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Aligning the Sustainable Development Goals in the Wine Industry: A Bibliometric Analysis

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Abstract: Academic contributions pertaining to the Sustainable Development Goals (SDGs) and the wine industry have seen a steady rise in recent years due to the tremendous importance of these topics for economic, social, and environmental advancement. This study seeks to explore the wine industry by using bibliometric techniques to analyze 107 articles published between 1997 and 2022. The findings of the research indicate substantial growth in the rate of production since 2015, with the Environmental Sciences being the most predominant domain of study. Furthermore, the most influential publishers of related content are MDPI, Elsevier, and Springer. Thus, this research may be beneficial for researchers, both new and experienced, who wish to gain a more thorough understanding of the academic output related to SDGs in the wine industry.

Keywords: sustainable development goals; wine industry; bibliometric analysis; VosViewer; Web of Science

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1. Introduction

The wine industry must embrace sustainable measures to ensure its long-term survival [1]. This involves protecting natural resources, providing secure and fair jobs, and harnessing technology to improve production and product quality, all while reducing environmental impacts [2].

There are several reasons for adopting sustainable actions in the wine industry, and doing so allows wineries to improve the quality and taste of wines by reducing the number of chemicals [3]. It also helps to reduce environmental impacts by minimizing the use of pesticides and fertilizers, reducing water use, and improving waste and energy management [4]. Sustainability also contributes to improving the industry's image by adopting responsible practices and promoting respect for the environment [5]. This, in turn, helps to promote tourism, as tourists seek out sustainably produced wines [6]. Similarly, sustainability also helps to reduce production costs by improving energy efficiency and resource management [7].

The wine industry is economically, socially, and environmentally significant, contributing billions of dollars annually to international trade and economies of both Old and New World producing countries [8]. From a social perspective, wine has become an integral part of culture, providing pleasure, recreation, and a variety of social experiences [9]. At the same time, wine is also a source of pride for many local communities, as the industry is an important source of employment and contributes to the development of culture [10]. The wine industry has been identified as an important contributor to sustainable development, with positive impacts on local ecosystems, renewable energy utilization, and greenhouse gas emissions reduction [11–21]. The industry has also adopted a series of sustainability

practices to reduce the use of pesticides and fertilizers, improve water quality, and promote biodiversity [22].

The wine industry is an important partner in the fulfillment of the United Nations' Sustainable Development Goals (SDGs), with this being a new framework for analyzing economic, social, and environmental sustainability [23]. The SDGs are a set of 17 global goals that aim to eradicate poverty, protect the planet, and ensure a future of peace and prosperity for all [24]. The United Nations Summit on Sustainable Development in 2015 established new goals to replace the Millennium Development Goals that had expired that same year [25].

These goals are designed to address economic, social and, environmental sustainability in a comprehensive manner. First, the SDGs contribute to improving economic sustainability by promoting inclusive and sustainable economic growth, supporting innovation and technological development, strengthening trade integration and capital mobility, and fostering productivity growth [26]. Second, the SDGs contribute to improving social sustainability by promoting employment and entrepreneurship, improving education levels, promoting social justice and equity, protecting workers' rights, and ensuring accessibility to basic services [27]. Third, the SDGs contribute to improving environmental sustainability by promoting the sustainable management of natural resources, reducing pollution and resource-intensive use, promoting the conservation and restoration of ecosystems, and ensuring sustainable production and consumption [28].

The wine industry serves these goals through job creation, infrastructure development, investment in education, and the promotion of sustainable agricultural activities [29]. This assists in improving farmers' incomes as well as their quality of life and allows more people to have access to basic resources [30]. Furthermore, the wine industry fosters the preservation of the environment by respecting sustainable farming systems and environmentally friendly production methods [31]. This aids in reducing the impact of agriculture on soil, water and air, helping to protect biodiversity and prevent pollution [32]. In terms of gender equality, the wine industry has made great efforts to remove gender barriers in the production, consumption, and marketing of wine [33]. This has allowed more women to become involved in the industry, which, in turn, has increased family incomes and improved their quality of life [34].

However, wine production can negatively affect sustainable development if it is carried out inappropriately. The use of pesticides and fertilizers for grape production can have harmful effects on the environment, such as soil, watercourse, and air pollution [33]. Intensive agriculture can also affect local biodiversity, as it reduces the number of habitats and can lead to the extinction of some species [30]. Similarly, the excessive use of water for growing grapes can negatively affect sustainable development [29]. The burning of fossil fuels to transport grapes and wine, the production of packaging, and the production of electricity to power wine processing equipment all emit greenhouse gases into the environment, which contribute to the acceleration of global climate change [32]. Furthermore, the expansion of vineyards can lead to deforestation, soil erosion, and reduced availability of land for other uses, which can negatively affect local ecosystems and local communities that depend on the land for their livelihoods [31].

This 2030 agenda has generated a growing interest in the wine industry, as the industry is expected to be an important driver in the fulfillment of the SDGs [35]. However, despite this growing interest in the wine industry and the SDGs, there is a scarcity of bibliometric studies on the topic [36]. In fact, no prior bibliometric studies have been found to assess the relationship between the Sustainable Development Goals and the wine industry. Therefore, there is a need to investigate how the wine industry is contributing to the SDGs and how the SDGs, in turn, are affecting the industry. The objective of this research is to review the existing literature at the intersection of the SDGs and the wine industry by employing a bibliometric method in order to address any unaddressed research needs.

