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Sostenibilità e Greenwashing nell'Industria Alimentare: Alcune riflessioni sul Caso Italiano // Sustainability and Greenwashing in the Food Industry: Reflections on the Italian Case

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Abstract

The new Millennium has brought a growing interest towards the topic of Sustainability and all the related themes that this transversal, paramount, controversial word contains. The main objective of this manuscript is to investigate the relation between Sustainability and Food, knowing that the food industry is one of the most, if not the most influential in terms of need to manage the supply chain the right way to avoid unnecessary waste. This research focuses on the evolutionary trajectory of the academic scientific production on sustainable food and will display how the usage of specific words and concepts can change over time to disclose to stakeholders the importance it has in our everyday life. To do this, we conducted a systematic literature review using Scopus with research' keywords that include "Sustainab*" and "Food", and considering only Articles (7178), Book Chapters (1491) and Reviews (560) as document types in the fields of Business, Management, Accounting, Economics and Finance. All the results have been consequently exported and analyzed through Bibliometrix, a software that allows developing a bibliometric analysis to get insights about the thematic evolution of the field using descriptive statistics and network analysis tools. In particular, a co-citation network analysis identified five thematic clusters covering different areas. The first concerns food waste and methods to reduce food waste in the whole supply chain. The second analyzes the management of the food supply chain and how this has transformed to become more sustainable over time. The third covers theories explaining the consumption behavior. The fourth is about agricultural sustainability and food environmental impacts. Finally, the fifth focuses on resource management with a view into the circular economy.

Furthermore, this thesis will examine the phenomenon of greenwashing into the food sector and in particular it will highlight incorrect practices conducted by three Italian companies based in the Emilia-Romagna region in Italy. The three companies are Inalca S.p.A., based in Castelvetro di Modena (MO), Barilla G. e R. Fratelli S.p.A, based in Parma (PR), and Granarolo, based in Bologna (BO). Comprehensive research through the reading of news, articles, reports, investigative services has been conducted. In addition, secondary data on the industry have been collected accessing specific sectorial databases which contain several indexes for our analysis, to derive insights and explain the concept of greenwashing into the food industry.

Abstract in Italian

Il nuovo millennio ha portato un crescente interesse verso la Sostenibilità e tutti i temi correlati che questa parola trasversale, controversa e sempre più fondamentale contiene. L'obiettivo principale di questo lavoro è indagare la relazione che esiste tra Sostenibilità e Food, tenendo in considerazione che l'industria alimentare è una delle più influenti, se non la più influente, in termini di necessità di gestire la supply chain nel modo giusto per evitare inutili sprechi. La nostra ricerca si concentra sull'evoluzione della produzione scientifica accademica dell'alimentazione sostenibile e mostrerà come l'uso di parole e concetti specifici possa cambiare nel tempo per rivelare a tutti gli stakeholder l'importanza che ha nella nostra vita quotidiana. A tal fine, abbiamo condotto una revisione sistematica della letteratura utilizzando Scopus con keywords di ricerca che includono "Sustainab*" e "Food", e considerando solo articoli (7178), capitoli di libri (1491) e recensioni (560) come tipi di documenti nei campi di Business, Management, Contabilità, Economia e Finanza. Tutti i risultati sono stati quindi esportati e analizzati su Bibliometrix, un software in grado di sviluppare un'analisi bibliometrica per ottenere approfondimenti sull'evoluzione tematica del settore utilizzando strumenti come l'Historiograph e il Co-citation Network. Attraverso quest'ultimo, sarà possibile ricavare cinque cluster sul tema che coprono diverse aree. Il primo riguardante lo spreco alimentare e i metodi per evitarne le parti superflue lungo l'intera filiera. Il secondo che analizza la gestione della filiera alimentare e come questa si sia trasformata nel tempo in sostenibile. Il terzo che copre le teorie che spiegano il comportamento pianificato e il comportamento di consumo. Il quarto sulla sostenibilità agricola e gli impatti ambientali del cibo. Il quinto che evidenzia la gestione delle risorse in un'ottica di economia circolare, sia dal punto di vista dell'impresa che del singolo individuo.

Inoltre, il presente lavoro esaminerà il fenomeno del greenwashing nel settore alimentare e, in particolare, pratiche scorrette condotte da tre aziende italiane con sede nella regione settentrionale dell'Emilia-Romagna. Le tre aziende sono Inalca S.p.A., con sede a Castelvetro di Modena (MO), Barilla G. e R. Fratelli S.p.A, con sede a Parma (PR), e Granarolo, con sede a Bologna (BO). Verrà condotta una ricerca completa attraverso la lettura di notizie, articoli, report, servizi investigativi, anche con l'ausilio di specifiche banche dati settoriali che contengono diversi indicatori per la nostra analisi, al fine di ricavare approfondimenti e spiegare il concetto di greenwashing nell'industria alimentare.

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1. Introduction

1.1 Sustainability and greenwashing

Stakeholders in the food industry are seeking practices capable of transitioning from prevalent customs regarding food waste towards a green economy. The various layers of the consumption chain, as defined in this paper, are responsible for considerable damage and pollution. However, a critical issue to highlight is the percentage of food wasted within households. In fact, at the household level, food waste in Europe is estimated to represent more than 50 percent of the total food waste (Kummu et al., 2012). Conversely, companies worldwide are increasingly attentive to environmental issues due to the worsening of environmental pollution (Guo et al., 2018). Many market stakeholders, such as investors, consumers, governments, and corporate customers, are raising their awareness of environmental considerations, asking companies to disclose information about their overall performance (Kim et al., 2015). As the Nielsen Media Research indicates, 66% of customers globally declare their willingness to accept higher prices for environmentally friendly products (Nielsen Media Research, 2015).

What is paramount for firms is the ability to appear as "green players," operating in the market not only from an economic perspective seeking profits but also focusing on developing sustainable initiatives. These initiatives should address objective and actual needs, such as implementing a circular economy, limiting food waste, and improving supply chain management. The food industry is a key market segment because it alone is responsible for a significant percentage of pollution and greenhouse gas emissions. In fact, the food sector is assessed to cause approximately one-third of all greenhouse gas emissions (Aschemann-Witzel, 2015). The growing demand for sustainable practices "drives firms to develop green marketing strategies to show consumers their good corporate image and social responsibility" (Zhang et al., 2018).

The term "appearance" is controversial here because it suggests that companies might not need to implement sustainable practices. In this sense, a firm could build its green campaigns solely on consumer perceptions without real and tangible actions. This could lead to a situation where positive communication about environmental performance is not accompanied by effective environmentally friendly performance (Delmas, Burbano, 2011). This is the definition of greenwashing, a practice that has gained popularity in recent years due to the increasing attention stakeholders pay to the development of sustainable practices by companies. Corporations can not only distort customers' perceptions of their overall performance but also miscommunicate the benefits of their products or services.

What consequences may this phenomenon bring to the table? At first glance, customers may lose trust in what companies communicate about green products. Especially in the food industry, where final products have important nutritional indicators for diets and where clear and transparent communication about practices throughout the entire supply chain is crucial, it remains important to balance conducted practices and communication to stakeholders.

Nowadays, several organizations invest in sustainability not only as a mere section to cite on their website. Sustainability and sustainable practices have become core values around which firms plan their future business activities and for which companies are recognized in the market. For example, Ryanair, the Irish airline company based in Swords, is known for its competitive prices. Conversely, fashion luxury brands such as Gucci or Prada are famous for the high quality of the products they manufacture, which consumers perceive as the best on the market. The brand Ferrari distinguishes itself in the automotive industry by transmitting the excellence of Italian tradition and continuous innovation to clients, who aspire to experience driving such a car. These are all examples of market positioning across different segments.

Linking this reasoning to our research, an example of a brand known for its longstanding environmentally friendly practices is Patagonia, an American textile company founded in California, specializing in outdoor and athletic apparel. Patagonia has recently become the most recognized corporate leader by sustainability professionals, after transferring the ownership of the company to a trust that seeks to address climate change and protect nature. Patagonia overtook Unilever, a British multinational consumer goods company that owns 400 of the most popular brands in the fields of food, drink, hygiene, and household products, which held the top spot for over a decade as the most recognized corporate leader for sustainability (GlobeScan/SustainAbility Survey, 2023).

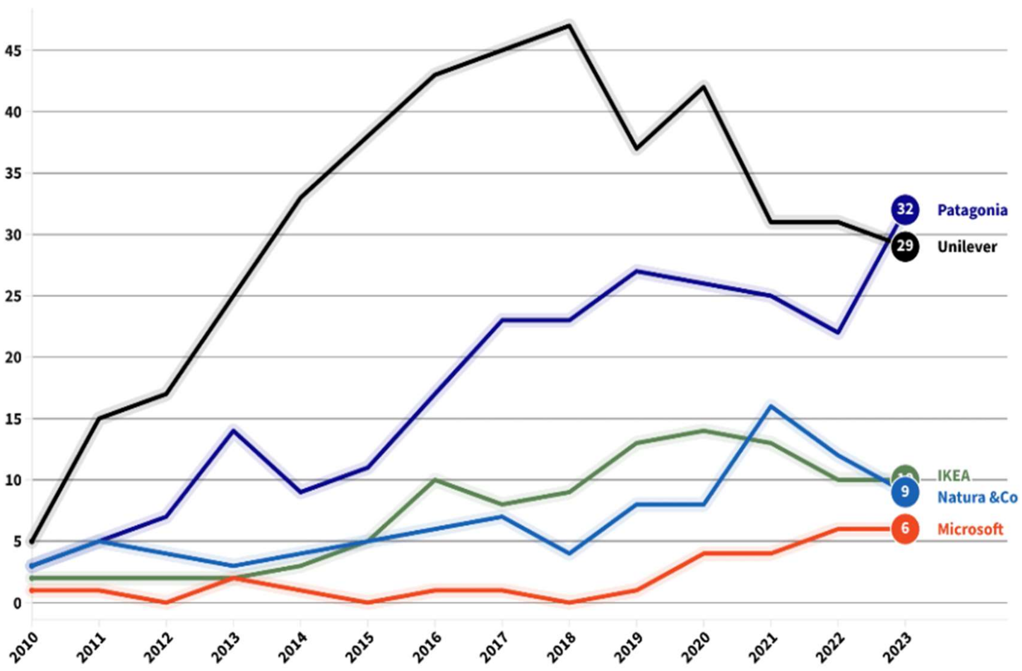

Figure 1: Most Sustainable Corporate Leaders, % of Experts, Total Mentions. Source: GlobeScan/SustainAbility Survey of 520 experts representing business, government, NGOs, and academia across 63 countries from March-May 2023.

Focusing on the food industry, the importance of being known for respecting green practices throughout the business cycle and for innovating in sustainability is crucial. Stakeholders who perceive a company as pioneering, investing in circularity and sustainable supply chain management, are more likely to trust it and invest in its products and services. In Italy, revenues in the food market amount to €175.70bn in 2024, with an expected growth of 3.52% annually (Statista, 2024). An analysis conducted by Coldiretti on the report of Waste Watcher, the International Observatory on Food & Sustainability, highlights that in Italy, around 1.5 billion kilos of food per year end up in the bin, with consequent disruptive effects on the economy, sustainability, and the environment (Waste Watcher International Observatory, 2024).

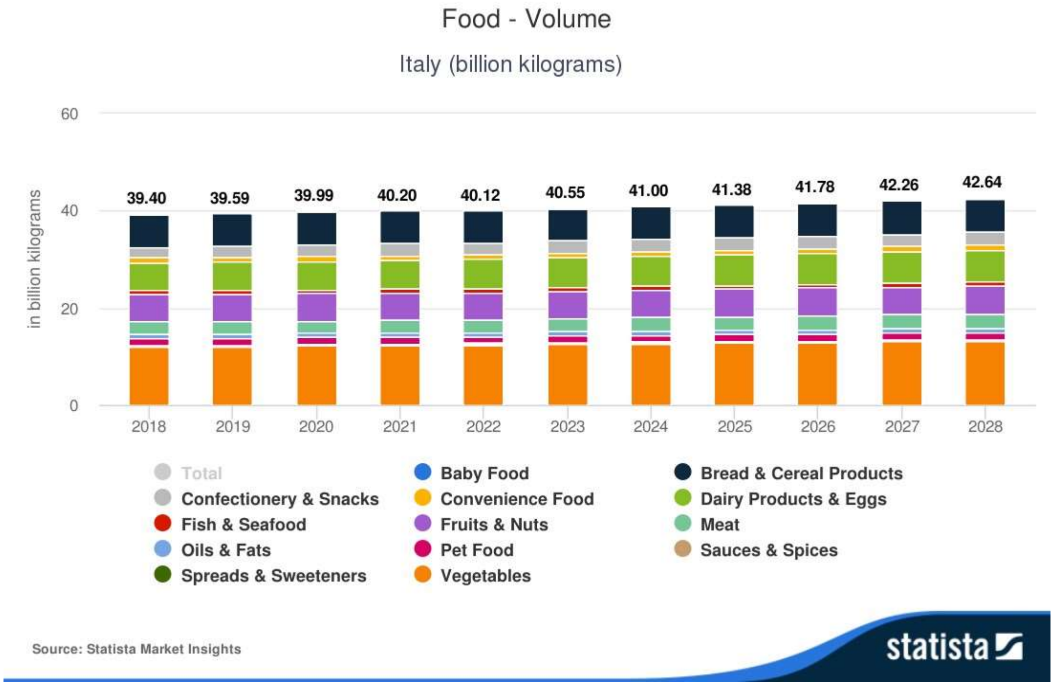

Figure 2: growth in the total volume of food produced in Italy, from 2018 to 2028. Source: Statista Market Insights.

The figure above shows a clear path for the volume the food industry will handle in the coming years. Between 2024 and 2028, there will be an increase of 1.64 billion kilograms in the amount of food produced, which means that more food will need to be managed in the best possible way. From both suppliers' and vendors' standpoints, the utilization of frameworks such as the one proposed by Poore (Poore and Nemecek, 2018) would outline a clear path towards monitoring the process of final goods completion, making it possible to recognize the factors that positively or negatively affect the different stages of the agri-food production chain. Introducing machines to constantly monitor the supply chain lowers costs in the long term since it enables companies to keep track of factors that negatively affect the implementation of green practices and to understand whether they met sustainable targets. The alternative would be to reach the end of the production chain and, if an inconsistency is found downstream, such as regarding the nutritional values displayed on the output's label or the amount of greenhouse gas emissions produced during manufacture, reanalyze all the procedures contained in the different stages of the chain, going backward. The problem is, without knowing the origin of the issue, re-examining everything in detail would increase costs. Investing in monitoring machines, which may seem daunting initially, would prove to be a better solution in the long run as it would reduce time, costs, and increase the effectiveness and efficiency of the whole production process.

From the consumers' point of view, given the figures showing that the incidence of food waste is higher at the household level (Kummu et al., 2012), suitable measures need to be applied to reduce the phenomenon and better curb the issue. One starting point to pursue in the upcoming future relates to dietary changes, an action capable of delivering higher environmental benefits than initiatives taken by producers. For example, "(...) Moving from current diets to a diet that excludes animal products has transformative potential, reducing food's land use by 3.1 billion ha (a 76% reduction) and food's GHG emissions by 6.6 billion metric tons of CO2 eq." (Poore J., 2018). It is essential for producers to communicate average product impacts to enable dietary changes among consumers. While this process may seem feasible individually, a widespread behavioral change across different cultures is difficult to imagine, especially considering the short time available to halt global warming and prevent irreversible biodiversity loss.

1.2 Greenwashing in the food industry: the drivers

In the context introduced, the practice of greenwashing infiltrates various industries and benefits market players, allowing them to keep pace with demands for greater transparency in sustainable practices. Some authors describe it as a decoupling behaviour, relating greenwashing with symbolic actions which often draw attention away from smaller problems or result in "green talk". The "green talk" concerns statements meant to appease stakeholders about sustainability, but no concrete action is taken (Siano et al., 2017). To understand the drivers that lead firms to operate incorrectly, Delmas and Burbano (2011) provide a clearer picture of the reasons behind the unethical behaviors companies adopt. They classify the following factors:

- **Non-Market External Drivers: The Regulatory and Monitoring Context.** The governmental and regulatory context plays a central role in the decision to communicate practices correctly or incorrectly. Activists, NGOs, and media pressure are actively involved as well. Given the limited control that regulators still exert over greenwashing actions, independent players such as activist groups and NGOs can have a much wider impact. Media pressure is also a paramount factor, as it informs readers about various issues, obliging companies to act rightly and avoid reputational losses.

- **Market External Drivers: Consumer, Investor, and Competitor-Induced Incentives.** Factors in the corporation's operational environment include pressure from customers and investors, dictated by the evolutionary trajectory of sustainable practices in recent years. These market agents, whose interest is shown by how companies and brands are performing through the purchase of items or services proposed, or by investing capital, demand increased transparency in communication. The competitive landscape is an additional factor that leads firms to greenwash. Companies follow competitors' lead if they perceive them to be more successful, possibly through adopting sustainable practices.
- **Organizational-Level Drivers.** These include firm characteristics, incentive structure and ethical climate, effectiveness of intra-firm communication, and organizational inertia (more present in larger, older firms).
- **Individual-Level Psychological Drivers.** These include optimistic bias, where greenwashing may be influenced by people's propensity to overestimate the chances of favorable outcomes and underestimate the likelihood of unfavorable ones; and hyperbolic intertemporal discounting, meaning that when a leader has to take a decision today about whether to communicate the sustainable performance of the firm, he could decide to actively discuss the company's social responsibility and environmental sustainability while bearing the costs to implement green practices in the future. Optimistic bias, namely when managers may over-estimate the consequences of greenwashing and the positive results it may bring, under-estimating the probability of negative events such as receiving negative media or NGO inspection.

After a comprehensive introduction regarding the context in which companies operate, we begin our analysis regarding sustainability in the food industry, especially in Italy. The following chapter will highlight the trends characterizing the evolution of the theme, through a bibliometric analysis.

2 Systematic literature review

2.1 Introduction

When we consider the concept of sustainability, which might initially appear straightforward, it evokes a convergence of numerous related concepts, images, and everyday experiences. What might initially seem difficult to analyze due to the complexity of simplifying and concretizing these notions may reveal itself as an intriguing and valuable topic for analysis. Linking the concept of sustainability with the food industry can provide a clearer understanding of how the food supply chain can be managed more effectively and efficiently. In fact, the food sector is responsible for approximately one-third of all greenhouse gas emissions in the EU (Aschemann-Witzel, 2015). Furthermore, nearly one-quarter of the food supplied for human consumption is wasted across the food supply chain (Stancu, 2016; Kummu et al., 2012), and at the household level, food waste in Europe accounts for more than fifty percent of total food waste (Kummu et al., 2012). How can this trend be reversed?

