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Nunc est Bibendum: Sustainability in the wine industry, a literature review

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Abstract

Purpose: The present research expands the debate on environmental sustainability in the wine industry by observing how management academia has addressed this topic over the last twelve years.

Design/Methodology: The research has been structured as a systematic literature review of academic papers from 2009 till the first half of 2022. This methodology provides a clear overview of sustainable management practices, effective and potential, throughout the entire agri-food wine production process.

Findings: The literature review provides a categorization of the papers divided into major (most recurrent) and secondary topics. The classification has been made according to the prevalence criterion.

Originality/Value: The paper describes the state of the art, identifies literature gaps and since we were unable to find similar work would like to be an opportunity to align the interest of academia and wine companies for future researches.

Word count: 6983

1. Introduction

The problem of sustainable food production has gained considerable attention in the last decade as highlighted by different authors. The exploitation of natural resources and the inexorable destruction of the environmental heritage (Liberti, 2016), the presence of real pollution paradise (Candau and Dienesch, 2017), the greenwashing issue (Brusset, 2016), the agri-food oligopoly (IPES-Food, 2017) are just some of the major topics regarding this industry and some of the key points for the green revolution of a sector usually neglected because of its inappropriate “clean” connotation. Even wine production, a specific niche of the agri-food industry, has not been exempt from the necessity of a shift in the business paradigm. The aim of this work is to conduct a systematic literature review to analyze how the problem of sustainability in the wine sector, throughout the entire agro-food production process, has been addressed by academia.

“Nunc est Bibendum” is the famous Latin phrase used by the poet Horace in his own odes, Book I-Carme 37, to exhort the Roman people to drink wine to celebrate the death of Cleopatra. Centuries later, the strong symbolism associated with this phrase, still used with an auspicious tone for toasts or important events, is the proof of how this drink and the system of values connected to it, is inherent in human nature, to the point of surviving the test of time almost unchanged.

Actually, wine production represents an important niche of the agri-food industry that should be studied deeply and separately for different reasons. First of all, from the economic perspective, wine has an enormous weight in terms of revenues for different countries, both arising from the new and the old world. Secondly because this industry plays an important role in the national cultural heritage, making this product a potent social and religious symbol (Unwin, 2022). In countries like Italy, for example, wine has always represented an excellence of local production, a symbol that mixes both tradition and innovation, the continuum between the glories of the ancient Rome and the modern times. Because of the strong psychological connotation, the role played in different nations and its environmental impact, wine has slowly gained ground even within academic studies.

The characteristics of wine production have slowly changed overtime. Even if Italy still remains the biggest wine producer, alongside with other traditional wine country like France and Spain, there has been a shift in balance from countries of the old world (Bandinelli et. al., 2020), to countries of the “new world”, such as New Zealand (Gilinski Jr et. al., 2015) also due to climate change.

Historical wine producers (Italy, Spain and France) have seen a strong contraction in their production, (22 million overall in 2021) because of late spring frosts and general unfavorable weather conditions, while vineyards of the Australian hemisphere have registered record productions, except for New Zealand (OIV, 2021). Moreover, this is the third year that wine production attests levels below average as a result of adverse weather conditions. Countries from the old world have slowly seen their hegemony redimensioned in favor of “newborn” ones that have rapidly gained more power and can no longer be treated as simple wine importers. The growing diffusion of wine production has also gained more and more importance in terms of sustainable practices, taking into account that the agri-food industry stands for 70% of global fresh water use and 20-37% of GHG emissions (UN, 2021), that are mostly diffused amongst producers of the new world, who have used these variables as an element of differentiation from the incumbents of the industry. We could mention, for example, certifications systems voluntarily settled by the Australian hemisphere countries. Initiatives like New Zealand’s SWNZ program 1998, 1997 or Regional Environmental best practices for viticulture in the Victorian wine region of Australia or America’s California Wine Code of Sustainable Practices (the Code) of 2002 are all good examples.

Even in the vineyards of the absolute leader of wine countries, Italy, the green shift in the production paradigm has gained more and more ground. In fact, Tuscany’s wine-growing vocation has married innovative drives to the point that in 2021 the organic production of Chianti Classico exceeded the traditional one, demonstrating that sustainability can leave behind the traditional preconceptions that attribute to it the prerogative of exclusive and elite productions and become a “popular” productive choice (Fiordelli, 2021).

Despite the central role, both from an economical and cultural side, that this industry has gained worldwide throughout the years, we have to take into account that even if sustainability is already a quite explored into the agri-food area, this is not so evident regarding the wine sector (Bandinelli et al., 2020).

The limited amount of literature reviews and the absence of recent ones regarding the role of academia in addressing sustainability in the wine industry, especially after 2021 UN Food system summit and the Italian Piano Nazionale di Ripresa e Resilienza (PNRR), has inspired us in the development of this work.

The paper is divided as it follows. First a brief introduction regarding the wine sector and the sustainability concept. Second, a section regarding the methodology used to conduct the analysis. Third, a presentation of findings and the major themes emerging from the analysis of the papers. The Fourth section has been dedicated to conclusions. The goal of this paper is to combine of the needs of the players in the wine value chain and the interests of the academia in order to assess the current state of the art of sustainability strategies that can hopefully be the starting point for future researches, defining the literature gaps and providing suggestions for new topics of analysis.

2. Methodology

In order to deeply understand the multiple empirical and academic applications of sustainability within the wine industry, a systematic literature review has been conducted to investigate state of the art (Carrera-Rivera et. al.,2022), what are the major topics explored, the theory applied and the possible research gaps on which attention should be focused.

First, the search algorithm was defined to include as many results as possible regarding sustainability in the wine industry, within the 2009-2022 (half year) period. This search algorithm is divided into three strings. The first one: wine OR “wine sector” OR “wine industry”; the second: “environmental sustainability” OR sustainab* OR “circular economy” OR “environmental practices” OR “climate change” OR “green”; the third: management OR manag*. The algorithm was applied inside two different databases, Scopus and Web of Science (WOS), to compare the results and to have a more detailed view of the topic. We first obtained respectively 947 and 1389 results. To ascribe the results to the managerial area a first selection was performed and filter were applied: business and managerial for WOS and business, managerial and accounting for Scopus. Then we obtained 183 for Scopus and 159 for WOS. Then the scripts were limited to the English language and book chapters and conference papers were removed. After this the abstracts have been read and the research was further refined, excluding papers that were not pertinent to the topic. Results were refined and a comparison between the database was made. Finally, 120 papers from both databases (30 in common) were accurately read.