The bibliometric study explores how the industry is engaging with the SDGs and can help industry leaders better understand how these goals can improve the sustainability of

their businesses and, as a result, adopt better strategies to meet existing challenges and take advantage of emerging opportunities. Additionally, the study can provide policy-makers with insights into the wine industry's progress in regard to the SDGs and potential areas of improvement. This could be useful in formulating policies that enable the industry to meet its sustainable development goals while making progress towards achieving The UN's SDGs. The results derived from the research may also be useful for researchers, as it will help them to better understand the mechanisms that lead to sustainable development and how these differ between different wine regions. In this way, the research can help to better comprehend how the SDGs are being implemented in the wine industry and how these goals can be achieved more effectively. It should also be noted that, given the scientific production analyzed, it is hypothesized that research on the subject has intensified in recent years and is dominated by countries with a wine-growing tradition.

This study is structured as follows: an introduction is followed by a description of the research methodology (Section 2), results (Section 3), and finally, the main conclusion, limitations, and future lines of research (Section 4).

2. Materials and Methods

This research employed bibliometric analysis of the Web of Science (WoS) database. Boolean operators, proximity operators, and markers were employed for the purpose of evaluating the quality and accuracy of the works, making use of the WOS due to its strict selection of articles. The WoS database is composed of three indices: the Science Citation Index Expanded (SCI-E), Social Sciences Citation Index (SSCI), and Emerging Sources Citation Index (ESCI). These components provide comprehensive coverage of scholarly literature in the sciences, social sciences, and emerging areas.

SCI-E is a comprehensive online database of citations from scientific and technological publications since 1900, including 8000 scientific journals and 12,000 conference and press journals [37]. SSCI is a compilation of references from more than 3000 social science journals and both press and conference journals. This index provides access to the latest research in the fields of anthropology, economics, political science, sociology, and many other social sciences [38]. ESCI is an index of references that encompasses a variety of scientific publications, such as those from developing countries. It boasts over 5000 journals, including both emerging science journals and press and conference journals. This index is aimed at representing the wide range of scientific publications for researchers worldwide [39].

An evaluation of the WoS Core Collection was conducted to identify papers related to the subject. Multiple attempts were made to differentiate the most important and least relevant results in order to eliminate any irrelevant findings. Ultimately, the most suitable search equation was decided upon after consideration of all options and was as follows:

TS = (((sustainab* development goal$ OR SDG$) AND (wine* OR grape* OR viticult* OR vitis vini*)))

The search equation was separated into two categories: SDGs and wine industry. The Thesaurus dictionary was used to find synonyms for the searched terms in order to account for different search options. The AND operator was used to limit the results to articles that included data from the two groups. The wildcard (*) was applied to consider word variations in the possible results. Additionally, the Boolean operator OR was employed for the two categories when synonyms were present. Boolean operators are a major component of bibliometric reviews as they enable users to create complicated and specific queries to gain more pertinent information. They can also be utilized to focus or broaden the search to certain subjects, records from particular years, or kinds, allowing investigators to obtain the most relevant results while diminishing search time.

Regarding the time period covered by the bibliometric review, the first year was 1997, as it was the first year in which the first record was found, and the last was 2022, as it was the last complete year that could be fully analyzed. In this way, the analysis covers a broad range, from the first record found to the last complete year that could be analyzed. The

year 2023 has not been selected because it could distort the values and trends offered, since there is still a large amount of scientific information that still has to be indexed in that year.

A search algorithm was applied on 25 February 2023, resulting in the acquisition of 114 articles, which were analyzed using the "Preferred Reporting Items for Systematic Reviews and Meta-Analyses" (PRISMA) statement due to its reliability, reproducibility, comprehensiveness, and frequent use in bibliometric studies [40–42]. Adopting the PRISMA methodology can be advantageous in enhancing transparency and communication between authors and readers. This ensures that the outcomes are reliable and reproducible [43]. It is recommended to promote the quality of research studies and to make it easier for readers to comprehend the results, which decreases the risk of bias and mistakes in data collection [44]. The number of documents was reduced from 114 to 107 since articles were the only accepted scientific output format, and duplicates were eliminated (see Figure 1).

