends on the specific type of extractivism under consideration and “some researchers now include activities that are not part of the conventionally defined natural resources sector, including digital extractivism” (Christopher W. et al., 2022)

In the case of marble sector many are the impacts generated from the extraction of the resources. An indirect impact arises from the necessary transportation of dehydrated dust - produced during extraction and processing - to designated special waste disposal sites. The pollutants associated with these activities include CO₂ (carbon dioxide), NO_x (nitrogen oxides), PM₁₀ (particulate matter), CO (carbon monoxide), and HC (unburnt hydrocarbons). These emissions entail significant costs in economic, social, and ecological dimensions, underscoring the broader implications of marble extraction activities.

It is important to note that the sector’s impacts are not limited to these direct emissions. Numerous additional effects, some more readily visible and others definitely more challenging to measure and quantify, are present. While their existence cannot be denied, these particular impacts fall outside the scope of the present study and will not be examined in detail. However, a comprehensive understanding of the environmental footprint of the marble industry therefore requires not only an analysis of direct and indirect effects, but also an approach that captures certain aspects of the production cycle that seem less related to the impacts produced by the industry. This underlines the importance of interdisciplinary studies that integrate technical, environmental and socio-economic perspectives to provide a holistic assessment of mining practices and their wide-ranging impacts.

Additional emissions arise from upstream and downstream activities such as fuel production, refining and secondary dust generation. Noise pollution from transport vehicles imposes additional social costs in urban areas and ecological impacts in rural areas. Indirect environmental consequences, such as soil and water degradation, although increasingly rare, must also be considered. A widely used method in the reconstruction of impacts along the life cycle of a material is the Life Cycle Assessment. The Italian literature only takes into account the largest marble basin in Italy, that of Massa Carrara, so if one wanted to understand the impact of the Custonaci basin, these data would not have to be taken into account for an

accurate quantification. Nevertheless, these data paint a useful scenario for understanding the general dynamics of the sector.

Primary energy consumption for the production of a 1 m² marble tile

Life cycle phase [a]	Electric energy (kWh) [b]	Thermal energy (MJ) [c]	Electric energy+thermal energy (MJ) ^a [d=(b×9.2)+c]
<i>Pre-production</i>	5.94	9.1	63.75
Marble extraction	5.94	1.67	56.32
Transport	0	7.43	7.43
<i>Production</i>	6.48	0	59.61
Raw blocks cutting	1.67	0	15.36
Standard blocks cutting	1.94	0	17.85
Polishing-buffing	2.87	0	26.40
<i>Use</i>	3.78	0	34.77
<i>Disposal</i>	0	3.73	3.73
<i>TOTAL</i>	16.2	12.83	161.83

^a 1 kWh=9.2 MJ.

Table 2: Primary energy consumption for the production of a 1m² marble tile, divided in life cycle phases⁵

As can be seen from the table, which shows energy consumption in the various phases - pre-production, production, use, disposal - the most important impactful phase, comprising both thermal and electrical energy, is the pre-production phase, with a total of 63.75 MJ.

The marble sector also contributes significantly to the increase of some eco indicators, such as Global Warming Potential (GWP), Human Toxicity (HT) and Acidification Potential (AP), and the pre-production phase confirms its position as the most impactful phase, which include extraction and transport.

⁵ Nicoletti et al. 290, 2001

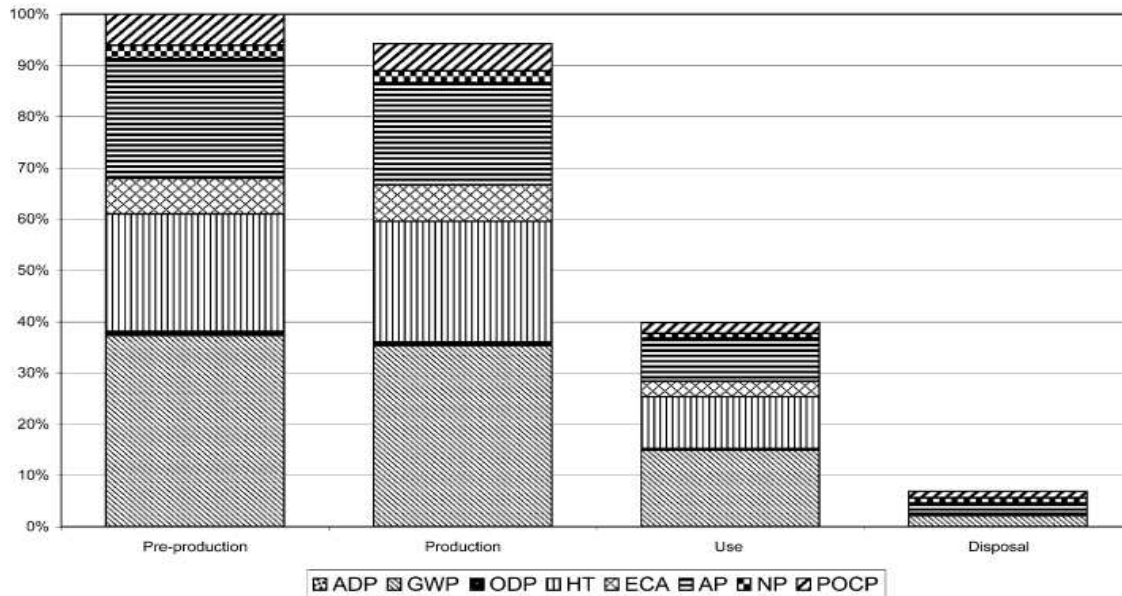


Fig. 7. Marble tile — contributions of the life cycle phases to the eco-indicator.

Table 3: Marble Tile – Contribution to the life cycle phases to the eco-indicators⁶

All work sections are difficult to analyse based on the availability of data, but the transport stage is particularly difficult, in fact, it is not calculated in Nicoletti’s study, mainly due to the complexity of its numerous variables, therefore no comparison between the extraction and transportation stages is given. However the impact of the extraction stage on the eco-indicators is highlighted, making the pre-production phase the most impactful among the others despite the lack of the second factor.

Contributions of the pre-production and production phases to the impact categories in the marble system (in percentages)

	Pre-production (transport excluded)	Production			Total
	Marble extraction	Blocks cutting	Standard blocks cutting	Polishing and buffing	
ADP	38	11	13	19	43
GWP	36	10	12	17	39
ODP	34	10	11	17	38
HT	38	11	12	18	41
ECA	37	11	12	18	41
AP	34	10	11	16	37
NP	33	9	10	14	33
POCP	33	9	11	15	35
TOTAL ^a	36	10	12	17	39

^a This total refers to the contribution of each operation to the eco-indicator.

Table 4: Marble life stages contribution to the Eco-indicators

⁷ Nicoletti, 292, 2011.

ADP (Abiote Depletion Potential), GWP (Global Warmin Potential), ODP (Ozone Depleting)

As no data on the transport stage could be calculated, the interview with the owner of a quarry in Custonaci may be useful to better understand the impact of this pre-production phase. The economic costs that marble companies have to stem from transportation and the correlated fuel expenses vary depending on the distance between quarry sites and landfills (a part for market fluctuations and international dynamics), as well as landfill fees, whether private or public, which are typically charged per tonne and fluctuate annually. According to the respondent, these charges represent a significant operating burden that affects both the short-term and long-term profitability of the industry.

The marble company from Custonaci interviewed offers an interesting exception. Thanks to an environmental reclamation project, the company avoids using other private or public specialised landfills for dewatered sludge, but disposes of the waste in its own plant 7 km away from the quarry. Most other marble producers, however, have to transport sludge classified as CER 010413 to authorised landfills and pay a fee. In the province of Trapani, there are 10 such landfills with varying capacities. Two are located in Custonaci itself, including the private landfill of the Custonaci Marble Company (capacity: 40,000 tonnes) and another managed by one of the largest operators in the area (capacity: 14,085 tonnes).

Assuming that these private facilities do not accept external waste, as the owner interviewed, the other marble companies must transport the sludge to the nearest landfill in Custonaci, which in this case is in Valderice and has a capacity of 11,000 tonnes. The work carried out by Famoso and Corrao in 2024 considers the closest landfill to Custonaci that can contain marmettola, thus a specific type of waste, to be in Marsala.

Taking Custonaci's Via Asse del Marmi as a starting point - a road that is a kilometre or more away from the quarries, but is also the road that every lorry has to take in the direction of both Custonaci and Valderice - and considering its proximity to several marble extraction sites - the distance to the only company in Valderice capable of storing inert waste is approximately 8 km, and to Marsala 50 km. Each fully loaded truck transports about 20 tonnes of products, with an estimated three trips per week, a figure that is probably low.

Potential), HT (Human Toxicity), ECA (Environmental Costal Allocation), AP (Acidification Potential), NP (Nutrient Pollution), POCP (Photochemical Ozone Creation Potential).

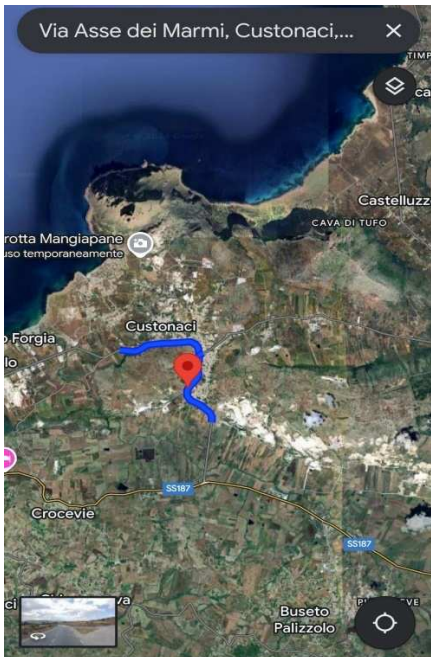


Figure 1: Google Maps Image of Via Asse dei Marmi, Custonaci (TP)

The pollutants majorly produced only by the transport vehicles of the hydrated dust to the landfills, and their impacts are:

1. **CO₂**: Related to climate change costs, it is the primary greenhouse gas responsible for global warming, with costs calculated based on its contribution to climate change.
2. **NO_x and PM₁₀/PM_{2.5}**: Due to impacts on human health and ecosystems. NO_x (Nitrogen Oxides) contributes to acidification, photochemical smog, and respiratory diseases, while PM 10 and PM2.5 (Particulate Matters) degrade air quality and cause respiratory and cardiovascular issues.
3. **HC and CO**: For their role in photochemical smog formation. HC (Unburnt Hydrocarbons) is a volatile organic compound that contribute to ozone and smog formation, while CO (Carbon Monoxide) is a toxic gas that reduces oxygen delivery in the bloodstream and contributes to ground level ozone formation.