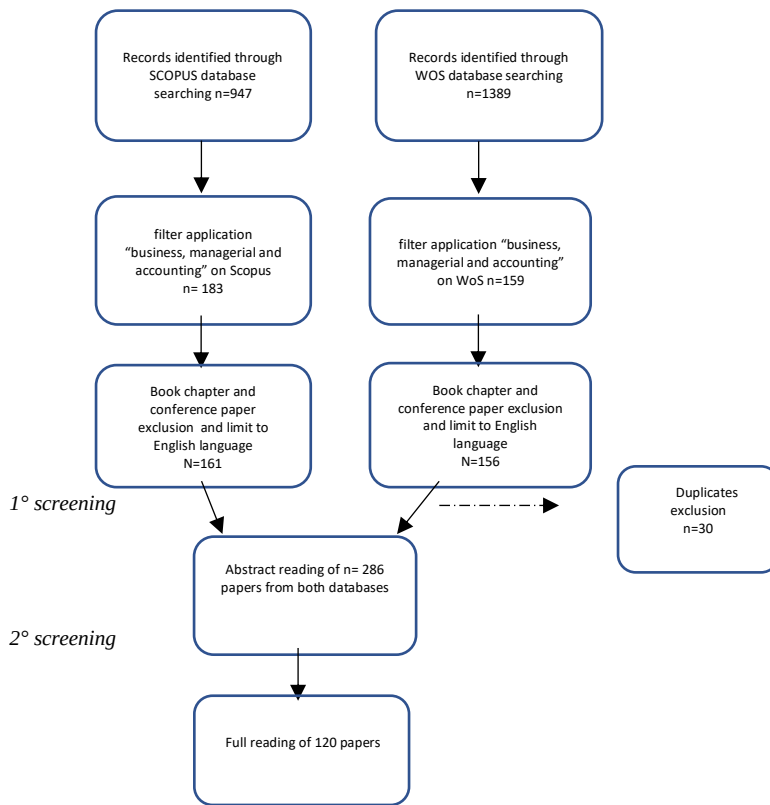


Table 1: Overview of articles screening process with resulting number of articles

3. Findings and analysis

According to the analysis of the papers some initial considerations could be drawn before observing each topic identified. To carry out the categorization we decided to opt for the criterion of prevalence, taking into account that some articles belong to several topics. The box below indicates the major categories, according to the higher number of papers identified, that were selected:

Major topics	
1	Sustainable supply chain management: explores how firms successfully integrate environmental and practices inside the entire supply chain lifecycle.
2	Environmental certifications: analyzes the role and impact of voluntary environmental certification inside the wine business.
3	Internal and external drivers for wine firms sustainability: a category that is dedicated to the analysis of the antecedents and the leverages that foster the adoption of sustainable business practices inside wine firms.
4	Environmental Assessment: refers to the papers that explore the best methodology to measure the impact of each stage of wine production, like water consumption, packaging alternatives or even waste management.
5	Classification of firm's sustainable practices: includes all the papers that list sustainable business practices adopted by firms belonging to a specific regional area or to a single virtuous case study.
6	Green purchase and sustainable consumption: explores the perspective and attitudes of final and intermediate buyers of wine, observing the favorite sustainable attributes adopted during the purchasing process.
7	Wine and tourism: a single category that analyzes the role of wine as an experience good and its bond with tourist services.

8	Theoretical and empirical framework for wine sustainability: in this category are presented the papers that have the specific aim of developing a theoretical framework to help firms in the successful integration of the sustainability issue within their business model successfully.
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Table 2: Major topics identified

Beyond the category mentioned in table 2 we have also decided to name as secondary topics the ones with a limited number of papers, equal or less than five, and to group them in the “Other” category, that will be further explored in paragraph 8.

The following tables provide a general overview of the papers and some major observations before the in-depth analysis of each category.

The first two tables present the total amount of papers for each category throughout the years.