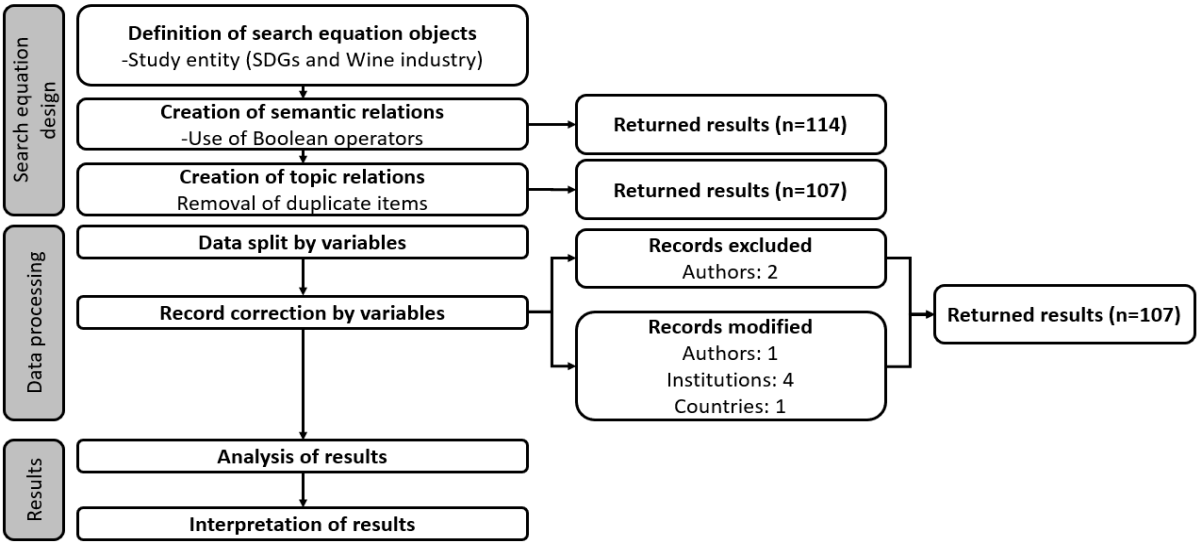


Figure 1. Diagram of the bibliometric review process flowchart. Source: preparation according to PRISMA directives.

The analysis of the scientific production was performed by selecting several classification variables. First, the initial step of the analysis was to divide the records by year of publication in order to assess the level of interest in the topic over time. Second, the documents were classified by the WOS Categories to determine which areas of knowledge they belonged to. The results of the analysis were corroborated by a network map created with VOSviewer. Third, the authors were identified, and their number of publications as well as citations were calculated to find the most prominent figures in the field and their associated institutions. Fourth, the institutions to which the authors belonged were analyzed. Fifth, the main journals, volume of records, and geographical classification of production were examined. It should be noted that the analysis of scientific production by country was carried out using the Bibliometrix software version 4.1.2.3, being an R package, which was developed by the Department of Statistics at the University of Auckland in 1993 (Auckland, New Zealand).

A bibliometric review can provide a more comprehensive and generalized view of a topic than a narrative or systematic review, as it is based on a wide range of published materials [45]. It allows one to identify trends in a field of research, detect areas of interest, and ascertain connections between different papers and authors [46]. The research conducted in a particular field can be objectively assessed and used to set priorities for future work [47]. A bibliometric review is distinct from other forms of reviews, including narrative reviews, in that it uses a more systematic approach to provide a more extensive overview of a given topic. This method allows for a more thorough analysis of the literature and helps to identify key areas of research [46]. This means that researchers can examine

the entire literature related to a topic rather than focusing on a limited subset of papers, thus helping to assess the quality of the information available, as researchers have the opportunity to analyze the information more critically [45]. Moreover, using a literature review software allows for the tracking of the evolution of a subject by observing the publication of papers in a specific field, reducing the amount of time required to perform a manual review of literature, enhancing coherence and consistency when assessing scholarly output, providing a visualization of the significance of a topic through a visual depiction of published articles, aiding in the visualization of the structure and interconnection of the available literature on a specified topic, providing a quick and easy way to confirm citations and references for all articles related to a topic, and helping researchers to identify and evaluate works created by an individual or a group of authors [48].

3. Results and Discussion

The United Nation's approval of the SDGs in 2015 sparked increased research and development in the area of renewable energies. This is reflected by a 633.33% increase in the number of articles from 2015 to 2022, from 3 to 22 (Figure 2). This upsurge can be attributed to the United Nations Conference on Environment and Development that was held in Rio de Janeiro in the late 1990s, which laid the foundation for the Agenda 21, focusing on the importance of renewable energies. Thus, the SDGs were the framework for sustainability-focused research [49–51].

Recognizing the moderate increase in scientific output in the first decade of the 21st century and the resulting exponential growth since then, one can largely attribute this to the Millennium Summit in 2000. At this event, the Millennium Development Goals (MDGs) were established with the aim of promoting economic, social, and environmental sustainability through the setting of specific targets [52]. In 2012, the United Nations initiated the SD21 project to further sustainable development in the 21st century, with renewable energy sources playing a significant role in reaching this aim [50].

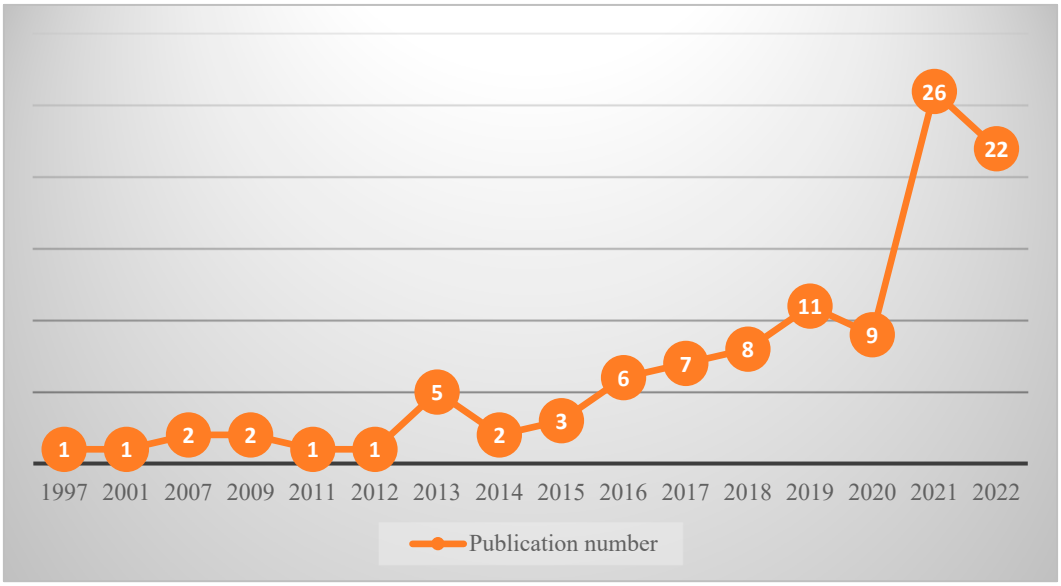


Figure 2. Scientific output by year of publication. Source: own elaboration based on WoS.

