

## SUSTAINABLE INNOVATION IN WINE INDUSTRY A SYSTEMATIC REVIEW

**Valéria LEKICS**

Hungarian University of Agriculture and Life Sciences, H-7400 Kaposvár, Guba Sándor u. 40.

### **ABSTRACT**

*The article analyses the literature on sustainable innovation in wine industry, applying the systematic review approach. The recent review provides answer to the questions: What kind of innovations wineries implement in order to operate sustainably? What are the driving forces of these innovations and how do these effect company performance? We find that the majority of the innovations are process or product oriented focusing on the cultivation and winemaking process or on the product itself. The key motivation factors of innovations are managers'/owners' commitment, consumer needs and export orientation, networking. Costs of investments, lack of information and knowledge, negative managers'/owners' attitude, inadequate regulations, profit pressure from shareholders, uncertainty are the main barriers of innovations. Sustainable innovations effect positively companies' performance. Economic performance is measured by competitiveness, new markets, volume of export, costumers' loyalty, operational risk, strong brand and eco-efficiency. Environmental performance is measured by lower environmental impact, better product and company image, higher level of reputation. The review of innovation and performance interaction may allow drawing policy implications for future actions.*

Keywords: sustainable innovation, wine, motives, barriers, company performance

### **INTRODUCTION**

Winemaking is one of the eldest human activities, its cultural importance exceeds market terms. The sector had to be renewed several times during history, one example is the epidemic of phylloxera at the end of the 19<sup>th</sup> century.

The wine sector has a wide-ranging socio-economic importance: viti- and viniculture are deeply embedded in culture and religion. Vineyards, wine-press houses and cellars formulate the very basics of the rural landscape. Wine is a high value added product, and an export-import article of a great importance. Vine cultivation and wine making are knowledge intensive agricultural and food sectors.

These days humanity faces a global ecological crisis. *Steffen et al.* (2015) found that the three most irreversible „planetary boundaries” are unbalanced biogeochemical (Phosphorous and Nitrogen) flows, biodiversity loss and land system change. Surprisingly, climate change „only” comes at the fourth place in the list of most severe global problems (*Steffen et al.*, 2015).

Global environmental problems challenge viti- and vinicultural enterprises greatly. Increase in temperatures and extreme agroclimatic events are expected to

cause damage to vine stocks. Pests and diseases are likely to cause problems. The suitable location for vine is expected to shift to higher altitude and latitude as well. Actors of vine and wine sector have to mitigate the negative impact of their activities on the environment (mitigation strategy) on the one hand, and they have to adapt themselves to changing climatic conditions (adaptation strategy) on the other hand. Mitigation measures are reducing carbon and water footprint, increasing energy efficiency, utilizing renewable energy sources and process residues to produce biofuels, new packaging alternatives to minimize weight. Adaptation measures are the use of cover crops, irrigation, changes in the geography of wine, introduction of new vine varieties in the maintained area (Carroquino *et al.*, 2020; Király, 2017). The search for sustainable solutions may hide innovative solutions for wine businesses.

The international wine market is characterized by strong competition, changing consumer attitudes and it needs to stimulate the actors of the wine market to continuous improvements. Innovation is indispensable to survive, improve, grow and to continuously assure the ability to generate profit in this turbulent environment (Gilinsky *et al.*, 2008).

Schumpeter emphasized the role of entrepreneurship and innovation in economics in the early 20<sup>th</sup> century. He pointed out that entrepreneurs can alter the competitive market through new products and processes, which is a result of their successful innovation. He underlined the relevance of entrepreneurship to the development of innovation. His classification of innovation activities specifies product innovation (focusing on new product development), process innovation (focusing on new production methods), marketing innovation (focusing on new markets), supply innovation (focusing on new sources of raw materials) and organizational innovation (focusing on new organizational structures) (Schumpeter, 1934).

Sustainable businesses of the wine sector „are committed to behave ethically and contribute to economic development while improving the quality of life for the workforce, their families, the local and global community as well as future generations” (Cralc & Verecke, 2004). Thus sustainable innovations generate new solutions to improving companies’ performance in environmental, economic and social terms at the same time (Elkington, 1998). This kind of modernization requires strategy and system oriented leadership, and can lead to success if the whole structure of the organization is involved in the development process (Kneipp *et al.*, 2019).

The rate of adoption of innovations depends on their several perceived attributes. Relative advantage of a certain development (profit, cost efficiency) effects positively its adoption. Incentives in form of direct or indirect payments of cash are able to speed up the diffusion of agricultural innovations. Compatibility of an innovation with former ideas, beliefs can either foster or hinder its rate of adoption. The complexity of an innovation effects negatively its rate of adoption, as understandable, easy to use solutions are preferred for implementation. Trialability of innovations relates positively to their adoption rate. If the results of the innovation are visible or can be communicated to others, the rate of its adoption rises (Rogers *et al.*, 2019). These factors have a complex effect with different intensity on the rate of adoption.

Although literature suggests that companies can benefit from the implementation of sustainable innovation, empirical results are still inconclusive. Several studies have

investigated the application of sustainable innovation practices in the wine sector, but there are still gaps regarding wineries' performance. In addition, there is a lack of comprehensive overview on the innovation in the wine sector. Thus, the aim of the study is to provide a systematic review on sustainable innovation of wineries with special emphasis on the classification innovation activities, motifs and barriers of adoption and the effect of innovation on the performance of businesses.