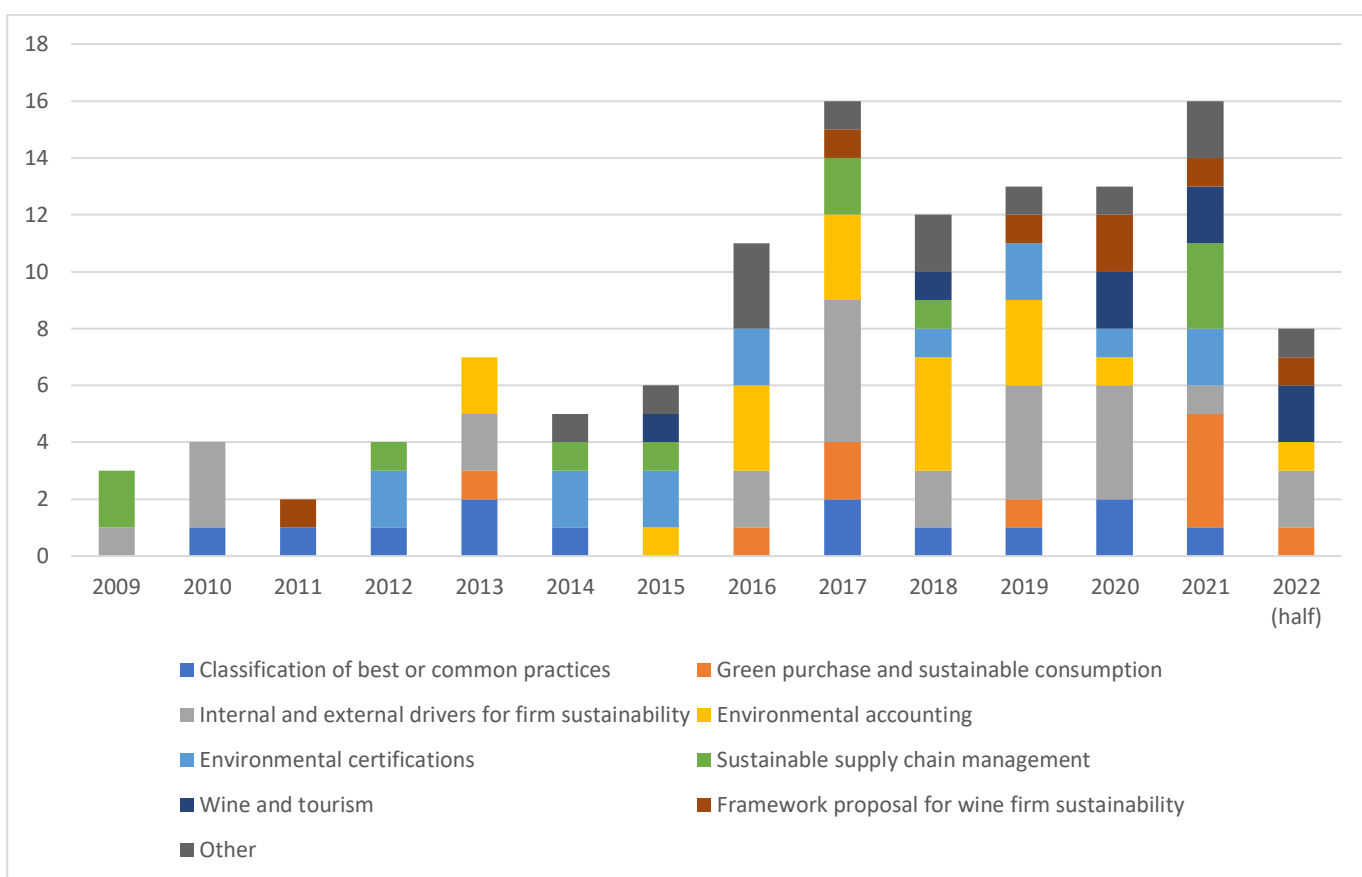


Table 3: annual paper variation for each category

<i>Year/category</i>	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022(half)	tot
<i>Sustainable supply chain management</i>	2			1		1	1		2	1			3		11
<i>Environmental certifications</i>				2		2	2	2		1	2	1	2		14
<i>Internal and external drivers for wine firms sustainability</i>	1	3			2			2	5	2	4	4	1	2	26
<i>Environmental assessment</i>					2		1	3	3	4	3	1		1	18
<i>Classification of best or common practices</i>		1	1	1	2	1			2	1	1	2	1		13
<i>Green purchase and sustainable consumption</i>					1			1	2		1		4	1	10
<i>Wine and tourism</i>							1			1		2	2	2	8
<i>Theoretical and Empirical framework for wine sustainability</i>			1						1		1	2	1	1	7
<i>Other</i>						1	1	3	1	2	1	1	2	1	13
<i>Tot/ year</i>	3	4	2	4	7	5	6	11	16	12	13	13	16	8	120

Table 4: *tot n. papers for each category/year*

The third table is focused on the different typologies of papers observed for each category.

<i>Category/type</i>	<i>Quantitative</i>	<i>Qualitative</i>	<i>Mixed</i>	<i>Tot.</i>
<i>Sustainable supply chain management</i>	6	3	2	11
<i>Environmental certifications</i>	10	2	2	14
<i>Internal and external drivers for wine firms sustainability</i>	15	7	4	26
<i>Classification of firm's environmental practices</i>	1	10	2	13
<i>Green purchase and sustainable consumption</i>	10			10
<i>Environmental assessment</i>	16	2		18
<i>Wine and tourism</i>	3	5		8
<i>Theoretical and empirical framework for wine sustainability</i>	2	4	1	7
<i>Other</i>	6	7		13
<i>Tot.</i>	69	40	11	120

Table 5: *type of papers for each category*

The last two tables observe the trend regarding the major categories inside different countries.

<i>First author's home country</i>	<i>n.paper</i>
<i>Italy</i>	29
<i>USA</i>	21
<i>Australia</i>	18
<i>New Zealand</i>	7
<i>Spain</i>	7
<i>Other</i>	Less than 7

Table 6: paper production/countries

<i>First author's country/categories</i>	<i>Internal and external drivers for wine firms sustainability</i>	<i>Classification of firm's sustainable practices</i>	<i>Environmental assessment</i>	<i>Environmental certifications</i>	<i>SSCM</i>	<i>Green purchasing and sust.</i>	<i>Wine and tourism</i>	<i>Framework</i>
Italy	(8) Dominici A., et. al. (2019) Cobelli N. et. al. (2021) Pucci T. et. al. (2019) Annunziata E. et. al. (2018) De Salvo M., et. al.(2017) Muscio A. et. al.(2017) gigi S. et. al. (2015) Pucci T. et. al.(2020)	(2) Bandinelli R. et. al (2020) Cantino V., et. al. (2019)	(5) Ferrara C. et. al (2020) Chiariacò M.V. et. al.(2019) Bartocci P. et. al. (2017) Iannone r. et. al. (2016) Chiusano L. et. al. (2015)	(4) Stranieri S.et. al.(2021) Dainelli F. and Daddi T. (2019) Merli R. et. al.(2018) Fiore M. et. al. (2016)	(2) Cavicchi C. and Vagnoni E. (2021) Signori P. et. al. (2015)	(1) Gazzola P. et. al. (2022)		(2) Fait M. et. al. (2020) Moggi et. al. (2021)
USA	(3) Tyler B. et. al (2020) Cordano M. et. al. (2010) Roehrdanz PR. And Hannah L. (2016)	(1) Moscovici D. et. al. (2017)	(1) Christ K. L. et. al.(2016)	(7) Gilinsky A. et. al. (2015) Lahneman B. (2015) Atkin T. et. al. (2012) Delmas M.A ,Grant L.E(2014)	(2) Flint D. J. and Golicic S. L. (2009) Cholette S. and Venkat K. (2009)	(6) Moscovici D. et. al. (2021) Bonn et. al. (2021) Bonn M.A. et. al. (2016) Chi ,CG.Q. (2021)		(1) Golicic S. L. (2017)

				Delmas MA Gergaud O (2021) Delmas MA Gergaud O (2014) Delmas et. al.(2016)		Delmas MA (2017) Kelley, KM et. al. (2017) Schmit, TM et. al. (2013)		
Australia	(3) Christ K. L. et. al. (2017) DuarteAlonso A. (2010) Galbreath J. et. al. (2016)	(3) Christ K. L. Burrit R.L.(2013) Galbreath J.(2011) Galbreath J. (2014)	(1) Christ K. L. et. al. (2016)		(5) Varsei M. et. al. (2017) Christ K. L. (2014) Soosay C. et. al. (2012) Varsei M. Polyakov skiy S. (2017) Taghikhah F. et. al. (2021)		(2) Duarte Alonso A. et. al. (2022) Duarte Alonso A. (2020)	(1) Bonn I. Fisher J.(2011)
New Zealand	(1) Gabzdylova B. et. al. (2009)	(1) Kariyapperuma N. et. al.(2021)	(2) Biswas S. et. al. (2016) Herath I. et. al. (2013)	(1) Forbes S. L. et. al. (2012)		(1) Tait P. et. al. (2019)		
Spain	(1) Marco. Lajara B. et. al. (2022)	(2) Carroquino J. et. al. (2020) Barba Sanchez V. et. al. (2012)	(4) Ferreira V. J. et. al. (2019) Guardia L. et. al. (2018) Villanueva Rey P. et. al. (2018) Navarro A, et. al. (2017)					

Table 7 : leading countries paper production for primary category

After this overview we can now continue with an indepth analysis of each category presented.

