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Paola Nardone

Environment, Economy and Society: Approaches, Models and Tools for Sustainable Development

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Volume 28 No. 2 **2024**

TABLE OF CONTENTS

In memory of Eva,

Friend and Colleague

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Paola Nardone*

ENVIRONMENT, ECONOMY, AND SOCIETY: APPROACHES, MODELS, AND TOOLS FOR SUSTAINABLE DEVELOPMENT

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Abstract

This essay introduces a special issue that aims to explore the origins of the sustainable development concept, and how the idea of sustainability evolved in recent decades. Although the concept came into being relatively recently, the fundamental ideas on which it is based evolved rapidly over time. The United Nations conferences and commissions that have brought sustainability to the center of the international agenda in recent decades can be seen, in a sense, as the outcome of three centuries of thinking about the relationship between human beings and the natural environment. In subsequent years, however, the concept of sustainability has taken on a different and broader meaning. It no longer covered only the environmental aspect but was gradually associated with the social dimension (often summarized as well-being, equality, democracy and justice), the economic dimension and, above all, the interconnection of these areas. The integration of these three dimensions – environmental, economic and social – gives value to the concept of sustainability, so much so that we can say that only when all three aspects are considered can we truly speak of sustainable development. Starting from these reflections and the analysis of scientific literature, this special issue intends to promote reflections on the topic of sustainability through multidisciplinary approaches aimed at developing models and tools for sustainable development.

JEL CLASSIFICATION: N40, N50, O44, Q56, Q58

KEYWORDS: ENVIRONMENT, SUSTAINABILITY, SUSTAINABLE DEVELOPMENT, GROWTH

* Department of Socio-Economic, Management and Statistical Studies University Centre "Ud'A-TEMA", University G. D'Annunzio for Land and Sea, Viale Pindaro 42, 65127, Pescara, Italy, Phone: +39 85 453.7536; *E-mail address*: paola.nardone@unich.it.

1. Introduction

The traditional economic development model adopted by industrial and post-industrial civilizations has increasingly been characterized by a conflict between the economy and the environment. The production system, driven by growth, failed to account for the negative externalities it generated, including environmental damage and, more broadly, social harm. Since the Industrial Revolution, economic development has thus led to serious phenomena related to the depletion and deterioration of resource quality, while simultaneously exacerbating inequalities and fostering conflicts rooted in biological and cultural diversity. In more recent times, this has prompted the scientific community to shift the debate toward fundamental concepts underpinning the functioning of environmental and socio-economic systems, such as complexity, interdependence, and uncertainty.

This essay introduces a special issue that aims to explore the origins of the sustainable development concept, and how the idea of sustainability evolved in recent decades. Although the concept came into being relatively recently, the fundamental ideas on which it is based evolved rapidly over time. The United Nations conferences and commissions that have brought sustainability to the center of the international agenda in recent decades can be seen, in a sense, as the outcome of three centuries of thinking about the relationship between human beings and the natural environment. To fully understand the contemporary sustainability movement, therefore, it is essential to trace the historical events that enabled its birth.

Sustainability emerged as a social, environmental, and economic ideal born in the late 1970s and 1980s. By the 1990s, the term had already become familiar in the world of politics and economics and was growing in importance in literature and scientific debate[1]. The concept of sustainability comes from the scientific and naturalistic literature, in which in fact the management of a resource is defined as sustainable if, its reproductive capacity is known, its exploitation is not exceeded beyond a certain threshold. The use of the term sustainability in the literature has increased exponentially since the second half of the 1970s. In fact, according to Caradonna, it is difficult to find books published before 1976 that use the word "sustainable" or "sustainability" in their titles or even among their keywords. After this date, however, the use of

[1] In reconstructing the history of sustainability, one cannot ignore the work of Egelston (2013) and Caradonna (2014). A chronology of the stages that led to the consolidation of the concept of sustainable development can also be found in the recent work of Jacob (2024). For a broader examination of the concept of sustainable development, see the work of Lanza (2013). For an analysis of the concept of sustainability as applied to business and entrepreneurship, among others see the volume by Jones (2017).

the same terms in the literature grew exponentially, which gives an idea of the intensity of the debate on this issue (Caradonna, 2014, 2).

The term sustainability is not only about the environmental aspect but is now associated with the social dimension (often summarized as well-being, equality, democracy and justice), the economic dimension and, most importantly, the interconnectedness of these domains. Indeed, the field of sustainable development has generated overlapping definitions of economic, environmental and social sustainability. The economic dimension requires, for example, a system capable of producing goods and services on an ongoing basis, avoiding excessive debt, and balancing the needs of different sectors of the economy. The environmental dimension requires maintaining a stable resource base, conserving renewable resources, and preserving biodiversity and essential ecosystem services. Finally, the social dimension of sustainability involves several factors, including a fair distribution of resources, equal opportunities for all citizens, social justice, health, mental well-being and the ability to live a safe life, access to education, gender equality, democratic institutions, good governance and political participation. In short, for a society to be considered sustainable, it must address not only environmental issues, but also social and economic issues (Caradonna, 2014, 13).

The concept of development is closely related to the social sciences and economics. Growth and development are terms that economics borrows from common language. Indeed, economic growth refers to the increase in gross domestic product, which measures the output of goods and services valued at market prices. The concept of development and the origins of the branch of the social sciences, called development economics, coincide historically with the process of decolonization that characterized many countries in the global South. Over the years, a purely economistic view, which measured development only through per capita gross domestic product values and placed the emphasis solely on human well-being, has gradually been abandoned. This phase, in which we referred to the issue with the noun "development" alone, was followed by a second one in which development was to be "social" and thus no longer solely related to income growth, but also to the improvement of several social variables (education, health, civil and political rights, protection of minorities) considered essential in the process. The end point of this evolutionary process is, precisely, sustainable development to which we will return more fully within this essay. As Spindler notes, "Sustainability or sustainable development has its roots in all cultures"

(Spindler, 2013) and can therefore be declined differently based on the cultural elements that distinguish a given society. In this essay, however, the concept of sustainable development is in line with the determinations of the Brundtland Commission, according to which the concept is also an effort to help humanity, and the planet survive all adversities that threaten their existence (WECD, 1987).

2. The origins of the sustainable development debate

From the perspective of historical-economic discourse, a pivotal milestone in the extensive and multifaceted debate on sustainable development is represented by the so-called *Club of Rome*. This international group of intellectuals, comprising experts in science, economics, and institutional matters, convened for the first time in Rome in 1968 to address the pressing challenges facing humanity[2]. The work of the Club of Rome culminated in the drafting of a report commissioned to the Massachusetts Institute of Technology (MIT) and published in 1972 under the title *The Limits to Growth*[3]. The fundamental thesis put forth in this report was that unlimited quantitative growth is incompatible with the Earth's finite resources. It is important to recall that during those years, quantitative growth was measured through GDP analysis. The groundbreaking report produced by MIT immediately sparked debates as well as controversial and contradictory interpretations. The report highlighted the need to control population growth, the pace of industrialization, and the depletion of natural reserves. Particular attention was devoted to the issue of energy reserves following the 1973 oil crisis and the subsequent economic downturn it triggered.

However, the 1972 report faced significant criticism. In response, the Club of Rome commissioned a second report on systems modeling, titled Mankind at the Turning Point by Mesarovic and Pestel (1974). This second report addressed criticisms of Limits to Growth by halving the study's temporal scope, which allowed the authors – and the Club of Rome in general – to moderate the intense debate surrounding the assumptions on resource depletion. Furthermore, the second report increased the number of modeling inputs, thereby reducing criticism regarding the relationships between variables. Most notably, *Mankind at the Turning Point* employed regional

[2] The Club of Rome was a think tank founded in 1968 by an Italian industrialist and visionary named Aurelio Peccei (Peccei, 1981).
[3] The report, written by Donella Meadows, Dennis Meadows, Jørgen Randers, and William W. Behrens, was first published in 1972 (Meadows et Al., 2023).

representations for population dynamics, incorporating political and social dimensions in resource management (Egelston, 2013).

Since the 1970s, several environmental protection movements have emerged, engaging in demonstrations and protests to demand responses from governments, international agencies, corporations, and the public. These efforts significantly contributed to raising societal awareness and interest in environmental issues. During this initial phase in the development of the sustainability concept, the debate on growth was fueled by so-called "ecological economists," such as Boulding, Daly, and Schumacher[4]. Although their work was still far from what would later be defined as the economics of sustainability, their critiques during the latter half of the 1970s highlighted social concerns and the societal consequences of economic growth. These early attempts by economists to integrate social, environmental, and economic considerations marked a significant step forward for the sustainability movement, which continued to evolve in the following decade[5].

These ecological economists, although sometimes in disagreement with one another, shared a common critique of the deficiencies inherent in neoclassical economics, which had up to that point guided economic policy across much of the Western world and beyond. One defining feature that distinguished ecological economics from the later sustainability economics was its condemnation of traditional growth-at-all-costs economic paradigms rather than the formulation of pathways toward a *Green Economy* (Caradonna, 2014, 116).

Ecological economists further criticized several key aspects of traditional economic thought: i) The treatment of the environment as an inert entity, entirely disconnected from the processes of wealth creation; ii) The reliance on Gross Domestic Product (GDP) or Gross National Product (GNP) as meaningful measures of economic well-being; iii) The assumption that human-made technologies were inherently benign or that their benefits outweighed the damage caused by their unintended side effects (Caradonna, 2014, 131).

The initial reflections emerging from the Club of Rome debate led to further developments during the United Nations Conference on the Human Environment held in Stockholm in 1972. Although the concept of sustainability was not explicitly addressed at the conference, three key

[4] See, for example, the works of Boulding (1966), Schumacher (1973), and Daly (1977).

[5] For a more in-depth analysis of the debate that developed in those years on economic growth, see the works of Mishan (1967 e 1977) and Hirsch (1976).

elements surfaced, shaping a lasting approach to sustainability. The first element was the establishment of the United Nations Environment Programme (UNEP), which became the permanent environmental branch of the United Nations[6]. The second element was the development of an "action plan" for national governments to consider when establishing their own environmental ministries. The third was the creation of a global monitoring system, now known as Earthwatch. This system provides an integrated system for data collection and dissemination, serving as the primary focal point for the distribution of scientific and sociocultural information on environmental issues, including sustainable development (Egelston, 2013, 65). The decisions made by the United Nations during the Stockholm Conference would have a tangible impact on global environmental policy and international development programs.

Starting in the 1970s, the traditional model of economic development gradually gave way to the concept of sustainable development. This notion first appeared in an official document and at an international assembly in 1980, later converging in the World Conservation Strategy (IUCN-UNEP-WWF, 1980). The report, developed by the United Nations, the WWF, and other organizations, addressed themes related to development and conservation. It introduced fundamental concepts about environmental functioning, emphasizing the crucial importance of maintaining the regenerative capacity of natural systems. The report marked a significant turning point, reflecting a shift in environmental awareness from conservatism – focused on resource protection – toward a more dynamic approach integrating environment, economy, and human well-being. The report outlined three key objectives: i) Maintaining essential ecological processes and life-support systems; ii) Preserving the planet's genetic diversity; iii) Ensuring the sustainable use of species and ecosystems (Caradonna, 2014, 142).

3. From the Brundtland Report to Agenda 2030

In the journey toward implementing a sustainable development model, a crucial milestone is represented by the *Our Common Future* report, published in 1987 by the World Commission on Environment and Development (WCED), chaired by the Norwegian minister Gro Harlem Brundtland

[6] The General Assembly acted on this recommendation in Resolution 2997 (XXVII) (Egelston, 2013, 64).

(WCED, 1987) [7]. The report encapsulates the Commission's work on three key objectives: 1) examining the connections between environment and development, 2) outlining issues where international cooperation could address the dual challenges of environmental degradation and underdevelopment, and 3) raising awareness and fostering commitment toward sustainable development as part of the international political agenda (Egelston, 2013, 83).

The Brundtland Report emphasizes the need for a "development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs"[8]. This definition thus became the most appropriate and universally accepted one for sustainable development, which must be based on vigorous economic growth that is also socially and environmentally sustainable. Since then, countless organizations and scholars have embraced the Brundtland Report's intergenerational definition of sustainable development. Its balanced approach to sustainability has set the tone for international development policy since the late 1980s (Caradonna, 2014, 144).

The report subsequently inspired further reflections, highlighting the inherent contradiction between the concept of unrestricted, effectively infinite economic growth, and the conservation of natural resources. Following the Brundtland Report, numerous attempts have been made to define the concepts of sustainable development and sustainability. Only a few years later, in 1991, the United Nations and WWF introduced for the first time the concept of renewable resources in a strategic document on sustainable living (UNEP-IUCN-WWF, 1991). These are the only resources capable of reconciling growth with their ability to self-regenerate, thereby preserving the ecosystems' productive capacity.

The following year, the United Nations Conference on Environment and Development, held in Rio de Janeiro in 1992, further advanced the concept of sustainability. The Rio debate highlighted that genuinely sustainable development cannot be limited to environmental aspects alone but must also incorporate the inseparable issues of economic justice and social equity. Therefore, sustainability must simultaneously be environmental, economic, and social, bridging global and local dimensions.

The Rio Conference produced numerous official documents, among which

[7] On the Brundtland report see more extensively the volume by Borowy (2014).
[8] On this definition see WCED (1987), chapter 2, paragraph 1.

Agenda 21 deserves mention. This action plan, structured into 40 chapters, identifies the objectives of sustainable development and the interventions necessary to achieve them. One of its central recommendations was to develop "better measurement tools" to understand the value of "natural capital" and the sustainability of human practices. Until 1992, industrial society lacked reliable methods for determining whether a particular practice was sustainable, making sustainability an essentially unmeasurable abstraction.

From the 2000s onward, sustainability became less vague and more calculable due to the development of new metrics, methodologies, and measurement tools. Traditional economic instruments were either abandoned or supplemented by social and environmental metrics, and entirely new sustainability assessment tools were developed from scratch (Caradonna, 2014, p. 179). However, the Rio summit was marked by disagreements between the Global North and South, as well as between NGOs and governments. The political response to the declarations of intent made at Rio was notably weak. Over the following decade, nations failed to meet the goals, particularly regarding the integration of economic and environmental aspects. The United Nations summits in Johannesburg (2002) and Rio (2012) effectively acknowledged the failure to implement the earlier declarations of intent. Global inequalities persist, the world population continues to grow, and the consumption of many scarce resources, including fossil fuels, remains a significant obstacle to building a sustainable society and a green economy.

The Johannesburg Summit of 2002 was organized with the aim of promoting the integration of three key elements of sustainable development – economic development, social development, and environmental protection – as interdependent and synergistic pillars. Among the essential conditions for sustainable development were the eradication of poverty, the transformation of unsustainable production and consumption patterns, and the protection and management of natural resources vital for economic and social development.

Despite good intentions, the global interpretation of sustainable development largely materialized in some widely accepted best practices among nations, which remain the subject of ongoing debate. This debate highlighted the need for a paradigm shift in the relationship between economic activity and the natural environment, advocating for the replacement of the traditional growth-oriented development model with a new sustainable development model. This alternative framework focuses on the qualitative improvement of living standards as the foundation for future progress.

In the journey toward defining sustainable development, it is essential to recall the Millennium Development Goals (MDGs) of 2000. These were approved at the United Nations General Assembly in 2000, a landmark

gathering attended by nearly all countries, represented by heads of state or government. The MDGs solidified global consensus on poverty eradication as the essential purpose of development, fundamentally reshaping the very concept of development itself[9]. The MDGs garnered unprecedented attention for the cause of global development, defined as meeting people's basic needs and ending extreme poverty. While it remains uncertain whether the MDGs directly influenced the pace of poverty reduction, they undeniably mobilized international attention. However, they also faced criticism for their narrow agenda, overlooking key challenges such as inequality, governance, climate change, growth, and employment (Fukuda-Parr, 2018, pp. 764–765). As the MDGs reached their deadline, abandoning the pursuit of global goals was not an option. It became imperative to establish a subsequent set of targets, leading to the creation of the Sustainable Development Goals (SDGs) in 2015.

The 2030 Agenda, signed in 2015 by the governments of the 193 United Nations member states and approved by the UN General Assembly, serves as an action plan for people, the planet, and prosperity. It establishes 17 Sustainable Development Goals (SDGs) as part of a broader framework comprising 169 associated targets to be achieved in environmental, economic, social, and institutional domains by 2030. Compared to the Millennium Development Goals (MDGs), the SDGs represent a far more comprehensive, integrated, and challenging agenda for countries to implement. The agenda acknowledges the ecological limits to economic growth and consumption, incorporating goals and targets focused on environmental sustainability. While environmental objectives were limited and relatively unambitious in the MDGs, they are prominent and far-reaching within the SDGs.

The scope of priorities under the SDGs is significantly broader than that of the MDGs, which were primarily focused on meeting basic needs. The SDGs extend well beyond issues of economic transformation and social progress, encompassing topics such as education, health, employment, and economic growth. Importantly, they apply to both developing and developed countries alike, reflecting a truly global agenda for sustainable development.[10]. The SDGs can generally be understood as "a global agreement and reference point

[9] According to Díaz-López et al. (2021), the MDGs focused mainly on economic growth and poverty alleviation, and not so much on the necessary social and political changes, thus ignoring aspects such as human rights, empowerment and equality.

[10] According to Allen et. Al. (2016), given the broad scope of the SDGs, policy makers will need to be able to easily assess the economic, social and environmental implications of their strategies in an integrated manner over the long term.

that reinforces the debate on sustainability in research, policy, and practice" (Eisenmenger et al., 2020).

The SDGs thus introduce a paradigmatic shift in international development. Two novel aspects pertain to their implementation. First, the principle of national adaptation and implementation was emphasized from the outset. This approach can be seen as a response to controversies over whether quantitative targets should be achieved globally or by each individual country. It also reflects a reaction against the top-down structure of the MDGs and the North-South agenda. Second, the role of the private sector emerged as an essential component of the new agenda. The formulation assumed that implementation funding would come from private investments, that the private sector should be involved as a key stakeholder, and that new forms of financing and implementation – such as public-private partnerships – needed to be promoted.

According to the United Nations, this program serves as a common foundation for building a different world, offering everyone the opportunity to live in an environmentally, socially, and economically sustainable society.

4. Reflections on sustainability

The concepts and principles outlined above can give rise to specific management practices within the framework of sustainability, all grounded in the interconnections between environmental, economic, and social dimensions – in other words, the relationship between environment, economy, and society, which inspired the title and focus of our special issue. More specifically, the environmental dimension of sustainability considers the integrity of ecosystems and environmental quality, viewed as a common good that enables development and improves quality of life. Environmental sustainability entails maintaining the quality and reproducibility of natural resources. This implies recognizing the environment as natural capital, acknowledging the finite nature of natural resources, ensuring that renewable resources are not exploited beyond their regeneration capacity, and that non-renewable resources are not consumed at a faster rate than the development of viable substitutes.

The economic dimension of sustainability revolves around generating income and employment to support the population. It requires pursuing economic efficiency through careful management of resources – not only natural but also historical, artistic, and cultural resources – while promoting intra-generational equity sustainable over the long term. The economic system

must be fully aware of the limits and impacts of economic choices on society and the environment. Furthermore, it should implement strategies to monitor and preserve natural, human, social, and cultural capital to avoid compromising the well-being of future generations. The social dimension of sustainability emphasizes the ability to ensure equitably distributed human well-being across social classes and genders. Social sustainability must therefore be grounded in the concept of social equity, as development is incompatible with significant inequalities in income distribution and living conditions. Social equity should be pursued at all levels – urban, national, global – and extended to future generations. More concretely, social equity can be achieved through key elements such as equitable access to essential services, intergenerational equity, the protection and enhancement of diverse cultures, citizen participation in political decision-making processes, and fostering a sense of community responsibility.

The integration of environmental, economic, and social dimensions enhances the value of the sustainability concept, allowing us to assert that true sustainable development can only be achieved when all three aspects are considered. Consistent with this interpretation, sustainability is often depicted as the intersection of three overlapping sets. Building on these reflections and an analysis of the scientific literature, this special issue aims to promote discussions on sustainability through multidisciplinary approaches aimed at developing models and tools for sustainable development.

The essay by Donatella Furia and Piera Cascioli, titled *To North from South: Italy's journey towards sustainability* analyses the evolution of sustainability in Italian regions from 2004 to 2019 using cluster analysis based on selected SDG indicators. The study demonstrates how public policies and investments influence regional sustainability, emphasising the need for tailored, region-specific strategies to address disparities and foster equitable development.

Simone Cifolelli, Marco Berardi, Fabrizia Fontana, and Andrea Ziruolo, in the paper titled *Creating Public Value through Sustainable Initiatives: Environmental, Economic, and Social Impacts*, explore the role of Energy Communities in generating public value and their contribution to environmental, economic, and social sustainability. In this context, Energy Communities emerge as key actors in achieving the Sustainable Development Goals (SDGs), promoting local renewable energy production, and fostering social cohesion.

The essay by Monica Lupetti and Marco Guidi, *From capitalist*

exploitation to socio-environmental sustainability: the language of the Portuguese left in the years of the Carnation Revolution, examines the evolution of the economic and political language of the Portuguese Left during the Carnation Revolution (1974-1975), focusing on the concepts of capitalist exploitation and socio-environmental sustainability. The article focuses on the dissemination of ecological terminology and its integration into the political and social debate of the time, in which ecology was part of a broader vision of social transformation. The paper shows how the linguistic and terminological choices adopted in the translations left a legacy that is still relevant in contemporary discussions on sustainability and social justice.

The paper by Antonella Del Signore, Ilaria Zappitelli, Concetta Cardillo et al., titled *Evaluation of Policies for Enhancing Sustainable Wheat Production in Italy*, presents some results from the Ecowhealty project, which aims to provide financial incentives to Italian farms to transition from less sustainable wheat production techniques to more sustainable ones. The study also describes the characteristics of the Italian and global context in wheat production and trade, analyzing EU and national regulations related to agricultural policies. Then the paper presents an example of the application of the life cycle assessment methodology to illustrate the approach used in sustainability evaluation.

Matteo Foglia and Maria Melania Povia, in their paper entitled *Climate Attention and Stock Market: Evidence from Italy*, examine the impact of Climate Policy Uncertainty (CPU) on the Italian stock market, employing the wavelet coherence method to analyze the time-frequency relationship between CPU and stock market volatility indices. The study demonstrates how increasing climate policy uncertainty generates negative spillover effects on the stock market, significantly influencing market dynamics.

The essay *The challenge of sustainability: the Terranova case* by Elia Fiorenza and Renato Ghezzi, providing a diachronic perspective on the growth and diffusion of small and medium-sized enterprises (SMEs) in Italy, focuses on the case of Terranova, a medium-sized enterprise specialized in software development which has managed to establish itself in a highly specialized sector. Through the analysis of this case study, the paper demonstrates that the adoption of a sustainable development model is based on the ability to innovate, as it entails the redefinition of strategies and operational processes and requires the restructuring of relationships within production chains and between businesses, society, and institutions.

The process of exploiting natural resources, particularly forests and rivers, has played a central role in the economic and social history of Abruzzo. Natascia Ridolfi's contribution, entitled *Woods and rivers: 'unsustainable'*

exploitation in contemporary Abruzzo, shows how the management of these natural resources has often taken unsustainable forms, contributing to significant ecological alterations and environmental damage. The essay investigates the use of Abruzzo's forests and rivers in the 19th and early 20th century focusing on the study of the laws that regulated the management of resources and the effects that this 'unsustainable' model of exploitation had on the territory, economy and society.

The essay of Francesco D'Esposito, titled *Productivity, sustainability and beauty in 19th-century Sorrento and Amalfi agriculture,* studied the evolution of the landscape of the Sorrento peninsula with reference to the market opportunities that the local maritime trade offered. This led, during the 19th century, to a profound transformation of the territory, unique in the history of Italian agriculture. The Sorrento and Amalfi landscape, with its terracing and enclosing walls, reflects the intensive use of land for agricultural purposes, which influenced the economy and favoured significant demographic development.

Dario Dell'Osa, in the paper *Organic viticulture in Italy: a recent history*, describes the growth path of organic viticulture in Italy from 1991 to 2023. Organic production falls squarely within the sphere of sustainability because it has elements within it that reflect on the environmental dimension of agriculture but also on the economic and social dimension. Using statistical data and official reports, the essay traces the history of organic viticulture in Italy, assessing the impact of regulations on the sector's evolution. What emerges is a very interesting picture of this form of viticulture, in which premiums and economic incentives play a decisive role in the increase of cultivated areas.

Finally, Ada Di Nucci's paper, entitled *Abruzzo's agrifood SMEs between tradition, innovation and sustainability*, offers a sector analysis of Abruzzo's small and medium-sized enterprises operating in the agri-food sector. It highlights how the adoption of sustainable practices by these enterprises can become a key element for success in the global market without compromising local identities. In fact, 'sustainability', in addition to favouring the transformation of raw materials into unique, high-quality products with internationally recognised certifications, contributed to increasing the competitiveness and provides added value to local production.

A common element in all these essays is, therefore, the concept of sustainability, which is explored in this special issue through multidisciplinary approaches. The study of sustainability allows us to understand and interpret

the dynamics of the modern welfare economy, considering the interconnections between its environmental, economic, and social dimensions as essential factors for economic growth.

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Donatella Furia[1], Piera Cascioli[2]

TO NORTH FROM SOUTH: ITALY'S JOURNEY TOWARD SUSTAINABILITY

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Abstract

The paper analyzes the evolution of sustainability in Italian regions from 2004 to 2019 using cluster analysis based on selected SDG indicators. It highlights a persistent North-South divide, with Northern regions like Emilia-Romagna and Lombardia consistently achieving high performance due to stability and effective policies, while Southern regions face ongoing structural challenges despite improvements in areas like healthcare.
The study demonstrates how public policies and investments influence regional sustainability, emphasizing the need for tailored, region-specific strategies to address disparities and foster equitable development. The findings provide valuable insights for policymakers aiming to achieve sustainable growth and bridge regional gaps.

JEL CLASSIFICATION: Q01; R58; C38

KEY WORDS: Economic growth; Cluster analysis.

1. Introduction

The topic of sustainability has become a priority for many governments (Alfirević et al., 2023), actively engaging numerous citizens interested in adopting a model of social well-being. Thus, in response to the need to halt the environmental, social, and economic decline witnessed in recent times, the governments of the 193 member states of the United Nations have developed

[1] Università degli studi G.D'Annunzio, Pescara. *E-mail address*: donatella.furia@unich.it
[2] Università degli studi G.D'Annunzio, Pescara. *E-mail address*: piera.cascioli@unich.it

an Agenda (the so-called "2030 Agenda") to promote and provide guidelines for the development of the concept of sustainability, taking into account the economic, social, and ecological dimensions that determine a country's inclination toward sustainable practices.

Addressing this challenge is complex and requires time, not only due to the urgency of the matter (which is equally important) but also because of the need to establish clear objectives to align all entities, both micro and macro, toward sustainable development.

Unfortunately, prioritizing SDGs represents a challenging task for countries (Gonzalez & Peña-Vinces, 2022; Nsafon et al., 2023), as sustainable development, economic growth, and environmental protection are deeply interconnected concepts (Allen et al., 2018). Therefore, it is necessary to formulate targeted policies (Liu et al., 2021) and strategies (Elavarasan et al., 2022), highlight the role of social (Eichler & Schwarz, 2019) and digital innovation (Taddei et al., 2022), promote sustainable education (D'Adamo & Gastaldi, 2023), and so on, especially in countries like Italy, where significant differences exist between geographical areas.

The objective of this work is to demonstrate the evolution of the concept and practice of sustainability across Italian regions during the 2004–2019-time frame. Using a cluster analysis, the aim is to identify areas with a greater propensity for sustainability, understand the driving factors, and at the same time investigate regions showing stagnation or decline, studying the hindering factors and potential remedial actions by implementing policies aimed at fostering sustainable growth.

The analysis is based on selected Sustainable Development Goals from the 2030 Agenda. However, due to data availability constraints, proxies will refer to some of the following "goals": 1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 16.

2. Literature review

Innovation and sustainability play a crucial role for Italy, as the country strives to grow sustainably and strengthen its competitive position in the international market through the introduction of advanced technologies and environmentally friendly methods.

Innovation refers to the ability to introduce new ideas, processes, and technologies that can enhance productive efficiency and promote a country's competitiveness. In particular, Italy benefits from a strong heritage of

scientific and technological knowledge thanks to its universities and research centers.

Sustainability, on the other hand, focuses on the responsible management of resources, environmental protection, and maintaining a balance between economic growth, environmental preservation, and social well-being (D'Amore et al., 2022). Respect for sustainable practices has become a necessary step for the economic development of every country. Consequently, the 2030 Agenda, created by the 193 member states of the United Nations and approved by the UN General Assembly, with its 17 Sustainable Development Goals (SDGs), acts on a global scale to eliminate poverty, fight inequality, address climate change, and establish peaceful and human rights-respecting societies.

However, achieving the SDGs is not without challenges, as these goals do not always provide a comprehensive view of all sustainability contexts (Giannetti et al., 2020), potentially favoring certain dimensions over others. Since local territories—cities, provinces, or regions—are crucial for achieving the SDGs in the 2030 Agenda (Yigitcanlar, 2022; Yigitcanlar and Kamruzzaman, 2022), it is essential to adopt a National Strategy for Sustainable Development (Mallick et al., 2021) to optimize the balance between sustainability and land use (Iannillo and Fasolino, 2021), considering the specific needs and diversity of the signatory countries.

To gain a comprehensive perspective that allows measuring, monitoring, and evaluating progress in sustainability (De Neve & Sachs, 2020), a Sustainable Development Index and tools for assessing advancements in sustainability at the country level (Sachs et al., 2019) have been proposed. These tools can also be applied to regions, provinces, cities, or municipalities, as in the case of Italy's regions (D'Adamo et al., 2021).

The use of appropriate statistical methods is therefore essential to achieve these sustainable objectives (van Zanten & van Tulder, 2021). For example, the use of Multi-Criteria Decision Analysis (MCDA) is suitable for evaluating various goals (Vishnupriyan et al., 2021), and this methodology can be employed to aggregate multiple SDGs to compare different territories.

Literature has shown that this approach allows for the aggregation of multiple indicators, providing a classification among countries and highlighting strengths and weaknesses. Results have been applied to European countries for a specific economic dimension (D'Adamo et al., 2022), Italian regions (D'Adamo et al., 2021), and cities (D'Adamo, 2022a). In the first case, Italy ranks 23rd and 26th among European and OECD countries regarding

sustainability levels, with incomplete achievement of SDGs (SDSN and IEEP, 2020). In the latter two cases, sustainable performance reveals a North-South divide. Additionally, performance has been measured against a target value (D'Adamo & Gastaldi, 2022). Other studies highlight the benefits of using multi-criteria methods to evaluate SDGs (Hezam et al., 2022; Resce & Schiltz, 2021; Ricciolini et al., 2022). Some research focuses on European capitals (Akande et al., 2019), while others analyze the performance of European countries regarding SDGs (Hametner & Kostetckaia, 2020). It is particularly noted that the 2030 goals can be achieved not only by leveraging synergies among the goals but also by overcoming trade-offs (Kostetckaia & Hametner, 2022). Moreover, the European Commission (2022), to facilitate the measurement of sustainable transition, has developed the EU SDG indicator set to track SDG progress.

Given the confirmed importance of MCDA analysis, the literature on the Italian case agrees on the dissemination of the concept and practices of sustainability in Italy, especially when investigations are conducted based on geographical differences (D'Adamo et al., 2022). This work aims to showcase the evolution of the concept and practice of sustainability across Italian regions, highlighting the inherent differences within each area.

3. Data

The variables considered in the analysis were selected from those available in the ISTAT dataset related to the Sustainable Development Goals (SDGs) that comprise the 2030 Agenda for Sustainable Development.

Table 1. Descriptions of goals

Goal	Indicator	Description	Unit of measurement	Notes
Goal 1 - End all forms of poverty worldwide	Risk of poverty	Percentage of men, women, and children of all ages living in poverty (in all its dimensions) based on national definitions	Percentage values	
Goal 2 - End hunger, achieve food security, improve nutrition, and promote sustainable agriculture	Informal employment in agriculture, forestry, and fishing	Share of agricultural land allocated to sustainable and productive agriculture	Percentage values	
Goal 3 Ensure healthy lives and promote well-being for all at all ages	Influenza vaccination coverage age 65+	Percentage of the population covered by all vaccines included in the national program	Per 100 inhabitant	
Goal 5 - Achieve gender equality and empower all women and girls	Voluntary abortion rate for women aged 15-49 per 1,000 women	Proportion of women (aged 15-49) making informed decisions about sexual relations, contraceptive use, and reproductive health services	Per 1.000 women	Data from 2005-2019
Goal 6 - Ensure access to affordable, reliable, sustainable, and modern energy for all	Efficiency of drinking water distribution networks	Change in efficiency of water resource use	Percentage values	Data from 2005-2018
Goal 7 - Assicurare a tutti l'accesso a sistemi di energia economici, affidabili, sostenibili e moderni	Renewable energy electricity	Share of energy from renewable sources in total final energy consumption	Percentage values	
Goal 8 - Promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all	Annual growth rate of real GDP per capita	Annual growth rate of real GDP per capita	Percentage values	

Table 1. Descriptions of goals (continued)

Goal 9 - Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation	Research intensity	Research and development expenditure as a percentage of GDP	Percentage values	
Goal 10 - Reduce inequality within and among countries	Net income inequality (S80/S20)	Growth rate of household spending or per capita income of the poorest 40% of the population	Pure number – income ratio	
Goal 11 - Make cities and human settlements inclusive, safe, resilient, and sustainable	Percentage of people living in overcrowded housing	Percentage of the population living in urban slums, informal settlements, or inadequate housing	Percentage values	
Goal 12 - Ensure sustainable consumption and production patterns	Separate collection of urban waste	National recycling rate, tons of material recycled	Percentage values	
Goal 16 - Promote peaceful and inclusive societies for sustainable development, provide access to justice for all, and build effective, accountable, and inclusive institutions at all levels	Overcrowding in penal institutions	Percentage of detainees without sentencing among the total prison population	Percentage values	

4. Methodology

Cluster analysis is a term generally used to describe a range of methods employing multivariate and quantitative measurements to group objects or events based on their similarity (Jaeger & Banks, 2023). The methodology adopted in the paper is Cluster Analysis, which enables the identification of homogeneous yet distinct areas composed of regions that exhibit the highest similarities based on the considered elements (Jaeger & Banks, 2023).

This analysis allows for the formation of territorial aggregates based on observed common characteristics, rather than relying solely on macro-areas defined by administrative or geographical boundaries. The analysis will be conducted at two distinct time points, 2004 and 2019, to highlight any differences in clustering in 2019 compared to 2004 due to changes in the indicators considered.

Clustering analysis, a well-established statistical technique, offers the advantage of not requiring prior assumptions about the development of clusters. Instead, it can classify regions ex post into similar categories. The problem of classification was originally tackled by Pearson in the late 19th century. Today, numerous clustering algorithms and grouping techniques are available, applicable to both quantitative and qualitative variables. In this analysis, we focus on quantitative data.

Cluster construction can be performed in various ways using techniques that may yield different results. For example, similarity or dissimilarity criteria among data can be applied, or different grouping methods, such as hierarchical or non-hierarchical techniques, may be used. In our case, we employ the agglomerative hierarchical method, where groups are nested within broader classes, forming a tree-like structure called a dendrogram.

Aggregation occurs gradually, starting with an initial number of groups equal to the total number of regions considered. Subsequently, groups are combined based on their proximity, and a new distance matrix is recalculated. This process continues until a single group representing the entire national territory is achieved or until a predefined criterion of minimum distance is met.

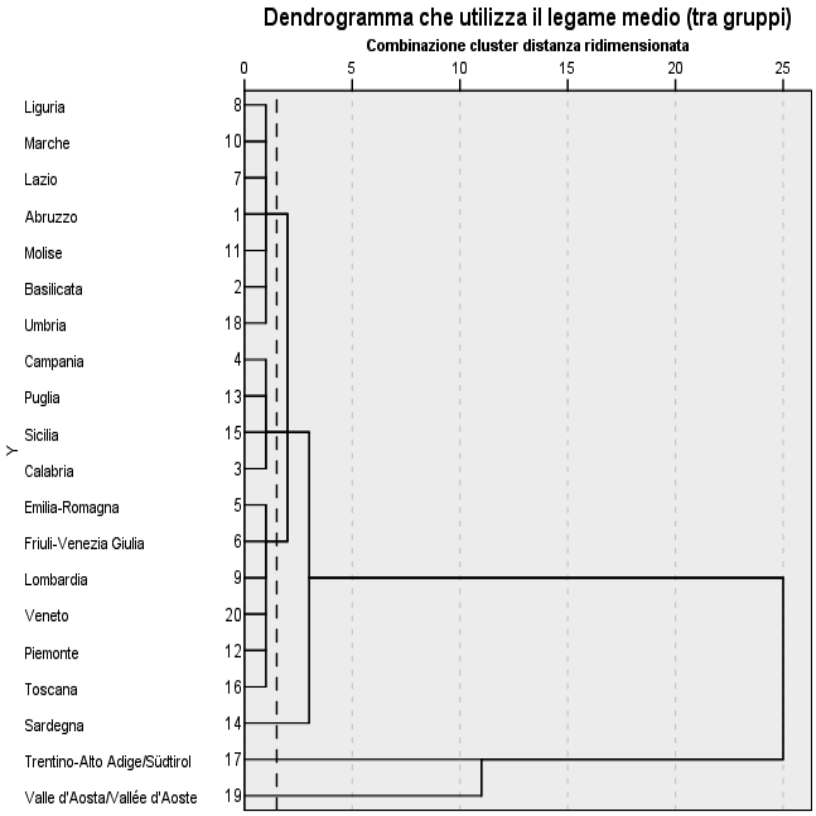
The selection of the algorithm for creating clusters is crucial and must align with the type of data analyzed. In our analysis, we adopted the average linkage algorithm, which calculates the distance between clusters by taking the average of distances between all elements of each group and then considers the maximum of these averages as the distance between two clusters. This approach produces more reliable results, with groups that are more homogeneous and distinct from each other. We chose squared Euclidean distance as the measure of distance, as it is commonly used for numerical data and provides accurate results.

5. Results of 2004 analysis

The cluster analysis of Italian regions in 2004 and 2019 revealed significant changes in regional sustainability over these fifteen years. Using various indicators of socioeconomic, infrastructural, and health performance, the generated dendrograms show how regions grouped differently in the two periods, reflecting changes in the economic and social context.

The first step of the analysis involved applying cluster analysis for 2004 and 2019, resulting in the following dendrograms and corresponding clusters:

Fig.1. Dendrogramma 2004

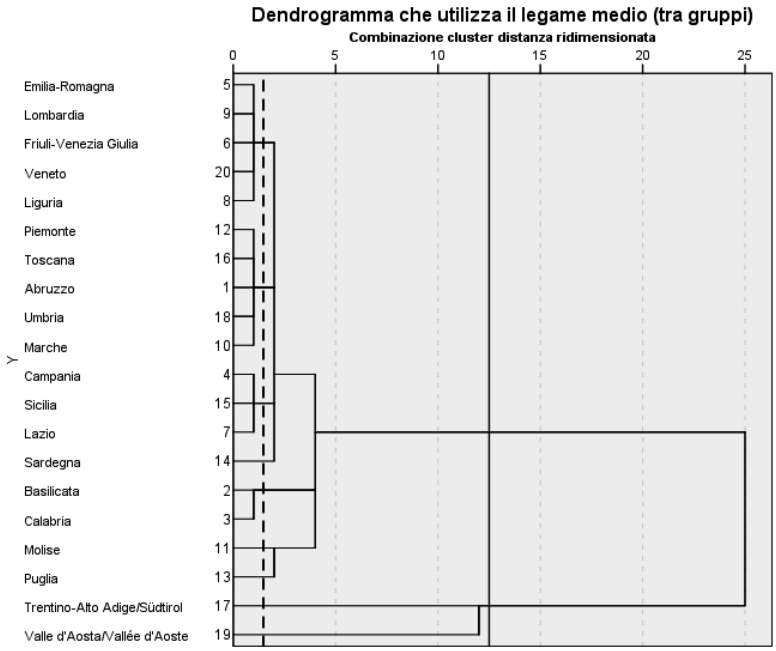


2004	
Cluster 1	Liguria, Marche, Lazio, Abruzzo, Molise, Basilicata, Umbria
Cluster 2	Campania, Puglia, Sicilia, Calabria
Cluster 3	Emilia-Romagna, Friuli-Venezia Giulia, Lombardia, Veneto, Piemonte, Toscana
Outliers	Sardinia, Trentino-Alto Adige, Valle D'Aosta.

Cluster 1 included regions with average performance across sustainability indicators, showing mediocre results particularly in the areas of poverty and water efficiency. Cluster 2, consisting of regions in Southern Italy, exhibited generally low performance across many indicators, reflecting significant socioeconomic challenges. Cluster 3, encompassing regions in Northern Italy, demonstrated high performance, indicative of greater economic and social sustainability. The outliers, such as Sardinia and Trentino-Alto Adige, displayed unique variations that could not be easily classified into the main clusters.

Fig. 2. Cluster 2004

Fig. 3. Dendrogramma 2019



2019	
Cluster 1	Emilia-Romagna, Lombardia, Friuli-Venezia Giulia, Veneto, Liguria
Cluster 2	Piemonte, Toscana, Abruzzo, Umbria, Marche
Cluster 3	Campania, Sicilia, Lazio
Cluster 4	Basilicata, Calabria
Outliers	Molise, Puglia, Sardinia, Trentino-Alto Adige, Valle D'Aosta.

In 2019, Cluster 1 represented the regions with the best performance, including some like Liguria, which significantly improved its position compared to 2004. Cluster 2 comprised regions with average performance that showed progress in specific sectors. Clusters 3 and 4 reflected regions still struggling with socioeconomic challenges, although Basilicata and Calabria improved in specific indicators such as vaccination coverage. The outliers retained unique characteristics that made their classification into the main clusters difficult.

Fig. 4. Cluster 2019

After identifying the clusters, each indicator was divided into three intervals to highlight different value ranges, each assigned a performance rating of high, medium, or low. Subsequently, the averages for each indicator within each cluster were calculated and compared with the three intervals, ultimately resulting in performance ratings as follows. (*The higher the values of indicators G1, G2, G11, and G16, the worse the situation in the region. When assigning ratings to these indicators, the reasoning was inverted: higher average values for these indicators correspond to worse ratings*).

Table 2. Performance ratings 2004

Indicator	Cluster 1	Cluster 2	Cluster 3	Outlier 1	Outlier 2	Outlier 3
G1	M	L	H	L	H	H
G2	M	L	H	M	H	H
G3	M	L	M	L	L	L
G5	M	L	M	L	M	M
G6	M	M	H	L	H	M
G7	M	M	M	L	H	H
G8	M	M	M	H	M	L
G9	M	M	H	M	M	L
G10	M	H	M	H	L	L
G11	M	L	H	M	M	H
G12	M	L	H	L	H	M
G16	H	M	L	H	M	H

L=low; M=medium; H=high

Table 3. Performance ratings 2019

Indicator	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Outlier 1	Outlier 2	Outlier 3	Outlier 4	Outlier 5
G1	H	M	L	L	L	L	L	H	H
G2	H	M	L	L	M	L	M	H	L
G3	M	M	M	H	H	L	L	L	L
G5	M	M	M	L	M	H	L	L	M
G6	H	M	M	M	L	M	L	H	H
G7	L	M	L	H	H	H	M	H	H
G8	L	M	M	L	H	L	H	H	L
G9	H	H	M	L	M	L	L	M	L
G10	M	L	H	H	H	H	H	L	L
G11	H	L	M	L	L	H	H	L	L
G12	H	M	L	L	L	L	H	H	M
G16	L	M	M	H	L	L	H	H	M

L=low; M=medium; H=high

The evolution of clusters from 2004 to 2019 suggests that public policies, investments in infrastructure, and improvements in the healthcare and education sectors have had a significant impact on the development of Italian regions. Northern regions, such as Emilia-Romagna and Lombardia, have maintained or improved their performance due to a combination of economic stability and effective interventions. Conversely, some Southern regions, although showing improvements in specific indicators, continue to face structural challenges.