## **METHODS AND RESULTS**

The systematic review approach has become an increasingly popular research tool in social science including economics and business studies. However, the use of systematic review is still rare in wine business research. The first step of the systematic review is to formulate research questions. The next phase is to design a review protocol describing the research strategy, the criteria for inclusion and quality assessment, the process for screening, data extraction, synthesis and reporting. The third step is to summarize and discuss the main findings of the relevant literature (Xiao & Watson, 2019). This rigorous protocol minimizes researcher bias occurring in data selection and analysis. It also provides validity, reliability and repeatability for the study, upon which comprehensive scientific report on literature of a specific theme can be filed (Tranfield *et al.*, 2003).

### **The selection process**

We focus on studies exploring sustainable innovations of vineyards and wineries. We investigate the sustainability issues in the triple bottom line context.

Search strings were created with the words *sustainable*, *innovation*, *viticulture*, *viniculture* and their synonyms as follows:

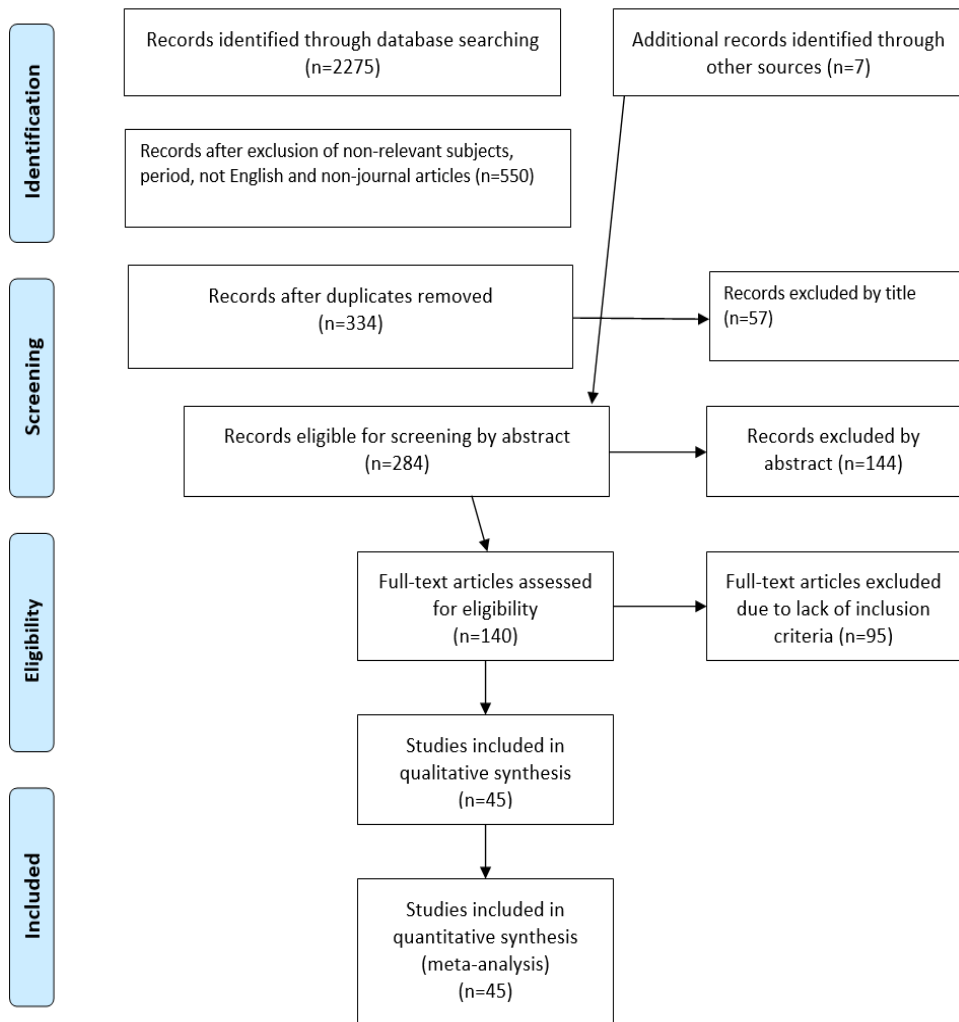
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sustainab* OR green* OR eco* OR environment* AND innovat* OR  
chang* OR improve* wine* OR vine* OR grape* OR oenolog* OR  
viticultur* OR vinicultur*
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The systematic search for literature was based on the two electronic databases Web of Science and Scopus in February 2021. The search provided 1239 results in Scopus and 1036 results in Web of Science, altogether 2275 results. After refining the search with the inclusion of the research area of environmental studies, agricultural economics policy, agriculture multidisciplinary, social sciences interdisciplinary, ecology, development studies, business, management, operations research management science, economics, multidisciplinary sciences, business finance and behavioral sciences, and inclusion of journal articles published between 2000 and 2020 in English language, the number of results for screening has decreased to 550.

The screening process of the literature is illustrated on *Figure 1*.

216 articles appeared in both databases, so they were excluded as duplicates. 57 articles were excluded because of the title and 144 articles because their abstract did not show a high level of importance with the research topic. We read the full text of 140 articles and excluded 95, because they did not focus exclusively on vineyard's or winery's innovation. Finally, we find 45 articles for detailed analysis (See Annex).