This chapter examines the evolutionary trajectory of academic research on sustainable food and demonstrates how the usage of specific terms and concepts evolves over time, highlighting its significance to a broad range of stakeholders, including investors, corporations, consumers, regulators, and NGOs. The recent surge in attention to sustainability, coupled with the broadened scope of operations and supply chain management, stems from increasing demands for greater transparency in corporate activities, often framed in terms such as sustainability management, corporate social responsibility, and corporate governance (Seuring, 2008). Moreover, the scope of literature on sustainable practices adopted by organizations has expanded, reflecting the benefits these practices bring, both environmentally and reputationally. However, additional solutions are required to guide a larger proportion of industry players toward the common goal of environmental sustainability, achievable only by adhering to the three criteria used to assess the ethics of a company or investment: environmental, social, and governance (ESG).

Among the five general categories of Sustainable Supply Chain Management (SSCM) identified to ensure sustainable performance, "Continuity," which refers to mutually beneficial relationships between firms throughout the supply chain, is particularly significant. It is therefore incorrect to consider only the performance of individual supply chain members, even in terms of sustainability (Beske and Seuring, 2014).

In this sense, our analysis aims to respond to the following research questions: RQ1. What are the foundational works of food sustainability research? RQ2. What are the main evolutionary trajectories of food sustainability research? RQ3. What solutions can the food industry adopt to avoid unnecessary food waste and improve supply chain management? RQ4. Do the Indexes derived from the examined databases coincide with how companies act on the marketplace? RQ5. What incorrect practices do companies in the food industry engage in to portray themselves as sustainable to the public? To answer these questions, the present paper adopts a bibliometric analysis, a “scientific computer-assisted review methodology that can identify core research or authors, as well as their relationships, by covering all the publications related to a given topic or field” (Journal of Biomedical Informatics, 2020). Using this tool, it is possible to gain a thorough understanding of the fields of sustainability related to an enduring industry such as the food industry, obtaining information about trends, foundational works, and future possibilities.

In practical terms, the analysis begins with the use of the bibliometrix R-package for performing comprehensive bibliometric analysis. The typical science mapping workflow consists of five stages: study design, where scholars define the research questions and choose the appropriate bibliometric methods; data collection, in which academics select the database containing the bibliometric data, filter the core document set, and export the data from the selected database; data analysis, where one or more bibliometric or statistical software tools are employed, such as co-word analysis, co-author analysis, and citation analysis (which can be decomposed into bibliographic coupling and co-citation analysis); data visualization and interpretation, where scholars decide on the visualization methods (conceptual structure mapping and network mapping), then interpret and describe their findings (Aria and Cuccurullo, 2017). The work of this chapter is organized as follows. Section 2.2 illustrates the research methodology, section 2.3 describes the data collection process, and section 2.4 presents the results of the bibliometric analysis, both from the perspectives of foundational works (through a co-citation analysis) and evolutionary trajectories.

2.2 Methodology

The research methodology utilized for this paper is bibliometric analysis. Numerous definitions have been offered for this tool throughout its longstanding history. The most recurrent definition stems from the studies conducted by Zupic and Čater (2015), who highlighted the importance of this type of analysis compared to the classical method of reviewing theoretical literature. They argue that "the volume of research work has increased dramatically in recent years, making it difficult for researchers to track the literature relevant to their field of work, which has led them to use quantitative bibliometric analysis methods that can deal with this wealth of data, filter research work, and estimate their impact while discovering the foundational studies." Considering this, it is logical to assess that literature reviews conducted with this method have significantly increased in popularity (Blasi and Sedita, 2022; Donthu et al., 2021).

Researchers utilize bibliometric analysis for various reasons, including studying growing trends in article and journal performance, collaboration schemes, and research components, as well as investigating a particular domain's intellectual structure in the existing literature (Donthu, Kumar, Pandey, & Lim, 2021a; Verma & Gustafsson, 2020; Donthu et al., 2020c). An important concept to remember is that the data around which bibliometric analysis is built is enormous (in our case, the analysis is based on more than 9,000 documents) and objective. However, the interpretations that could be given to this large amount of data rely on both objective (e.g., performance analysis) and subjective (e.g., thematic analysis) evaluations (Donthu et al., 2021).

The two main techniques applied in bibliometric analysis are performance analysis and science mapping. Performance analysis studies the contributions of research constituents to a given field (Cobo, Lopez-Herrera, Herrera-Viedma, Herrera, 2011; Ramos-Rodríguez & Ruíz-Navarro, 2004) and is descriptive in nature. Science mapping, on the other hand, examines the relationships among research constituents (Baker, Kumar, Pandey, 2021; Cobo et al., 2011; Ramos-Rodrígue & Ruíz-Navarro, 2004). The procedures included in science mapping analysis are citation analysis, co-citation analysis, bibliographic coupling, co-word analysis, and co-authorship analysis.

In this paper, we conducted a three-stage analysis:

1. First, we collected the data necessary for our bibliometric analysis from the Scopus database, then analyzed descriptive statistics such as "Annual Scientific Production," "Authors' Production Over Time," "Most Global Cited Documents," and the "Three-field Plot."
2. Then, we analyzed the backward citations of the 9,669 documents derived from our Scopus research through a co-citation analysis. From this co-citation analysis, we identified five clusters on the topic of "food sustainability" that contribute to

explaining the foundational works of our research theme. We selected some of the publications from each major subject to base our cluster analysis.

3. Finally, we examined the evolutionary trajectory of the research field. We first studied the "Historiograph" tool, then focused on the "Thematic Evolution," to obtain a clear view of how trends within the food sustainability theme have evolved over time in the literature. These two instruments were then compared to test the accuracy of our assumptions.

2.3 Data collection

This chapter concerns data collection and the methodology used to obtain the results analyzed throughout this document. Data collection took place between March and April 2022, following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flowchart, which is organized into three steps (Identification, Screening, Inclusion). The process begins with deciding on the most suitable search strategy to obtain documents related to the topic in the Scopus database (Identification). This is a crucial part of the research as it represents the starting point of our study, laying the foundation for the analysis. After testing several combinations of keywords in Scopus's search engine, the search query TITLE-ABS-KEY "Food" AND "Sustainab*" was chosen as the most representative for the study's needs, capable of covering the full breadth and depth of academic production on the sustainability of the food industry. This query returned a total of 94,986 documents.

For a software like bibliometrix, this would mean too many results to analyze effectively. Therefore, we further refined the analysis to include only publications meeting the following three criteria: 1) belonging to the subject areas of Business, Management, and Accounting, or Economics, Econometrics, and Finance; 2) categorized as "journal," "book," or "book series"; 3) published in English. Regarding the year of publication, no specific time range was set for the database search, as the goal was to analyze the evolutionary trajectory of all relevant publications, not just the most recent ones. After applying these filters, we obtained a list of 9,669 documents to work with.

In the second stage of the process, we downloaded the resulting list of documents in CSV format (Comma-separated values), a text file in which information is separated by commas (Business Insider, 2022). Downloading the list allowed us to export metadata related to the title, publication year, source title, abstract and keywords, bibliography, and other relevant information to bibliometrix. No screening stage was included, so the decision was made to consider the 9,669 documents in their entirety. The final collection (Inclusion) comprised 9,669 documents, including 7,821 journals, 1,539 books, and 309 book series, from 1,855 different sources. Publications span from 1979 to the present day (2024). Publications on the topic of food sustainability have grown significantly since 2010, with previous literature offering limited quantity on which to focus a systematic literature review. The most relevant source by far is the "Journal of Cleaner Production," with a total of 1,396 publications, followed by the international journal "Environment, Development and Sustainability," with 307, and "Resources, Conservation and Recycling," with 266 publications. The "Journal of Cleaner Production" is an international, transdisciplinary journal focusing on Cleaner Production, Environmental, and Sustainability research and practice. The aim of the articles published is to help societies become more sustainable (ScienceDirect, 2023).

The exported CSV file and subsequent meta-analysis conducted using bibliometrix highlight several statistics useful for an initial examination, including publications per year, most relevant sources, most relevant authors, most globally cited documents, and most frequent words, among others.

2.4 Bibliometric analysis

2.4.1 Descriptive analysis

The descriptive analysis section is based on plotting the 9,669 documents according to the parameters already cited, which include top authors, publication year, most relevant sources, thematic trends over the considered period, most cited documents, top topics, and geographic distribution.

Figure 3 illustrates the trend in publications year by year. The first document addressing the topics of food and sustainability appeared in 1979. This period was marked by a concentration of publications exploring consumer behavior and habits in the purchasing process. Sustainability and its related concepts gradually gained public interest in the literature starting from 1987, the year the Brundtland Report was declared. The graph shows a steady trend until the beginning of the new millennium when, particularly from 2006 onwards, the volume of literature began to grow consistently, continuing to the present day. Notably, there is an upward trend in annual scientific production, with a Compound Annual Growth Rate (CAGR) of 21.5% for the period 2001-2023. The calculation excludes years before 2001 because publications from 1979 to 2000 account for only 1.45% of the total. Additionally, 2024 is not considered as data collection was conducted up until March-April of that year.

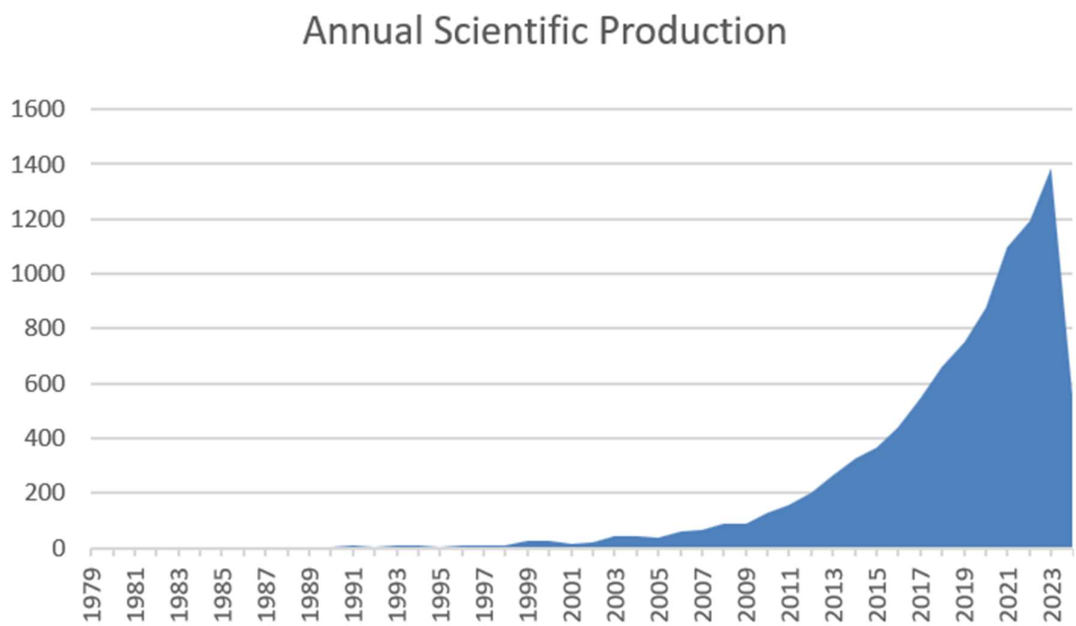

Figure 3: Annual Scientific Production. Source: Biblioshiny.

Figure 4 depicts the top 10 authors' production over time, covering the period from 2006 to 2024. The graph distinguishes between the number of articles published per year per author and the total citations (TC) per year per author. The first measure is represented by bubble size: the larger the bubble, the greater the number of publications. The second measure is indicated by color intensity: the darker the bubble, the higher the number of total citations. The period of greatest activity for the 10 authors considered spans from 2019 to the present day. Kumar, A. has the highest number of publications within a year, having published 11 articles in 2023 on the themes identified in our Scopus research, which was based on the keywords "food" and "sustainab*". Conversely, Zhang, X. holds the record for the most total citations per year, with 131.8 citations in 2020. Wang, X. is the author with the highest total citations, particularly for the article "Applying Blockchain Technology to Improve Agrifood Traceability: A Review of Development Methods, Benefits, and Challenges" (2020).

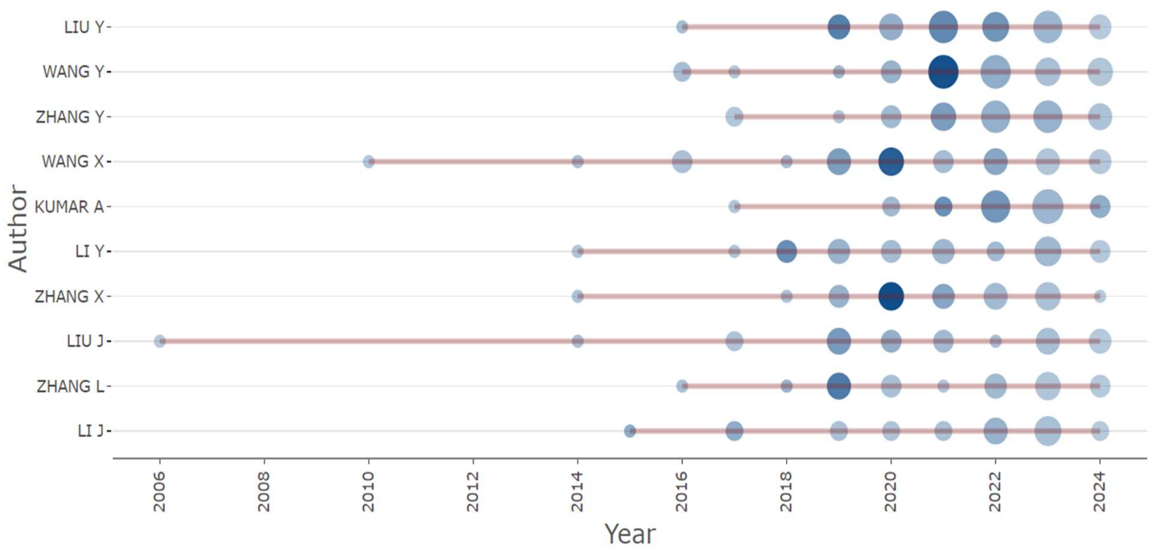

Figure 4: Authors' Production Over Time. Source: bibliometrix.

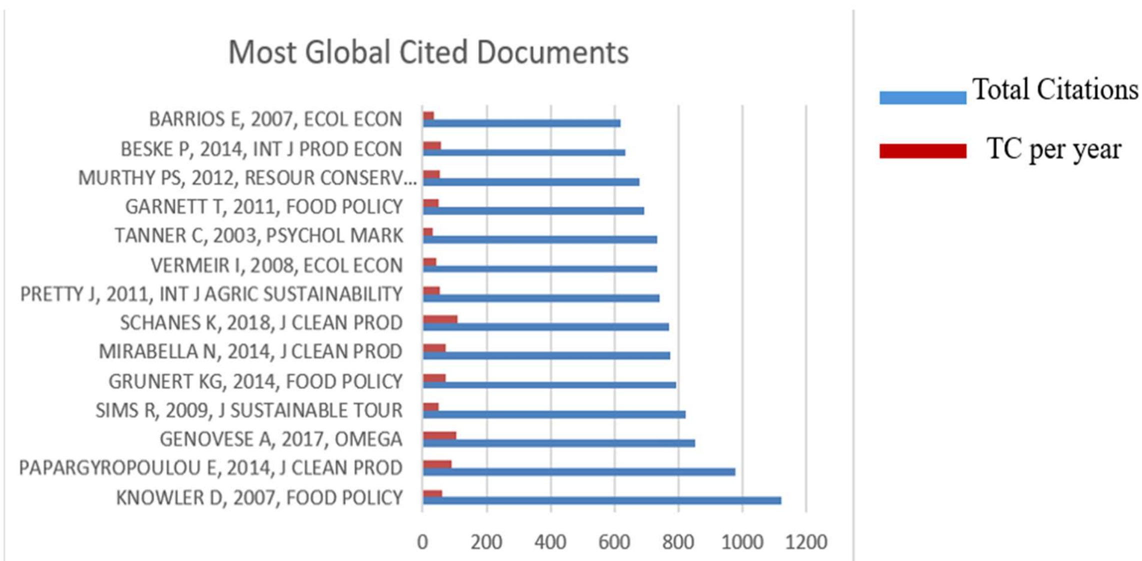

Figure 5: Most Global Cited Documents. Source: bibliometrix.

Figure 5 displays the most globally cited documents from our Scopus query. The publication with the highest number of total citations (TC) is by Knowler, D., with 1,120 citations for the article titled "Farmers' Adoption of Conservation Agriculture: A Review and Synthesis of

Recent Research" (2007), which discusses methods for "conservation agriculture" and a collection of techniques for preserving soil, as promoted by the Food and Agriculture Organization (FAO). The second and third most cited documents are by Papargyropoulou, E. (2014), with 978 citations, focusing on food waste and practices for improving food waste and food surplus management, and by Genovese, A. (2017), with 852 citations, emphasizing the transition towards a circular economy. These topical issues demonstrate how the literature on food sustainability is evolving to address the management of all stages of the supply chain from a greener and more sustainable perspective. Regarding total citations per year, among the documents displayed in Figure 5, the highest number of citations per year is for the document titled "Food Waste Matters - A Systematic Review of Household Food Waste Practices and Their Policy Implications" by Schanes, K. (2018), with 110 citations.

The three-field plot presented in Figure 6 visually emphasizes the links between top sources, main authors, and topics, expressed as keywords. Among the top sources, the "Journal of Cleaner Production" stands out above all others. In terms of top authors, the plot shows a high concentration of Chinese authors, with Liu Y., Wang X., and Wang Y. being particularly prominent. Lastly, the focal topics from the keywords section include "sustainability," "food security," "food waste," and "sustainable development." Additionally, subthemes such as "life cycle assessment," "environmental sustainability," "sustainable agriculture," and "food supply chain" are regarded as essential to the food sustainability literature. It is important to note that the width of the edges represented in gray corresponds to the strength of the connections between the three categories. Furthermore, the frequency of items in the collaboration network increases with the size of the rectangles.

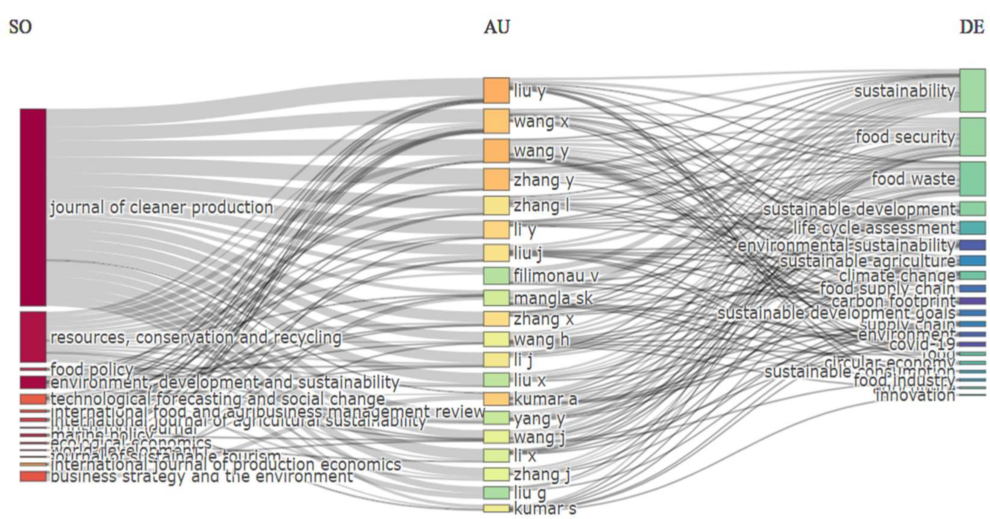

Figure 6: three-field plot. Parameters: top sources, top authors, keywords. Source: bibliometrix.