3.1. Sustainable Supply chain Management

A good portion of the papers that we have read, focuses on the concept of sustainable supply chain management. They aren't usually pure management or economics papers but a hybrid of more disciplines that reunite managerial and economic theories with engineering and agronomic practices and usually belong to the case study analysis type.

A recent explorative case study analyzed the concept of performance measurement systems to promote the integration of the circular economy in the entire wine supply chain of a wine cooperative. The idea is that, to promote the real accomplishment of SDGs, the entire value chain should be

analyzed and divided into smaller systems in order to set KPIs for each phase, to see who are the stakeholders involved in each stage and how they can contribute to the sustainability of the entire supply chain. (Cavicchi and Vagnoni, 2021). Other authors have gone a step further by incrementing the range of analysis to a global perspective, by studying the GHG emissions of the global wine supply chain that cover more than 90% of Finland's wine imports. A complex combination of LCA and Scenario analysis was performed regarding the eight main exporting countries of the Finnish market to see the main bottlenecks and main sources of GHG emission and to address the problem (Ponstein, Ghinoi, and Steiner, 2019). Aivazidou et. al (2018) and Christ et. al (2014) have chosen instead to analyze how to manage specific aspects of sustainability inside the supply chain, such as fresh water use that is one of the main issues of agricultural industry.

Other important issues like costs of carbon emissions, location of wine bottling plants (Varsei and Polyakovskiy, 2017 and Varsei, Christ and Burritt, 2017), certification adoption (Stranieri et. al., 2021) or the role of behavioral factors and their influence on consumer preferences in guiding the transition to a sustainable supply chain were analyzed both from a qualitative and quantitative perspective (Soosay, Fearne and Dent 2012; Taghikhah et. al., 2021), to identify sustainable tradeoffs. Also, the practical implications of establishing a philosophy that integrates the general sustainability principles in the daily activities of a specific company with qualitative case studies was explored (Flint and Golicic, 2009). There are also some quantitative papers that provide a model to optimize the capacity of supply chain facilities, the production rate of wine and the number of materials and final products that are moved throughout the entire supply chain, according to the final goal of Pareto Optimization (Fragoso and Figueira, 2021). According to the maximum optimization approach other studies analyzed different possible scenarios to route wine to consumer in the greenest possible way (Cholette and Venkat, 2009). Other authors like Signori, Flint and Golicic (2015) approached to the concept of sustainable supply chain orientation from an individual and personal point of view. The idea is that the tendency to develop sustainability inside the wine supply chain relies on participant initial orientation, and that this directly influences the strategy they choose to adopt. From this premise the authors define three major categories of interpretation: sustainability embracement, focus and extent of competing motivation. According to the categories, ten types of executives are profiled.

3.2. Environmental certifications

The debate regarding the implementation of certification has always been an important topic for academia and lots of authors have actually tried to understand the dichotomy between formal and effective adoption (Boiral, 2007), or the greenwashing effect (Delmas and Burbano, 2011) or even the results of a formal Environmental Management System on company performance (Melnik, Sroufe, and Calantone, 2003). The same inquiry has been also extended to the wine sector because of the urgency to find a justification for a process that is so costly and time consuming and also because of the need to understand what certification system is the most suitable for such a complex competitive environment. Dainelli and Daddi (2019) have explored how the adoption of voluntary organic certification directly influences financial performances of firms in the wine industry from different perspectives. Actually, organic firms achieve better performance in terms of profitability, thanks to the application of a premium price, that represents the proof of the added value recognized by the market. Also, the lower costs associated to the absence of pesticides, counterbalance the higher labor costs during the production phase. Even if the huge investments impact negatively on ROI and ROS of organic firms, net profitability and capitalization are considerably higher than non-organic ones. Delmas and Grant (2014) on the other hand, have observed a positive correlation between the presence of ecolabels and an effective superior quality of wine. Some interesting comparisons have also been made between different certifications systems (VIVA, CSWA and EMAS) taking into account the differences existing between countries belonging to the "Old world" and the "New world" (Merli, Preziosi and Acampora, 2018). The latter, despite coming late into a sector traditionally dominated by European countries, have advocated the sustainability transition, by implementing

environmental certifications in their strategy, years before the incumbents. Certifications have also been analyzed in cross national studies as a key element to evaluate the presence of disparities inside the same country (Atkin, Gilinsky Jr and Newton., 2012; Fanasch, 2019) or in cross-national studies (Gilinsky et. al., 2015) for implementing sustainability practices and EMS according to the perception of competitive advantage and long-term success (cost reduction or differentiation) of sustainable strategies (Porter,1985). As mentioned before, the fact that new comers' countries have married in first place the cause of certified wine production is also testified by the fact that the majority of the academic studies deal with the efficacy of correct implementation of EMS (Forbes and De Silva, 2012). Notwithstanding this, however, some relevant studies regarding European countries like, Italy, Germany and France have been carried out exploring the role of environmentally friendly certifications (Stranieri et. al.,2021; Fiore et. al., 2016) and ecolabelling (Delmas and Gergaud, 2021), analyzing the perception of internal and external stakeholders. Some innovative analyses have been also made to find a connection between the adoption of environmentally certified management standards and the perception of the concept of sustainability and its application inside the wineries (Lahneman, 2015). In addition, how information flows in tele coupling systems to favor wine certifications has been explored (Marola et. al, 2020). According to the nature of wine as credence good, third party eco certification processes and eco labeling have been studied as two separated strategies, to clearly identify the benefits associated with them. The role of the eco label is useful to reduce asymmetric information but the lack of understanding or the presence of different types of ecolabels could lead to confusion during the purchasing process. Wine can be also considered as an impure public good, and consumers tend to buy it only when they see an increment of their private advantage. From this study results indicate that only eco certification leads to a premium price (Delmas, Gergaud and Lim, 2016). Also, the idea of creating a continuum between present and future generations inside the same wineries can be seen as a strong driver for the adoption of sustainable certifications (Delmas and Geargaud, 2014).