The load transported by lorries has a significant impact on the amount of fuel used, as the engine effort for towing changes depending on the weight of the vehicle, consuming more fuel on the way out (full load) than on the way back (empty load).

According to calculations made in 2015 by Maria Vittoria Prati, a researcher of UNRAE that assessed the emissions of the car fleet in Italy, a EURO 2 articulated truck running on petrol produces around 50,000 tonnes of CO per year, less than 10,000 tonnes per year of NOx and less than 500 tonnes per year of PM2.5 (Prati, 5, 2018). These results vary depending on the type of fuel used by the vehicle in question. A lorry carrying tonnes of waste will use more petrol to travel a stretch of road than a car carrying only people, even though the kilometres travelled are the same. In reality, there are many more variables; the type of road surface, average speed and speed constancy throughout the stretch must also be taken into account, as each of these changes the result.

Based on an estimation made by the European Union in 2019, “the transport sector is responsible for about a quarter of the total CO2 emissions in Europe, 71.7% of which is produced by road transport” and of this, 27.1% by heavy goods vehicles.⁹ It is precisely CO2 that is the main pollutant emitted by transport vehicles, produced by the combustion reaction of a generic hydrocarbon. “The amount of carbon dioxide emitted is proportional to the amount of fuel burned. (...) and it is also related to the amount of carbon atoms forming the hydrocarbon molecule. In particular, the more carbon atoms there are, the greater the amount of CO2 produced per unit of fuel mass burned. (...) A full tank of 50 litres of petrol emits 60 cubic metres of carbon dioxide (...) but CO2 emissions also depend on the size and type of engine” (Saffioti, 3 - 4, 2016).

According to the information given by the owner of the Custonaci quarry, the lorry travels about 7 km, but it is difficult to calculate the exact amount of CO2 it produces on the way to and from the quarry to the sorting site, considering that all the many variables involved difficult to calculate. For example, nothing is known about the type of traffic from Via Asse dei Marmi to the landfill site, either in Custonaci or in Valderice, and the intensity of the traffic changes depending on the time of day at which this route is taken.

The combustion process generates other pollutants such as nitrogen oxides (NOx) and carbon monoxide (CO), the concentration of which is much lower than that of CO2 but whose effects should not be underestimated. CO intoxication can lead in the most severe cases to coma and death, while nitrogen oxides are irritants and give rise to photochemical smog and acid rain. (Saffioti, 9, 2016). The European Union has increased its control over vehicle emissions with the unrealistic goal of reducing greenhouse gas emissions from transport by 90 per cent by

⁹ Source: Parlamento europeo (Data di pubblicazione: 25-03-2019, Ultimo aggiornamento: 09-12-2024 - 15:47) [Emissioni di CO2 delle auto: i numeri e i dati. Infografica | Tematiche | Parlamento europeo](#)

2050 (compared to 1990 levels). Between 1990 and 2019, in fact, the transport sector increased its greenhouse gas emissions by 33.5%.¹⁰

The social costs of this pollutants are mainly related to health risks and are called market externalities. As Knut Einar Rosendahl said in 1998, to measure “health damages one either chooses results from a Willingness To Pay (WTP) study (or other contingent valuation studies), or uses results based on a Cost Of Illness (COI) approach, which intends to measure the lost earnings and medical costs. Valuation methods of non-market effects have been subject to a lot of criticism. One main reason is that objective valuations of, e.g., increased mortality or biological diversity may not be feasible.” (Knut, 13, 1998).

Both methods have weaknesses and strengths and, depending on the type of disease on which the research is based, the effectiveness, type of data and veracity of the results change. As the illnesses caused to the population by CO₂, CO, NO_x and PMs are many, this research will not address the social cost calculation, but some other studies have been conducted over the years, and, for examples it has been discovered that “Exposure to fine particulate matter (PM_{2.5}) and nitrogen dioxide (NO₂) increases the risk of non-communicable diseases (NCDs) such as cardiovascular disease, respiratory disease, and lung cancer, as well as exacerbating existing conditions such as asthma and chronic obstructive pulmonary disease (COPD). These chronic conditions are expensive to treat and put unnecessary strain on an already overworked healthcare system. Little is known about the extent of the attributable cost of these diseases to air pollution, now and into the future.” (Pimpin, 5, 2018).

Through Nicoletti's study, it was possible to highlight the most impactful work phase in terms of energy and eco-indicators, with a strong result for the pre-production phase in both contexts. However, the lack of a specific study on the impact of product transportation made it difficult to obtain useful data to understand the real impact of this phase in relation to all the processes in the sector. Nevertheless, Prati's study has revealed a general figure on transport, which highlights the seriousness of the effects of fuel combustion. The social costs in Custonaci have been minimised by the construction of the Via Asse dei Marmi road, thus avoiding the passage of heavy vehicles through the town's streets and considerably reducing the direct and indirect impact that close and repeated contact with pollutants has on the population.

¹⁰Source: Parlamento europeo (Data di pubblicazione: 25-03-2019, Ultimo aggiornamento: 09-12-2024 - 15:47), [Emissioni di CO2 delle auto: i numeri e i dati. Infografica | Tematiche | Parlamento europeo](#)

CHAPTER 2. REGIONAL ISSUES RELATED TO THE MARBLE SECTOR

2.1 Regional Transports and Infrastructures

The coastline of the Sicilian region extends approximately 1600 km, characterized by its highly varied geology and composition. This diversity includes rocky shores, carbonate platforms, and sandy beaches, which frequently require municipal interventions due to erosion (Scala et al., 3, 2024). Coastlines have historically been prime locations for human settlements, with ports facilitating connections to increasingly distant commercial hubs. This has meant that coastal urbanization has often outpaced development in inland areas.

Urbanization in Sicily followed a similar trajectory: while coastal areas and densely populated towns near the sea, such as Trapani, Palermo, Messina, Cefalù, Catania, and Taormina, among others, underwent constant infrastructural and architectural transformations and became increasingly connected to surrounding areas with efficient transport services, inland regions were relegated to pastoral activities, limiting their development. This uneven progress mirrored a broader trend in Southern Italy, where development lagged behind the North and often occurred unevenly across the territory. Over a span of fifty years, Sicily has experienced significant changes, albeit not on a scale comparable to the simultaneous transformations occurring in Northern Italy. Innovations that reached cities like Milan, Turin, Bologna, Florence, or Rome would take years - sometimes decades - to reach the South and the situation today remain unchanged.

The underdevelopment of Southern Italy cannot be attributed to a single cause; instead, it results from centuries of historical processes that have left these territories lagging behind other Western regions. Factors such as quality of the land and challenging climatic conditions have profoundly influenced the Mezzogiorno's economy, particularly by creating serious irrigation problems that harmed agriculture. All the conquests that followed one after the other over the centuries exploited the southern regions through colonisation that gave no room for social or economic improvements for the citizens. Starting from the Arabs, who invaded and then governed Sicily, Sardinia and Calabria from the eighth to the eleventh century, left behind a much more organised territory than they had found, especially from an agricultural point of view. Later, with the Normans, it was introduced one of the reasons why underdevelopment in

southern Italy was so incisive and long-lasting, the latifundium, which divided the population into two different classes, the landowners and those who worked that land. Feudalism continued to doom the Mezzogiorno while in the North the bourgeoisie was born in the Maritime Republics and free communes. The list of deleterious invasions culminates with that of the Spaniards who for centuries administered in an exemplarily terrible manner and exploited the territory under their rule, devastating its resources. The history outlined so far in a very concise manner gives a sense of what comes in the second part of Italian history, that from the Unification of Italy onwards. “The recognition of the infrastructural weakness of Sicily and Calabria and of their gap with the Northern regions, due to both the low level of investment by the State that to the inherent weakness of the forces economic and local policies, it has encouraged public authorities to with ever greater commitment to the transport problem, in the conviction that a solution would help to develop the productive and economic activities of the southern regions. In the South, in fact, the entrepreneurial weakness was so deep that only with the Cassa per il Mezzogiorno was set up after 1950, and it became possible to obtain funds for the construction of a large part of the road works in Sicily and Calabria.” (Angelini, 38, 2016) The development polarization continued to operate, and it was worldwide accepted and used in different socio-cultural contexts, fostering “new patterns of imbalances and socio-economic divides”. (Angelini, 38, 2016)

An alternative approach that operated in the last three decades highlights culture as a driving force that can fortify tourism processes that could “led development in urban contexts” but that “has proven to foster socio-economic inequalities and cultural polarizations, as well as new forms of marketization stemming from the assemblages of neo-liberal governance” (Graziano, Ruggiero, 92-93, 2023).

The lack of public transports represents the result of all these dynamics and a step towards which some politicians want to start to regenerate the south. The bridge over the Strait of Messina is an example of this type of thinking, which in theory is appreciable, but in reality conceals a lack of consciousness of the real needs of the entire population of the region. A work that from the very beginning of the Italian Unity seemed necessary both from an ideological and practical point of view and that surely at that time and even in the post-war period could have had a logical basis. The region’s transport improvements were being implemented and transport development was gradually taking place. Today, at a time when Sicily does not reach the minimum connections between one point and another of the region, it seems, especially in the eyes of those who live the inconveniences resulting from these shortcomings, a waste of economic resources. Today it doesn’t have to be waited 48 hours or more to go from the island

to the mainland, (Angelini, 42) as happened in the last century, while to get from one point to another of the island with public transport can count up to 8 hours.

A number of studies have analysed the effects of the realisation of the work at several levels, ecological, social, internal transport level, as well as the time needed to reach the two points in connection, with and without the bridge. What emerged from a report co-participated by several authors in 2023, there is no evidence of an improvement in the situation in the South, specifically in Reggio Calabria and Sicily, neither with regard to tourism, nor economic revenue nor an increase in the funds to be allocated for the modernisation of internal transport routes. (Lenzi et Al., 15, 2023). The advantages that Minister of Transport, Matteo Salvini, refers to, therefore seem to be nothing more than hypotheses without support by scientific evidence and are contradicted by a population that is mobilised daily through the creation of 'No Ponte' (No Bridge) associations and the block of the commencement of works in every possible way.

Thus an imbalance between the intentions of the government and of the population, continues to play out in the history of southern Italy.

If a marble company in Custonaci needs to ship its products to northern Italy or Europe, it must travel 320 km to Messina following the fastest route designated by the motorway. A truck on the motorway, based on Italian street regulations, cannot exceed 80km/h if it has a load of more than 12 tonnes, it cannot exceed 100km/h if it has a load of 12 tonnes, and 130km/h with 3.5 tonnes. In the first case, at a constant maximum speed, it takes 4 hours and 48 minutes to reach Messina, in the second case 3 hours and 26 minutes and in the third 2 hours and 38 minutes.¹¹ Transporting such materials for marketing can only be done by private transport. These calculations have been made to illustrate that while the motorway connecting Trapani to Messina exists, travel times remain long.