2.4.2 Identifying the foundational works through co-citation analysis

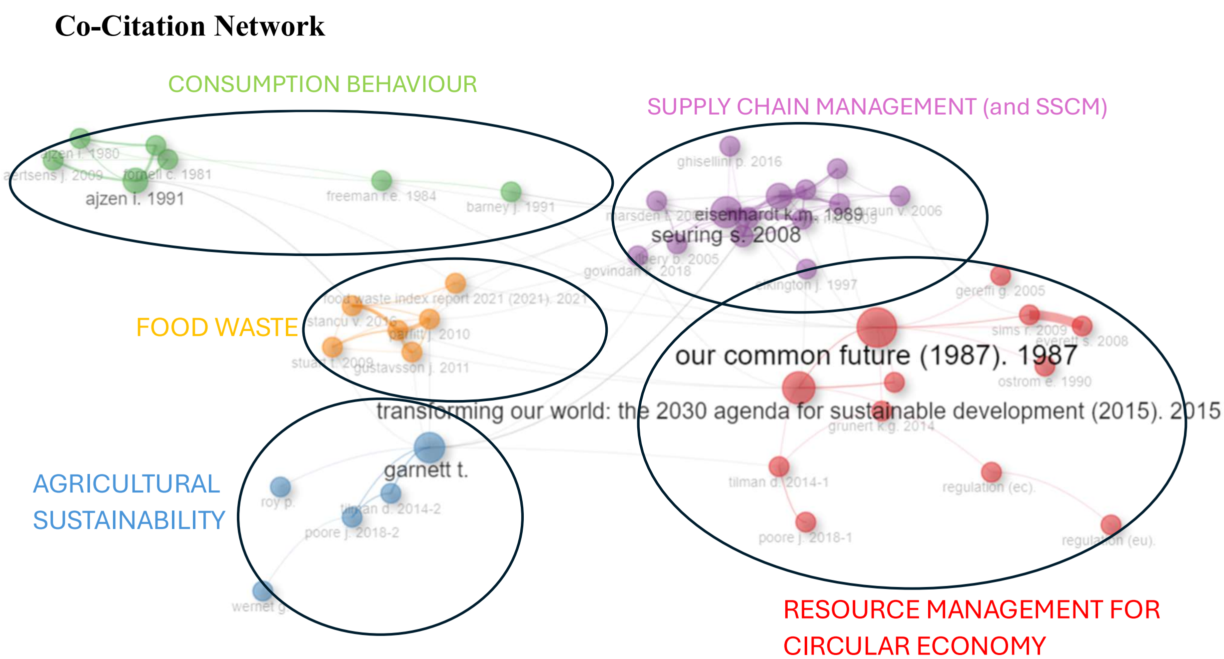

Figure 7: co-citation analysis. Source: bibliometrix.

Co-citation analysis is one of the most employed methods in bibliometric analysis (Ding et al., 2001). It is defined as the occurrence of two publications being cited together in a single article (Small, 1973). When two documents are frequently co-cited in other articles, it often indicates that the two references share a common theme or subject matter (Benckendorff and Zehrer, 2013). This tool is particularly valuable for identifying clusters of co-citation pairs, which provide insights into the cumulative tradition, knowledge base, and intellectual structure of scientific research (Small, 1978; Culnan, 1986; Pasadeos et al., 1998).

To achieve these results, we utilized bibliometrix software, applying specific filters such as selecting “Papers” as the field option and using “;” as the field separator character. Regarding method parameters, the "Fruchterman & Reingold" was chosen for network layout, while the

"Louvain" algorithm was selected for clustering. The analysis was limited to 50 nodes to ensure clarity and avoid excessive crowding in the final visualization. Finally, the minimum number of edges was set at 3 to exclude overly isolated nodes.

The co-citation analysis conducted with bibliometrix allowed us to identify five distinct clusters using the search query, which included the keywords "Food" and "Sustainab*." The following paragraphs provide a detailed description of each of these clusters.

1st Cluster: Food Waste

The first cluster focuses on food waste and methods to reduce unnecessary waste throughout the entire supply chain, from manufacturing to retail and consumer consumption. It is notable that publications on this topic are concentrated between 2009 and 2022, indicating a growing interest in recent years. As illustrated by the "Thematic Evolution" graph (Figure 10), until 2015, the term "Sustainability" dominated the discourse. However, companies and the market began to recognize that this term could be perceived as complex at both micro and household levels. Consequently, the trend has evolved, with market players now focusing their marketing and sustainability efforts on more specific themes to engage consumers more effectively, making them active participants in the change. One such theme is food waste and strategies to mitigate it. The literature on food waste has expanded significantly in recent years, gaining considerable momentum.

This cluster comprises six key nodes, with publications by Stuart (2009), Parfitt (2010), Gustavsson (2011), Aschemann-Witzel (2015), Stancu (2016), and the Food Waste Index Report (2021).

Beginning in 2009, there was limited evidence or methods available to quantify food waste at various levels of the supply chain, highlighting the need for culture-specific innovations and technologies to reduce losses in the food industry. Parfitt (2010) defines food waste using three different definitions, the two most relevant being:

1. "Wholesome edible material intended for human consumption, arising at any point in the Food Supply Chain (FSC), that is instead discarded, lost, degraded, or consumed by pests (FAO 1981);"
2. "As (1) but including edible material that is intentionally fed to animals or is a by-product of food processing diverted away from human food (Stuart 2009)."

These definitions emphasize that food waste can occur at any stage of the food supply chain. Parfitt makes a significant distinction between developing countries and affluent economies based on where losses occur. In developing countries, losses are much higher at the immediate post-harvest stages, particularly for perishable foods, while in affluent economies, post-consumer food waste accounts for the greatest overall losses. He further identifies three interrelated global drivers influencing supply chain losses:

1. Urbanization and the contraction of the agricultural sector, necessitating the extension of FSCs to feed urban populations.
2. Dietary transition, where increased household incomes lead to decreased consumption of starchy staples and increased consumption of vulnerable, shorter shelf-life items, resulting in greater food waste.
3. Increased globalization of trade, which creates opportunities for agricultural exports but may also pose a threat to the development of internal markets.

Parfitt concludes by noting that there is no consensus on the proportion of global food production currently lost, with estimates ranging between 10 and 40 percent of total global food production, and in some cases as high as 50 percent. These estimates often trace back to the same limited primary datasets, with much of the data originating from fieldwork conducted in the 1970s and 1980s.

An additional insight provided by Parfitt is that as the proportion of income spent on food decreases, food waste increases. This finding underscores the need for continuous investment to maintain high standards in food infrastructure.

Gustavsson (2011) analyzes two studies conducted by the FAO that focused on the extent, effects, causes, and prevention of food losses and food waste—one study for medium/high-income countries and one for low-income countries. These studies examined the amount of food loss and waste occurring globally each year. Gustavsson was able to define:

1. Food losses as a decline in food quality or quantity in the early stages of the food supply chain, which reduces the amount of food suitable for human consumption. This issue is particularly prevalent in developing countries.
2. Food waste as occurring in the later stages of the food supply chain, such as at retail and consumer household levels, and is primarily observed in developed countries. This distinction underscores the role of human behavior in causing food waste.

The stages at which food becomes unavailable for human consumption are directly linked to the quantity of waste generated, which has significant environmental consequences. The food sector is responsible for approximately one-third of all greenhouse gas emissions (Aschemann-Witzel, 2015), and roughly one-quarter of the food supplied for human consumption is wasted across the food supply chain (Stancu, 2016).

Aschemann-Witzel (2015), along with expert interviews, identifies the major factors contributing to consumer-related food waste in households and supply chains:

1. A culture of "consumerism and abundance," combined with generally low food prices, which leads to poor planning and management of food purchase, storage, preparation, and reuse.
2. A broad consumer focus on price and the search for the optimal price-quality ratio as a leading factor in food purchases.
3. A reluctance among consumers or household members to eat the same meal repeatedly or to store and eat leftovers, sometimes even experiencing disgust at the thought.

Aschemann-Witzel also outlines several "Potential Actions against Consumer-Related Food Waste":

1. Date labeling: Improved legislation and usage by producers should be implemented to educate consumers on proper understanding and usage. Retailers can make significant contributions through in-store communication and product package information. Consumers frequently check expiration dates, particularly for products where diminished quality is a concern and for products with which they have prior experience.
2. Consumer expectations and perceptions: Addressing expectations and perceptions about food without date labeling or in cases where the expiration date has passed.
3. Enhancement of household food management behavior: The primary aim should be to improve food management skills comprehensively. However, this may prove challenging due to the low priority consumers place on food waste.

From a retailer's perspective, the following actions could be implemented:

1. Pricing strategies: Retailers could introduce different price levels for quality classes, reduce prices for products with reduced storage life, and price items by piece or

weight depending on the category, to avoid unnecessary over-purchasing that leads to waste being transferred from the store to the home.

2. Packaging size and functions: Adjusting packaging to better meet consumer needs and reduce waste.
3. Supply chain influence: Retailers can exert influence both upstream, by using their negotiation power, and downstream, by finding alternatives to food disposal.

Results from a study conducted by Stancu (2016) indicate that perceived behavioral control and routines related to food purchase and reuse of leftovers are the most significant drivers of food waste, while planning routines contribute indirectly. At the household level, food waste in Europe is estimated to account for more than 50 percent of total food waste (Kummu et al., 2012). This has severe environmental, social, and economic consequences. Environmentally, food waste is associated with large emissions of greenhouse gases (Bio Intelligence Service, 2010; WRAP, 2009) and the wasteful use of resources such as water, cropland, fertilizers, and fossil fuels (Hall, Guo, Dore, & Chow, 2009; Kummu et al., 2012). Moreover, with the global population expected to grow in the coming years, the constraints on available food will become more pronounced, making the prevention of food waste essential for achieving environmental impact reductions.

The UNEP Food Waste Index Report (2021) emphasizes the critical importance of reducing food waste at retail, food service, and household levels. Increasing efforts to measure food waste, including inedible parts, at these stages and tracking food waste generation in kilograms per capita at the country level are necessary steps. Doing so will enable tracking of progress on SDG target 12.3, one of the 17 Sustainable Development Goals promoted by the United Nations (2015). This target aims to halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses

2nd Cluster: Supply Chain Management (and SSCM)

Continuing our study of the co-citation network, the focus shifts from exploring alternative ways to reduce food waste throughout the supply chain to examining the management of the supply chain and how these value chains have evolved into sustainable models.

The second cluster, highlighted in purple, comprises multiple nodes, with key publications from Eisenhardt (1989), Marsden (2000), Ilbery (2005), Seuring (2008), and Beske (2014).

The central themes of the documents in this cluster are Supply Chain Management (SCM) and Sustainable Supply Chain Management (SSCM). The literature initially explores alternative methods for creating value within the supply chain, with the ultimate goal of capturing that value in the market. In the works of Marsden (2000) and Ilbery (2005), the concept of "Short Supply Chains" (SSC) is introduced, which refers to the types of relationships that exist between producers and consumers and the role these relationships play in constructing value and meaning. Three types of SSCs are defined:

1. Face-to-face: Direct sales from producer to consumer.
2. Spatial proximity: When products are produced and retailed within the same region of production.
3. Spatially extended: Where value is communicated to consumers outside the region of production.

A practical example of the evolution of SSCM and of increasing requests by customers is the case of the Llyn Beef Producer Co-operative. Established in May 1997 in response to a livestock crisis in Wales, characterized by falling prices in traditional beef markets and declining consumer confidence in product quality, Llyn Beef represents a response to new consumer demands for quality-assured, fully traceable, mature, lean beef of consistent quality. Additionally, it addresses broader societal demands for natural methods of animal rearing, stress-free handling and transportation, and biodiversity maintenance. Marsden (2000) discusses how the implementation of such initiatives is challenging due to the complexities of sustaining them over time and across different contexts. He emphasizes the importance of rural development clustering, which refers to farmers' ability to interface with a growing number of supply chain agents. The reliability of these initiatives depends on producers' capacity to develop approaches associated with the innovative use and identity of rural space and nature.

As the literature on the theme continues to evolve, there is increasing interest in sustainable supply chain management. The literature on this topic, along with the management of operations within companies, has expanded in recent years. Unlike in the past, there is now greater demand for transparency in corporate activities, which is captured in related concepts such as sustainability management, corporate social responsibility (CSR), and corporate governance. Seuring (2008) identifies the core issues in SSCM through a Delphi Study, gathering opinions from various experts in the field. Four major themes have been identified:

1. Pressures and incentives for sustainable supply chain management: Among all stakeholders, customers were rarely mentioned by experts; instead, the concept encompasses government regulation and NGO pressure.
2. Identifying and measuring impacts on sustainable supply chain management: The three dimensions of sustainability—economic, environmental, and social—are assessed for their impact on supply chain management.
3. Supplier management: When selecting and managing suppliers, the main issue arises from the "supplier selection, including environmental and social criteria." Additionally, it is crucial to "audit and monitor suppliers" over time.
4. Supply chain management: Issues across all companies involved in the supply chain are addressed.

As time progresses, there is a growing need to identify the necessary practices for becoming sustainable players within one's industry. Beske and Seuring (2014) discuss the opportunity to integrate sustainability into the general topic of supply chain management and to identify the key categories and practices required to meet market demands and expectations regarding sustainability. A renewable and circular performance by businesses can be achieved by considering all three dimensions of sustainability (economic, environmental, and social). The idea of SCM originates from the minimization of waste, as waste reduces economic profitability (Sarkis et al., 2011). The inclusion of sustainability in SSCM is typically based on the Triple Bottom Line (TBL). But how can this be done? Beske and Seuring (2014) categorize sustainable practices into five general areas: orientation, continuity, collaboration, risk management, and proactivity.

1. Orientation: This category reflects the values of a company and how it intends to incorporate sustainability from a strategic standpoint. The first practice introduced here is a "dedication to the TBL" (Beske and Seuring, 2014). It is important to note that "to create a sustainable chain, managers need to integrate sustainability goals, practices, and cognitions into day-to-day supply chain management" (Pagell and Wu, 2009). Dedication to the TBL is one of the core principles distinguishing SSCM from SCM.

2. Continuity: This category concerns how different partners collaborate within the supply chain. It emphasizes the performance of the entire supply chain rather than just individual members (Gold et al., 2010a).

3. Collaboration: Collaboration operates at both structural and operational levels within the framework. It plays a crucial role in enhancing the competitive advantage of a supply network (Chen and Paulraj, 2004; Gold et al., 2010b).

4. Risk Management: It is commonly believed that companies engaging in sustainability and implementing SSCM practices face different and sometimes higher risks compared to conventional SCM (Walker et al., 2008; Colicchia and Strozzi, 2012; Miemczyk et al., 2012). These risks include the potential for supply chain disruption due to a smaller supplier base or the risk of reputational damage if shortcomings are publicized by NGOs (Markley and Davis, 2007; Seuring and Müller, 2008a).

5. Proactivity: Companies that engage in sustainability practices are considered proactive (Pagell and Wu, 2009). As they often pioneer new paths, they must develop new technologies and methodologies. Consequently, they utilize tools to foster innovation within their supply chains.

3rd Cluster: Consumption Behaviour

This third cluster explores the theories that explain planned behavior and consumption behavior, beginning with a general overview and then focusing on the case of a consumer in the market during the purchasing process. What are the drivers? What are the main influencing factors?

The green cluster, as depicted in Figure 7, comprises seven nodes, with key contributions from authors such as Fishbein (1975), Freeman (1984), Barney (1991), Ajzen (1991), and Aertsens (2009). The study of this cluster will demonstrate how factors such as subjective and objective norms can influence our everyday decisions, including the decision to purchase or not purchase a product. Fishbein (1975) demonstrates, through Bayes's theorem, that "The observer may receive information about an actor's behavior, the circumstances under which it was performed, and the effects it produced. Based on this information, the observer is to make an inference about the causal factor or factors responsible for the observed behavioral event." This process allows the observer to build beliefs about themselves, others, and the surrounding environment. Bayes's theorem, which concerns the formation or revision of beliefs based on new information, serves as a valid tool for studying attribution processes in a unified and integrated manner. The process of attributing intentions suggests that actions are informative to the extent that they emerge from a context of choice and reflect the selection of one option among several alternatives (Jones & Davis, 1965).

Ajzen (1991) describes the "Theory of Planned Behavior," which seeks to provide a framework for understanding the complexities of human social behavior. The primary factors influencing and predicting human intentions with a high degree of accuracy are attitudes toward the behavior, subjective norms regarding the behavior, and perceived control over the behavior. Although these three concepts are interrelated, the exact nature of their relationships remains uncertain. Of particular relevance to our research are the insights gained from applying the theory of planned behavior to the purchasing process. These insights are invaluable for understanding consumer behaviors and implementing interventions that effectively change them (van Ryn & Vinokur, 1990). Studying the theory of planned behavior in the context of the purchasing process can help industry players, such as retailers, adapt their marketing and communication strategies to better align with customers' needs and desires by leveraging knowledge of consumer perceptions and purchasing habits.

The literature then shifts focus to the determinants of organic food consumption. In a global context where terms such as "Sustainability," "Organic Food," and "Circular Economy" are becoming increasingly significant within the food industry, Aertsens (2009) attempts to develop a framework to highlight the personal determinants of organic food consumption. This framework is derived by linking Schwartz's values theory with the theory of planned behavior, which has often been applied in the area of food choice. As depicted in the "Thematic Evolution" graph (Figure 10), this topic has gained prominence since the early 2000s, with a growing body of research focusing on sustainability and its related aspects, including organic food consumption. Aertsens emphasizes that although most consumers hold positive attitudes toward organic food (Magnusson et al., 2001; Saba & Messina, 2003; Kihlberg & Risvik, 2007), the percentage of consumers who regularly purchase organic food remains low.