These changes highlight the importance of adopting targeted regional policies and supporting sustainable development in a differentiated manner to address the varying needs of Italian regions. Regional performance is not static, and the analysis demonstrates that with the right approach and interventions, it is possible to significantly enhance the sustainability and socioeconomic well-being of the regions.

6. Results of 2019 analysis

The analysis of clustering data for Italian regions in 2004 and 2019 reveals significant regional dynamics and how these have evolved over fifteen years. Using various indicators of socioeconomic, infrastructural, and healthcare performance, cluster analysis highlighted how regions grouped differently in these two years, reflecting changes in the country's economic and social fabric.

Regions such as Emilia-Romagna, Lombardia, Veneto, and Friuli-Venezia Giulia consistently remained in high-performance groups. This indicates economic stability and resilience that enables these regions to maintain high levels of well-being and infrastructure.

The inclusion of Liguria in Cluster 1 in 2019, moving from an average performance in 2004, demonstrates a significant improvement, likely due to effective regional policies or a favorable economic context.

Traditionally less-performing regions, such as Basilicata and Calabria, showed improvement in 2019 by joining Cluster 4 with high performance in specific indicators such as vaccination coverage. This may reflect improvements in public healthcare management and investments in essential services.

Some regions, despite the passage of time, continue to face challenges in terms of economic indicators and informal employment, as evidenced by the persistence of regions such as Campania, Sicily, and Puglia in medium to low-performance groups (Cluster 2 in 2004 and Cluster 3 in 2019).

The shifts in groupings and performance suggest that public policies, both at the regional and national levels, have a significant impact on the economic and social development of regions. The effectiveness of these policies is reflected in the changes in clustering and relative performance across the analyzed indicators.

7. Conclusions

Sustainability in Italian regions is a complex challenge that requires differentiated approaches, taking into account the various territorial, socioeconomic, and cultural characteristics. From the Alps to Sicily, each region exhibits unique features and resources, necessitating tailored strategies to promote environmental, economic, and social sustainability. A thorough analysis of regional specificities and synergistic collaboration between public and private sectors, as well as local communities, is essential to ensure a sustainable future for all Italian regions.

The comprehensive analysis of data highlights the dynamic nature of Italy's regional landscape, influenced by a variety of factors, including economic policies, infrastructure investments, and healthcare interventions. Italian regions are not static in their performance, and their evolution between 2004 and 2019 underscores areas of success as well as persistent challenges, providing critical insights for future policies and development strategies.

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Simone Cifolelli [1], Marco Berardi[2], Fabrizia Fontana[3], Andrea Ziruolo°

CREATING PUBLIC VALUE THROUGH SUSTAINABLE INITIATIVES: ENVIRONMENTAL, ECONOMIC AND SOCIAL IMPACTS

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Abstract

This paper explores the role of Energy Communities (ECs) in creating public value by contributing to environmental, economic, and social sustainability. Drawing on the theoretical frameworks of Smart City Governance and Hybrid Organizations, the study positions ECs as key drivers of the Sustainable Development Goals (SDGs), particularly SDG 7 (Affordable and Clean Energy) and SDG 13 (Climate Action). ECs empower communities to become active participants in the energy transition by promoting local renewable energy production and fostering social cohesion. Through a case study of an Italian Energy Community, this research applies the Public Value Scorecard (PVSC) to evaluate the societal impact of ECs across multiple dimensions. The study finds that ECs generate significant public value by reducing energy poverty, enhancing energy autonomy, and improving social inclusion, especially in rural areas. Additionally, ECs promote local economic resilience by creating new economic opportunities and supporting sustainable growth. Despite their potential, ECs face challenges in ensuring financial sustainability, navigating regulatory complexities, and integrating advanced technologies.

The study highlights the need for tailored policy interventions to address these barriers and suggests future research directions for refining EC financial models, regulatory frameworks, and governance structures to bridge a key gap in the literature. Lastly, it offers a comprehensive evaluation of how ECs create public value and provides practical insights for policymakers and

[1] "G. d'Annunzio" University, Pescara, Italy, simone.cifolelli@unich.it
[2] "G. d'Annunzio" University, Pescara, Italy, marco.berardi@unich.it
[3] "G. d'Annunzio" University, Pescara, Italy, fabrizia.fontana@unich.it
° "G. d'Annunzio" University, Pescara, Italy, andrea.ziruolo@unich.it

practitioners seeking to harness the potential of ECs to drive sustainability and community well-being.

JEL CLASSIFICATION: Q42, Q01, H41, L31

KEYWORDS: ENERGY COMMUNITIES, PUBLIC VALUE CREATION, ENVIRONMENTAL IMPACT, ECONOMIC SUSTAINABILITY, SOCIAL BENEFITS

1. Introduction

The concept of sustainable development, formalized at the 1992 Rio Earth Summit, has become a key guiding principle for global policies aimed at addressing the complex interplay of environmental, economic, and social challenges. Central to this is the 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals (SDGs), which underscore the need for integrated efforts to achieve sustainability on multiple fronts, including poverty reduction, climate action, and economic growth (Bouckaert et al., 2016; Bisogno et al., 2023). Within this broader global context, the role of Energy Communities (ECs) has gained prominence as a promising model that aligns with the SDGs by promoting localized energy production, social innovation, and community-driven economic resilience.

Energy Communities are not just energy distribution collectives but also represent a participatory model where citizens take on the role of "prosumers," those who both produce and consume energy. This dual role, coupled with the bottom-up structure of ECs, enhances local economic growth, energy independence, and social inclusion, particularly in rural areas (Ceglia et al., 2020; Cappellaro et al., 2022). By generating renewable energy and fostering local development, ECs are seen as critical in advancing multiple SDGs, notably SDG 7 (Affordable and Clean Energy) and SDG 13 (Climate Action). However, despite the recognized potential of ECs, research into their long-term effectiveness and societal contributions remains fragmented, particularly regarding their role in creating public value across environmental, economic, and social dimensions.

The literature on ECs, while growing, has primarily focused on their technical and economic aspects, often overlooking their broader societal impact and the mechanisms through which they generate public value (Moore, 1995; Moore, 2003). This gap is particularly relevant when considering the increasing emphasis on sustainability and the need for communities to balance

financial sustainability with social and environmental objectives. The existing studies lack a comprehensive evaluation framework that addresses these intersecting concerns, especially within the specific regulatory and socio-economic contexts of countries like Italy.

In response to this gap, the aim of this paper is to explore how ECs create public value through their contributions to environmental sustainability, economic development, and social cohesion. Drawing on the theoretical frameworks of Smart City Governance, Hybrid Organizations, and Public Value Creation, this study proposes a multidimensional approach to understanding the societal impacts of ECs. Using a case study of an Italian Energy Community, this research also employs the Public Value Scorecard (PVSC) to assess the contributions of ECs in measurable terms, providing a practical tool for evaluating their impact (Moore, 1995; Moore, 2003; Caragliu et al., 2013; Doherty et al., 2014; Meijer & Bolívar, 2016).

The research question guiding this study is the following: how do Energy Communities contribute to public value creation in the context of sustainable development, and how can their contributions be measured and evaluated effectively? By addressing this question, the paper seeks to bridge the gap between theoretical discussions of public value and the practical implementation of ECs as a tool for sustainability and community empowerment.

The paper is structured as follows: the second section provides a detailed review of the literature on ECs, public value creation, and their relevance to sustainable development. The third section presents the theoretical foundations of the study, including Smart City Governance and Hybrid Organizations. The fourth section outlines the methodology, detailing the systematic literature review and case study approach. In the fifth section, the results of the case study are presented, followed by a discussion of the implications for public value creation. The paper concludes with recommendations for future research and policy, emphasizing the potential of ECs to act as catalysts for sustainable development.

2. Contextualising Sustainable Development

The concept of sustainable development, first introduced during the pivotal 1992 Rio Earth Summit, has since become a cornerstone of international policymaking aimed at fostering a more just and resilient global future. This framework underscores the inherent interconnectedness of social, economic, and environmental spheres, advocating for an integrated approach to address complex global challenges (Bouckaert et al., 2016; Bisogno et al., 2023). At

the summit, leaders emphasized the urgent need for growth models that balance economic advancement, social inclusivity, and environmental stewardship, a vision enshrined in both the Rio Declaration and Agenda 21. These documents laid the foundation for a global agenda that would evolve through subsequent efforts, such as the 2002 Johannesburg Summit and the Rio+20 Conference, each building on the last to refine strategies and strengthen commitments to sustainability.

The adoption of the 2030 Agenda for Sustainable Development in 2015 represented a significant milestone in this journey. Its 17 Sustainable Development Goals (SDGs) call for a unified international response to address a wide array of pressing issues: from eradicating poverty and promoting health and education to fighting inequality, stimulating sustainable economic growth, mitigating climate change, and protecting finite natural resources. Within this broader context, Energy Communities (ECs) have emerged as vital players, leveraging renewable energy, driving social innovation, and catalyzing local economic development (Ceglia et al., 2020; Cappellaro et al., 2022).

2.1. The Role of SDGs and Energy Communities

Energy Communities, by their very nature, represent more than just collectives focused on pooling and distributing energy resources. They act as incubators for social innovation and examples of participatory governance (Doherty, 2014). Unlike traditional energy models that rely on passive consumption, ECs empower individuals and communities to transition to active roles as energy 'prosumers'—those who both produce and consume energy (Ceglia et al., 2020). This transformation fosters not only local economic growth but also promotes greater inclusivity and resilience, hallmarks of sustainable development.

This paper argues that ECs, through their localized and bottom-up structure, have a unique capacity to generate public value and contribute significantly to the achievement of various SDGs, particularly in rural areas (Cappellaro, 2022). For instance, ECs directly contribute to SDG 1 by reducing energy poverty, which in turn creates new economic opportunities essential for lifting people out of poverty. They also play a pivotal role in achieving SDG 7 by making renewable energy both accessible and affordable. Furthermore, ECs advance SDG 11 (Sustainable Cities and Communities) and SDG 12 (Responsible Consumption and Production) by driving urban sustainability and promoting circular economy principles. In the context of SDG 13, they contribute to the reduction of greenhouse gas emissions by promoting clean

energy solutions. Lastly, SDG 17 highlights the importance of partnerships, emphasizing the need for collaborative, multi-stakeholder efforts to maximize the impact of ECs in achieving the broader goals of sustainable development.

2.2. Italian Public Sector engagement with SDGs and BES

Italy's approach to sustainable development is further enriched by the "Benessere Equo e Sostenibile" (BES) initiative, launched in 2010. This framework seeks to measure well-being in a holistic and equitable manner, going beyond traditional economic indicators to include social and environmental factors (Papi et al., 2018). BES complements GDP by incorporating metrics related to life quality and environmental sustainability, providing a more comprehensive understanding of national progress. Since 2016, Italy's National Statistics Institute (ISTAT) has integrated various indicators related to the SDGs into the National Strategy for Sustainable Development (NSSD), establishing a regional framework that mandates local authorities to align their strategies with these goals.

ISTAT's system for monitoring the NSSD includes 130 indicators across 12 categories, each designed to measure progress in fostering equitable and sustainable well-being. This work intersects with both the SDGs and BES indicators, covering key areas such as Economic Well-being (BES 4), Landscape and Cultural Heritage (BES 9), Environment (BES 10), and the Quality of Services (BES 11). A dedicated working group has been active since the project's inception, continually refining these indicators to ensure they accurately reflect the complex interplay between sustainability and well-being.

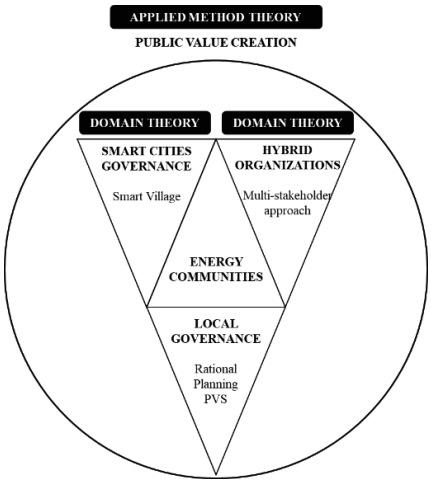
Local governments in Italy are increasingly recognizing the value of sustainable development in shaping future policies (Guarini et al., 2022). In collaboration with ISTAT, the National Association of Italian Municipalities (ANCI) launched the UrBES project, which provides city-level benchmarks for BES. Local officials have embraced the BES framework, as it offers precise metrics that not only guide policy decisions but also reveal geographic disparities. By analyzing these metrics, policymakers can identify regions that are either excelling or falling behind in specific benchmarks, thus offering a clearer picture of where inequality is concentrated. This, in turn, allows for

targeted interventions that address both local challenges and opportunities within the broader context of sustainability.

3. Theoretical foundations

This research is grounded in two key domain theories, supplemented by a specialized applied method theory. The theories of Smart City Governance and Hybrid Organizations are integrated to demonstrate how Energy Communities (ECs) can play a critical role in advancing the Sustainable Development Goals (SDGs). Furthermore, the work explores the concept of public value creation as a strategic framework and applied method theory, specifically using the Public Value Scorecard, which serves as a tool to evaluate the societal impact of ECs. Additionally, the study situates Rational Planning within the realm of Local Governance, highlighting its relevance within the broader paradigms of New Public Management (NPM) and New Public Governance (NPG) in both urban and rural settings. See Figure 1 for an overview of the theoretical framework.

Figure 1. Theoretical premises



Source: authors elaboration

3.1. Domain theories

The integration of Smart City Governance and Hybrid Organizations offers a comprehensive lens to understand the potential of Energy Communities in

contributing to sustainable development. Smart City Governance provides a framework for the incorporation of ECs into urban development strategies, leveraging technology to foster sustainability. On the other hand, Hybrid Organizations serve as a model for ECs to simultaneously address economic, social, and environmental objectives. This approach underscores the pivotal role of ECs in advancing sustainability by actively engaging diverse stakeholders. In the Italian context, these theories provide crucial insights into how ECs can be mobilized to achieve the SDGs through grassroots, community-driven initiatives (Caragliu et al., 2013; Meijer & Bolívar, 2016).

Smart City Governance adopts a holistic approach to urban management, incorporating technology to enhance sustainability and improve the quality of life. This model encourages the integration of ECs into city planning by focusing on local energy solutions that drive SDG 11 (Sustainable Cities and Communities) through energy efficiency and sustainable development. Although traditionally focused on urban areas, the Smart City framework has evolved to include the concept of Smart Villages. Smart Villages address the unique challenges of rural and peri-urban communities by using digital technologies and innovative approaches to enhance social cohesion, economic opportunities, and the overall quality of life (Satoła & Milewska, 2022).

In contrast, Hybrid Organizations combine elements from both the public and private sectors to meet goals across the social, environmental, and economic spectrum. ECs, as hybrid entities, are designed to drive sustainable development by balancing economic feasibility with social and environmental imperatives. This model supports key SDGs, particularly SDG 7 (Affordable and Clean Energy) and SDG 13 (Climate Action), by fostering the adoption of renewable energy and promoting community-driven sustainability initiatives (Doherty et al., 2014).

As hybrid organizations, ECs embody both nonprofit and for-profit characteristics, aiming to achieve dual missions: promoting renewable energy and fostering community engagement through a collaborative, multi-stakeholder approach. This dual approach enables ECs to address the intertwined challenges of energy sustainability and climate change, all while advancing innovative, community-led projects that engage both the public and private sectors (Meynhardt, 2009; Ceglia et al., 2020; Cappellaro et al., 2022). ECs are categorized into Renewable Energy Communities (RECs) and Smart Energy Communities (SECs). While RECs focus on the generation and sharing of renewable energy to enhance energy sustainability, SECs incorporate advanced technologies to improve energy efficiency and foster

active participation in energy markets, both working towards sustainable energy transitions.

3.2. Applied method theory

Public value creation serves as the applied method theory in this study, explaining how ECs contribute to societal well-being and sustainable development. Public value creation entails a strategic approach that brings together public, private, and community actors to generate benefits for society. Within the context of ECs, public value is realized through the use of renewable energy sources, the promotion of energy efficiency, and the reinforcement of social cohesion and local development (Reis et al., 2021). This strategic approach aligns with the broader goals of sustainable development by addressing economic, social, and environmental challenges in an integrated manner.

The theory of public value creation highlights the importance of participatory governance and stakeholder engagement, emphasizing the pursuit of collective societal interests over individual gains. Under this framework, ECs are seen as essential to facilitating the transition towards sustainable and resilient energy systems, while simultaneously empowering communities and enhancing their quality of life. The public value model, particularly in the context of ECs, touches upon themes of strategic management, collaborative governance, and performance measurement (Moore, 1995; Meynhardt, 2009; Ziruolo, 2016; Papi et al., 2018).

Moore's (1995) foundational Public Value theory highlights the role of public organizations in delivering societal benefits that extend beyond traditional market values. This framework is particularly relevant for ECs, whose resources are directed towards sustainable development goals. The Public Value Scorecard (PVSC) builds on this theory, providing a practical tool for evaluating the effectiveness of ECs by assessing their contributions across multiple dimensions. The PVSC offers a structured way for ECs to measure their impact and identify areas for improvement, ensuring alignment with broader public value objectives.

In this regard, the PVSC acts as a valuable tool for measuring the contributions of ECs towards societal well-being and sustainable development, while aligning their efforts with Local Governance principles. It facilitates strategic planning and decision-making by providing ECs with predefined metrics that address social, environmental, and economic objectives. This structured approach allows ECs to systematically plan,

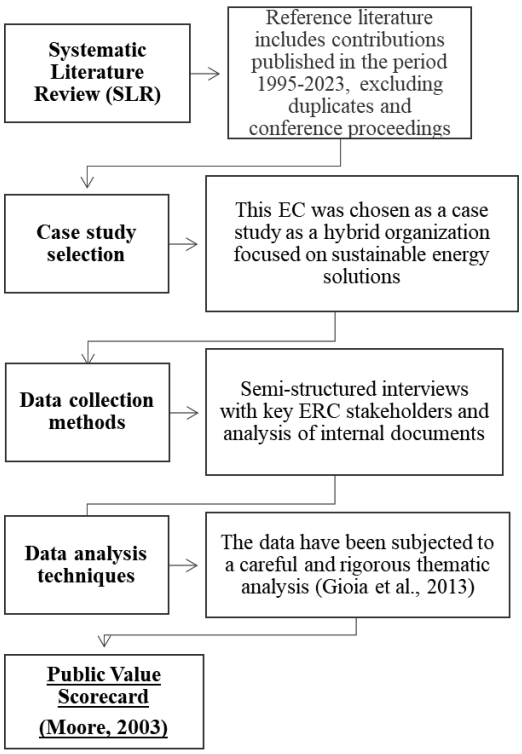
execute, and monitor their initiatives, ensuring they contribute meaningfully to sustainable development and public value creation.

Finally, the relationship between Public Value and Rational Planning is articulated by examining how ECs, as participatory models, contribute to the SDGs and public value creation, especially in rural contexts. By linking ECs to strategic planning frameworks, the study aims to demonstrate how local governance can effectively support broader goals of sustainable development.

4. Methods

The methodology adopted in this research is both systematic and comprehensive, designed to thoroughly investigate the role of Energy Communities (ECs) in creating public value. It follows a qualitative approach, structured across five main phases: a Systematic Literature Review (SLR), the selection of a case study, data collection methods, data analysis techniques, and the application of the Public Value Scorecard (PVSC). Each of these phases contributes to building a robust framework for understanding how ECs can drive sustainability and social well-being, while advancing the achievement of Sustainable Development Goals (SDGs) as reported in Figure 2.

Figure 2. Research design



Source: authors elaboration.

The research begins with a Systematic Literature Review (SLR) spanning from 1995 to 2023, focusing on peer-reviewed journal articles to explore key concepts like Energy Communities (ECs), public value, hybrid organizations, and sustainable governance. This review helps position the study within existing academic debates and identifies gaps for future exploration.

After establishing the theoretical foundation, the research moves to its empirical phase by selecting a hybrid EC case study. Chosen for its intersection of public and private sectors, this EC exemplifies Italy's supportive legislative and social framework for community-driven energy

sustainability. The case study explores the EC's role in advancing SDGs, with emphasis on its socio-economic and environmental contributions.

Data collection relies on semi-structured interviews with stakeholders (Merriam, 1998; Hristov & Mechelli, 2021), including management and local authorities, as well as document analysis. These methods offer a holistic view of the EC's governance, stakeholder engagement, and operational strategies, capturing diverse perspectives on sustainability and public value creation. Thematic analysis, following Gioia et al. (2013), is applied to the data, identifying key patterns in public value creation, stakeholder involvement, and the balance of economic, social, and environmental goals. This links the findings to the broader theoretical frameworks of governance and hybrid organizations.

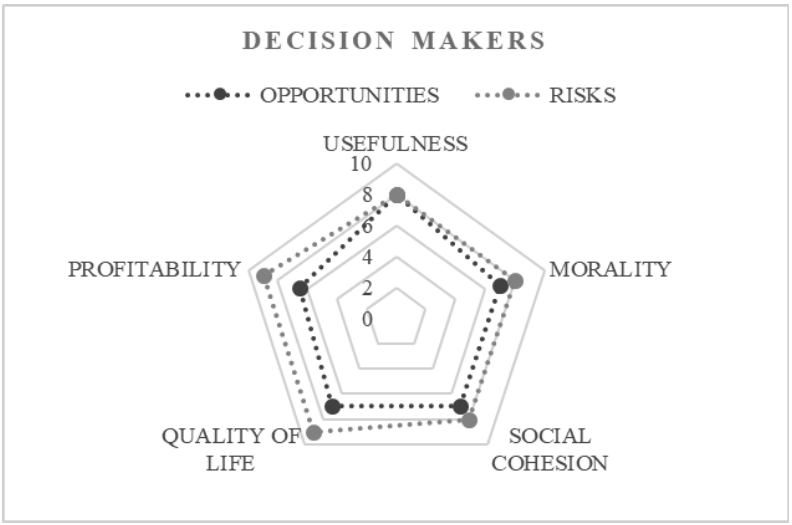
Finally, the Public Value Scorecard, based on Moore's theory (2003), evaluates the EC's societal impact across social, environmental, and economic dimensions. The PVS provides concrete metrics to assess how well the EC aligns with sustainable development goals, offering insights into its strengths and areas for improvement. Overall, the methodology integrates theoretical and empirical approaches to assess the role of ECs in public value creation, providing a rigorous framework for evaluating their impact on sustainability and governance.

5. Results and discussions

5.1. Findings report

The PVSC charts presented in Figure 3 illustrate the perceived opportunities and risks associated with the Energy Community (EC) in Gagliano Aterno, as evaluated by two distinct groups: decision-makers and stakeholders. These perspectives offer valuable insights into how different actors view the potential benefits and challenges of EC initiatives, highlighting areas of alignment and divergence (Moore, 2003).

Figure 3. The PVSC metrics



Source: authors elaboration.

From the decision-makers' perspective, there is a strong perception of opportunities across multiple dimensions, particularly in usefulness and quality of life. Usefulness scores notably high at 9, indicating that decision-makers believe the EC can provide substantial functional benefits in meeting

local energy needs. Quality of life is also seen as a significant opportunity, scoring around 8, which suggests that decision-makers expect the EC to positively impact the community's overall well-being.

However, decision-makers also perceive risks, especially in areas related to morality and social cohesion. Morality scores indicate a moderate risk level, implying concerns about the ethical implications of the EC's operations, possibly linked to fairness or transparency issues in how energy resources are distributed. Social cohesion is rated as a slightly lower risk but still a concern, suggesting that decision-makers worry about potential divisions or inequalities that the EC might exacerbate within the community.

On the other hand, stakeholders exhibit a somewhat different assessment of the EC's potential. Similar to decision-makers, stakeholders perceive high opportunities in usefulness and quality of life, both scoring close to 9. This suggests a broad consensus that the EC can deliver practical benefits and improve the living standards of the community. However, stakeholders see more pronounced risks in profitability, with a risk score of 6, compared to decision-makers' assessment of around 3. This indicates that stakeholders are more concerned about the financial sustainability of the EC and its ability to generate adequate returns or savings. Furthermore, stakeholders identify social cohesion as an opportunity rather than a risk, with a score of 7, which contrasts with decision-makers' view. This suggests that stakeholders may feel the EC could strengthen community ties, possibly through greater participation and shared benefits.

The comparative analysis between decision-makers and stakeholders reveals both commonalities and differences in their assessments. Both groups align on the usefulness and potential improvement in quality of life that the EC can bring to Gagliano Aterno. However, discrepancies arise in areas such as profitability and social cohesion, where stakeholders express more concern about financial risks but see greater social benefits, while decision-makers are more cautious about the EC's social impact but less concerned about its profitability. In this sense, the data underscores the need for tailored communication and policy strategies that address the specific concerns of each group. Engaging stakeholders more actively in discussions around financial sustainability and ensuring transparency in governance could mitigate perceived risks. At the same time, efforts to enhance social cohesion through

community-building activities may align both groups' expectations and strengthen the EC's overall impact.

5.2. Environmental, economic and social impacts

The environmental, economic, and social impacts of Energy Communities (ECs) have been the focal point of much academic and policy discourse, particularly considering their capacity to address pressing global challenges such as climate change, energy poverty, and social inequality. This study contributes to this discussion by assessing the specific impacts of ECs within the context of Gagliano Aterno, with a focus on how these communities generate public value across environmental, economic, and social dimensions (Savelli & Morstyn, 2021).

One of the most significant contributions of ECs is their role in environmental sustainability, particularly through the promotion of renewable energy sources and the reduction of greenhouse gas emissions. ECs, by their very nature, are designed to utilize local renewable energy resources, thus contributing directly to the reduction of fossil fuel dependence and mitigating the environmental impacts of traditional energy systems. In the case of Gagliano Aterno, the decision-makers and stakeholders both recognized the environmental benefits, particularly in terms of reducing carbon emissions and enhancing local energy autonomy. The findings indicate that the EC plays a pivotal role in advancing SDG 7 (Affordable and Clean Energy) and SDG 13 (Climate Action), as it fosters the adoption of clean energy solutions that have a direct impact on reducing the community's carbon footprint.

Furthermore, the concept of "usefulness" as highlighted in the radar charts reflects the practical environmental benefits that decision-makers and stakeholders attribute to the EC. Both groups perceive the EC as a tool to improve local energy resilience and decrease the community's environmental impact, though decision-makers expressed a higher level of confidence in these outcomes. This underscores the critical role ECs play in achieving sustainable development through environmental stewardship, which is a central goal of the EC's operation in this region (Ceglia et al., 2020; Cappellaro et al., 2022).

The economic implications of ECs are equally profound, particularly in terms of cost savings, local job creation, and economic resilience. ECs, as hybrid organizations, combine elements of public, private, and community-driven initiatives to create a localized, sustainable energy system that generates both economic and social capital. In Gagliano Aterno, profitability emerged as a key area of concern, particularly among stakeholders. The radar

charts reveal a disparity between decision-makers and stakeholders in their perception of the EC's economic sustainability, with stakeholders viewing profitability as a more significant risk.

This divergence can be attributed to the uncertainty around long-term economic returns and the potential challenges of maintaining financial sustainability in a localized, renewable energy market. While decision-makers appear more confident in the EC's capacity to generate economic benefits, stakeholders express reservations, potentially due to concerns about market fluctuations, initial capital costs, and the ongoing operational expenses associated with renewable energy infrastructure (Doherty et al., 2014).

Nevertheless, the EC's economic impact extends beyond mere profitability. It also contributes to local economic development by providing opportunities for community involvement and creating a market for local energy producers and prosumers. This aligns with the broader goals of SDG 1 (No Poverty) and SDG 8 (Decent Work and Economic Growth), as the EC has the potential to lift local communities out of energy poverty while fostering economic resilience through the creation of green jobs and sustainable local economies (Bouckaert et al., 2016; Bisogno et al., 2023).

Lastly, the social dimension of ECs is perhaps one of their most unique and impactful features. Unlike traditional energy models, which often alienate consumers from production processes, ECs empower individuals and communities to actively participate in the energy transition. In Gagliano Aterno, this empowerment is reflected in the positive social cohesion scores reported by stakeholders. The radar charts indicate that stakeholders view the EC as a significant opportunity for enhancing social ties and fostering greater community collaboration. This aligns with the broader notion of public value creation, where ECs not only provide energy but also serve as incubators for social innovation and participatory governance (Doherty et al., 2014; Esposito & Ricci, 2015).

The contrast between decision-makers' and stakeholders' views on social cohesion is also telling (Matei & Dorobantu, 2015). Decision-makers were more cautious, perhaps reflecting concerns about potential divisions or inequalities that could arise from the distribution of energy resources or participation in decision-making processes. However, stakeholders are more optimistic, viewing the EC as a unifying force that strengthens social bonds through collective action and shared benefits. This points to the potential of ECs to address not only energy needs but also broader societal issues, contributing to SDG 11 (Sustainable Cities and Communities) by fostering inclusive and resilient urban and rural communities. Additionally, the EC's emphasis on participatory governance, where community members are

actively involved in the management and operation of the energy system, promotes transparency, trust, and collective ownership. This, in turn, enhances the quality of life for participants, as they are not merely passive consumers but active contributors to a sustainable future. The improvement in quality of life, as highlighted in the radar charts, further demonstrates the EC's ability to create public value by addressing not only material needs but also social and psychological well-being.

The discussion also reveals an underlying tension between the perceived risks and opportunities associated with ECs, particularly as viewed by different stakeholder groups. While both decision-makers and stakeholders recognize the significant opportunities for improving environmental sustainability, economic resilience, and social cohesion, there are distinct concerns about potential risks (Ceglia et al., 2020; Reis et al., 2021). For decision-makers, these risks are more focused on issues of morality and social cohesion, reflecting concerns about the ethical implications of energy distribution and the possibility of social fragmentation. Stakeholders, on the other hand, are more focused on financial risks, particularly in terms of profitability and long-term sustainability.

This divergence suggests that while the theoretical benefits of ECs are well-recognized, there is still a need for careful risk management and the development of strategies that address the specific concerns of different stakeholder groups. By doing so, ECs can better align their operations with the broader goals of sustainable development while ensuring that the risks are minimized, and the opportunities are fully realized.

6. Concluding remarks

This paper set out to explore how Energy Communities (ECs) contribute to public value creation across environmental, economic, and social dimensions. By applying theoretical frameworks such as Smart City Governance, Hybrid Organizations, and Public Value Creation, alongside the practical evaluation tool of the Public Value Scorecard (PVS), the study has demonstrated that ECs play a pivotal role in advancing the Sustainable Development Goals (SDGs), particularly SDG 7 (Affordable and Clean Energy) and SDG 13 (Climate Action).

The main findings underscore that ECs generate significant public value by fostering local renewable energy production, enhancing social cohesion, and promoting economic resilience (Doherty et al., 2014; Papi et al., 2018). Specifically, the case study of an Italian Energy Community revealed that ECs not only reduce energy poverty and increase energy autonomy but also

stimulate local economic opportunities by engaging communities in energy production. These benefits are particularly impactful in rural areas, where ECs help address regional inequalities in energy access and drive localized sustainable development.

A key novelty of this paper lies in the integration of multiple theoretical perspectives with the applied PVSC framework (Moore, 2003). This multidimensional approach allows for a comprehensive assessment of ECs beyond their technical or economic aspects, highlighting their broader societal contributions. Additionally, the use of the PVSC provides a practical tool for measuring and evaluating the impact of ECs in real-world settings, offering insights that are both academically valuable and practically applicable for policymakers and community leaders.

However, the study is not without its limitations. The research focuses primarily on a single case study, which, while illustrative, may not fully capture the diverse range of ECs operating in different geographic and regulatory contexts. The findings are therefore context-specific, and further research is needed to assess how ECs perform across varying conditions, particularly in urban environments or in regions with different policy frameworks. Additionally, the paper highlights several challenges that ECs face, including financial sustainability, regulatory complexity, and technological integration, all of which require further investigation to ensure the long-term viability of ECs.

In conclusion, Energy Communities represent a transformative model for achieving sustainable development, as they empower communities to take active roles in the energy transition while fostering social innovation and economic resilience. By aligning their operations with the SDGs, ECs have the potential to not only address pressing environmental challenges but also to build stronger, more inclusive communities. As this study has shown, ECs are more than just energy providers - they are incubators of public value, driving forward local sustainability initiatives that contribute to global objectives (Ceglia et al., 2020; Cappellaro et al., 2022).

The strategic role of Energy Communities in sustainable development cannot be overstated. They offer a blueprint for how localized, community-driven initiatives can scale up to meet global sustainability challenges. As we look to the future, ECs will undoubtedly serve as key actors in the global movement towards a more sustainable, equitable, and resilient energy system. It is imperative that policymakers, practitioners, and researchers continue to

support and refine these innovative models to ensure their full potential is realized.

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Monica Lupetti[*], Marco E.L. Guidi[†]

FROM CAPITALIST EXPLOITATION TO SOCIO-ENVIRONMENTAL SUSTAINABILITY: THE LANGUAGE OF THE PORTUGUESE LEFT IN THE YEARS OF THE CARNATION REVOLUTION[‡]

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Abstract

This study examines the evolution of the economic and political language of the Portuguese left during the Carnation Revolution (*Revolução dos Cravos*, 1974-1975), focusing on the concepts of capitalist exploitation and socio-environmental sustainability. Through the analysis of the *Cadernos Dom Quixote*, a publishing series that disseminated Marxist and progressive ideas in Portugal between the last years of the *Estado Novo* dictatorship and the first years of democracy, the role of translations of Italian and French texts in the construction of the political discourse of the left is highlighted.

The article focuses on the dissemination of ecological terminology and its integration into the political and social debate of the time. The analysis of keywords and recurrent terms in the translated texts shows how environmental language was closely linked to a radical critique of capitalism, seen as the main culprit of ecological degradation. Concepts such as 'antipoluição', 'subdesenvolvimento' and 'limites ao crescimento' emerge as central to the discourse of the revolutionary Portuguese left.

The research also highlights how environmental protection policies were perceived as tools of capital to consolidate its power, rather than as real solutions to the ecological crisis. Furthermore, the debate on ecology was part of a broader vision of social transformation, with the goal of a new democratic and socialist model of development.

[*] Università di Pisa, Dipartimento di Filologia, Letteratura e Linguistica, piazza Evangelista Torricelli, 2, 56126 Pisa, PI, Italy, Phone: +39 050 2215189; *E-mail address*: monica.lupetti@unipi.it.

[†] Università di Pisa, Dipartimento di Economia e Management, via Cosimo Ridolfi, 10, 56124 Pisa, PI, Italy, Phone: +39 0502212206; *E-mail address*: marco.guidi@unipi.it.

[‡] The article is the result of joint research. However, in drafting the paper, Marco Guidi was responsible for section 2 and Monica Lupetti for section 3. Introduction and Conclusions are the work of both.

Finally, the paper shows how the linguistic and terminological choices adopted in the translations helped shape the environmental debate in democratic Portugal, leaving a legacy that is still relevant in contemporary discussions on sustainability and social justice.

JEL CLASSIFICATION: B24, N44, Q56, P16, Z13

KEYWORDS: CARNATION REVOLUTION, MARXISM AND THE PORTUGUESE LEFT, SOCIO-ENVIRONMENTAL SUSTAINABILITY, POLITICAL AND ECONOMIC LANGUAGE, TRANSLATIONS AND DISSEMINATION OF IDEAS

1. An introduction perhaps too long, but containing indispensable premises

25th April 1974 at 00:20. Rádio Renascença broadcasts the song *Grândola, Vila Morena* by José (Zeca) Afonso. It was the signal awaited by the progressive faction of the Portuguese armed forces to launch a bloodless coup d'état that put an end to the longest dictatorial regime in Europe: the *Estado Novo* (New State) established by António de Oliveira Salazar in 1933. The military deposed Prime Minister Marcello Caetano, Salazar's successor since 1968, and initiated the country's democratic transition. The Carnation Revolution (*Revolução dos Cravos*), named after the young women who placed red carnations in soldiers' rifles, was not a popular uprising. However, the Portuguese enthusiastically took to the streets to celebrate democracy. In the following months, freed from repression, they actively engaged in shaping a new democratic system characterized by a strong internal dialectic.

At first, left-wing groups dominated the political scene, holding strong representation in both the MFA (Movimento das Forças Armadas) and the Constituent Assembly. The Socialist and Communist Parties, along with the centrist-leaning Social Democratic Party, secured a majority in the Assembly. Meanwhile, the MFA and the country witnessed the rise of a turbulent far-left faction, which, among other actions, attempted a *coup* in the summer of 1975 to push the new democratic institutions towards a more radical, non-aligned socialist direction. On the other hand, he Constitution approved by the Assembly embraced a mixed approach. It reaffirmed Western democratic principles while also expressing the intention to establish a multi-party

socialist system. The constitutional reforms of 1982 and 1989 significantly diluted this objective, aligning Portugal with other European democracies. On 1 January 1986, the country officially joined the European Union (then known as the EEC) (Pinto and Monteiro 2023; Rezola 2024).

This brief overview underscores the crucial role of Marxist culture, in its various strands, in shaping the political formation of the army factions, parties, and movements that dominated Portugal's public sphere in the early years of democracy. It is self-evident that Marxist ideas did not emerge suddenly in 1974; rather, they had been absorbed and debated in the preceding years.

For these reasons, we initiated a study on the circulation of Marxist culture in Portugal during the 1970s, focusing specifically on Portuguese translations of Italian Marxist texts. Italian authors were translated into Portuguese starting in the 1960s, with a surge in the early 1970s. These ranged from key figures of the Italian Communist Party—such as Gramsci, Togliatti, and Berlinguer—to heterodox intellectuals and New Left thinkers like Tronti, Rossanda, Magri, and Negri. Additionally, historians, philosophers, and scientists, including Sereni, Cerroni, Della Volpe, Banfi, Geymonat, and Lombardo Radice, were also widely translated. Only the French Left had a comparable impact, largely due to linguistic and historical ties. Portuguese, Italian, and French all stem from the same Neo-Latin roots, fostering strong cultural exchanges. Throughout history, political dissidents have sought refuge in Paris and Rome, from the Napoleonic era to the 20th-century dictatorships. During the Carnation Revolution, numerous Italian and French intellectuals, as well as grassroots activists, crossed Europe—often with limited resources—to take part in what they saw as a bold political experiment and a beacon of hope for a fairer future (Ferrari 2024[1]; Moiso and Strippoli 2024)[2].

How did politically sensitive texts get translated and published during the final years of the *Estado Novo*? Marcelo Caetano promised 'liberalisation' when he took power, but never fulfilled it. While newspapers and magazines faced prior censorship, books continued to be subject to censorship only after publication. The PIDE (renamed DGS in 1968), Salazar's political police, seized more than 90 per cent of opposition books. However, their publication

[1] From the first edition of this book (1995), a film was made. See Sciarra (2001).

[2] Rai Radio 3 dedicated to the topic a series of five podcasts edited by Graziano Graziani (2024), in which Franco Lorenzoni, Luciana Castellina, Raoul Mordenti and Afra Mannocchi, Tano D'Amico and Marino Sinibaldi were interviewed.

could still be attempted, sometimes leading to clandestine circulation (Silva 2013). Translating renowned authors, combined with strategic editorial choices, became a crucial way to bypass censorship and safeguard both authors and publishers. This approach was adopted by publishing houses such as *Edições Afrontamento* in Porto and *Publicações Dom Quixote* in Lisbon. The latter, founded in 1965, launched the *Cadernos Dom Quixote*, a series that functioned as an unofficial periodical, exclusively publishing translations from leading European and international leftist magazines.

This essay analyzes a corpus of *Cadernos* issues, focusing on their role in shaping and adapting a censored language to Portuguese before and after the Carnation Revolution. These texts played a crucial role in giving voice to an ideology that criticized capitalism and advocated for the transformation of Portugal's socio-political structures into a democratic and socialist system. Specifically, this study examines how this language addressed environmental degradation and the emerging ecological policies of the 1970s in Europe. Behind language lie concepts, and our analysis highlights the significance and distinctiveness of ecological issues within the ideological framework of the Portuguese left during this period. As Portugal embraced European intellectual movements, this study captures the spirit of an era that, while past, continues to shape today's discussions on environmental sustainability and economic development.

2. The *Cadernos Dom Quixote* and ecological issues

Publicações Dom Quixote, founded in 1965 in Lisbon, remains active today as part of the LeYa group. Among its earliest publications was *Cadernos Dom Quixote*, a series designed as a left-wing magazine. Due to preventive censorship, its publication would have been otherwise impossible. To avoid seizure, the series adopted several strategies. Until 1974, it refrained from discussing Portuguese politics, focusing solely on international affairs. It avoided publishing articles by Portuguese authors—except for introductions—relying instead on translations of foreign works. Additionally, it omitted references to editorial boards, editors-in-chief, and other figures who might face repression. Each issue's colophon listed only foreign authors and graphic designer Fernando Felgueiras as copyright holders (Santos 2003). In some cases, when the cover was designed by a foreign artist, their name was also included. For example, the cover of the ecology issue—subject of

this study—was likely an original contribution[3] by Ron Cobb (1937–2020). Cobb was a cartoonist and designer known for his work on *Alien*, *Back to the Future*, and *Total Recall*[4].

Figure 1. Ron Cobb, *Que é a ecologia?*, 1973.

Source: *Ecologia contra Poluição*, *Novos Cadernos Dom Quixote*, Lisboa: Edições Dom Quixote, 1973, Front Cover (Cunha *et al*. 1973).

In each issue, the names of Portuguese translators were listed in full. Some went on to have distinguished careers in translation, while others later emerged as intellectuals, scholars, academics, and political figures in democratic Portugal. Legally, translators were considered neutral technicians. However, under the dictatorship, listing their names was a bold act, as it inevitably placed them under political surveillance.

Despite these obstacles, certain individuals were instrumental in shaping editorial resistance. One such figure was Ebba Merete Seidenfaden, widely known as Snu Abecassis (Copenhagen, 1940 – Camarate, 1980)[5], founder of *Cadernos Dom Quixote*. Following her marriage to Alberto Vasco Abecassis in 1961, she co-founded *Dom Quixote* on 16 March 1965 alongside her

[3] The drawing, unmistakably by his hand, features the Portuguese inscription 'Que é a ecologia?'.
[4] See the blog dedicated to Cobb: https://www.roncobb.net/index.html.
[5] After the Revolution, Snu became the partner of Francisco Sá Carneiro, who in 1979 won the elections at the head of a centre-right coalition and became Prime Minister. Both died a year later in a mysterious plane crash. See Bonnier (2003); Pinto (2011). A film (Sequeira 2019) was also made from the latter book.

husband and António Neves Pedro. Pedro brought experience from *Penguin Books* and *Publicações Europa-América* in Lisbon[6].

First published in 1967, *Cadernos Dom Quixote* quickly became a major intellectual platform. In less than five years, it produced fifty volumes covering key contemporary issues, including international politics and conflicts, the '68 movement and youth counterculture, drugs, feminism and birth control, ecology, and racism (Melo 2023, 3). In 1973, the series continued under the name *Novos Cadernos Dom Quixote*, documenting the final years of the dictatorship and the transition to democracy. Snu was not a left-wing extremist, as reflected in her editorial policy and later affiliation with the Social Democratic Party. Nevertheless, she actively promoted progressive voices from Cuba, Soviet dissidents, and Maoist China in international debates.

Early issues include those on *O Conflito Israelo-árabe* (1967); *Bolívia – Um Segundo Vietname* (1967), *Grécia 67* (1968), *A Crise da Igreja* (1969). In an issue dedicated to the Italian New Left, an editorial note cautiously premised:

> CADERNOS D. QUIXOTE – Pretendem pôr à disposição do leitor português textos internacionais considerados relevantes para a compreensão de problemas que afectam o mundo dos nossos dias. Nem sempre estamos de acordo com as ideias expressas pelos autores. Todavia, entendemos que elas exprimem diferentes maneiras de pensar, cujo conhecimento se torna indispensável para quem pretenda formar uma opinião (Rossanda *et al*. 1970, 3)[7].