3.3. Internal and external drivers for wine firms sustainability

One of the main purposes of academia is to try to meet the real need of enterprises and create a strong connection with the issues they are facing day by day. For this reason, it is really important to understand what are the main drivers and antecedents that push a firm in the shift towards a more sustainable behavior and what are the main barriers that it will probably face throughout the transition process (De Steur et. al., 2020). The main purpose is to try to analyze the internal, external and strategic drivers (Dodds et. al., 2013) to comprehend their role as possible sources for the development of corporate sustainability. As a consequence, it is fundamental to put the focus on the possible higher level of performance that can arise from the adoption of general sustainable practices as much as on the different types of pressure faced by management (Tyler et. al., 2020) to choose specific ones, such as water management (Christ, 2014), usually related to geographical or governmental characteristics. Frequently the role of the stakeholder's engagement stands out as the major source of value creation (Pucci et. al., 2020). From the internal perspective the focus can be put on organizational capabilities such as capacity of collaboration with partners, capacity of product innovation and adoption of advanced technologies (Annunziata et. al., 2018) or specific features of firms, like size and direct foreign investments (Spielmann ,2017). The absorptive capacity of firms has a major effect on both climate change innovation and knowledge exchanges between firms operating in the same cluster and vice versa (Galbreath, Charles and Oczkowski, 2016) while internal and external knowledge sourcing positively affects the adoption of Eco innovation (Muscio, Nardone and Stasi, 2017). A study specifically focused on New Zealand wineries also highlighted the importance of individuals systems of values, finding that environmental values, personal preferences and professional satisfaction occupy a higher position with respect to the marketplace (Gabzdylova, Raffensperger and Castka, 2009). Furthermore, an Australian paper bonds the adoption of sustainable practices to attitudes and norms held by the managers of SMEs (Knight et. al.,2019). For other authors

the choice of following a sustainable strategy, both from a social and from an environmental point of view has become the only possible answer to the request arising from the consumer side which is acquiring a lot of new knowledge regarding this topic (Duarte Alonso, 2010). For Christ, Burritt and Varsei (2017) instead the major antecedents of sustainability is coopetition. Cobelli, Chiarini and Giaretta (2021) focused the attention on the leadership guiding the firm, trying to understand if there are some characteristics of producers that affect their sustainable vocation. Surprisingly age, gender, experience in the sector don't have any relevant influence. Meanwhile the degree of different wine producers' perceptions of new organic technologies (easiness of use, association with better job performance, overall affective perception, presence of a strong infrastructure for their use) and also the importance attributed to people in their personal life have a significant effect. Also, Dominici, Boncinelli and Marone (2019), in a study that explores the key role of non-economic motivations of winery owners, show that "life-style oriented" stands for one of the major drivers of sustainability of Italian winemakers. The personal attitudes of company guidance are not the only important intangible internal drivers on which academia stresses its attention. Pucci et al. (2019) have highlighted the importance of Green Technological Orientation as a leverage of a firm's sustainable performance. But its impact is moderated by the environmental competitive strategy, positively in case of differentiation, negatively in case of cost leadership. Another main internal source of the firm that positively affects its green innovation performance is the green intellectual capital held by its members, even if the strength of this relationship is moderated by corporate social responsibility and knowledge management (Marco Lajara, et. al., 2022). Rather the level of maturity of an industry drastically influences the profile and timing of adoption of circular economy practices for SMEs in a developed country like Italy. This leads to a win win environment where stakeholder engagement, consumer needs, scientific knowledge of managers strengthen, empowering a firm's ability to gain and maintain a competitive advantage overtime (Sehnm et. al., 2020). In another developed country like USA, the adoption of environmental management programs relies strongly on managers perception of internal pressure and that change is usually fostered by the interactions that take place within a network of peers and trade associations, to reduce the fragmentation that characterize this industry (Cordano, Marshall, and Silverman, 2010). Observing SMEs in a growing country context like that of South Africa leads to different conclusion. Managers' environmental responsibility is actually considered the most important driver for the adoption of sustainable practices in a rural environment where state regulations are almost inexistent even if proactive firms are influenced by the possibility of a competitive gain (Hamann et. al., 2017). Interestingly in a study that compares drivers of firms operating in developed and developing countries, the importance of internal pressures is still confirmed while the pressure associated to export dependance and managerial practices is stronger in developing ones (Marshall Scott et. al., 2010). The driving role of human factors and perception of climate change, particularly related to the level and type of agriculture practiced are also confirmed by the study of De Salvo et. al. (2017), which is focused on the Moldova wine region. In general, the majority of the study converges on the idea that internal drivers have a greater role on the adoption of sustainable practices than external drivers and that adoption of green innovation practices positively impacts on a firm's performance, but there are important moderator factors that have to be taken into account. The effect of Green Internal Practices on Financial Performances is actually strongly moderated by the length of the channel structure adopted by firms. The more they use direct sales the better the effect (Leenders and Chandra, 2013). Also, the adoption of innovative specific sustainable solutions (Pougnet, Martin-Rios and Pasamar, 2022) related to packaging have been studied by academia to understand how to effectively integrate market request, innovation orientation of the firm and intellectual property protection strategy to enhance the performance of the firm (Darroman, Gurău and Mandou, 2019). From the external factor perspective, it is clear that climate change by itself plays a strong role in influencing company strategies in terms both of product quality and availability of natural rare sources, like water. The strong interdependency between the environment and wine production imposes on managers a rapid adoption of adaptation strategy as the only possible solution to survive

in a constantly changing environment. In an important wine region like California, for example, the suitability of grapes will progressively reduce in internal areas in favor of the coastal and upslope ones. To pair with this loss of competitiveness, the increase of water usage in the penalized areas can lead to a strong damage in the general ecosystem, with reduction of stream flows and conflicts with other important water usages. To survive and contextually answer to the global growing demand these areas should adopt a proactive approach and try to embrace a culture of less water intensity like vine orientation trellising or a varietal switch to survive without damaging the environment (Roehrdanz and Hannah, 2016). According to the SDGs, the European Green Deal, and the food system summit of 2021 one of the major goals is also to enhance the food security but this aspect, in some countries like Romania despite the urgency of the topic, doesn't seem to be as relevant because of the financial and social impediments associated with environmentally friendly strategies (Epuran et. al.,2018).