Table 1 reveals that the highest levels of scientific production related to ODS and the wine industry are in Environmental Sciences (28), Environmental Studies (20), Green Sustainable Science Technology (20), and Food Science Technology (15). Furthermore, significant production can also be observed in Horticulture (8), Agriculture Multidisciplinary (7), Agronomy (7), Business (7), Agricultural Economics Policy (5), and Economics (5). This reflects the strong focus of the literature reviewed on environmental, technological, and business studies.

The present study highlights the multidisciplinary nature of the research on ODS and the wine industry, which is essential for gaining a better understanding of the sector's potential to contribute to the improvement of the environment (Environmental Sciences, Environmental Studies, Green Sustainable Science Technology), to the economic diversification of wine-growing territories (Business, Economics, Management), and to the advancement of practices employed in the production process (Agriculture Multidisciplinary, Horticulture, Agronomy). Furthermore, numerous research fields demonstrate a considerable capacity to expand the knowledge base around the research topic at hand. For instance, studies in the field of geography can provide crucial insights about the distribution of wine regions, helping to meet the SDGs.

A co-occurrence analysis of keywords was conducted to supplement the analysis of the correlation between the SDGs and the wine industry. This analysis enabled us to identify the relationship between keywords, thus revealing the interrelationships between themes, as illustrated in Figure 3. It is evident that the main keywords used in the scientific production examined, in addition to SDGs and wine, are sustainable development and sustainability (which encompass the field of SDGs and renewable energies), management (which is imperative for aligning the objectives of the wine industry with the SDGs), and climate change (which is one of the major issues to be addressed after adhering to the SDGs).

Table 1. Number of results from the top thirty research fields.

No.	WOS Categories	Documents	No.	WOS Categories	Records
1	Environmental Sciences	28	16	Entomology	3
2	Environmental Studies	20	17	Plant Sciences	3
3	Green Sustainable Science Technology	20	18	Biodiversity Conservation	2
4	Food Science Technology	15	19	Business Finance	2
5	Horticulture	8	20	Engineering Chemical	2
6	Agriculture Multidisciplinary	7	21	Forestry	2
7	Agronomy	7	22	Geography	2
8	Business	7	23	Geosciences Multidisciplinary	2
9	Agricultural Economics Policy	5	24	History Philosophy Of Science	2
10	Economics	5	25	Hospitality Leisure Sport Tourism	2
11	Management	5	26	Instruments Instrumentation	2
12	Agricultural Engineering	4	27	Microbiology	2
13	Biotechnology Applied Microbiology	4	28	Nutrition Dietetics	2
14	Automation Control Systems	3	29	Public Environmental Occupational Health	2
15	Engineering Environmental	3	30	Regional Urban Planning	2

Source: own elaboration based on WoS.