Three pages later a second disclaimer (not without truth, however) warns that 'As opiniões expressas neste volume não são necessáriamente as da Editora' (ibid., 6)[8]. There is plenty of reason for this, because the issue contains articles from *Quaderni Piacentini* (by Francesco Ciafaloni and Carlo Donolo) and *Il Manifesto* (by Rossanda herself), as well as from *Problemi del Socialismo*, *L'Europeo*, *La Stampa*, *Die Zeit*, *L'Actualité*, and books published by *De Donato* (Rossanda 1968) and *Einaudi* (Iraci Fedeli 1969).

[6] In 1966, Pedro was replaced by Carlos de Araújo, also from Europa-América Editions. Cf. Melo (2023).
[7] Translation: 'The aim is to provide Portuguese readers with international texts considered relevant to understanding the problems that affect the world today. We don't always agree with the ideas expressed by the authors. However, we believe that they express different ways of thinking, knowledge of which is indispensable for anyone wishing to form an opinion'.
[8] Translation: 'The opinions expressed in this volume are not necessarily those of the publisher"'

Ecology took center stage in a 1973 issue of *Novos Cadernos*, titled Ecologia contra Poluição (Ecology against Pollution; Cunha *et al*. 1973). The book featured translations of articles from several influential magazines. These included *Le Nouvel Observateur* and *Actuel*—the latter serving as a platform for Sixty-Eight activists at the time. It also incorporated content from *Triunfo*, which had championed the Spanish left since June 1962 under Francoism (Ezcurra 2024)[9]. Other notable sources were *Les Temps Modernes*, founded by Jean-Paul Sartre, Simone de Beauvoir, and Maurice Merleau-Ponty, and *The UNESCO Courier*, the anthology's most institutional voice.

The authors featured prominent thinkers of the European 1968 Left, including Herbert Marcuse and Edgar Morin. Political figures from the social democratic sphere were also present, such as Sicco Leendert Mansholt, a key architect of European agrarian policy, and Edmond Marie, general secretary of the CFDT trade union. The volume featured contributions from renowned economists like Gunnar Myrdal and ecological economics experts Barbara Ward and Ignacy Sachs. Environmentalists such as Edward Goldsmith and Philippe Saint-Marc were also included, along with futurologists Robin Clarke and Aurelio Peccei—co-founder, with Alexander King, of the *Club of Rome*. Sociologists played a key role, particularly the Brazilian Josué de Castro, a political *émigré* in France and an expert on underdevelopment. The volume also included prominent journalists: Michel Bousquet (*Le Nouvel Observateur*), Henri Gougaud and Colette Saint-Cyr (*Actuel*), and Ricardo G. Zaldivar (*Triunfo*). This collection stands out for its strong international perspective, with a particular emphasis on early Europeanist thought.

The translators of this issue were Alberto Carneiro, António José Massano, António Pescada, Calado Trindade, Manuel Lopes, Manuel M. Costa and Maria Teresa Soares.

The articles primarily focus on two key themes: the economics of underdevelopment and the limits of growth, a concept widely discussed by the *Club of Rome*. A debate on this issue between Aurelio Peccei and Gunnar Myrdal—who was critical of this theoretical approach—had appeared a few months earlier in *The UNESCO Courier*. A defining moment in environmental

[9] On this magazine, see also the accurate entry and related bibliography in Wikipedia: https://es.wikipedia.org/wiki/Triunfo_(Espa%C3%B1a).

policy was the *Stockholm Conference on the Human Environment* (United Nations 1972), which laid the groundwork for global ecological awareness.

Another issue of *Novos Cadernos*, also from 1973, explores the intersection of social and environmental issues. This is Issue No. 7, *A Sociedade de Consumo* (The Consumption Society; Hervé and Jaubert *et al*. 1973). The sources for the translations in this issue are similar to those of the previous one. They include the French magazines *Le Nouvel Observateur*, *L'Express*, and *Nature et Progrès*; the Spanish *Triunfo*; the British *The New Statesman* and *The Observer*; and the American *Newsweek*. As in previous issues, the graphics were consistently designed by Fernando Felgueiras.

The contributors to this issue included journalists such as Michel Bosquet, Alain Hervé and Alain Jaubert (*Le Nouvel Observateur*), Paulino Posada (*Triunfo*); Michael Davie (*The Observer*), Paul Foot (*The New Statesman*), James Bishop Jr. (*Newsweek*). The issue also featured contributions from experts in various fields, including organic farming specialist J. Behagel, French chemist François Custot, American lawyer and environmental activist Ralph Nader, and French writer and documentary filmmaker Patrick Séry.

The translators featured in this issue were Alice Nicolau, António Massano, Calado Trindade, Manuel J. Palmeirim and Manuel Lopes.

The issue covers a wide range of topics, including an economic and social analysis of consumerism (Bishop Jr.; Posada), the rise of ready-made food (Séry), and concerns over food poisoning (Behagel, Custot; Hervé and Jaubert). It also examines the dangers of health-damaging chemicals (Bosquet) and pharmaceuticals (Foot), which played a central role in some of the most notorious scandals of the 1950s and 1960s.

In the next section, we will explore how all the authors in these two issues of *Novos Cadernos* link environmental issues to the characteristics of the world economy. Our analysis will take a linguistic approach, tracing terminology back to its underlying concepts.

3. Environmentalist terminology in the early 1970s through the prism of Portuguese translations

The translators of *Dom Quixote*—and other publishing houses—were instrumental in introducing international debates to Portugal in the 1960s and 1970s. Censorship had kept key issues—such as underdevelopment, women's emancipation, labor struggles, student movements, socialism, and environmental concerns—largely absent from public discourse. Their task

was daunting: they had to adapt new terminology and syntax to Portuguese while conveying both scientific knowledge and political slogans—concepts often unfamiliar in a society deprived of freedom of speech and the press.

Translators often coined neologisms, drawing inspiration from Romance sister languages—primarily French, but also Italian, which functioned as an 'adstratum' of Portuguese. They also repurposed existing Portuguese words, assigning them new meanings not yet recognized in dictionaries.

This linguistic adaptation also influenced environmental discourse. During the 1960s and 1970s, ecological terminology evolved in parallel with political narratives, a dynamic we will explore in the following analysis. In the following pages, we examine a selection of texts from *Cadernos Dom Quixote*, dating back to the 1970s—around the time of the Carnation Revolution. Our goal is to highlight environmentalist terminology and evaluate its significance in the debates of the era, as documented in Snu Abecassis' book series.

The following analyses draw on a corpus consisting of the two *Cadernos* issues discussed in the previous section: one on ecology and the other on consumer society.

3.1 Key words in context (KWIC)

One of the most interesting results of linguistic analysis software such as Sketch Engine, which we used, is the keywords-in-context search. A 'keyness score' is applied to each word in the corpus, a score that serves to identify the elements that are typical of the corpus or that best represent it: essentially words and terms (recurring sets of words). The algorithm used compares the frequencies of the words contained in the focus corpus (corpus to be analysed = *X*) with those of the reference corpus (reference corpus = *Y*), which is usually a much larger corpus, comprising texts of a different and varied nature and content, and which is therefore representative of a language as a whole. The individual results of this algorithm can be described as variations of 'the word W is so-and-so more frequent in corpus *X* than in corpus *Y*'.

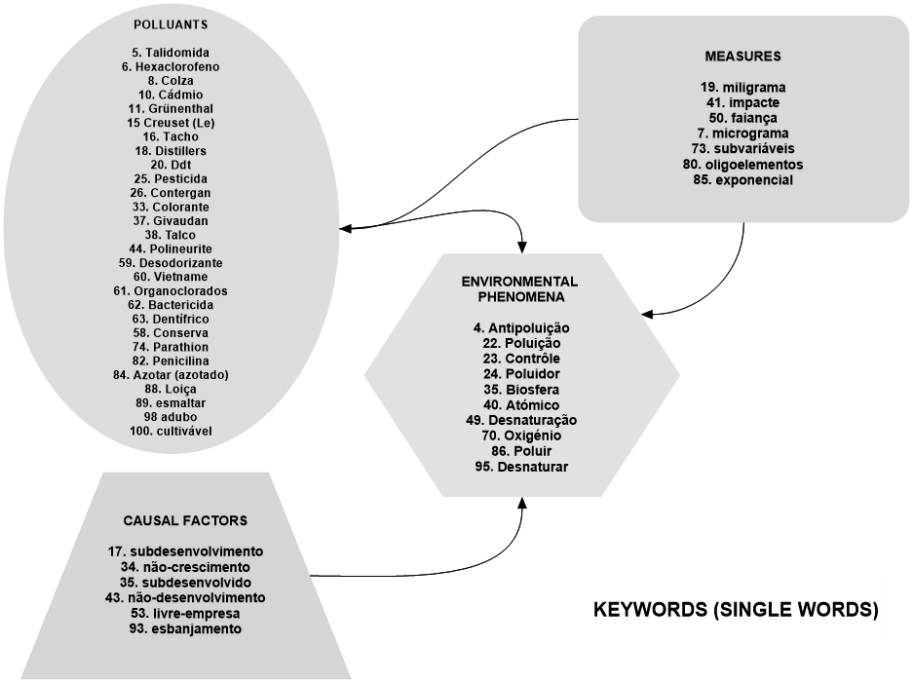
The relevant formula is $\frac{fpmfocus+N}{fpmref+N}$,where

- *fpm focus* is the normalised frequency (per million) of the word in the reference corpus;
- *fpm ref* is the normalised frequency (per million) of the word in the reference corpus;
- *N* is the smoothing parameter (*N* = 1 is the default value)[10].

The keyword list is ranked from the most specific term (with the highest score) to the least specific ones. In our corpus, the keyword results include names of scholars, experts, and influential journals in the environmental debate. Beyond these, several notable lexical fields emerge, as summarized in Figure 2.

[10] The value of *N* causes the score to favour more frequent or less frequent items. A higher *N* value shifts the focus to higher-frequency words (more common words), while a lower N value focuses on lower-frequency words (rarer words). The value must be changed in orders of magnitude, i.e. 0.1, 1, 10, 100, 1000, 10000 etc. Smaller changes rarely produce any noticeable effect.

Figure 2. The main keywords.



Source: own elaborations.

The most extensive category concerns pollutants and toxic substances linked to industrial production. These harmful products are aggressively marketed by companies prioritizing profit over public health. Frequently, they manipulate toxicological and environmental data to create a false sense of safety. Among the most infamous products of the 1960s and 1970s is Thalidomide (*Talidomida* in Portuguese, listed at position 5). This tranquillizer was patented and initially marketed in 1954 by Chemie Grünenthal under the name *Contergan*. Later, Distillers Biochemicals distributed it under the name *Distval*. When administered to pregnant women, this drug caused severe birth defects, including limb malformations and polyneuritis (pos. 44). It was banned in 1961. Hexachlorophene

(*hexaclorofeno* in Portuguese, listed at position 6) was initially marketed with caution by the Swiss pharmaceutical company Givaudan. However, after its patent expired, it became widely used in toothpastes, skin bactericides, and deodorants—until the FDA banned it in 1971.

Rapeseed (*colza* in Portuguese), ranked 8th, is a plant whose oil, used in food, has been linked to myocardial damage. Despite this, the EEC actively promoted its production, leading to disastrous consequences. Cadmium (*cádmio* in Portuguese), ranked 10th, was used by the French company Le Creuset for enamelling pots and pans. The company manipulated data to falsely claim that its products—particularly lids (*tachos*, pos. 16)—were non-toxic. DDT (pos. 20) is an insecticide that does not dissolve in water and poses serious health risks. Banned in the USA in 1972, it was later used by the US army during the Vietnam War to dispose of excess stock. Pesticides (pos. 25), including harmful organochlorines (pos. 61), also raise major health concerns. Other items on the list follow similar patterns of environmental and health risks.

In addition to harmful substances, another crucial focus is environmental degradation and the policies aimed at mitigating it. One notable term in this category is *antipoluição* (anti-pollution), which ranked fourth and is closely associated with words like política and luta. Its specificity makes it particularly significant. Its high ranking among keywords likely reflects its greater prevalence at the time. Today, terms like 'environmental policies' and 'sustainability' have largely replaced it. Another, perhaps more significant, reason is ideological. Some authors translated in the *Cadernos* viewed anti-pollution policies as a litmus test for the relationship between large capitalist corporations—seen as the main drivers of environmental pollution—and Western governments. While these governments were expected to lead and finance environmental efforts, in reality, they often acted to serve corporate interests.

Thus, Ricardo G. Zaldivar (1973, 78-79), in *A crise do meio ambiente*, argues that the cost of pollution reduction measures disproportionately affects weaker companies, particularly SMEs:

> Evidentemente, graças à defesa do meio ambiente, as empresas mais pequenas encontram-se geralmente em nítida inferioridade no momento de arcarem com os custos da antipoluição. [...] A urgência de salvar o meio ambiente oferece, como diz

Michel Bosquet, 'aos grupos mais poderosos a possibilidade de eliminar as empresas mais débeis, de monopolizar a sua parte do mercado e por fim a economia inteira'[11].

But the most serious aspect is that 'as indústrias da antipoluição coincidem com as maiores contaminadoras do meio ambiente' (ibid., 77)[12]. This point is also emphasised in Jean-Paul Cerón's article (1973, 84-85), *Quem lucra com a antipoluição?*

a antipoluição tem tendência para se tornar ela própria uma actividade industrial florescente, onde numerosos grupos financeiros e industriais frequentemente comprometidos nas actividades mais poluidoras têm as suas vantagens. [...] Isto mesmo é corroborado pelos anunciantes do número especial da revista "Scientific American" consagrado à biosfera. 60 % das firmas que aí oferecem os seus serviços para a antipoluição têm uma actividade principal poluidora; 40 % dessas firmas pertencem aos sectores da química, do petróleo, da energia e da embalagem[13].

Public policies play a decisive role in this dynamic. On one hand, they impose anti-pollution regulations; on the other, they create conditions that allow large companies benefiting from environmental clean-up contracts to thrive:

O mercado da antipoluição é um mercado parcialmente criado pelo Estado por leis e uma regulamentação especial. [...] Sobretudo, o Estado vem em auxílio da indústria da antipoluição financiando generosamente as suas actividades, perpetuando assim a 'divisão do trabalho', que consiste em interiorizar os lucros para as firmas privadas e em fazer pagar os custos sociais da produção pela colectividade (ibid., 88)[14].

[11] Translation: 'Of course, thanks to the defence of the environment, smaller companies are generally at a distinct disadvantage when it comes to bearing the costs of anti-pollution. [...] The urgency of saving the environment offers, as Michel Bosquet says, "the most powerful groups the chance to eliminate weaker companies, to monopolise their share of the market and ultimately the entire economy"'.

[12] Translation: 'the anti-pollution industries coincide with the biggest polluters of the environment'.

[13] Translation: 'anti-pollution is tending to become a thriving industrial activity in its own right, where numerous financial and industrial groups often involved in the most polluting activities have their advantages. [...] This is borne out by the advertisers in the special issue of Scientific American devoted to the biosphere. 60 per cent of the companies offering their anti-pollution services there have a main polluting activity; 40 per cent of these companies belong to the chemical, oil, energy and packaging sectors'.

[14] Translation: 'The anti-pollution market is a market partly created by the State through laws and special regulations. [...] Above all, the state comes to the aid of the anti-pollution industry by generously financing its activities, thus perpetuating the 'division of labour', which consists of internalising profits for private firms and making the social costs of production paid by the community'.

Ignacy Sachs (1973, 118), in *Meio Ambiente e Civilização*, argues that public policies within a capitalist framework create adverse incentives that should be eliminated. Under this system, increased pollution becomes profitable when companies can later benefit from anti-pollution contracts:

> O problema não é pròpriamente tecnológico. O que é preciso é impedir que os industriais se lancem numa antipoluição especiosa, que consiste pròpriamente em não modificar os processos de produção, mas em acrescentar ao ciclo produção-poluição uma nova actividade mais ou menos dispendiosa: a deslocação dos poluentes. A lógica do sistema capitalista leva-o a uma tal escalada de produção, poluição e antipoluição pela simples razão de que esta última se torna uma fonte de lucros ao mesmo título, por exemplo, que os armamentos. Se, por acréscimo, o Estado intervém para financiar a antipoluição, os mesmos grupos industriais podem encontrar vantagem em ganhar poluindo para em seguida ganhar despoluindo[15].

This passage underscores two critical themes in this issue of *Cadernos*. First, the myopic strategy of outsourcing pollution to Third World countries. Second, the alarming parallel between public spending on environmental remediation and military expenditures.

From today's perspective, the intervention of Edmond Maire, leader of the French CFDT, in the debate on 'Ecologia e Revolução' in *Le Nouvel Observateur* (pp. 28–29), appears prophetic. He argues against framing the ecological issue in personal or moral terms. He warns that this approach fosters an interclass ideology, where responsibility is equally distributed, requiring everyone to play a role in combating environmental degradation. This narrative, however, obscures the accountability of big capital in polluting the environment and its ongoing efforts to avoid internalizing the costs of decontamination.

> Fazem tudo para superarem esta crise do sistema com uma campanha de mistificação em torno da luta pelo ambiente, encarada como uma defesa da natureza,

[15] Translation: 'The problem is not primarily technological. What is needed is to prevent industrialists from embarking on a specious anti-pollution programme, which consists not of modifying production processes, but of adding a new, more or less expensive activity to the production-pollution cycle: the displacement of pollutants. The logic of the capitalist system leads it to such an escalation of production, pollution and anti-pollution for the simple reason that the latter becomes a source of profit on a par with, for example, armaments. If, in addition, the state intervenes to finance anti-pollution, the same industrial groups can find an advantage in gaining by polluting and then gaining by depolluting'.

na qual toda a gente, do servente de pedreiro ao P. D. G., se organizaria solidariamente contra os riscos criados por um progresso técnico considerado neutro, indeterminado e contra os abusos a que 'a natureza humana' pode levar. Como não se trata de diminuir os lucros, mas, pelo contrário, de os aumentar, visto que as medidas antipoluição são dispendiosas, é preciso que todos os indivíduos aceitem pagar o custo da antipoluição como consumidor ou como contribuinte, e, para isso, cada qual deve sentir-se culpado, poluidor. A revolta é, por conseguinte, desarmada, transformada em nova fonte de lucros. As classes dominantes procuram ao mesmo tempo criar o sentimento duma solidariedade objectiva entre o director e os seus empregados atingidos igualmente pelos vapores de gasolina ou pelos efeitos do 'smog' e conduzi-los a reacções interclasses, ou até de colaboração de classe[16].

Maire argues that resolving the environmental crisis requires transforming the production model, dismantling capitalist alienation, and embracing a 'new humanism' in which workers take active control of a sustainable economy.

A verdadeira solução é a mobilização da opinião pública, não apenas contra uma espécie de catástrofe de que ninguém seria responsável, mas contra as prioridades impostas pela classe que monopoliza o Poder. Para mudar a sociedade é necessário outro tipo de relações sociais, estruturas que dêem o poder de decidir do seu futuro ao conjunto dos cidadãos finalmente desalienados. Deve conceber-se relações sociais e humanas numa base igualitária que exclua qualquer discriminação de sexo, classe ou raça. Deve realizar-se a autogestão e a planificação auto-gerida num sistema de propriedade social dos meios de produção onde a melhoria do ambiente assumirá a sua verdadeira dimensão – a de uma transformação das relações do ser humano com a natureza e das relações dos homens entre si que levaria a reconsiderar o tipo de desenvolvimento industrial e a aplicação dos recursos, e donde poderia sair um novo humanismo (ibid. 30-31)[17].

[16] Translation: 'They do everything they can to overcome this crisis of the system with a campaign of mystification around the fight for the environment, seen as a defence of nature, in which everyone, from the bricklayer to the CEO, would organise in solidarity against the risks created by a technical progress that is considered neutral, indeterminate, and against the abuses that 'human nature' can lead to. As it is not a question of reducing profits, but on the contrary of increasing them, given that anti-pollution measures are expensive, it is necessary for everyone to accept paying the cost of anti-pollution as a consumer or taxpayer, and for this to happen, everyone must feel guilty, a polluter. Revolt is therefore disarmed, transformed into a new source of profit. At the same time, the ruling classes are trying to create a feeling of objective solidarity between the manager and his employees, who are also affected by petrol vapours or smog, and to lead them to inter-class reactions, or even class collaboration'.

[17] Translation: 'The real solution is to mobilise public opinion, not just against some kind of catastrophe for which no one is responsible, but against the priorities imposed by the class that monopolises power. In order to change society, another type of social relationship is needed, structures that give the power to

This perspective, widely embraced by the European left in the 1960s and 1970s, closely aligns with Kōei Saitō's (2020) stance in contemporary discussions.

'Biosphere' is one of the keywords introduced into Portuguese through *Cadernos*, ranking 35th with 15 occurrences in the corpus. It is defined as 'um ecossistema único composto de uma multidão de subsistemas'—a single ecosystem made up of multiple subsystems (Castro 1973, p. 136). This may explain why the publishing house selected texts that defined the term, including Barbara Ward's *Há só uma terra* (pp. 97–98):

> Actualmente, os nossos especialistas sabem algo de novo. Sabem que o ar, o solo e a água formam um sistema universal totalmente interdependente, ou biosfera, que sustenta a vida, que transmite a energia, isso a despeito dos seus ásperos poderes de sobrevivência, dos mecanismos vulneráveis e extremamente delicados, das folhas, bactérias, plâncton, catalisadores, níveis de oxigénio dissolvido, equilíbrios térmicos – e que só ele permite formar as cauterizantes energias solares e continuar a vida.[18]

Ward highlights the global inequalities in development, noting that rich countries have already exhausted—or are close to exhausting—the planet's development limits and the biosphere's natural resilience. As a result, poorer nations struggle to sustain a growing population, even when resources for development are available.

> [A]s nações, actuando individualmente, não produzirão necessàriamente uma resposta praticável e planetária. O incessante prosseguimento de separação de interesses nacionais, tanto por ricos como por pobres, pode, numa biosfera totalmente

decide on their future to all citizens who are finally disalienated. Social and human relations must be conceived on an egalitarian basis that excludes any discrimination grounded on gender, class or race. Self-management and self-managed planning must be realised in a system of social ownership of the means of production where the improvement of the environment will take on its true dimension - that of a transformation of human relations with nature and of human relations with each other that would lead to a reconsideration of the type of industrial development and the application of resources, and from which a new humanism could emerge'.

[18] Translation: 'Today, our experts know something new. They know that air, soil and water form a totally interdependent universal system, or biosphere, which sustains life, which transmits energy, despite its harsh survival powers, vulnerable and extremely delicate mechanisms, leaves, bacteria, plankton, catalysts, dissolved oxygen levels, thermal balances – and that it alone makes it possible to form the cauterising solar energies and continue life'.

interdependente, levar a calamidades de danos irreversíveis para o meio ambiente (ibid., 102)[19].

Josué de Castro (1973, 135) highlights how transferring polluting activities to developing countries not only worsens living conditions but also accelerates global ecological collapse: 'Através do jogo de interacções ecológicas, os desequilíbrios profundos a que o Terceiro Mundo tem sido condenado ameaçam toda a biosfera e com ela toda a humanidade'[20].

This last point sparks differing perspectives, some of which overlook the need for radical changes. These changes are essential in production and consumption models, as well as in the relationship between rich and poor countries, to reconcile welfare with ecological balance. Edmond Maire (1973, pp. 26–27) challenges the Western model of development, which is primarily measured by GDP. He argues that '[u]m regime socialista democrático deverá determinar, politicamente, os valores relativos a conceder ao conjunto dos elementos quantitativos e qualitativos que correspondem às necessidades humanas fundamentais'[21] However, he insists that even in a socialist society, 'o crescimento é necessário e que a expressão "crescimento zero" é uma negação do desenvolvimento da humanidade' (ibid., 27)[22].

In the keyword analysis, the lexical field of pollution measurement stands out, emphasizing the empirical approach taken in many discussions. Another key lexical field relates to identifying the economic causes and associated phenomena of environmental disruption. These terms are primarily economic, reflecting both the foundational principles of capitalism (*livre empresa*, free enterprise) and the global imbalances created by capital itself (*subdesenvolvimento*, underdevelopment; *subdesenvolvido*, underdeveloped; *não-crescimento,* non-growth; *não-desenvolvimento*, non-development). The connection is clear: the profit-driven policies of wealthy nations have

[19] Translation: 'Nations acting individually will not necessarily produce a practicable, planetary response. The incessant pursuit of separating national interests, by rich and poor alike, can, in a totally interdependent biosphere, lead to calamities of irreversible damage to the environment'.
[20] Translation: 'Through the interplay of ecological interactions, the profound imbalances to which the Third World has been condemned threaten the entire biosphere and with it all of humanity'.
[21] Translation: 'A democratic socialist regime must politically determine the relative values to be given to all the quantitative and qualitative elements that correspond to fundamental human needs'.
[22] Translation: 'Growth is necessary and that the expression 'zero growth' is a denial of human development'.

perpetuated underdevelopment. The latter, 'é um produto ou subproduto do desenvolvimento, um resultado inevitável do sistema colonial de exploração económica que vigora ainda em muitas partes do globo'[23] (Castro 1973, 134). The pollution of the Global South is its inevitable consequence. Underdevelopment itself is a form of social pollution.

> Os efeitos primeiros, e os mais graves, do desenvolvimento encontram-se precisamente nas regiões que estão económicamente subdesenvolvidas e que estavam ontem sob o domínio colonial. Nestas regiões o subdesenvolvimento foi o primeiro resultado do desenvolvimento desequilibrado do mundo no seu todo. O próprio subdesenvolvimento representa um tipo de poluição e de degradação humana localizado em certas regiões exploradas injustamente pelas grandes potências industriais (ibid.)[24].

A noteworthy term is *esbanjamento* (waste), which appears only four times in our corpus yet ranks among the top hundred keywords, underscoring its specificity. This noun stems from the verb *esbanjar*, which the Priberam dictionary defines as 'Gastar de maneira exagerada ou descontrolada'—excessive or uncontrolled spending. Its synonyms include *desbaratar* (dismantle, noun: *desbaratamento*), *dissipar* (dissipate, noun: *dissipação*), *estragar* (spoil, nouns: *estrago*, *estragação*, *estragamento*), and *malbaratar* (squander, noun: *malbaratamento*). However, these terms are either absent or rarely appear in our corpus. A distinct case is *desperdício*, a more common term not included in the keywords, with nine occurrences in the corpus. The verb *desperdiçar* appears three times. Today, these terms mainly relate to consumption and recommendations on reducing food waste and disposable products. This aligns with the individualistic and moralistic perspective that Edmond Maire criticized. In the two volumes we are analysing, however, a vision prevails that attributes all forms of waste to the capitalist organisation of production. In Ricardo Zaldivar's (1973, 81) words:

[23] Translation: '...is a product or by-product of development, an inevitable result of the colonial system of economic exploitation that still prevails in many parts of the world'.

[24] Translation: 'The first and most serious effects of development are to be found precisely in the regions that are economically underdeveloped and that were under colonial rule yesterday. In these regions, underdevelopment was the first result of the unbalanced development of the world as a whole. Underdevelopment itself represents a type of pollution and human degradation localised in certain regions that have been unfairly exploited by the major industrial powers'.

… é raro que uma problemática tenha a formidável capacidade da crise ecológica para servir de base à crítica total do sistema capitalista. E não só do capitalismo, mas do modo de vida e de produção que pressupõe a civilização industrial proveniente do capitalismo. Porque, não nos iludamos, é a única que existe: a própria U. R. S. S. adoptou as suas técnicas, lançando-se na corrida do consumo que o modelo americano lhe "emprestava" como objectivo. Porque, apesar da ofensiva ideológica que constantemente nos enche o cérebro, a problemática ecológica baseia-se numa realidade que está presente nas cidades insuportáveis, na destruição total dos ciclos naturais, no esbanjamento contínuo e institucionalizado de recursos e de capital acumulado, nos países empobrecidos e desgastados pelo imperialismo, na destruição de toda a forma de vida no Vietname, em …[25]

The list remains intentionally open, highlighting the relentless destructive force of the capitalist mode of production. Therefore, reiterates Ignacy Sachs (1973, 122), 'pôr em causa a estrutura do consumo e o esbanjamento que lhe é implícito é pôr em causa o capitalismo triunfante, seguro de si'[26].

Between the two terms, *esbanjamento* and *desperdício*, the former represents the dark side of consumerism in our texts. The latter, however, also carries broader meanings, associated with imperialistic militarism (Marcuse *et al*. 1973, p. 53) and political corruption (Sachs 1973, p. 115). For comparison, *esbanjamento* appears 19 times in the *Corpus do Português* (*Genre/Historical*)[27], across 17 texts from the 19th and 20th centuries. It primarily refers to the waste of money, public goods, private fortunes, and productive resources. In contrast, *desperdício* appears 131 times in 106 texts from the same period. While it shares some meanings with *esbanjamento*, it

[25] Translation: 'It's rare that a problem has the formidable capacity of the ecological crisis to serve as the basis for a total critique of the capitalist system. And not just of capitalism, but of the way of life and production presupposed by the industrial civilisation stemming from capitalism. Because, let's not deceive ourselves, it's the only one that exists: the U.S.S.R. itself adopted its techniques, throwing itself into the consumer race that the American model '"ent" it as a goal. Because, despite the ideological offensive that constantly fills our brains, the ecological problem is based on a reality that is present in unbearable cities, in the total destruction of natural cycles, in the continuous and institutionalised squandering of resources and accumulated capital, in countries impoverished and worn down by imperialism, in the destruction of every form of life in Vietnam, in…'.

[26] Translation: 'To call into question the structure of consumption and the waste that it implies is to call into question triumphant, self-assured capitalism'.

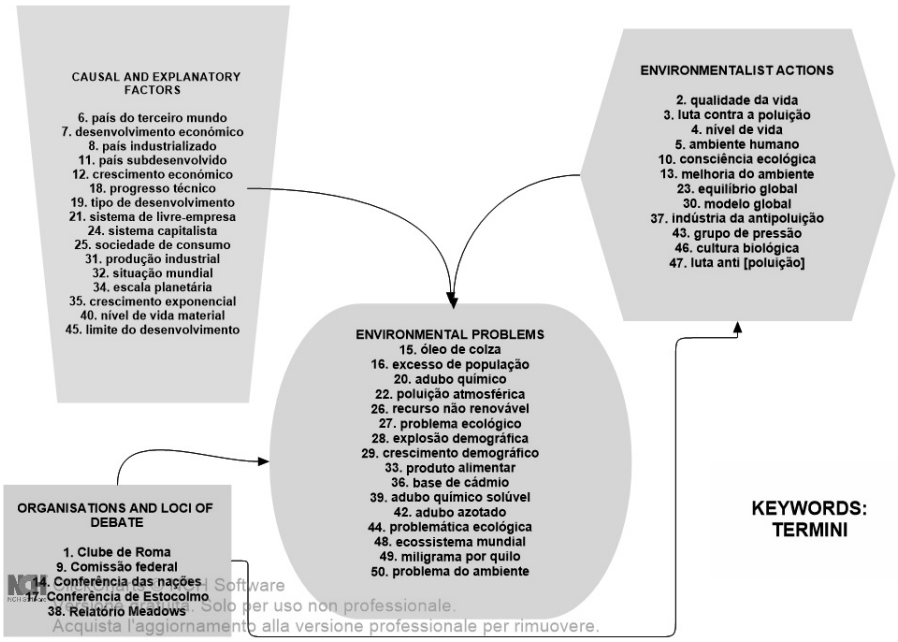
[27] https://www.corpusdoportugues. org/hist-gen/. This corpus contains 45 million words taken from texts ranging from the 13th to the 20th century, equally divided (in the case of those of the 20th century) between speech, fiction, newspapers and academic texts.

also extends to common phrases such as *desperdício de tempo* (waste of time) or *de ação nervosa e muscular* (of nervous and muscular action).

3.2 Terms (multi-words) and collocates

The 'keywords' function in Sketch Engine helps identify 'terms'—sets of associated words—using the same method applied to single words. When these terms frequently co-occur, they form 'collocates', which can be seen as 'formulas' or 'idioms'. As before, we have grouped these terms into lexical fields, as illustrated in Figure 3.

Figure 3. The main terms.



Source: own elaborations.

As illustrated in the figure, some of these terms refer to organisations and forums that played a pivotal role in environmentalist debates during the 1970s. The most prominent among them is the Club of Rome, founded in 1968 by Aurelio Peccei and Alexander King. It played a leading role in the influential debate on the 'limits of development', initiated by the publication of the Meadows Report in 1972. Another pivotal event was the 1972 United Nations Conference on the Human Environment, held in Stockholm. It was the first international summit to address the urgent need for preserving the planet's resources and environment.

The key environmental crises of the time include population growth, air pollution, harmful chemicals and fertilisers, and the depletion of non-renewable resources.

As with individual words, the field of causal and explanatory factors is even more prominent. Key themes include the contrast between industrialized and underdeveloped countries, the exponential growth of the former, and the limits to development. Also evident are the responsibilities attributed to capitalism and liberalism, as well as the global scale of the environmental crisis.

Another crucial lexical field focuses on responses to the environmental crisis. These responses include pollution control, increased environmental awareness, and broader objectives such as enhancing quality of life, restoring ecosystems, and fostering a more balanced relationship between humans and nature. A clear connection emerges between a cohesive global development model and the planetary ecosystem. Finally, attention must be given to the anti-pollution industry. Once again, this perspective connects capitalist economic growth to the degradation of the planetary ecosystem, resulting in food shortages, population expansion, resource depletion, and social fragmentation. As ecologist Edward Goldsmith (Marcuse *et al*. 1973, 41) writes:

> E mesmo que conseguíssemos reduzir 80% todas as poluições isso não constituiria uma solução definitiva para o problema da poluição, mas apenas permitiria ganhar alguns anos – vinte-e-sete para sermos exactos: a actividade económica geradora de poluição, que aumenta a uma cadência de 6 % ao ano, quadruplica na verdade de vinte-e-sete em vinte-e-sete anos. Também é fácil demonstrar que nenhuma solução tecnológica consegue resolver definitivamente os problemas da alimentação, do crescimento da população, da exploração dos recursos não renováveis ou da desagregação social que é uma das consequências inelutáveis do crescimento económico[28].

3.3 The wordlist

We now analyze our corpus by identifying the most frequently occurring words, ranked by frequency. Table 1 presents the fifty most frequent noun lemmas.

Table 1. Wordlist (nouns)

[28] Translation: 'And even if we managed to reduce all pollution by 80 per cent, this would not constitute a definitive solution to the problem of pollution, but would only allow us to gain a few years - twenty-seven to be exact: the economic activity that generates pollution, which increases at a rate of 6 per cent a year, actually quadruples every twenty-seven years. It is also easy to demonstrate that no technological solution can definitively solve the problems of food, population growth, the exploitation of non-renewable resources or the social breakdown that is one of the inescapable consequences of economic growth'.

Item	Frequency	Relative frequency	Item	Frequency	Relative frequency
vez	183	1958,45507	indústria	84	898,96298
ano	181	1937,05119	modelo	82	877,5591
ambiente	176	1883,54149	pessoa	80	856,15522
problema	165	1765,82014	mercado	77	824,0494
desenvolvimento	157	1680,20462	consumidor	76	813,34746
nader	143	1530,37746	consumo	75	802,64552
produto	138	1476,86776	modo	74	791,94358
poluição	134	1434,06	terra	73	781,24164
homem	129	1380,55029	exemplo	72	770,5397
país	127	1359,14641	f.	72	770,5397
mundo	127	1359,14641	nível	70	749,13582
sociedade	120	1284,23283	estado	69	738,43388
crescimento	119	1273,53089	caso	66	706,32806
sistema	116	1241,42507	trabalho	65	695,62612
vida	113	1209,31925	dia	65	695,62612
água	100	1070,19403	necessidade	63	674,22224
parte	95	1016,68432	relatório	62	663,5203
produção	94	1005,98238	natureza	61	652,81836
tempo	94	1005,98238	fim	59	631,41448
população	93	995,28044	efeito	59	631,41448
meio	92	984,5785	empresa	58	620,71254
recurso	88	941,77074	ação	58	620,71254
estados	88	941,77074	princípio	57	610,01059
e.	85	909,66492	capitalista	55	588,60671
n.	84	898,96298	alimento	55	588,60671

Excluding some 'noise', such as initials mistakenly listed as headwords, this dataset allows for multiple interpretations. First of all, the first specific word in order of frequency is, as might be expected, *ambiente*. More interestingly, *produção* (18th = 94 occurrences) comes before *consumação* (31st = 75 occ.), confirming that the causal factors of environmental disruption are more identified in the organisation of capitalist production than in consumption choices.

The high frequency of *desenvolvimento* (5th, 157 occurrences) and *crescimento* (13th, 119 occurrences) reinforces the evident link between economic growth and environmental degradation, as well as the search for sustainable development models.

Next, we will analyze the term *ambiente* in greater detail, examining its usage and contextual variations. The word sketch of this lemma, which identifies the main associated words, reveals the nominal locution *meio ambiente* (analogous to the Spanish *medio ambiente*), in which our word appears as an adjective. The occurrences of *meio ambiente* in our corpus are 55 (out of 176 of *ambiente*, *i.e*. 31.25%). For the sake of comparison, in the aforementioned *Corpus do Português Genre/Historical*, *meio ambiente* has 548 occurrences and *ambiente* 2920 (scattered in 1656 different texts of the 19th and 20th centuries), with a percentage of 18.77%. The most relevant feature of our focus corpus, however, is another: *ambiente* alone is found not only in the meaning of 'atmosphere', in locutions such as *ambiente humano*, *físico*, *natural*, *social*, but also in the meaning of 'ecosystem', overlapping with the locution *meio ambiente*. In particular, there are 32 occurrences of *ambiente* not followed by an adjective and preceded by the determinative article 'o', with or without a preceding adjective (*o deteriorado ambiente*, *o nosso* -), plus 4 occurrences with the indeterminative article 'um'. There are also several occurrences where the word is preceded by an articulated preposition:

ao ambiente = 1 occurrence
do ambiente = 29
no ambiente = 6
pelo ambiente = 1
sobre ambiente = 1

Overall, there are 74 occurrences of *ambiente* in the meaning of 'ecosystem', 19 more than *meio ambiente* and amounting to 42.05%.

Consequently, the locutions in which *ambiente* has the meaning of 'atmosphere' are about a quarter.

The situation is different in the *Corpus do Português Genre/Historical*, In the occurrences of the word *ambiente*, the meanings linked to the meaning of 'atmosphere' prevail (e.g. *o ambiente acadêmico*; *ambiente teatral*, *social*, *cultural*, etc.; *ambiente de casa*, *de igreja*, etc.; *a Idalina veio procurar seu ambiente para morrer*; *trabalhar num ambiente que não lhe dê satisfação*), while rare (and all in the 20th century) are the occurrences consistent with the notion of 'ecosystem': e.g. *dano ao ambiente*. In the latter case, the association with 'meio' in the locution *meio ambiente* is dominant. In the *Corpus do Português Now*, there are 228,760 occurrences of *ambiente* and the association with *meio* ranks first among collocates, with a frequency of 71,549, or 31.28%, the same row percentage as in our corpus. In addition, although we cannot do a minute analysis of the concordances, given the large number of occurrences, we can observe the top 20 collocates (see Table 2). If we filter them by country (Portugal, Brazil, Angola, Mozambique), we observe that in contemporary Brazilian Portuguese (PB), the locution *meio ambiente* is dominant (e.g. *Ministro do Meio Ambiente*, which is the official designation within the Brazilian government), while in European Portuguese (PE) it is prevalent, but occurrences with only *ambiente* are also found, albeit less frequently (*Ministro*, *Secretaria do Ambiente*: *Ministério do Ambiente* is the official designation in Portugal): *impactos sobre o ambiente e recursos naturais*; *proteção do nosso ambiente*" (but *proteção do meio ambiente* in occurrences in PB)[29].

[29] The *Dicionário Priberam* actually records, in addition to two meanings in adjectival function, the coexistence of the two forms in contemporary Portuguese:
'adjetivo de dois gêneros
1. Que envolve ou está à volta de alguma coisa ou pessoa. = ENVOLVENTE
2. Que é relativo ao meio físico ou social circundante (ex.: música ambiente; temperatura ambiente).
nome masculino
3. Conjunto das condições biológicas, físicas e químicas nas quais os seres vivos se desenvolvem. = MEIO AMBIENTE
4. Conjunto das circunstâncias culturais, económicas, morais e sociais em que vive um indivíduo (ex.: ambiente familiar; ambiente laboral; ambiente descontraído). = ATMOSFERA, MEIO AMBIENTE
5. Espaço físico delimitado (ex.: ambiente fechado). = LUGAR, RECINTO' ('ambiente', in *Dicionário Priberam da Língua Portuguesa* [online], 2008-2025, https://dicionario.priberam.org/ambiente).

Table 2. Collocates of 'ambiente'

Rank	Item	Frequency
1	Meio	71549
2	Ministro	7226
3	Ministério	7055
4	Secretaria	6712
5	Recursos	4633
6	Agência	3650
7	Estadual	3591
8	Negócios	3020
9	Instituto	2888
10	Portuguesa	2702
11	Criar	2678
12	Secretário	2543
13	Proteção	2161
14	Preservação	2085
15	Virtual	1967
16	Escolar	1939
17	Familiar	1796
18	Temperatura	1694
19	Favorável	1672
20	Urbano	1499

Source: *Corpus do Português Now*

Translators of the *Cadernos* played a key role in introducing the 'European' notion of 'environment' as an ecosystem in Portuguese. This notion gained traction in Portugal in the following decades, while Brazilian Portuguese solidified the dominance of 'meio ambiente'.

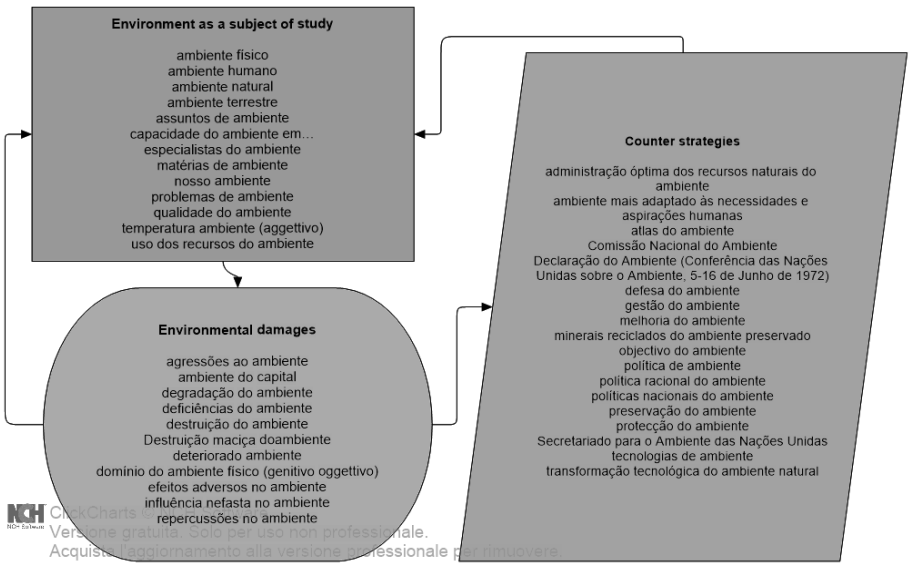
It can also be noted that, in our corpus, the noun *ambiente* (preceded by 'de') appears in many locutions in which the adjective 'environmental' would

be preferred in English: *matérias de ambiente*; *assuntos de ambiente*; *problemas de ambiente*; *política de ambiente*; *tecnologias de ambiente*, to give a few examples. Incidentally, the adjective *ambiental* (which records 99,879 occurrences in the *Corpus do Português Now*) has only the following five occurrences in our focus corpus, reflecting a language still in the making in Portugal in the last years of the dictatorship:

- *restrições de carácter ambiental*;
- *degradação ambiental*;
- *condições ambientais*;
- *benefícios sociais, económicos e ambientais*;
- *estímulos ambientais*.

Regarding the main semantic fields that emerge from the study of the concordances of the word *ambiente*, Figure 4 shows that causal factors and concomitant economic imbalances (capitalist expansion, underdevelopment) are less prominent than the keywords. Instead, more emphasis is placed on the effects, i.e., the damage of pollution on the environment, on the one hand, and clean-up policies, on the other.