As the picture shows, motorways do not connect the entirety of Sicily, leading to drastically varying travel times fortune or unfortune location of one's residence. Infrastructure deficiencies not only hinder the sector's ability to compete effectively in global markets but also limit the region's overall economic potential.

¹¹ The calculations were obtained according to the formula $t = \text{speed} / \text{distance}$, where the load of 12T could hypothetically influence the resistance to motion by 20%. The time taken to travel 1km, by adding this coefficient, would increase from 45 seconds to 54 seconds. The total time was then calculated by multiplying the total seconds by the km to be covered, 320. A resistance to motion of 7% was then assumed with the weight of 3.5T.



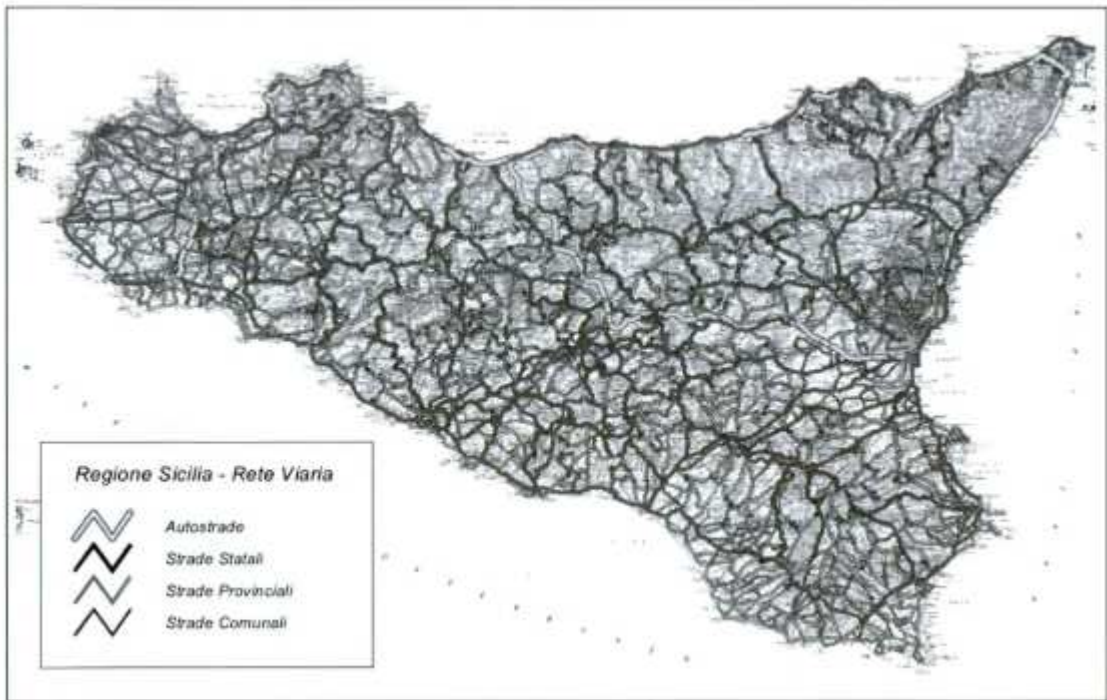
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Figure 2: Sicilian Highway

If a citizen had to travel this same route using the infrastructure and transport that the region offers, the estimated time would be 6 hours with three changes, between train and bus, and an expenditure of about 250€. On the other hand, if one were to travel from Rome to Bologna, approximately 350 km, it would take just over 2 hours by train at a cost of about 30€.¹³ Investments in infrastructures are therefore crucial, as they can expand market accessibility and attract economic activities to the region. Businesses tend to establish operations in areas where transportation costs are minimized, given that the trade-off between the concentration of facilities and proximity to target markets optimizes returns (Vengust, 24, 2024). In Sicily, the primary regional road network, which encompasses highways, state roads, and major provincial roads, spans 12,897 kilometres (Corriere, 43, 2024). Despite this extensive network, the region suffers from pronounced underdevelopment, as evidenced by the poor condition and limited capacity of its transportation infrastructures. These challenges are further exacerbated by the inadequacies of the railway system, which remains underdeveloped and poorly maintained.

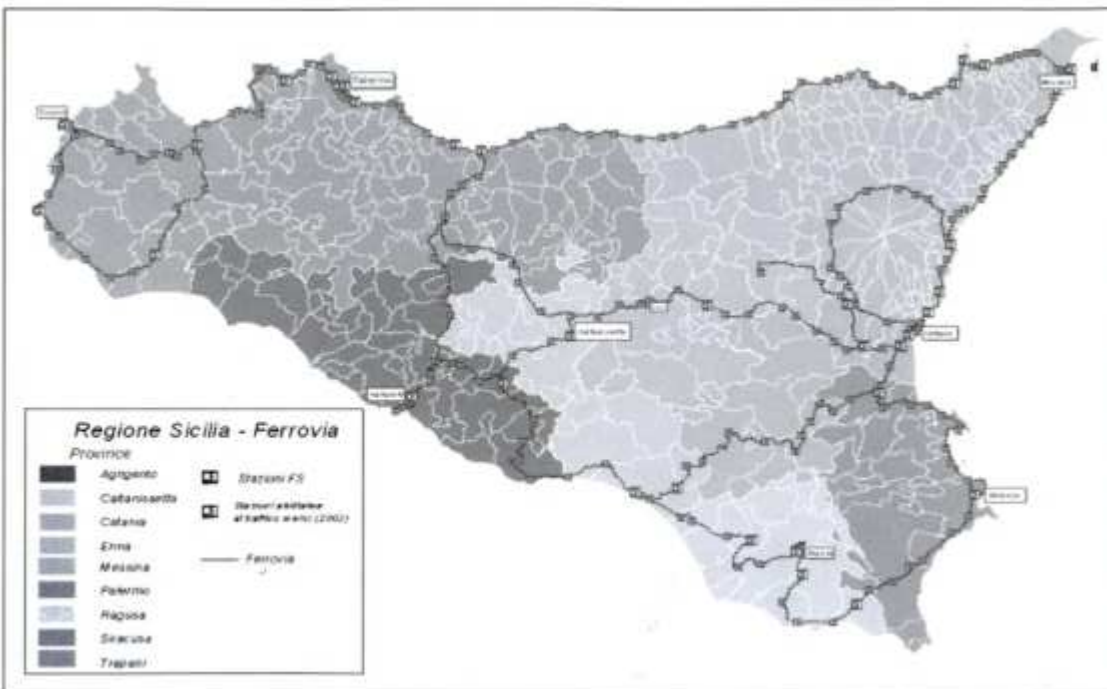
¹² Source: [Autostrade siciliane - Sicily-Holiday.com](http://Autostrade%20siciliane%20-%20Sicily-Holiday.com)

¹³ These information are taken, from Rome to Bologna, from Italo's site, and from Custonaci to Messina, from Rome2Rio site: [Messina to Custonaci](http://Messina%20to%20Custonaci), the only site containing such data.



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Figure 3: Sicilian Road Network



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Figure 4: Sicilian Railway Network

¹⁴ Figure from Corriere, 43, 2024

¹⁵ Figure from Corriere, 46, 2024

2.2 The Perspective of Labour

Working in the mining sector has never been an easy task. Particularly before the advent of advanced machinery, which significantly facilitated and lightened the daily workload, mining demanded exclusively manual labour characterized by both strength and precision. However, one aspect has remained unchanged over time: workers' exposure to prevailing weather conditions, subjecting them to suffocating heat during summer months and freezing temperatures during winter.

Salvo Cardinale, the general secretary of FILLEA CIGL Siracusa explained the heat issue in Sicily declaring that only a fraction of Sicilian companies apply for the 'cassa integrazione per caldo' (integration fund for heat) for their employees. On an extremely hot day, a group of trade unionists visited some construction sites, pointing out that it is the right of workers to stay at home on such a day, but they were not taken seriously. According to Salvo, moreover, the problem is so widespread that the regulatory aspect should be completely revised.

Mi potresti illustrare in che modo viene gestito il problema delle alte temperature in Sicilia?

“Incrociando i dati dell’Inps e di cassa edile nel 2021, ci siamo resi conto che soltanto il 18% delle aziende aveva fatto richiesta di cassa integrazione per caldo. Le aziende non collaborano. Quando a Siracusa siamo andati, un giorno in cui c’erano 36 gradi, davanti un cantiere per chiedere il motivo per cui i dipendenti stessero lavorando, ci hanno riso in faccia, non prendono nemmeno in considerazione la possibilità di lasciarli a casa e pagargli la giornata lavorativa intera. Nei cantieri si lavora sempre, con qualsiasi temperatura. Si fermano i cantieri dove c’è rappresentanza sindacale, mentre dove non c’è, questa sensibilità ovviamente si abbassa.

È chiaramente impossibile fermare tutti i cantieri nello stesso momento: bisogna parlare con i lavoratori terrorizzati dall’impresa, parlare con l’imprenditore, con il capo cantiere, sollecitarli a rispettare le regole. È un problema diffuso, generale e assolutamente incontrollabile se non prendiamo coscienza del fatto che qui c’è da rivedere completamente l’aspetto normativo, legato alla vigilanza. C’è la necessità di aumentare le stazioni di vigilanza della temperatura per avvicinarci quanto più possibile all’oggettività dei dati.”

The physically demanding nature of the work, combined with the challenging climatic conditions, has historically required exceptional resilience and adaptability from those employed in this field. Despite technological advancements, the human element remains central, and the risks associated persist. The importance of the weather issue was finally addressed in Ordinanza Regionale N° 1 of 17/07/2024, enacted by the President of the Sicilian Region, Renato Schifani. This ordinance prohibits labour under specific conditions deemed hazardous to workers' health. Effective from 17/07 to 31/08/2024, the ordinance states: "*Work in the agricultural, floriculture, construction, and related sectors is prohibited under prolonged exposure to sunlight between 12:30 PM and 4:00 PM in areas and on days where the risk map published on the website <http://www.workclimate.it/scelta-mappa/sole-attivita-fisica-alta/>, referring to 'workers exposed to the sun' with 'intense physical activity' at 12:00 PM, indicates a 'HIGH' level of risk.*"

The significance of this ordinance cannot be overstated. It marks an important instance of regulatory attention being directed at this critical aspect of quarry work, particularly in Sicily, where temperatures routinely exceed 35°C under normal circumstances and can surpass 40°C in quarry environments during summer. However in Sicily, summer conditions often persist well beyond August 31, a reality the President of the Region should acknowledge. Extreme temperatures not only pose a significant health risk, but also negatively affect productivity. The slowdown of work in the middle of the day often forces companies to rearrange shifts during the weeks, resulting in both additional costs for breaks and an overall reduction in performance.