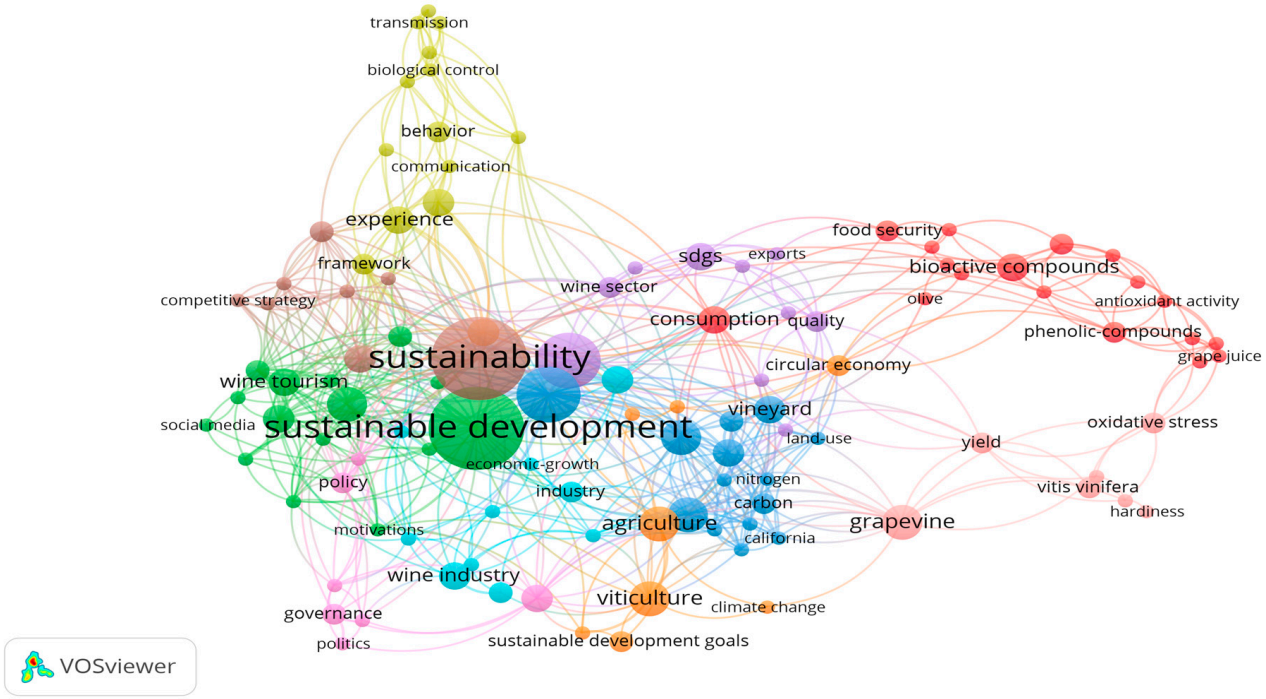


Figure 3. Network map on the keyword cooccurrence. Due to convenience, all keywords occurring at least five times in the records under consideration have been listed. The node size is in proportion to the number of occurrences of the keyword. Source: elaborated on the basis of WoS and VOSviewer.

The results listed in Table 2 indicate that Alex Sander da Rosa Araujo is the primary author who keeps returning to the analyzed topic with 3 records. Following them are Patricio Arce-Johnson, Artemi Cerda, Monica Cooper, Kent Daane, Concetta Ferrara, Elisa Giacosa, Barbara Iannone, Kimberly Nicholas, and Jesús Rodrigo-Comino with 2 records each, illustrating the high atomization of scientific production on the subject. Additionally, it is worth mentioning that one-third of the first thirty authors who discussed the topic are Italian, with Spain being the country with the second-highest number of authors in the first thirty.

As can be seen, while Table 3 reflects the main authors in the field, Figure 4 displays an analysis of the relationships between them. Alex Sander da Rosa Araujo not only has the largest number of publications, but also acts as a bridge between two large groups of authors, proving to be a cornerstone in the development of the discipline by collaborating with various researchers to further the knowledge of the topic.

Table 2. Total records, citations, paper impact, and country of affiliation for each leading author (Top-30).

	Author	Registers	Citations	Ratio	Institution	Country
1	Alex Sander da Rosa Araujo	3	13	6, 5	Universidade Federal do Rio Grande do Sul	Brazil
2	Patricio Arce-Johnson	2	39	19, 5	Pontificia Universidad Catolica de Chile	Chile
3	Artemi Cerda	2	97	48, 5	University of Valencia	Spain
4	Monica Cooper	2	105	52, 5	University of California System	USA

Table 2. *Cont.*

	Author	Registers	Citations	Ratio	Institution	Country
5	Kent Daane	2	105	52, 5	University of California Berkeley	USA
6	Concetta Ferrara	2	3	1, 5	University of Macerata	Italy
7	Elisa Giacosa	2	16	8	University of Turin	Italy
8	Barbara Iannone	2	1	0, 5	University of Chieti-Pescara	Italy
9	Kimberly Nicholas	2	105	52, 5	Lund University	Sweden
10	Jesús Rodrigo-Comino	2	31	15, 5	University of Granada	Spain
11	Thelma Zulfawu Abu	1	4	4	University Toronto Mississauga	USA
12	Abbas Afshar	1	1	1	Iran University Science & Technology	Iran
13	Fahad Al-Asmari	1	72	72	King Faisal University	Saudi Arabia
14	Alberto Mazzoni	1	1	1	University of Brescia	Italy
15	Eneka Albizu	1	0	0	University of Basque Country	Spain
16	Chiara Aleffi	1	2	2	University of Macerata	Italy
17	Rodrigo Almeida	1	99	99	Universidade Estadual Paulista	Brazil
18	Anil Kumar Anal	1	8	8	Asian Institute of Technology	Thailand
19	Emiliano Anceschi	1	1	1	Gruppo Filippetti SpA	Italy
20	Michael Andrades	1	0	0	Universidade Federal do Rio Grande do Sul	Brazil
21	Eleonora Annunziata	1	76	76	Scuola Superiore Sant'Anna	Italy
22	Sylvia Anton	1	0	0	Universite de Rennes	France
23	Felipe Aquea	1	39	39	University of Adolfo Ibanez	Chile
24	Vicent Arbona	1	36	36	Universitat Jaume I	Spain
25	Maria Arroyo-Hernandez	1	6	6	University of Francisco de Vitoria	Spain
26	Vanessa Assumma	1	0	0	Polytechnic University of Turin	Italy
27	Harshal Avinashe	1	0	0	Lovely Professional University	India
28	Karthik Sajith Babu	1	31	31	Kansas State University	USA
29	Lorenzo Baglieri	1	0	0	Polytechnic University of Turin	Italy
30	Bruno Bagnoli	1	2	2	Tuscia University	Italy

Source: own elaboration based on WoS.