Figure 4. Main collocates of the word *ambiente*



Source: own elaborations

This does not mean that the causes of environmental degradation are less rigorously identified. Let us leave the floor to Marcuse's (1973, 56) lapidary conclusions:

> Na medida em que ela se torna no ambiente do capital mais que no do homem, a natureza serve para fortificar a servidão humana. Estas condições têm a sua origem nas instituições de base do sistema estabelecido para o qual a natureza é primeiramente o objecto da exploração útil[30].

And, as to the solution of the problem, Philippe Saint-Marc (Marcuse *et al*. 1973, 51) echoes him as follows:

> Nós devemos ter como objectivo exigir a satisfação das verdadeiras necessidades, sobretudo no domínio do ambiente físico. É preciso mudar os meios de crescimento:

[30] Translation: 'To the extent that it becomes capital's environment rather than man's, nature serves to fortify human servitude. These conditions originate in the basic institutions of the established system for which nature is primarily the object of useful exploitation'.

o nosso sistema económico, materialista e liberal é o principal responsável. O único meio de proteger a natureza está em socializá-la[31].

Let us conclude the analysis of the Wordlists by taking a look at the most recurrent adjectives (Table 3).

Table 3. Most frequent non-generic adjectives

Rank	Item	Frequency	Relative frequency
3	económico	109	1166,51149
4	social	105	1123,70373
7	humano	87	931,0688
8	mundial	77	824,0494
9	industrial	75	802,64552
11	natural	71	759,83776
13	ecológico	60	642,11642
18	político	48	513,69313
19	meio	46	492,28925
20	público	46	492,28925
23	químico	45	481,58731
26	internacional	43	460,18343
32	alimentar	37	395,97179
36	científico	30	321,05821
37	técnico	29	310,35627
43	global	25	267,54851
47	nuclear	22	235,44269
49	biológico	22	235,44269
50	demográfico	22	235,44269

Source: own elaborations

In the table we omitted adjectives of generic meaning and those referring to geographical entities (*americano*, *francês*). The attention paid to economic

[31] Translation: 'We must aim to demand that real needs are met, especially in the field of the physical environment. We need to change the means of growth: our materialistic and liberal economic system is the main culprit. The only way to protect nature is to socialize it'.

causal factors is confirmed, but also the role attributed to public policies. Another aspect that is confirmed, in the environmentalist language of the Portuguese left in the 1970s, is the strong international, indeed global, approach with which the problem and its solution are viewed, as well as the human and humanistic dimension that must be at the core of the latter. Finally, the focus on scientific and technological data should be emphasized.

A separate place belongs to the 22 occurrences of the adjective *nuclear*, combined with the 11 of *atómico* and the 8 of *radioactivo*), revealing an early anti-nuclearist consciousness, as much in military uses (*holocausto nuclear*, *conflito nuclear*, *explosões nucleares*) as in civilian uses (*propulsão nuclear*, *electricidade nuclear*).

Thus Robin Clarke (1973, 125) highlights the effects on global warming of electricity production by nuclear power:

> [C]omo havemos de libertar-nos sem perigo dos resíduos radioactivos? Os tecnocratas sugerem pô-los em órbita à volta do Sol: esquecem que um carregamento tão considerável consumiria importantes quantidades de combustível fóssil, destruindo, assim, a vantagem inicial que o emprego de combustíveis nucleares apresentava. Admitamos que este problema se resolve; isso não chegaria. Cada quilovátio de electricidade nuclear produz dois quilovátios e meio de calor inútil, lançado de novo nos rios ou no oceano[32].

He is echoed by Colette Saint-Cyr and Henri Gougaud (1973, 148-149) as follows:

> As explosões nucleares, hoje interditas, continuam a produzir o seu efeito. Mas já se lhes juntam os resíduos das centrais atómicas lançados nos rios ou directamente no mar e o funcionamento dos navios de propulsão nuclear – o futuro. Contam-se presentemente trezentos. Desde já, a contaminação dos oceanos põe em grave perigo a vida dos homens, quer directamente por irradiação externa, se o organismo entra em contacto com águas ou areias irradiadas, quer indirectamente, pelo consumo de peixe, de moluscos ou de algas contaminadas[33].

[32] Translation: 'How can we get rid of radioactive waste without danger? Technocrats suggest putting them in orbit around the Sun: they forget that such a large load would consume significant quantities of fossil fuel, thus destroying the initial advantage of using nuclear fuels. Let's assume that this problem is solved; that wouldn't be enough. Every kilowatt of nuclear electricity produces two and a half kilowatts of useless heat, which is thrown back into rivers or the ocean'.

[33] Translation: 'Nuclear explosions, now banned, continue to have an effect. But now they are joined by the waste from atomic power stations that is thrown into rivers or directly into the sea and the operation of nuclear-powered ships - the future. There are currently three hundred of them. Contamination of the oceans

Perhaps it is because of this early environmental consciousness that the Portuguese ruling class that came out of the Carnation Revolution never introduced nuclear power generation in the country.

4. Conclusions

The translations of *Cadernos Dom Quixote* played a crucial role in shaping the environmentalist outlook of the leadership behind the Carnation Revolution and in fostering progressive political culture in contemporary Portugal. Along with new ideas, they introduced the key vocabulary needed for discussion. Some terms were imported and adapted from other languages, while others were repurposed from existing Portuguese words to better align with ecological discourse. This is particularly evident in the analysis of the central term in these debates: *ambiente*.

Our analysis revealed both continuity and change in the language and conceptual framework of the European left as introduced to Portugal through *Cadernos*. This study underscores the persistent emphasis on structural and macroeconomic causes of environmental degradation, both past and present. The main driver identified is capitalism's relentless pursuit of profit and free enterprise. This system fosters disregard for industrial pollution, the commercialization of harmful products, and the underdevelopment of what was then termed the 'Third World'. Moreover, the most polluting industries are often relocated to these regions. Most analyses indicate that the primary cause of environmental destruction is the production of goods rather than consumption patterns. Consumerism itself is a direct consequence of capitalism's structural mechanisms. Addressing the ecological crisis demands more than altering consumer habits. The real solution lies in dismantling capitalism and building a democratic socialist society, where people take active control in shaping a more just and ecologically sustainable world.

It is easy to imagine how this language was received by the *capitães* who rebelled against the dictatorial regime on the night of 25 April 1974, as well as the other political protagonists of the Carnation Revolution. It is less easy

already poses a serious threat to human life, either directly through external irradiation, if the body comes into contact with irradiated water or sand, or indirectly through the consumption of contaminated fish, shellfish or algae'.

to admit that these reflections should give pause for thought to those who study environmental problems and propose solutions today.

There is undoubtedly room for bolder thinking than the current ones: as Kōhei Saitō (2020) has lucidly pointed out, many strategies to combat environmental degradation and global warming may prove illusory if the structural causes are not attacked at their root. However, doing so comes at a cost that probably no government or society today is willing to bear.

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Antonella Del Signore[*], Ilaria Zappitelli[‡], Concetta Cardillo[†], Alessandro Ceccarelli[*], Edmondo Di Giuseppe[‡], Arianna Di Paola[‡], Antonio Gattone[*], Massimiliano Pasqui[‡], Sara Quaresima[‡], Marco Simonetti[‡], Piero Toscano[§], Gianfranco Giulioni[*]

EVALUATION OF POLICIES FOR ENHANCING SUSTAINABLE WHEAT PRODUCTION IN ITALY

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Abstract

Reducing the environmental impact of food production is one of the greatest challenges to achieving sustainability. The ECOWHEATALY project focuses on the role of policies in providing economic incentives for farms to move from less to more sustainable wheat production techniques, both during stable economic times or periods of crisis. In this context, ECOWHEATALY addresses the complex interactions among socio-economic and environmental factors. This paper provides an overview of both the global and Italian frameworks for wheat production and trade. Additionally, it reviews EU and national regulations related to agricultural policies. Finally, the paper presents an example of how life cycle assessment is applied to illustrate the methodology used for evaluating sustainability.

JEL CLASSIFICATION: F18, Q02, Q11, Q18, Q56

KEYWORDS: INTENSIFICATION OF AGRICULTURE, ECOSYSTEMS, GREEN POLICIES, LIFE CYCLE ASSESSMENT, FOOD PRICES

[*] Dipartimento di Studi Socio-Economici, Gestionali e Statistici (DiSEGS), Viale Pindaro 42 – 65127 Pescara, Italy, Phone: +39-085-4537584, email address: gianfranco.giulioni@unich.it

[†] Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria (CREA), Via della Navicella 2/4, 00184 Roma, Italy, email address: concetta.cardillo@crea.gov.it.

[‡] Institute for BioEconomy, National Research Council of Italy (IBE-CNR), Via dei Taurini, 19, 00185 Roma, Italy, email address: edmondo.digiuseppe@ibe.cnr.it

[§] Institute for BioEconomy, National Research Council of Italy (IBE-CNR), Via Giovanni Caproni 8 – 50145 Firenze, Italy, email address: piero.toscano@ibe.cnr.it

1. Introduction

Reducing the environmental impact of food production is one of the topics of the current research on sustainability (Poore and Nemecek, 2018). To have an idea of the phenomenon, food production accounts for over a quarter (26%) of global greenhouse gas emissions; half of the world's habitable (ice- and desert-free) land is used for agriculture; 70% of global freshwater withdrawals are used for agriculture; 78% of the global ocean and freshwater eutrophication is caused by agriculture; 94% of mammal biomass (excluding humans) is livestock (Ritchie and Roser, 2020).

Among the food staples, world wheat production increased by 43% between 1993 and 2022, whereas the harvested area remained almost constant, indicating that a profound intensification has been taking place since the second half of the last century.

The intensification of agriculture is responsible for negative side effects on ecosystems. Countries with intensive agricultural systems, such as Italy, are required to urgently adopt sustainable solutions to ensure the conservation of ecosystems while maintaining the current level of grain production. (Fischer and Connor, 2018). However, if we were to restore atmospheric CO_2 to pre-industrial levels (below 280 ppm), global agricultural production would drop by 20/40%, causing a food crisis from which human civilisation would recover with great difficulty (the purpose of neo-Malthusianism). For more on this aspect, see the works of Mariani (2014) (2017a) (2017b); Araus et Al. (2003); Sage & Coleman (2001); and the extensive literature therein.

Wheat (*Triticum spp.*) is a species of the grass family, whose area of origin is located between the Mediterranean Sea, the Black Sea and the Caspian Sea.

Both common wheat (*Triticum aestivum*) and durum wheat (*Triticum durum*) are used in human nutrition. From the former we obtain flours with fine, rounded granules, used for bread-making, to produce fresh or vacuum-packed pasta, biscuits, cakes, and other baked products. Durum wheat is used to produce dried alimentary pasta, some types of bread, and long-life dried bakery products.

Wheat was initially used to obtain straw which, mixed with mud, was used for the construction of huts. The latest studies, carried out by comparing the genetic make-up of extant wild and cultivated wheat, have identified the original centre of cultivation, for food purposes, in the Tigris and Euphrates

valley, historically known as the Fertile Crescent. Thus 10,000-11,000 years ago, after the end of the last ice age.

Archaeologists and historians have speculated on the importance that the cultivation of wheat may have played in pushing early human societies to more complex forms of organisation, moving from nomadic activity to settled groups: the construction of canal networks to extend cultivation, the building of the first walled cities to protect the harvest, and the organisation of armies to defend the canal-irrigated territory from nomads (Graeber and Wengrow, 2022).

The ECOWHEATALY project focuses on the power of policies in providing economic incentives for farms switching from less to more sustainable wheat production techniques either in tranquil economic times or in times of crisis. In this regard, ECOWHEATALY tackles this issue in a complex socio-economic and environmental interaction dynamics setting. The Lyfe Cycle Assessment (LCA) methodology is employed to evaluate the effects of green policies on ecosystems.

2. World economic data

According to FAOSTAT data, wheat is the world's second most cultivated cereal, producing 808.4 million tonnes in 2022, trailing only after maize (1,163.5 million tonnes) and preceding rice (776.5 million tonnes). Since 1993, global wheat production has surged by 43% (Figure 1).

The global wheat market is dominated by a few key players. As shown in Table 1, China, India, Russia, and the United States are the largest producers. Italy ranks 21st in global wheat production. The export landscape has evolved significantly over the past few decades. While the United States, Canada, and Australia were traditionally the dominant exporters, Russia and Ukraine have emerged as major players, especially since the 2000s. Russia's dominance in global wheat exports was particularly evident in 2016, though Australia regained the top position in 2021 (Figure 2).

Figure 1. World wheat production and cultivated area (1993-2022).

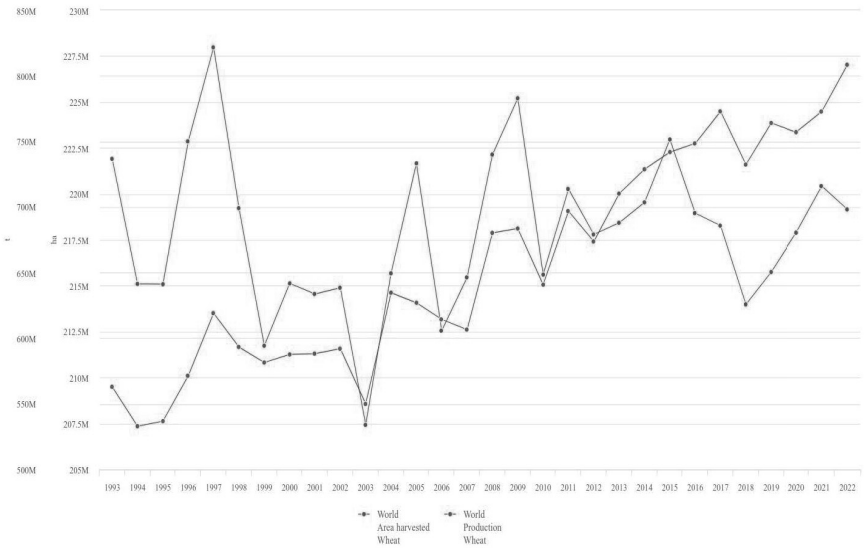
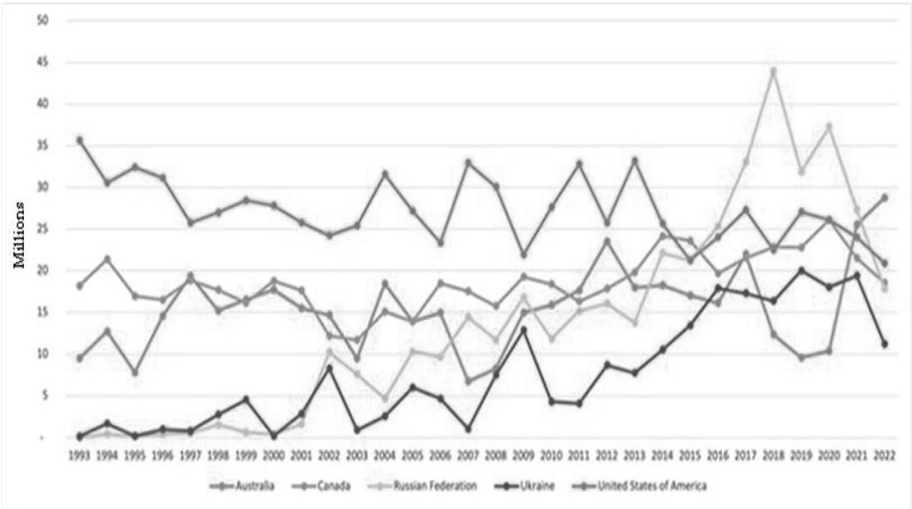


Table 1. The top 10 wheat producers in the world (2022).

Country	Production 2022 (Mt)	Production 2022 (%)
1 China	137.7	17.0
2 India	107.7	13.3
3 Russia	104.2	12.9
4 United States	44.9	5.6
5 Australia	36.2	4.5
6 France	34.6	4.3
7 Canada	34.3	4.2
8 Pakistan	26.2	3.2
9 Germany	22.6	2.8
10 Argentina	22.2	2.7
-	-	-
21 Italy	**6.6**	**0.8**

Source: FAOSTAT Data: https://www.fao.org/faostat/en/#data/QCL

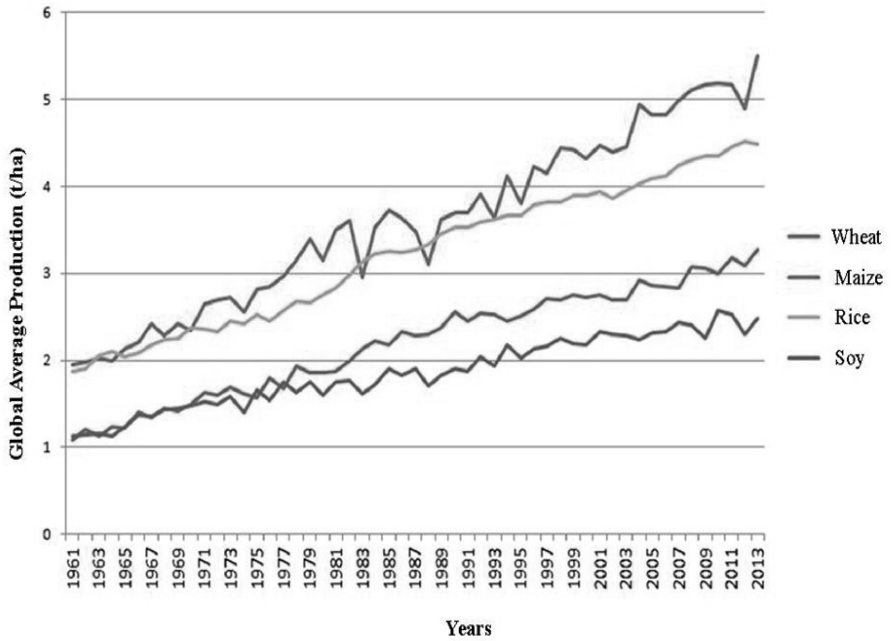
Figure 2. Major wheat exporting countries.



Source: FAOSTAT Data: https://www.fao.org/faostat/en/#data/QCL

Figure 3 shows the significant increase in yields for wheat since 1961, along with the maize, rice and soybeans. As depicted in Figure 3, the constant increase in global crop production is the evidence of intensification process stated with the Green Revolution. In line with (Mariani, 2017a and b), this surge in productivity, of which wheat is a key case, can be attributed to various factors, including technological innovations, improved crop varieties, and enhanced agricultural practices.

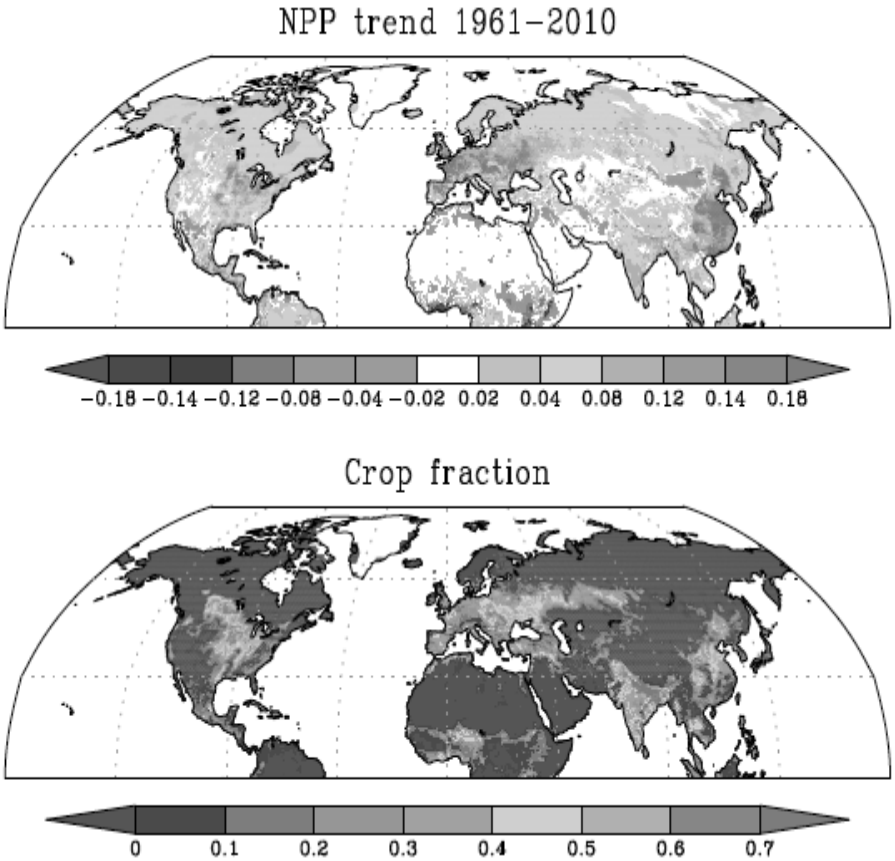
Figure 3. Global average production (t/ha) of the 4 main food crops.



Source: Mariani L. (2017b), *La rivoluzione verde e i suoi nemici*, 21mo Secolo Scienza e Tecnica, 1, 10-18.

The intensification of agricultural production, particularly evident in the Northern Hemisphere (Figure 4), has been significantly influenced by fertilizing effect of CO_2 and milder climatic conditions. As Zeng et al. (2014) highlight, these factors have contributed approximately 26% and 29%, respectively, to the observed increase in yields. The remaining productivity is due to genetic, technological and land use improvements in general (Chachar et al., 2024). Higher atmospheric CO_2 levels increase global vegetation production also because CO_2 improves the intrinsic water use efficiency (Mariani, 2017a)

Figure 4. The increases in primary production since 1961 (kg of C/m^2), spread over most of the northern hemisphere, are attributed to the milder climate (29%) and the fertilising effect of CO_2 (26%).



Source: Zeng N., Zhao F., Collatz GJ., Kalnay E., Salawitch RJ., West TO., Guanter L. (2014), *Agricultural Green Revolution as a driver of increasing atmospheric CO_2 seasonal amplitude*, Nature, 515, 394-397.

2.1 Italian economic data

As Table 1 shows, Italy has a wheat production of 6.6 million tonnes in 2022, more than half of which is durum wheat. It should be noted that Italy's need for durum wheat is about 6.5 million tonnes per year, about 4 million tonnes are produced on average; therefore, there is a structural deficit of 2.5 million tonnes, which must therefore be imported.

Figure 5 illustrates the evolution of Italian wheat production and imports from 1962 to 2022. Prior to 2000, imports, although on an upward trend, were lower than production. Since 2002, however, Italian wheat production has been roughly equal to imports, indicating a shift in the balance between domestic supply and foreign sourcing.

Figure 5. Import-export of wheat in Italy (1962-2022).

Source: FAOSTAT Data: https://www.fao.org/faostat/en/#data/QCL

3. The ECOWHEATALY project

In the ECOWHEATALY project, policies aimed at promoting sustainable wheat production in Italy are evaluated by assessing how they can influence the adoption of sustainable practices among farmers. Agricultural practices are analyzed for their environmental impacts within a dynamic socio-economic and environmental framework, while shifts in farmers' behavior following the adoption of national green policies are examined alongside fluctuations in major global market prices.

Figure 6 provides a visual representation of the design by showing the four model components represented by the nodes:

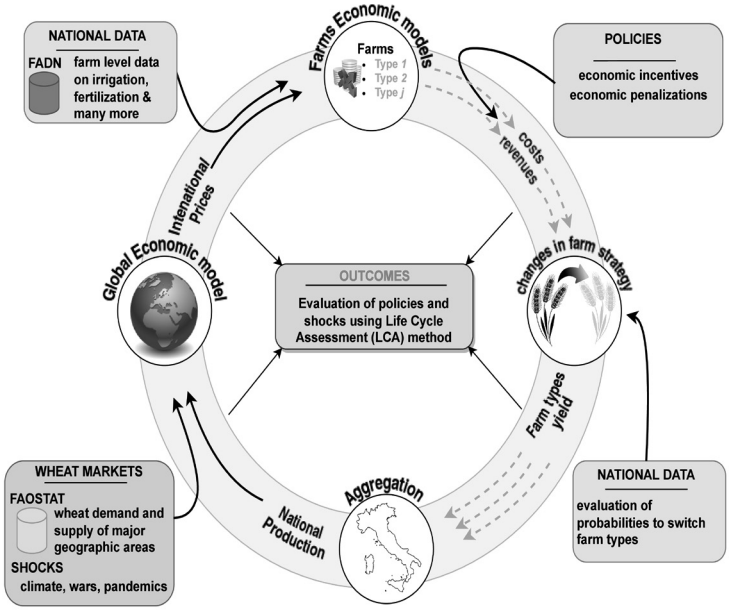
a) the identification of the economic models of farms with the quantification of their revenues and costs;
b) the identification of environmental policies, their effects on revenues and costs, and their incentives to change business strategy;
c) the aggregation phase;
d) the Computational Global Economic Model.

The output generated by each node, combined with other external inputs, feeds the next node producing a dynamic framework. This circular dynamic process is iterated over time to obtain time series of grain prices; grain exchange matrices; grain production and various measurable environmental indicators, the outputs of which are highly dependent on mutual behavioural responses to different inputs.

The outcome of the project is summarised in the central box of Figure 6, specifically focusing on evaluating the environmental impacts resulting from policies and external shocks. These impacts are quantified using state-of-the-art Life Cycle Assessment (LCA) approach, a widely used methodology for assessing the environmental footprint of a product (or service) throughout its entire life cycle.

The circular dynamics of the ECOWHEATALY model make it possible to assess the environmental impact of production after the adoption of green policies and/or after a global grain market shock.

Figure 6. Visual representation of the project with the four model components.



To perform the LCA assessment, the ECOWHEEATALY project uses the Farm Accountancy Data Network (FADN), an annual sample survey established by the European Economic Commission which serves to the definition of the Community Agricultural Policy. The Italian counterpart of FADN, known as RICA (Agricultural Accounting Information Network), is administered by the Council for Agricultural Research and Economics (CREA). This system annually collects survey data on approximately 12,000 farms, with over 3000 of them identified as wheat producers. The RICA dataset represents the only harmonized source of microeconomic data on the economic functioning and economic-structural dynamics of companies operating in the agricultural sector. It provides quantitative insights into agricultural practices at the individual farm level, covering all regions of Italy.

Specifically, the database holds many variables whose exploration enables an evaluation of individual farms' socio-economic and environmental behaviour, the uses of fertilizers, pesticides, and machinery alongside production quantity and cultivated area. Table 2 shows the sample size (number of enterprises) and the area they cultivated.

Table 2. Sample size of the enterprises and the area they cultivate.

years	n hard only	n soft only	n both	n farms total	ha hard	ha soft	ha total
2008	1822	1596	281	3699	40945	19716	60661
2009	1646	1405	226	3277	36090	17013	53103
2010	1803	1447	250	3500	36761	17513	54274
2011	1745	1344	199	3288	32783	15322	48105
2012	1878	1548	219	3645	36233	19620	55853
2013	1684	1607	206	3497	31725	19852	51578
2014	1587	1487	193	3267	29388	17214	46602
2015	1595	1346	232	3173	28768	15726	44494
2016	1855	1320	320	3495	33910	17369	51279
2017	1761	1379	280	3420	31594	17178	48771
2018	1716	1519	335	3570	30221	20152	50373
2019	1616	1487	312	3415	29104	19046	48151
2020	1646	1455	326	3427	29332	19463	48795
2021	1701	1607	353	3661	30871	21570	52441
2022	1737	1620	384	3741	31655	21662	53318

The LCA methodology is a valuable tool for assessing the environmental impact of grain production according to farm types; it is carried out in four steps: objective and scope, inventory analysis, impact assessment and

interpretation of results. Each of these four steps is developed according to a detailed methodology.

The inputs taken from the RICA data and analysed using the LCA methodology for the wheat production process are as follows:

- Use of agricultural tractors[1];
- Use of fertilisers[2]:
  - Amounts of nitrogen, potassium and phosphorus per cultivated hectare.
- Use of pesticides[3]:
  - Type: Acaricide; Anti-cryptogamic; Wetting agent; Adjuvant; Herbicide; Plant growth regulator; Geodisinfestant; Insecticide; Molluscicide, nematicide, rodenticide.
  - Toxicity class: 0=Careful handle with caution; 1=Very Toxic (T+); 2=Toxic (T); 3=Noxic (Xn); 4=Irritating (Xi).
  - Quantity applied per cultivated hectare.

4. Green Policies

Green Policies aim to optimise the use of natural resources by promoting sustainable policies, also aimed at preserving biodiversity and limiting greenhouse gas emissions. All this with the main aim of reducing the environmental impact of human activities. These are in fact regulations and initiatives promoted by relevant institutions, governments and businesses. Promoting sustainable agricultural practices, transitioning to renewable energy, reducing waste, improving energy efficiency and encouraging sustainable mobility are just some of the Green Policies practices and actions that could be implemented (Murray, 2012).

The general and main objectives of Green Policies are:

- Restoration and protection of biodiversity;
- Reducing greenhouse gas emissions (the main contributors to climate change);

[1] Federal LCA Commons, University of Washington Design for Environment Laboratory/Field Crop Production database

[2] Brentrup et al. (2004): The application to N fertiliser use in winter wheat production systems, EU.J. of Agronomy

[3] Fitogest®+ database

- Efficient use of natural resources (water, soil);
- Ensuring long-term sustainable growth;
- Promotion of a circular economy (reuse and recycling of products that are already designed with this in mind);
- Promotion of sustainable industries and consequently also job creation;
- Application of Green Policies in all agricultural areas.

These goals are also translated into legislation at international (such as the Paris Agreement), national and European level (such as the European Green Deal), and include incentives and economic practices to encourage companies, but also individuals, to contribute to the achievement of these goals (Borec, 2009).

And it is precisely the agricultural sector that is a key department in which these policies find application. Indeed, agriculture contributes significantly to greenhouse gas emissions (due to the use of synthetic fertilisers and agricultural machinery) and environmental degradation (through the intensive use of pesticides and water resources); in this sense, green policies aim to make this sector more sustainable. Among the practices promoted are improved soil management, crop rotation, organic farming and the use of smart farming technologies (e.g. precision agriculture). Within this agricultural context, wheat is one of the most important food crops in the world, and its production has a significant impact on the environment (Kogan, 2023).

At a global level, Green Policies for wheat cultivation focus on several aspects, such as reducing emissions (use of organic or controlled-release fertilisers, which reduce the amount of nitrous oxide (N_2O) emitted into the atmosphere) the use of new wheat varieties that are resistant to the recent extreme weather conditions caused by climate change; the encouragement of conservation agriculture (techniques such as minimum tillage or direct seeding reduce soil erosion and improve its capacity to absorb CO_2); the use of organic farming; and the reduction of food waste (Willer, 2011).

Looking at the Italian context, wheat is a key crop, particularly durum wheat, used for the production of pasta. The green policies applied to wheat production in the country reflect an approach based on environmental protection and the valorisation of local resources. Italy has adopted numerous initiatives under the European Union's Common Agricultural Policy (CAP),

which has placed sustainability at the heart of its reforms. Some of the approaches implemented include the integration of renewable energy and efficient irrigation techniques (e.g. drip irrigation), in addition to those already seen in the global context (Willer, 2011).

Wheat-related green policies will continue to evolve as environmental awareness grows. The main challenge will be to balance the need to meet global food demand with reducing the environmental impact of production. Technological innovation and the development of new wheat varieties will play a crucial role in this process.

5. An example of LCA assessment in the ECOWHEATALY project

The objective and scope of the LCA in the ECOWHEATALY project can be easily deduced from previous sections. Here, we give additional details on the inventory and assessment phases of the analysis as well as the results obtained in evaluating a farm.

The ECOWHEATALY project strives to rely on open-access materials. To achieve this goal, we use the Brightway LCA software framework (https://docs.brightway.dev/en/latest/). Even the inventory analysis leverages publicly accessible resources.

5.1 Inventory analysis

Tractors power

Among the freely available datasets on machinery use in agriculture, USDA's LCA Commons has the “University of Washington Design for Environment Laboratory/Field Crop Production” database, which contains several processes concerning the work of agricultural tractors for several cultures in several US states.

Among the datasets mentioning winter wheat, we chose Arkansas' because it is one of the primary wheat producers.

The process is named “work; ag. tractors for growing win wheat, 2014 fleet, all fuels; 100-175HP - US-KS”. It gathers the inputs and outputs of an agriculture tractor producing 1 megajoule of work employed in winter wheat production.

Nitrogen use

Nitrogen (N) is the most studied mineral fertilizer, while investigations on Potassium and Phosphorous are rare in the literature. Appendix A of Brentrup et al. (2004) reports an inventory analysis for Nitrogen use. We use information from the mentioned appendix in our analysis.

Pesticides

RICA provides the type, the toxicity level, and the quantity of the applied pesticides.

Unfortunately, the RICA dataset does not include information to retrieve the active ingredients in each used pesticide. Active ingredients are needed to perform the impact assessment of pesticides.

To overcome this gap, we use the Fitogest®+ database, where detailed information on pesticides available in Italy is recorded and can be accessed at https://fitogest.imagelinenetwork.com/it/.

We get from Fitogest®+ the products available on the market of a given type and toxicity level. The active ingredients inside each of them are recorded. Lastly, the most recurrent ingredient is associated with the type and tox level at hand.

Implementing this search for each pesticide type and toxicity level, we retrieve the active principles that make it possible to perform the LCA.

5.2 Impact assessment

Due to its diffusion, we use the ReCiPe 2016 methodology in the ECOWHEATALY project.

We proceed first with its regionalization because this methodology provides country-specific coefficients to scale characterization factors for the following impact assessment methods:

- Fine dust formation
- Photochemical ozone formation - human health damage
- Photochemical ozone formation - ecosystem damage
- terrestrial acidification
- freshwater eutrophication

For these methods, specific scaling coefficients for Italy are given.

We now present an example of our evaluations.

We obtained data from Rica concerning a farm that produces wheat. The inputs used by the farm are as follows:

- 2.5 hours of tractors use per hectare;
- 50 kg of nitrogen per hectare;
- one treatment with toxic insecticide.

Some adjustments are needed to apply the ECOWHEATALY LCA.

First, concerning tractors use, we have to convert hours of tractors use into megajoules of tractor power.

We have the following conversion:

1 Megajoule = 0.2778 kilowatt hours.

A 100 kW tractor used for 1 hour produces 100/0.2778=360 megajoules of power. Therefore, 2.5 hours is equivalent to 900 megajoules.

Second, concerning Pesticide, through our analysis on Fitogest we can see that one treatment of toxic insecticide implies spreading 0.13 kg of the Pirimicarb chemical substance per hectare.

The inputs of our LCA therefore are:

- 900 megajoules of tractors power per hectare;
- 50 kg of nitrogen per hectare;
- 0.13 kg of Pirimicarb

The valuation of the environmental effects of using these inputs through the ReCiPe 2016 methodology is reported in the Table 3.

Table 3. Results obtained from applying the ReCiPe 2016 methodology.

Method	Damage to	Geo CFs	Mid score	Unit	End score	Unit
Global Warming 100 year timescale	Humans and Ecosystems	Global	943.1366	kg CO2-eq	8.752307e-04	DALY
Toxicity	Humans - Carcinogenic	Global	1.1561	kg 1,4-DCB-eq	3.838143e-06	DALY
Toxicity	Humans - Non-carcinogenic	Global	0.2679	kg 1,4-DCB-eq	6.108489e-08	DALY
Particulate Matter Formation	Humans	Italy	2.6462	kg PM2.5-eq	2.646231e-04	DALY
Ozone Formation	Humans	Italy	3.3371	kg NOx-eq	3.036748e-06	DALY
Terrestrial Acidification	Ecosystems	Italy	15.9803	kg SO2-eq	3.387814e-06	Species.year
Ozone Formation	Ecosystems	Italy	7.6806	kg NOx-eq	9.908018e-07	Species.year
Freshwater Eutrophication	Ecosystems	Italy	0.0166	kg P-eq	1.114726e-08	Species.year
Toxicity	Ecosystems - Terrestrial	Global	185.9196	kg 1,4-DCB-eq	2.119483e-09	Species.year
Toxicity	Ecosystems - Freshwater	Global	0.0606	kg 1,4-DCB-eq	4.211711e-11	Species.year

The ReCiPe 2016 methodology is described in Huijbregts et al. 2016 and Huijbregts et al. 2017.

After a first version released in 2008, the ReCiPe methodology was updated in 2016. While the 2008 Characterization Factors concern the European scale,

the 2016 ones are representative for the global scale. Country and continental scale factors are provided for a number of impact categories.
ReCiPe provides impact factors both at Midpoint and at Endpoint.

At midpoint level, each method delivers a physical quantity which in general is the most damaging substance for the considered category.

At Endpoint level, each method is associated to one of three considered areas of protection: human health, ecosystem quality and resource scarcity.

The damage to each of these three areas are measured as follows:

- Damages to human health are measured by an indicator called "Disability Adjusted Life Years" (DALY) that gives the time (in years) that are lost or that a person is disabled due to a disease or accident.
- Damages to ecosystem quality are measured by the number of local species loss per year.
- Damages to resource scarcity are computed as the extra costs for future mineral and fossil resource extraction. It is expressed in Dollars.

Table 3 above reports both the Midpoints (column named Mid score) and the Endpoints (column named End score) results.

We do not delve into a detailed analysis of the results in Table 3. However, as an example, the activity of the considered farm impacts Global warming because it has various emissions that once converted into CO_2, amount to 943 kg of CO_2.

Although figures are considered less reliable, the results in terms of Endpoint are perhaps the more human readable. According to our analysis, for example, 10 farms producing wheat using 900 megajoules of tractor powers, 50 kg of Nitrogen fertilizer, and 0.13 kg Pirimicarb (an herbicide active principle) per hectare, reduce an individual healthy life by about four days (DALY).

6. Discussion and Developments

In the context of the ECOWHEATLY research project, we are currently exploring scenarios in which traditional policies are progressively replaced by alternative green policies in the Italian wheat production system. The intent is

to build a tool for policymakers to orient policies toward more sustainable wheat production.

Starting from a sample survey of Italian farms that gathers data from about 3000 wheat producers each year, we plan to identify, with the help of clustering techniques, the farm types present in the sample. An agent-based model will be built to simulate actions taken by heterogeneous farms corresponding to the types identified in the clustering phase. We aim to populate the agent-based model with a number of farms comparable to that operating in Italy. According to the latest Italian agriculture census (2020), the number of grain producers in Italy is 325313.

Clustering is performed using the k-means method, which provides clusters with about the same cardinality. We scale our survey data up to the size of the Italian system by sampling from the clusters.

Each farm in the ABM has a decision process for delivering the target production and the mix of inputs. Considered inputs are 1) fossil fuel use for tractors, 2) use of fertilizers, and 3) use of pesticides. Policies are introduced as incentives or deterrents affecting production decisions and input mix.

The Life Cycle Assessment (LCA) methodology is used on the ABM outputs to evaluate policies' effectiveness towards sustainability.

Moreover, we plan to integrate the Italian aggregate production obtained from simulations into a computational model of the international wheat markets system, which we developed in recent years. In this way, the double-sided interaction between farmers' choices and international prices will be endogenously accounted for. Indeed, a weakness in the current state of the art concerning agriculture decision-making is the poor integration of models in a global context.

Integration in the international context allows an evaluation of how adverse international shocks will affect the sustainability of the Italian system.

Indeed, the global context in which public authorities operate changes rapidly, requiring new tools and approaches to reduce the negative side effects of unexpected and sudden events such as those that have been characterizing the present historical period: the international crisis in Ukraine strongly impacts the internal market not only drastically reducing the imported quantity (about –30% -40%), but also with relevant effects on many other commodities, the cost of energy rocked, followed by most inputs, including chemicals and fertilizers; the selling price of agricultural commodities is also affected.

ECOWHEATALY is thought to be an example of an open-source dynamic model that integrates the social, economic, and environmental dimensions to serve several stakeholders.

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Matteo Foglia[1], Maria Melania Povia[2]

CLIMATE ATTENTION AND STOCK MARKET: EVIDENCE FROM ITALY

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Abstract

The growing interest in the effects of climate policy uncertainty (CPU) on financial markets, particularly regarding asset price dynamics, investment strategies, and stock market stability, motivates this study. This paper examines the impact of CPU on the Italian equity market, employing the wavelet coherence method to analyze the time-frequency relationship between CPU and stock market volatility indices. Further, we apply a time-varying parameter-vector autoregression (TVP-VAR) model to assess the direction and the degree of spillover effects between CPU and various equity sectors. Our findings indicate that rising climate policy uncertainty exerts negative spillover effects on the stock market, significantly influencing equity market dynamics.

JEL CLASSIFICATION: G10, G32, G41

KEYWORDS: CLIMATE UNCERTAINTY, EQUITY MARKET, CLIMATE CHANGE, SPILLOVER EFFECT

1. Introduction

In recent years, the occurrence of extreme events related to climate change has highlighted the necessity of enhancing the resilience of the economic system and communities to shocks that have a significant impact on entire economic sectors. In particular, over the past decade, the United Nations has launched an international resilience program with the clear objective of enhancing the awareness of policymakers worldwide regarding the significance of implementing targeted policies and interventions with a view

[1] Department of Economics and Finance, University of Bari Aldo Moro, Largo Abbazia Santa Scolastica, Bari, 70124, Italy; *E-mail address*: matteo.foglia@uniba.it.
[2] Ionian Department in "Legal and Economic Systems of the Mediterranean: Society Environment, Cultures", angolo Via Ancona, Via Lago Maggiore, Taranto, 74100, Italy; *E-mail address*: maria.povia@uniba.it.

to progressively enhancing the capacity of economies to adapt to ongoing changes (UNGA 2015; UN 2015a; UN 2015b; UN 2015c). Climate-related risks are usually classified as physical and transition risks. The first is associated with adverse climate-related natural events that impact productive assets, including floods, droughts, fires, and cyclones. In contrast, transition risks are primarily associated with the uncertainty surrounding the measures that governments will implement in order to facilitate a country's transition towards a low-carbon economy. The success of this transition is contingent upon the implementation of significant and rapid global policies (TCFD, 2017; Battiston et al., 2021). However, the implementation of such stringent climate policies will undoubtedly result in elevated compliance costs for carbon-intensive industries and diminished profits, which will have a negative impact on stock prices (Coeure, 2018; Chen et al., 2024). In this context, climate policy uncertainty has a significant impact on the stock market, which is a crucial channel through which climate change transition risk is realized (Kunreuther et al., 2013; Dietz et al., 2016).

Hence, to promote sustainable economic development, it is essential to understand the nexus between climate policy and financial markets. In this regard, several studies (NGFS, 2019; Alogouskofis et al., 2021; Gourdel et al., 2022) showed the financial implication of delayed transition or early action. As well suggested by Berg et al., (2023) the more volatile green policy measures are, the lower their impact on investment decisions and the lower the levels of green investment in the economy will be.

Italy, responsible for 11.4% of EU and 1% of global emissions in 2020, with 14% of Europe's population and 0.78% of the world's, is faced with a complex climate policy context (Salvia et al., 2023). Consequently, the uncertainty caused by the introduction of climate policies can affect stability and economic growth (Dell'Anna, 2021; Breckenfelder et al., 2023; Brunetti et al., 2023; Ciccarelli and Marotta, 2024). This is due to the fact that such policies can alter financial market stability and investor sentiment (Ramiah et al., 2013, Gao et al., 2020, Diaz-Rainey et al., 2021, Hanif et al., 2021, Liang et al., 2022, Sun et al., 2022, Zeng et al., 2022, Qiao et al., 2023). Indeed, uncertainty about climate policy can amplify climate risks, making it difficult for businesses and investors to plan for the future (Pastor et al., 2021; Wu and Liu, 2023). Therefore, understanding changing perceptions of climate risk and how climate policy interacts with financial markets is critical to promoting sustainable economic development. In this context, this research seeks to answer two key questions: (i) *How do shocks related to climate policy*

uncertainty affect the Italian equity sector? (ii) *What is the direction of the spillover between these indices?*

To answer these research questions, we investigate the nexus between the Italian Climate Policy Uncertainty Index (CPU) developed by Di Tommaso et al., (2024) and the Italian stock market. The index is based on the scaled frequency of mentions in major Italian newspapers to capture significant events related to climate policy. First, we analyze the time-varying interdependence between the CPU and the financial sectors using the wavelet framework (Torrence and Compo, 1998). Second, we compute spillover and connectedness effects using the time-varying parameter-vector auto-regression (TVP-VAR) model developed by Antonakakis et al., (2020). In particular, we examine the role of the CPU in influencing the Italian financial market and the direction of spillovers. Understanding the link between climate policy uncertainty and financial risk helps investors and policymakers to better manage climate risks, thereby contributing to financial market stability. This link allows for more informed investment decisions, improving market efficiency, and allows policymakers to assess and adjust the effectiveness of their policies according to market reactions.