An interesting aspect of values, in comparison with attitudes, is that values are more stable over time because they are more deeply connected to an individual's cognitive system (Rokeach, 1973). Furthermore, a limited set of ten values can encompass virtually all specific values across different cultures worldwide (Schwartz, 1992). In this section, we discuss the values that have been associated with organic food consumption:

- Security: Involves safety, harmony, and stability of society, relationships, and oneself. Several studies have concluded that health, which is linked with the value of security, is the strongest motive for purchasing organic food (Schifferstein & Oude Ophuis, 1998; Worner & Meier-Ploeger, 1999; von Alvensleben, 2001; Chinnici et al., 2002; Harper & Makatouni, 2002; Makatouni, 2002; Zanoli & Naspetti, 2003; Mintel, 2000; Millock et al., 2004; Chryssohoidis & Krystallis, 2005; Padel & Foster, 2005; Shepherd et al., 2005; Baltussen et al., 2006; Botonaki et al., 2006; Bonti-Ankomah & Yiridoe, 2006; Chen, 2009).

- Hedonism: Represents pleasure and sensuous gratification for oneself.
- Stimulation: Involves excitement, novelty, and challenge in life. People may be motivated to learn more about organic products as they perceive them as new and innovative, which can lead to increased purchases.
- Universalism: Encompasses understanding, appreciation, tolerance, and protection for the welfare of all people and for nature.
- Benevolence: Focuses on preserving and enhancing the welfare of those with whom one is in frequent personal contact (the "in-group").
- Self-Direction: Reflects independent thought and action, including choosing, creating, and exploring. Some individuals may consume organic food to differentiate themselves from others, thereby enhancing their self-image and identity.
- Conformity: Involves restraint of actions, inclinations, and impulses that are likely to upset or harm others and violate social expectations or norms.
- Power: Pertains to social status and prestige, as well as control or dominance over people and resources.

4th Cluster: Agricultural Sustainability and Food Environmental Impacts

The fourth cluster considered comprises five nodes, represented by publications from Tilman (2002), Garnett (2011), Tilman (2014), and Poore (2018). The primary focus of this cluster is on how stakeholders in the food industry can achieve agricultural sustainability while meeting the growing global food demand. Additionally, it is crucial to expand knowledge regarding opportunities to reduce greenhouse gas emissions within the food system, identifying which stages of the supply chain contribute most to emissions. An integrated ideal framework is also developed to enable producers to monitor their impacts, flexibly meet environmental targets, and effectively communicate their impacts to consumers.

Tilman (2002) discusses the projection that by 2050, global food demand will nearly double, presenting significant challenges for the sustainability of both food production and terrestrial and aquatic ecosystems. Sustainable agriculture encompasses practices that address current and future societal needs for food and fiber, ecosystem services, and healthy living. Ecosystems provide numerous benefits to society, termed ecosystem services, from both natural and managed systems. Sustainability requires maintaining high yields even amidst major disruptions and adopting agricultural practices with minimal environmental impact.

Another critical consideration is the need to increase yields on existing farmland to "save land for nature." Currently, the best quality farmland is largely utilized for agriculture, implying that further expansion would occur on less productive secondary land, which is prone to degradation. Additionally, balancing water use in irrigation practices is crucial. Without increased water-use efficiency, higher agricultural production will necessitate more extensive irrigation. Tilman asserts that sustainable agriculture aims to maximize the net benefits to society from agricultural production and ecosystem services. He emphasizes that sustainable agriculture "must be a broadly based effort that ensures equitable, secure, sufficient, and stable flows of both food and ecosystem services for the approximately 9,000 million people expected to inhabit the Earth."

Garnett (2011) examines greenhouse gas (GHG) emissions related to food across the entire supply chain. He identifies that GHG emissions occur at all stages of the food chain, from farming and its inputs to food preparation at home and waste disposal. Unlike previous studies, estimates suggest that global agricultural production accounts for about 10-12% of global GHG emissions. Garnett proposes two main concepts for achieving long-term agricultural sustainability:

1. Measures to reduce GHG emissions at agricultural and post-farm gate stages, summarized into five categories: a. Enhancing carbon removals. b. Optimizing nutrient use: precise application of organic and inorganic fertilizers. c. Improving productivity: increasing the yield of edible output per unit of emissions. d. Managing and benefiting from outputs. e. Reducing the carbon intensity of fuel inputs through energy efficiency improvements and alternative fuels.

2. The necessity for changes in consumption patterns, highlighting the importance of reducing meat and dairy consumption. Garnett (2009) and other studies (Goodland, 1997; Weber & Matthews, 2007; Stehfest et al., 2009; Audsley et al., 2010) suggest

that targeting high per capita consumption levels in developed countries is crucial, though this alone may not suffice.

Tilman (2014) explores global diets as a link between environmental sustainability and human health. Adopting alternative diets with substantial health benefits could mitigate global agricultural GHG emissions, reduce land clearing, and prevent diet-related chronic non-communicable diseases. Global agriculture and food production contribute over 25% of all GHGs, pollute fresh and marine waters with agrochemicals, and utilize approximately half of the ice-free land on Earth. Transitioning to alternative dietary options could significantly improve both human and environmental health. Without such changes, chronic diet-related diseases like diabetes and heart disease are expected to become increasingly prevalent, particularly in less affluent nations.

The widespread environmental impact of food production underscores the need for uniform solutions to meet environmental targets. Poore (2018) proposes a framework for tracking emissions and impact factors. The framework involves four steps:

1. Monitoring impacts using digital tools, with data verification against established ranges. In the U.S., such tools have been integrated with existing farm software.

2. Setting environmental targets and incentivizing producers through credits, tax exemptions, or adjusted agricultural subsidies. Policymakers would encourage producers to meet these targets. Global agricultural grants exceed half a trillion dollars annually.

3. Providing producers with assessment tools offering various mitigation and productivity enhancement options. Practice sharing is a particularly effective engagement strategy.

4. Communicating impacts throughout the supply chain to consumers.

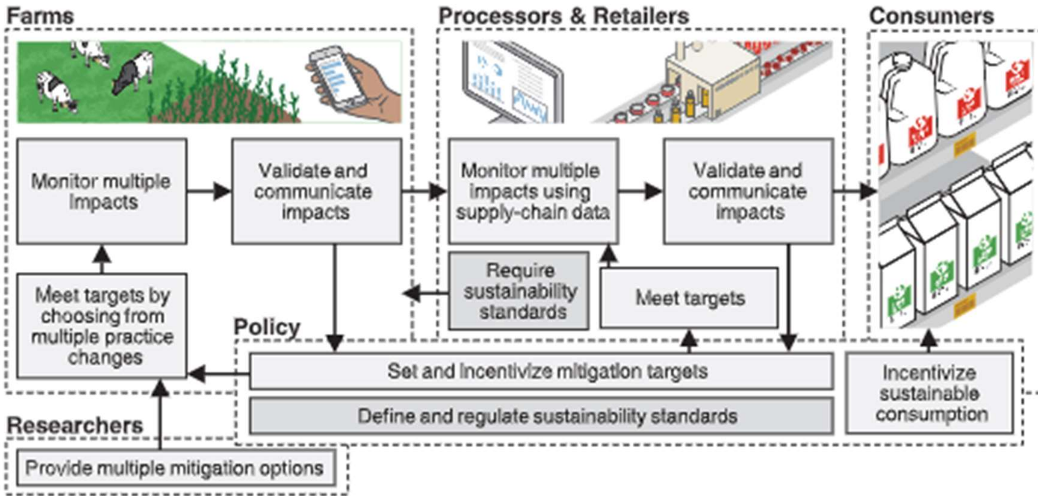

Figure 8: graphical representation of the mitigation framework. "From farms to consumers". Poore (2018). Source: Science.

5th Cluster: Resource Management for Circular Economy

The fifth cluster under consideration comprises 12 nodes, 10 of which address resource management within firms and their respective markets, with the common goal of achieving the sustainability objectives of a circular economy. The remaining two nodes pertain to regulatory aspects from the European Union (EU) and the European Council (EC). This cluster is notably diverse, encompassing themes from the Brundtland Report of 1987, which advocates for a sustainable global future, to Barney's (1991) transition from resource-based theory to a market-centered approach for sustaining competitive advantage. It also includes recent analyses of global value chains, decisions regarding in-house production versus outsourcing, and concludes with "Transforming Our World: The 2030 Agenda for Sustainable Development" (2015), which aims to eradicate poverty and hunger, uphold human rights, achieve gender equality, and ensure the protection of the planet and its resources. The Global Goals are integrated and indivisible, balancing the economic, social, and environmental dimensions of sustainable development.

In 1987, the United Nations, chaired by Gro Harlem Brundtland, the Norwegian Prime Minister, introduced the concept of sustainable development, outlining how it could be achieved. The Brundtland Report addresses topics such as the international economy, population, human resources, food security, species and ecosystems, energy, and industry, and proposes legal principles for environmental protection. It defines sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." The report also highlighted the unsustainable nature of unchecked global population growth and called for the establishment of the UN Programme of Action on Sustainable Development to implement its directives. This document is pivotal as it represents the first articulation of sustainable growth at both the firm and industry levels, emphasizing long-term viability.

Barney (1991) focuses on how firms can create and sustain a competitive advantage using their resources. Prior to the 1980s, literature generally supported the idea that firms achieved sustained competitive advantage through strategies based on internal strengths and responses to environmental opportunities, while mitigating external threats and internal weaknesses. More recent work shifts focus to external analyses of the firm's competitive environment, examining opportunities and threats. Barney defines sustained competitive advantage as occurring "when a firm implements a value-creating strategy not simultaneously being implemented by any current or potential competitors and when these competitors cannot duplicate the benefits of this strategy." However, sustaining a competitive advantage does not imply that it will endure indefinitely.

In industries characterized by competition with homogeneous and perfectly mobile resources, firms cannot sustain a competitive advantage. The exceptions to this are "first-mover advantages," where a firm gains an advantage by being the first to implement a strategy, and "barriers to entry," which allow firms within an industry to maintain a competitive advantage despite strong competition. A significant development in literature is Porter's (1985) concept of the value chain, which aids managers in identifying potential resource-based advantages. This concept aligns with Gereffi's (2005) work on "The Governance of Global Value Chains," which will be discussed shortly. Not all firm resources can confer a sustained competitive advantage; they must possess attributes such as value, rarity, imperfect imitation, and non-substitutability. According to Barney, firms cannot "purchase" sustained competitive advantage; it must be derived from rare, imperfectly imitable, and non-substitutable resources already under the firm's control.

Gereffi (2005) introduces two key features of the contemporary economy: the globalization of production and trade, and the vertical disintegration of transnational corporations. His research on global value chains and policy work highlights how global production and distribution systems are integrated and how firms in developing countries can enhance their global market positions. Gereffi's transition from a resource-based view of the firm to a vertically disintegrated value chain underscores the evolving perspective on resource management and the creation of a circular economy over the long term.

The focus of Gereffi's analysis is to determine which activities and technologies a firm should retain in-house, and which should be outsourced, and where these activities should be located. The article addresses organizational structures that span international borders, especially those with global reach. In various industries, selective exemptions for duties on value-added activities, such as section 807 and most-favored-nation status in the U.S., and outward processing arrangements in Europe, have promoted the geographical fragmentation of global value chains. Political pressures and managerial desires for geographical diversification are likely to keep the apparel value chain more fragmented than if production decisions were solely based on economic factors. An important area of focus is developing policy tools for industrial upgrading consistent with the framework. Gereffi's work indicates that understanding how global value chains are governed and structured is crucial for advancing sustainable development in today's economic context.

2.4.3 Evolutionary Trajectory of the Research Field

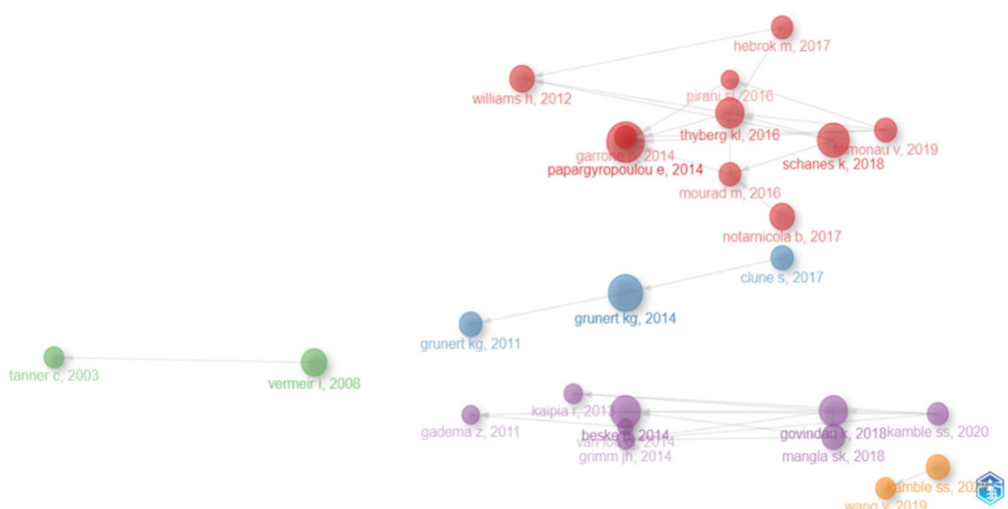

Figure 9: historiograph. Source: author's elaboration with bibliometrix.

Proceeding with our analysis, we shift our focus to the evolutionary trajectory of the field of food sustainability. The tool employed for this analysis is the "Historiograph," as depicted in the figure above (Figure 9). The historiograph, introduced by Garfield (2004), is a chart designed to represent a chronological network map of the most relevant direct citations derived from a bibliographic collection (Journal of Information Science, 2004). This bibliometric analysis produces a visualization aimed at capturing the chronological citation network within the collection. The “options” window in Bibliometrix allows for the output of research to be labeled with various key parameters, such as short ID (1st author, year), document title, author keywords, and keywords plus. We selected the short ID (1st author, year) option. Additionally, the number of nodes was limited to 30 to provide a meaningful sample without creating excessive complexity in the graph. The primary advantage of using the historiograph is its ability to reveal the temporal evolution of the field and the relative impact of each contribution. Different colors represent various clusters, indicating distinct themes related to keywords about food sustainability.

The first cluster, marked in red, focuses on food waste and strategies to prevent losses throughout stages of the food supply chain. It discusses not only methods for reducing food waste but also practices for developing sustainable policies to address current market challenges. The graph shows that literature on food waste began appearing around 2012, with a notable concentration in 2016 and 2017. The second cluster, identified in blue, addresses consumer behavior and perceptions of labeling, with an emphasis on greenhouse gas emissions. Sustainable consumption is the focus of the third cluster, with publications from the early 21st century (2003 and 2008) reflecting early awareness of sustainability issues. The fourth cluster illustrates the evolution of supply chain management from a basic model to a sustainable approach, emphasizing drivers, barriers, and practices related to the circular economy. Publications in this area span from 2011 to 2020, reflecting a continuously evolving literature that adapts to advancements in sustainable practices. The fifth cluster examines sustainable agricultural practices, including the application of blockchain technology in agriculture.

Turning to “Thematic Evolution,” we further explore how keywords and themes in the literature have evolved over time within the sustainable food industry. The historiograph provides a network of correlations among papers on food sustainability, including information on first authors, publication years, titles, and DOIs (Digital Object Identifiers). In contrast, Thematic Evolution highlights the most cited keywords and topics, indicating the directions in which literature has progressed. To achieve this, we establish three cut-off points: 2010, 2015, and 2022, as illustrated in Figure 10. The period prior to 2010 marks the beginning of the literature, with significant growth occurring in the new millennium. Between 2011 and 2015, there was a substantial increase in literature corresponding with heightened awareness of the topic. Post-2015, it is crucial to clearly define practices and keywords associated with "Sustainability."

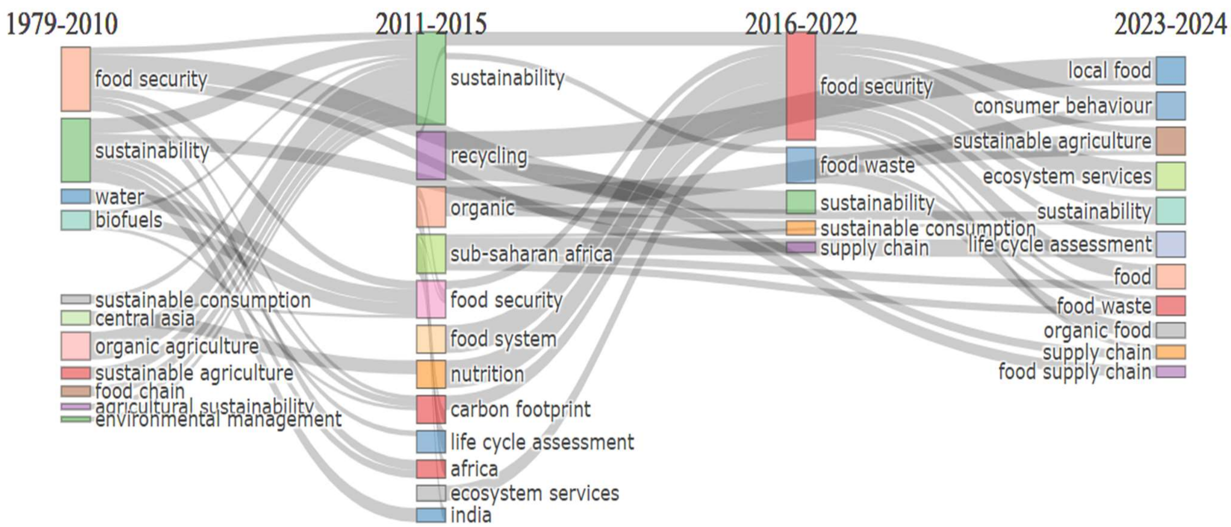

Figure 10: Thematic Evolution. Source: author's elaboration with bibliometrix.

Combining the Historiograph with the Thematic Evolution provides a comprehensive view of the research field's evolutionary trajectory. Keywords in the first period (1979-2010) focus on sustainable consumption and food security, as highlighted by publications from Tanner (2003) and Vermeir (2008) in the historiograph. The interval between 2011 and 2015 saw a significant increase in publications, with literature concentrating on sustainability, recycling, and life-cycle assessment. This period reflects a more specific focus on rational recycling, food waste avoidance, and the introduction of life cycle assessment, which has influenced future sustainable supply chain management from 2016 to 2022. Keywords such as food security, food waste, and supply chain dominate this period, supported by publications from Hebrok (2017), Govindan (2018), and Filimonau (2019). Recent literature emphasizes food waste as a central theme, with a focus on understanding its causes, particularly household consumption. Companies in the industry are promoting sustainable practices through advertising and awareness campaigns.

3. Statistical analysis: insights from the food industry in Italy

3.1 Methodology

The operational context described in the previous chapters appears to be well-defined. On one side, stakeholders, consumers, and other market participants, such as NGOs and the media, are increasingly seeking ways to directly monitor the sustainable performance of corporations. On the other side, companies are striving to align with ongoing trends that demand greater transparency in the communication of environmental goals to the general public, alongside practical activities requiring investments throughout the supply chain to meet sustainable performance indicators. The ultimate objective is to enhance collective awareness regarding the achievement of environmental certifications and results, which, at the end of each financial year, can significantly boost a company's reputation and attractiveness in the market.