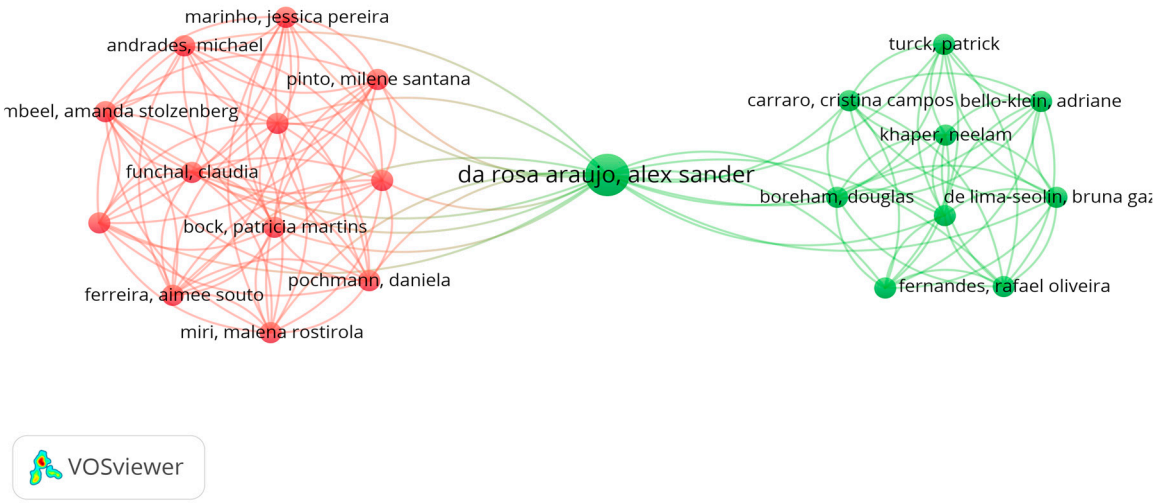


Figure 4. Co-authorship analysis of the scientific production reviewed (at least 2 shared articles). Source: elaborated on the basis of WoS and VOSviewer.

With regard to the major institutions supporting research on the SDGs and the wine industry, Table 3 illustrates that the University of Valencia is the frontrunner in terms of the number of articles, with five articles. Furthermore, INRAE, Lund University, the University of California System, and the University of Turin follow closely with four articles each. Moreover, Italy is the leading country when it comes to the number of institutions in the top 30 for scientific output on this subject, as evidenced by Table 2. As the nation with the most academics researching this area, it is not surprising that they take the lead. Spain has also made a notable contribution to this field.

Table 3. List of the top thirty journals, ranked by record number and their Journal Impact Factor (JIF) quartile 2021.

Institutions	Records	Region
University of Valencia	5	Spain
INRAE	4	France
Lund University	4	Sweden
University of California System	4	USA
University of Turin	4	Italy
Catholic University of the Sacred Heart	3	Italy
University of Cordoba	3	Italy
University of Lisboa	3	Spain
University of California Berkeley	3	USA
University of Tras os Montes Alto Douro	3	Portugal
Beijing Forestry University	2	China
Centre National de la Recherche Scientifique	2	France
CIRAD	2	France
Fondazione Edmund Mach	2	Italy
Annunzio University of Chieti Pescara	2	Italy
L'institut Agro	2	France

Table 3. *Cont.*

Institutions	Records	Region
Polytechnic University of Turin	2	Italy
Pontificia Universidad Catolica de Chile	2	Chile
Swiss Federal Research Station Agroscope	2	Switzerland
Udice French Research Universities	2	France
United States Department of Agriculture	2	USA
Universidad Autonoma de Chile	2	Chile
University of Castilla La Mancha	2	Spain
University of Malaga	2	Spain
Polytechnic University of Madrid	2	Spain
Universidade da Beira Interior	2	Portugal
Universidade Federal do Rio Grande do Sul	2	Brazil
Universitat Trier	2	Germany
University of Bologna	2	Italy
University of California Davis	2	USA

Source: own elaboration based on WoS.

Table 4 and Figure 5 show that Sustainability is the foremost journal with fourteen publications, while the Journal of Cleaner Production and Science of the Total Environment have three publications each. It is important to note that the top twenty-five journals have JIF, a measure to assess journals of adequate quality and research impact. Out of these, fourteen are in the first quartile, while eight are in the second quartile, showing that they are situated between the top 25% and 50% of journals with sufficient quality and impact. The most prominent publisher in terms of publications is MDPI, with twelve publications, followed by Elsevier, Springer, and Wiley (see Figure 5).

Table 4. Journal list by record number (top thirty) and its quartile of the JIF 2021.