**Figure 1: The selection protocol of the literature**



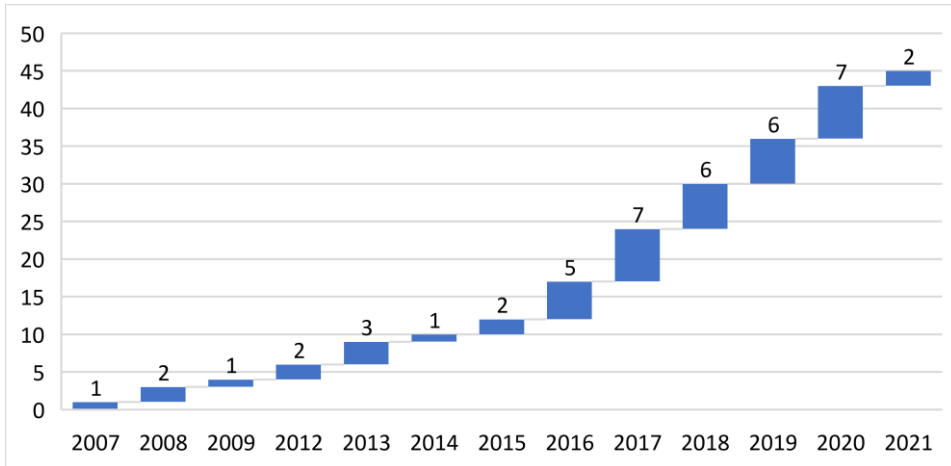
### Data analysis

We classify the articles, based on the following characteristics: publication year, research focus, research area, theoretical background, research question, research method, sample size, type and variables of analysis, types of innovation, driving forces and barriers of innovation, effect of innovation on performance (yes, no, not significant), findings.

### Topicality of the research theme and regional focus of the research

The number of articles exploring sustainable innovation in viti- and viticulture has been increasing since 2000 (*Figure 2*).

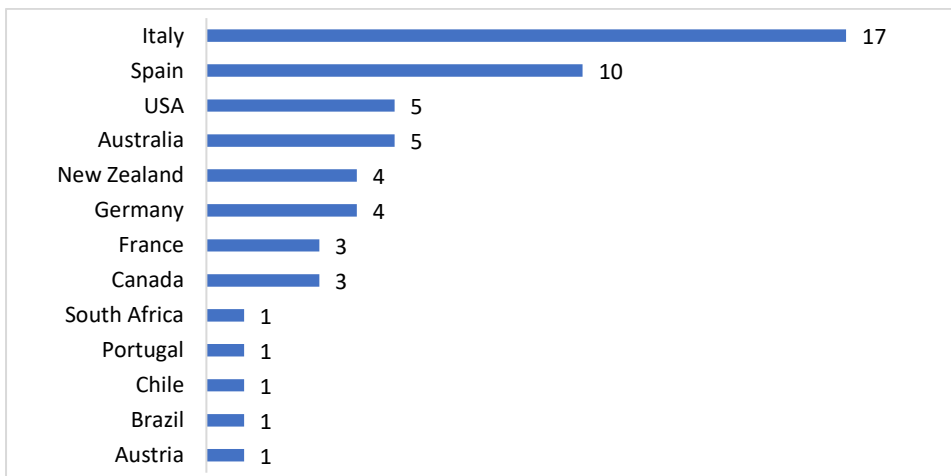
**Figure 2: Number of articles between 2007-2021**



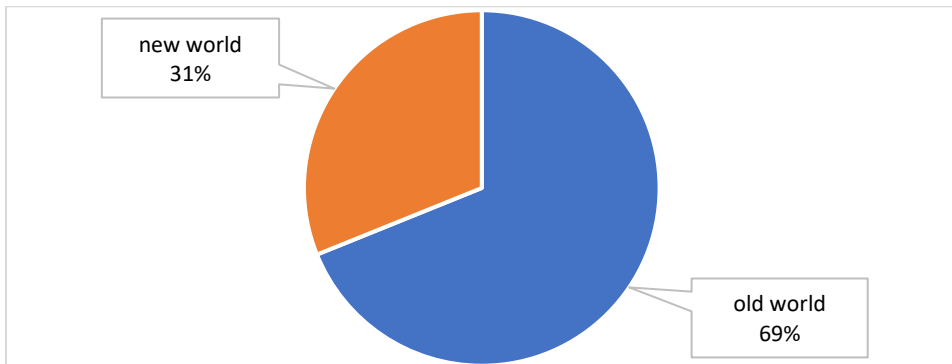
The rising research interest might be triggered by the expansion of New world wine on the international market. Australia has tripled its wine production and geared up to 7.5 times its wine export between 1992- 2004 (*Smith & Marsh, 2007*). Smith and Marsh regard technological innovation and capability creation, developments in collaboration and associational structure, processes of industry dynamics and consolidation as the main driving forces of dynamic growth in the wine sector.

The success of New world wines effected unfavorably the production and export indicators in the “Old world” (=Europe): only Spain could double its indicators, France and Germany could achieve a modest growth, but Italy bore a regression in the indicators (*OIV, n.d.*). Research on innovation in wine sector focuses therefore on Old world; primarily on Italy and Spain (*Figure 3* and *Figure 4*).