Focusing on the food market, and specifically considering Italy as the geographical area of reference, this study aims to identify firms that can be considered virtuous and sustainable by analyzing their websites and the extent to which they use language that appeals to stakeholders seeking greener practices. Applying Qiba, a tool developed by Quantitas (a firm specialized in the analysis, interpretation of data, and application of advanced data mining techniques) to extract and analyze data coming from the web, a "basket of words" (BOW) approach has been employed. This entails the proposition that different groups of words put together constitute different themes. If the tool identifies those words, this means that the website cites that topic.
This methodology enables to count and weigh the number of times a word (belonging to one of the four baskets of words) is mentioned within the analyzed companies' websites.
Moreover, Qiba allows to compute an index TFIDF (term frequency – inverse document frequency) which represents the step to move from the most frequent words within the text to those most relevant to content analysis.
Furthermore, any discrepancies between firms' public statements on sustainability and their ability to achieve performance standards (such as certifications) will be examined to identify companies that genuinely implement sustainable practices throughout their business cycle. Conversely, the study will also reveal whether companies are merely engaging in "greenwashing"—seeking reputational enhancement by proclaiming their environmental consciousness without substantiating it with material actions. The research begins with a file extracted from Orbis, containing a list of corporations with revenues exceeding €3 million at

the end of the two financial years, 2019 and 2020. This file was subsequently converted into an Excel format document, including AIDA data for 2,921 companies operating in the food industry in Italy.

3.1.1 BvD Independence Indicator

Among the derived data, an intriguing factor called the "BvD Independence Indicator," which highlights the level of independence within a company as reflected by the Board of Directors' autonomy from shareholders, is presented.

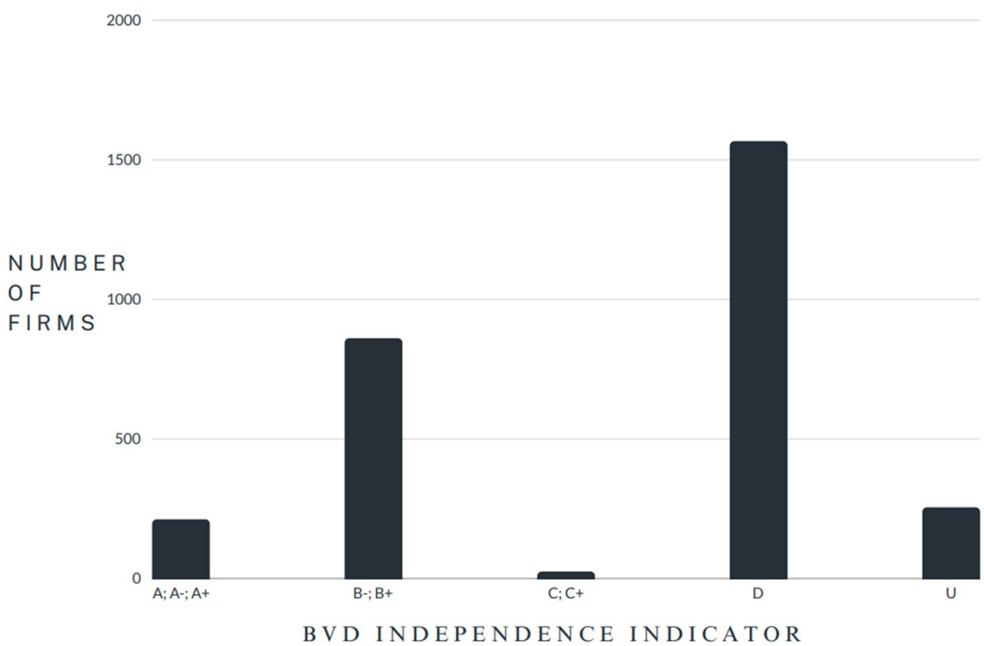

Figure 11: BvD Independence Indicator, a study from the food database. Source: Orbis.

In the graph shown, firms are classified based on their degree of ownership concentration. The classification ranges from A to D, with level A corresponding to low ownership concentration at one extreme, while level D represents cases with high ownership concentration and direct majority ownership. Low ownership concentration implies limited independence for the board of directors in making decisions independent of the company's shareholders. Conversely, high ownership concentration, and consequently a high independence indicator, suggests greater autonomy and decision-making latitude for the board. The graph indicates that level D has the highest percentage (1,567 results out of a total

of 2,921, representing 53.64%). Notable examples within this group include major players in the Italian food industry such as Parmalat, Barilla, Inalca, Granarolo, Lavazza, Coca-Cola HBC Italia, Nestlé Italiana, and Illy Caffè.
The category with the second highest frequency is “B-; B+,” with 861 results out of a total of 2,921. The “B” category generally represents medium-low ownership concentration, without majority ownership. Category U highlights corporations with an unknown level of independence.

3.1.2 Dimensional classification

Another important statistic to consider is the number of employees each company has. The classification of this metric begins with defining the different types of enterprises that may be encountered in the market based on the number of employees. According to the European Commission’s definition of SMEs, which has been in force since January 1, 2005, the criteria used are:

- Number of employees
- Total turnover
- Total balance sheet

Based on these criteria, the types of businesses present in the analyzed data can be categorized as follows:

- Micro-businesses: Businesses with fewer than 10 employees and a yearly turnover of less than €2 million.
- Small enterprises: Businesses with fewer than 50 employees and a yearly turnover of less than €10 million.
- Medium enterprises: Businesses with fewer than 250 employees and a yearly turnover of less than €50 million.
- Large enterprises: Businesses with more than 250 employees and a yearly turnover exceeding €50 million.

From the available data, when applying the filters for micro-businesses, it is evident that there are many firms with fewer than 10 employees in the food industry. However, none of these firms have a turnover of less than €2 million, indicating that no micro-businesses are represented in the file. This absence is due to the filter applied, which only considered corporations with revenues exceeding €3 million. Moving forward, the analysis reveals that small enterprises constitute 1,925 out of the 2,921 firms under investigation, representing 66% of the total. Medium enterprises account for 791 firms, or 27% of the total. Additionally, large enterprises, defined as firms with more than 250 employees and a turnover exceeding €50 million, represent 7% of the food industry in Italy.

As clearly depicted in the graph below (Figure 12), the structure of the Italian food industry mirrors the broader national entrepreneurial landscape. The industry is predominantly composed of small and medium enterprises, which together represent 93% of the total (this percentage is derived by adding the 66% of small enterprises and the 27% of medium enterprises). This statistic aligns with the general trend in the Italian industrial sector, where micro and small enterprises dominate, constituting 97.4% of all businesses, with only 2.2% classified as medium enterprises and a mere 0.4% as large enterprises (Source: Istat, 2022).

Furthermore, an analysis of these statistics reveals that the agribusiness sector tends to have larger businesses, on average, with a broader number of employees. This is evident from the data on medium enterprises (those with fewer than 250 employees), which account for 27% of the Italian food industry, compared to only 2.2% in the general industrial sector.

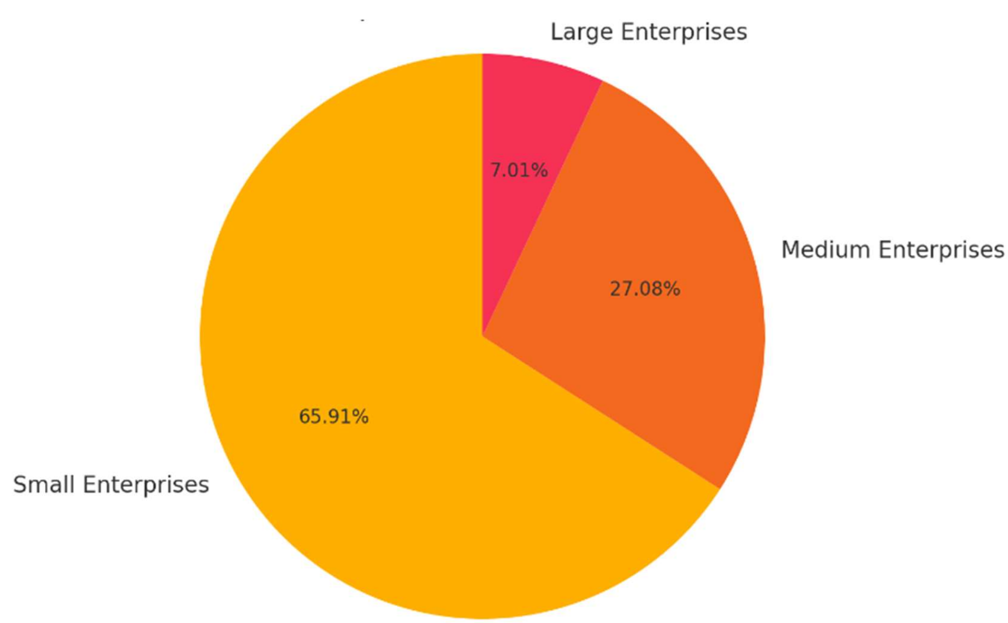

Figure 12: Structure of Italian Food Industry. Source: Istat.

3.1.3 Data Scraping – Baskets of words (bows)

The starting databases useful for the crawling phase are those provided by the University of Padua and extracted from Orbis. Firms included in those databases have been selected by means of their Ateco code, which needed to be akin to the three macro sectors considered in the survey and with a turnover exceeding 5 million euros. The second phase of the process involves "scraping" data, a technique that entails extracting information from websites using specialized software programs. Beginning with the various companies' websites identified during the first stage, the "Sustainability" and other related sections of these websites are analyzed. Sustainability-related words, which are considered thematically similar, are grouped into four categories, referred to as "baskets of words." Once these baskets are defined, specific keywords are associated with each of the four categories. This stage of the procedure is known as "word embedding," as it involves embedding the grouped words into four distinct topics related to sustainability. The four baskets of words identified are:

- Green sustainability
- Social sustainability
- Certifications
- Sustainability

For example, the "social sustainability" basket includes terms such as anti-corruption, B Corp, code of conduct, code of ethics, human rights, among others.

The next phase involves counting the frequency of each basket of words as they appear on the websites of the firms considered, and subsequently calculating the occurrence of each term. For every firm and every BOW, a TF-IDF indicator, which is called by us Sustainability Index, is computed. It represents the degree to which the issue covered by the BOW is addressed on the enterprise's website.

The document used for this analysis consists of the name of each company, followed by its website link, and a grid indicating the frequency score of each of the words collected during the research, as shown in Figure 13. Each firm under investigation is listed four times within the document, once for every basket.

For instance, when examining the word "Ambientale" (Italian for "Environment") in relation to "Nestlé Italiana S.p.A.," the score totals 324, indicating that the company places significant emphasis on sustainability and environmental safety. This is further evidenced by the extensive coverage of these topics on the company's website. Specifically, their "Nutrition & Sustainability" section highlights the numerous certifications obtained over the years related to eco-friendly activities and details the company's commitment to preparing the environment for a better future, protecting natural resources, and promoting balanced diets. Additionally, a commitment to the Sustainable Development Goals (SDGs) is prominently mentioned.

Basket	vat	name	website	agenda 2030
4	06880780728	ANDRIANI S.P.A.	https://www.andrianispa.com/	20
4	05194770722	ALFRUS S.R.L.	https://www.alfrus.it/	18
4	01414580991	PARODI NUTRA S.R.L	https://www.parodinutra.com/	4
4	00610140071	HEINEKEN ITALIA SPA	https://www.heinekenitalia.it/homepage	3
4	00126840354	MEDICI ERMETE & FIGLI S.R.L. IN SIGLA: CANTINE BEMA SRL , CANTI NE MEDERFIL SRL , CANTIN	https://www.medici.it/	3
4	04696960261	LA CANTINA PIZZOLATO SRL	https://www.lacantinapizzolato.com/	3
4	00070190707	FRATELLI FERRO - SEMOLERIE MOLISANE S.R.L.	https://www.lamolisana.it	3
4	01510070707	LA MOLISANA - S.P.A.	https://www.lamolisana.it/	3
4	00169350147	GALBUSERA S.P.A.	https://www.galbusera.it/	3
4	00106510191	OLEIFICIO ZUCCHI S.P.A. O ABBREVIATO O.Z. S.P.A. CR	https://www.oleificiozucchi.it/	2

Figure 13: Top 10 firms for the theme "Agenda 2030". Source: food sustainability database.

As shown in Figure 13, the food sustainability database provides several factors that help classify firms within the industrial context. On the far left, the "Basket" indicator represents the category to which each word belongs. For instance, the term "Agenda 2030" is associated with the fourth basket, which focuses primarily on sustainability. The example from the table (Figure 13) shows the top ten firms in terms of absolute frequency for the theme "Agenda 2030." Andriani S.p.A. is identified as the company that cites "Agenda 2030" most frequently on its website and, consequently, with the highest relevance for content analysis.

Basket	vat	name	website	b corp
2	04154750964	MITACA S.R.L.	https://www.illy.com/it-it/professionisti/uffi	221
2	00055180327	ILLYCAFFE' S.P.A.	https://www.illy.com/it-it/home	221
2	00395540081	FRATELLI CARLI SOCIETA' PER AZIONI SOCIETA' BENEFIT SIGLABILE IN FRATELLI CARLI S.P.A. S.B	https://www.oliocarli.it/	200
2	11202380157	DANONE S.P.A. SOCIETA' BENEFIT IN VIA BREVE DANONE SPA O D. SPA SOCIETA' BENEFIT	https://corporate.danone.it	95
2	00152620209	FARMER S.P.A.	https://www.farmer.it/prodotti/	19
2	01799290265	PERLAGE S.R.L.	https://www.perlagewines.com/	8
2	02160070245	CIELO E TERRA S.P.A. ENUNCIABILE ANCHE: CASA DEFRA' S.P.A. , C.D. S.P.A. , CI.MONT. S.P.A. ,	https://www.cieloeterravini.com:443/	6
2	06880780728	ANDRIANI S.P.A.	https://www.andrianispa.com/	3
2	00978660298	ABAFOODS S.R.L.	https://www.abafoods.com/	3
2	04696960261	LA CANTINA PIZZOLATO SRL	https://www.lacantinapizzolato.com/	1

Figure 14: Top 10 firms for the theme "B Corp". Source: food sustainability database.

Note: see *Appendix A* where all the themes linked with Agenda 2030 are described and all the words used to name it are included.

Another example can be drawn using the theme “B Corp,” which pertains to the classification of firms verified by B Lab, a nonprofit network aiming to transform the global economy to benefit all people, communities, and the planet. B Lab certifies that a business meets high standards of performance, accountability, and transparency across various factors, from employee benefits and charitable giving to supply chain practices and input materials (Source: B Lab Global). Illycaffé S.p.A. ranks highest in terms of citations and attention given to the B Corp theme on its website (Mitaca s.r.l., which tops the list, forms a partnership with the Illycaffé brand, focusing more on supplying other commercial establishments). The B Corp theme is part of the “Social Sustainability” basket, as it aligns with the goals pursued by B Lab. A functional analysis can be conducted to verify which of the top ten firms in this category actually meet the criteria for B Corporation certification.

Starting with Mitaca and Illycaffé, both part of Illycaffé S.p.A., it can be confirmed that the company has been a certified B Corporation since March 2021, with a B Impact assessment reporting an overall score of 90.4. This score is particularly notable, considering that the median score for ordinary businesses that complete the assessment is currently 50.9, and a minimum score of 80 is required to qualify for B Corp certification. This assessment evaluates both internal and external factors, including the company’s governance (overall mission, engagement around social/environmental impact, ethics, and transparency), workers (financial security provided, health and safety, wellness, career development, engagement, and satisfaction), community (how the business interacts with and affects the communities where it sources, hires, and operates), environment (climate, air, water, land, and biodiversity management), and customers (quality of products and services, ethical marketing, feedback channels, and data privacy and security).

Additionally, Fratelli Carli S.p.A. has been a certified B Corporation since July 2014, with an overall B Impact score of 85.3, demonstrating a strong commitment to people, the community, and the planet. Danone S.p.A., ranked fourth, is also a certified B Corporation with an overall B Impact score of 94.7, surpassing Illycaffé S.p.A. in this regard. After an interruption by Farmer S.p.A., an Italian company based near Mantova, which is not B Corp certified despite being ranked fifth, Perlage s.r.l., an Italian winery, holds B Corp certification with an overall B Impact score of 100.6, the highest among those observed in this category. Next is Cielo e Terra S.p.A., certified since March 2020, which produces and bottles wine primarily through the B2B channel. With an overall B Impact score of 87.3, it is a leading company in the production and marketing of wine according to ethical and integrated sustainability principles. Among the last three companies on the list—Andriani S.p.A., Abafoods s.r.l., and La Cantina

Pizzolato s.r.l.—only Andriani S.p.A. is certified as a B Corporation, with a score of 85.4. The other two are not only outside the certified companies list, but in one case, also highlight a clear instance of greenwashing. Specifically, on the Pizzolato Organic Wine website, the company claims to have met all the requirements and obtained B Corp status, but a check on the B Corporation global network reveals no evidence of this achievement.

3.1.4 Focus on Sustainability Index

In this context, how can the tools introduced be effectively utilized in our study? The issue under analysis centers on identifying firms in the Italian food market that claim to engage in sustainable practices but, in reality, either fail to implement these actions or only execute a small portion of what they promise—this is the essence of greenwashing.

The present chapter introduces the Sustainability Index, which represents the degree to which each company is committed to the sustainability issue, considering each one of the four baskets. Every firm will have four Sustainability Indexes, one for every basket. The Index, for example, of Basket 1 is obtained by making an average of the number of times each word belonging to the first basket is cited and weighted with its relevance to content analysis.

To explain further, every company under examination is going to be listed four times, and for every basket we are now proceeding ranking the top ten companies in terms of Sustainability Index.

Name of the company	Website	Sustainability Index
Angelo Colussi S.p.A.	https://www.colussigroup.it	57
Levico Acque s.r.l.	https://www.levicoacque.it	53
Casa Vinicola del primitivo s.r.l.	https://www.rina.org/en	52
Fratelli Ferro s.r.l.	https://www.lamolisana.it	48
La Molisana S.p.A.	https://www.lamolisana.it	48
Beyers Caffè Italia s.r.l.	https://www.beyers.eu/en	48
Nestlé Italiana S.p.A.	https://www.nestle.it	46
Andriani S.p.A.	https://www.andrianispa.com	40
Sarotto s.r.l.	https://www.sarotto.it	40
Coind società cooperativa	https://www.coind.it/en	37

Table 15: classification of top ten firms for Sustainability Index, Basket 1. Source: food sustainability database

Basket number 1 regards the Green Sustainability item. Using environmentally friendly goods and services is the definition of green sustainability. In this case, the company ranking first is Colussi S.p.A., an Italian food group based in Milan. Their utilization of resources and planning of future activities is always made with respect towards the environment's safety.