It is important to note that this ordinance came into being a good 16 years after the enactment of Decreto Legislativo N° 81 of 9/04/2008, which in an overly general manner, and for this reason also widely criticised, identifies generic protective measures, as well as obligations concerning workplaces in which precautionary measures must be taken against both extreme temperatures that can be detected outdoors and indoor. These are general indications that the various regional governments should extend and, through ordinances, make effective and more specific according to the specific climatic and working contexts on which they are to be applied.

Prior to the ordinance issued by Schifani other legislative decrees were issued: Article 11 of Decreto Legislativo N°148 of 14/09/2015, regulates the payment of unemployment benefits, including seasonal bad weather. Heat is therefore considered an event not attributable to firms and workers, which is why INPS (Istituto Nazionale della Previdenza Sociale- National Social

Security Institute) pays the CIGO (Cassa Integrazione Guadagni Ordinaria - Ordinary Redundancy Fund), a 'social shock absorber' that can be requested at the occurrence of company crises due to transitory events and not attributable to the entrepreneur or workers, or caused by temporary market situations. Transitory implies the certain expectation of the resumption of work activity. Wage integration intervenes against a suspension of activity or a simple reduction of working hours'. The benefit is provided by INPS, but through the employer, in order to supplement or replace employees' pay in the event of suspension or reduction of work activity. However, as Salvo Cardinale points out, not all companies allow workers to take advantage of it. For this reason, it is crucial to promote awareness-raising campaigns aimed at both workers and employers. For workers to feel incentivised to make demands, especially when their employer does not adequately respect their safety, it is essential to create an environment where they feel protected and listened to. This requires not only compliance with existing laws, but also the possible implementation of new regulations that guarantee the protection of their rights.

The INPS circular n° 139 of 01/08/2016 at point 6¹⁶ makes the requirements for temporarily suspending work more explicit and says: "Exceptionally high temperatures, normally above 35 degrees, constitute grounds for action" taking into account the type of work and the work phase. Temperatures are perceived according to this standard as an extraordinary and risky fact, but can no longer be considered as such, especially if we point out that the temperatures that Sicily reaches on a daily basis, especially in the cities and during the summer months, are always above 30 degrees. In fact, the days that exceed the threshold above the law have risen exponentially and so have the risks for workers. Fortunately, the year after the circular n°139, it was emitted the message n° 1856 dated 03/05/2017¹⁷ indicating that "Temperatures perceived in excess of 35° may constitute an event giving entitlement to wage subsidies, even if the actual temperature is below that value". In this way, more importance is given to the perceived well-being of the worker, although resistance from companies remains.

The objective of the Syracuse FILLEA is to increase the number of temperature measuring stations, getting closer and closer to the worksites, aware, however, that this is not a solution but that this type of action will increase workers' awareness of the reality and quantity of the risks they face. It is noteworthy that similar measures had been implemented by other regions

¹⁶ Source: [Circolare numero 139 del 01-08-2016](#)

¹⁷ Source: [Messaggio numero 1856 del 03-05-2017](#)

well before the 2024 ordinance implemented by the Sicily region. An example is the ordinance of the Apulia Region prohibiting agricultural activities during peak work hours.¹⁸

Despite these progresses, quarry work remains a demanding and unappealing career choice, particularly for younger generations entering the labour market. Work on construction sites, where the threat of heat exists in exactly the same way as in quarries, is already little considered. The lack of desirability of these jobs is echoed by Alessandro, a long-time worker and manager in the family marble company and, only from few years, employer in a quarrying company in Custonaci, who shared his perspective on the challenges and perceptions surrounding this line of work. When asked about the quality of work in the quarry, he responded by pointing out the weather difficulties, inconvenient hours and the need to adapt, all problems that young people today, in his opinion, do not want to face, so much so that he, at 39, is the youngest among his colleagues.

The second question was about alternatives to working in the quarry after forced retirement, as happened to some workers. He emphasised some experiences of colleagues who found a job in various fields.

Come è lavorare in cava?

“Ci devi essere un po’ abituato, d’estate fa molto caldo, d’inverno fa freddo, c’è vento, pioviggina. Io ci sono nato, per me è normale, ma un giovane non lo farebbe mai. In mezzo al fango, sudatissimo, credo che non lo farebbe nessuno. Anche il muratore, mica è facile! Infatti si cercano lavoratori e non c’è nessuno che lo faccia. Io sono il più giovane qui e ho 39 anni. D’estate si comincia a lavorare alle 6, cercando di approfittare del fresco del mattino e sperando che duri il più a lungo possibile e d’inverno alle 7. Abbiamo delle postazioni in cui c’è l’ombra e stiamo lì. Oggi ci sono 35 gradi in cava, ed è il 28 ottobre, immagina d’estate cosa ci deve essere. Qui ti deve piacere, sennò non lo puoi fare.”

¹⁸ Source: [Lavoro agricolo: Emiliano firma l’ordinanza di divieto nelle ore più calde - PRESS REGIONE - Regione Puglia](#)

Quelli che lavoravano all'interno di questo settore e che hanno dovuto abbandonarlo, come si sono ricollocati nel mondo del lavoro? Si trova un'alternativa?

“Quelli che erano qua per esempio? Alcuni lavorano sempre in altre cave, altri lavorano in campagna, un altro gli piaceva fare il fabbro o cose così e ha trovato un lavoro alla segatura... questo. L'alternativa se vuoi lavorare, diciamo che si trova, diciamo.”

From the interview with Alessandro, a disillusionment with this job was perceptible, and although through the questions one tried to find the positive aspects, it was easy to detect the disappointment in his words. The same kind of language was used by Giuseppe Bica, speaking of the quarrymen's wages. He pointed out that 50 to 60 years ago quarrymen were well paid, to such an extent that the more experienced quarrymen received extra money in black so that they would not to lose them.

“In passato, l'operaio di Custonaci era altamente qualificato e ben retribuito. I doppi turni di almeno 10 ore, compresi gli straordinari, erano comuni. Oggi gli straordinari sono scomparsi, così come i doppi turni, e i lavoratori guadagnano la metà di quanto guadagnavano un tempo, il che è insufficiente per mantenere una famiglia come si sperava. In passato i lavoratori qualificati venivano pagati in nero con 2-3 mila euro in più, oltre al salario ufficiale, perché la loro esperienza era preziosa e non poteva essere persa.”

The decline of the sector has led not only to a contraction of job opportunities, but also to a loss of the symbolic value that this trade held in the community of Custonaci, once known for the excellence of its workers in the mining sector.

Antonio (called Totò) Torre, a former marble milling employee of a sawmill company, is another example of the difficulties workers are experiencing nowadays. The company where he used to work, that 20 years ago had more than 100 employees, is now totally in crisis, as is the entire Custonaci marble industry, and has had to lay off more than half of its staff in 10 years, down to around 10-12 employees. He remembers the competitiveness in the industry for the company where he worked and that he slowly stopped paying his workers on time, making them

realise that they were experiencing a crisis, however, resulting from the quarry no longer sending material.

“10, ma anche 8, 7 anni fa non avrei mai immaginato un epilogo così brutto, mai. Era un’azienda molto competitiva, però negli ultimi due anni l’azienda stava andando indietro, rimandava il pagamento delle mensilità, quindi si capisce da sé che sta subendo il colpo, non c’è stato bisogno che ci parlassero per farcelo capire. La crisi della segheria è cominciata quando la cava ha smesso di inviarci materiale, ha smesso di produrre, ma era una cava enorme, posizionata nella Contrada Noce.”

In a period characterized by challenges that may lead to discouragement, it is essential to maintain the motivation to persevere despite adverse circumstances. Among the participants in the research, the owner of the company displayed the most optimistic outlook. Initially, he expressed reluctance to allow one of his employees to participate, citing concerns that the questions posed during the study might exacerbate the worker's existing sense of pessimism and discouragement stemming from the current situation. However, he ultimately consented, emphasizing that if the owner himself succumbs to apprehension, this negativity will inevitably be conveyed to the workforce, thereby influencing their morale and productivity.

CHAPTER 3. HISTORY OF CUSTONACI AND THE REASONS OF THE DECLINE

Introduction

This chapter will briefly present the most influential reasons for the decline of the Custonaci marble sector, and as such indicated by the various interviewees. Just as there is no single solution that can revitalise the sector, there is also no single cause for its decline. The historical framework of the city and its 'white gold' is therefore necessary to understand the contemporary situation and future prospects.

The owner of a quarry in Custonaci outlined the significant challenges faced by the marble sector, shedding light on the most critical factors underlying its difficulties. While the Sicilian industry, during the first decade of the 2000s, continued to make a substantial contribution to Italy's overall economic output in the marble sector, various dynamics shifted considerably in the following years. As a result of these profound changes, both the Italian marble industry as a whole and the Custonaci sector in particular experienced a severe decline, dealing a significant blow to their previously stable positions. The entrepreneur points to the year 2018 as the beginning of the crisis, listing the reasons for it: crisis in international markets, strong euro currency in exports, covid, war turmoils and the discovery of new materials in emerging countries.

Da quando e perché il Settore di Custonaci è in crisi?

“Dal 2018. I fattori sono diversi, non c'è un fattore eclatante: crisi dei mercati internazionali, valuta euro troppo forte quindi noi ci interfacciamo con monete diverse ed una moneta forte non va bene in export, ma va bene in import. Moti di guerra dappertutto, il covid non ha aiutato, scoperta di nuovi materiali in paesi emergenti: in Iran ci sono 3300 aziende di marmo, solo per farti un esempio.”

Economic globalization is widely recognized as the primary catalyst for the profound transformations observed within the marble sector, including its market fluctuations. The emergence of new competitors from Countries endowed with abundant raw materials has

significantly reshaped the competitive landscape. Prominent among these nations are China, which has attained a position of paramount importance as the leading producer and consumer of marble; India, which has reinforced its status as another global leader in the sector, recording a 6.2% increase in exports in 2020 compared to the previous year; as well as Brazil and Turkey¹⁹.

A noteworthy development in this restructured global market is the tendency for raw materials to be processed in their countries of origin, often utilizing state-of-the-art machinery designed and supplied by the Italian manufacturing industry for the international market. This shift in the international division of labour has introduced substantial challenges for traditional marble-producing districts, particularly in advanced economies. Competing solely on price has become increasingly untenable, given the cost advantages held by developing nations. Efficiency improvements alone are insufficient to offset these disparities, compelling firms in advanced economies to explore alternative strategies for maintaining competitiveness. To face these challenges, companies in traditional marble production districts must focus on enhancing non-price competitive advantages. These include offering superior quality products, innovative designs and tailor-made solutions that meet specific market demands. Sustainable growth of the industry requires a strategic shift towards modernisation and refinement of traditional products. By prioritising innovation and value creation over mere cost-cutting measures, companies can strengthen their market position and generate long-term profitability. (Vitali, Napoli, 11, 2011).