**Figure 3: Geographical focus of the articles (Countries)**

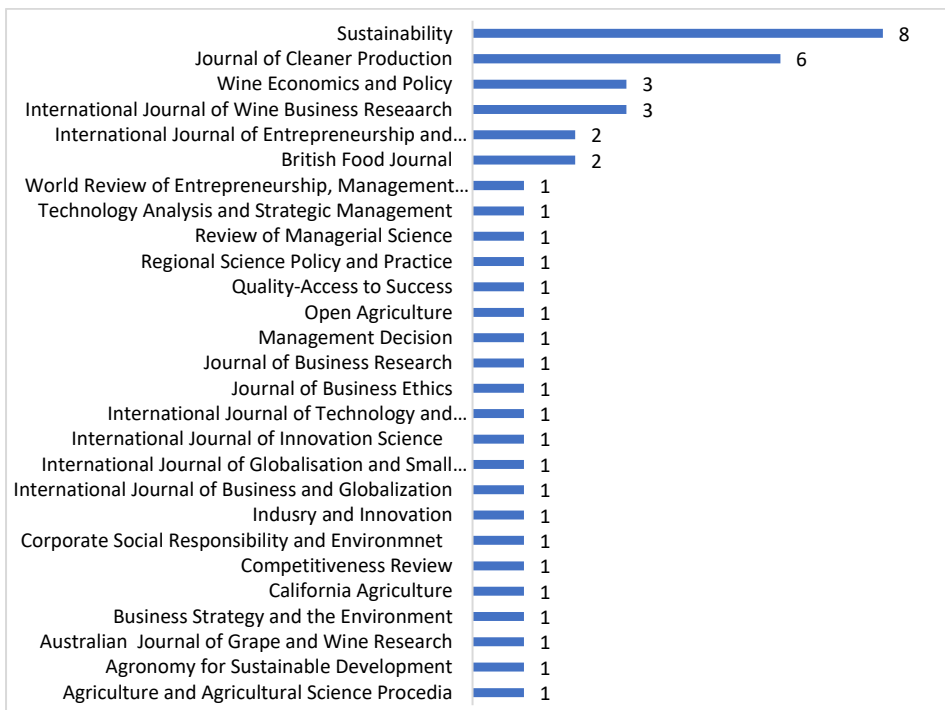


**Figure 4: Geographical focus of the articles (Europe – outside Europe)**



A wide range of disciplines is dealing with the research topic; more than a half of the analyzed articles were published in the following 6 journals: Sustainability, Journal of Cleaner Production, Wine Economics and Policy, International Journal of Wine Business Research, International Journal of Entrepreneurship and Small Business, British Food Journal. Additional 21 journals provided 1-1 article for this review (Figure 5). The number and diversity of journals dealing with the research topic demonstrate its multidisciplinary feature.

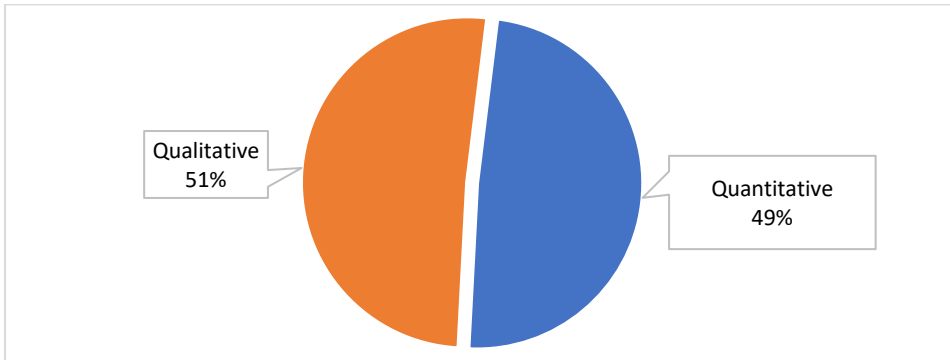
**Figure 5: Journals of the articles**



### Research methodology and analysis

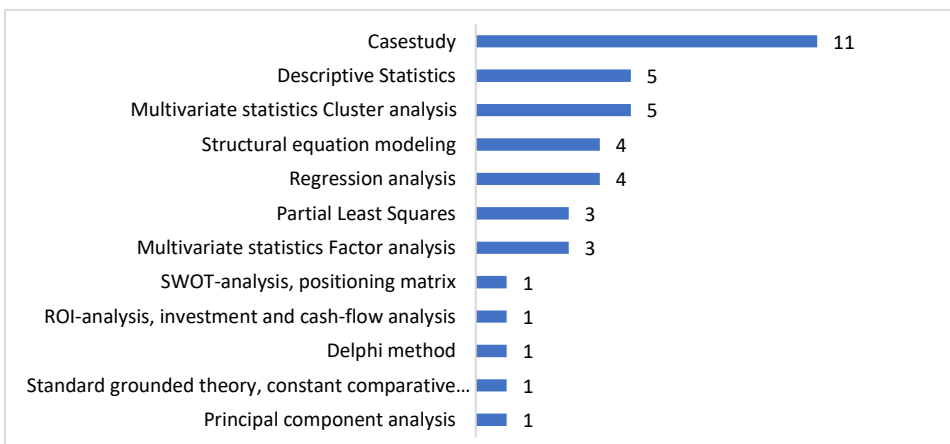
93% of the reviewed studies gathered primary data for the research via questionnaires. 51% of the studies applied qualitative and 49% applied quantitative methods for the analysis (Figure 6).