The analysis highlights a significant relationship between climate policy uncertainty and the Italian financial system. In particular, the CPU significantly influences financial market dynamics and is identified as a net spillover transmitter. In light of these analyses, the results suggest that climate risks foster negative stock market reactions. Our work contributes to the existing body of knowledge (Bouri et al., 2022; Ren et al., 2023; Treepongkaruna et al., 2023; Xu et al., 2023; Yan et al., 2023; Di Tommaso et al., 2024) by demonstrating the significant role of CPU dynamics in shaping the behavior of Italian financial markets.

2. The influence of climate uncertainty on financial market dynamics

In recent years, climate uncertainty has become an increasingly important factor in global financial markets, with significant implications for asset valuation, investment strategies and market stability. This is due to the increasing frequency of extreme weather events and the changing climate regulatory environment. In particular, financial markets face both the immediate physical risks of climate change, such as hurricanes and floods, and

the transition risks linked with the transition to a low-carbon economy, which carry significant implications for fossil fuel companies.

On the one hand, extreme weather events and climate-related disasters lead to increased market volatility. On the other hand, companies and industries heavily dependent on fossil fuels are at risk of asset devaluation as the world shifts to renewable energy sources (e.g., Treepongkaruna et al., 2023). Climate risks affect asset prices and market volatility, particularly in vulnerable sectors such as energy and insurance (Di Tommaso et al., 2023; Guo et al., 2024; Jiang et al., 2024). Climate regulation, such as carbon pricing, will require companies to adapt quickly, with potential impacts on profitability and competitiveness. In addition, climate change can cause economic instability and tensions in the financial system (Born and Viscusi, 2006; Chen et al., 2023; Curcio et al., 2023), requiring investors to integrate climate considerations into their decision-making processes (Treepongkaruna et al., 2023). The impact of climate risk on equity markets has received considerable attention over the past decade. The literature reviewed highlights different dimensions of uncertainty in climate policy and equity markets. One strand of research shows that high climate policy uncertainty is generally associated with lower stock returns (Pagnottoni et al., 2022; Zhang, 2022). However, other research suggests that climate change risks may have positive effects, particularly for green energy-related sectors (Si et al., 2021; Zhu et al., 2023). Another strand of research examines whether the CPU index can improve predictions of market volatility and returns (He and Zhang, 2022; Bonato et al., 2023; Chen et al., 2023**;** Lv and Li, 2023). In particular, Di Tommaso et al. (2024) developed the Climate Policy Uncertainty for the Italian context. The results suggest that the CPU shows distinct movements during national and international climate events and that a CPU shock has a negative impact on financial market performance. Finally, several studies have investigated the impact of CPU on investment decisions (Choi et al., 2020; Antoniuk and Leirvik, 2021; Dutta et al., 2023). In general, adapting to climate regulations often involves large investments in new technologies and processes, which affect profitability and competitiveness (Lee and Klassen, 2016; Borozan and Pirgaip, 2024; Vo et al., 2024). These policies are inherently uncertain, which in turn affects economic and stock market uncertainty (Coeure, 2018). As the stock market is characterized by clear risk contagion, financial risks caused by climate change will continue to spread (Dietz et al., 2016). Indeed, the

impact of climate policy uncertainty on the stock market is an important pathway for realizing climate transition risks (Kunreuther et al., 2013).

Given the increase in climate-related risks, it is crucial to integrate these considerations into the decisions of investors, companies and regulators in order to effectively manage risks and exploit opportunities.

3. Data and methodology

To capture the uncertainty surrounding climate policy in Italy, we utilize the Italian Climate Policy Uncertainty (CPU) index developed by Di Tommaso et al., (2024). This index measures the frequency and intensity of media coverage related to climate policy discussions in Italy. It index captures the attention climate policy receives and reflects the evolving sentiment and concerns of policymakers, businesses, and investors.

To analyze the impact of CPU on the stock market volatility, we focus on four sector-specific indices from the Borsa Italiana (Italian Stock Exchange). Each index represents a distinct segment of the Italian equity market, with varying levels of exposure to climate-related risks: i) FTSE Italia Energy (ENE); ii) FTSE Italia Industry (IND); iii) FTSE Italia Automotive (AUT); and iv) FTSE Italia Finance (FIN). The sample runs monthly from January 2009 (the first CPU data available) to February 2024. All stock indexes are sourced from Datastream. We estimate the stock market volatility using the GARCH (1,1) model.

We adopt a two-step methodological approach to investigate the dynamic relationship between CPU and sectoral indices. First, the wavelet coherence method (Torrence and Compo, 1998) is used to capture the time-frequency relationship between CPU and stock market volatility indices. Second, we estimate the time-varying parameter-vector auto-regression (TVP-VAR) model (Antonakakis et al., 2020) to study the direction and degree of spillover effects between the CPU and the equity sectors.

3.1 Wavelet Coherence Analysis

Wavelet coherence analysis is a powerful tool for decomposing time series into time and frequency domains. This method provides information about the co-movement between two variables at different frequencies over time. Therefore, this framework is helpful in this context, where climate policy uncertainty and stock market indices may exhibit relationships that vary across

different time scales. Following Torrence and Compo (1998), the wavelet coherence (WC) is computed using the following formula

$$R^2(\tau,\ s)\ =\ \frac{\left|S\left(s^{-1}\ W_{xy}(\tau,s)\right)\right|^2}{S(s^{-1}|W_x(\tau,s)|^2)\ S\left(s^{-1}\left|W_y(\tau,s)\right|^2\right)} \tag{1}$$

where S is the smoothing operator, while $R^2(\tau,\ s)$ is the wavelet coherence whose value ranges from zero to one. A value close to zero indicates no correlation between the variables, whereas a value near one signifies a strong dependence. The statistical significance of the wavelet coherence and cross-spectra is assessed through Monte Carlo simulations.

3.2 Time-varying parameter vector autoregressive framework

To analyze the transmission mechanisms between CPU and sector-specific stock market indices, we apply the time-varying parameter vector autoregression (TVP-VAR) model, following Antonakakis et al. (2020), which extends the network connectedness framework of Diebold and Yilmaz (2014). This method offers two distinct advantages: it avoids data loss from setting a fixed rolling window size and is less sensitive to outliers (Antonakakis et al., 2020). Therefore, it is remarkably adaptable to our analysis, where we work with a monthly dataset. The TVP-VAR model is represented by the following equations:

$$\begin{aligned} Y_t &= \beta_t Y_{t-1} + \varepsilon_t \\ \mathrm{vec}(\beta_t) &= \mathrm{vec}(\beta_{t-1}) + \nu_t \end{aligned} \tag{2}$$

where Y_t is a N×1 vector of endogenous variables at time t, β_t is a N×N time-varying coefficient matrix. The error terms $\varepsilon_t \sim(0,\ S_t)$ and $\nu_t \sim \mathrm{N}(0,\ R_t)$ are N×1 vectors, with S_t and R_t are the time-varying variance-covariance

matrices. We define the *H*-step ahead generalized forecast error variance decomposition (GFEVD, Koop et al., 1996; Pesaran & Shin, 1998) as follows:

$$\phi_{ij,t}^{g}(H) = \frac{s_{ii,t}^{-1}\sum_{t=1}^{H-1}\left(e_i' A_t S_t e_j\right)^2}{\sum_{j=1}^{k}\sum_{t=1}^{H-1}\left(e_i' A_t S_t A_t' e_i\right)} \tag{3}$$

Based on GFEVD estimation, we can compute measures of directional connectedness: i) from-connectedness, ii) to-connectedness, and iii) net-connectedness. In this study, we focus solely on the analysis of net-connectedness (Eq. 4) and pairwise directional connectedness. This is because these metrics provide a clearer understanding of how CPU dynamically interacts with individual sector indices. We also compute the pairwise directional connectedness between two variables *i* and *j* to quantify how much influence one variable has on the other.

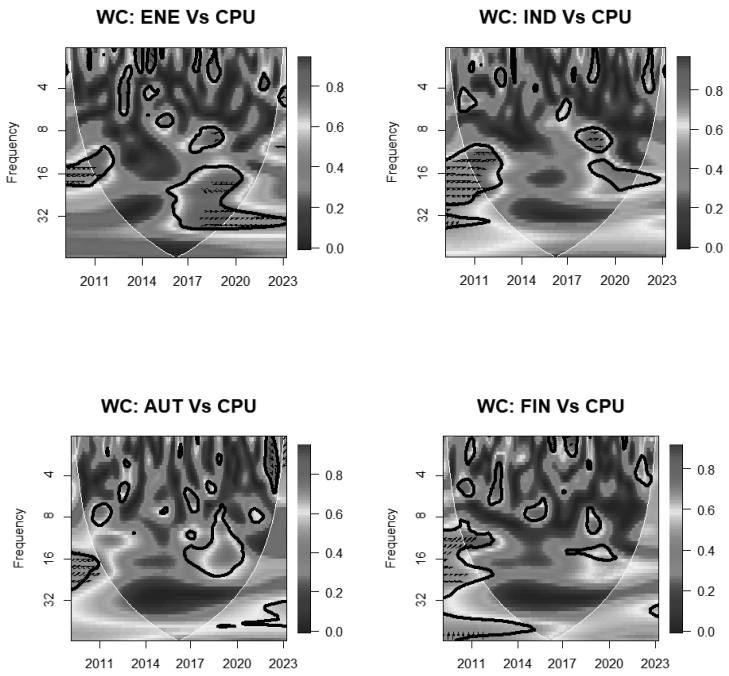
$$C_{i,t}^{g} = C_{i\rightarrow j,t}^{g}(H) - C_{i\leftarrow j,t}^{g}(H) \tag{4}$$

4. Empirical results

4.1 Wavelet coherence results

Figure 1 shows wavelet coherence diagrams. Wavelet coherence values range from 0 (no correlation) to 1 (strong correlation). The vertical axis shows frequency intervals (4-8, 8-16, 16-32), representing short-, medium-, and long-term scales, while the horizontal axis represents time. The white line (cone of influence) highlights correlations at the 5% significance level. Color indicates the correlation strength: blue for low coherence and red for high. Warmer colors represent significant dependence, while cooler colors indicate low dependence. Arrows indicate the lead-lag relationship: rightward arrows show in-phase (positive) co-movements, while leftward arrows show out-of-phase (negative) co-movements.

Figure 1. Wavelet Coherence Diagrams.



Source: Authors elaboration.

The results show several periods of high coherence, indicating a strong correlation between CPU and sector volatility risk. First, we can note that the energy sector (ENE) shows high coherence with CPU, especially during significant climate policy events. This sector is particularly sensitive to regulatory changes in climate policy, as the transition to low-carbon technologies and the imposition of carbon pricing directly impact energy companies' profitability (Chen et al., 2024). The coherence patterns reveal a leading relationship where the CPU influences the energy sector over time, with the CPU acting as the "driver" (as indicated by the arrows in the wavelet diagrams). The industrial sector (IND) shows a moderate but statistically significant relationship with CPU. The coherence is particularly strong during

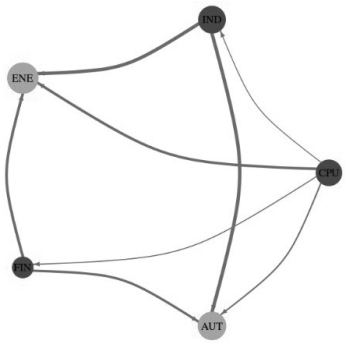
heightened policy discussions related to carbon-intensive industries. The results indicate CPU negatively impacts industrial stock prices, reflecting investor concerns over compliance costs and the potential obsolescence of existing technologies due to stricter environmental regulations (Pham et al., 2023). The automotive sector (AUT) exhibits lower overall coherence with CPU compared to the energy and industrial sectors. However, there are distinct periods of high correlation, particularly during discussions around emissions regulations, i.e., the shift towards electric vehicles. From 2018 to 2020, we can see a strong positive correlation. In fact, discussions about stricter European emissions standards were prominent in this period. Finally, the financial sector (FIN) has a strong relationship with CPU, especially in short periods. The wavelet coherence diagrams show that the financial sector is highly short-responsive to climate policy uncertainty. This could be due to investor sentiment being affected by the uncertainty surrounding future policy frameworks, which influence the sector's risk management, as well as investment strategies (Balvers et al., 2017; Krueger et al., 2020; Boungou et al., 2023).

4.2 Spillover channel of shocks

In this subsection, we turned our attention to the spillover effect, i.e., the transmission channel of shocks. By TVP-VAR model, we are able to identify the direction and the degree of spillover effects over time, capturing how shocks to CPU propagate across different financial sectors. Figure 2 plots the network connectedness of net pairwise directional spillovers during the entire period. The size of the node shows the degree of the net-pairwise directional connectedness, while the color of the node indicates whether an index is a net transmitter (blue) or net receivers (yellow). The energy sector is the largest receiver of spillover from CPU shocks. In fact, we can see that the energy sector (ENE) exhibits positive net connectedness with the CPU. This suggests that climate policy uncertainty significantly impacts this sector. Further, the

findings show that the automotive sector (AUT) is also a net receiver of spillover.

Figure 2. Network spillover

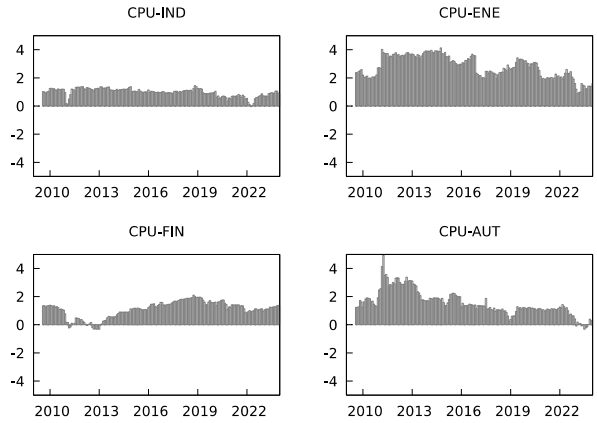


Source: Authors elaboration.

To further analyze the dynamic of volatility connectedness between the CPU and Italian stock markets, we investigate the time-varying net pairwise connectedness (Figure 3). This figure helps us understand the CPU's role as uncertainty on stock market volatility spillover. The analysis indicated that the CPU is a significant net transmitter of spillover effects, particularly in sectors vulnerable to climate-related risks, such as the energy and automotive industries. During elevated climate policy uncertainty periods, these sectors show a strong reaction, with the CPU driving changes in their financial performance. In the energy sector, which is directly exposed to climate regulations and carbon pricing mechanisms, there is a strongly positive net-connectedness with the CPU. This indicates that the sector receives more spillovers from the CPU than it transmits, suggesting that policy uncertainty strongly influences market sentiment and volatility in this sector. The peak period from 2015 to 2021 corresponds to major climate agreements, including the Paris Agreement (December 2015), the European Parliament's declaration of a climate emergency (November 2019) as well as the implementation of the European climate law (July 2021). Regulatory shifts generated significant uncertainty for traditional energy companies reliant on fossil fuels (Chen et al., 2024). The consistent spillover from the CPU to the energy sector highlights that market sentiment here highly depends on perceptions of

climate policy stability. When such a policy is uncertain, investors become risk-averse, resulting in increased volatility within the sector. On average, the financial sector (FIN) received CPU spillovers during the entire period. Heightened sensitivity to CPU has been evident since 2014. This volatility can be attributed to the growing integration of climate risks into financial models. Financial institutions have faced challenges in assessing the long-term impacts of climate policy on loan portfolios and investment strategies, particularly regarding carbon-intensive industries (Battiston et al., 2021). Additionally, the period from 2020 to 2022 saw significant developments, such as the expansion of the Task Force on Climate-related Financial Disclosures (TCFD) recommendations. This initiative influenced financial institutions' risk management practices (Ren et al., 2023; Boungou and Urom, 2023). Finally, the analysis underscores the CPU's role as a net transmitter in the automotive sector (AUT). Peaks in 2015 and 2016 are particularly interesting, as they coincide with discussions surrounding the tightening of EU vehicle emissions standards and the push for electric vehicle (EV) adoption. Furthermore, the spike in 2019 reflects renewed investor concerns about the economic viability of transitioning to EV production.

Figure 3. Dynamic of net pairwise directional connection



Source: Authors elaboration.

5. Conclusion

The paper investigates the dynamic relationship between climate policy uncertainty and the equity sectors in the Italian stock market using wavelet

coherence and time-varying parameter vector auto-regression (TVP-VAR) frameworks. Our analysis provides empirical evidence of significant spillover effects from CPU to the financial, energy, industrial, and automotive sectors.

The results have important implications for policymakers and investors. The strong spillover effects from CPU to key sectors of the economy underscore the importance of regulatory clarity stability. Uncertainty surrounding climate policies amplifies market volatility, particularly in energy sectors. To mitigate these effects, policymakers should focus on designing long-term, "predictable" climate policies that provide clear pathways for transitioning industries. For example, a "forward guidance" climate policy is ideal.

Moreover, given the financial markets' significant role in facilitating the transition to a sustainable economy, policymakers should continue to support the integration of climate-related risks into financial risk assessments. Strengthening disclosure requirements, such as those recommended by the TCFD, can improve transparency and reduce investor uncertainty.

On the other side, investors should incorporate climate policy uncertainty into their risk management frameworks. As our results show, sectors like energy are particularly sensitive to CPU, and portfolios with heavy exposure to these industries may face significant volatility during periods of regulatory uncertainty. Diversification into sectors less affected by climate policy uncertainty can provide a hedge against climate-related risks.

Overall, our findings provide evidence of the significant impact of climate policy uncertainty on equity market performance in Italy. Policymakers should prioritize clear regulatory stability to reduce market volatility, while investors should integrate climate risk into their decision-making processes. Further research could explore the effects of climate policy uncertainty in other markets and sectors, providing an extensive understanding of the global financial system's response to the climate transition.

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Elia Fiorenza [*], Renato Ghezzi [†]

THE CHALLENGE OF SUSTAINABILITY: THE TERRANOVA CASE

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Abstract

In the first part of the paper, it is observed that the adoption of a sustainable development model is based on the ability to innovate, as it entails the redefinition of strategies and operational processes. Moreover, it requires the restructuring of relationships within production chains and between businesses, society, and institutions. The paper then provides a diachronic perspective on the growth and diffusion of small and medium-sized enterprises (SMEs) in Italy, with particular attention given to SMEs specializing in high-quality production within niche sectors. It is argued that these organizations can serve as a virtuous model of cohesive enterprises when they operate in synergy with local communities and institutions. Due to their small size, they are unable to internalize many strategic functions as large companies do; therefore, they must rely on the market and aim to reduce transaction costs. Their existence depends on relationships, and they must constantly safeguard their reputation, which can only be built through virtuous behavior. As a result, sustainability becomes a necessary requirement for their operations. To support this thesis, the case study of Terranova—a software company that has established itself in the Energy and Utilities market through continuous research and innovation in digitalization processes—is presented. The paper concludes with some final considerations.

JEL CLASSIFICATION: D2, L1, N6, N7, N8

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[*] Università della Calabria, via Pietro Bucci, Rende (CS) 87036, Italia, Phone: +39-391-460-3551; E-*mail addres*: elia.fiorenza@unical.it.
[†] Università "Magna Graecia" di Catanzaro, viale Europa, Catanzaro (CZ), 88100, Italia, Phone: 337-102-142; E-*mail addres*: renatoghezzi@unicz.it.

1. Sustainable development

The stakeholder theory (Freeman, 2010) is now interpreted through more inclusive approaches than in the past, based on the belief that a company's existence depends on a multiplicity of interests, who's proper fulfillment ensures a stable and long-lasting equilibrium. Among these new developments is the concept of shared value, which Porter and Kramer introduced in 2011 in the Harvard Business Review, bringing renewed attention to the ability of businesses to generate value for society (Porter, Kramer, 2011). The primary difference from the original stakeholder theory lies in overcoming the dichotomy between value creation and value distribution, prompting a shift in corporate objectives. Companies are encouraged to use their tools and resources to achieve outcomes that are shared with the state and civil society—fundamental pillars of human communities. The creation of shared value is based on identifying the intersections between corporate activities and civil society. Porter and Kramer advocate for distinguishing between generic social issues, which have little impact on corporate operations, and those that significantly influence the value chain. They also call for a redefinition of productivity, leveraging innovation to reduce the environmental impact of economic processes. Furthermore, they urge companies to actively promote sustainable development in the regions where they operate. By contributing to the construction of new infrastructure or educational programs, businesses can become an integral part of the community, which, in turn, generates shared value—for instance, by cultivating a skilled workforce with strong local ties.

The creation of shared value thus concerns a company's ability to go beyond merely meeting customer needs, addressing fundamental social issues through its business model (Rossi, 2017). The traditional approach has been to manage business operations while considering their social impact as a separate matter. The prevailing idea was to produce for the market while avoiding environmental harm, maintaining transparency, and operating sustainably. In addition to focusing on their core business, companies would engage in philanthropy, employee volunteerism, and other initiatives typically classified under corporate social responsibility.

Charity, for instance, manifests when a company donates a portion of its resources or profits to a charitable initiative, aiming to alleviate specific social and economic inequalities. While philanthropy is widespread and driven by altruistic motives, it does not address the root causes of inequality; rather, it

provides temporary relief. Through donations, businesses assume some responsibility for social injustice, yet they do so from an external, compassionate perspective rather than through systematic intervention. This activity is purely discursive and does not require strategic or operational transformation.

One could argue that an entrepreneur who adheres to this model is guided by a Weberian ethic (Weber, 2012), in which concern for others is a purely voluntary choice, driven by personal moral inclination rather than any external obligation. A prominent historical example is Andrew Carnegie, who emigrated from Scotland to the United States in 1848, starting as a factory worker before becoming a leading figure in the steel industry. In 1873, he initiated philanthropic efforts, establishing numerous foundations to promote education, culture, and social services. An article he wrote clearly outlines his motivations: he believed that successful entrepreneurs were the best stewards of public wealth, given their proven ability to manage private resources effectively (Carnegie, 2006). However, as Vera Zamagni (2020) has noted, entrusting a select few—especially highly influential individuals—with the autonomous and arbitrary decision-making power to determine how to improve society and allocate resources poses significant risks.

A paradigm shift has thus become necessary, based on the premise that the most effective way for any company to address social issues is through its core business—namely, by designing products and services that create both economic and social value (Vinante, Basso, 2017). In a sense, this is not entirely new: businesses have always sought to meet societal needs, whether by generating employment, building housing, or producing food. However, the paradigm shift lies in assigning corporate activities the primary role of addressing societal needs while generating profit, thereby unlocking entirely new strategic and product development opportunities. A sustainable company, therefore, is not only capable of generating sufficient revenue to meet the expectations of shareholders and ensure economic viability, but also of disseminating innovations that benefit society (Mio, 2021).

Initiatives aimed at creating shared value can be structured across four levels.

The first concerns the product or service itself and its target consumers. If a product serves a nutritional function, for instance, it can enhance public health. Nestlé was a first mover in this domain with its Health Science

initiative, which is based on the concept of "food as medicine" and explores the potential of nutrition to improve health and combat certain diseases (Nestlé Health Science, n.d.). Another notable case study is Embrace, a social enterprise that developed a thermal pouch designed to keep premature infants warm, even in resource-constrained environments. Embrace aims to address a critical social challenge—the high infant mortality rate in low-income countries—through a market-based economic response (Mio, 2021).

Further examples of interest can be found in the textile and apparel sector, where many companies have committed to minimizing their environmental footprint by reducing water consumption in fiber processing, eliminating microplastics, and adopting circular economy models that promote recycling and waste reduction[1].

The second level at which companies can drive innovation is within the value chain by sourcing raw materials and resources in ways that benefit both suppliers and the broader community. Corporate procurement departments can influence supply chain dynamics and stakeholder relationships by prioritizing reliable suppliers that adhere to responsible environmental and social practices, thereby improving efficiency and mitigating risks. Similarly, logistics operations can enhance sustainability by optimizing warehouse management, transportation, and goods handling processes (Mio, 2021).

The approaches to hiring and employee training can also be reimagined by providing continuous learning opportunities, enabling employees to develop new skills.

The third level of shared value innovation concerns the business environment itself. In many cases, when a community faces challenges—such as inadequate education, weak logistical systems, or a lack of suppliers—these shortcomings inevitably affect businesses as well, reducing efficiency and hindering innovation. The concept of shared value expands this third area, allowing companies to take a proactive role in improving the business environment within the communities in which they operate. In this case, the objective is not philanthropy or corporate social responsibility; rather, it is

[1] In 2020, the textile sector was the third-largest contributor to water resource degradation and land use in EU countries. That year, an average of nine cubic meters of water, 400 square meters of land, and 391 kilograms of raw materials were required to supply clothing for each citizen of the European Union. Additionally, it is estimated that textile production is responsible for approximately 20% of global drinking water pollution due to various processes such as dyeing and finishing. Furthermore, washing synthetic garments releases around half a million tons of microplastics into the oceans annually. According to estimates by the European Environment Agency, only 1% of used clothing is recycled into new garments, and textile purchases in the EU in 2020 generated approximately 270 kg of CO_2 emissions per person.

about taking action to enhance business activities over the long term.

A fundamentally healthy business cannot exist without a healthy community—one in which citizens thrive and have opportunities for growth. If a company prospers while the surrounding community struggles, it will eventually lose its legitimacy and will not be able to sustain growth as the economic and social environment deteriorates. Conversely, a prosperous community cannot exist without strong businesses. Employment is the primary source of wealth creation, aside from inherited assets and natural resources. When a company effectively meets a societal need while generating profit, it can hire workers, purchase goods and services, pay fair wages, and expand. Shared value, at its core, consists of aligning a company's success with that of the broader community.

A final fundamental pillar of the shared value theory is the reproducibility of production processes. The concept of development was first defined in 1987 by the World Commission on Environment and Development in the Brundtland Report, Our Common Future (United Nations, 1987). The report highlighted that the critical global environmental challenges stem largely from severe poverty in the Global South and the unsustainable production and consumption patterns of the Global North. It emphasized the necessity of a strategy that integrates development and environmental concerns—an approach that was subsequently termed sustainable development. Sustainable development is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Far from being a static condition of harmony, it is instead a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are made consistent with future as well as present needs" (United Nations, 1987).

In the corporate context, sustainable development encompasses all three dimensions: economic, environmental, and social. Businesses must continue to grow while maintaining their role within the economy and ensuring the continuity of their products and services. Their activities must not compromise future operations. Companies must integrate sustainability with profitability and embed sustainable development principles into their business models. This necessitates redefining and rethinking strategies and operational processes to adapt to change, meet market and societal needs, and ultimately enhance competitiveness and profitability—always with a long-term

perspective[2].

2. The economic and social functions of SMEs

The Second Industrial Revolution marked the rise of large corporations, and their overwhelming success led many to predict the disappearance of small family-owned businesses. Indeed, until the 1950s, economists generally regarded small enterprises as a residual form of production, incapable of innovation and inefficient due to their inability to achieve the economies of scale that characterize large corporations (Brusco, Paba, 2020).

Among the first researchers to observe that not all firms were subjected to market pressures pushing them toward becoming large corporations were Michael Piore and Charles Sabel (1984). In fact, when production is oriented toward customization rather than standardization, when machinery must be adapted to the needs of end users—as in plant engineering or software development—or when services are provided in the presence of the producer, large firms with continuous production flows hold no comparative advantage. This has allowed small and medium-sized enterprises (SMEs) to maintain their organizational autonomy and remain dynamic and competitive within their respective markets (Zamagni, 2020).

By the late 1970s, Italian sociologists further expanded the field of study, arguing that research should not focus exclusively on production structures but should also consider their connections with the economic system, institutions, society, and value systems. They emphasized that the cultural choices made by entrepreneurs and local communities play a significant role in shaping business forms (Bagnasco, Trigilia, 1984). In the 1980s, the local business clusters present in Italy gained international recognition in academic literature, being considered as case studies for understanding how production structures reorganized in response to demand personalization and technological innovations that contributed to the crisis of the Fordist system (Sabel, 1982; Scott, 1988; Camagni, 1995).

Small and medium-sized enterprises tend to establish integrated production systems in regions where they can access a skilled workforce, reliable

[2] In microeconomic theory, the long run refers to a time horizon sufficiently extensive to allow a firm to adjust its productive capacity by varying all factors of production, including those that determine fixed costs, in response to new economic conditions. The sustainability model is thus based on the premise that a firm can engage in responsible business practices by adopting an innovative business model capable of transforming production processes in an environmentally sustainable direction.

subcontractors, a financial intermediation system attuned to entrepreneurial needs, and the presence of technical institutes, vocational schools, research centers, and universities offering specialized degree programs. As Vera Zamagni (2020) has observed, these systems generate a high level of social capital, ensuring the smooth functioning of business networks through informal relationships. In Italy, they are known as industrial districts (Becattini, 1989) and are directly linked to the country's long-standing artisanal expertise, which has successfully merged with industrialization without losing its focus on high-quality, customized production on a small scale. In many regions, the concentration of SMEs has given rise to local enterprise systems with high sectoral specialization, enabling firms to compete while simultaneously fostering collaboration.

The widespread presence of small and medium-sized enterprises (SMEs) in regions of so-called new industrialization has been one of the most defining features of Italy's economic geography in the second half of the twentieth century. Industrial districts are particularly concentrated in the NEC area (North, East, and Center). As early as 1961, based on levels of industrialization, it was possible to identify "three Italies" (Muscarà, 1967). A "middle Italy," known as the Third Italy, emerged between the historically industrialized manufacturing hub formed by the Milan-Turin-Genoa triangle and the Mezzogiorno, where industrial presence was generally sparse, except for a few centers whose industrialization levels remained modest (Muscarà, Brice, Matard-Bonucci, 1998). This transformation in regional production structures has continued in subsequent decades.

In the North and Center, the number of enterprises has grown significantly. The artisan sector has undergone innovation processes, and many workshops have evolved into small and medium-sized enterprises, which, in some areas, have clustered together to form industrial districts. Between 1971 and 2011, the manufacturing centers of the Third Italy (Veneto, Emilia-Romagna, Tuscany, and Marche) expanded considerably (Conti Sforzi, 1997; Becattini, 2000), with the number of manufacturing employees in industrial districts increasing from approximately 1.5 million, recorded in the 1971 census, to nearly 2 million in 2011[3].

[3] Istat has defined industrial districts as local systems that, at the time of each census, met the following four conditions: the share of employees in the manufacturing industry out of the total non-agricultural workforce was higher than the national average; the share of employees in the manufacturing industry

Today, Italy's more than 200,000 SMEs generate 41% of the country's total revenue, 38% of its added value, and employ 33% of the workforce, making them a fundamental pillar of the national production system (Perrini, 2022).

There exist SMEs that do not pursue dimensional growth, vertical integration, or diversification—either because they serve as subcontractors for large enterprises or because they specialize in prototype production. Additionally, there is a broad category of firms that remain small because they operate within a production model where ties to the local territory play an explicit and crucial role (Preti, 2011). The distinguishing characteristics of this model pertain to the production process, relationships with other firms, and the role of external economies. The production process must allow for its decomposition into different stages, which can be outsourced to medium or small establishments, often grouped within the same geographical area—so-called subsidiary industries (Marshall, 1890; Becattini, 1987; Whitaker, 1975). This organizational structure minimizes transportation costs and enables the advantages of larger-scale production without requiring substantial capital investments. Furthermore, the physical proximity of firms fosters the dissemination of industrial culture, which plays a crucial role in shaping entrepreneurs and promoting the spread of innovation.

For this system to remain competitive, continuous cooperation among the various actors operating within the same territory is essential. Such cooperation is necessary both to mitigate the risks associated with excessive competition and to reduce transaction costs, facilitated by an atmosphere of mutual trust that ensures the quality of products exchanged within the supply chain.

In academic literature, SMEs have often been cited as exemplary models of sustainable and cohesive enterprises when they maintain strong ties to their local territories and institutions. The social dimension of the territory becomes particularly significant when the community is characterized by a collective identity that fosters a sense of belonging and a spirit of collaboration, serving as the context in which economic intelligence develops (Pini, 2017). Alongside this value system, it is crucial to have a robust institutional framework that establishes and upholds regulations over time. In fact,

working in enterprises with fewer than 250 employees was higher than the national average; in at least one sector, the share of total manufacturing industry employment was higher than the national average; and in at least one of the sectors where the local system had a share of employment above the national average, the share of employees in enterprises with fewer than 250 employees was also higher than the national average.

Becattini identified the relationship between enterprises and institutions as a key determinant of competitiveness. Institutions encompass schools, public administrations, trade unions, public and private economic entities, cultural associations, religious organizations, and, of course, businesses and markets (Becattini, 1989).

Small and medium-sized enterprises (SMEs) are unable to internalize many strategic functions as large corporations do, precisely due to their limited size. Consequently, they must rely on the market and seek to minimize transaction costs. SMEs thrive on relationships and operate within niche markets; therefore, they must pay close attention to their reputation, which can only be built through virtuous behavior.

Moreover, in many cases, SMEs are deeply integrated into production chains where their clients are large firms with significant bargaining power. These companies are increasingly inclined to engage with suppliers that adhere to specific environmental and social standards to ensure sustainable sourcing (Perrini, Minichilli, Pogutz, De Silvio, Stoppani, 2022). Sustainability thus becomes an integral aspect of risk management—a necessary requirement to mitigate the structural risk of losing access to credit or the market (Perrini, 2022)[4].

3. The Terranova Case

Considering the considerations, the case study analyzed in this paper focuses on a medium-sized enterprise, Terranova, a software production company founded in Florence in 2001. Through a continuous process of research and innovation in digitalization, the company successfully established itself within a decade in the Energy and Utilities market.

In 2011, the company further consolidated its position by becoming a partner of the multinational corporation Pietro Fiorentini, an industrial firm specializing in the production of equipment and plants for gas and oil regulation and measurement. This partnership enabled Terranova to expand into international markets, leading to the establishment of new offices in Milan and its first international branch in Shanghai, followed by subsequent

[4] Without an adequate sustainability profile, companies may be denied access to credit and preferential insurance premiums, as well as to qualified and motivated human resources, public or private procurement opportunities, and certified supply chains.

openings in Birmingham, UK, and Tashkent, Uzbekistan.

Subsequently, in 2016, through a horizontal integration process, Terranova acquired Trilance, a competing firm with a significant client portfolio in Italy, operating almost exclusively in the field of gas and electricity sales solutions. The headquarters in Verona and the secondary office in Rome were retained as part of this acquisition. Continuing its path of growth and business consolidation, which involves continuous investment in development and evolution, Terranova became a partner of Arcoda, holding a 60% stake, and of Ambiente.it, also with a 60% ownership. Through these partnerships, the company expanded its software offerings to include the environmental sector.

Today, Terranova's products are developed by more than 300 employees and are utilized by companies not only in the traditional Gas and Energy Distribution and Sales sector but also in Water Services and Waste Management. Furthermore, collaborations have been initiated for the development of smart networks and smart grids aimed at smart cities, both in Italy and abroad. As a result of these activities, the company's annual revenue is approximately 48 million euros. From a corporate standpoint, Terranova is equally owned by Terranova Group S.r.l. and Pietro Fiorentini S.p.A., operating as a limited liability company (https://www.Terranovasoftware.eu/sostenibilita).

In 2020, Terranova voluntarily decided to publish its first sustainability report, recognizing it as a valuable tool for substantiating the topic, clearly monitoring the company's environmental, social, and economic impact, and transparently communicating the results achieved and the set objectives to stakeholders. In 2023, the company acquired the status of a benefit corporation.

Since 2016, when Italy transposed Directive 2014/95/EU, large enterprises classified as public interest entities and employing 500 or more individuals at the end of the financial year are legally required to include a non-financial disclosure in their management report. This disclosure must contain, at a minimum, information on environmental, social, and personnel-related matters, respect for human rights, and the fight against active and passive corruption, to the extent necessary to understand the company’s performance, results, situation, and the impact of its activities (https://def.finanze.it/). Additionally, growing attention from institutions and investors increasingly focused on these themes has led to the development of methodologies and measurement tools at the microeconomic level, known as ESG (Environmental, Social, and Governance) indicators. These indicators provide

a concrete quantitative assessment of sustainability.

The "E" criterion pertains to environmental parameters, including attention to climate change, food security, emission reductions, and the sustainable use of natural resources. The "S" criterion addresses corporate social relations, employee well-being, respect for human rights, gender equality, and the fight against all forms of discrimination. Lastly, the "G" criterion evaluates corporate governance structures, particularly assessing meritocracy, gender diversity, anti-corruption policies, and remuneration strategies (Tettamanzi, Minutiello, 2022).

These ratings are updated annually by database providers, who assess, on a scale of 1 to 100, the level of attention given by listed companies to sustainability issues. In recent years, the market has shown an increasing focus on these aspects, penalizing companies with lower scores (Bellavite Pellegrini, Cannas, Dallocchio, 2022).

Although unlisted SMEs are not required to disclose this information, Terranova's governance has nonetheless deemed it essential to refer to indicators that allow the assessment of the impact of its activities, believing that only companies that can harmoniously coexist with the environment and society will be able to survive in the long term. On the other hand, empirical evidence shows that the transformation into a benefit corporation impacts the cost of capital in a way like an increase in the ESG rating of a listed company, as well as medium- to long-term profitability, due to a better use of financial leverage.

The sustainability report is a dynamic representation of the internal organization, the relationship with stakeholders, and the business model, updated considering the rapid evolution of the market and regulatory framework. It provides a comprehensive overview of business activities, including social and environmental aspects. The publication of this information demonstrates the company's commitment to responsibility and the sharing of accurate data. This transparency can enhance the trust of customers, investors, and the community, helping to build a solid, long-term reputation. Through the measurement and management of non-financial impacts, companies can identify areas for improvement and adopt more sustainable strategies. This can lead to greater operational efficiency, cost reduction, and improved employee engagement. Finally, the sustainability report helps companies identify and manage risks related to the social and environmental

impacts of their activities. Through accurate performance assessment, companies can prevent potential issues such as regulatory violations, disputes, or reputational damage. Proactive risk management enables companies to take preventive measures and mitigate any negative consequences.

For the preparation of its sustainability report, Terranova's governance has decided to align with the GRI (Global Reporting Initiative) standards, an independent, non-profit international organization founded in 1997, which serves as an international benchmark for preparing reports on environmental and social sustainability (https://www.globalreporting.org/). The GRI Standards allow organizations not only to measure and publicly disclose the impact of their activities on the environment, but also to serve as a useful support tool for goal setting, performance measurement, and assessing the risks and opportunities related to sustainability (Tettamanzi, Minutiello, 2022).

Another point of reference is the United Nations' 2030 Agenda, which identifies 17 topics related to sustainable development within an action plan signed in 2015 by 193 countries, including Italy, to ensure a better present and future for our planet and its inhabitants. The 2030 Agenda brings with it a major innovation: for the first time, a clear judgment is expressed on the unsustainability of the current development model, not only in environmental terms but also economically and socially, thus definitively overcoming the idea that sustainability is solely an environmental issue, and asserting an integrated vision of the different dimensions of development (https://unric.org/it/agenda-2030/).

An initial research process allowed Terranova to identify the following categories of stakeholders: customers/customer representatives; suppliers; shareholders; employees/trade unions; opinion leaders; media/industry journalists. This was followed by a materiality analysis, through which the company identified the material issues on which it generates the most significant impacts.

Terranova provides tools that inherently contribute to increasing operational efficiency. The sustainability report highlights, first and foremost, that in alignment with its mission, the company intends to continue its research and development activities by investing in innovative technologies and software products that support the digitalization of urban ecosystems and contribute to the creation and development of smart cities. This approach aims to enable greater efficiency and achieve long-term, high-performance results, both economically and in terms of energy.

Terranova considers the adoption of tools and means to promote environmental awareness essential, facilitating access to and dissemination of data related to resource usage as the foundation for inspiring sustainable and conscious behaviors in individuals, with particular regard to the use of limited resources such as energy and water, as well as waste management capabilities. In addition, the company has set the goal of spreading actions and a culture aimed at promoting the conscious use of resources within the organization.

The report also highlights the company's attention to both workplace safety and the professional development of its staff. This is manifested by encouraging a balance between personal life and work, implementing actions that promote the overall well-being of individuals, and investing in training courses aimed at both skill development and personal welfare. These actions are consistently supported by the protection of diversity (gender, ethnicity, religion, culture) and equal opportunities.

Finally, the company reveals its strong international orientation, aiming to constantly expand its product range and adapt it to various economic and environmental contexts outside national borders, with the goal of fostering the growth of a high level of sustainability culture.

4. Conclusions

Porter and Kramer, in their pioneering study, brought to the forefront the ability of businesses to create value for society, urging the need to overcome the dichotomy between the production and distribution of value and to reconsider the traditional concept of productivity. This rethinking should aim to reduce the impact of economic processes on the environment through the adoption of process and product innovations. To embark on the path towards sustainable development, production systems must, first and foremost, be based on the rational and non-intensive use of resources—not only to avoid negative externalities that damage the ecosystem balance, but also because companies that place excessive pressure on the environment risk compromising their future activities and, consequently, their long-term survival.

The paradigm shift concerns not only environmental issues but also requires a redefinition of relationships within production chains and between businesses and society. Businesses are not isolated entities; they do not operate

in complete autonomy. On the contrary, they are embedded in the communities that host them, interacting with them continually. There cannot be solid productive activity in a weak social and cultural context that is incapable of offering the necessary institutions, professional figures, services, and infrastructure. The creation of shared value, therefore, refers to the ability of the production system to identify connections with communities, pursuing common goals with them in search of greater well-being and an improved quality of life.

The social dimension of the territory assumes relevance in the activities of small and medium-sized enterprises (SMEs) oriented towards quality production in niche sectors. Due to their small size, they are unable to internalize many strategic functions as large companies do; they must therefore rely on the market and aim to reduce transaction costs by collaborating with other actors within their geographical area or in the same production chain. Cooperation is based on a climate of mutual trust, ensuring the quality of the products that each company produces for others and for consumers.

The analysis of the Terranova case has helped to illustrate the value system that guides a virtuous company, in constant relationship with the market, institutions, and society, and which, therefore, places particular emphasis on quality. The company has established itself in both national and international Energy and Utilities markets, subsequently expanding its activities into the environmental sector. Terranova provides software products that enable the monitoring and increased efficiency of energy and land use, thereby promoting environmental awareness and ensuring both economic and social value. In 2020, it voluntarily decided to create its first sustainability report, aiming to provide a comprehensive overview of the company's activities, including social and environmental aspects. The publication of this information, demonstrating the company's commitment to responsibility and sharing accurate information with stakeholders, enhances the trust of customers, investors, and the community, contributing to the establishment of a solid, long-term reputation.

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Natascia Ridolfi*

WOODS AND RIVERS: "UNSUSTAINABLE" EXPLOITATION IN CONTEMPORARY ABRUZZO

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Abstract

The use of woods and rivers by humans is historically well-known. The perpetual use of trees and river waters has fulfilled economic and social needs, representing a vital support for both agricultural and industrial activities, as well as the primary motivation for the creation of human settlements. The process of exploiting natural resources, particularly woods and rivers, has played a central role in the economic and social history of Abruzzo. The region, historically characterized by a strong dependence on agriculture and the mining industry, has seen its wood and river ecosystems undergo intensive exploitation since the 19th century, especially after the Unification of Italy.

Abruzzo, with its vast mountainous area and the presence of numerous rivers, has always been a strategic place for the use of such resources. However, their management has often been carried out in unsustainable ways, contributing to significant ecological alterations and environmental damage.

In this study, we will examine the use of Abruzzo's woods and rivers in the 19th and early 20th centuries, focusing on the laws regulating resource management and the effects that this "unsustainable" model of exploitation had on the territory, the economy, and society.