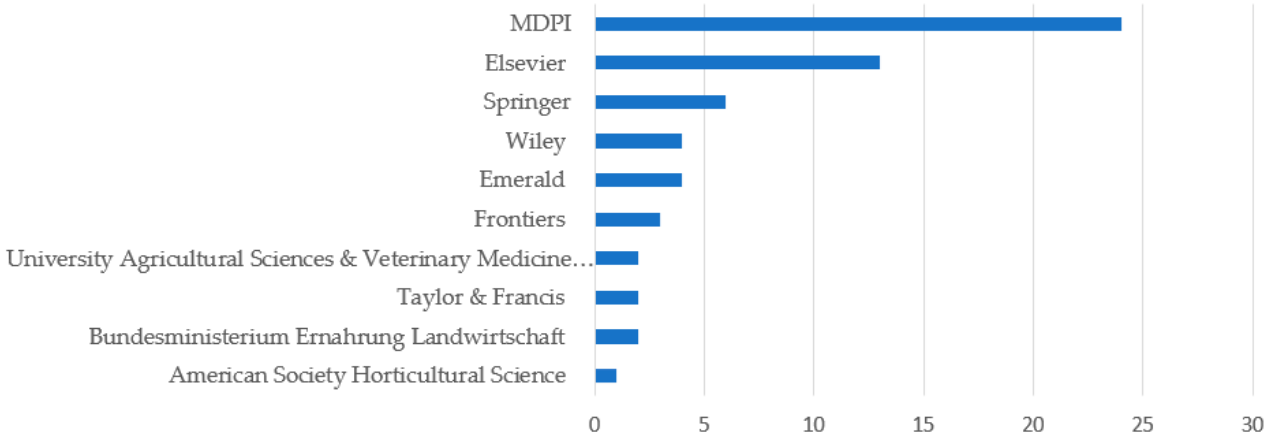
Journals	Records	Highest 2021 JIF Quartile	Publishing Houses
Sustainability	14	Q2	MDPI
Journal of Cleaner Production	3	Q1	Elsevier
Science of the Total Environment	3	Q1	Elsevier
Berichte Uber Landwirtschaft	2	Q4	Bundesministerium Ernahrung Landwirtschaft
British Food Journal	2	Q2	Emerald
Foods	2	Q1	MDPI
International Journal of Environmental Research and Public Health	2	Q1	MDPI
International Journal of Wine Business Research	2	-	Emerald
Aestimum	1	Q3	Firenze University Press
Agriculture and Human Values	1	Q1	Elsevier
Agriculture	1	Q1	MDPI
Applied Sciences	1	Q2	MDPI
Arthropod Structure Development	1	Q2	Elsevier

Table 4. *Cont.*

Journals	Records	Highest 2021 JIF Quartile	Publishing Houses
Australian Journal of Grape and Wine Research	1	Q1	Wiley
Baltic Journal of Economic Studies	1	-	Baltic Economic Studies
Birth Defects Research	1	Q3	Wiley
Chemometrics and Intelligent Laboratory Systems	1	Q1	Elsevier
CIRIEC Espana. Revista de Economia Publica Social y Cooperativa	1	-	CIRIEC
Computers and Electronics in Agriculture	1	Q1	Elsevier
ECO MONT Journal on Protected Mountain Areas Research	1	Q4	Austrian Academy Sciences Press
Ekonomika Poljoprivreda Economics of Agriculture	1	-	Balkan Scientific Association Agrarian Economists
European Journal of Sustainable Development	1	-	European Center Sustainable Development
Fermentation	1	Q2	MDPI
Frontiers in Microbiology	1	Q1	Frontiers
Frontiers in Nutrition	1	Q1	Frontiers
Frontiers in Plant Science	1	Q1	Frontiers
Hortscience	1	Q2	American Society Horticultural Science
Industrial Crops and Products	1	Q1	Elsevier
Insects	1	Q1	MDPI
International Entrepreneurship and Management Journal	1	Q2	Springer

Source: Prepared by authors based on WoS.

In terms of geographical distribution by country, it is worth noting that Italy is the country with the highest scientific production in this field, followed by Spain, the United States, and France (see Figure 6).



Source: Own elaboration based on WoS.

Figure 5. Leading publishers by number of publications.

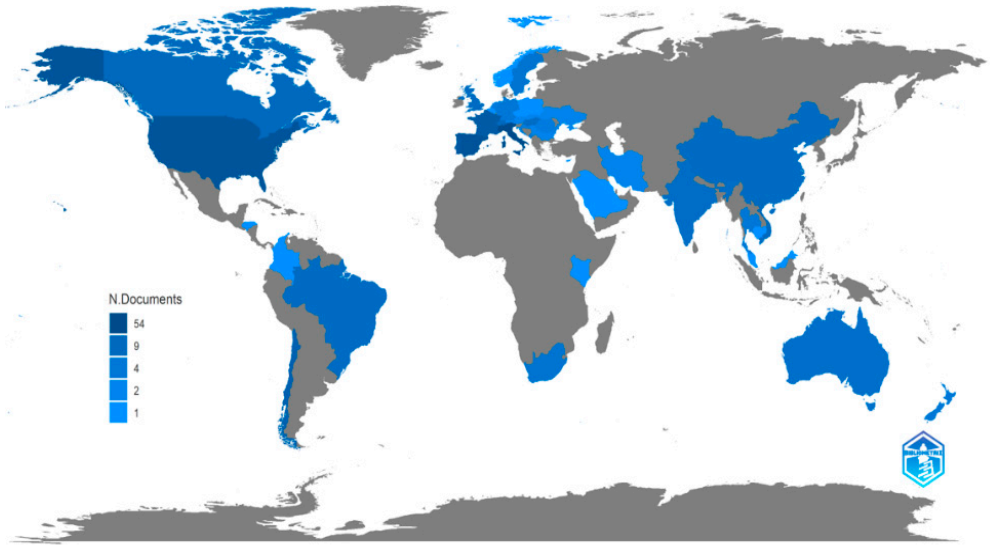


Figure 6. Scientific distribution of the published scientific production analyzed. Source: Own elaboration based on WoS.

The research results obtained confirm the research hypothesis, since there has been a significant increase in the scientific production analyzed in the last five years and it is the countries with a wine tradition that seemingly have been the main producers. On one hand, the wine industry is experiencing increasing pressure to comply with the SDGs and contribute to their achievement as a result of the growing global awareness of the importance of implementing sustainable development practices. In addition, governments, businesses, and consumers are increasingly aware of the effects that wine production can have on the environment, health, and social well-being, which has led to a growing interest in studying the link between the SDGs and the wine industry. On the other hand, countries with a wine tradition have a great responsibility in meeting the SDGs, as they have a long history of wine production and are where most of the wine manufacturing takes place.