For the marble district of Custonaci, product quality holds paramount importance, as the intrinsic characteristics of the raw material constitute a critical determinant of the sector's success. The decline of numerous marble enterprises can often be attributed to shortcomings in maintaining the desired standards of raw material quality. This underscores the need for businesses to invest in quality assurance processes and technologies that enhance the value of their offerings but sometimes the efforts to pursue a specific objective is not enough. If the availability of the material that the mountain has in itself is not the one requested by the market, there is nothing that the company can do and all the efforts, the years spent to search the best quality, and the money needed to fund the excavations, will be done in vain.

¹⁹ Source: [I dati 2020 del settore lapideo dall'anteprima del XXXII rapporto Marmo e Pietre nel mondo – MarmoNews](#)

In addition to quality improvements, collaboration among enterprises is emerging as an indispensable strategy in an increasingly interconnected, complex, and competitive global environment.

The formation of business networks provides a viable response to the challenges posed by globalization. By fostering collaboration, these networks enable firms to compete more effectively through shared knowledge, resources, and innovations. The establishment of such networks requires the careful identification of partner companies with aligned goals and the collaborative development of a structured program. This program should detail critical focus areas, the tools and resources available, anticipated outcomes, organizational frameworks, and budgetary considerations. The strength of a business network lies in its ability to operate as a cohesive and integrated system rather than a loosely connected group of entities. Moreover, such collaborative frameworks contribute to improve the quality of life in the region and foster new opportunities for regional development (Gervasio, 35, 2016).

3.1 History of Custonaci and its Marble

The Trapani province of Sicily boasts a rich tradition of marble quarrying and processing, deeply intertwined with the region's historical and cultural identity. Quarrying activities in this area date back to the Romanesque period, with evidence of early extraction efforts discovered on Mount Cocuccio in the municipality of Custonaci (Grammatico, 2014, p. 3). Custonaci, a small city with a population of approximately 4,700 inhabitants and a density of 299.6 people per square kilometer, became the first to gain administrative autonomy from the province of Erice, marking the 50th anniversary of its independence in 1999 (Salvatore Corso, 14, 1999).

In more recent historical periods, marble extraction in the Trapani area has undergone diversification. The province features both coloured marbles, prized for their aesthetic qualities but difficult to extract due to the remote and challenging locations of the deposits, and white marbles, which were more readily accessible but considered less valuable. The situation reversed in the early 20th century, following the discovery of Perlato di Sicilia. This ivory-coloured marble, known for its brown arabesque motifs, darker hues and occasional flecks of pure calcite reminiscent of mother-of-pearl, catalysed the decline in demand for coloured marbles, further exacerbated by the reduction in church construction, historically a major consumer of these materials, as architectural practices increasingly adopted reinforced concrete for structural purposes.

Before World War II, the marble industry was labour-intensive and lucrative, particularly for workshop-worked marble. However, the industry's operations were slower and less mechanized compared to the accelerated pace observed in the post-1950s period. The quarrying process during this time was conducted by pioneers who possessed minimal formal training and relied on rudimentary tools made of iron and wood.²⁰ These tools, including the palu, subbia, mazzetta, picu, and zappa²¹ underscored the artisanal nature of the trade.

²⁰ Source: [Custonaci Perla di Sicilia - 2014 - YouTube](#) : 12:10 – 12:24 - Cesifop, 2014

²¹ Palu: Steel chisel-tipped tool used with water to drill into rocks before the advent of the jackhammer;

Subbia: Hand tool, usually struck with a metal hammer, the cutting edge is a simple pyramid-shaped point;

Mazzetta: Iron hammer with square mouth and short wooden handle for one-handed operation;

Picu: Quarry pick with the size of a sledgehammer used with two hands to break up hard ground and softer rocks, used for considerable roughing work;

Although still predominantly dominated by family-run businesses, the sector gradually evolved into a more organized and industrialized domain, which became an immense source of wealth for Custonaci and its neighbouring towns. Consequently, marble earned the moniker “white gold” (Torre, 2010, pp. 5-7).



Figure 5: Young Chiseller - 1950s

Zappa: Tool used to load soil and/or small stones into ‘cardarelle’ (containers).
(Torre, 90-93, 2010)



Figure 6: Quarrymen with Tools. Palu, Zappa, Subbia and Mazzetta²²

Quarry operations during this period typically lasted 40 working days, also called "quarantina," which predominantly occurred during summer months. Workers would ascend the mountains and remain onsite for the entire duration, returning home only occasionally for provisions. In the winter months, labour shifted to workshops where marble was processed. The extraction of Perlato di Sicilia marked a pivotal moment in Custonaci's history. Roughly 80 years ago, Custonaci was a modest village with an economy centred on pastoralism and subsistence agriculture, including the cultivation of grapes, cereals, and olives, as well as the rearing of livestock for meat, milk, and derivative products.

The commercialization of marble fundamentally transformed Custonaci, facilitating its transition into a modern industrial hub. Some workers, having acquired expertise in quarrying, took entrepreneurial risks and opened their own quarries (Grammatico, 22, 2014). The unique properties of Perlato di Sicilia attracted the attention of entrepreneurs from Carrara, who brought technical expertise and market access, compensating for the limited commercial

²² Pictures from Torre, 38, 34, 2010

knowledge within Custonaci up to that point (Grammatico, 37, 2014). This discovery initiated Custonaci's evolution into the renowned "City of Marble."

Between 1950 and 2000, Custonaci experienced unparalleled prosperity, culminating in the town's architectural transformation. Marble became the defining material of the townscape, used extensively in pavements, benches, private staircases, and public spaces. The Sanctuary of Maria Santissima di Custonaci, constructed in the 1500s and later adorned with polychrome marble often donated by prominent residents, epitomizes the town's artistic and cultural heritage. These embellishments reflect Custonaci's historical affluence and the pride its residents took in their marble heritage. Characteristic of Mediterranean towns, Custonaci's aesthetic is dominated by the chromatic variations of processed marble slabs, giving rise to its identity as a "white city."

At its peak in 2010, the Custonaci marble sector directly and indirectly employed approximately 5,000 individuals across various industries, including extraction, processing, marketing, and ancillary services such as mechanical workshops, packaging, and haulage. The town's globally renowned marble became a prominent material for iconic projects like Milan's central railway station and St. Peter's Basilica in Rome. Other notable varieties included Perlatino di Sicilia, Crema di Roccia, Nerello di Custonaci, Rameggiato, Libeccio Striato, and Botticino di Sicilia ²³.



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Figure 7: Top view of Monte Cofano, Custonaci and one of the first quarries

²³ Source: Cesifop, 2014 [Custonaci Perla di Sicilia - 2014 - YouTube](#) : 11:15 – 13:53

²⁴ Overview of Custonaci, Monte Cofano, and one of the firsts quarries in the area that are now abandoned.

Source: Google

3.2 Globalization, Competition

From 2000 to 2004, Italy was the world leader in the export of stone and marble, steadily increasing its total annual export value to \$2,146,577 in 2004, from 1899,869 in 2000, creating a significant gap with its closest rival, China. However, this period of dominance was short-lived. Over the following years, the balance of power among producing countries shifted dramatically, with India emerging as the global leader. (Zahda, 26, 2009). By 2020, India was the first in producing precious stones, near to the award of 14 million tonnes, while China stands at about 8 million tonnes. Italy ranks 6th among the 16 major producers.²⁵

The remarkable competitiveness of countries like China and Turkey in the extractive industries is heavily influenced by their approach to environmental and social regulations. In China, for example, the abundance of raw materials coupled with historically lenient regulatory frameworks, allowing companies to operate without strict extraction limits, granting them a significant cost advantage. Similarly, in Turkey, despite the introduction of laws mandating quarry restoration and water pollution limits in the 2010s, enforcement remains inconsistent (Ozcelik, 1 - 3, 2016). Such approaches enable these countries to compete aggressively in the global market, but often at the expense of environmental integrity and social equity.

Yet, the issue of sustainability is not limited to these contexts and extends to nations with stricter regulations, such as those in Europe. Although some European environmental policies impose to curb over-extraction and promote responsible practices, they do not always succeed in achieving true sustainability. The concept of environmental preservation frequently conflicts with the economic imperatives of extraction-based industries, creating a tension that is not resolved merely through regulation. In essence, even where sustainability is purportedly a priority, the practices necessary to ensure it remain largely unimplemented, or at best, insufficient.

This pervasive issue exemplifies what Gregory Bateson and Thomas Hylland Eriksen have described as a double bind: a structural contradiction in which economic growth and environmental preservation are locked in perpetual conflict (Eriksen, 32, 2016). Globalized economies incentivize relentless extraction and production, but the environmental and social consequences of these practices undermine long-term stability. Eriksen argues that this paradox is deeply ingrained in the mechanisms of global markets and cannot simply be

²⁵ Source: [Marble and Stones in the world Report - Rapporto marmo e pietre nel mondo](#) , 17, 2021

addressed by balancing competing priorities. Instead, a fundamental re-evaluation of the values and systems underpinning these dynamics is required.

The challenges faced by the Sicilian marble industry provide a poignant illustration of this conflict. According to the owner of a quarry site in Custonaci, Turkey, one of the most important rivals, exports marble remarkably similar in colour to Custonaci's product but at a lower cost due to its regulatory and economic advantages. Furthermore, innovations in material science, such as ceramics and engineered alternatives, are reshaping consumer demand, further eroding the relevance of traditional marble (Vitali, 11, 2011).

This situation is compounded by the absence of global standards governing the marble trade. According to the entrepreneur, international agreement enforcing universal regulations - particularly regarding workplace safety and fair wages - could help level the playing field. Such measures, if carried out by excluding non-compliant companies from the market, would discourage the exploitation of workers and natural resources in countries with laxer laws. However, as the case of Europe demonstrates, even strict regulation does not guarantee meaningful environmental reform if economic incentives remain misaligned and the non-achievement of certain rules does not provide any sanctions or restrictions. The marble sector's ongoing struggles underscore that sustainability cannot be achieved in isolation, nor can it emerge from systems that consistently privilege profit over preservation. Ultimately, the example of the global marble industry reveals the urgent need for systemic change. Without addressing the structural pressures that incentivize environmental exploitation, sustainability will remain an elusive goal, not only in countries like India and China, where regulations are limited, but also in regions like Europe, where regulatory frameworks exist but fail to fundamentally challenge the destructive logic of extraction.