JEL CLASSIFICATION: N50, N53, N73, N83, N93

KEYWORDS: WOODS, RIVERS, UNSUSTAINABLE DEVELOPMENT, ITALY, ABRUZZO

* Department of Socio-Economic, Management and Statistical Studies University Centre "Ud'A-TEMA", University G. D'Annunzio for Land and Sea, Viale Pindaro 42, 65127, Pescara, Italy, Phone: +39 85 453.7032; *E-mail address*: natascia.ridolfi@unich.it.

1. Introduction

Discussing economic development and sustainability requires an aware admission: these two processes are positioned differently, where the growth of the former often results in a detriment to the latter (Senatore 2013). It is well known that nature and its resources embody rules of use that are often incompatible with any development path that fully involves society, institutions, and politics.

In this study, the analysis is primarily focused on the socio-economic aspect of the development-sustainability relationship, as well as the effects this has had during a historical period in which environmental respect was not considered a priority to be safeguarded, despite the damage caused to territories and communities. Moreover, this refers to a historical moment prior to the awareness of the concept of sustainable development, which began to gain significance only after the second half of the 20th century (Lena and Pirollo 2017, 43).[1] For this reason, it is clear why environmental protection was rarely aligned with development processes.

In this context, it is also necessary to highlight that, while the evolution of modern economic systems has included discrepancies and questionable environmental impacts, it has had the merit of mitigating, if not outright eliminating, in many cases directly or indirectly, the specter of poverty - a commendable and socially valuable goal that has often overshadowed potential environmental issues (Dasgupta 2007).

2. Forestry policies in Italy in the 19th century

During the period from the Unification of Italy to the final decades of the 19th century, the country faced the pressing need to modernize the administration of natural resources. The decision to focus the analysis on the last forty years of the 19th century is, in many respects, inevitable, as this period was marked by processes of subdivision and alienation of woodlands. Moreover, for earlier periods, no reliable data were available to accurately quantify the extent of the national woodland heritage and, consequently, the

[1] The United Nations World Commission on Environment and Development first provided the definition of sustainable development in 1987: "lo sviluppo sostenibile è uno sviluppo che garantisce i bisogni delle generazioni attuali senza compromettere la possibilità che le generazioni future riescano a soddisfare i propri". (Lena, Pirollo, 2017, 43).

scale of deforestation activities.

The statistics compiled during the Bourbon period, for instance, proved unreliable. This was due to "alla molteplicità delle agenzie e delle legislazioni preposte alla tutela dei boschi, alla confusione delle unità di misura e, infine, alla difficile definizione dello stesso concetto di bosco" (Armiero 2000, 884-885; Armiero 2007, 242-246; Ciancio, 2014).[2]

The 1870 Forest Statistics used as a starting point the data collected between 1830 and 1851, making the reliability of the results inevitably weak - a heavy legacy that the "young" Italian state struggled to absorb in a short time (Ministry of Agriculture, Industry, and Commerce 1870; Armiero 2000, 885). Moreover, the "Atti della Giunta per l'inchiesta agraria e sulle condizioni della classe operaia" of 1884 often referenced data from the *Statistica Forestale*, resulting in similarly incomplete and unreliable information.[3]

Within this fragmented and inconsistent information framework, the investigation conducted by the economist and politician Leopoldo Franchetti on the living conditions of southern populations was introduced (Franchetti 1985). This inquiry, structured as a dialogic and journalistic report, was rich in thematic insights and was carried out between 1873 and 1874 - three years before both the promulgation of the Regio Decreto of June 20, 1877, No. 3197, which would revolutionize the doctrinal and managerial system of public and private woodlands, and the appointment of Stefano Jacini by the government to initiate and organize the national agrarian inquiry, with the participation of Franchetti himself (Jacini 1976).

Beyond the statistical data, the severe degradation of the country's woodland heritage was already evident, as reported around 1860 by Lionardo Dorotea, provisional director of the Amministrazione delle Acque e delle Foreste:

"Infelicemente le indagini da me prese [….] e alla meglio approfondite, mi han fatto conoscere quello che pure innanzi erami a notizia, che lo stato de'

[2] Moreover, Armiero himself observes that the low reliability of 19th-century *Statistiche Forestali* has been highlighted by all scholars who have engaged in the study "storia del bosco e del suo andamento dinamico". (Armiero, 2000, 884-885; Armiero, 2007, 242-246). As for the socio-cultural aspect of the forest, reference is made to Ciancio (2014).

[3] *Atti della Giunta per l'inchiesta agraria e sulle condizioni della classe operaia*, Rome, 1884, vol. XII, folder I.

nostri boschi è nella peggiore condizione; che non rimangono di essi che miseri avanzi, e che le acque corrono irrefrenate ne' piani, distruggendo le migliori terre coltive, allargando gli alvei de' fiumi, elevandoli molto al di sopra dei primieri livelli, e tanti altri guasti producendo che fa orrore insieme e pietà di ridire." (Dorotea 1862, III; Tino 1989, 682).

The introduction of the 1877 Forest Law marked a pivotal moment in the history of Italian forestry policies, representing a watershed in the protection and enhancement of woodland resources.

On January 22, 1877, Salvatore Majorana, Minister of Agriculture, Industry, and Commerce in the Depretis government, presented the bill with the aim of completely reforming the management of the country's woodland heritage, which was largely publicly or municipally owned. The minister took great care in consulting pre-unification legislation, seeking to integrate the new regulatory framework without completely severing ties with the past. However, in practice, the new legislation effectively broke away from previous laws: rather than reinforcing woodland protection, it ultimately became a measure aimed at facilitating land release.

"Il vincolo forestale, come noi l'abbiamo inteso, non offende le ragioni della proprietà, non quelle della libertà; limita soltanto la maniera di applicarvi l'industria, in quanto possa recare danno pubblico, anzi la coordina alle esigenze di interesse generale, alle quali non è straniero lo stesso proprietario" (Atti parlamentari 1876-1877, 10).

The first Forest Law of 1877 allowed local authorities to sell off and release municipal woodlands, often without considering the environmental context or the long-term consequences for the hydrogeological stability of mountain areas. The key aspect of the legislation was the so-called "linea del Castagno" (chestnut line). (Article 1):

"Sono sottoposti a vincolo forestale, a norma delle disposizioni della presente legge, i boschi e le terre anche spogliate di piante legnose sulle cime e pendici dei monti fino al limite superiore della zona del castagno; e quelli che, per la loro specie e situazione, possono, disboscandoli o dissodandosi, dar luogo a scoscendimenti, smottamenti, interramenti, frane, valanghe, e, con danno pubblico, disordinare il corso delle acque, o alterare la consistenza del suolo, oppure danneggiare le condizioni igieniche locali" (Gazzetta Ufficiale del Regno d'Italia, 1877, 2777–2779).

Lands located above the chestnut line were subject to forest constraints, while in the area below, the imposition of constraints was often an exception: in fact, public and private entities enjoyed considerable freedom to deforest. The "chestnut line" was chosen by the legislator because the plant was widespread throughout the national territory, even in the presence of different climatic and soil types, up to about 1,500 meters of altitude, with significant variations in different Italian regions. Furthermore, woodland cultivation and the cutting of woods were not subject to any prior authorization, but only to the regulations established by the Provincial Forestry Committee. This was an organization that predated the 1877 forest Law and was formed by the initiative of the Provincial Council and the Provincial Deputation, which submitted the request to the Minister of Agriculture. The committees operating under the 1877 law included the prefect, the forest inspector, the engineer of the Ministry of Agriculture, and three members appointed by the Provincial Council. For the management of municipal woodland areas, the law required that a council member also be present in the Committee. The functions of the Committees were complex and among various activities, they were called upon to approve the lists for the deregulation of municipal and private woods. Inspectors were required to compile a list of protected woods, which often were deregulated under the forest Law of 1877, also due to pressures exerted by notables and large landowners

The phenomenon became so widespread that over time it consolidated the view that this law, instead of aiming for forest conservation (vincolo forestale), was actually a measure designed to promote its unbinding (svincolo), despite an attached technical report that considered reforestation activities "come parte integrante di tutto quel complesso di provvedimenti e di lavori che si devono attuare per sostenere le pendici montane, regolare le acque e ridonare il perduto equilibrio al regime dei nostri fiumi, tramutando in benefiche sorgenti di ricchezza e di forza quelle acque che ora sono causa di rovina e di miseria" (Corona et al. 2023, 172).

Criticism of the severe effects of the 1877 Forest Law on hydrogeological stability and the impoverishment of the territory was intense and emerged immediately, as documented by some passages in the Atti della Giunta per l'inchiesta agraria e sulle condizioni della classe operaia and the extensive contemporary literature (Ciampi 1999, 145-160; Tino 1989, 685-687), particularly of a technical and agronomic nature.

"L'inconsulto disboscamento che lo stampo nettamente liberista della politica forestale dello Stato unitario ha violentemente concorso a dilatare fenomeni, dalla modificazione delle condizioni climatiche e del sistema idrometeorologico, all'aumento della franosità e delle inondazioni, all'estensione e intensificazione del paludismo" (Tino 2004, 36).

These phenomena profoundly altered «gli equilibri ambientali» and had a "drammatico impatto sulla vita di intere comunità" (Tino 2004, 36).

The analysis by Giuseppe Carboni, one of the most renowned botanists and agronomists of the time, represents an emblematic summary of the negative effects of the 1877 forest Law, which led to an exponential increase in unbound lands:

"Dopo ciò, bisogna convenire che coloro che hanno chiamato la legge 20 giugno 1877 non legge forestale ma anti forestale, non hanno avuto tutti i torti."[4]

Table 1. Authorizations for Unbinding in Italy

Period	Released land (in hectares)
1866-1877	160,000
1877-1897	2,154,630

Source: Carboni 1909, 1067-1076.

During the decade 1866-1877, the government authorized the clearing of 160,000 hectares of woodland land. In the following twenty years, from 1877 to 1897, 2,154,630 hectares of land were deregulated. At that time, Italy's woodland area was estimated at over 4.5 million hectares, so as a result of the Majorana law, the Italian government authorized the destruction of about half of the country's entire woodland area (De Dominicis 1912, 454).[5]

[4] The italics are in the text. In the National Agricultural Congress of Como and Lonigo (September 5-12, 1909), Giuseppe Carboni presented a report, *Le origini e gli effetti della legge forestale 20 giugno 1877*, published in Bollettino quindicinale della Società degli Agricoltori Italiani, 1909, no. 23, pp. 1067-1076. The report was fully reproduced by P. Tino, in I frutti di Demetra, as referenced in note 14, pp. 37-42.

[5] In this regard, the literature of the time also included detailed lists of damages resulting from deforestation activities, such as the following: "1° Dissoluzione completa di tutta la regione montuosa. 2° Isterilimento delle terre disboscate e conseguente mancanza di produzione ed abbandono delle terre. 3° Mancanza di freni ai corsi d'acqua, divenuti torrenti. 4° Disordine completo della distribuzione idrografica in pianura. 5° Pericolo costante ed immediato per le proprietà (le più fertili) poste in pianura e lungo le rive dei torrenti.

These land releases led to an increase in agricultural areas and, inevitably, to the loss of woodland resources that played vital roles, such as protecting against soil erosion and preserving biodiversity. The impact of this regulatory measure did not go unnoticed, prompting the Minister of Agriculture and the Minister of Finance to propose a law specifically aimed at reforestation efforts. [6] After some amendments, this proposal was incorporated into the law of March 1, 1888, No. 5238. After several revisions, this initiative culminated in the enactment of the Law of March 1, 1888, no. 5238, *Concernente il rimboscamento ed il rinsodamento dei terreni montuosi, e norme da seguirsi*:

"Col sistema finora seguito il rimboschimento riusciva talmente frazionato e disperso, da offrire ben poche speranze sui risultati che ne sarebbero conseguiti. Ormai le superfici denudate sulle nostre montagne si contano a centinaia di migliaia di ettari, e vano sarebbe lo sperare che dal riordinamento e miglioramento di una piccola plaga, potessero risentire beneficio, per quanto riguarda specialmente il regime delle acque, i bacini idrografici. Conviene dare opera a ricostituire le selve in una intera pendice di montagna o in più versanti che facciano capo in una sola vallata e che interessino il sistema idrografico di un determinato bacino. Così si potranno rendere palesi gli importanti effetti del rimboschimento" (Greco 2017, 234).

Other legislative provisions in this area marked a new direction in the State's forestry policy at the beginning of the 20th century.[7] Although the

6° Successivo inghiaiamento delle rive e spiagge. 7° Impaludamento della pianura e fomite di malaria. 8° Alterazione radicale delle condizioni igieniche delle terre di pianura. 9° Mancanza di freni al movimento della superfice del suolo e conseguenti continue frane. 10° Scoscendimento a valle dei terreni coltivati. 11° Impossibilità di correzione al regime meteorologico, mancanza assoluta di freno alla grandine ed alla siccità". (De Dominicis, 1912, 454).

[6] Minister of Agriculture and Minister of Finance, bill proposal to the Chamber of Deputies, session of April 2, 1886, in «Bollettino ufficiale per l'Amministrazione forestale italiana», edited by the Direzione generale dell'agricoltura del Ministero di agricoltura industria e commercio, vol. II, 30 June 1886, 27-34.

[7] In particular, reference is made to the law of March 30, 1893, No. 173, *Concernente le spese intorno alle acque pubbliche*, which provided for reforestation activities on lands that also required hydraulic interventions, to the Regio Decreto 22 March 1900, n. 195, *Che approva il Testo unico della legge sulle bonificazioni delle paludi e dei terreni paludosi* and to the law of June 2, 1910, No. 277, *Riguardante i provvedimenti per il demanio forestale di Stato e per la tutela e l'incoraggiamento della silvicoltura*. Regarding forest exploitation during the First World War, see: M. Ermacora, *Lo sfruttamento delle risorse forestali in Italia durante il primo conflitto mondiale* in «Venetica», 20, 2009, 53-75. For the Fascist Twenty-Year Period, reference is made to Armiero et al. (2022).

protection of the woodland heritage remained an unresolved issue that still required appropriate interventions, primarily aimed at preventing the degradation of the mountain landscape.

"Bisogna dunque dire che in altri tempi solo pochi studiosi notavano lo squallore delle pendici denudate e i danni che ne derivavano, mentre oggi, affinato ed esteso il senso del bello e dell'utile, quello spettacolo colpisce tutti e fa l'impressione di una cosa nuova, mentre è solo una cosa vecchia nuovamente osservata" (Valenti 1911,100).

3. Forest Policies and Deforestation in Abruzzo in the 19th Century

Abruzzo, with its predominantly mountainous terrain (Armiero 1997, 41-71; Poli 2022, 409-436; Sansa 2012, 256-272), was one of the regions most affected by the 1877 Forest Law. However, the exploitation of woodlands did not always align with sustainable and forward-thinking policies aimed at collective well-being. Starting from the last four decades of the post-unification period, Abruzzo's woodlands - rich in valuable tree species such as beech, pine, and oak - were subjected to intense deforestation to meet the increasing demand for timber from both local and national industries.[8] Before the enactment of the 1877 law, Abruzzo's woodland area covered over 171,000 hectares (Table No. 2).

Table 2. Extent of Abruzzese forests in 1870 (in hectares)

Province	State-owned	Municipal	Private	Total
L'Aquila	515.98	78,253.37	17,652.65	96,442.00
Chieti	1,964.44	20,659.18	8,520.35	31,143.97
Teramo	702.98	33,436.47	10,026.85	44,166.30
Totale	3,183.4	132,349.02	36,199.85	171,752.27

Source: Data processing in *Atti della Giunta per l'inchiesta agraria e sulle condizioni della classe operaia,* Roma, 1884, vol. II, folder I, p. 65.

[8] Nel territorio abruzzese non mancarono politiche a tutela delle piantagioni e dei boschi, in particolare si ricorda quella sostenuta negli ultimi anni del XVIII secolo dall'assessore militare prima e governatore poi, Melchiorre Delfico, a favore della coltivazione degli alberi da ulivo, considerata volano per lo sviluppo dell'agricoltura. M. Delfico, *Memoria per l'abolizione o moderazione della servitù di pascolo invernale detto de' Regi Stucchi nelle province marittime di Apruzzo,* Napoli 1791, p. VIII. Per un'ampia ed esaustiva trattazione dell'argomento si rimanda a: P. Pierucci, *Pastorizia e fiscalità in Abruzzo. Secoli XVII-XVIII*, Bari 1984. Per gli altri aspetti, F. Bettoni, *La montagna abruzzese. Gli equilibri agricoli e pastorali tradizionali tra Unità e anni Trenta*, in «Trimestre», XXIII (1990), 3-4, 226-227.

However, following the implementation of the legislative provisions, numerous requests for land release were submitted across the region, leading to widespread forest destruction (Table No. 3).

Table 3. Released forested lands in Abruzzo (1877-1880)

Province	Released lands (in hectares)
Chieti	2,353.16
L'Aquila	37,449.82
Teramo	2,290.37
Total	42,093.35

Source: Data processing in *Atti della Giunta per l'inchiesta agraria e sulle condizioni della classe operaia»* Roma 1884, vol. II, folder I, p. 115.

Among the Abruzzese localities, those in the province of L'Aquila experienced a significant increase in the granting of agricultural land at the expense of woodlands (Bettoni and Grohmann 1989, 632-634). Deforestation practices were not solely driven by the need to expand cultivable land in a predominantly mountainous region but also by the growing demand for timber for industry and the concessions issued by local municipalities, which saw deforestation as a source of revenue.

The clearing and conversion of woodlands were, in fact, strategies adopted by mountain municipalities not only to meet private demands but also to generate, albeit modest, profits from land concessions. It goes without saying that this practice reflected the presence of a subsistence-based and impoverished economy (Bettoni and Grohmann 1989, 632-634).

It is also true that, in Abruzzo, the process of woodland clearance was, in many cases, facilitated by the Provincial Forestry Committees themselves, which were often overly lenient in approving requests for the release of protected land. In this context, the woodland protection measure imposed by the 1877 law, as previously mentioned, aimed at safeguarding the integrity of woodlands, became a more complex process due to the bureaucratic timelines required for land release, especially considering the morphological structure that characterized Abruzzo.

In this regard, it was not uncommon for unlawful practices to be carried out, driven by "improper" land-clearing operations conducted by local

residents who: "nei boschi comunali, poco custoditi, [commettevano] ogni tipo di abuso […] Non hanno limiti e spesso danno luogo al monopolio […] facendosi forti del diritto di legnare nei boschi comunali" (Quaranta 1885, 92-94), selling substantial quantities of timber in the markets of nearby localities "tanto nello stato greggio per uso combustibile, quanto lavorato, traendo così profitto in danno dell'economia boschiva" (Quaranta 1885, 92-94). The phenomenon of illegal woodland exploitation became particularly alarming: between 1877 and 1879, 9,273 violations were recorded in Abruzzo's municipal woodlands, with the highest concentration in the L'Aquila area.[9]

The deforestation activities and the exploitation of woodlands for both economic and non-economic purposes had a profound impact on the Abruzzo region in the second half of the 19th century, undermining the delicate environmental balance of the area. In addition to its significant seismic risk, the region began to experience increasingly frequent landslides, collapses, and various forms of ground instability.

4. The Use of Rivers for Industrial Energy Production Between the 19th and 20th Centuries

Another crucial aspect of natural resource management in Abruzzo was the intensive use of river waters for hydroelectric energy production, a process that was not always guided by sustainable or forward-looking planning. Although the exploitation of the region's river systems (Pescara-Aterno, Sangro-Aventino-Verde, Vomano, and Sagittario) contributed significantly to economic development, it also presented numerous critical issues (Ministero dei Lavori Pubblici, 1929, 54-57).

One illustrative example is the exploitation of the Pescara River and its tributaries, which, from the second half of the 19th century, served Abruzzo's hydroelectric industry and industrial sector.

In 1894, the German mining company Reh & Company built a hydroelectric power plant on the Lavino River, a tributary of the Pescara, to supply power to its industrial facilities in Scafa.[10] By 1896, other companies followed suit, including Neuchâtel Asphalte Company and Società Italiana di Elettrochimica (SIE). The former produced asphalt and bitumen in Scafa and

[9] *Atti della Giunta per l'inchiesta agraria e sulle condizioni della classe operaia, cit., vol. XII, fasc. I, p. 317.*

[10] For more information regarding the electrical system of Reh & Company, see: *Foglio annunzi legali della provincia di Chieti* (Falpc),1910-1911, n. 277 and *Ministero per l'Agricoltura, Ispettorato generale delle miniere*, *Rivista del servizio minerario al 1919*, Roma, Bertero, 1921, pp. 197-199.

San Valentino. The latter, an Italian-French-Swiss holding, produced chlorine soda and derivatives in Bussi sul Tirino and sulfuric acid in Piano d'Orta.

The SIE's water usage was particularly intensive. By 1901, at the peak of its expansion, the company established a hydroelectric power plant on the Tirino River and, in 1907, built the first on the Pescara River, which became a key resource for industrial production.

This was further reinforced when the SIE expanded by founding the Società Italiana per la Fabbricazione dell'Alluminio (SIFA) and the Società Italiana Prodotti Azotati (SIPA). In 1907, the Società Meridionale di Elettricità (SME) also became part of the group (Bruno, 1987, 943-984; Di Gregorio, 1987, 793-798). However, this expansion was immediately challenged by the 1907-1908 industrial crisis, which inflicted heavy losses on the holding. In response, SME and SIE focused their activities on supplying electricity to Naples, both for civil uses and Bagnoli's steel industry (Comitato Centrale Abruzzese «Pro Energia Pescara» 1910, 113).[11]

As part of this effort: A 150 km-long power line, then considered state-of-the-art in Europe, was built to operate at 88,000 volts. The first power plant on the Pescara River and its second expansion (1912) were redirected to Naples, undermining industrial development in Val Pescara. This decision effectively relegated Abruzzo to the role of an energy supplier for the more developed regions of Southern Italy, conforming to a logic where more "advanced" regions dictated the fate of less developed ones, which were sacrificed in the process.

The intensive exploitation of the Pescara River sparked protests from local communities and economic stakeholders. In response, they established the Comitato Centrale Abruzzese "Pro Energia Pescara", publicly denouncing the deprivation of local water resources in favor of external industrial interests. The committee deemed this an "energy robbery," orchestrated by electric companies solely driven by profit, to the detriment of Abruzzo's economy. A petition was published to "protect the vital interests of the Abruzzo region", urging state intervention to safeguard the rights of local populations: "I Poteri Centrali [salvaguardassero] il buon diritto delle popolazioni d'Abruzzo […]

[11] It was estimated that the municipalities of the Pescara Valley gave up "un'importante quantità di energie di circa 27.000 cavalli" intended for the Campania area. (Comitato Centrale Abruzzese «Pro Energia Pescara» 1910, 113).

dalla minaccia della spogliazione" (Comitato Centrale Abruzzese «Pro Energia Pescara» 1910, 7).

The municipalities of Val Pescara demanded exclusive use of the hydraulic capacity of the second expansion of the Pescara River so that the region could benefit from its waters for agricultural irrigation, the construction of the Pescara-Bussi hydro-navigation system, [12] - became impossible at that point because in the periods of "straordinaria siccità produce[va] il prosciugamento tra la prese e il luogo di restituzione, per un tratto di circa 12 km" (Comitato Centrale Abruzzese «Pro Energia Pescara» 1910, 84, 143-144)—and, more broadly, for the economic development of the valley (Comitato Centrale Abruzzese «Pro Energia Pescara» 1910, 68).

"[…] Le acque benefiche animatrici dei mulini, irrigue di campi, letificatrici dell'aria si sarebbero convertite in una più potente forza; e i beni dell'avvenire avrebbero esuberantemente compensati i benefici del passato […]" (Comitato Centrale Abruzzese «Pro Energia Pescara» 1910, 9).

The protest also highlighted the "inevitable damage caused by frequent floods in the valley," which not only disrupted local populations but also imposed a significant financial burden on municipalities, which were forced to carry out costly restoration works (Comitato Centrale Abruzzese «Pro Energia Pescara» 1910, 60).

The opposition from the Val Pescara municipalities even reached parliamentary discussions. The Minister of Public Works, Pietro Bertolini, introduced a bill proposing compensation of two lire per year "for every lost horsepower." However, the Bertolini Law was never approved, and with it, the hope of the Val Pescara municipalities to promote fair and sustainable regional development against the "colossal monopoly over the Pescara's waters" exerted by the SIE (Comitato Centrale Abruzzese «Pro Energia Pescara» 1910, 89). The greatest disappointment lay in the lack of recognition of the Pescara River's value and role for the valley's communities—a river that represented far more than just a watercourse:

"si tratta[va] di paesi che hanno nel fiume principale speranza di ricchezza, paesi a frane, senza grande viabilità, con intensa emigrazione, e dove non v'è che una ricchezza sola, solo quella di questo carbone bianco; veda come debba riuscire doloroso per quelle forti e pazienti popolazioni, vedersi trasportare altrove questa sola loro ricchezza." (Comitato Centrale Abruzzese «Pro

[12] Regarding the Pescara-Bussi waterway project, see the relevant documentation filed at the State Archives of Chieti (ASCh), Fondo Prefettura, IV versamento, b. 169.

Energia Pescara» 1910, 99).

The exploitation of the Pescara River continued throughout the following decades under the same dynamics. In 1927, SME initiated the construction of the third expansion on the Pescara River, with a capacity of 23,000 kW, completed in 1931. In 1938, construction of the fourth expansion in Triano (Chieti) began "per consentire la fornitura del considerevole quantitativo di energia richiesto dall'Azienda Idrogenazione Combustibile […] e per l'integrazione della fornitura alle Ferrovie dello Stato e allo stabilimento della Cellulosa del Poligrafico dello Stato."[13]

The power plant, completed in June 1942, generated over 40,000 kW and was part of a large-scale industrial energy supply program launched in 1936, which also aimed at providing electricity to the Bari industrial hub. To achieve this, SME built a 310 km-long power line between Alanno and Bari in March 1938, once again diverting Pescara River water resources for non-local interests.

This continued diversion of the Pescara River's resources did not trigger any significant intervention from the State, despite persistent protests from the Val Pescara communities.

The government's inaction reflected the broader historical context a period of intense industrialization, which the State prioritized over the excessive exploitation of Abruzzo's natural resources, as demonstrated by the case of the Pescara River.

6. Conclusion

The natural heritage of Abruzzo was, at times, also misused, effectively leading to "unsustainable" forms of development. The forestry policy of the newly unified Italian state promoted extensive deforestation in the region, which, in a sense, betrayed the rational framework that traditionally assigned woodlands both a social and economic function. In the past, forests had been managed through carefully planned anthropogenic projects, whereas, under the new policies, they were subjected to indiscriminate exploitation. At the same time, the utilization of rivers for the benefit of more developed areas deprived the Abruzzo region of both resources and identity, reducing it to a

[13] ASCh, prefettura, I serie, V° versamento, b. 255, *Sme al prefetto 27 dicembre 1938*.

mere center of production, despite significant local protests.

As a result, the forestry and water management policies of the 19th and 20th centuries, although intended to promote national economic development, proved in many respects to be "unsustainable" for both the Abruzzo region and its population. While the necessities and contingencies that justified the exploitation of both woodlands and rivers are understandable, these activities contributed to disrupting the delicate environmental balance of the region (Bonan, 2019, 319).

It is evident that the relationship between development and resources in Abruzzo was highly complex and difficult to accept, especially because it failed to stimulate the region's economic growth, leaving it stripped and depleted of its resources (Tino 1989, 694-695). This led to a progressive decline in environmental conditions, which required the establishment of new balances inspired by a more prudent relationship between humans, resources, and development. While it is true that the environment adapts to human will, it is equally true that the changes it undergoes "impongono la modificazione degli uomini stessi, della loro cultura, della loro mentalità" (Romani 1999, 23).

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Francesco D'Esposito[*]

PRODUCTIVITY, SUSTAINABILITY AND BEAUTY IN 19TH-CENTURY SORRENTO AND AMALFI AGRICULTURE

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Abstract

The proximity to large markets has enhanced agriculture on the Sorrento and Amalfi Coast since the late Middle Ages. Agriculture evolved by exploiting the market opportunities that the local maritime trade offered and this led to a profound transformation of the territory, unique in the history of Italian agriculture. The landscape of Sorrento and Amalfi, with its terraces and enclosing and retaining walls, reflects the intensive use of land for agricultural purposes, which influenced the economy and favoured significant demographic development. The constant availability of labour and capital from the city stimulated further investment, which never strayed far from sustainability and beauty. By incentivising local production, the farmer has become a maintainer of the land, a manager of the landscape and conservator of environmental quality, a producer of environmental services for the benefit of the entire community, while at the same time bringing greater security to the settlement. In the first paragraph we will illustrate the modifications of the territory in the Middle Ages and in the Modern Age and, in the next two, we will examine the transformations introduced in the 19th century, the golden age of citrus growing in Sorrento and Amalfi.

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KEYWORDS: SORRENTO PENINSULA, AMALFI COAST, CITRUS FARMING, LANDSCAPE, GRAN TOUR

[*] Department of Socio-Economic, Management and Statistical Studies University Centre "Ud'A-TEMA", University G. D'Annunzio for Land and Sea, Viale Pindaro 42, 65127, Pescara, Italy, Phone: +39 85 453.7580; *E-mail address*: Francesco.desposito@unich.it.

1. Traditional mixed farming and terracing of the land

Naples, the capital of the Kingdom and a true demographic monster, has always been able to attract a large part of the agricultural production, not only of the fertile plain close to it, but also of the entire coastal area of Campania. (Fig. 4) As proof of the significant presence of sailors and merchants from Sorrento and Amalfi in the capital, we recall that the port, opposite the Maschio Angioino, was once called the port of the Sorrentini and Amalfitani. Today in the same area stands the Beverello pier, which connects Naples with the islands and Sorrento, a tangible sign of continuity with the past[1]. Navigation in the Gulf of Naples was often accompanied by more extensive routes. The Latium coastline was well known to sailors from Sorrento and Amalfi, who frequented it since the 14th century to bring cargoes of local wines, renowned since Antiquity, to Rome (D'Esposito 2021, 23-25).

Before the 19th century, fruit trees were scattered here and there confusedly and mixed with mulberry trees, vines and olive trees. Wherever possible, the local farmer optimised the cultivable area by combining different crops, thus maximising their yield. In the flat areas, the landscape was predominantly dominated by orchards, but the farmer of the time, operating in a subsistence family economy, supplemented the main crop with a variety of vegetables and fruit trees. In hilly regions, vast expanses of olive groves were often associated with vineyards, while pastures and forests predominated in mountainous areas. The prevailing crops in specific areas, even when close to each other, often had different agricultural characteristics. Mariane Starke, who had visited the Sorrento Peninsula around 1820, wrote in what can be considered the first description of the area in a modern tourist guide:

'The Plain is one continued series of Orchards, divided from each other by walls, and intersected with Villas,Towns,and Villages: these Orchards, however, are not of the common sort; for here, the promegranate, the aloe, the

[1] Further proof of the active presence of the Peninsula's operators in the capital of the kingdom is provided by the very name of Via Porta di Massa. Before the university building was erected, in fact, boats from Massa Lubrense and the entire Sorrento Peninsula docked on this shoreline. Here it was possible to buy, or even consume on the spot, the typical products of Massa Lubrense and Sorrento that had just arrived in town. Gino Doria tells of the enthusiasm with which the typical products of Massa Lubrense land that landed in Naples were welcomed: dairy products, wine, fruit and, above all, the renowned and vigorous Massa Lubrense calves (Filangieri di Candida 1910; Doria 1943; D'Esposito 2021).

acacia, the abeal, the mulberry, the apple, the pear, the apricot, the peach, the sorbus, the fig, the vine, the olive, the bay, the cypress, the chestnut, .the walnut, the wide -spreading oak, and magnificent maritime stonepine, are so beautifully mingled and contrasted with multitudes of oranges and lemons, that persons standing on an eminence, and looking down upon this Spot, might fancy it the Garden of the Hesperides.'

To cope with local demand and the demand for Naples, our ancestors turned the hills into terraces, first with ridges and then with drystone walls, extending cultivation to mountainous terrain and at the same time helping to preserve the soil from landslides and mudslides. With the hard work of their arms and the simple hand tools of the time, they cut the hard stone of the hills and reduced them to terraces, building ridges and drystone walls to maintain and hold the land. Each terrace thus became a strip, a long rectangle of land, sometimes scarce, that not only allowed farming but also helped to defend the soil of large areas of hillside. The maintenance of hillside terraces is not only a productive choice, but also serves to stem hydrogeological instability and ensure the historical and environmental conservation of the site. (Figures 1 and 2)

Figure 1. Terracing of the Amalfi Coast

Source: Author's archive

Figure 2. Dry stone wall of the Amalfi Coast and Sorrentine Hills

Source: Author's archive

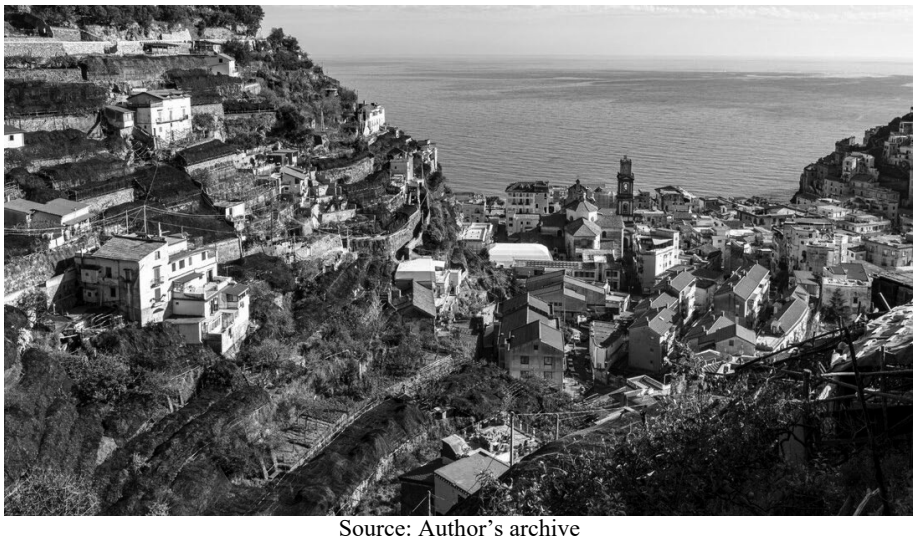
Terracing was more daring on the Amalfi Coast, where the slopes are steeper, with steep rocks and covered by very thin layers of humus. The Sorrento Peninsula has a tuff formation that covers the mountain slopes and makes them less steep and in the central part becomes almost flat, favouring more profitable and less costly agricultural activity. The topographical layout of the Peninsula was in fact affected by the changes induced by the nearby Phlegraean-Vesuvian volcanic area. In this sense, the deposition of grey Campanian tuff (also known as 'Ignimbrite Campana') played a decisive role. This occurred following eruptions datable on average around 33,000 years ago, which raised the level of the plain by about ten metres and filled in the depressed areas (Fig. 3) (Pisanti 2007, 1967).

Figure 3. The Sorrentine Plain viewed from Meta

Source: Author's archive

On the Amalfi Coast, on the other hand, the steep orography makes the terrace the true protagonist of the entire spatial organisation: a hanging garden, the design of the wooded buttresses, the plot structuring the inhabited centres themselves. The urban centres of the Coast such as Positano, Amalfi, Atrani, Maiori, Minori (Fig. 4) are structured according to vertical lines on embankments cantilevered along the mountain sides, they are hanging garden-cities.

Figure 4. Terraces in Minori, on the Amalfi Coast. The urban-rural continuum is noticeable.



Source: Author's archive

The neighbourhoods are connected by innumerable flights of steps and narrow streets set against the steep slopes that form the only possible routes. The dwellings follow the flow of water and agricultural access rights in successive spirals from the coast to the mountain, follow the course of cultivated terraces, are themselves terraces and gardens. They are assembled one on top of the other and the terrace-garden is always an integral part of the house itself, covering an essential function for daily life: it is a place of work, communication, and aggregation' (Laureano, 2004).

2. The spread of citrus cultivation in the first half of the 19th century and the complication of the landscape: walls and terraces

Until the end of the 18th century, agriculture in Sorrento and Amalfi had remained largely promiscuous, but citrus fruit cultivation began to spread. Until then, it had been limited to a few planted trees, located in the most protected places, around houses and in places sheltered from the wind. On the slopes of the Amalfi Coast, lemon cultivation intensified. The technique of growing this precious fruit, known since ancient times, had been stimulated in the Middle Ages by the experience of the maritime republic of Amalfi with

the introduction of agricultural and hydraulic knowledge resulting from the relations the area had with the North African and Arab world. According to data from Murat's Cadastre, compiled from 1815 onwards, lemon groves covered some twenty hectares on the Coast (Tino 1997, 39-43). In the Sorrento Peninsula until the mid-19th century, the main crops were olives and vines. According to the Murattiano Cadastre, compiled in 1809, vines occupied 46% of the land in Piano, 28% in Sorrento, 21% in Massa and 14% in Vico. Olive groves covered 22% of the land in Massa, 19% in Sorrento, 11% in Vico and about 8-9% in Meta and Piano. In Massa, traditional arable crops prevailed, while in Vico, woodland and pasture were favoured, occupying 60% of the territory. Citrus groves accounted for less than 10 per cent of the land in Piano, Sorrento and Meta, covering around 200 hectares throughout the Peninsula (Assante 1986, 21; Tino 1997, 39-43; De Angelis 2009).

Figure 1. Philipp Hackert, Marina di Alimuri (in Meta) near Sorrento, Caserta, Royal Palace

Source: Author's archive

The strong demographic increase in the 18th century pushed the people of Sorrento and Amalfi to boost the agricultural economy and seek new sources of income. They turned their gaze to the sea and poured substantial resources into maritime activities. In the 19th century, the Sorrento navy became one of

the most flourishing in the Kingdom. After the Napoleonic interlude and the Congress of Vienna, the development of the fleet and its modernisation continued unabated. The greater freedom on the seas, as a consequence of the 'peace' imposed by the supremacy of British naval power, also opened up wider spaces for navies, like the Neapolitan one, not protected by powerful military fleets. Ship-owners' expectations were further encouraged by the Bourbon government, which as early as 1818 promulgated laws and decrees granting a strong franchise to high tonnage ships (Passaro 2009, 360-362).

The maritime economy, integrating with the agricultural economy, elevated and transformed the standard of living of the inhabitants and the urban and territorial aspect of the localities in a short space of years. A new agricultural, maritime and artisan entrepreneurial bourgeoisie was formed, which invested huge amounts of capital in the reconstruction of the countryside and the decisive definition of the towns. The agrarian landscape changed its face: kilometres of retaining walls formed wide terraces; high walls protected and delimited gardens (Figures 6 and 7); buttresses and new road junctions were built; aqueducts were verified and strengthened; deep wells were dug in the tuffaceous bank (De Angelis 1996, 41).

Figure 6. Imposing terracing system in Sant'Agnello, on the Sorrento Peninsula

Source: De Angelis Archive

Figure 7. Terracing system for the Sorrentine citrus grove

Source: De Angelis Archive

The result is a landscape marked by the presence of innumerable containment and enclosure walls. This characteristic, linked to the intensive use of the land that has characterised the landscape of the Peninsula since the 19th century, has fascinated the most cultured visitors. One example is Gabriele D'Annunzio, who wrote in Notturno (Nocturne) that he remembered "di un aranceto murato, a Massa, verso la riviera d'Amalfi […] Ero sbigottito come se fossi penetrato in un labirinto inimmaginabile. I tronchi parevano scolpiti nella pietra delle grotte segrete" (D'Annunzio 1916).

The foothill areas were also cultivated, as well as the areas at the bottom of the valleys, adjacent to the rivulets, where there was a good possibility of capturing and channelling water for irrigation. In order to integrate and increase income, attempts were also made to diversify production: olive trees, walnut trees and rows of vines on espaliers were planted both at the edges and within the new plantations, all emerging against the dark green of the citrus trees (De Angelis 1996, 41)

Moreover, since the Sorrento Peninsula represents the northernmost climatic limit in Italy for intensive commercial citrus cultivation, thought must be given to protecting the trees from the rigours of winter. The first answer is the windbreak, to defend the planted trees from the coldest winds. In front of the citrus groves facing the sea, tree rows were used, especially of olive trees, especially where these had been cleared to make room for citrus trees. (Savastano 1919-1921, 7) This type of windbreak is documented as far back

as 1858 by the account of one of the many travellers who admired the Sorrentine landscape in enchantment: 'a narrow path shaded by olives, some of which had reached the size and the strength of oaks, and which had been planted there to shield the orange-trees against the winter wind, wound by the side of the sea' (Kavanagh 1999, 83-85).

Characteristic of this agriculture is extreme fragmentation. Property, and even more, enterprises are literally broken up, except in a few cases and in some areas. The transformation itself, made by manpower and requiring the wait of a few years, has led to the splitting up of properties. The largest holdings do not exceed five hectares, the average ones are one and a half hectares and the small plots, which are the majority, do not exceed one hectare. The dense farm distribution bears witness to how a process of democratisation of production has developed in the Sorrento area, which has allowed the affirmation of small, independent farming estates. This gave rise to widespread prosperity even among the more modest strata of the population. This phenomenon prevented the bourgeoisie from asserting its total hegemony and, at the same time, sheltered it from the social clashes that, instead, occurred in other parts of southern Italy. Consequently, a strong moderate bloc was formed and consolidated over time on the Sorrento Peninsula, which in many respects still persists, even if fuelled by different economies. (De Angelis 1996, 41)

Therefore, the entire hillside area remained marginalised, where there is and remains a poorer agriculture linked to vineyards, olive groves, woods and sowable land, and therefore to marginal activities such as zootechnics and sylvo-pastoral. The geographical and productive isolation of those areas has kept those populations dislocated in scattered cottages, far from social and commercial exchanges, for which the few contacts are only established during religious practices and the first experiences, for males, are linked to military service. From these areas originated a substantial supply of cheap labour labourers. Thus, in a limited geographical area, a different level and degree of social development, a different way of satisfying needs and procuring income was recorded. A proof of this is offered by an examination of migratory flows. In fact, the areas of the Sorrento peninsula with poorer agriculture (Torca, Colli di Fontanelle, Colli di San Pietro and the Vicane hills) gave rise to a higher number of emigrants to non-European continents than the citrus grove area. (Berrino 1990, 397-422; De Angelis 1996, 41).

3. The participation of local and Neapolitan capitalists and the creation of large funds: investment, sustainability and aesthetic sense in the constitution of the Sorrento citrus grove

The years following the Unification were of further growth for the economy of the Sorrento peninsula. The expansion of the local navy, with the passage from the Kingdom of the Two Sicilies, from a horizon necessarily limited to the Mediterranean world, to the much more powerful Kingdom of Italy, mostly at a time of great growth in world trade, was the main factor for the seafaring population. The age-old skills of Sorrentine seamen on the routes of large and small cabotage made them extraordinarily quick to seize the opportunity to join the expansion of trade in the second half of the 19th century, to expand their routes and push on to the ports of Northern Europe and those of the American continent.

The process of citrus farming expansion, which radically changed the face of large rocky verses of the Amalfi Coast and significantly affected the agricultural landscape of the Sorrento Peninsula, began under the growing stimulus of the export trade to the English and American markets and the high sales prices that characterised citrus production from the early 1970s onwards and for almost twenty years The growing commercialisation of citrus fruit on foreign markets, at a time characterised by a substantial production monopoly in southern Italy, was not yet threatened by American and Spanish competition.

Almost all of the citrus fruit produced on the Amalfi Coast and the Sorrento peninsula was exported to the markets of England, Holland and the United States, and only the mediocre quality citrus fruit, not suitable for export, was destined for the domestic market and, above all, to supply the consumer demand of the Naples area (Tino 1997, 39-44).

The considerable fall in prices that from the second half of the 1980s, first slowly and then with greater intensity at the beginning of the new century, affected citrus production, due to the rapid change in the American and European market conditions caused by the spread of citrus growing in Florida and California and competition on the European markets from Spanish and Tunisian oranges, slowed down the process of expansion of citrus growing in Campania and of lemon-growing itself, which was also forced to reduce its exports to the American market in the first decade of the 20th century because

of the protectionist measures adopted by that country52. Until 1897, the American market absorbed 50% of the export trade in lemons from the Amalfi Coast and the other 50% the English market; by the second half of the twentieth century, exports to America had already been reduced to less than 30% of the total (Tino 1997, 39-44).