Name of the company	Website	Sustainability Index
Andriani S.p.A.	https://www.andrianispa.com	37
Teapak s.r.l.	https://www.teapak.com/	22
Casa Vinicola del primitivo s.r.l.	https://www.rina.org/en	21
Perlage s.r.l.	https://www.perlagewines.com/	19
Angelo Colussi S.p.A.	https://www.colussigroup.it	18
Danone S.p.A.	https://corporate.danone.it	17
La Cantina Pizzolato s.r.l.	https://www.lacantinapizzolato.com/	17
Farmer S.p.A.	https://www.farmer.it/prodotti/	17
Emiliana Conserve S.p.A.	http://emilianaconserve.it/home/	15
Sedamyl S.p.A.	https://sedamyl.com/	15

Table 16: classification of top ten firms for Sustainability Index, Basket 2. Source: food sustainability database

The second basket entails the Social Sustainability theme. The main objective of social sustainability is to recognize and monitor the effects that businesses have on people, both positive and negative. The level of a company's interactions and connections with its stakeholders is crucial. The highest scoring is reached by Andriani S.p.A., with 37. This firm is present in both the top ten rankings of the first and second baskets, together with Casa Vinicola del primitivo s.r.l. and Colussi S.p.A.

The third basket concerns Certifications, probably the most tangible way of proving that companies are actually investing and pursuing in a sustainable strategy. Furlotti Prosciutti s.r.l. reaches the highest scoring with 10 in the Sustainability Index, meaning that this company cites widely and gives a strong importance to the words included in this basket. The firm is based in Langhirano (PR), in the area where the Parma Ham district is located.

Name of the company	Website	Sustainability Index
Furlotti Prosciutti s.r.l.	https://www.furlotti.com/	10
Toschi Vignola s.r.l.	http://www.toschi.it/	10
Enoitalia S.p.A.	https://www.enoitalia.it/	9
Manini e Miazza s.r.l.	https://www.beverfood.com/	9
Levico Acque s.r.l.	https://www.levicoacque.it/	9
Oleificio Zucchi S.p.A.	https://www.oleificiozucchi.it/	9
Angelo Colussi S.p.A.	https://www.colussigroup.it	9
Beyers Caffè Italia s.r.l.	https://www.beyers.eu/en	8
Prosciutt. San Domenico S.p.A.	http://www.sandomenicospa.it/	8
Coind Società Cooperativa	https://www.coind.it/en/	8

Table 17: classification of top ten firms for Sustainability Index, Basket 3. Source: food sustainability database.

The fourth and last analyzed basket is more general and wider in scope, containing the Sustainable word. In it, the Italian subsidiary of Nestlé, the Swiss multinational food company, reaches the highest score. Within the fourth basket, to better define the concept of Sustainability utilized here as a filter of our research, the words applied are among the others Agenda 2030, global goals, SDGs (sustainable development goals), sustainability report, transparency, etc..

Following Nestlé, also Carlsberg Italia and Andriani S.p.A. show high scores, highlighting a serious commitment towards the topic.

Name of the company	Website	Sustainability Index
Nestlé Italiana S.p.A.	https://www.nestle.it/	46
Carlsberg Italia S.p.A.	https://www.carlsbergitalia.it/	24
Andriani S.p.A.	https://www.andrianispa.com/	14
Angelo Colussi S.p.A.	https://www.colussigroup.it	12
Heineken Italia S.p.A.	https://www.heinekenitalia.it	11
Oleificio Zucchi S.p.A.	https://www.oleificiozucchi.it/	11
Beyers Caffè Italia s.r.l.	https://www.beyers.eu/en	10
Medici Ermete e Figli s.r.l.	https://www.medici.it/	10
Venchiaredo S.p.A.	https://venchiaredo.eu/	9
Casa E. di Mirafiore s.r.l.	https://www.fontanafredda.it/	9

Table 18: classification of top ten firms for Sustainability Index, Basket 4. Source: food sustainability database.

Among the four baskets of words analyzed earlier, the third one focuses on certifications. This category is particularly functional because, if a company frequently discusses sustainability but lacks certifications in the field, it reveals a discrepancy between their claims and actual practices, indicating a deficiency in implementing tangible actions.

The fact that many corporations have recently engaged in greenwashing or misleading behaviors suggests that the benefits of falsely communicating sustainable actions to the public often outweigh the potential reputational damage from internal or external stakeholders recognizing these unethical practices. Therefore, the presence of objective factors, such as certifications, which indicate whether a company genuinely possesses sustainable credentials, is of paramount importance. To assess whether a firm is genuinely working towards a greener and circular economy, it is essential to examine the absolute frequency of terms such as:

- B Corporation, already analyzed in previous sections.
- ISO 14001: A standard for corporations to adopt environmental management systems (EMS) (Source: International Organization for Standardization, ISO).
- Sustainable Development Goals (SDGs): The 2030 Agenda for Sustainable Development, adopted by the United Nations Member States in 2015, includes 17 SDGs, which are an urgent call to action by all countries. Regarding the food industry, the two most relevant SDGs are the second, “Zero Hunger,” and the twelfth, “Responsible Consumption and Production.” Both goals can be achieved through a

more responsible organization of the food supply chain, both upstream and downstream, to ensure the safe management of all production stages, minimize waste, and distribute excesses to those in need.

After discussing and analyzing all the different baskets of words and the associated terms, it is worthwhile to focus on the indicator representing the average score of the 193 concepts that constitute the four baskets of words. This measure, called the Sustainability Index, reflects the average score of all the terms within the four baskets analyzed in the study. The higher the value of the "Sustainability Index," the greater the company's proportional attention towards the topics labelling each one of the four baskets considered.

Making an average of the results of the four different baskets of words, Nestlé achieves the highest average score (26), chased by Angelo Colussi (24) and Andriani (23). Nestlé Italiana S.p.A. can be used as an example in this sense, since the main objective of the company regards seeking to co-create a sustainable future for the planet and for the people who live on it. The main proposal for them is to develop a regenerative food system at scale to support the preservation, renewal, and restoration of the environment, enhance the livelihoods of farmers, and boost community resilience and consumer well-being.

Furthermore, Nestlé tries to respect the objective of zero emissions. With the help of a ten-year commitment, the company will cut in half greenhouse gas emissions by 2030 and reach zero net emissions by 2050. The three main areas addressed in order to achieve these goals are:

- Supporting regenerative
- Reimagining production and distribution
- Transforming the products' portfolio.

Concerning the theme of circular economy, in 2018 Nestlé declared its goal to reduce the amount of virgin plastic used by a third and to make all its packaging recyclable or reusable globally. Specifically for Italy, by means of a 360° strategy which includes four steps: research, reduction, reuse and recycling of packaging. Fostering collaborations with external entities, the main objective is to raise awareness among all the customers and stakeholders.

Taking now under analysis Colussi Group, it manages several brands across various industries, including pasta production, preserved fruits, and the manufacturing of confectionery and breakfast products. Their focus on sustainability within their supply chain and the execution of green initiatives is confirmed by a long list of concrete actions undertaken by the firm. Some of these actions include:

- Innovative packaging and plastic reduction.
- Sustainable agriculture with a controlled supply chain.
- LCA analysis and the launch of CO2-compensated products: Products whose emissions generated throughout their entire life cycle are neutralized by purchasing certified carbon credits.
- Sustainable energy to combat climate change.
- Support for the Apennine Cycle Route: Including the creation of assistance stations for bicycles equipped with essential tools for emergencies, as well as charging stations for e-bikes.
- Reforestation projects to support cities and the climate, with initiatives financed throughout the Italian peninsula.
- The Colussi Flower House for Biodiversity: A project that created three gardens in Milan, Rome, and Bologna to enhance biodiversity and restore green areas.

In conclusion, the Sustainability Index serves as an objective performance measure for companies based on their website content. The list utilized is made of 193 nouns which are connected with the four baskets of words described above. High scores in each of the four baskets indicate a strong commitment to addressing environmental issues, which are increasingly important to stakeholders. However, it is crucial to verify that high scores correspond to practical actions; otherwise, companies risk engaging in greenwashing—making grand claims without taking substantive action or obtaining relevant certifications.

3.2 Sustainability – Geographical distribution in Italy

In the image shown below on the left (Figure 19a), we can see the distribution of the top ten companies ranked by the Sustainability Index across the Italian peninsula. These firms are positioned on the map according to the location of their headquarters. Companies under investigation may either be headquartered in Italy, such as La Molisana S.p.A., or be the Italian subsidiary of a multinational corporation, as in the case of Nestlé Italiana S.p.A., the Italian division of the Swiss multinational. The first observation is the geographical distribution of businesses along the peninsula. Out of the top ten companies analyzed, eight are located in northern Italy, one in central Italy, and only one is based in southern Italy.

On the right, in contrast, the map displays the distribution of the ten companies with the lowest Sustainability Index scores. In this case, the distribution is more balanced, with a greater share of firms located in central and southern Italy (including the islands). This difference highlights the challenges faced by businesses in the South. The issue becomes even clearer when considering the overall entrepreneurial landscape in the country. The total percentage of companies operating in northern Italy amounts to 49.8%, meaning that almost half of all businesses are located in the North, while the Center accounts for 19.9%, and the South and Islands together comprise 28.6% (Istat, Registro statistico delle imprese attive, 2020). This clear division suggests that, proportionally, more firms with low Sustainability Index scores should be found in the North, but this is not the case. In fact, five out of the ten companies analyzed are based in central, southern, and insular Italy.

Figure 19a (on the left): distribution of top 10 companies in terms of Sustainability Index in Italy. Source: author's elaboration on food sustainability database.

Figure 19b (on the right): distribution of worst 10 companies in terms of Sustainability Index in Italy. Source: author's elaboration on food sustainability database.

The statistics derived from Figures 19a and 19b are corroborated by the 2022 "Sustainable Italy" Cerved Report, which measures the country's sustainability and analyzes regional differences. The study employs a general index that includes measures of economic, social, and environmental soundness across different territories. This analysis uses more than 200 variables organized into 56 themes and 17 components.

As Figure 20 indicates, there is a significant gap between the territories of northern and central Italy and those of the South and Islands. The performance of the southern regions alone lowers the overall score for the country, bringing it below the EU-27 average. According to the report, this poor performance is primarily due to economic weakness and productivity stagnation, the latter of which is attributable to a lack of foreign investment and limited capacity for innovation.

Tavola B

Sostenibilità generale europea

PAESE	INDICE DI SOSTENIBILITÀ GENERALE
Svezia	103.51
Danimarca	103.36
Paesi Bassi	102.82
Germania	102.35
Finlandia	102.08
Italia Nord-Ovest	101.91
Italia Nord-Est	101.65
Belgio	101.64
Estonia	101.47
Austria	101.20
Francia	100.63
Italia Centro	100.51
Malta	100.24
UE 27	100.00
Repubblica Ceca	99.91
Norvegia	99.88
Slovenia	99.69
Spagna	99.52
Italia	99.10
Slovacchia	99.05
Irlanda	98.37
Regno Unito	98.04
Grecia	97.91
Croazia	97.53
Polonia	97.24
Lussemburgo	97.19
Portogallo	97.05
Italia Sud e Isole	97.02
Bulgaria	96.69
Cipro	96.52
Ungheria	96.25
Romania	95.97
Lituania	94.83
Lettonia	93.98

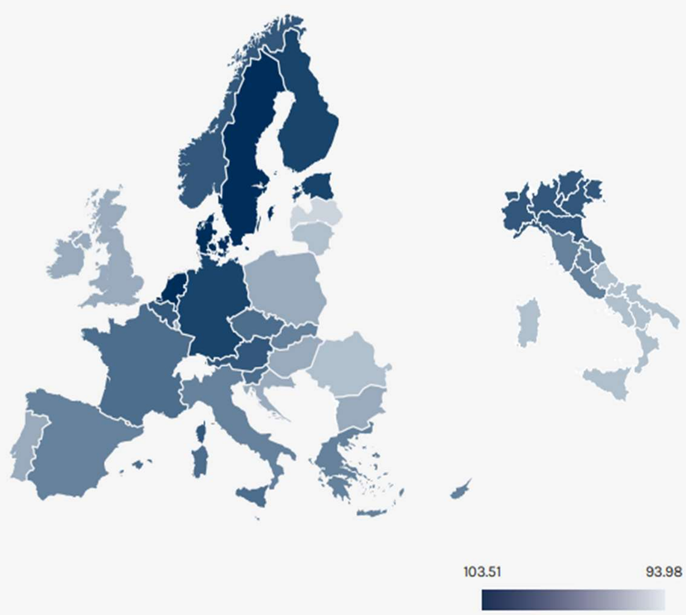

Figure 20: General level of sustainability in Europe. Source: Cerved – Rapporto Italia Sostenibile 2022.

The study highlights the existence of three distinct "Italies". While the central regions are closing the gap with the North, the disparities with the South are significant and difficult to overcome without immediate intervention. The image below (Figure 21) confirms the distribution of sustainable practices among firms across the national territory, as depicted in Figure 20. On one hand, there is a virtuous and innovative Italy with high levels of commitment to environmental, economic, and social sustainability, actively engaging in transition policies and accompanied by investments to meet increasing stakeholder demands. On the other hand, there are provinces characterized by weak productive structures and extensive areas of social fragility.

This context illustrates the stark differences between northern and southern Italy. However, not all is lost. Even in the South, despite the generally low to medium levels of sustainability, there are provinces, including major urban areas like Bari and Naples, that benefit from a vital production system, important infrastructure, and educational institutions (highlighted in light pink on the map in Figure 21). The graph on the right identifies seven distinct “Italies” in terms of sustainability, with levels ranging from “Virtuous Italy,” characterized by high scores, to “Fragile provinces,” which need to shift their strategies and invest in sustainability to improve performance (e.g., Sicily and Calabria). This introduction explains the distribution of firms across the country, as illustrated in Figures 19a and 19b.

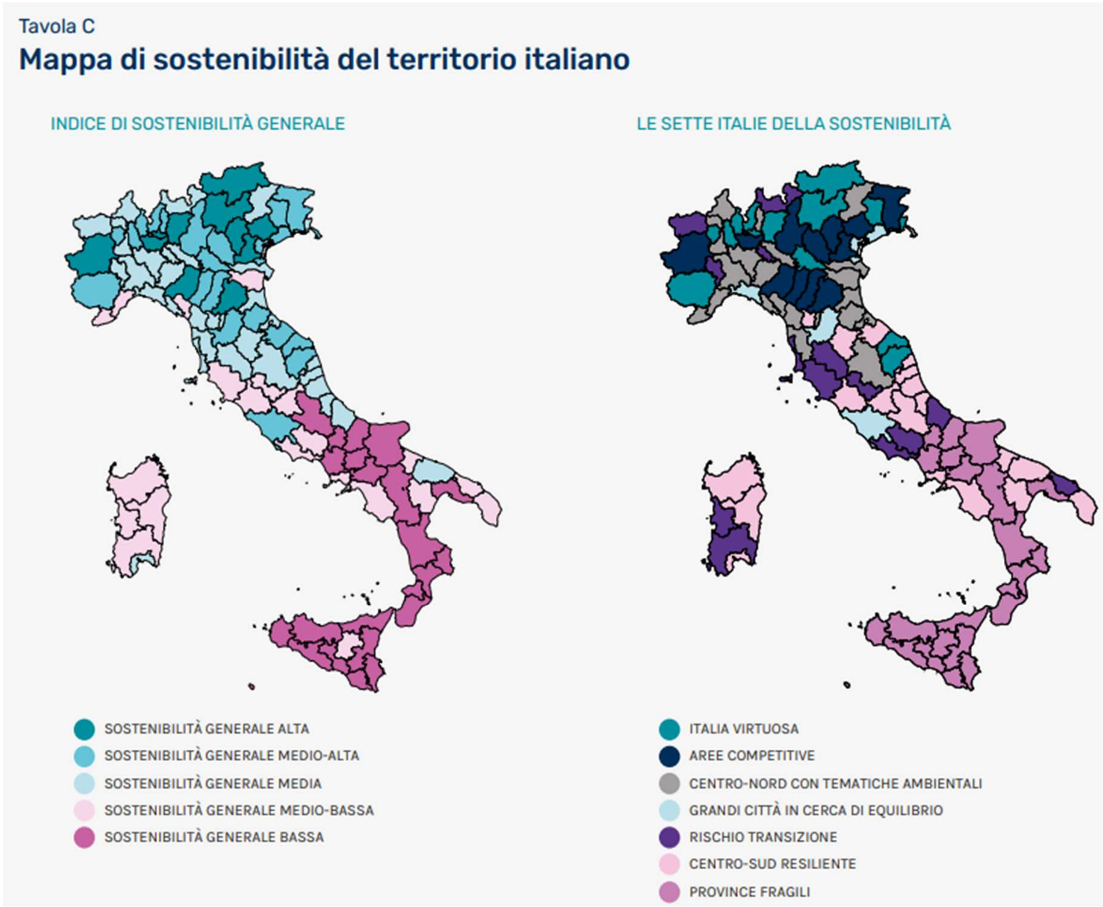

Figure 21: Italian territory Sustainability map. Source: Cerved – Rapporto Italia Sostenibile 2022.

When internal investments are hindered by a lack of economic resources, high levels of debt, and political corruption, foreign investments become crucial as they can help revitalize challenging situations. However, the purple (transition risk), light pink (resilient center-south), and violet (fragile provinces) areas lack the local companies' ability to fund a sustainable transition. This leads to a limited capacity to attract investments due to low attractiveness indexes. As the Cerved Report states, these provinces already exhibit low levels of social sustainability and may not be ready for a transition to a zero-emissions economy, as poverty and social exclusion could increase.

Despite these challenges, there are positive trends in the report. The adoption of sustainable practices within corporate strategies is growing. At the national level, the share of enterprises providing precise quantitative sustainability targets increased from 40% to 54% in 2022. Moreover, an analysis of ESG (Environmental, Social, and Governance) scores shows a slight improvement compared to 2019 data. Companies engaged in sustainable supply chains may attract more interest from investors, potentially through the creation of specialized funds that invest exclusively in SMEs. This is significant in Italy, where SMEs dominate, especially in the food industry.

However, sustainable finance remains relatively unknown among companies: 70% of participants in a survey conducted by the Forum for Sustainable Finance reported that they had not received proposals for Socially Responsible Investing (SRI) products to finance their activities. The main barrier to attracting sustainable finance in Italy is the lack of ESG performance measurement for most SMEs. Reporting obligations currently apply to a small percentage of large (listed) companies; extending similar standards to SMEs is crucial for expanding the focus of sustainable finance to the broader production system (Cerved Report, 2022). On the other hand, companies that demonstrate a deep commitment to sustainability gain significant advantages in modern society and everyday life. While avoiding reporting obligations may be financially beneficial for SMEs that lack the resources to meet sustainability parameters or achieve certifications, it can also result in reputational losses due to a lack of operational transparency. Public and external stakeholders, such as NGOs and the media, are difficult to convince without tangible actions toward a healthier environment and a circular economy. Investments, or at least a concrete commitment, are necessary. Without them, companies risk being excluded from the business community and gradually becoming obsolete due to their slow response to market stimuli.