**Figure 6: Distribution of methodology applied**



Case study is the most frequently applied method (5, 8, 9, 13, 15, 19, 22, 23, 25, 34, 41) (Figure 7). This qualitative research method is also suitable for showing the effect of hard-to-quantify variables like tradition or generational succession and innovation. A lot of research used descriptive statistics to show relationships between variables (6, 10, 12, 25, 32). Multivariate statistical methods are frequently applied; factor analysis is appropriate to arrange and analyse groups of factors motivating or hindering innovation (2, 4), cluster analyses enable clustering and analysis of vineyards or wineries upon their relation to innovation activities (2, 4, 11, 14, 33). Regression analysis is a well suited method to survey how a company’s feature, employee’s ability, knowledge network or demand factors effect innovation (3, 27, 30, 38).

**Figure 7: Distribution of articles by methods**



### Sustainable innovation in the viti- and vinicultural sector

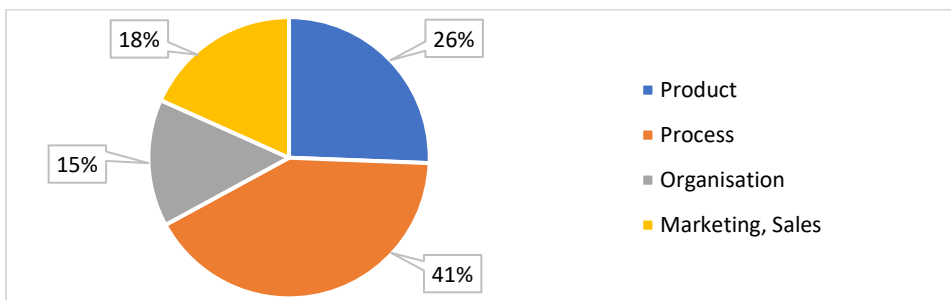
In papers a total of 5300 enterprises and their innovation practices were surveyed worldwide. The majority of the articles differentiate product and process oriented innovation (2, 7, 23, 26, 27, 28, 34), a smaller part of literature differentiates according to the functional unit of its orientation; viti- or vinicultural innovation (3, 15, 37).

We classify innovations following the classical typology (*Schumpeter*, 1934): product innovation, process innovation, marketing innovation and organizational innovation. The most frequently implemented product innovations were planting of new vine varieties, improving product characteristics, applying product labels, participating in voluntary certification, broadening the wine assortment, producing high quality wine with less alcohol content, charging premium price, introducing packaging alternatives, new design of bottles and labels. Most of the innovations are process oriented and intend to improve the sustainability of the process of vine cultivation and wine making. The most frequently recognized process innovation activities were integrated viticulture management, organic farming, introducing environmental management systems (EMAS, ISO 14000), vine and plot monitoring, eliminating chemicals from pest control, use of sexual confusion, interrow plantings to avoid insecticides and assure soil retention, use of mulches, less use of machinery, applying renewable energy; solar energy and utilization of biomass, efficient use of water, energy and materials, waste and wastewater treatment, recycling.

We find innovation focusing on marketing and sales of the companies: „Our sellers are our ambassadors” slogan emphasizes the importance of sales representatives in the transmission of a firm’s value to the consumer (34), raising the importance of cellar door sales and wine tourism (33), optimizing the distribution channel, the connection to short supply chain (11), green marketing (36).

Organizational and structural innovation enable businesses to correspond to the environmental and social needs via restructuring the organization of the company or developing a sustainable business model (34, 35): new management positions will be created (e.g. environmental manager), favoured position of research and development and HR activities within the organization, adopting team work management, training and raising the environmental awareness of the employees, integration of new channels of communication like Facebook, Instagram into the firm’s communication strategy (*Figure 8*).

**Figure 8: Types of innovation**





In the next step we have classified the motives (*Table 1*) and barriers (*Table 2*), which may foster and hinder a company's innovation according to their source; internally determined and externally determined factors.

**Table 1: Driving forces of sustainable innovation**

Internal driving factors	External driving factors
<ul style="list-style-type: none"> <li>- Owners' managers' awareness</li> <li>- Generational succession</li> <li>- Strategic approach in management</li> <li>- Cost reduction</li> <li>- Improving product and service quality</li> <li>- Risk avoidance: need for safety and security</li> <li>- Vision of a sustainable business</li> <li>- Minimizing ecological footprint</li> <li>- Tradition</li> <li>- Structural characteristics (size, corporate organization)</li> <li>- Absorptive capacity</li> <li>- Knowledge exchange</li> <li>- Quality and Environmental Management Systems</li> <li>- Voluntary certifications</li> </ul>	<ul style="list-style-type: none"> <li>- Market trends, consumer needs</li> <li>- Competition</li> <li>- Customer expectation</li> <li>- Industry initiatives</li> <li>- Export orientation</li> <li>- Government regulations (supportive)</li> <li>- Subsidies</li> <li>- Climate change</li> <li>- Networking and cooperation with customers, suppliers, research institutes, government organizations, marketing agencies</li> <li>- Supporting national wine strategy</li> <li>- Sectoral infrastructure</li> </ul>