However, the expansion of domestic demand, especially for oranges, together with the acquisition of new commercial outlets in the direction of central and eastern European countries and Austria-Hungary in particular, and the competitive capacity of lemons from Sorrento and Amalfi, most of which were now destined for the English market, helped to keep the Campania citrus economy alive, albeit with its ups and downs. During the favourable economic situation of the years following the end of the war and the advent of Fascism, it experienced a further, albeit limited, phase of expansion (Tino 1997, 39-44).

The favourable domestic and international situation in the citrus fruit market led to an enormous increase in land values, especially in the Sorrento peninsula. Many ship-owners, who had derived often considerable capital from the sea, spent it on the purchase of land. In order to become landowners, after a life on the sea, they did not bother to spend the capital even at a low reason, contributing to the further increase in the price of orange groves. In the meantime, the assets of the religious orders forfeited by the State after Unification were put up for sale, and the purchases of local capitalists were joined by those of various exponents of the nobility and the Neapolitan business bourgeoisie for whom the Sorrentine citrus groves, as well as being an object of economic speculation, had become a refuge where they could shelter, in the enchantment of the coast, from the stress of the city and host the illustrious travellers epigones of the Grand Tour. They did not differ from the many other families who, following the aristocratic example of the Giusso, Colonna and Maresca di Serracapriola families, had bought land and citrus gardens; they spent their holidays there, but were also involved in the improvement of the foundations and the marketing of agricultural products. Gaetano Massa, fu Leone, who lived in Piano; Mariano Arlotta, who in Sant'Agnello built the villa Il Pizzo, the splendid citrus garden overlooking the sea (De Angelis 1996, 41-43).

André Gide, who in 1902 owned the Arlotta estate, told the cultured European man of the wonders of the Sorrentine garden: In the most characteristic Mediterranean landscape, which some would pretend to see exclusively dazzled with light, sun and colour, the Sorrentine citrus garden reminded him of something quite different, and the trunks of the trees

reminded him of the polished columns of the mosque of Cordova, which rise thickly - almost as if forming a forest - in the half-light of the Andalusian temple:

«De ce jardin-verger nul ne dira l'éclat, la splendeur: sombre, l'ordre, la rythmique beauté, la mollesse... J'entrai sous le couvert des orangers, moitié pleurant, moitié riant, et plein d'ivresse; à travers le branchage épais, à peine voyait-on le ciel. Il avait plu; lé ciel était encore gris; il semblait que la lumière ne vînt que de la profusion des oranges. Leur poids ployait les branches. Les citronniers, plus grêles, plus élancés, avaient tout à la fois moins de, fafte et plus d'élégance. Parfois des claies protectrices au-dessus d'eux leur faisaient un abri presque sombre. Sur le sol, entre les troncs dont le nombre, la discrète hauteur, l'apparence onftueuse et polie, me rappelaient les riches piliers de la mosquée de Cordoue» (Gide 1948, 100-101, *Sorrento, Villa Arlotta -chez Vollmceller*)[2].

Pietro Tino, to whom we owe an exhaustive series of studies on the whole of the wide-ranging history of agriculture in Campania in the 19th century, emphasises the imposing costs that this process of transformation entailed and which, as he writes, 'confer on the rapid expansion of citrus cultivation in Sorrento and Amalfi an economic and social importance that goes far beyond what the figures relating to surface area say, which are somewhat uncertain and approximate in their term a quo and of modest significance when compared to the infinitely more robust ones expressed by the analogue phenomenon in Sicily'. In fact, the planting of citrus groves involved the investment of huge amounts of capital, far greater, in proportional terms, than any other area in southern Italy. Here, the cultivation of citrus fruits required a singular work of construction of the land, of a veritable creation of the habitat destined to welcome it. On the Amalfi Coast, according to the results of

[2]«Nothing in this orange grove can express the brightness, the gloomy splendor, the order, the rhythmic beauty, the softness... I entered under the canopy of the orange trees, half moved, half smiling and full of energy; through the dense branches I could barely see the sky. It had rained: the sky was still gray; it seemed that the light came only from the large quantity of oranges. Their weight bent the branches. The lemons, more delicate, slenderer, had at the same time less majesty but more elegance. Sometimes protective straw above them formed an almost dark shelter. On the ground, among the trunks whose number, discreet height, sweet and smooth appearance reminded me of the rich pillars of the mosque of Cordoba».

investigations carried out by Briganti at the beginning of the 20th century, which in his opinion can be reliably attributed to a quarter of a century earlier, this work of creating the habitat by means of daring terracing required an expenditure varying, depending on the greater or lesser ruggedness of the land, between 12,000 lire and 42,000 lire per hectare, with a sharp rise in costs. Added to this sum was the cost of planting the lemon grove, which up to the sixth year resulted in an average outlay of ITL 16,000 per hectare, without taking into account taxes, the cost of replacing dead plants and any other costs caused by natural causes. So, a hectare of lemon grove, taken up to the sixth year of planting, entailed an expenditure, on the Amalfi Coast, ranging from 30,000 to a good 60,000 lire and even more. On the Sorrento Peninsula, the planting of citrus groves generally required lower costs, both because of the better conditions of the land and because most lemon and orange groves were planted in land already occupied by other tree crops, clearing vines and olive trees (Tino 1997, 37-41).

Along with the modification of the land to make it suitable for citrus cultivation, techniques were experimented with to protect the plants from the damage of a not particularly favourable climate. The introduction of the techniques that proved to be, or were considered to be, most effective for defence against the weather - dense planting, windbreaks, direct plant cover or supported by pergolas - in a continuous experimentation that belied the commonplace of the peasant enemy of innovation, contributed to the definition of the Sorrento agricultural landscape, of which the orange and lemon garden is the most significant aspect.

The construction of the pergola of chestnut poles represents the final stage of the Sorrentine growers' experiments. The largest and straightest poles are planted in the ground, according to a square-meshed grid of 2.80 metres per side, to a depth of about one metre, leaving 6/7 metres outside. A grid of somewhat thinner posts is created one metre below the tops. In order to avoid skidding and to give greater solidity to the entire pergola structure, poles were added diagonally. Until a few decades ago, straw matting, the means of covering par excellence in the Sorrento citrus grove, was spread over the pergolas. Later, in order to obviate the considerable expense that this technique entailed - not only in terms of the cost of the artefact, but also the number of working days necessary for its application - the pagliarella was replaced by a dense, dark-coloured metal or plastic mesh, which has the undeniable advantage of not having to be removed, while fulfilling all the requirements, it always lets the sun in, forms a valuable protective barrier

against hail, breaks up the rain, and above all, with the sudden drop in temperature it allows a thin film of surface ice to form, which creates a minimum greenhouse effect inside the pergola (Figures 8, 9, 10).

Under the cover of the pagliarelle, on occasions of excessive cold and frost, damp straw and grass leaves were burned to create hot vapors according to practices already used in Roman times (Amodio 2005, 41-57; Ruocco 1961). The cover, created for protective needs, was also used to protect plants from excessive sunlight, in order to delay their flowering and obtain out-of-season products that are more profitable (Figures 11, 12, 13, 14).

4. The crisis of a sustainable development model

Starting from the sixties of the twentieth century, there was a profound turning point. In those years, after the post-war reconstruction was completed, the general crisis of agriculture coincided with the launch of large-scale tourism and the urban expansion of large and small towns. In addition, the spread of the city of Naples on the outskirts and therefore on the immediately surrounding areas has given rise to the transformation of agricultural land into more profitable building land. So, the crisis of agriculture on the one hand and the demand for land for new houses and hotels on the other, have added up their effect and pushed citrus cultivation towards decline.

In the Sorrento Peninsula, in fact, the cultivation of citrus fruits in recent years has been significantly reduced by the pressure of the construction industry, which is covering ancient and celebrated citrus groves with concrete. The cultivation of oranges, then, has been almost abandoned due to the low price that the Sorrento fruit is now able to fetch on the markets. On the other hand, lemon cultivation resists, since it can still offer a high-quality product, the demand for which is also supported by the spread of limoncello. So, for about ten years, the citrus growers of Sorrento have begun to transform orange groves into lemon groves, both with the new planting and with the grafting of lemon on old orange trees. The traditional covering involves high costs but these citrus groves, which are protected by windbreaks and pergolas, can represent an opportunity for the survival of the ancient local knowledge (Fig. 15).

In addition, man, not mindful of the catastrophes that have devastated this

area in the past, continues to challenge nature, inflicting wounds that expose it to the continuous risk of landslides and landslides. He alters its natural balance by opening quarries, creating communication routes and artificial canals, overloading the soil with the most varied constructions and destroying the vegetation cover, which often performs a protective action against the degradation of the rocks. Suffice it to say that, along the numerous abandoned quarry fronts, the conditions of stability, already naturally critical, are worsening. In Castellammare di Stabia, in the locality of Pozzano, on January 10, 1997, a landslide broke off, causing six victims as well as serious damage to the road and houses.

The lack of maintenance of the numerous artificial terraces built for agricultural use has also contributed to aggravating the problem of slope instability. The crisis of agriculture has led to the obstruction of the joints between the stone ashlars of the dry-stone walls, made by man to support the thrust of the earth, preventing the drainage of water and causing "chain" collapses of the terraces (Pisanti 2002, 1962-64).

In recent years, in fact, in the Sorrento Peninsula it has been preferred to support the dynamics of housing and tourist expansion rather than accompany the recovery and adaptation of agriculture towards new and more advanced models (De Angelis, 2009, 352). Today, what was once the agricultural environment is being transformed into a convulsive urban environment of very poor quality, with the role of perieria not only of Sorrento but, in extension of the Vesuvius belt, of the city of Naples itself (De Angelis 2009, 353). A separate discussion can be made for the Amalfi Coast. Due to its great aesthetic value, the terraced landscape of the Amalfi Coast has been included by UNESCO in the list of World Heritage Sites Formica (2010, 26-39).

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Dario Dell'Osa*

ORGANIC VITICULTURE IN ITALY: A RECENT HISTORY

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Abstract

Organic farming is defined as a cultivation method aimed at producing food using natural substances and processes, thereby minimizing environmental impact. In the early 1990s, European institutions addressed the issue of sustainability by implementing the regulation of organic agricultural production. The Italian wine sector has also benefited from regulations promoting organic practices, initially through the application of general laws valid for all product categories, then with specific regulations on viticulture and winemaking. Since the introduction of organic wine production regulations in 2012, organic viticulture has expanded in Italy. Basing on the analysis of data on organic production, this study aims to reconstruct the development of organic viticulture in Italy from the 1990s to 2023. After reviewing the existing literature on organic viticulture, the paper will trace the history of organic production in the country, assessing the impact of regulations on the sector's evolution.

JEL CLASSIFICATION: N54, N44, Q15, Q18, L66

KEYWORDS: ORGANICAGRICULTURE, WINE, VITICULTURE, RURAL HISTORY, ITALY

1. Introduction

Between the late 1980s and the early 1990s, European institutions, within the broader framework of the Common Agricultural Policy (CAP), addressed the issue of sustainability by implementing, among other initiatives, the

* Dario Dell'Osa, University of Bari Aldo Moro, Department of Economics and Finance, Largo Abbazia di Santa Scolastica, Bari, Italy, Phone +39-080-571-5222; *E-mail address*: dario.dellosa@uniba.it.

regulation of organic agricultural production. Organic farming is defined as a cultivation method aimed at producing food using natural substances and processes, thereby minimizing environmental impact. For farmers to benefit from organic production methods, it is crucial that consumers have full confidence in compliance with organic production standards. Therefore, it is essential that all stakeholders involved in organic food production adhere to a rigorous control system. The Italian wine sector has benefited from regulations promoting organic practices, initially through the application of general laws valid for all product categories, and later, starting in 2012, through specific regulations for organic wines, which complemented the pre-existing rules for typical wines.

Organic production fully falls within the sphere of sustainability, as it encompasses elements that impact the environmental dimension of agriculture, such as the adoption of less impactful cultivation techniques and the absence of harmful chemical substances. Additionally, it has economic and social implications. From an economic and social perspective, organic farming has been the subject of initiatives aimed at encouraging producers and compensating for the decline in productivity and profitability of crops. These initiatives have enabled businesses engaged in organic farming to benefit from economic incentives for production. Markets have also received particular attention, with regulations designed to allow the certification of organic products and their recognition by consumers. This ensures that organic production can be identified and rewarded with significantly higher prices compared to their non-organic counterparts in target markets. In addition to institutional initiatives, the past few decades have witnessed an increase in demand, driven by growing consumer interest in organic supply chains (Jones 2017, 31).

Since 2012, the year of the introduction of regulations governing organic wine production, consumer demand for this product has shown steady growth. Organic wine is perceived as a choice of quality and reliability (Gismondi 2020). For these reasons, organic viticulture has expanded in Italy, reaching 22.8% of the total national vineyard area by 2023 (SINAB 2024, 18).

Based on the analysis of data on organic production in Italy, this study aims to reconstruct the development of organic viticulture in Italy from the 1990s to 2023. After reviewing the existing literature on organic viticulture in Italy, the paper will trace the history of organic production in the country, assessing the impact of regulations on the sector's evolution. In the early years, organic viticulture had to be examined alongside other organic products due to the

lack of statistical data specifically related to organic grape and wine production. However, starting from the year 2000, the availability of specific data on organic viticulture has allowed for more in-depth analyses of trends in organically cultivated vineyard areas and their distribution across the national territory. The resulting picture of organic wine production is particularly insightful, revealing that financial incentives and subsidies have played a crucial role in the expansion of organic viticulture—far more so than the otherwise strong market demand.

2. The origins of organic farming

A fundamental role in the spread of organic agriculture in Western countries has been played by subsidies provided by institutions to support producers. It can be argued that these subsidies have undoubtedly stimulated the conversion to organic farming since the 1990s. However, it is important to clarify that financial support for organic production was a consequence of the growing interest that Western societies had shown in these cultivation methods in the preceding decades (Lockeretz 2007, 3).

The historical origins of organic agriculture can be traced back to the early 20th century as a response to the increasing large-scale use of chemical fertilizers and pesticides (Merrill 1983; Conford 2001; Kirchmann et al. 2008). The fundamental principle that inspired organic production was based on the notion that soil cultivation without fertilizers or pesticides had been practiced for millennia and had nevertheless ensured human survival. The early theorists of organic agriculture believed that the only way to obtain healthy food was through traditional soil cultivation methods, without the use of chemical inputs. The first form of organic agriculture was practiced in 1924 by the Austrian Rudolf Steiner (Steiner 1924), who is considered the founder of biodynamic agriculture[1]. Steiner also delivered a series of lectures providing instructions on how to produce organic food capable of imparting spiritual forces to humanity (Kirchmann et al. 2008, 15). Further impetus for the development of organic farming came from the United Kingdom, where, in the early 1940s, Lady Eve Balfour (widow of British Prime Minister Arthur James Balfour) and Sir Albert Howard founded the British Soil Association in 1946. The two British authors published several studies emphasizing the

[1] The Biodynamic agriculture method is based on a closed production system that aims to reproduce an agroecological model focused on a reduction of energy consumption and capable of achieving high levels of environmental efficiency (Santoni et al. 2022).

importance of traditional farming methods (Howard 1940, 1947) and the superior nutritional value of organically grown food (Balfour 1943). In the 1950s, the Swiss couple Hans and Maria Müller further developed organic farming methods, drawing inspiration from Steiner's biodynamic agriculture (Kirchmann et al. 2008, 15). In 1968, the German physician Hans-Peter Rusch laid the foundation for modern organic agriculture (Rusch 1978). In 1972, five organic organizations from different countries established a global organization called IFOAM (International Federation of Organic Agriculture Movements), which promoted the adoption of organic farming worldwide, set standards, and developed certification procedures (Reed 2010, 79).

In this context, the growing environmental awareness that took root in Western society and culture from the 1960s onward allowed organic farming advocates to develop their theories further. Organic farming methods were also presented as a solution to the issues caused by modern agriculture (Kirchmann et al. 2008, 15) and the harmful use of pesticides (Carson 1962). The period between 1980 and 1990 saw further advancements in organic farming, which was increasingly regarded as a sustainable and environmentally friendly practice. Political debates, environmental organizations, and green political parties began to consider organic production as a means to mitigate the environmental damage caused by modern agricultural practices. In the early 1990s, initiatives were launched to promote organic farming, including subsidies for research, funding for research centers, and the establishment of university departments dedicated to organic agriculture studies. Institutions were encouraged to support the development of organic production through subsidies, incentives, and other forms of financial support, though not without controversy (Kirchmann et al. 2008, 15). During this period, subsidies in Western countries appeared more attractive to farms cultivating extensive lands, such as grasslands, olive groves, and vineyards in disadvantaged areas, rather than to arable lands with high soil fertility (Lockeretz 2007, 132). As a result, viticulture also became involved in the organic farming movement, undergoing a gradual transition to more sustainable production models that excluded the use of mineral fertilizers and synthetic plant protection products[2].

[2] According to Szolnoki (2013), the first sustainable viticulture program was implemented in California in 1992, leading to the development of the California Code of Sustainable Winegrowing Practices. This was followed by similar initiatives in New Zealand, South Africa, France, and Australia (Laureati & Pagliarini, 2016, 187).

3. The start of organic production in Italy

The European and Italian regulatory framework for organic viticulture underwent a long and complex development process, which can be traced back to the early 1990s. Initially, it followed the same regulatory path as organic agriculture in general but began to diverge from other organic production sectors starting in 2012.

The first European directives on the production methods for organic agricultural products were issued in 1991 and covered all types of agricultural products, including organic grapes. In the preceding years, increasing consumer awareness has driven the expansion of the organic agriculture market, despite the absence of a clear regulatory framework.

While awaiting national legislation, some regions and the Autonomous Province of Bolzano introduced their own regulations to fill the legal gap in organic production, establishing local certification systems[3]. However, local laws soon came into conflict with national regulations, and the initial steps toward the regulation of organic production in Italy were marked by uncertainties and jurisdictional disputes at multiple levels. The process of recognizing the organic farming method in European agriculture began with EC Regulation 2092/91[4], the first articles of which contained provisions aimed at protecting consumers and regulating the information presented on labels and in advertising of products. The regulation stipulated that for products to bear the label "Organic Farming - EC Control Scheme" they would need to undergo a certification process to ensure compliance with production standards. The certification would be carried out by recognized public or private bodies supervised by a designated public authority. Initially, no further details were provided regarding the nature of the controls or the characteristics of the certification bodies (INEA 1992, 108).

Starting in 1991, European regulations limited themselves to specifying which and how many plant protection products and fertilizers could be used in organic farming, including viticulture, and to establishing control mechanisms. These controls were intended to verify that the claims made by wine producers were truthful and that the information on product labels was clear enough to prevent confusion among consumers in their purchasing

[3] At the time of the entry into force of Regulation 2092/91, some regions had already enacted regulations on the matter. Among these were the Autonomous Province of Bolzano, the Abruzzo Region, the Marche Region, and the Sardinia Region. For further details, see the *Annuario* INEA (1991, 110-111).
[4] This refers to Council Regulation (EEC) No. 2092/91 of 24 June 1991.

decisions. The risk of information overload existed, and the decision to label only the most important information helped wine producers effectively differentiate their products from competitors (Stranieri and Tedeschi 2019). Organic wine production, however, was not initially specifically regulated, and there was no European certification mark for wine that would guarantee the product's characteristics for the benefit of the final consumers. However, generic organic certification labels could be used by subjecting grape production to organic standards and requiring the registration of vineyards in the appropriate national register[5]. The label could only state "wine made from organic grapes." This was because the community regulations referred to all agricultural products obtained according to the principles of organic farming, excluding the use of certain chemicals such as artificial chemical fertilizers, pesticides, fungicides, and herbicides. Nothing was stipulated regarding winemaking practices.

Upon the entry into force of the European regulation, transposed into Italian law, however, the regions of Umbria, Emilia-Romagna, Lombardy, and Tuscany, which had moved ahead with organic farming, filed a case with the Italian Constitutional Court over a conflict of competence. Indeed, the European regulation assigned the Ministry of Agriculture and Forestry the coordination and oversight of the correct implementation of the tasks entrusted to private bodies authorized to carry out the control activities for organic production. This effectively removed the local authorities' powers and rendered the certifications previously granted to certification bodies and certified entities null and void. Following the implementation of the new regulations, producing companies would have to notify the Directorate-General for Agricultural Production at the Ministry of Agriculture and Forestry regarding their activities for the organic production of fresh plant products, as well as in the wine and olive sectors. The Directorate, in turn, would transmit the data to the European Commission (INEA 1993, 315).

The Constitutional Court indeed recognized the validity of the arguments put forth by the regions, and in 1993, the temporary suspension of national certification regulations was recorded. To resolve the issue, a Committee of Agreement was established between the regions, the autonomous provinces,

[5] The labeling regulations initially provided for the designation of a product as organic if it was derived from the processing of agricultural products, linking this designation to compliance with a specific set of production standards. The conditions required that non-organic agricultural ingredients did not exceed 5% of the final product's ingredients, that the company underwent specific inspections, and that the production areas were registered in designated records (INEA 1991, 228).

and the Ministry to identify unified actions in this area of activity (INEA 1994, 175)[6]. Subsequently, the organic production method was comprehensively regulated by Legislative Decree No. 220 of March 17, 1995, which governed the organization of the control and certification system for products from organic agriculture (INEA 1997, 337), coming into force in December 1995. The provision established a Committee within the Ministry of Agricultural Resources with the task of evaluating the bodies responsible for controlling organic processes and products. Farmers interested in organic production, in addition to obtaining certifications through control bodies, were also required to notify their activities to the regions or autonomous provinces, which would maintain a list divided into three sections: producers (organic, in conversion, and mixed), preparers, and collectors. Finally, the Ministry would create a national list that also included importers and certifiers.

The issue of certification and technical and administrative controls over production and producing companies became of high importance, as it allowed farmers to benefit from specific production incentives. The inclusion, by virtue of Regulation EEC 2078/92[7], of organic production methods among the agri-environmental measures eligible for aid indeed contributed to the development of organic agriculture. From a substantive perspective, some delays in the approval of regional plans, the actual initiation of programs, bureaucratic complications, and the not particularly high amounts of premiums for annual crops, significantly limited the effects of support measures for organic farming. Despite this, among all the community initiatives for agriculture, incentives for organic production have been the most successful measures. During the early, tumultuous phases of the development of organic production in Italy, it is not possible to obtain specific data on viticulture. However, it may be useful to consider the data on areas already cultivated using organic methods or in the process of conversion to organic methods. As seen in Figure 1, in the first four years following the introduction of regulations on organic production, areas cultivated with this method increased more significantly in the larger islands and the southern regions of Italy[8]. It can be estimated that by the end of April 1996, the areas

[6] In February 1994, with the Law No. 146/94, the Italian State temporarily addressed the issue by recognizing the validity of the determinations made by certification bodies established under previous regulations.

[7] This concerns EEC Regulation No. 2078/92 of the Council of 30 June 1992.

[8] The success of the organic production method is largely attributable to the financial support provided by EU incentive measures for organic farming. Furthermore, it should be noted that the performance of Sicily and Sardinia was influenced by the fact that, in these regions, permanent meadows and pastures were also

cultivated using organic methods for viticulture accounted for 5% of the total organic areas in Italy (INEA 1997, 350)[9].

Despite the significant increase in cultivated areas, organic farming throughout the 1990s was still predominantly practiced by larger agricultural enterprises compared to the national average, mostly with extensive farming systems (INEA 1998, 261) and predominantly located in the continental Southern regions and the larger islands. An in-depth study conducted by INEA in 1997, based on data provided by AIAB, one of the accredited bodies for the certification of organic crops[10], hypothesized that pastures and forage crops constituted approximately 54% of the land cultivated using organic methods. Permanent crops, particularly olive groves (8.7%), followed, while cereals represented 14.5% of the organic areas. In this analysis, it was assumed that vineyards represented only 2.8% of the organic areas in Italy during that same year.

The analysis of land use was outlining a picture of organic farming conditioned by the accompanying measures of the Common Agricultural Policy (CAP), rather than being market-oriented or designed to meet the demand for organic products. The large presence of land dedicated to pastures was, in fact, due to the relative ease of converting extensive livestock farming into organic farming. However, this was not easily justified by market demand alone, given the substantial absence of a national market for organic meat at that time and the lack of specific regulations for the organic livestock sector.

The explanation for this phenomenon was to be found in the premiums granted by EEC Regulation No. 2078/92, which provided generous support to extensive farms[11], which was poorly linked to an increase in environmental benefits or a decrease in farm income during the conversion phase. The larger organic areas in Sicily, Sardinia, and Calabria compared to other Italian regions could be explained by the massive presence of large areas of pasture

eligible for organic farming subsidies. These land types represented the highest percentage of cultivated areas under organic farming during this period.

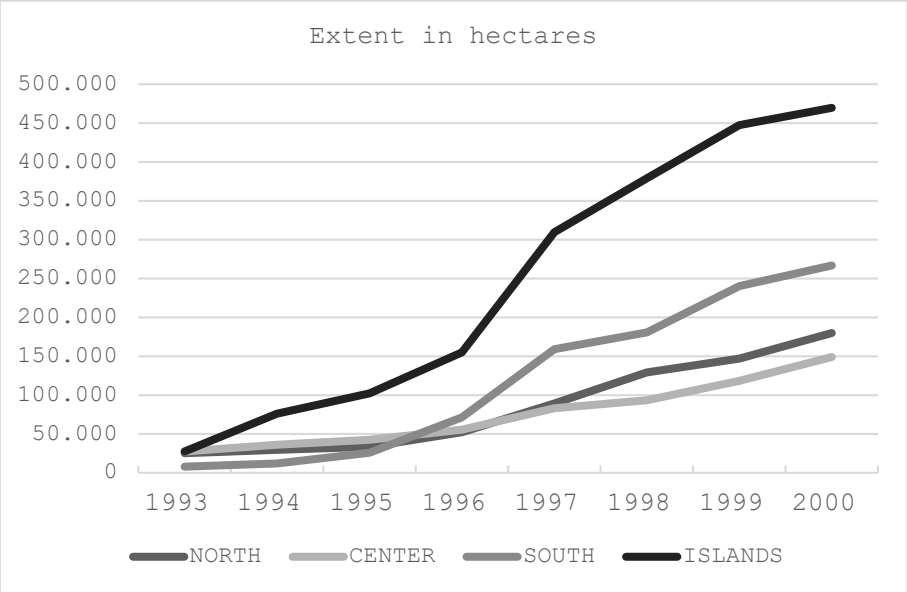
[9] The year 1996 was the last in which data collection on organic farming was conducted centrally by the Ministry of Agricultural Policies. Subsequently, the regulation of organic production was transferred to the regional authorities, and from 1997 onwards, statistical surveys have been centrally managed by ISTAT.

[10] Crop-related information was estimated based on data from approximately 30% of organic farms in Italy, corresponding to AIAB-certified farms (INEA 1997, 261).

[11] In the early 2000s, significant territorial differences emerged in the average per-hectare subsidies associated with agro-biological practices. Some regions implemented measures that provided high per-hectare payments. In Campania, Calabria, and Sicily, where the average subsidy received by farmers in 2001 was approximately 500 euros per hectare, the most widespread measures were integrated farming and organic farming applied to orchards, vineyards, and citrus groves (INEA 2001, 343).

managed using organic methods. These regions, in fact, allowed the disbursement of incentives and subsidies for organic farming, even for pastureland, while this was not permitted in other Italian regions.

Figure 1. Extent of areas cultivated using organic methods by geographical zone (all crops)



Source: INEA 1997, 347; INEA 1998, 260; INEA 1999, 357; INEA 2000, 413; INEA 2001, 330.

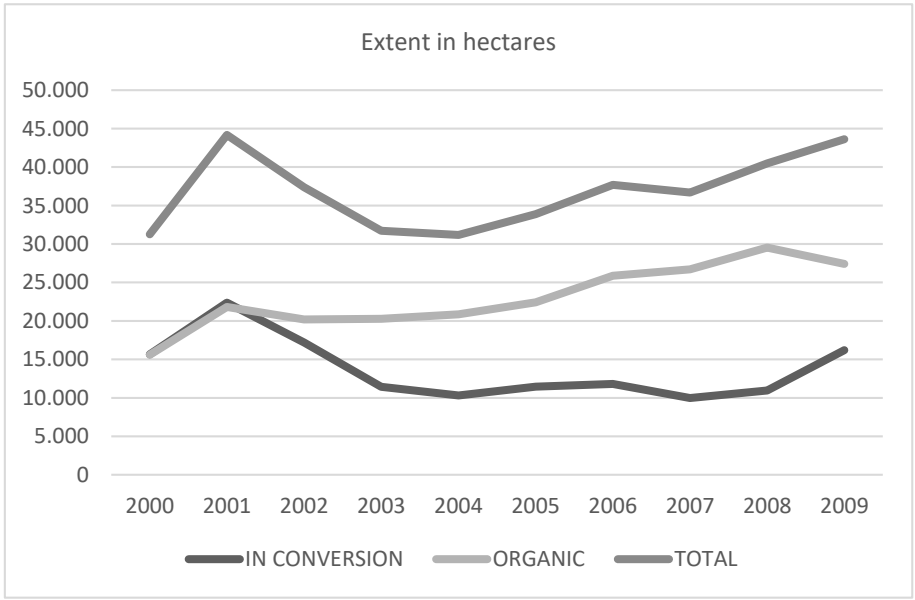
4. Organic viticulture in Italy (2001-2008)

Since 2000, data on the extent of vineyards cultivated using organic farming methods have been collected by the Agency for Agricultural Disbursements (AGEA). From 2000 to 2009, only nationwide macro-aggregated data are available, referring to areas already converted to organic farming and areas in the process of conversion, as reported in Figure 2.

The conversion or transition period to organic farming refers to the three-year timeframe generally required for shifting an orchard or vineyard from conventional cultivation to organic farming methods. This period represents the most complex phase for an organic farm, as it undergoes several critical

challenges from both an agronomic and economic perspective.

Figure 2. Extent of Italian vineyards cultivated using organic methods (2000-2009)



Source: data from SINAB (2000–2009). Data refer to December 31 of each year.

During these years, although production is managed according to organic farming principles, it cannot benefit from the certifications reserved for areas that have fully completed the conversion process. For this reason, land undergoing conversion typically experiences a significant decline in yields, which is much greater than that observed in farms that have long completed their transition to agro-biological techniques. Additionally, during the conversion phase, income losses can occur that are not directly attributable to the reduction in yields. These include: the inability to access the higher market prices generally granted to organic products; specific transformation costs, including investment expenses for new machinery or equipment and disinvestment costs for equipment no longer compatible with the new method; increased technical assistance costs; and expenses related to production control and certification. In some cases, as previously observed, these costs were offset by an increase in subsidies under EEC Regulation No. 2078/92.

However, this was not uniformly implemented across all regions, and the difference in subsidies between the conversion period and the full organic cultivation period was usually negligible.

Considering these factors, it is possible to observe that vineyards, both for wine grape production and for table and drying grapes, showed an expansion trend until 2001. However, starting in 2002, the reduction in EU subsidies led to a contraction of organically cultivated vineyards, resulting in an overall stabilization of organic vineyard surfaces at an average of 35,000 hectares between 2003 and 2006[12].

In the second half of the 2000s, the new Regulation 834/2007 was approved[13], introducing specific rules on winemaking and allowing the production of organic wine from January 1, 2009[14]. However, the legislation remained rather vague, merely listing the processes that were prohibited and those permitted only under certain conditions. Essentially, it was possible to produce organic wine, but the correct procedures for vinification had not yet been clearly defined. Significant debates divided wine producers and EU member states, particularly regarding the use of sulfites. From 2007 onwards, the legislative developments in organic wine production generated moderate optimism among industry operators and led to an increase in vineyard areas cultivated using this production method, encouraging the conversion of new surfaces to organic farming[15].

The new regulation defined organic production as a "holistic farm management and food production system based on the interaction of best environmental practices, a high level of biodiversity, the preservation of natural resources, the application of strict animal welfare criteria, and

[12] The decline in the number of organic farms largely recorded since 2002, and consequently the reduction in organically cultivated areas, is attributable to the termination of EU subsidies provided under Regulation 2078/92. This led to the exit of farms that were unable to place their products on the organic market (INEA 2002, 321).

[13] This refers to EU Council Regulation No. 834/2007 of 28 June 2007 on organic production and the labeling of organic products, which repealed EEC Regulation No. 2092/91. However, the regulation was set to enter into force in 2009, while the technical implementation rules were to be defined in a subsequent regulation (INEA 2007, 343).

[14] The term "organic wines" still referred to wines certified by a third-party certification body in accordance with EU regulations, specifically Regulation (EC) No. 834/07 and Regulation (EC) No. 889/08, primarily concerning the agronomic management of vineyards, that is, the production of grapes from certified organic farming.

[15] Further progress was also made in the field of organic viticulture controls. In 2006, the Central Inspectorate for the Control of Agro-Food Product Quality (formerly ICRF) was renamed ICQ, with a particular focus on high-quality agro-food production, including wines with a designation of origin, as well as PDO, PGI, and organic farming products (INEA, 2006, 98–99).

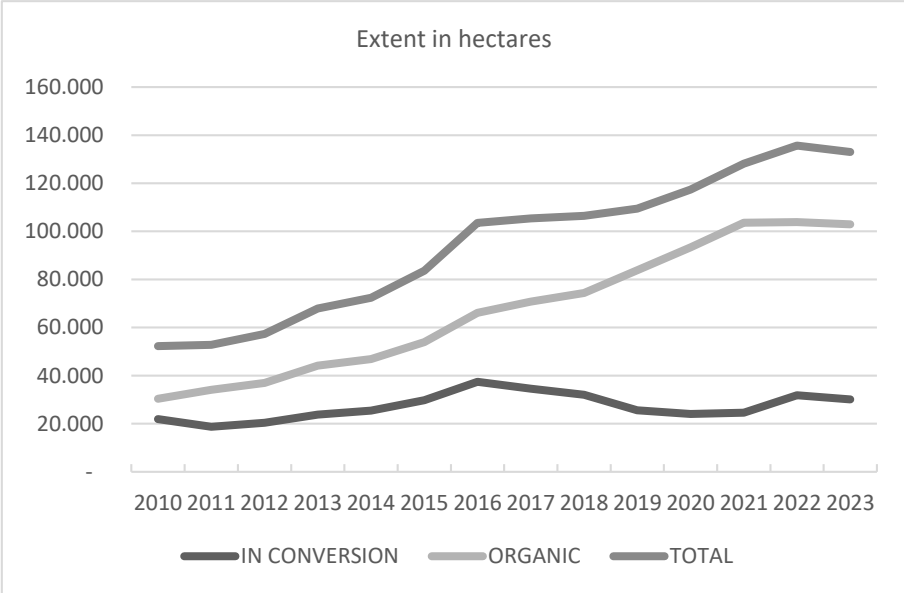
production aligned with consumer preferences for products obtained through natural substances and processes".
Thus, the organic production method was recognized as having a dual social function: it met consumer demand while also providing public goods that contributed to environmental and biodiversity protection, animal welfare, and rural development.

5. Organic Production (2010-2023)

The legislative innovations introduced with Regulation 834/2007 were expected to be effectively implemented starting in 2009, a reasonable timeframe given the need to draft implementing regulations and incorporate these provisions into national legal systems. However, the situation remained unchanged for a considerably longer period. Nevertheless, a qualitative shift in organic agricultural production and investments was observed.

Examining individual crops, an important trend emerged during these years: the decline of extensive farming systems (cereals, forage crops, and pastures), which had characterized the early phase of organic production in Italy, in favor of more intensive (tree-based) cultivation. At the same time, starting in 2007, two concurrent phenomena were recorded: a decrease in the number of farms engaged in organic food production and an increase in the total area cultivated using organic methods. This trend can be attributed to the withdrawal of smaller operators, who could no longer achieve adequate profit margins, alongside the expansion of larger, exclusively organic producers with higher revenues. These larger enterprises were able to internalize multiple stages of the organic supply chain (INEA 2010, 311-313). The growing dominance of production systems characterized by a more structured and consolidated supply chain indicated that participation in the organic system was increasingly the result of deliberate and committed choices, with a particular focus on sustainability.

Figure 3. Extent of Italian vineyards cultivated using organic methods (2010-2023)



Source: SINAB, data extracted from the *Bio in Cifre* publications for each respective year.

In the absence of European regulations on the labeling of organic wines, the first rules applied to the wine sector from 2010 until the summer of 2012 resulted from agreements among private organic winegrowers' associations from France, Italy, Spain, and Switzerland. These associations established the European Organic Wine Charter (EOWC), which effectively became the foundational document for European regulations. These regulations officially marked the introduction of wines labeled as "organic wine" on August 1, 2012. The long-awaited wine regulation, which came into force in 2012, concluded an extensive preparatory phase involving key stakeholders in the supply chain (INEA 2012, 285)[16].

In 2013, European institutions adopted an additional reform aimed at harmonizing and simplifying the framework of the Common Agricultural Policy (CAP). While maintaining the regulatory structure of the 2008 reform, several modifications were introduced for the wine sector, particularly

[16] This refers to EU Council Regulation No. 203/2012 of 8 March 2012.

concerning designations of origin and geographical indications. Furthermore, new rules definitively established methods for organic wine production, improving procedures to enhance environmental sustainability and reduce sulfite levels[17]. The significant regulatory developments of these years were a tangible demonstration of the European institutions' recognition of the wine sector as a crucial element both for environmental conservation and economic development.

When analyzing data on organically cultivated vineyard areas, it becomes evident that the national macroaggregate experienced continuous growth between 2010 and 2023, surpassing 130,000 hectares in the latter year. This figure accounted for 22.8% of the total vineyard area in the country. However, at the end of the 2021-2022 season, organic wine production totaled approximately three million hectoliters, representing only 6% of national wine production (Del Bello et al. 2023, 9).

For the same year, 2022, even considering the lower productivity of vineyards cultivated using organic methods compared to intensive non-organic cultivation, as well as the areas in conversion and those allocated for table grape production (Figure 4)[18], a significant disproportion was observed. According to SINAB data, organically farmed vineyards covered 135,667 hectares, whereas the total vineyard area in Italy was 673,529 hectares according to INEA data (2023, 358). This meant that while organic vineyards represented 20% of the total vineyard surface in Italy, they contributed only 6% of national wine production.

The explanation for this evident imbalance lies in the fact that many farms engaged in organic grape production were mixed operations, combining organically managed vineyards with conventionally farmed areas. These farms benefited from incentives and subsidies tied to certified organic vineyard areas. However, during the winemaking process, the grapes were either processed in facilities not suited for organic wine production or simply vinified together with conventionally grown grapes.

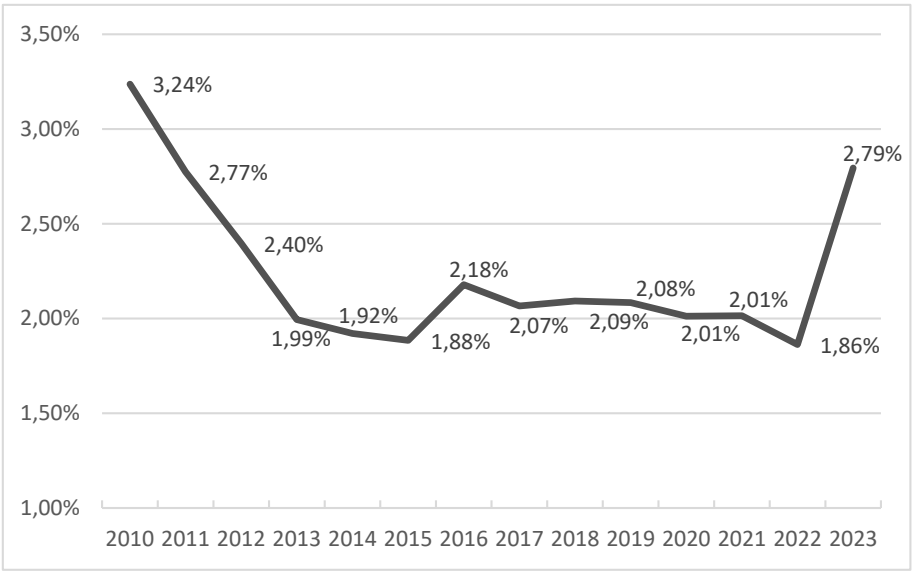
Greater added value could have been derived from organic production by

[17] The new regulation established a subset of enological practices and restrictions applicable to organic wines. For example, sorbic acid, de-sulfurization, and thermal treatments were not permitted, and the level of sulfites in organic wine must be at least 30–50 mg/L lower than their conventional equivalent (depending on the residual sugar content). In addition to this subset of specific rules, the general winemaking rules defined in the regulations also apply (Laureati and Pagliarini, 2016, 186).

[18] The conversion areas remained stable at around 20,000-30,000 hectares annually (Figure 3), and the already converted areas showed a progressive increase in organic vineyards, mostly intended for wine grape production, with only a small portion, ranging from 2 to 3%, allocated to table grape production (Figure 4).

encouraging producers to complete the entire supply chain, thereby increasing the quantity of certified organic wine. While there remained significant room for improvement in optimizing the organic wine supply chain, it is essential to emphasize the substantial contribution of organic vineyards to sustainability, particularly regarding environmental conservation and ecosystem protection.

Figure 4. Ratio of organic table grape vineyard areas to organic wine grape vineyard areas in Italy (2010-2023)

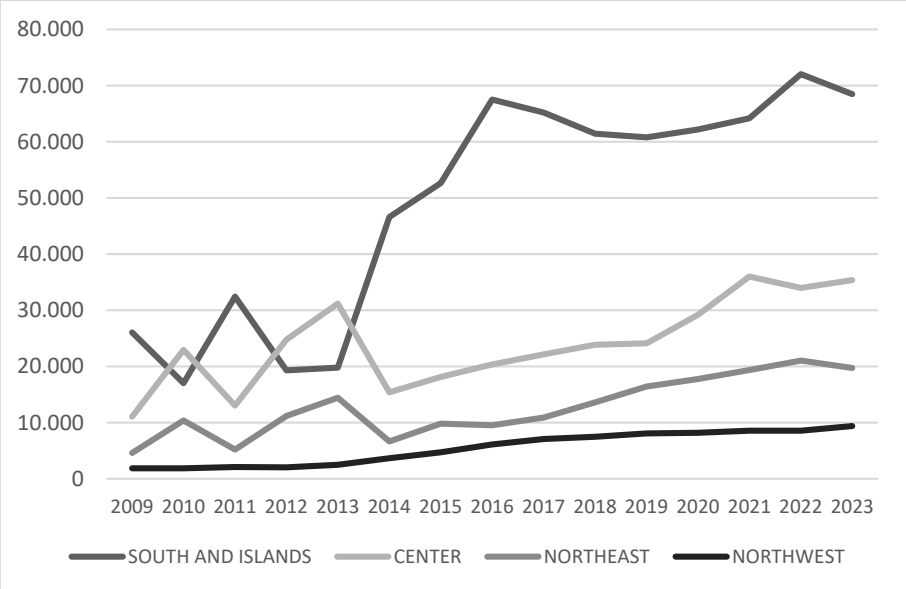


Source: SINAB, data extracted from the *Bio in Cifre* publications for each respective year.

The growth of vineyard surfaces cultivated using organic methods since 2016 has also been accompanied, over the years, by notable business dynamism in terms of innovation and productivity. In some cases, producing companies have undertaken diversified strategies to increase and stabilize their incomes, such as integrating their distribution channels with direct sales at the company site to establish a connection with consumers and foster loyalty (ISMEA 2020, 9). Furthermore, producers have demonstrated an increasing ability to efficiently communicate the quality of their products, often diversifying into activities related to production, such as agritourism. The product was thus enriched with experiential content that could add value,

participating, for example, in wine tourism projects and gastronomic routes, similarly to what has occurred in other European countries (Szonolki and Tafel 2022).