3.3 Marble Valorisation Assessments

The problems facing the Sicilian marble sector extend beyond international competition a range other factors, such as increased use of substitutes. the lack of effective techniques to minimise waste; and a global culture that accentuates the idea of purity.

Even in Roman times there was the possibility to have inside houses something similar to marble. Those people with more limited financial means - though still comfortably well-off - had the opportunity to showcase marble thanks to a specialized painting technique that imitated the appearance and texture of marble with remarkable precision. By using this method, homeowners could achieve a convincing likeness to the architectural style and luxurious feel of real marble, creating an elegant atmosphere without the need for the actual costly material (Napoli and Tronzo, 3, 2018). These historical precedents, combined with modern technological advancements, underline that the appeal of marble has always been deeply tied to its symbolic value and aesthetic qualities, rather than only its intrinsic practicality. To preserve its competitiveness in an evolving market, the marble industry must adapt by balancing tradition with innovation. This involves not only optimizing extraction techniques to minimize waste but also embracing strategies that celebrate marble's imperfections, highlight its unique qualities, and redefine its value in an age increasingly dominated by substitutes.

In terms of pre-extraction methods, one particularly promising avenue lies in the application of advanced technologies, such as Ground Penetrating Radar (GPR) which can be utilized either by outsourcing to specialized companies that provide geological surveys and analyses at relatively low costs but require frequent engagements or through the direct purchase of GPR equipment, which constitutes a more substantial but long-term investment.

The growth strategies available to marble companies typically fall into two broad categories: targeting niche markets or appealing to the mass market. An innovative strategy that could bridge these two approaches is mass customization. This strategy, as defined by Fogliatto et al. (1, 2012), focuses on delivering a wide range of personalized products and services through modular design, flexible production processes, and integrated supply chain management. Such an approach could offer a means for companies to differentiate themselves while maintaining scalability and operational efficiency. However, the Sicilian marble sector faces significant hurdles in implementing such strategies, primarily due to the scarcity of high-quality raw materials. White marble, once a symbol of prestige for Custonaci, is becoming increasingly

rare. As the mountains are quarried, a recurring issue emerges: blue veins. These streaks, undervalued by the global market, are deemed imperfections with no economic worth. As a result, vast quantities of marble are discarded as waste, relegated to what is known as "ravaneto", big amount of residual material.

This phenomenon is not new. As early as the 19th and 20th centuries, the demand for white marble centred exclusively on its "pure" form, uniformly bright and unblemished. Blue or violet veins were considered unacceptable for both sculpture and interior design because prevailing aesthetic ideals favoured a flawless, monochromatic finish.

This pursuit of purity in marble mirrors a deeper human tendency: the aspiration toward an ideal of perfection that is often unattainable. It reflects how we project our sense of incompleteness and imperfection onto external objects. Cultural norms teach us to value perfection, to reject what appears "flawed" or unconventional. In the case of marble, this obsession with flawlessness becomes a symbolic attempt to address internal inadequacies, but at what cost?

The cost is evident in the significant waste generated by dismissing blue-veined marble, which, despite its appearance, retains qualities like robustness, durability, and versatility, leading to unsustainable depletion of marble-rich mountains.

This paradigm, however, can and should be challenged. Recognizing the value of veined marble - not as an imperfection but as a natural variation - would not only conserve resources but drastically reduce waste. Embracing the beauty of imperfection, both in marble and in our broader perspective, would allow for slower extraction practices, repurposing of materials, and more sustainable environmental management. After all, "purity" is an abstract ideal, whereas every inch of a mountain is tangible and irreplaceable that deserves to be cherished, not squandered. Overly aggressive mining practices have not only reduced the availability of quality marble but have also demonstrated a lack of regard for the inherent value of the natural environment.

This unsustainable exploitation of resources has compounded the sector's difficulties. The adoption of a more conscientious and respectful attitude towards the mountain as a natural resource could have facilitated a shift from a purely quantitative to a more qualitative valuation of marble. Enhancing the perception of marble as a resource of intrinsic and enduring value may, in the long term, strengthen the sector's reputation and market position.

3.4 Synergy Between Companies

The lack of collaboration among marble companies, an issue evident since the industry's inception, has been highlighted repeatedly in interviews with both company and workers as a crucial factor contributing to the current challenges. Historically, the prevailing approach has been one focused on performance and achieving rapid and easy profits, completely bypassing the possibility of gradual transformation aimed at long-term objectives. Such transformation would have entailed substantial effort and the improvement of relationships with nearby competitors, potentially preventing the closure of dozens of businesses.

Giuseppe Bica has offered a cultural explanation for the reluctance of entrepreneurs in this sector to collaborate. According to his perspective, and not his alone, southern Italians, particularly Sicilians, exhibit a deep-seated mistrust toward one another and prefer to handle their affairs independently, as deception is perceived to be perpetually looming. This phenomenon has been aptly described as a "negative subculture."

But Bica is not the only one to attribute a feature of distrust among fellow citizens. It was emphasized also by a worker of the company participating to the research; he argued that this distrust is often exacerbated by a form of arrogance that leads individuals to believe they possess all the knowledge they need, thereby dismissing the value of collaboration or input from others.

Initially, such observations may have been taken lightly, given that there is no place in the world where residents do not identify flaws in both their locality and their fellow inhabitants. However, the ubiquity of such behaviour does not undermine the validity of these analyses. On the contrary, who better than those living in a community can speak to its less visible aspects—those less apparent to outsiders or transient visitors?

On the other hand, this propensity to critique one's own community can also be interpreted as a common form of personal disengagement. By externalizing the issue—by asserting that "others are the problem, but not me"—responsibility is shifted away from the individual. Yet this perspective raises critical questions: if everyone claims that others exhibit this flaw, how can it be that I heard the same narrative from all interviewees? Were only the "virtuous" individuals willing to share their insights while the "culprits" remained hidden?

Clearly, this is not the case. Instead, it seems that this behaviour is widespread, but those involved remain largely unaware of their participation in it. This lack of self-awareness fosters

stagnation, hindering the social and economic progress of the community. The mistrust and individualism identified by Bica and the worker likely influenced the way marble businesses managed (or avoided) collaborations with one another. However, negative narratives about one's own community, while common everywhere, serve only to perpetuate a cycle of disconnection. Without self-recognition, there can be no meaningful improvement to the social and economic structures that underlie these patterns.

One such missed opportunity lies in the potential adoption of a *Contratto di Rete* “an economic-legal tool for cooperation among enterprises that mutually commit to collaborate in forms and areas related to their activities, exchanging information and/or services of an industrial, commercial, technical, or technological nature and/or jointly carrying out certain activities related to the business objectives of each enterprise” (Gervasio, 35, 2016). Such a contract could have helped companies to remain competitive in the sector. For instance, a network participating in a project in the United Arab Emirates, one of the most rich clients, might have been able to secure a significant contract through collaborative efforts, resulting in mutual benefits for all involved. However, with companies operating entirely independently, no marble company in Custonaci today is capable of participating in large-scale projects, particularly due to the issue of raw material shortages. These shortages prevent businesses from effectively competing in such ventures.

It is important to recognize that there is no single way to create a network; each form of aggregation can be tailored to specific needs. In the case of Custonaci's marble sector, the pressing necessity is to establish horizontal circuit integration. This model aims to deliver benefits to clients through high-quality services, superior materials, and offerings that emerge from cooperation among companies within the same sector. Such a strategy requires moving beyond traditional competitive dynamics by adopting a perspective that transcends mere rivalry. This shift is underpinned by the principle that “*through cost structure reductions, the provision of more advantageous solutions for clients, and the use of more efficient channels*” (Gervasio, 36), the added value provided to customers leads to tangible benefits that manifest not only in economic terms but also in client loyalty and sector-wide reputation, signalling both potential and quality certification.

The economic world is constantly changing, bringing new challenges that businesses need to face in an ever-evolving market. These changes shouldn't be seen as obstacles to overcome with the same old methods just because they're familiar. Instead, they should be embraced as opportunities to grow and adapt. Sticking to outdated ways of doing things only risks making

the situation worse, often leading to stagnation or even a full-blown crisis. This is why it's so important to take a step back and rethink how a business operates. It's not just about staying competitive, it's about finding better ways to manage costs and resources, improve productivity, and take care of the environment. Addressing these challenges means being open to new ideas and approaches that are better suited to today's fast-moving global market.

CHAPTER 4. ECOLOGICAL RESTORATION, RECLAMATION AND REHABILITATION

The terms ecological restoration, reclamation and rehabilitation are still under consideration for a correct definition. In fact, scientific literature and often legislation on the subject in different countries, or even regions within the same country, use and interchange these terms as if they were synonyms. Gerwing et al (2022), propose changes to the definitions of these terms.

While the SER (Society of Ecological Restoration) defines the Ecological Restoration as - 'the process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed', scholars prefer to better specify which kind of recovery takes place, with this definition:

Ecological Reclamation: *"the process of assisting the recovery of severely degraded ecosystems to benefit native biota through the establishment of habitats, populations, communities, or ecosystems that are similar, but not necessarily identical to surrounding and naturally occurring ecosystems."* (Gerwing, 2)

This second definition seems more timely, as it excludes the possibility of using land for human uses.

On the contrary, the terms Reclamation and Rehabilitation, as given by the SER, identify possibilities for changes in the use of degraded, damaged or destroyed ecosystems for human use. Reclamation – *"the process of making severely degraded land (e.g., former mine sites or wastelands) fit for cultivation or a state suitable for some human use. Also used to describe the formation of productive land from the sea"*.

Rehabilitation – *"management actions that aim to reinstate a level of ecosystem functioning on degraded sites, where the goal is renewed and ongoing provision of ecosystem services rather than the biodiversity and integrity of a designated native reference ecosystem"*.

These two definitions mislead, and as Gervis et al (2, 2022) comment "reclamation could be considered as conceptually nested within rehabilitation. In practice, the delineation between these terms, as well as their relationship to ecological restoration is unclear."

The work done by Gervis et al, although limited to redefinition and renaming (actually increasing confusion around terms at this time) is useful in trying to highlight which terms should be used,

to be sure that the meaning is shared by all. At the moment there is incredible confusion and it is not easy to use the terms in the correct way.

Therefore, the term Ecological Restoration, as outlined by Gervis, is here used, and the term Reclamation to refer to the process of recreating ecosystems similar to those before soil destruction with the remediation of ecosystem services; Rehabilitation, on the other hand, to indicate the process by which human services, such as agriculture or infrastructure, are prioritised, as outlined by Lima et al (2016).

It is important to distinguish these terms also because Italian legislation very often uses the term Recovery without any specificity on the actions to be undertaken. It indicates a variety of types of actions, therefore increasing confusion that is not solved or managed by scientific literature. Therefore it is crucial to implement definitive and specific terminologies.