In this context of uncertainty, Italy must leverage its longstanding reputation in the food industry. Italy is among the top ten global exporters in the agrifood sector, which is also one of the country's leading industries, offering the highest standards in quality and safety while combining innovation with tradition. To provide some context, Italian exports in this sector amount to €8.8 billion (Italian Directorate General for Cultural and Economic Promotion and Innovation, Italian Ministry of Foreign Affairs and International Cooperation, 2020). With more than 200,000 companies, Italy also holds nearly a third of the world's Protected Designations of Origin (822 out of approximately 3,000), making it the highest-ranking country in this category. For these reasons, the food industry needs to be preserved and innovated to keep pace with the times and, if resources permit, to become a pioneer in research and development.

3.3 Italian Food Sector Output

The last document analyzed, called Food Output, pertains to 2,790 Italian companies or Italian subsidiaries of multinational corporations located around the world. It is the most comprehensive database examined thus far. The information provided for each company includes key details such as the Italian VAT number, the company name, the URL of each company's website, keywords embedded within each website, a link to the company's logo, links to the products offered and certifications obtained over the years, company contacts, links to social media pages, and, finally, an index that measures the veracity of what each company writes and communicates on its website, called the Bounty Index. A score of 2 represents the highest level of reliability, while scores below 1 are negative, indicating that companies in this category need to revise—or in some cases, completely rethink—their sustainability strategies and communication with the public. It is worth noting that many companies do not have a dedicated website; in such cases, their URL contains the placeholder "https://www.quotidiano.net/" due to the lack of online information related to the particular firm. This absence of a proper web presence is a sign of obsolescence and backwardness.

Name of the company	Number of employees	Turnover (million euros)	Type of enterprise (micro, small, medium, large)	Bounty Index
Italatte s.r.l.	11	525	Hybrid	0,98
Real Beef s.r.l.	100	61,5	Medium/Large	0,97
Sag s.r.l.	179	17,5	Medium	0,87
Trinità S.p.A.	38	23,4	Small/Medium	0,81
Le Due Valli s.r.l.	44	32,7	Small/Medium	0,75
Cooperativa Latte Abit	1	12,8	Hybrid	0,63
Furlotti Prosciutti s.r.l.	9	9,4	Micro/Small	0,52
Fraccaro Spumadoro S.p.A.	47	10,2	Small/Medium	0,47
G. V. Caffè s.r.l.	23	6,3	Small	0,41
Bugin Carni s.r.l.	/	23,7	Medium	0,35

Figure 22: sample of 10 companies with a bounty index below 1. Source: author's elaboration of Food Output, Excel file.

Among the firms with a bounty index lower than 1, a sample of ten companies was selected for analysis, out of a total of 84 such firms. Several interesting statistics emerge: first, the number of employees never exceeds 250; second, the turnover of these firms surpasses €50 million in only two cases. These two companies, Italatte s.r.l. (with a turnover of €525 million) and Real Beef s.r.l. (with a turnover of €61.5 million), qualify as large enterprises based on turnover but do not meet the employee threshold. Overall, firms with low levels of reliability are typically small to medium-sized enterprises.

The next category encompasses firms with a bounty index between 0.99 and 2. Among them, 52 companies have an index of 1, indicating still insufficient commitment towards the duty of informing well and precisely stakeholders. Conversely, 152 firms have an index of 1.5. These companies show significant potential in reaching a clear and well-grounded communication, though they still lack trust in some sections.

Lastly, 2,408 companies have been classified with an index of 2, the maximum achievable score. These firms are well-established in the Italian food market, which is one of the markets that demands the highest standards of transparency throughout the entire production chain. This is due to the nature of the raw materials used, the hygiene standards required, the treatment of agricultural and animal resources, and numerous other regulations that must be consistently met. These companies already invest substantial sums to stay ahead of the curve and to be recognized as pioneers in innovation and certified as virtuous entities. Notable examples of key players in the Italian food industry include Lavazza S.p.A., Parmalat S.p.A., Inalca S.p.A., Pastificio Rana S.p.A., Kimbo S.p.A., Barilla S.p.A., among others.

The paramount question is whether these companies are genuinely operating as sustainable entities, seeking to improve the environmental, social, and economic aspects of the world we live in, or if they are merely trying to attract more attention to themselves, responding to societal demands for increasingly higher sustainability standards. The following chapter will explore this theme in depth, with an analysis of how the three Italian corporations with the highest turnover in the food industry, located in Emilia-Romagna, may have engaged in incorrect or unethical practices that risked damaging their reputations.

4. Greenwashing in the Italian food industry: reflections on the Emilia-Romagna case

4.1 Operational context

A comprehensive analysis of the evolutionary trajectory within the research field, specifically examining the growing interest and attention towards sustainability and its related themes over time, has served as the foundation for our discussion. Subsequently, objective parameters derived from Excel files, which allowed for the derivation and commentary on several important indicators, such as the "Sustainability Index" and the "Bounty Index," were instrumental in advancing the research. In the final chapter addressed, we graphically represented the distribution of these parameters concerning sustainability across the Peninsular region, yielding significant insights into Italian firms.

The focus now shifts to the examination of three real-life case studies of companies operating within the Italian food industry, particularly in the Northern region of Emilia-Romagna. The companies under review are:

Inalca S.p.A.

Barilla G. e R. Fratelli S.p.A.

Granarolo S.p.A.

These three private companies were selected because they are the ones with the highest turnover within the Italian food market, as our starting database states. The fact that they are all located in the Emilia-Romagna region is a mere coincidence. For each of these companies, the analysis will begin taking under consideration their average scores in sustainability-related themes (Sustainability Index), and the soundness of what is reported on their website (Bounty Index), to then verify whether these indexes actually report the true about the companies throughout their lifetime.

The objective is to take as a parameter three big and established players in the Italian food market to see how they respond to the investigation conducted in this paper. This approach will be used as a benchmark to verify the accuracy of their claims, but also to investigate instances where these companies have instead faced scrutiny, accusations of unfair practices, or actual cases of greenwashing.

4.2 Inalca S.p.A.

Inalca S.p.A. is located in Castelvetro di Modena, in the province of Modena. Established in 1963 by its current president, Luigi Cremonini, Inalca is a leading Italian company and a major European player in the beef sector. It is the leading producer of burgers in Italy and the largest Italian producer of canned meat. In 2022, the Cremonini Group, which controls Inalca S.p.A., reported total revenues of €2,849.8 million. The Group includes several well-known brands such as Marr (for distribution), Chef Express (for travel and commercial catering), RoadHouse Restaurant, and Carne Montana (for canned meat), among others.

From the Excel files previously examined, specifically the Food Sustainability database (which includes the "Sustainability Index"), Inalca results to have a medium score of 2 for the Sustainability Index among the four baskets under analysis. This score is relatively low compared to the top ten firms, where, for example, Nestlé Italiana S.p.A. is first with 26 average points. In the other file studied, "Output Food," Inalca achieved a score of 2 for the "Bounty Index," indicating a high rate of reliability for the sustainable issues addressed on their website.

The company extensively promotes sustainability on its website, highlighting its integrated and sustainable supply chain along with concrete actions related to environmental and social sustainability. These actions include minimizing packaging, reducing water consumption and increasing its recovery and reuse, and aiming to recover up to 99% of waste produced. Social sustainability efforts include animal welfare throughout the supply chain, ensuring food safety, and maintaining quality and hygiene standards. Additionally, systematic health and workplace safety activities focusing on health surveillance and worker safety are integral to the company's operations.

However, a seemingly low scoring concerning the Sustainability Index, crossed with the highest achievable for the Bounty Index, are the base for the beginning of our analysis of Inalca and all the controversial cases in its history, where the company faced several problems and had to answer in front of its actions on the market.

Chronologically, Inalca S.p.A.'s timeline of controversies begins in 1994, a year marked by socioeconomic instability in Russia following the collapse of the Soviet Union and high inflation levels. Despite this crisis, Inalca secured an EU contract to supply canned meat to Russia, marketed under the brand "Acsal Montana." This led to the distribution of spoiled canned meat, resulting in the death of a Russian boy and the hospitalization of other family members. The cause was a lack of standard quality controls. Rather than withdrawing the goods from the market, Inalca chose to compensate the victims with €150,000 to retain the lucrative Russian market, which represented a gold mine at the time for Inalca.

In 2000, Europe experienced several outbreaks of ‘mad cow disease,’ a degenerative neurological condition originating in cattle that was also transmissible to humans. Luigi Cremonini, then president of Assocarni, assured during a television program that his meat was exclusively from Italian cattle and thus not susceptible to the disease, as most cases were from Great Britain and Northern Europe. However, cases of mad cow disease were later discovered in Italy, including at Inalca's Ospedaletto Lodigiano plant. Cremonini was sentenced for "fraud in the exercise of trade" to eight months in prison, suspended with parole. Evidence revealed that the Group also slaughtered meat from French, German, and Dutch cattle, with 40% of meat marketed under the Marr brand coming from outside Italy.

In 2004, Inalca faced controversy in Cuba, where citizens could obtain food and basic necessities at political prices. Despite the high cost of beef, Italian beef marketed under the brands "Bill Beef" and "Texana" was sold in Cuban supermarkets. Cuban authorities requested that Inalca retrieve a batch of canned meat found to be spoiled, containing fat, maggots, and emitting bad odors. Alimport, a Cuban import authority, accused Inalca of bad faith. Although quality checks in Switzerland did not report defects, the problematic batch had not been inspected. "Bill Beef" was eventually sold, while "Texana" was redirected to the Angolan market, where Inalca operates its largest agribusiness center in Africa.

Another incident involved a well-known homogenized food company that purchased 1,500 tons of canned meat from Inalca. The labels claimed "beef <24 months," indicating high-quality beef from young cattle. However, an investigation by NAS (Italian Carabinieri command for health protection) revealed that the cattle were between 5 and 17 years old. Inalca faced charges of "fraud in trade" and "process fraud," as older cattle, though cheaper, do not necessarily indicate lower quality. Inalca's claim of traceability was contradicted by their misrepresentation to increase trade success.

An investigation conducted by the editorial staff of Report, a well-known program aired on the RAI channels of Italian television, reported health issues among Inalca employees and severe back pain and hernias, with INAIL recognizing 35 workers with occupational diseases. Complaints about health risks due to high work rates have been persistent. Inalca has not signed the national workers' contract, acknowledging only its economic section. Periodic checks by ATS (Agenzia Tutela Salute Lombardia) are known in advance, allowing the company to sanitize facilities before inspections. Pathologies have been repeatedly identified, affecting employees consistently.

An ATS doctor suggested improvements to working conditions, including:

- reducing the number of animals to be deboned,

- increasing the number of employees on the production line, and

- adding compensatory breaks.

What is worse, the Organizational Secretary of the Lodi Chamber of Labor CGIL criticized Inalca for lacking respect for workers' dignity. Inalca's response minimized these concerns, arguing that only a few employees complained about working conditions.

One proposed solution is to place meat on a horizontal work belt to ease employees' workload. However, uncertainties remain about how the company meets market demands without increasing employee risk. The two things should remain separated to ensure more than decent working conditions for workers.

Finally, the company's sustainability report, audited by Deloitte & Touche S.p.A., revealed that the workspace provided for the audit was insufficient for a comprehensive examination according to ISAE 3000 Revised, raising concerns about the assurance of identifying all significant facts and circumstances.

Inalca S.p.A. has faced numerous challenges due to negligence or shortcomings in meeting market standards, and even nowadays some doubts regarding the good faith in their way of operating remain. The low result reached for the Sustainability Index is a confirmation of what has been analyzed thus far throughout the chapter.

4.3 Barilla G. e R. Fratelli S.p.A.

Barilla S.p.A. is an Italian multinational food company that has been operational since 1877, specializing in dry pasta, ready-made sauces, bakery products, flour, and bread. Originating from Parma, a city in Emilia-Romagna, Barilla's production network comprises 30 production districts, with 15 located in Italy and 15 internationally. The Barilla Group owns several prominent brands, including Pan di Stelle, GranCereale, Mulino Bianco, and Voiello. In 2022, the Group reported a turnover of €4.6 billion, positioning it among the top four agrifood companies in Italy, alongside Cremonini Group, Granarolo, and Veronesi Holding (MedioBanca Report, 2023).

The company extensively addresses sustainability on its website, featuring a dedicated page that covers various aspects. The 2023 sustainability report highlights the production of wholesome products with a balanced nutritional profile, the creation of sustainable supply chains, minimizing environmental impact, and respect for people and communities. Additionally, Barilla emphasizes its commitment to the 2030 Agenda and the 17 Sustainable Development Goals (SDGs).

Referring to the Excel files examined in Chapter 3, particularly the "Food Output" file, the Barilla Group has achieved a score of 2 on the "bounty index," which is the maximum obtainable, indicating a high level of reliability. To further validate this result, an in-depth analysis is conducted to uncover instances where the company may have acted unfairly in the marketplace to seek a higher profit or failed to uphold consumer expectations, given Barilla’s reputation as a leading and innovative player in its industry.

The analysis begins with the use of Google Trends. Google Trends is a tool provided by Google to find out the popularity of a topic or search term by selecting a time period and geographic area of interest. We looked for the term “Barilla” in the search bar to see how the trend representing consumers’ interest over time was, at an international level.

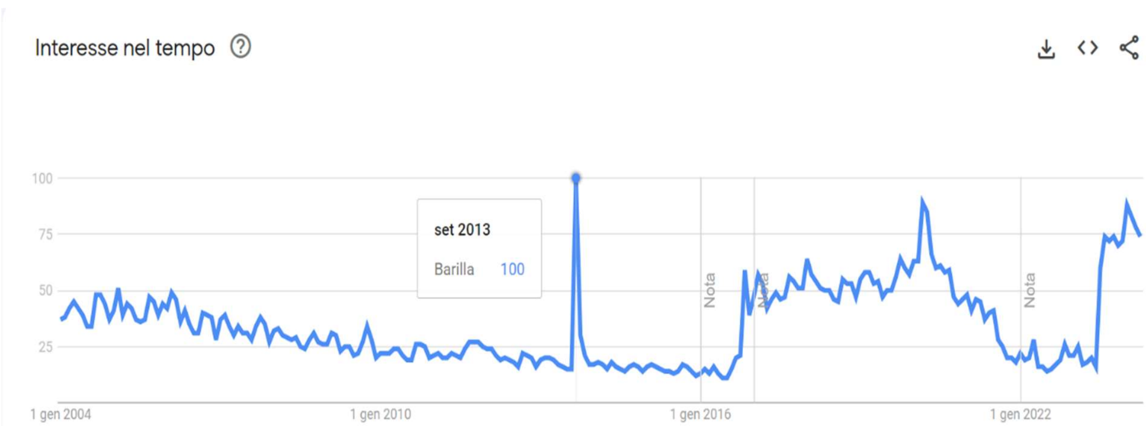

Figure 23: Interest over time for the word “Barilla”. Parameters of research: “Worldwide”; “2004-Present”. Source: Google Trends.

The line representing interest over time of the search word has a peak in September 2013. What was the reason for this increase in interest? Examining particularly the year 2013, the graph derives another peak, which lies in the week between the 22nd and the 28th of September 2013, as Figure 24 represents.

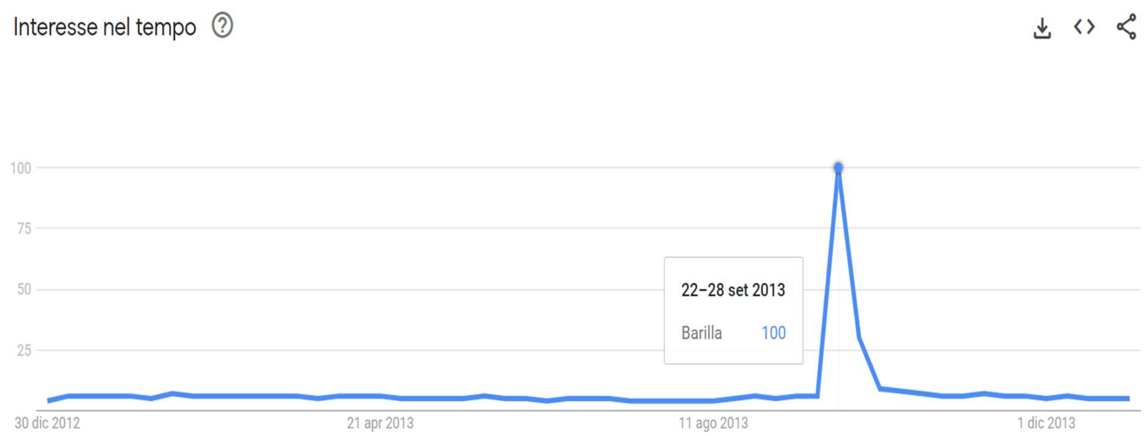

Figure 24: Interest over time for the word "Barilla". Parameters of research: "Worldwide"; "Year 2013". Source: Google Trends.

Google Trends also highlights associated topics and queries linked to "Barilla," including "boycott," "homophobia," "CEO – Role in the project," and "Guido Barilla – Entrepreneur and manager." The related queries include "boycott Barilla," "Barilla gays," "Barilla pasta gay," and "Barilla homophobic." This spike in interest corresponds to a scandal involving homophobic remarks made by Guido Barilla, the company's owner, in September 2013. During a radio program, the president of the Group expressed a preference for traditional families over homosexual ones, stating, "We won't advertise with homosexuals because we like the traditional family. If gays don't agree, they can always eat pasta from another brand. Everyone is free to do what they want as long as they don't annoy others." This controversy led to widespread backlash from LGBT associations, other companies, and competitors like Garofalo, which responded with a counterstatement on their website. The public outcry prompted Guido Barilla and the company to issue apologies, framing the incident as a misunderstanding and reaffirming Barilla's respect for all individuals.

Another case involving Barilla that still sees the Parma-based company at the center of numerous criticisms concerns the risk that the company is facing for a millionaire class action. In October 2022, two consumers in the USA suited the company because they considered the advertising on the pasta packages as misleading. On them, Barilla defines itself as "the number one pasta brand in Italy", displaying a logo with the colors of the Italian flag, but in reality these two American consumers discovered that the pasta sold in the US is not originated from Italy. The pasta is directly produced in the United States, where Barilla has two production plants, one in Ames, Iowa, and the other in Avon, New York. The lawsuit has recently been certified by a California judge, denouncing Barilla for deceiving consumers about the origin of pasta. The judge accepted the appeal of these consumers who accused the Parma company of Italian sounding. In order to fight these kinds of behaviors, which can be simply put under the broad definition of greenwashing, the Codacons (Coordination of associations for the defense of the environment and the rights of users and consumers) and its president & founder, Carlo Rienzi, have asked the Barilla Group for specific information on the data and on the concrete actions on sustainability that they usually conduct. Only these could justify the content of the advertising message conveyed. “The Codacons”, the president continues, “asked the company to suspend publication until the real commitments made to consumers have been clarified, with data also verified by us.”