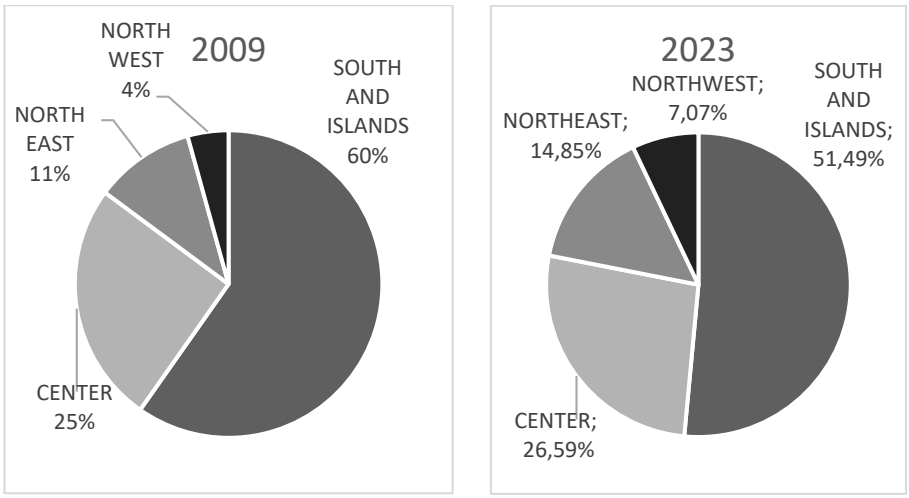
Figure 5. Extension of organic vineyard areas by geographical region in Italy (organic and conversion areas)



Source: SINAB, data from *Bio in Cifre* publications for each year.

When analyzing the extent of vineyards cultivated using organic methods in Italy, it can be observed that they are predominantly found in the Southern regions (Figure 5), with the highest concentration in Sicily and Puglia. The reasons for the increase in organic vineyards in the southern regions are attributable to a combination of environmental factors, including the climate, which favors a reduced need for phytosanitary treatments. Additionally, economic and social factors play a significant role, particularly the economic sustainability of organic production and production incentives that help increase the profitability of vineyards in areas where capital is scarce for investing in tools more suited to intensive cultivation.

Figure 6. Distribution of organic vineyard areas by geographical region in Italy (years 2009 and 2023)



Source: SINAB, data from *Bio in Cifre* publications for 2009 and 2023.

A separate discussion is warranted for certain central regions of Italy, such as Tuscany and Marche, where the increase in organic vineyards is partly driven by the high demand for organic wines characteristic of these areas. According to an IMEA-Nielsen report from 2022, the highest concentration of organic wine sales is found in central Italy (including Sardinia), accounting for 41.6%, followed by the Northwest with 26.8% and the Northeast with 16.4%. Only 15.4% of organic wine sales were recorded in the South during that year (Del Bello et al. 2023).

At the provincial level, the areas with the largest organic vineyard surfaces in the 2019-2020 campaign were Trapani (14,000 hectares), Siena (6,795 hectares), and Foggia (5,433 hectares). In relative terms, the provinces with the highest percentage of organic vineyards compared to the total vineyard area were Ascoli Piceno (50.5%), Crotone (46.6%), and Pisa (38.5%) (SINAB 2021). Finally, considering the percentage distribution of vineyard areas cultivated using organic methods, it can be observed that there are no significant variations between 2009 and 2023. The data show only a slight decline in the incidence of southern regions, offset by an increase of 2 to 3 percentage points in other areas of the country (Figure 6).

6. Final Remarks

The introduction of specific regulations on organic farming in the early 1990s officially marked the beginning of organic production in Italy. After an initial period of uncertainty following the implementation of these regulations, the areas cultivated using organic methods progressively increased, primarily driven by incentives and production subsidies provided by institutions. Consequently, in the following years, organic farming expanded when financial incentives were introduced in new areas and contracted when these incentives were reduced in value or eliminated by new regional regulations. This was the case, for example, with the expansion of organic production in Basilicata in 2005 and Calabria in 2006 (INEA 2007, 339).

Initially, organic wine production was not covered by regulations on organic farming; wine labels could indicate the quality of the grapes used but could not certify the characteristics of the winemaking process. It was only in 2012 that more precise and detailed regulations on organic wine provided the necessary framework for certified winemaking, thereby creating additional added value for producers and industry operators.

The distribution of organic vineyards in Italy has shown a higher concentration of cultivated areas in the South due to climatic factors, as well as economic and social reasons. The southern regions have greatly benefited from incentives aimed at promoting more sustainable production practices. As a result, southern farms seized the opportunity to enhance their profitability margins. Moreover, the growing demand for organic wines, both in Italy and internationally, fueled by increased consumer awareness, has led many wineries in Central and Southern Italy to invest in this type of production to access more profitable markets.

Although the cultivated areas using organic methods have expanded significantly over the past decades, much remains to be done concerning the rest of the supply chain. Only a portion of the grapes harvested from these organic vineyards is actually used for the production of organic wine. This issue must be addressed in the coming years to ensure that producers and industry operators can derive greater added value from organically cultivated production.

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Ada Di Nucci[1]

THE ABRUZZO AGRI-FOOD SMEs BETWEEN TRADITION, INNOVATION, AND SUSTAINABILITY

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Abstract

This study analyzes the role of small and medium-sized agri-food enterprises (SMEs) in Abruzzo in the transition towards sustainable practices during the 20th and 21st centuries. These enterprises, successfully combining tradition, innovation, and sustainability, have contributed to the region's economic development. Their commitment to sustainability has been essential, as the agri-food sector, while acting as a driver of innovation, has also played a role in environmental impact.

Building on Yin's (2009) case study methodology and Stake's (1995) qualitative multiple-case approach, this research focuses on three companies - Adi Apicoltura srl, Casina Rossa srl, and Aureli Mario s.s. agricola - that have effectively integrated sustainable practices into their production and commercial strategies while maintaining strong ties to local traditions. Through the analysis of corporate documentation, oral sources, and relevant economic literature, this study examines how the adoption of sustainable practices has influenced the competitiveness of these Abruzzo-based agri-food SMEs. Specifically, it highlights how these businesses have transformed raw materials into unique traditional products, certified for excellence according to international quality standards.

This case study of the Abruzzo agri-food sector demonstrates how sustainability, reinforced by a strong sense of corporate responsibility, can become a key factor in harmonizing innovation with respect for the local

[1]Department of Socio-Economic, Management and Statistical Studies University Centre "Ud'A", University G. D'Annunzio, Viale Pindaro 42, 65127, Pescara, Italy; *e-mail address*: ada.dinucci@unich.it.

territory.

JEL CLASSIFICATION: N50, N53, N63, N83, N90

KEYWORDS: AGRI-FOOD SMES, INNOVATION, SUSTAINABILITY, ITALY, TERRITORIAL DEVELOPMENT

1. Introduction

The agri-food sector is one of the primary drivers of a region's economic, social, and environmental development, where tradition and innovation converge to create a resilient and sustainable system (Platania et al. 2015; Diether and Effernberger 2012; Schultz 1964). Through their activities, enterprises in this sector play a crucial role in supporting local communities. On the one hand, they contribute to job creation, helping to counteract depopulation in rural areas. On the other, they produce high-quality food products that, beyond their economic value, represent a key element of cultural heritage (Ray 1998; Terluin 2003). This process has not only strengthened local identities but has also provided a tangible opportunity to enhance the value of the involved territories (Brunori and Rossi 2000; Marsden et al. 2000).

The increasing awareness of the economic, social, and environmental benefits generated by the agri-food sector has encouraged numerous producers to innovate their operational models by adopting sustainable and advanced practices. While traditional processing techniques, passed down through generations, have ensured the preservation and authenticity of food products, the introduction of innovative technologies has enhanced productivity, enabling businesses to face the competitive challenges of the global market. This balance between tradition and innovation has transformed many small and medium-sized agri-food enterprises into dynamic businesses capable of competing in national and international markets without compromising the quality and authenticity of their products (Vallone and Iannone 2016). Furthermore, the production of high-quality food has emerged as a strategic driver of local development, attracting visitors interested not only in regional flavors but also in the stories and traditions that shape the production environment. This has created a virtuous cycle, significantly contributing to the growth of food and wine tourism.

Despite these positive effects, the agri-food sector is also partly responsible

for global warming, water pollution, high electricity consumption, greenhouse gas emissions, and the production of organic waste (Faccilongo et al. 2017). Consequently, agri-food SMEs, strongly influenced by the diversity of soil and climatic conditions and by European and national regulations, have gradually implemented strategies aimed at reducing their environmental impact and promoting more sustainable production models (Platania et al. 2015).

In this context, Abruzzo stands out as a virtuous example of local resource enhancement in a globalized environment. The diversity and excellence of its agri-food production range from traditional sectors, such as fine wines, extra virgin olive oil, artisanal cheeses, and traditional cured meats, to enterprises operating in less conventional sectors. Agri-food SMEs such as Adi Apicoltura srl, Casina Rossa srl, and Aureli Mario s.s. agricola actively experiment with how the transition toward sustainable models can enhance business competitiveness while strengthening the synergy between innovation and territorial identity.

This study, based on an analysis of corporate archival documentation, oral sources, and relevant economic literature, examines the transition of these agri-food SMEs, operating in less explored sectors, toward environmental, economic, and social sustainability. In particular, the research investigates how these businesses have transformed external pressures (both regulatory and market-driven) related to sustainability into opportunities for growth, effectively integrating tradition, innovation, and environmental responsibility.

The structure of this paper is as follows: Section 2 outlines the economic literature on sustainability in the agri-food sector, including methodology and sources. Section 3 discusses sustainability regulations in agriculture, while Section 4 examines the evolution of agri-food SMEs in Abruzzo. Section 5, divided into several subsections, presents the case studies analyzed. Section 6 provides a comparative analysis of the studied cases, and finally, Section 7 presents the conclusions.

2. Stat of the art

The literature on sustainability in the agri-food sector is extensive, encompassing contributions that range from the analysis of global socio-economic phenomena to specific studies on local contexts. However, research on the transition process of agri-food SMEs toward a low-carbon economy remains partially explored (Vallone and Iannone 2016), particularly

concerning long-term dynamics. In contrast, numerous studies have focused on sustainability strategies adopted by large agri-food corporations (Faleri 2022, 449-467; Scavarda et al. 2021; Crisci and Fonte 2014, 2-6; Paoloni 2011, 25-56). Recent studies highlight how this sector, at both regional and sub-regional levels, significantly contributes to rural area development, thanks to its substantial role in employment generation and the presence of high-quality agri-food production (Ilbery and Kneafsey 2000; Kneafsey et al. 2001; Marsden et al. 2000; Murdoch et al. 2000; Parrott et al. 2002; Tregear et al. 2007).

There is no doubt that, in general, agri-food enterprises have had to "change the lenses through which they view the world" (Bastioli 2024, 15). The transition toward sustainability has not been immediate; rather, it has been a gradual process requiring regulatory and cultural adaptation. To address the various challenges posed by climate change and respond to political pressures regarding environmental protection (Habat and Lagerkvist 2024), many companies have accelerated their transition toward greater environmental sustainability in line with the Sustainable Development Goals and the European Green Deal (Apostolopoulos et al. 2018; Stein and Santini 2022).

However, the relationship between business activities and sustainability has often been contradictory, as enterprises, according to Geoffrey Jones (2017), have frequently had to balance conflicting objectives: on one side, increasing profits, and on the other, reducing their environmental impact (Fornasari et al. 2022, 145). Nevertheless, some companies have embraced sustainability as a *conditio sine qua non* for their production processes, transforming it into an engine of innovation (Palmi et al. 2020). Over time, the adoption of circular economy models and the use of renewable energy sources have become quasi-mandatory business choices due to legislative directives, particularly to mitigate the adverse effects of climate change (de Hoop et al. 2022).

Not all enterprises, however, have adapted at the same pace. Some companies have chosen a more gradual approach, carefully evaluating the costs and benefits associated with the ecological transition phase. Recent studies have demonstrated that sustainability is not merely a regulatory constraint but is gradually becoming a strategic factor for business competitiveness (Cavernago et al. 2015). In reality, sustainability strategies are not limited exclusively to production but also extend to the adoption of digital technologies (Bohnsack et al. 2022; Deirmentzoglou and Deirmentzoglou 2022). The introduction of digital solutions in the agri-food sector has significantly reduced environmental impacts (Mäkitie et al. 2023).

In recent years, many SMEs have invested in digitalization to promote their "sustainable" products in the global market (Apostolopoulos and Petropuolo 2024). Other companies, instead, have leveraged social media to raise consumer awareness and encourage sustainable behavior (Galeotti and Filocamo 2024).

Nonetheless, despite leading the sector's modernization, some agri-food SMEs have remained constrained by technological and organizational barriers (Chandler 1980). As a result, they have often overlooked environmental implications, favoring energy-intensive and highly polluting production processes (Bergquist 2019a). This tendency, compounded by prolonged dependence on fossil fuels, pesticides, chemical fertilizers, and polluting industrial processes, has made the transition toward more sustainable production even more challenging (Moffet 2013), often perceiving it as an obstacle to productivity (Oreskes and Conway 2010).

For these reasons, environmental concerns have gradually been incorporated into corporate strategies, although the transition process has been long and complex (Berghoff and Rome 2017; Bergquist 2019b). As previously mentioned, existing literature has primarily analyzed the transition process in large agri-food enterprises and their environmental impact while neglecting SMEs in the sector. Unlike large corporations, these smaller enterprises have not only had to reduce their ecological footprint but have also played a crucial role in promoting Triple Bottom Line growth, economic, environmental, and social, within local communities (Elkington 1994, 1997). This perspective is particularly useful in understanding the case of the Abruzzo agri-food SMEs analyzed, which operate in a context where sustainability must be integrated with tradition and territorial development.

This study aims to investigate how Abruzzo's agri-food SMEs operating in less explored sectors, despite their production barriers (Chandler 1980), have addressed environmental, economic, and social sustainability challenges through a strong sense of corporate responsibility. The research examines how these enterprises have transformed sustainability from a challenge into a competitive growth strategy, contributing to territorial enhancement and the development of a resilient and sustainable economy.

The research methodology is based on a qualitative approach following Richard Yin's (2009) case study method, employing a multiple-case perspective as suggested by Robert Stake (1995). This method allows for an in-depth examination of business dynamics (Berends and Deken 2019),

observing each company as a "standalone case" (Eisenhardt 2002, 88-91) and assessing the sustainability strategies implemented by agri-food SMEs through the Triple Bottom Line framework (Elkington 1994), which considers the economic, social, and environmental dimensions of sustainability.

The analysis is based on corporate documents archived by the studied companies and informal interviews conducted with their owners/entrepreneurs. The objective is to explore innovation strategies, investments in sustainability, and the challenges faced in complying with regulatory requirements while accessing the global market.

3. Regulations, Sustainability and Agriculture

In recent decades, the growing awareness of the environmental impact of agricultural practices has led to the introduction of European and national regulations aimed at promoting sustainable production models and ensuring food safety. The concept of organic farming in Europe is not a recent phenomenon but has its roots in alternative production models developed in the mid-20th century. As early as 1946, inspired by Rudolf Steiner's theories (UNESCO 1994) and the initiatives of the Soil Association in the United Kingdom, agricultural practices focusing on soil fertility and biodiversity conservation began to spread. These efforts led to the establishment of the International Federation of Organic Agriculture Movements (IFOAM), which standardized organic farming principles at the international level (Simoncelli 2020).

In 1991, Europe began formal regulatory oversight with Regulation (EC) No. 2092/91, later replaced by Regulation (EU) No. 834/07, which introduced stricter criteria for the use of fertilizers, pesticides, and eco-friendly cultivation methods. Over time, as the sector expanded (FiBL and IFOAM 2021), a regulatory revision became necessary, culminating in Regulation (EU) No. 848/18, which came into effect in 2022. This regulation introduced key innovations, including group certification to facilitate small enterprises and a compliance principle for imports to ensure uniform international standards.

Alongside organic farming regulations, other policies have influenced the agri-food sector, imposing new sustainability standards. The Kyoto Protocol (1997) incentivized low-emission agricultural practices, recognizing the sector's role in greenhouse gas emissions. The EU Renewable Energy Directive (2001) encouraged businesses to adopt biomass, solar, and wind energy systems to reduce reliance on fossil fuels (European Renewable

Energy Directive, 2001). In 2002, Regulation (EC) No. 178/2002 introduced the requirement for traceability throughout the entire agri-food supply chain to enhance product quality and transparency. At the national level, Legislative Decree No. 152/2006 strengthened environmental protection measures and sustainable water resource management, promoting a more responsible use of natural resources (Lonigro et al. 2007, 217-259). A few years later, in 2018, Regulation (EU) No. 848/18 set stricter criteria for organic certification, further encouraging investments in sustainable agricultural practices and biodiversity conservation.

These regulations have played a crucial role in shaping the evolution of agri-food enterprises, driving them to integrate sustainability into their strategies. Throughout the 20th century, numerous Italian agri-food companies, at different times and in various ways, implemented concrete actions to reduce reliance on non-renewable resources, minimize the environmental impact of production activities, and improve working conditions and the quality of life in local communities (Viaggi 2010).

Among the initiatives undertaken, some companies have chosen to implement regenerative agricultural practices, such as crop rotation and cover cropping, which enhance soil productivity, promote biodiversity, reduce the need for chemical inputs, and create a more resilient agricultural environment (Pronti and Bertinaria 2017; Gilioli et al. 2020, 69-76). Others have directed their investments toward renewable energy sources, such as solar and wind power, reducing carbon dioxide emissions while simultaneously achieving cost savings in operations (Boccia and Covino 2016).

Meanwhile, beyond adopting individual sustainable practices, some enterprises have focused on transitioning from a linear to a circular production model. This shift represents a true revolution in organic waste management, based on a "take-produce-use-recycle" model (Giannola and Imbriani 2024), in which waste is considered a resource to be valorized. Through this innovative reconfiguration of production processes, organic waste is no longer discarded, as it was in the linear model, but recovered and reintegrated into other production cycles. Similarly, pollutant gas emissions from production waste are reduced and repurposed as renewable energy, thereby closing the sustainability loop.

This growing trend among national agri-food enterprises toward environmental and social sustainability is also reflected in the Abruzzo agri-food SMEs.

4. The Transition of Abruzzo's Agri-Food SMEs Toward Sustainability

Throughout the 20th century, Abruzzo's agri-food SMEs faced numerous challenges. However, through the adoption of modern technologies and the innovation of production processes, they successfully enhanced the value of local raw materials. This allowed them to transform traditional products into recognized excellences, safeguarded by European quality labels and destined for both national and international markets.

The introduction of digital technologies facilitated the creation of "networks" among enterprises, improving business process efficiency and strengthening the competitiveness of SMEs in the global market (Fantini and Valente 2014). In this regard, a study conducted in 2010 by the Agri-Food Innovation Hub for the Abruzzo Region (AGIRE Scarl) revealed that Abruzzo's agri-food enterprises exhibit a higher-than-average propensity for innovation compared to the national level. This inclination toward innovation has significantly contributed to the sector's success, which today represents a pillar of the regional economy. Over the past decade, the trade balance has shown a positive trend, with exports growing at a faster rate than imports.

One of the key factors driving the successful ecological transition of Abruzzo's SMEs has been a shift in entrepreneurial mindset. Business owners realized the need to modify their modus operandi, adopting sustainability not just as an obligation but as a powerful tool to "do more with less" (Bastioli 2024). This evolution, grounded in a strong sense of corporate responsibility, has enabled Abruzzo's agri-food SMEs to establish themselves at both national and international levels. As a result, the region's agri-food sector has become a model of resilience and adaptability, demonstrating how the balance between tradition and innovation is essential for economic success.

This is precisely the case for three Abruzzo-based agri-food SMEs: Adi Apicoltura srl, Casina Rossa srl, and Aureli Mario s.s. agricola. These family-run businesses have remained deeply rooted in their cultural traditions while producing high-quality foods certified under the PDO (Protected Designation of Origin) and PGI (Protected Geographical Indication) labels. As previously mentioned, these enterprises are analyzed using Yin's (2009) case study method to assess the importance of transformation strategies adopted by each company. Their approaches are then compared following Stake's (1995) multiple-case study methodology to identify commonalities and differences in their sustainability transitions.

5. The Sustainability Strategies of the Business Cases

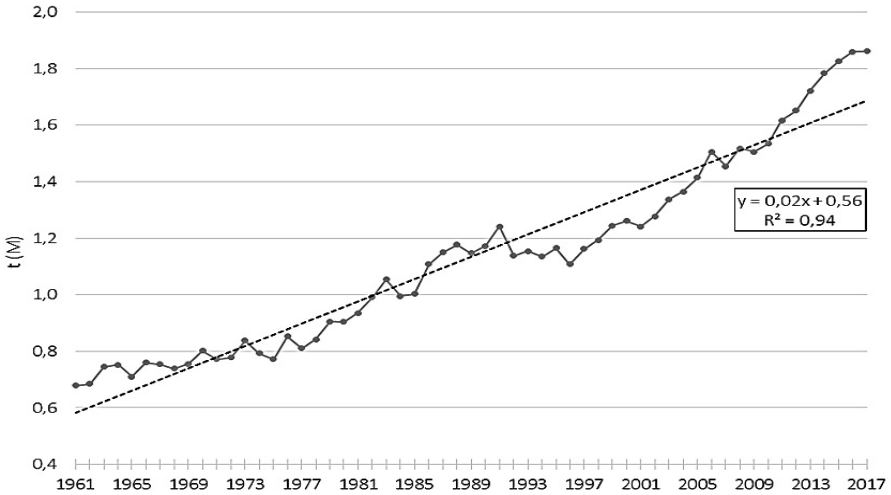
5.1 Adi Apicoltura srl

Adi Apicoltura srl has specialized in the production of high-quality organic honey, establishing itself as an Italian excellence in the national beekeeping sector (Forbes, 2021, https://leonardo.it/news/eccellenze-italiane-food-2020-forbes/). Founded in 1858 by Giuseppantonio Iacovanelli in Tornareccio, a small village in Abruzzo, the company introduced a major innovation to Italian apiculture in the late 1950s when it was among the first in Italy to experiment with the "nomadic beekeeping" technique (Iacovanelli D., oral interview, May 2024).

This practice involved moving beehives overnight in accordance with the seasonal blooms of the main nectar-producing plants. The technique had a dual purpose: to ensure a constant food supply for bees and to optimize honey production throughout the year. This revolutionary method, later adopted by many beekeepers first at the local level and then nationwide, earned the founder the title of "Pioneer of Bees", awarded in the 1970s by the Association of Abruzzo Beekeepers (Iacovanelli D., oral interview, May 2024).

Starting from the 1960s, while nomadic beekeeping became widespread in the national beekeeping sector, honey production in Italy experienced significant growth. This expansion was partly driven by a shortage of sugar beet, which led many consumers to choose honey as a natural alternative to sugar. However, the subsequent production increase also brought about environmental challenges, such as water pollution caused by the washing of machinery with solvents and the higher energy consumption required for melting crystallized honey. These environmentally harmful practices persisted over the following years due to a series of obstacles defined by Chandler (1980) as "technological or organizational barriers", which slowed down the transition to more sustainable production methods.

Figure 1. Honey Production in Italy (1961-2017)



Source: https://www.researchgate.net/figure/Figura-61-Andamento-della-produzione-di-miele-globale_fig1_333396048

Adi Apicoltura, despite being traditionally tied to conventional beekeeping technologies and lacking a well-structured distribution network for honey, gradually began to adopt regenerative beekeeping practices and invest in sustainable technologies. In 1997, the company, now led by brothers Piero and Fabio Iacovanelli (the fourth generation of the family), took a decisive step toward sustainability by voluntarily initiating the production of 100% Italian organic honey. This responsible decision marked a significant turning point toward environmentally friendly and biodiversity-conscious practices, anticipating future market demands for sustainability.

According to Weber (2012), an entrepreneur following this model does not act solely to comply with regulatory obligations but rather makes an ethical, voluntary choice, driven by a business vision focused on the common good. From this perspective, and according to Yin's (2009) approach, the case of Adi Apicoltura represents an important example of how enterprises, despite facing technological and organizational barriers, have successfully undergone a structural transition. In fact, the sustainable practices adopted by Adi Apicoltura srl have become its new modus operandi, in which resource management for high-quality food production is integrated with a strong

commitment to environmental sustainability and consumer well-being.

To achieve organic beekeeping, the company introduced several innovative measures that reduced environmental impact and improved the quality of its honey.

Among these measures, the company drastically reduced the use of pesticides and antibiotics, eliminating substances harmful to bees and the surrounding ecosystem. To protect beehives from temperature fluctuations and atmospheric agents, it opted for natural linseed oil-based paints, avoiding aggressive chemical products and ensuring bee safety while preserving honey quality.

Another key aspect of environmental sustainability was biodiversity conservation. The company created protected areas where bees could feed on a diverse range of plants, promoting the reintroduction of native plant species at risk of extinction. This method contributed to preserving ecological balance and supporting bee health.

To further enhance product quality, Adi Apicoltura introduced a cold crystallization system for honey (Iacovanelli D., oral interview, May 2024). This process allows for the preservation of the honey's organoleptic properties without subjecting it to high temperatures. Instead, the crystallization occurs at a low temperature, preventing the alteration of its natural characteristics while also reducing excessive electricity consumption (Piana, 1994).

Regarding resource management, Adi Apicoltura implemented rainwater harvesting systems, reducing water waste, and adopted low-emission transport methods to limit greenhouse gas emissions. Additionally, the company invested in energy efficiency, installing photovoltaic systems to power machinery with renewable energy.

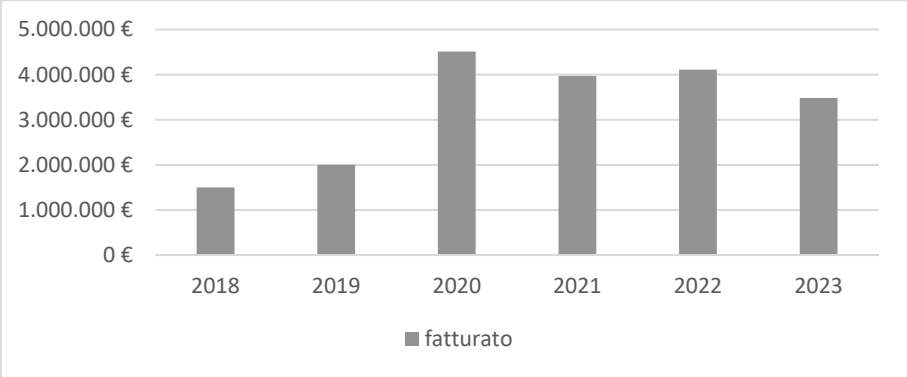
Waste management also followed sustainability principles: beeswax was recovered and repurposed, while non-recyclable waste, such as printer toner, was disposed of through specialized waste management companies, preventing soil and water pollution (Iacovanelli D., oral interview, May 2024).

Thanks to these initiatives, Adi Apicoltura, anticipating European regulations on product traceability and organic quality standards, gained several competitive advantages. The company expanded its production lines with new honey varieties that have received prestigious national and international certifications, including: British Retail Consortium di Bureau Veritas, l'International Food Standard, Star-K-Kosher e da Bio Agricert, Print Releaf, 100% Green Power, Usda Organic e Canada Organic.

Today, Adi Apicoltura's honey is exported worldwide, with particularly

high demand from the United States and Canada for its hazelnut cream and honey cream, valued for their high-energy properties. Despite the company's decision to maintain limited production, at approximately 500,000-600,000 jars of honey per year, to preserve product quality (https://forbes.it/eccellenza/adi-apicultura/), its revenue has consistently grown, reaching around 4 million euros.

Figure 2. Adi Apicoltura Revenue Distribution (2018–2023)



Source: https://m.fatturatoitalia.it/adi_distribuzione_srl-02602960698

Currently, Adi Apicoltura srl manages a beekeeping heritage of over 2,000 hives, involving numerous local and national beekeepers, thereby consolidating a wide, environmentally friendly production network. The company's success has contributed to enhancing the town of Tornareccio, known as the "Land of Honey" (Bell'Italia 2019), thereby promoting the local territory and tourism.

5.2 Casina Rossa srl

Another notable agri-food business in the Abruzzo region that has successfully combined tradition, innovation, and sustainability is Casina Rossa srl, owned by the De Laurentiis family. Founded in 1956 by Antonio De Laurentiis in Roccascalegna, a picturesque medieval village in the province of Chieti, the company underwent several phases of transformation before becoming a benchmark for sustainable food production. Initially, Casina Rossa started as a sole proprietorship, specializing in the production

and sale of olive oil (Spadetto P., oral interview, May 2024).

However, starting in 1999, under the management of Nicola De Laurentiis (son) and Paola Spadetto (daughter-in-law), the company expanded its product range, overcoming technological and production challenges, referred to by Chandler (1980) as technological barriers. This transformation allowed Casina Rossa to establish itself as a key player in sustainable high-quality food production (https://www.casinarossa.com/la-famiglia/).

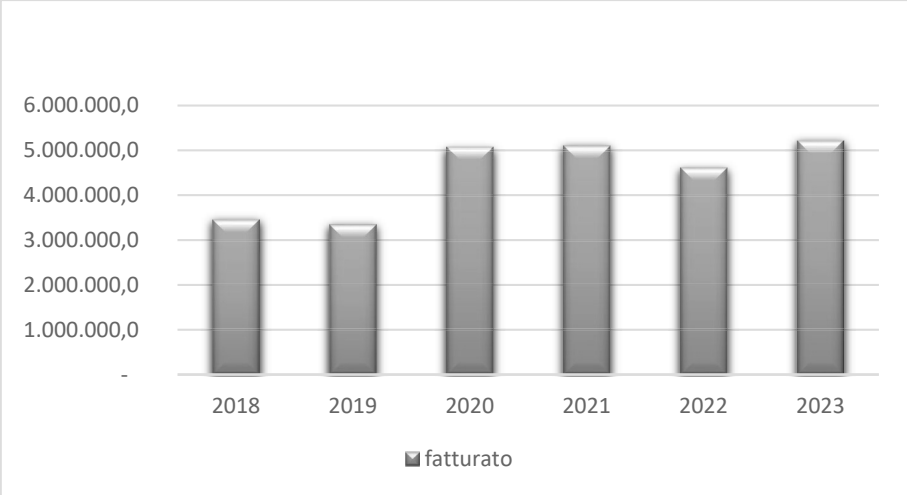
The transition toward sustainability, however, was not simple but rather a gradual adaptation process. According to Yin's (2009) case study analysis, examining a case like Casina Rossa could provide valuable insights into how the company progressively overcame production and technological barriers. These included reducing the use of plastic and replacing hard-to-substitute materials without significantly increasing production costs.

To achieve organic food production, Casina Rossa adopted innovative and sustainable techniques, such as: reducing the use of chemical substances in agriculture; introducing eco-friendly farming practices, including organic farming and crop rotation; optimizing water resource management by implementing drip irrigation systems, as promoted by Legislative Decree No. 152/2006.

Additionally, the company installed a photovoltaic system to reduce electricity consumption and implemented low-energy consumption systems, effectively balancing efficiency and environmental responsibility.

Regarding waste management, Casina Rossa introduced recycling and composting practices to minimize environmental impact, transforming waste into resources (Spadetto P., oral interview, May 2024).

Figure 3. Casina Rossa srl Revenue (2018–2023)



Fonte: https://www.fatturatoitalia.it/casina_rossa_srl-02609220690

Following this new corporate philosophy, in 2017, the company transitioned into a capital company, expanding its market reach to over 40 countries and achieving a turnover of 5 million euros in 2020. Additionally, Casina Rossa, thanks to its strategic decision to implement certified production processes (in compliance with Regulation (EC) No. 178/2002), has received numerous awards and recognitions for its commitment to sustainable, high-quality food production. Among these, a significant achievement was its success at the Superior Taste Award in June 2021, where its organic tomato purée and flavored salts, particularly truffle salt, received prestigious accolades (Spadetto P., oral interview, May 2024).

These awards not only validate the quality of Casina Rossa's products but also reflect the company's continuous commitment to environmentally friendly and sustainable agricultural practices.

Casina Rossa's truffle salt, saffron salt, and tomato purée have also been included in the Touring Club Italiano guide, further promoting gastronomic tourism in the region.

Ultimately, Casina Rossa has established itself as a symbol of excellence, successfully enhancing the authentic flavors of the Abruzzo region while promoting sustainable agriculture. The company has become a benchmark for

other farmers, inspiring them to embrace environmentally responsible practices (https://www.casinarossa.com/produzione/).

Thanks to its commitment to quality and environmental sustainability, Casina Rossa has played a key role in positioning Roccascalegna as a prominent destination for gastronomic tourism. The town has been included in the Touring Club guide, attracting numerous tourists and visitors eager to taste traditional local products and explore the natural and cultural beauty of the region (https://www.touringclub.it/destinazioni/roccascalegna).

5.3 Aureli Mario s.s. agricola

Another entrepreneurial reality that has made sustainability its core pillar is Aureli Mario, a company founded in 1968 by an entrepreneur from Ortucchio, a small town in the Fucino region. After a trip to California, Mario Aureli had a revolutionary idea: to cultivate carrots and transform them into innovative products, such as carrot juice and carrot flour (Aureli A., oral interview, May 2024).

This entrepreneurial vision was based on territorial valorization, innovation in production processes, and the reuse of agricultural waste, converting it into raw materials for new production cycles. However, as observed in the other case studies, the transition to sustainability for Aureli Mario was not immediate but was hindered by technological and production barriers (Chandler, 1980).

According to Yin's (2009) case study approach, the case of Aureli Mario s.s. agricola represents a significant example of how a company can successfully undergo a structural transition toward sustainability, despite the complex challenges associated with the agricultural sector. In particular, the company had to overcome a production context strongly dependent on chemical fertilizers and fossil fuels, factors that have traditionally impeded the adoption of more ecological models.

However, thanks to the strategic vision of founder Mario Aureli and, later, his children, the company embarked on a progressive innovation journey, implementing several sustainable processes (Aureli A., oral interview, May 2024).

These transformations included: the adoption of organic farming, reducing the use of pesticides and fertilizers; the implementation of zero-residue farming, integrating guided pest control and integrated pest management techniques to reduce chemical fertilizer use by up to 70%.

(https://www.aurelimario.com/coltivazioni); logistics optimization, by localizing crop cultivation within a 50 km radius of the processing facility to minimize the environmental impact of transportation; investments in water conservation, through recycling and purification systems to reduce water consumption; energy transition, by installing a photovoltaic system on production facilities, significantly reducing electricity consumption. (https://www.aurelimario.com/sostenibilit%C3%A).

Additionally, in 2010, Aureli Mario s.s. agricola took another significant step toward sustainability. In response to the EU Renewable Energy Directive (2001), the company invested in a 1 MW biomass plant, further advancing its commitment to renewable energy (https://www.aurelimario.com/sostenibilit%C3%A0). Through this biomass plant, agricultural waste is converted into biogas via an anaerobic fermentation process, producing electricity that is supplied to the national grid. Within the biomass plant fermenter, a diverse community of bacteria plays a crucial role in the degradation of organic matter.

Beyond biogas production, which is used to generate renewable energy, another significant outcome of this process is the production of digestate. This byproduct is utilized as a natural fertilizer in the company's agricultural fields, allowing for a substantial reduction in the use of chemical fertilizers. (https://www.aurelimario.com/sostenibilit%C3%A0).

Through these sustainable practices, such as using agricultural waste to generate energy via its biomass plant, the company has not only reduced costs but also created a virtuous cycle, allowing it to reinvest savings into new environmental and economic initiatives.

In this way, sustainability has become a fundamental pillar of modern agriculture. As Weber (2012) states, an entrepreneur following this model acts according to a voluntary ethical commitment, driven by personal moral inclinations rather than external obligations. Aureli Mario stands as a concrete and tangible example of this approach. Its commitment to sustainability has resulted in practical actions demonstrating that it is possible to reconcile productivity with environmental responsibility and consumer well-being.

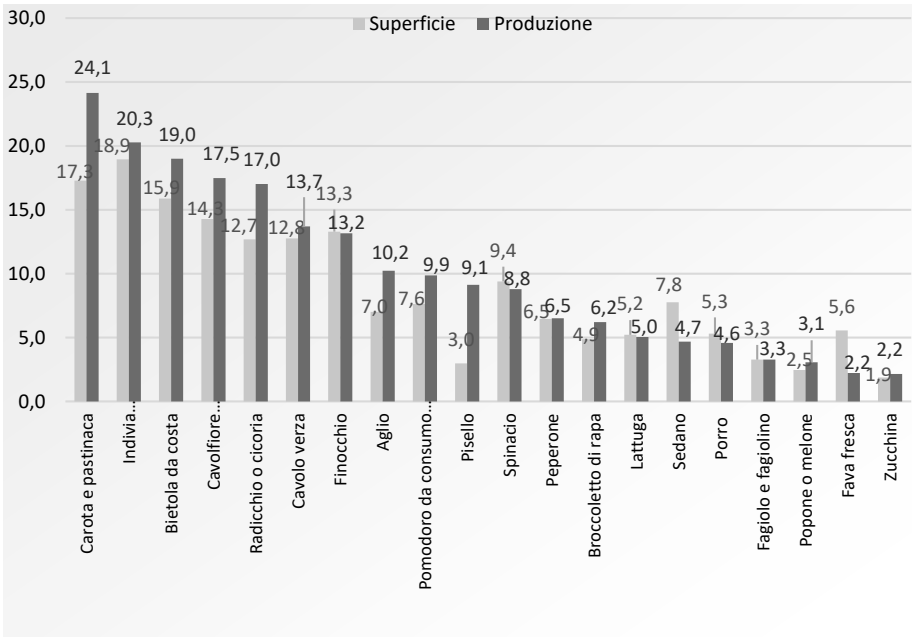
Thanks to its innovative vision, the company has transformed the Fucino region into a key reference point for vegetable production, particularly carrots, which have been officially recognized by the Ministero delle Politiche Agricole, Alimentari e Forestali with the designation "Carote dell'Altopiano del Fucino IGP" (Gazzetta Ufficiale n. 28 del 3 febbraio 2022).

The high market demand has not only reinforced the company's success

but also encouraged local farmers to invest further in this cultivation, creating a positive chain reaction that has contributed to local economic development. Considering that 50% of the company's suppliers are producers from the Marsica region, this impact has been particularly significant.

Additionally, Fucino carrot production reaches approximately 1.5 million quintals per year, representing: 30% of national production; 5% of European production; 1.1% of global production (Gazzetta Ufficiale n. 28 del 3 febbraio 2022).

Figure 4. Surface Area and Vegetable Production in Abruzzo – Percentage Share Compared to Italy (2021)



Source: ISTAT - Indagine di Stima delle superfici e produzioni delle coltivazioni agrarie. Elaborazione Ufficio di statistica della Regione Abruzzo

Aureli Mario has successfully implemented a true circular economy, a model that transforms waste and minimizes resource wastage (Aureli A., oral interview, May 2024). Furthermore, the company's production processes

integrate advanced innovation with a strong tradition, where human expertise remains the fundamental pillar.

Currently, Aureli Mario exports to 60 countries worldwide and has chosen to adopt the Social Balance Report as a strategic tool to demonstrate operational efficiency and transparency toward customers, suppliers, and institutions (https://www.aurelimario.com/bilancio-sociale).

This approach has not only enhanced the company's production efficiency but has also generated profits, demonstrating that the adoption of sustainable practices does not hinder business operations but instead serves as a driver for growth.

The commitment of Aureli Mario s.s. agricola extends beyond commercial excellence, and its philosophy is not limited to the present.

6. Comparative Analysis of the Three Business Cases

The analysis of the three business cases, based on Richard Yin's (2009) case study approach and adopting a multiple-case perspective as suggested by Robert Stake (1995), reveals both commonalities and differences among the companies.

All three companies have integrated sustainability into their production models, adopting environmentally responsible practices since the 1990s to enhance efficiency and reduce environmental impact. In doing so, they anticipated the provisions of Regulation (EU) 848/18. Each company has obtained environmental certifications that guarantee the quality and sustainability of their products. They also employ innovation strategies to strengthen their market competitiveness, whether through technological advancements (Adi Apicoltura and Aureli Mario) or through process optimization (Casina Rossa). Most importantly, they have had a significant impact on the local territory, contributing to regional development and resource enhancement.

Regarding their approach to sustainability, the three companies display distinct strategies:

- Adi Apicoltura has focused on biodiversity conservation and supply chain traceability.
- Casina Rossa has adopted a waste reduction model and short supply chain strategies.
- Aureli Mario stands out for its regenerative agriculture practices and

circular economy model.

Furthermore, all three companies have demonstrated a strong orientation toward international export, actively promoting the Made in Italy brand while simultaneously enhancing the local market with a strong emphasis on crop quality.

Table 1. Comparison of the Three Business Cases

Criteria of Analysis	Adi Apicoltura Srl	Casina Rossa Srl	Aureli Mario s.s. Agricola
Production Sector	Beekeeping (honey)	Tomato preserves and sauces	Vegetables and organic farming
Sustainability Strategy	Regenerative beekeeping and biodiversity conservation	Circular economy and waste reduction	Circular economy, regenerative agriculture
Technological Innovation	Hive monitoring; honey crystallization	Eco-friendly production processes and sustainable packaging	Agricultural automation, crop monitoring sensors
Environmental Certifications	Certifications for the organic and international market	Certifications for the organic and international market	Certifications for the organic and international market
Market Strategy	International expansion and promotion of Made in Italy	International expansion and promotion of Made in Italy	Development of the organic market with international exports
Territorial Impact	Biodiversity protection and support for local beekeepers	Local economy and sustainable craftsmanship	Reduction of ecological footprint and enhancement of agricultural land
Social Impact (People – TBL)	Collaboration with local beekeepers, bee education programs	Involvement of local producers, development of food and wine tourism	Job creation in Fucino, support for local farmers
Economic Impact (Profit – TBL)	Revenue growth, expansion into the global market	Revenue growth, increased exports, premium market positioning	Circular business model, reduction of operational costs

Source: Author elaboration

The comparison reveals that the three analyzed SMEs have adopted a sustainable approach, albeit following different strategies. This demonstrates that, despite their differences, sustainability remains a key driver of growth and competitiveness for these agri-food SMEs, confirming the central role of innovation and certifications in the sector's ecological transition.

However, the determining factor for the success of this ecological transition has been the mindset shift among entrepreneurs and subsequent generations,

enabling them to transform environmental challenges into growth opportunities.

These are, therefore, "virtuous" agri-food SMEs that have successfully integrated territorial identity, innovation, and sustainability into their business models.

7. Conclusions

Based on the analysis conducted according to Yin's (2009) case study approach and Stake's (1995) multiple-case model, it emerges that the three Abruzzese agri-food SMEs—Adi Apicoltura srl, Casina Rossa srl, and Aureli Mario s.s. agricola—have adopted different sustainability strategies, all aimed at integrating innovation, tradition, and environmental responsibility. However, their transition towards environmental practices has not been immediate but has occurred gradually, following different modalities and timelines. This adaptation has been primarily driven by the strategic choices made by each company and, to a lesser extent, by external pressures (both legislative and non-legislative). This decision-making autonomy has allowed the three SMEs not only to respond to emerging environmental demands but also to transform sustainability from a regulatory obligation into a lever for development and competitive differentiation.

Investments in sustainable technologies have not altered the territorial identity; on the contrary, they have reinforced its value by preserving the quality and authenticity of local products and facilitating their wider distribution. The attainment of quality certifications and international recognition has made these products highly competitive in the national market and sought after in foreign markets. Consequently, sustainability has assumed a central role in enhancing corporate reputation, helping to attract new customers and investors who are increasingly attentive to ESG (Environmental, Social, and Governance) standards.

The ecological transition has primarily occurred through a shift in mindset among entrepreneurs. In this regard, business owners and successive generations have interpreted sustainability as an opportunity for economic and social growth rather than as an obstacle. This strategic vision has generated a virtuous cycle, engaging other local and national entrepreneurs and strengthening the connection between business and territory. As a result, the territory itself has been integrated into a network of food and wine tourism, enhancing its cultural identity.

In light of this, the experiences of Abruzzese agri-food SMEs confirm that sustainability is not only a moral imperative but also a driver of business and economic development. Their long-term trajectory demonstrates that integrating innovation, tradition, and environmental responsibility not only enhances the competitiveness of the agri-food sector but also makes it more resilient, competitive, and forward-looking.

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