4. Conclusions

Sustainable wine production not only benefits the environment but also has positive impacts on social and economic sustainability, making it a key component of the wine industry's future. As in many other sectors, sustainability is becoming increasingly important in the wine industry due to the growing awareness of environmental concerns and the need to promote responsible production and consumption practices. Sustainable wine production involves incorporating environmental, social, and economic considerations in all aspects of the winemaking process, from vineyard management to packaging and distribution. The wine industry is particularly sensitive to environmental factors, such as climate change, soil quality, and water availability, all of which have a direct impact on grape quality and wine production. Sustainable wine production aims to reduce the carbon footprint of the industry, preserve natural resources, and protect the ecosystem in which vineyards are located. This can be achieved through the use of sustainable farming practices. Adopting sustainable practices in wine production can have a positive impact on the environment, society, and the economy. Reducing the use of pesticides, preserving water, and employing sustainable energy sources are all essential aspects of sustainable agriculture. It is important to minimize the use of chemicals that can be harmful to the environment, conserve water resources, and switch to renewable power sources for the long-term health of farms. Furthermore, supporting fair labor practices and local communities can bring a range of social and economic benefits. Consumers are increasingly aware of the need for sustainability, and wine producers who implement sustainable practices can

stand out in a crowded marketplace and attract those who prioritize sustainability when making purchasing decisions.

In this vein, the wine industry may play a significant role in achieving the SDGs, especially those related to responsible consumption and production, climate action, sustainable agriculture, and economic growth. The SDGs provide a framework for promoting sustainability, and by incorporating them into the wine industry, it can help to ensure that the production and consumption of wine are sustainable. By considering the SDGs in their operations and decision-making processes, wine producers can contribute to achieving these global goals while also benefiting their business and the communities in which they operate. By promoting sustainable agriculture and supporting local food systems, the wine industry can contribute to SDG 2. For example, some wine producers use organic and biodynamic farming practices that help to reduce the use of pesticides and promote soil health. Moreover, wineries can source their food products locally and support small-scale farmers, thus promoting food security and reducing food waste. Furthermore, drinking wine in moderation has been linked to health benefits such as a decreased chance of cardiovascular disease. The wine industry can do their part to promote Sustainable Development Goal 3, which focuses on ensuring healthy lives and promoting well-being, by encouraging responsible drinking and raising awareness about the risks of consuming too much alcohol. In addition, wineries can offer activities that promote physical and mental well-being, such as vineyard hikes and yoga classes.

As wine production requires a significant amount of water, wineries can contribute to SDG 6 by implementing water conservation measures and reducing their water footprint. For instance, some wineries use drip irrigation systems that minimize water waste, while others recycle their wastewater for irrigation or other purposes. They can also promote water conservation in their communities by supporting water infrastructure projects and raising awareness about the importance of clean water. In connection with the above, the wine industry can contribute to SDG 7 by investing in renewable energy sources such as solar, wind, or geothermal energy, as well as promoting clean energy in their communities by supporting renewable energy projects and advocating for policies that incentivize clean energy adoption. Furthermore, wineries can implement waste reduction and recycling measures, reduce their greenhouse gas emissions, and promote sustainable packaging. Moreover, wineries can support sustainable tourism practices, such as offering eco-friendly accommodations or promoting low-carbon transportation options. Thus, by promoting responsible consumption and production, wine producers can reduce their environmental footprint and minimize waste, which not only helps to achieve SDG 12 but can also lead to cost savings and increased efficiency.

Similarly, by adopting sustainable agriculture practices, such as organic farming and regenerative agriculture, wine producers can help to mitigate climate change, protect biodiversity, and promote sustainable land use, all of which contribute to achieving SDGs 13, 14, and 15. In addition, by considering the SDGs, wine producers can also contribute to social sustainability by promoting fair labor practices and supporting local communities, which aligns with SDGs 8 and 10. This can create a positive impact not only for the wine industry but also for the broader community, contributing to economic growth and sustainable development. The SDGs provide a framework for sustainable development that can guide the wine industry towards a more sustainable future.

It is worth noting that the academic literature on SDG compliance in the wine industry can enhance the sustainable development of the wine industry by providing useful knowledge and strategies to address the challenges related to sustainable development in the wine sector. In this regard, it can provide insights on how wineries can achieve the SDGs through different practices, such as using renewable energy, minimizing waste, and improving resource efficiency. This information can help companies in the sector to develop practices that reduce environmental impact and improve sustainability. In addition, the academic literature on the subject can also provide guidance to help companies develop sustainable development strategies that are appropriate for the sector, such as promoting

sustainable farming practices and improving food safety and product certification, thereby helping companies in the sector to achieve better sustainability and meet the SDGs.

Despite conducting a literature review on sustainability and SDGs in the wine industry using specific keywords and a single database (WoS), it was not possible to include all relevant papers in this area. Future studies of sustainability in the wine industry could benefit from alternative research methodologies, such as social network and factor analysis, in addition to bibliometric methods. Examining recent publications and pertinent databases can help to identify current trends in research and deepen our understanding of sustainability in the wine sector. Moreover, a holistic approach to researching sustainability would be beneficial, incorporating different types of research methods to gain a comprehensive understanding of the issue.

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