**Table 2: Barriers of sustainable innovation**

Internal barriers	External barriers
<ul style="list-style-type: none"> <li>- Owners' managers' negative attitude</li> <li>- Cost of innovation</li> <li>- Lack of (environmental) knowledge</li> <li>- Lack of information</li> <li>- Financial risk</li> <li>- Tradition</li> <li>- Dependence on technology suppliers</li> <li>- Organizational restraints</li> <li>- Resistance of (key) employees</li> <li>- Time intensity</li> </ul>	<ul style="list-style-type: none"> <li>- Government regulations (inadequate)</li> <li>- Pressure from shareholders</li> <li>- Uncertainty and risk</li> <li>- Lack of technical and financial support</li> <li>- Insufficient public financing</li> <li>- Bureaucracy</li> <li>- Sectoral economic culture</li> <li>- Short-term perspective in economic thinking</li> <li>- Greenwashing</li> </ul>

The viti- vinicultural companies are value-oriented businesses, their development strategy is oriented by ethical considerations (*Schimmenti et al., 2016; Remaud et al., 2012*); the owners' and managers' awareness, tradition (*Vrontis et al., 2016*) and the intention of preserving biodiversity (*Fiore et al., 2017*). Sustainable innovations have

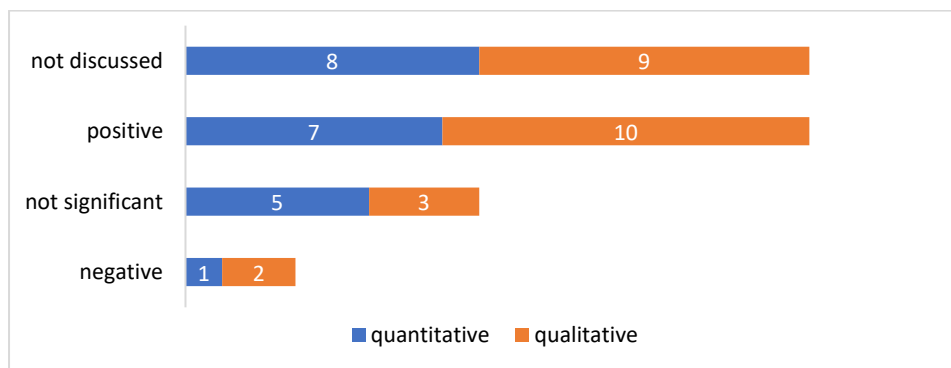
to effect companies' performance positively, too (Forbes & De Silva, 2011; Cullen et al., 2013). Forbes and Cullen explored the development intentions of farmers having been engaged in Greening Waipara project in New Zealand, and stated that only those development actions would be realized, where benefits exceeded costs.

We have investigated the articles according to the effect of the innovation on business performance. More than a half (62%) of the studies analyse the effectiveness of development actions and 61% of them stated a positive impact. We assume a demonstrative intension of the researcher (they want to prove the effectiveness of sustainability) and (with cost-efficiency analysis) well supported investment decisions behind this number. More than half of the studies analyzing the effectiveness of sustainable innovation apply qualitative methods (54%). It can be seen obviously, since many of the indicators expressing effectiveness are difficult to quantify; such as image or reputation (Figure 9).

Performance perceptions can be altered by certain business models. Guerrero-Villegas et al. (2018) found a divergence between objective performance in its conventional sense and subjective performance concerning the managers' way of thinking of performance and disclosed that innovation influenced subjective performance directly and indirectly, with the mediation of CSR (Corporate Social Responsibility) the objective performance. Consequently, if managers want to achieve greater performance, they need to implement innovation activities enhanced by CSR practices (Guerrero-Villegas et al., 2018).

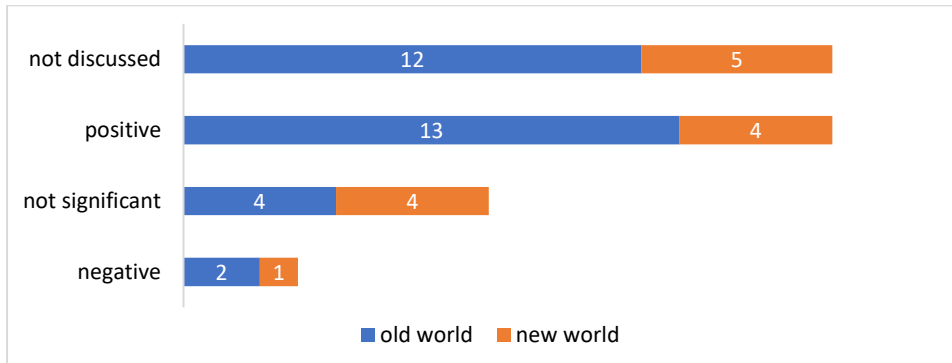
We have classified performance indicators by sustainability criteria: 1) economic performance is indicated by competitive advantage, economic efficiency, cost efficiency, profitability, growth, increase in sales, stronger brand, pricing power, increase in value added, new markets, export, customers' loyalty, lower level of risk (legal and regulatory, commercial risk), improved management system 2) environmental performance is indicated by levels of GHG (greenhouse gases), waste and noise emissions, consumption of water, energy and raw materials, integration of environment into productive processes, value capture image, reputation and 3) social performance is indicated by employee recruitment, creation of job positions, greater professionalization.