3.4. Environmental assessment

One of the most recurrent topics explored by academia is to try to find a way to account for the contribution to the pollution of the environment of the wine industry. These papers usually combine managerial skills and chemical or agronomical knowledge to evaluate models that empirically propose ways to contribute to the green transaction throughout application of LCA, LCT or other accounting methodologies to measure the impact of wine production throughout the wine supply chain (Ponstein, Ghinoi and Steiner,2019; Jradi et al., 2018; Litskas et. al.,2017; Navarro et. al.,2017; Iannone et al., 2016; Chiusano et. al., 2015; Bartocci, Fantozzi and Fantozzi.,2017; Soosay et. al., 2012; Wong et. al.,2022). Studies focus on different specific topics inside the wine production process, that can be bettered to reduce their impact while maintaining the same efficiency. These range between different interesting themes like the analysis of the pollution reduction according to solid winery waste valorization through a mild hydrothermal carbonization (Guardia et. al.,2018), the pyrolysis-based bioenergy (Zabaniotu et. al.,2018), the adoption of pulsed electric field to reduce the timing of the maceration stage (Ferreira et. al.,2019), alternatives of wine packaging (Ferrara and De Feo,2020), or even the best position for bottling implants (Christ, Burritt and Varsei,2016). Chiriaco et. al. (2019) adopt a “cradle to gate approach” while exploring the overall contribution to GHG emissions of a wine bottle. Considering all the GHG budget, biogenic fluxes, carbon stock emissions related to vineyard management, anthropogenic emission related to grape production and anthropogenic emission related to transformation of grapes into wine, these latter stand for the 85% of the carbon footprint related to wine production. Biswas S. and O'Grady (2016), tried instead to analyze the relationship between external environmental reporting and internal strategy processes and activities related to carbon measure accounting, finding that external accounting influences not just firms' reputation in the short term but also strategic planning, target setting and control activities in the long term. Even if GHG emission is the most analyzed topic when it comes to environmental accounting studies, other authors focused the analysis on the water consumption (Ene et. al., 2013) a really urgent issue for the agri-food industry. Villanueva- Rey et. al. (2018) assessed it from a quantitative point of view, water availability, and qualitative, water degradation, while Herath et. al. (2013) measured the water footprint of wine produced in two different areas of New Zealand with four different methods (Water Footprint Network, two LCA based and Hydrological water balanced method) to achieve an all-around evaluation.

3.5. Classification of firms' sustainable practices

According to the increasing importance of the wine industry, its vulnerability to climate change (Galbreath, 2014) and the fact that still a lot of research has to be done to address the problem of green transition, another important topic that emerges from the analysis refers to classification systems and the need to identify the major practices adopted by the firms to favor the implementation and dissemination of climate change awareness (Alonso Ugaglia and Peres, 2017). Trying to

understand how sustainability can be integrated inside the strategic decision-making process is key to achieving a systematic and effective climate friendly approach. Bandinelli et. al. (2020) have carried out a systematic literature review of the 30 years of papers published in Italian specialized journals along with a survey of Italian wineries to find a correspondence between academia studies and firms' behavior. Moscovici and Gottlieb (2017) have applied the same approach for a specific area of USA (New Jersey) where wine sustainability has gained ground throughout the years. Other authors have adopted a more empirical approach and made a classification of wineries according to the effective measure and practices used against climate change (Carroquino, Garcia-Casarejos and Gargallo, 2020; Szolnoki, 2013). In South Africa it has been observed that climate change could potentially lead to a loss of 55% of wine cultivated land by 2050, so water, energy and soil management as well as knowledge sharing systems between actors inside the supply chain are no longer an option but necessary practices to build resilience overtime (Trollip, 2018). Galbreath (2011), focused on the Margaret region in Australia and deeply explores the actions adopted to face climate change challenge, in particular distinguishing between mitigative and adaptive ones and the reason behind the different levels of implementation. Usually, firms are largely influenced by location as long as climate change could have positive or negative impacts on wine production depending on geographical position. Firms in southern and eastern parts of Australia are more prone to the risks of long droughts and increased temperature and so more prone to adaptive measures, while firms belonging to the Margaret River region tend to be more protected. The same conclusion can be made for different countries. Other papers revolve around a specific case study of an "old world country", Italian winery (Cantino, Giacosa and Cortese, 2019), or a new world country, Argentinian winery (Novaes Zilber et. al., 2010) as virtuous example of sustainable strategy, identifying characteristics of a successful business model, that blends sustainability and great economic performance, and its possible adoption by other players of the same industry. Another important study tried to classify the major areas of concern faced by the global wine industry through an integrative literature review to identify what current practices adopted by firms meet the real needs pointed out by scholars and what areas still face lots of problems according to academia (Christ and Burritt, 2013). Even a mature and lucrative industry of a developed country cannot avoid the climate issues as is also shown by Barba-Sanchez et. al. (2012) who find that managerial commitment is the principal source for green environmental practices for Spanish wine producers. In New Zealand the sustainability engagement is deeply influenced by family logics and their analysis provides a taxonomy of different types of business strategies to understand how sustainability is managed (Kariyapperuma and Collins, 2021).

3.6. Green purchase and sustainable consumption

Taking into account that consumers are one of the major stakeholders that gravitate around the firm (Porter, 1985) it is undeniable that firms should understand how much value is attributed by them to sustainable strategic choices to understand if the decisions are worthy. It is also really important to notice that climate change has impacted not only consumer attention on sustainability issues, but also consumption habits related to traditional and historical peculiarities as is shown by the direct correlation between wine consumption and climate change, only partially mitigated by globalization variables (Miroslava, Marketa and Lucie, 2021). For this reason, a relevant portion of studies regarding wine sustainability explores how firms react to societal change by exploring consumer purchasing attitudes regarding knowledge and willingness to pay for wine labeled with different environmental Eco certifications (Moscovici et. al., 2021; Magali et. al., 2016) or identifying a value scale for sustainability attributes (Tait et. al., 2019) or analyzing consumers perception of sustainable practices adopted by producers and retailers (Bonn, Cronin and Cho, 2016). According to the evolution of consumer preferences Gazzola et. al. (2022) observed a general propensity of young adults (especially females), compared to the previous generation, to look for sustainable attributes when making a purchase. To manage the supply chain, not just the preferences of final wine consumers are analyzed but also the purchasing behavior of wine retailers according both to