What concerns Rienzi is the possibility of greenwashing by the company, a typical action conducted by firms to deceive consumers in an era where being recognized as virtuous players on sustainable themes is paramount. To explain what has just been said with an example, many multinationals within the food industry try to create a fictitious connection with the Mediterranean diet, considered a UNESCO world heritage site, so that their products can be associated with a healthy lifestyle that reflects Italian tradition.

For its part, Barilla defends itself by stating that this does not represent a case of misleading advertising that confuses buyers, but the intention is to “recall the company’s Italian roots”. It is also worth saying that an increasing number of consumers is interested in knowing where the food they buy is coming from. For example, many Italians only buy pasta made with national wheat. In any case, further investigation will be conducted to establish the veracity of the allegations filed against the Parma-based company.

Proceeding with our in-depth examination of controversial greenwashing cases regarding Barilla, in 2017 the GranoSalus association, founded in 2016 and born with the idea of having to defend consumers, giving a voice to farmers, accused the pasta sold by big brands like Barilla, Voiello and De Cecco of being contaminated by mycotoxin, glyphosate and cadmium. The use of these substances would be a clear proof that, even though the makers state on the label that the pasta is prepared with 100% Italian wheat, it is possible that the mixture of national durum wheat and wheat imported from Canada (which until last year was Italy's main foreign supplier) was used to produce the pasta. Focusing on the glyphosate, it is a chemical that is widely used in herbicide products. Glyphosate-based pesticides are used in agriculture and horticulture to combat weeds that compete with cultivated crops and in the maintenance of railway lines, amongst other uses. Between several criticism, such as the several U.S. court rulings against Bayer Monsanto, one of the main manufacturers of the substance, arguing that it would cause cancer, the use of glyphosate has been approved in the EU for the next ten years. Furthermore, in Italy the use of glyphosate is prohibited in public spaces such as parks, gardens, playgrounds for kids, sports fields, and green spaces inside medical facilities and school buildings, and the ban also applies to its use in fields to accelerate ripening and harvesting.

At that point, a decision will have to be made regarding the borders for the utilization of the chemical. Used in Canada to promote the ripening of durum wheat, GranoSalus argues that it cannot be present in Italian wheat because "European legislation has prohibited the use of glyphosate in pre-harvest for durum wheat since August 2016". It is also true that, although it is not used in pre-harvest, it is allowed for other crops, such as tomatoes and legumes, and, for instance, a straightforward field rotation can account for wheat's low glyphosate levels. Moreover, the levels of glyphosate are so low that they are sometimes below the threshold that is thought to be credible (50 μg/kg).

In Barilla's defense, according to a study conducted in April 2022 by a Swiss magazine called K-Tipp, several brands of pasta, commercialized also in Italy, hold signs of abnormal pesticides. This research was conducted on a sample of 18 different pasta brands, thirteen produced with durum wheat and five with organically grown wheat. According to this research it was found that this chemical can actually be found in several Italian brands, specifically Lidl, Divella, Agnesi and Garofalo. In contrast, the only brand that did not show traces of glyphosate was Barilla, specifically in "spaghettoni" and "penne rigate integrali". This result differentiates the Parma-based brand from the other pasta brands, making it a virtuous player in the sustainable field and confirming high quality and health standards kept by the company.

Overall, Barilla has been facing more cases regarding social sustainability rather than other. The reputational loss linked to a missing response to the accusations received on the market may bring several negative consequences for a multinational company like Barilla, which has always been recognized as a virtuous and fair player in the food market.

4.4 Granarolo S.p.A.

Granarolo S.p.A. is an Italian company based in Bologna, Emilia-Romagna. The Granarolo Group is the biggest and most important Italian milk supply chain. It is the first agri-food group with Italian capital and one of the most important operators in the food industry in Italy. It is composed by over 500 farmers distributed in 11 Italian regions, with 14 production plants in Italy and 9 abroad. Worldwide, Granarolo can count on a total of 40 million daily consumers in 76 different countries. Within the Group several important brands can be cited, for example Yomo, active in the production of yogurt, Accadi high digestibility milk, and Pettinicchio for the bufala mozzarella market, among the others. In 2022, the company registered a turnover of 1.060 million euros.

From the "Food Output" file, the company ranks among the best players for the Bounty Index with a score of 2, which represents the maximum obtainable. Regarding the Sustainability Index, on the other side, Granarolo achieves a medium 4,5 among the four baskets. This result is still low if compared to the companies ranking in the top ten.

Looking at their website, within the "For the planet" section there are three main topics on which Granarolo focuses. They are:

1. Animal welfare and reduction of environmental impact
2. Plastic reduction
3. Anti-waste plan.

These three goals emphasize four of the 17 SDGs of the 2030 Agenda, namely number two, "Defeat hunger", number twelve, "Ensuring sustainable production and consumption patterns", number thirteen, "Fight against climate change", and number seventeen, "Strengthening the means of implementation and renewing the global partnership for sustainable development".

Among the projects pursued by Granarolo, the "Animal Welfare" is the first cited, meaning that the Group is committed and has created a new supply chain assessed for animal welfare. The aspects analyzed through the assessment are:

- Staff training and company management;
- Structures and zootechnical equipment used in breeding;
- Measurement of the impacts that these aspects have directly on the animals.

This initiative got Granarolo the opportunity to achieve and become the first large-scale Italian supply-chain certified on animal welfare.

The second project in which the Group is committed is called "Biomethane from the Supply Chain". This strategy will provide the creation of ten new biomethane plants all around Italy over a period of three years. The objective is to get clean energy, to reduce milk processing costs and to produce fertilizers.

The second and third topics discussed by the company on the currently analyzed section “For the Planet” are “Plastic Reduction” and “Anti-Waste Plan”. The first one is obtainable through the limitation of greenhouse gas emissions produced during the entire product life cycle. The second one considers as a starting point the statistics underlining that milk and dairy products are major contributors to food waste. Better milk quality at the source and throughout the cold chain would allow dairy products and milk to have longer shelf lives, reducing at the same time food waste. In this sense, an initiative introduced in 2022 was to impose a 10-day fridge milk shelf life, which greatly decreased market returns and contributed to a decrease in family waste. The newly commercialized milk, namely the new high-temperature pasteurized milk, differs from fresh milk because it lasts 10 days instead of 6, increasing the shelf life of the product. Another intriguing feature is that Granarolo's new plastic bottles use 13% less plastic overall, and the cap has a creative opening mechanism that keeps it linked to the bottle and consumes 30% less raw material. Granarolo claims that all of this enables an annual plastic savings of 355 thousand kilograms.

Despite everything we have analyzed so far, the company has ended up in the center of media attention due to controversial cases concerning some marketed products and untruthful sustainable slogans. To give an example, going back to 2010, an article highlighted the action undertaken by the Codacons, the coordination of associations for the defense of the environment and the rights of users and consumers, against Granarolo. The association has, in fact, filed a complaint to request checks on the Bologna-based company’s advertising campaigns. These campaigns are subject to criticism because they discuss the use of verified and certified Italian milk while in reality acquiring supplies to prepare some of their goods from the German firm responsible of the fiasco involving the blue mozzarella.

According to the news that surfaced, it was discovered that the mozzarella distributed in Italy and produced by Granarolo included the bacteria Pseudomonas fluorescens, which is responsible for the unusual blue color. What is being challenged against Granarolo is that the company would purchase goods from the German company indicted for producing mozzarella cheese that took on a blue tint, going to jeopardize the uniqueness of “Made in Italy” so much emphasized on the Bologna-based Group's website. Carlo Rienzi, president of Codacons, explains how the company’s advertisements relating to “High Quality Milk” highlight the major factors stressed in their way of making business, such as the singularity of the selected Italian cows, guaranteed and certified milk utilized, guaranteed and controlled supply chain.

Whether all of these turned out to be ostentations for the brand to be recognized nationally and globally as one demanding high levels of process quality and as a fair player in the field of sustainability, we would have to deal with a possible deceit of Italian customers, which may bring detrimental effects on the nation's economy as well as on the "Made in Italy"' and DOC Italian products' general reputation.

Doubts about the topic remain. For its part, Granarolo defends itself by saying that it would never have bought milk, mozzarella, semi-finished products or ingredients from the German company Jaeger in question, which instead was the company's supplier, but only of sweet provola. "If the packaging bears the words 'Only fresh Italian milk,'" the Group continues", it means that the raw material is exclusively Italian.

In addition to this, an ethical issue that Granarolo is facing in recent years concerns the business it conducts in Asia, in particular in China. There, the government has announced the beginning of an anti-dumping investigation of dairy products imported from the EU. This move was the prompt response to the decision taken by the European Parliament of a five-year surcharge on Chinese electric cars. The president of Granarolo, Gianpiero Calzolari, says that China, while not among the largest markets for Italian dairy exports, is growing fast. So, the decision to impose duties on exports would hurt future growth opportunities. To explain the problem with numbers, the Group has a turnover of 10 million euros in China, with many different products such as mascarpone, cream, UHT milk and infant milk that are having strong performances. Unfortunately for Granarolo, certain situations and conflicts at the geopolitical level are beyond the control of promotional and marketing campaigns. The fact remains that, if possible, the company would find a more than thriving market in the Asian nation in the years to come.

Conclusions

Food waste is a sub-topic concerning sustainability that has been increasingly addressed by authors within the academic literature. The evidence from the analysis conducted in the first section of this paper regards the evolution that scientific research has had over the past few years. The transition from a general interest towards sustainability and everything that is eco-friendly and can help the environment in becoming healthier and more livable, to a deeper commitment in more specific sub themes that constitute the sphere, is clear.

The positive consequence that can be derived is a growing consciousness about the respect for what we have around us, that brings to the table many different topics on which the study can focus. The co-citation analysis conducted in Chapter 2 highlighted five clusters, that are important because they provide insights into the intellectual structure of scientific research of the food industry. Among them, food waste contains interesting solutions that we think it's appropriate to take in consideration when planning a strategy for the future.

The impacting data to take into account are the percentage of food that gets wasted at the household level in Europe, which goes above the 50% of total food wasted (Kummu et al., 2012). Furthermore, the volume of food production is expected to grow considerably within 2030 (Statista, 2024). This means that better ways of running the squander of food have to be found. Moreover, another disturbing fact concerns the amount of greenhouse gas emissions generated by the food industry alone, which is around one third of the aggregate (Aschemann-Witzel, 2015).

How to curb the problem? Possible solutions found by the literature stand both from the retailer's and the consumer's perspective (Aschemann-Witzel, 2015). For the first ones, different pricing strategies applied and packaging sizes can increase customers' willingness to buy one product rather than another, in order to avoid unrestrained consumption of products at the supermarket.

From the consumers' point of view, an enhancement of household food management behaviour and a change of dietary habits are slow but paramount processes needed in order to decrease the amount of food that gets wasted. The difficulty stands in the differentiation of culinary cultures around the world, which makes it hard for everyone to follow one, common goal of sustainable consumption. The starting point is a general awareness of the existence of a tangible problem, and through targeted communication and information to the public, the opportunity to address said problem increases the chances of seeing improvements. In addition to this, the inclusion of awareness campaigns regarding the problem of food waste, and especially refresher courses for those who trade certain consumer goods so that they are the best possible conduit to the end customer may be introduced.

In chapter 3 we analyzed the entrepreneurial horizon constituting Italian food industry. The structure is clear: small and medium enterprises represent by far the majority. Concerning the sustainable sphere, and the obtainment of certifications able to enhance the reputational scope of companies, the problem in Italy is the lack of reporting obligations. In fact, these only apply to a small percentage of large companies. This difference in treatment is financially advantageous for SMEs, because they do not need to meet any parameter at the end of the financial year, but at the same time it can worsen the way the company's stakeholders or possible investors see them from the outside. Since it is not mandatory for SMEs to obtain certain certifications (that can also include sustainable certifications), nor to financially report the results achieved, investors prefer those firms that distinguish on the market because of their choice of gaining validation of the investments they make to guarantee a higher quality, safety and circularity in their way of operating.

In the Italian landscape, with a clear structure of the food industry, the possible solution can be represented by the implementation of reporting obligations applied also to SMEs. These can not be the same in size as for large, listed companies, but the imposition of parameters to be met at the end of each financial year could incentivize entrepreneurs to invest in areas that can improve the company's image in the market, also favoring its attractiveness in the eyes of foreign investors. Sustainability is one of those areas where investments are needed, and this common approach could improve the overall average of sustainable practices implemented in the food sector in Italy.

Foreign investments would become crucial in those areas where firms' sustainable performance is very low. The study of the Sustainability Index let us understand the uneven distribution existing in Italy with regards to virtuous firms that actually invest in sustainable themes, with Figures 19a and 19b, 19 and 20 being a proof of the existence in Italy of a problem. The problem stands in the existence of three distinct "Italies", where the northern regions lead the way with high indicators of performance, central Italy is progressively achieving good results and closing the gap with the North, while the South remains highly backward.

The lack of a common base that could be the springboard for a very high percentage of businesses that, especially in Southern Italy, sail in a sea full of difficulties due to high levels of corruption and a backward local mentality and culture, is the biggest problem. The previously mentioned common ground could be represented by state funds that invest only in SMEs, so as to improve, in the long run, their performance financially and sustainably, so that they can also attract the attention of foreign investors. In the short-term, the imposition of sustainability goals to be met to fall into virtuous categories of enterprise and/or to grant subsidies if targets are met could constitute another possible way for enhancing the complicated situation.

The last chapter of this document analyzes three real life cases of companies operating in the food industry in Italy. Specifically, the three companies chosen are those found to have the highest turnover among all those examined by our databases. These three companies fall within the category of those with the highest Bounty Index, equal to 2. This means that what they convey on their website to the public must be considered true and highly reliable. Despite a more than good reputation and three businesses that have been well functioning for decades now, what we derived is that the controversial cases regarding the three brands still exist. The message to transmit to readers, to clients and suppliers in the market, to stakeholders with an interest towards Inalca, Barilla and Granarolo or other big brands operating the industry is that cases of social or environmental greenwashing can be found also in these companies. There is a tendency to blindly trust those firms that are established in the market because they have been there for so many years, and have incredible economic performance, both in Italy and abroad, but the reality is that they too make mistakes more or less consciously.

Given the reputation they enjoy on the market, these brands could take advantage of consumers by imposing, for example, a constant and almost imperceptible increase in prices, decreasing the quality of the product sold, or, even worse, telling the false about the origin of the raw material used for the final good, as we saw happen for the three companies under analysis. The best thing to do from a client’s perspective is to be informed and always try to understand whether you are buying a company's product just because of its brand name or also because the economic and nutritional benefits are the best obtainable. On the other hand, more controls on the actions of companies should be introduced in order to minimize cases of greenwashing and curtail the problem.

Appendix A

Agenda 2030

Within the fourth basket of words among the four analyzed, the one focusing on the "sustainability" theme, the Agenda 2030 was chosen as an example to bring on the discussion. A deeper investigation can be conducted by looking at the keywords chosen by the top ten firms to define the Agenda 2030.

The company showing the highest scoring is Andriani S.p.A., located near Bari in the South of Italy. Searching "Agenda 2030" on their website, many hyperlinks appear. The first one indicates Andriani as a virtuous player in terms of ESG rating, with an improved score with respect to the precedent year of 78/100. This rating, as the website continues, highlights a very high capacity for ESG risk management compared to the reference sector. Furthermore, the firm obtained a certification for gender equality, underlining their commitment towards an open corporate culture and an inclusive working environment. An important concept to add regards the business model, which is oriented towards the creation of shared value for its stakeholders and an impact perspective based on contributing to the Agenda 2030 goals. The mentioned business model integrates inputs, business activities and processes, output and outcomes in terms of impact on stakeholders, in line with the SDGs pursuit by the Andriani S.p.A. The company is chasing a path of Open Innovation in the field of sustainable development, in which the focal point turns out to be the creation of a sustainable supply chain, where suppliers become strategic partners in ensuring agricultural and food production characterized by traceability, quality and safety of the products offered. An important fact concerns also the share of volumes coming from local suppliers in 2021, which is equal to 89,49%. Big figures which certify the commitment by Andriani S.p.A. in sustaining economically the regional and national market.

The second-best firm in the ranking with a score of 18 is Alfrus s.r.l., located near Bari in Puglia. They have created a hyperlink from the homepage which directly connects with the initiatives regarding the Agenda 2030. The keywords with which the company addresses the theme are hunger elimination by means of 100% sustainable agricultural practices, gender equality in the workplace, use of clean and purified water, renewable energy, decent work guaranteed to all employees and economic growth, sustainable innovation and industrialization, responsible and environmentally sustainable production, fighting climate change, protection of life on earth, and lastly the agreement of international partnerships for sustainable development. The high number of initiatives describes is a sign of the commitment and the importance the company gives to the issue.

Takes its place on the podium also Parodi Nutra s.r.l., a company located in the province of Genova, in the Northern region of Liguria. They produce organic vegetable oils and protein flours. They treat the Agenda 2030 topic focusing on one of the seventeen SDGs: life on land, the fifteenth. The aim is to protect biodiversity, restoring and promoting the sustainable use of land resources ecosystems, sustainably managing forests, combat desertification, halt and reverse land degradation. Therefore, unlike the two companies analyzed above, they decide to focus their commitment towards one goal rather than covering all (or almost all) of them.

Proceeding further, we find six corporations with a score of 3 in the top ten ranking. Among them, Heineken Italia S.p.A., La Molisana S.p.A. and Galbusera S.p.A. The first one mentions the Agenda 2030 citing sustainability goals achieved by the company, like water, CO2 and energy reduction. Heineken also gives importance to a responsible consumption, stressing the theme in several advertising campaigns. La Molisana is also very active on the theme, highlighting the Agenda 2030 targets which is pursuing, such as the achievement of a sustainable food production and the utilization of resilient agricultural practices, the preservation of good health and promotion of the well-being, the attainment of gender equality on the workplace and the capacity to increase the number of people with skills relevant to financial success, together with the project of making cities and human settlements inclusive, safe, resilient and sustainable. Overall, most of the firms address the issue about the Agenda 2030 by setting up smaller goals, temporarily and dimensionally speaking, in order to achieve the highest possible number of Sustainable Development Goals. The latter represent the beating heart of a renaissance that must be undertaken globally, to ensure steady growth over the years from an economic, social and environmental point of view.

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