4.1 Difficulties in the Realization of a Project

As delineated by the L.R n° 127 of 1980, the quarries must undergo a Recovery Process, that can be interpreted as Restoration, Rehabilitation or Reclamation. The easiest, fastest and cheapest implementation seems to be the Rehabilitation, as most of the projects in Sicily involve the creation of olive tree agriculture.

An example of environmental rehabilitation was carried out in C.da Carrubba-Bastione, a territory of the Municipality of Agira (EN). The project envisaged the “Environmental Recovery of the Dismissed Bastione Quarry” through the “backfilling of the same depression with excavated soil and rocks and other special non-hazardous waste (all governed by Legislative Decree 152/2006 and Ministerial Decree 186/2006), the subsequent planting of a layer of vegetable soil and, finally, the creation of an olive grove. The above-mentioned activities consist in the restitution of degraded areas to productive or social uses through morphological remodelling, understood as operations R10 (Land spreading for the benefit of agriculture or ecology) of Annex C to Title IV of Legislative Decree no. 152/2006 as amended and supplemented”. (Puiti, 2, 2021). The proposed project, following the definitions outline in the last section, falls within the Rehabilitation project, since it envisages the creation of services for human beings, agriculture, since the term Recovery hasn’t any specificity.

It is definitely less likely to see the implementation of Restoration Projects, and even more so to find examples within quarries, probably due to longer timeline, less cost-effectivity and the much longer study process. An example by Gentili et al, (2020) considers the ecological restoration implemented in the Colle Pedrino quarries in Lombardy, Italy, where active and inactive quarries alternate. The process took 10 years to be completed, from 2007 to 2018, with a top-to-bottom approach in succeeding phases. (Gentilia et Al, 2, 2020). It was pointed out by the researchers that the success of an ecological restoration project is highly dependent on certain soil factors, such as the absence of stones, potassium richness and presence of sand. A soil rich in potassium greatly accelerates soil fertility and plant performance. (Gentilia, 6) The process of naturalising abandoned quarries is slow and costly, requiring field studies “to find the right balance between the grain size composition of the backfilling materials used in the slope reclamation” as well as their quality, “which favours the use of fine materials while preserving the stability of the slope”. Moreover, “native seed mixtures, including successful species according to the backfilling material, improve and accelerate the natural dynamics by increasing biodiversity” (Gentili, 7).

An example of Reclamation could be the environmental recovery project of the “Cugno Marino” limestone quarry in Noto (SR) integrated with a non-hazardous inert waste recovery plant, “with a total capacity exceeding 10 t/Day” (Gioffriddo, 1, 2010). This Project therefore envisages both an environmental rehabilitation project through the planting of vegetative species “leaving an evident permanent trace of the past mining activity(...) aimed at the renaturalisation of the area for agricultural-productive purposes with the planting of olive and carob trees” (Gionfriddo, 4, 2010), and the installation of an aggregate recovery plant.

These examples help to understand what kind of projects can be pursued. In the specific context of Custonaci, with a very high number of abandoned quarries, it would be interesting and right to start implementing projects.

Environmental Rehabilitation or Reclamation projects in quarries are often unsuccessful because of the economic burdens involved in their implementation.

In Campania, in the Valle di Diano, around 2006, a group of professionals developed a masterplan entitled ‘Biovallo’, an ambitious project of 13 different quarries situated in different locations within the Valley, containing more than 70 abandoned quarries. The team was composed of engineers, geologists, landscape architects, lighting designers, whose objective was to take a comprehensive census of all the quarries and design new purposes to restore these sites.

Maurizio Cocilova, an engineer involved in the project, graciously shared his experience, recounting that the proposal for a master plan was a project funded by the region itself but that then none of the pilot projects devised by the experts were accepted, not because of the lack of value, but because of the lack of funds. Indeed, it seems that these projects were very complex and required a large expenditure, from 500 thousand euros to 1.5 million. At that time there were no calls, either European or Italian, that supported work of this kind, so it was not possible to rely on other income. The people of the surrounding localities, however, seemed very interesting and happy that the landscape quality of the area could improve and that such projects could come to life.

“Il progetto fu finanziato come masterplan dalla regione Campania, però poi furono eseguiti anche dei cosiddetti progetti pilota su ogni singola cava e presentati alla regione Campania per essere poi finanziati. Purtroppo nessuno è stato finanziato, non perché non ne valeva la pena,

ma perché la regione non aveva una disponibilità economica di questo tipo. La comunità montana della Valle di Diano ha provato a reinserire questi progetti ma la regione non lo ha mai fatto. Sono rimasti delle idee su carta, ma a livello preliminare.”

-Quale era il costo per ogni progetto, più o meno?

“Spaziavano dai 500 mila fino ai 1 milione e mezzo di euro, perché poi ognuna ha le proprie dimensioni, per ogni cava era stato creato un progetto e in base all’entità del progetto vi era il costo relativo, però un peccato che non fu finanziato. Per alcune speravamo di recuperarle ma non è stato possibile.”

-Ci sono dei bandi europei o statali a cui si potrebbero chiedere dei finanziamenti per progetti del genere?

“Noi non li abbiamo mai trovati. Nei primi anni, con gli altri colleghi, abbiamo approfondito questo aspetto, ma non abbiamo mai trovato nulla. Adesso non so se c’è qualcosa in merito. Alcune sono cave private, altre del demanio, quindi in base al finanziamento bisogna proporlo a chi di dovere. La comunità montana dovrebbe continuare ad insistere sulla fattibilità e proposta del finanziamento, ma forse in base alle disposizioni regionali, si è puntato su qualcosa di più concreto, immediato, non so... Sono dal punto di vista ambientale e paesaggistico un pugno nell’occhio, per alcune di queste, però l’idea era quella di riqualificarle dal punto di vista paesaggistico.”

-“Avete fatto dei questionari alla popolazione per capire l’indice di gradimento per un progetto simile?”

“Sì, tra i vari progetti ci fu un questionario che riguardava principalmente la qualità della vita nella Val di Diano e tra le varie domande c’era anche quelle di come il cittadino poteva pensare di migliorare l’aspetto paesaggistico ed ambientale. I risultati furono tutti positivi, molti erano interessati. Se vuole, con l’autorizzazione della comunità montana io posso inviarle la scheda esplicativa.

It was Maurizio himself who then gave me the number of a fellow engineer who participated in the project, Luigi Centola. He explained more in details some of the projects he developed, and sent some documents containing images of future quarry scenarios. Each type of quarry, as Luigi explains, is different from the others, so through a preliminary study of the site a specific

project is created. The one in Atena Lucana for example was designed as a market-crop precisely because the terrain was appropriate. The one in Padula, on the other hand, had a cone shape, hollowed out like a funnel so it was thought to make it a kind of elevator and a place for aging typical foods. The third one, the one in Consilina, was an art project and place for events.

“Erano dei bei progetti, 3 erano i più evoluti, uno a Padula, uno a Consilina e uno ad Atena Lucana. Secondo me dipende da che tipo di cava trovi, come è scavata e in base al contesto diverso. Quella di Atena Lucana l’abbiamo sistemata come una specie di market coltivazioni.. diventava una cava da produzione “eno-gastronomica”, ed era attrezzata, c’era un market e una serie di attrezzature ma la cosa principale è che c’era un pianoro molto grande e su questo si poteva coltivare facilmente. Diventava un parco produttivo, come concetto. Un altro, Padula, era una cava scavata come un vulcano, all’interno, uno scavo a imbuto. Era interessante. C’erano dei macchinari antichi e abbiamo preso lo spunto dalle macchine di ferro, metallo che c’erano per creare anche delle macchine moderne, come un ascensore e in qualche modo risalire in alcuni punti dove, all’interno ce n’erano parzialmente delle grotte e venivano rese edificabili e si faceva una parte di invecchiamento dei prodotti tipici, perché uno dei temi conduttori era questo dell’enogastronomia, e voleva che si valorizzassero i prodotti della valle di Diano.”

“La terza cava, in alto, aveva un uliveto. Tagliando la cava gli ulivi sono caduti e si sono fatti degli uliveti anche nella parte bassa, quindi c’era questa idea di collegare e far capire che l’uliveto stava sopra e sotto, con dei fili artistici.. è un’installazione d’arte diciamo, questo dell’uliveto. Poi c’era un banco di materiale più chiaro nel fronte di cava che veniva lucidato, spazzolato e diventava anche schermo per proiezioni, attività di concerti ed eventi. La cava in base a quello che trovavamo, diventava anche opportunità per fare un progetto adeguato a quello che c’era e quello che serviva alla comunità. Dipende anche dalla sicurezza, bisogna metterle in sicurezza per entrare e poi si vede come si può sviluppare. Ma deve avere uno sviluppo economico. In Campania c’è questa legge che permette di prendere del materiale se metti in sicurezza la cava abbandonata, non so se c’è anche in Sicilia.”



Figure 8: Design of the Atena Lucana Quarry - Valle di Diano, 2006 ²⁶

²⁶A description is given in the lower right-hand corner: “Cultural & productive garden with free descending terraces reproducing the Valley’s characteristics botanical systems: forests, orchards, vegetable gardens”.