individual factors and organizational culture (Bonn et. al.,2021). According to the nature of “experience good” associated with wine, an interesting study combines sensory preferences of consumers and environmental friendly canopy management to see how the purchasing process changes when different variables are introduced (Schmit, Rickard and Taber, 2013). In the analysis of the Chinese consumer market Chi et. al. (2021) have highlighted that the antecedents that motivates green wine purchasing are social trust, health consciousness and positive emotions but the strength of the influence varies according to the familiarity with the product. Analyzing consumer perception is also really useful from a strategical point of view, because firms’ choices could be interpreted in a way really far from reality and firms would modify their marketing strategy according to this. Delmas and Lessem (2017) have evidenced that consumers associate ecolabels to a lower quality of wine and they prefer buying this type of wine only if it is low price or it comes from a lower quality region. So, firms should focus on information regarding consumer awareness of ecolabels and choose one that stresses both the environmental and private attributes of the product. Kelley et. al. (2017) instead conducted an experiment to analyze what are the attributes preferred by consumers when it comes to buying green wine (one economical and two environmental). The greatest impact comes from base retail attributes, followed by bunch root control measures and finally weed control. Also the level of interest in buying wine produced with sustainable techniques, like avoiding pesticides and cover crops strategy, is quite low indicating that it is important to raise consumer awareness.

3.7. Wine and tourism

It is clearly no mystery that tourism and wine are linked together by a double knot. Wine has a strong cultural value and is related to specific terroir to the point that it could be defined as a complex tourist product and as a connection enabler between different areas and regions (Peris-Ortiz, Del Río Rama and Rueda-Armengot, 2016). For this reason, many studies have focused on the power of wine as a leverage to enhance rural areas (Vukovic et. al.,2020) and fortify local tourism (Barbosa et. al., 2018). The goal is trying to create a holistic and fulfilling experience, enabling tourists to benefit from the added value that wine can bring to a normal trip and making them proactive part of the process of value cocreation inside the supply chain, (Rachão et. al., 2021) understanding the drivers, antecedents and barriers (Nave, Laurett and Do Paço, 2021) that can lead to the accomplishment of sustainability pillars in the wineries that offer this type of combined experience (Duarte Alonso et. al.,2022). Even if wine-tourism seems to be the perfect bionomy to promote food paring and local and cultural heritage as well as a way to develop rural areas, some important issues emerge regarding sustainability like general natural resources exploitation, water usage, rapid urbanization, overloading bureaucracy and necessity to collaborate with institutions. Duarte Alonso,Kok and O’Brien, (2020) developed a toolkit relying on the dynamic capabilities theory to explain how seizing and sensing can be used as an instrument to address these problems and also establish a strong brand image and niche positioning through time. It is also important to notice that a great deal of uncertainty is brought about by the internal economy and bureaucracy of the countries analyzed. Subsequent to the health crisis that the world has recently experienced Kastenholz et. al. (2022) explored wine tourism through the lenses of crisis management, trying to identify the strategy adopted to overcome the major issues associated with the pandemic in relation to social capital and networking and to sustainable tourism to make this industry more resilient over time. The paper written by Nedelcu et. al. (2015) stands out from the wine and tourism category because it focuses on the role of a specific group of stakeholders involved in the wine value chain, the local action group, as a major leverage for the adoption of sustainability of a historical wine region from different points of view. Their role is based on a bottom-up vision as they represent the lens through which goals can be settled and investment could be prioritized to meet the real need of the community, including rural development and best use of natural and cultural resources.

3.8. Theoretical and empirical framework for wine sustainability

The final topic in which we would like to group our results refers to the use of a specific theoretical and empirical framework to merge sustainability and the wine industry. Actually, despite the growing importance attributed by entrepreneurs to the concept of sustainability, the majority of them finds very challenging to integrate it into their business strategy (Bonn and Fisher ,2011). For this reason it is really important to develop practical models to help businesses achieve resilience through sustainability in a turbulent environment, dramatically influenced by the impact of climate change (Golobic, Flint and Signori, 2017). Some authors based their researches on the development of a specific conceptual framework to address the problem of sustainability in the wine industry, regarding implementation of motivational engagement system of consumers to create a network of knowledge exchange through a potential virtual community to reduce asymmetric information and promote sharing of virtuous behavior (Fait et. al., 2020). Dressler and Paunović (2020) analyzed areas of the food and beverage German system to develop seven suitable strategical business models, while Naude and Naude (2022) developed a risk management framework specifically made to help sustainability practices adoption for South Africa firms. Flores and Medeiros (2019) created a really interesting framework called Baccus structured in matrix basis, relating the five dimensions of sustainable development: Social, Economic, Environmental, Political/Institutional and Territorial and 18 themes for the guidelines, articulated in four major dimensions: Management, Articulation and Cooperation, Innovation, Learning and Sustainability. Moggi, Pierce and Bernardi, (2021) developed a framework where sustainability is not the key ingredient but the way to walk to face systemic threats at ecosystem level that can only be addressed through collective action, shared with other entrepreneurs and the community. Business models based on regenerative, rather than recycling or extractive, processes of resource use are the only ones that really enable success and self-fulfillment in the long term, as they enhance prosperity. This process can be facilitated by a focal organization like local wine consortium as long as it is considered legitimate as the common knowledge gatekeeper.

3.9. Secondary themes

There is also a limited number of papers that explore residual themes that cannot be conducted to the above mentioned categories but can be a useful starting point to expand the debate. They have been included in the category other and they are briefly presented in the table below.