**Figure 9: Effect of innovation on performance by type of analysis**



Innovations of Old world wineries will be more frequently analyzed by their effect on company performance than those of the New world. We suppose the expansion of New world wine in the international market for the main reason (Figure 10).

**Figure 10: Effect of innovation on performance by type of analysis**



## SUMMARY AND CONCLUSION

The paper overviews the state of art of research on sustainable innovation in the wine sectors to gather current evidence and identify the gaps for future research. A robust protocol of the systematic review and a rigorous procedure selected 45 studies which contributed to identify the barriers to sustainable innovation creation and diffusion in the wine sector.

Two-thirds of the studies were published in the past 5 years. This is both evidence of the early and partial nature of the findings, and also of the potential, importance of this research subfield. This research attention coincides with the fact that in the last decade the importance of new wine world increased.

One of the major success factors implying this expansion is innovation. Innovations with a firm's resources and development capacities are able to build organizational resilience, which is essential for the long-term sustainability of businesses (Golicic et al., 2017).

The literature shows that the sustainable innovation in the wine sector is about the creation or adoption of new ideas and technologies. Various studies point to the on-going importance of diverse capacity for innovation embedded in and constituted by dynamics between geographical, socio-economic, political and legal subsystems. Several factors appear as predominant barriers to innovation across different settings and geographical areas. If owners and managers are not committed to sustainability, the major driving force of environmental and social improvements fail. In such cases other factors like resource deficiency in terms of finance, information gap or inadequate government regulations will be perceived as (more) momentous drawbacks to innovate in sustainability.

The manager's awareness is also crucial to manage sustainable development as a strategy and to integrate innovation into the overall structure of the company. This

embeddedness can be forced by several sustainable management standards and tools; guidelines and self-assessment handbooks for farmers. Two examples are the Farm-A-Syst in California (Obmart, 2008) or Best Management Practices in Southern Spain (Triviño-Tarradas *et al.*, 2020).

The additional advantage of the application of Best Management Practices is that it does not require desperate changes in the current cultivation and production process. It is also relatively cheap and easy to apply and results in indirect benefit, like increase in productivity and quality (Barba-Sánchez *et al.*, 2012). Measuring and comparing results of overall sustainable innovations require indicators. There is an excessive need for a sustainability indicator that covers both mitigation and adaptation in the wine sector (Carroquino *et al.*, 2020).

Local and small-scale innovations are of high importance. The collaborative business model is favorable for this kind of innovation, since its complexity requires local experiments that are easily applicable and enable interaction with local actors (Losada *et al.*, 2019).

The role of networking and cooperation in wine eco-system is emphasized in a lot of research; regional and functional cooperation are of high importance for the wineries' development ability. Eco-innovation multiplies its effect if customers are involved (Frigon *et al.*, 2020). The propensity to eco-innovate correlates positively with networking. Businesses cooperating with supply-chain members (vertical collaboration) and with competitors (horizontal collaboration) adopt ecological innovations more easily and faster. Wineries' R&D effort correlates positively with their innovative behavior as well (Stasi *et al.*, 2016).

Additional factors motivating sustainable innovation are consumer expectations, market needs and export orientation. It is not surprising that subsidies and governmental regulations only enhance the adoptions ability when managers' and owners' sustainability commitment would be otherwise low. (Carroquino *et al.*, 2020).

Some factors may have positive and negative effects. Tradition for example forces innovation in case it refers to high quality wine, production process or historical terroir. Nevertheless, it hinders development in case it is interpreted as a rigorous process, norm: „It's an innovation recovering the ancient wine making method” (28) (Vrontis *et al.*, 2016). Legal setting and governmental regulations have also dual effect on innovations: they may motivate the adoption of sustainable practices if they are simple, easy to comply with. Inadequate regulation on the other hand may hinder the willingness to innovate.

Managers' and owners' awareness of sustainability, their commitment to run the business in a sustainable way are the most important driving forces for sustainable improvements, as their negative attitude is the major barrier to ethical innovations. Ambitious goals, proactive and innovative managerial attitude are able to effect the companies' performance positively, as proven by the reviewed literature. Sustainability innovators should work as change agents to solve the “wicked problem” of finding ways of climate mitigation and address other challenges of unsustainable development.

The considerable need for finance and knowledge, the importance of supporting national wine strategy and legal setting related to sustainable innovation are the most relevant implication for government organizations and policy makers.

Sustainability is an environmental issue with a very narrow attention to its social aspects in the recent study of the wine sector. In this review of literature, we identified a wide range of sustainable innovation activities and their (positive, negative or not significant) effect on business performance in its economic and environmental sense. Socio-cultural aspects deserve more emphasis regarding that heritage as the fourth aspect of sustainability in viti- and viticulture. Future research in the area should focus on documenting best practices systematically. In order to assess development activities with their impact more precisely we would gather numerical data. This quantification of sustainable innovations and performance indicators enables us to study the relation between them more exactly.