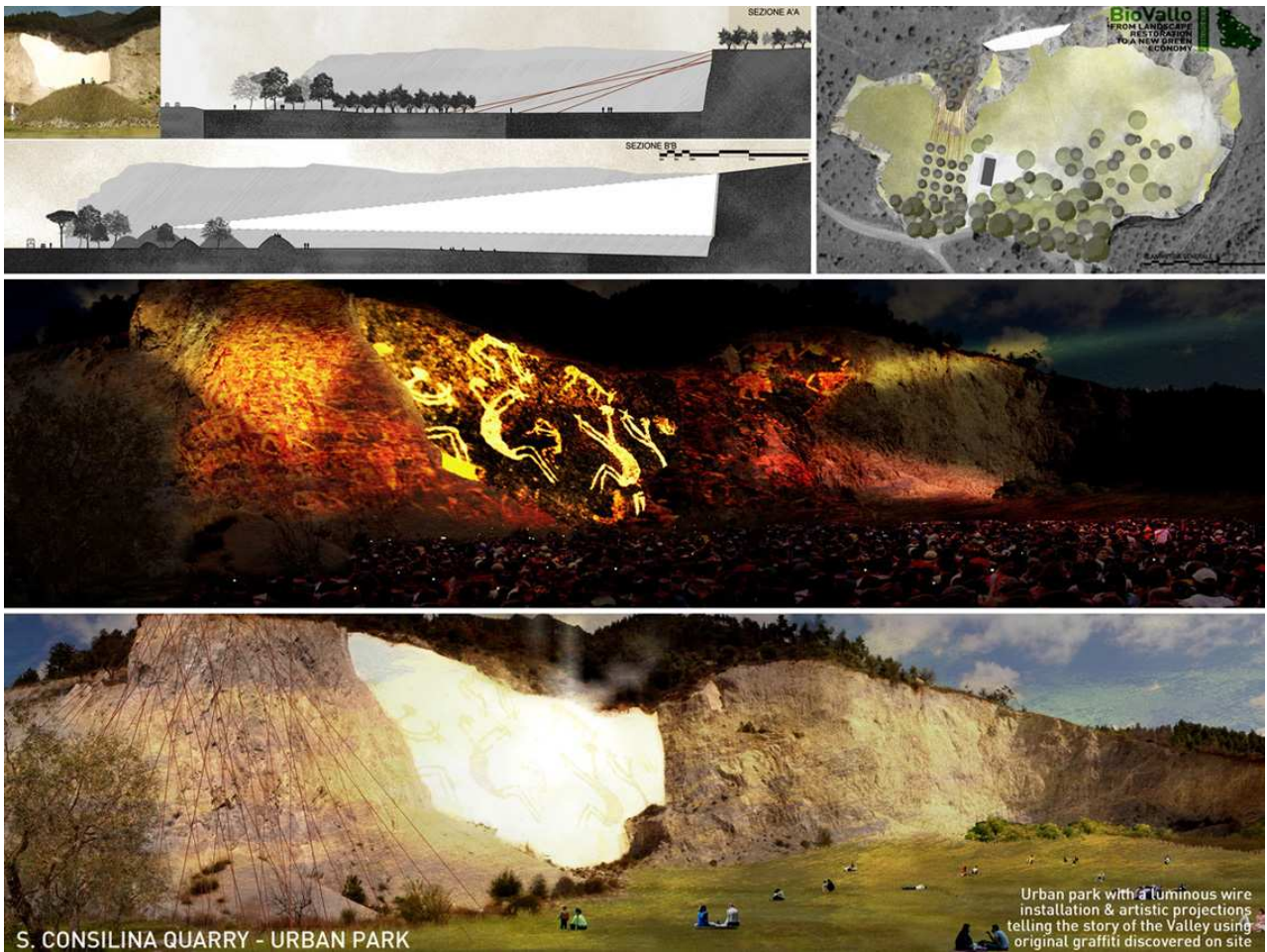


Figure 9: Design of the Consilina Quarry in a Urban Park – Valle di Diano, 2006²⁷

As can be seen, the complexity of the various projects is high, so the cost required to implement them also increases, and the chances of such beautiful ideas becoming a reality is greatly lowered.

It is necessary to think of less expensive, simpler, and no less effective ideas.

²⁷ A description is given in the lower right-hand corner: Urban park with a luminous wire installations & artistic projections telling the story of the Valley using original graffiti discovered on site.

4.2 Results and Proposal Custonaci Project

It was noted that the Custonaci marble sector has been under strong international pressure, nor have the entrepreneurs ever managed to create a collaboration, thus excluding the possibility of overcoming the adversities caused by the increasingly extreme competition between companies around the world. Some techniques have been hypothesised that could help either to improve certain processing steps, such as through GPR, or through networking techniques, such as the currently unfeasible horizontal integration circuit. Throughout this process, it is not only the companies and their workers who suffer the consequences of this decline, losing jobs and being forced to reinvent themselves, but the entire population, which suffers indirectly from the collapse of the marble market, with major consequences. During the interview in front of his shop, Giuseppe Buccellato pointed out the absence of banks and also explained why in a place where a few years ago there were five banks in such a small town, now even the last one is leaving. The reason lies in the lack of businesses and therefore interest in staying.

“Uno dei problemi è che non ci sono più banche, se ne stanno andando tutte, ne è rimasta solo una, ma ad ottobre smonterà anche quella. Prima, quando le cave erano tante, si lavorava bene e Custonaci era ricca, ce ne erano cinque! Cinque banche in una cittadina così piccola, capito? Questo ti fa capire quanti interessi avevano, quanti soldi giravano! E così il fatto che non ci sono più banche ti fa capire che soldi non ne girano più.”

This was the interview that changed the starting perspective. The fieldwork had begun with an approach to extractivism that followed the views of Gudyanas (2018), Klein (2014), and Willow (2019), judged as a practice of resource appropriation, a one-sided process whereby it is only human beings who benefit. I believe, while still supporting these views and believing in the need to raise awareness of the harmfulness of extractivism on land, ecosystems, and local equilibriums, that the past of a place should not undermine its future.

In another respect, one must also take into account the significance of marble and its extraction to the population. It is not only an economic issue, but there emerges, although not explicitly said by the interviewees, but understandable from their gestures, tones and expressions, a sense of pride towards their past. A sense of identity derived from marble has grown, Residents are known around the world for the resources their land has and for the

quality of processing that has been carried out by companies and workers until then. This is not an insignificant detail because it is the perception of self and the perception that others have about us that make us who we are. The writing of poems, songs, and even books that tell about this activity and those who lived and worked in it, is a tangible image of the importance it has on their lives.

However, if it were not for extractivism, Custonaci would have thrived on tourism, and its effects are no less harmful. The era of extractivism therefore should not end abruptly, because the consequences at the economic level would be devastating, but the approach should be less destructive and more proactive. There are no magic solutions that solve problems, but there are multiple proposals that together instigate change. Indeed, Custonaci has the good fortune to rise in a place whose beaches and coastline have been left untouched by municipal and/ or regional bodies in charge, allowing the algae that land on the coast, to settle and accumulate without being removed. This approach, while not always appreciated because of the foul odor generated by a large pile of algae that also results in oxygen depletion and accumulation of sulphides, which are toxic to all but a few species, a smaller number has a positive effect on marine ecosystems as it creates a positive cascading effect on the entire food web, from primary consumers to higher trophic level fauna (Orr et al, 126, 2014), increasing invertebrate abundance and diversity (Schlacher et al, 31, 2017).

In addition, infrastructure near the seaside location is minimal and services inexpensive. Places that have undergone rapid urbanization suffer consequences generally associated with this procedure, such as “coastal vulnerability, introducing physical transformations of the coast that generates important environmental impacts on the original status of the territory, altering coastal dynamics whose effects may not become apparent for years or even decades” (Garcia-Ayllon, 4, 2018).

All these positive notes are not present in adjacent areas with a greater vocation for tourism. These peculiarities could be leveraged for a slow and rational local regeneration that also takes quarries into consideration. In fact, as already pointed out, currently active quarries will be subjected to ecological restoration, rehabilitation or reclamation projects; quarries that were closed before the law that imposes these actions, on the other hand, are not included in this planning. Therefore, it would be interesting to apply ecological restoration projects also in the

abandoned sites and at the same time bring out the history and future of Custonaci, leaving a few others untouched.

A Project for Custonaci

The idea of leaving some quarries, with the signs of extraction intact, stems from the need not to forget and disown the past, but there is no doubt that they can be managed as recreational, cultural and sports spaces. If all other quarries were subjected to Ecological Restoration, restoring space for ecosystem connections and enriching the native biodiversity of the Custonacian mountains, the balance between restored quarries and quarries that do not undergo this type of process would be rebalanced. Specifically, an interesting and inexpensive project for the region would involve the creation of a nature trail including the crossing of Custonaci's most striking and scenic places. From Monte Cofano, one of the sites under the protection of the Natura 2000 network, to visiting both restored and unrestored quarries, enhancing the history, culture and present of the place.

Visits inside abandoned quarries, after their stabilization, would be joined by specialists in certain sports activities, such as rock climbing, thus changing an abandoned site into a space for recreational activities.

The trail could extend to the center of Custonaci, inviting visitors to explore and discover its charms. In addition, a secured quarry could serve as a unique venue for cultural events of all kinds. One example is the possibility of creating an outdoor marble museum. In fact, a marble museum has already been opened in 2017 inside a dedicated building, which also includes meeting and conference space. Building a separate facility, despite the presence of places, such as abandoned quarries, that could be used for this purpose, is, in my opinion, an imprudent use of resources.

Such a project would open the door to a range of side-by-side services, revitalizing the town location and not just its shores. It would allow the opening of stores to rent bicycles, for the sale of equipment suitable for safe climbing, the employment of labour to build benches along the path, as well as its delineation and maintenance. This project would certainly not solve the city's current situation, but it would allow citizens not to feel abandoned, and perhaps the return of banks, making life easier for residents.

This example of a project, feasible mainly because it does not require an excessive amount of funds, needs to be combined, as already anticipated, with other ecological restoration projects, which instead might be more expensive and would be possible only with state and regional participation.

4.3 Conclusion

Following the plumbing of all the issues around the marble sector in general and that of Custonaci in particular, it can be pointed out that there are still many steps to be taken for a proper management of the sector, and it is necessary to start from what difficulties the sector is going through in order to take action. In conclusion then, waste still turns out to be a problem, both because of its accumulation at extraction sites, also due to its innumerable quantity, and because of the insufficient number of landfills suitable for its proper disposal and reuse, causing a reckless increase in emissions due to the transport of aggregates. In this case a cultural change and consequently a change in market demand is necessary, lest marble be judged less valuable, and therefore to be discarded, only because of its colour and some fractures.

From the workers' point of view, the problems relate mainly to controls, which are lacking in the workplaces to ensure that safety regulations are complied with. In this case, therefore, it is not only increased controls that are needed, but also a cultural change that predisposes employers to take care of their staff, putting the health of their employees first over profit.

Regarding the problem of abandoned quarries, there is a growing attention to the dynamics of abandonment, accompanied by an expanding body of literature on this issue. Despite these developments, there continue to be a paucity of design proposals of any type, so I felt it was important to come up with a simple design, to show that in one way or another it is possible to change for the better something that has remained unchanged for decades.

A positive look into the future is the bearer of revolutionary ideas.

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ORAL SOURCES

Name	Role & Description	Date
Marble company owner	Owner of a Marble Company in Custonaci	07/08/2024
Pietro	Pro Loco volunteer involved in cultural valorisation	09/08/2024
Giuseppe Buccellato	Owner of retail store and manager of tourist services	09/08/2024
Giuseppe Bica	Former mayor of Custonaci (1994-2003, 2013-2019)	09/08/2024
Salvo Carnevale	General Secretary of FILLEA CGIL Siracusa	28/10/2024
Totò Torre	Former marble presser, currently unemployed	28/10/2024
Alessandro	Employee at a Marble Company	28/10/2024
Maurizio Cocilova	Engineer for the Biovallo project, Campania	10\11\2024
Luigi Centola	Engineer for the Biovallo project, Campania	10\11\2024

Table 5: People interviewed in order of contribution.

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