<i>Cultural Ecosystem service</i>	It is no secret that wine production relies on natural sources to act and that firms operating in this industry should protect them to survive. Also, the cultural value of wine, as an experience good has been highlighted in different studies but in the paper of Winkler and Nicholas (2016) these two dimensions are merged together. The authors highlighted the perception that different stakeholders, locals and producers, belonging to different wine regions, Napa and Sonoma and Southeast England, have of vineyards landscapes. Results indicate that perception completely differs according to geographical location. In England perception of CES is positively taken into account by producers but not always by locals while in America it stands for all as part of the cultural heritage.
<i>Corporate Social responsibility</i>	Galati et al. (2019)explored the broader concept of CSR by finding a direct relationship between activity on social media and the desire of communicating responsible behavior externally with philanthropic purposes. The analysis of internet, this time through web sites, is also verified by Esposito et. al. (2021) that through their results show an extensive use of CSR through web sites, particularly for bigger ones while geographical location moderates the relationship. Moreover,

	Iannone (2018) have stressed how CSR has to play a key role in firms' strategic vision to improve corporate reputation.
<i>Industrial symbiosis and business networks:</i>	The concept of industrial symbiosis has been applied to company reality and studied as a tool where waste produced by a company becomes raw material for another, closing the loop and achieving the zero-waste goal. Castiglione and Fiore (2022), formalized the implementation of this theory, choosing the Innova Eco food Project as the case study of their work. This project studies a systemic model that exploits marc and rice hulls, respectively by products of the wine and rice production system, for the production of marc flour, rice hull flour and butter and their use in baked food products. Another interesting concept is studying how digital transformation strategy can be used as a tool to manage a collaborative network in the wine industry to create a sustainable business model that fosters common preservation and regeneration (Zoppelletto, Bullini Orlandi and Rossignoli, 2020).
<i>Change Management</i>	We found only few papers that explore how a green change in business model can be effectively introduced and sustained inside a firm. The first one is written by Hatak, Floh and Zauner (2015), when exploring organizational change inside SMEs in the Austrian wine industry. Based on Lewin's framework, with the application of the qualitative Delphi model. The major findings suggest that change evolves with an iterative process that starts with the unfreezing phase disclosed by business owners' attitude towards green practices, moves through different layers of the firm in a hierarchical order and is closed again by the owner's will to persist in the sustainable change process. The second instead observes the role of environmental managers as a facilitator for the change towards the adoption of environmentally friendly strategy, as long as they are strongly influenced by financial pressure and acceptance of their philosophy in the surrounding environment (Zaharie et. al., 2016)
<i>Barriers for sustainable innovation</i>	This category could be considered a subgroup of the driver's one but we decided to highlight it separately according to the prevalence criterion that we mentioned in the methodology section. Signori, Flint and Golicic (2017), have chosen an interesting approach by applying a resource based view to the analysis of the major constraints that managers in the wine industry face when approaching to sustainable innovation.
<i>Cluster analysis for Eco innovation and climate change adaptation</i>	During the reading process some papers stand out for their focus on the dynamics of clusters in promoting multiple firm's sustainable behaviors. Ratten (2018) observed that clusters are one of the major leverages of wine Eco innovation, that is in turn responsible for the increasing firms' competitiveness inside international markets. For this reason, Galbreath, Charles and Klass, (2014) and Galbreath (2016) in an exploratory study defined the process of acquisition and knowledge exchange related to climate issues. Relying on the cluster theory authors highlighted that knowledge does not flow easier between firms inside the same regional sub cluster or outside the cluster but instead they acquire lot of knowledge from external cluster sources especially national industry bodies and trade journals.

	For Boyer and Touzard (2021) the decision-making process of adaption to climate change of French winemakers is strongly associated to regional cluster characteristics bringing important strategic differences between regions.
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Table 8: *secondary themes presentation*

4. Conclusions and further research paths

The aim of this paper is to understand what are the major areas explored by management academia regarding sustainability in the wine industry, to define the possible future research paths on which literature should focus to meet the needs of the actors involved in the entire wine supply chain and contribute to the fight against climate change. From the analysis some conclusions can be drawn. First, we have identified some recurrent topics studied by academia. The exploration of internal and external drivers, antecedents and barriers, especially with the use of stakeholder and resource-based view theory, are the most common topics. Another theme that gained a lot of interest is supply chain management, used to picture the most efficient solutions both from an economical and an environmental point of view, that producers can adopt to make sustainable choices. Furthermore, lots of studies have been performed regarding LCA or other environmental accounting systems to measure the impact of the production of a wine bottle, or to find alternatives to the most polluting phases of the entire chain. Moreover, voluntary environmental certifications have an important place at the center of this debate. Their effective implementation and their connection with superiority in terms of financial performance, market share, reputational advantage, and effective quality of products have been deeply discussed. Many authors have also tried to set a standard and find common practices adopted by wineries, usually brought together by geographical proximity, to favor best practices dissemination and also knowledge sharing.

Despite this, there are some areas that are still quite unexplored. The literature that focuses on the management of the impact of climate change on the entire value chain could be expanded, due to the fact that climate change could both have both positive and negative impacts on wine production (especially in the agricultural phase) and drastically differs from one location to another, leading to threats but also to opportunities. Consumers perspective, even if it is one of the major categories identified, has great scope for further study. Trying to understand what dimension of sustainability is privileged during the purchasing process of wine bottles, with surveys or experimental studies, is an empirical and practical way to understand on which variables wine producers should put more attention and link it to the actual practices implemented by firms that frequently rely on isomorphy to adopt sustainable practices instead of focusing on the actual needs of their direct stakeholders. Another important topic of analysis could be the internalization of change, how firms can successfully implement a strategy where sustainability is not just an attribute but the way to perform to maintain competitiveness. This aspect is particularly important because climate change is no more an eventuality to question but a negative condition that is placing under discussion business models on which firm, especially from the old world, have relied on for years. Management has the duty to limit wine firm impact but also to develop a strong internal model than can lead to resilience and to cope with the unavoidable changes that will have to be faced. There is a lack also, according to our opinion, of sufficient case studies, especially for European countries, that analyze successful business models that have married sustainability without compromising their competitive advantage and even acquiring more success.

Our paper has some limitations. First the definition of the algorithm and search parameters, that even if defined to be as more objective as possible, are traceable to the specific interests and research aims of the authors. We tried to use a great number of specific keywords related to sustainability topics in the wine industry to reach a maximum level of inclusion but to make this work coherent with our research idea we have to refine it and make some exclusions. We also used our algorithm in two really famous databases. Similar searches with different algorithms and different databases could provide alternative results. Second, this paper focuses on the concept of environmental sustainability, but as we know, from the triple bottom line approach, there are areas like social and economic ones that could be deepened. Despite these, the last two areas mentioned are partially explored by our search algorithm, because of the strong interdependency with the environmental dimension, and the benefit they can provide each other. Possible follow up will lead to expand the debate on social and economic aspects. Finally, our paper, observes the environmental sustainability in the wine industry from an academic approach. The same analysis can be conducted from the empirical side, and lead to other important observations.

This paper hopes to be a starting point for further researches to avoid redundancy and contribute actively to merge academia interests and the wine firms' realities to guarantee the sustainable development of one of the most important industries in the world.

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