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Corresponding author:

**Valéria LEKICS**

Hungarian University of Agriculture and Life Sciences  
Doctoral School in Management and Organizational Sciences  
H-7400 Kaposvár, Guba Sándor u. 40.  
ORCID: <https://orcid.org/0000-0003-2188-3634>  
e-mail: [dabibere@t-online.hu](mailto:dabibere@t-online.hu)

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ANNEX

Final articles of the structured literature review

#	Authors	Article Title	Journal	Year	Region	Research method	Sample	Type of analysis	Profit effect
1	Dressler, M.	Motivating sustainable entrepreneurship: The deployment of a visual navigation tool	World Review of Entrepreneurship, Management And Sustainable Development	2021	Germany	questionnaire: structured face-to-face interviews	50	qualitative	0
2	Marques, KS; Lermen, FH; Gulate, AC; de Magalhaes, RF; Danilevicz, AMF; Echeveste, MES	Inside of an innovation ecosystem: evidence from the Brazilian wine sector	Australian J. of Grape And Wine Research	2021	Brazil	questionnaire: semi-structured interviews	138	quantitative: multivariate statistics; factor analysis, cluster analysis	2
3	Frigon, A; Doloreux, D; Shearmur, R	Drivers of eco-innovation and conventional innovation in the Canadian wine industry	J. of Cleaner Production	2020	Canada	firm-level survey: questionnaire via computer-aided telephone interviewing (CATI)	151	quantitative: logistic regression	n.d.
4	Javier Carroquino; NievesGarcia-Casarejos; Pilar Gargallo	Classification of Spanish wineries according to their adoption of measures against climate change	J. of Cleaner Production	2020	Spain	questionnaire: semi-structured and in-depth interviews	87	quantitative: multivariate statistics; factor analysis, cluster analysis	n.d.
5	Pucci, T; Casprini, E; Galati, A; Zanni, L	The virtuous cycle of stakeholder engagement in developing a sustainability culture: Salcheto winery	J. of Business Research	2020	Italy	primary data source: interviews and informal speeches, secondary data source: articles, reports	1	qualitative: longitudinal, single case study	2
6	Dressler, M.	The entrepreneurship power house of ambition and innovation: Exploring German wineries	Int. J. of Entrepreneurship And Small Business	2020	Germany	questionnaire; online interviews	>300	quantitative: descriptive statistics: correlation, and variance analyses	2
7	Perretti, B.	Economic sustainability of quality wine districts in the South of Italy. The case of Vulture	Int. J. of Globalisation And Small Business	2020	Italy	survey with face to face interviews	1	quantitative: ROI-analysis, investment and cash-flow analysis	2
8	Trivino-Tarradas, P; Carranza-Canadas, P; Mesas-Carrascosa, FJ; Gonzalez-Sanchez, EJ	Evaluation of Agricultural Sustainability on a Mixed Vineyard and Olive-Grove Farm in Southern Spain through the INSPIA Model	Sustainability	2020	Spain	survey with face to face interviews	1	qualitative: case study	n.d.
9	Chaminade, C; Randelli, F	The Role of Territorially Embedded Innovation Ecosystems Accelerating Sustainability Transformations: A Case Study of the Transformation to Organic Wine Production in Tuscany (Italy)	Sustainability	2020	Italy	questionnaires and face to face semi-structured interviews, document analysis, participant observation	1	qualitative: single case study	n.d.
10	Merot, A.; Alonso Ugaglia, A.; Barbier, J.-M.; DePhomme, B.	Diversity of conversion strategies for organic vineyards	Agronomy for Sust. Development	2019	France	questionnaires: semi-directive interviews	16-13	quantitative: descriptive statistics	2
11	De Steur, Hans; Temmerman, Hélène; Gellynck, Xavier; Canavari, Maurizio	Drivers, adoption, and evaluation of sustainability practices in Italian wine SMEs	Business Strategy And The Environment	2019	Italy	Standardized survey (questionnaire)	64	quantitative - multivariate statistics: cluster-analysis	n.d.
12	Galletto, L; Barisan, L	Carbon Footprint as a Lever for Sustained Competitive Strategy in Developing a Smart Oenology: Evidence from an Exploratory Study in Italy	Sustainability	2019	Italy	questionnaire: in-depth face-to-face interviews	10	quantitative: descriptive statistics	2



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13	Losada, R.; Gómez-Ramos, A.; Rico, M.	Rural areas receptivity to innovative and sustainable agrifood processes. A case study in a viticultural territory of Central Spain	Regional Science Policy And Practice	2019	Spain	semi-structured questionnaire: MESMIS evaluation framework incorporating the principles of participatory action research (PAR)	1	qualitative: case study	2
14	Doloreux, D; Kraft, L	A Taxonomy of Eco-Innovation Types in SMEs: Exploring Different Firm Profiles in the Canadian Wine Industry	Sustainability	2019	Canada	questionnaire: computer assisted telephone interview	151	quantitative: principal component analysis and cluster analysis	2
15	Cantino, V; Giacosa, E; Cortese, D	A sustainable perspective in wine production for common-good management: The case of Fontanafredda biological reserve	British Food J.	2019	Italy	questionnaire: primary data from semi-structured in-depth interviews with managers, secondary data from company's materials	1	qualitative: case study	2
16	Guerrero-Villegas, J; Sierra-Garcia, L; Palacios-Florencio, B	The role of sustainable development and innovation on firm performance	Corp Social Responsibility And Environmental Management	2018	Spain	questionnaire	121	quantitative: partial least squares (PLS), a variance-based structural equation modeling technique	2
17	Siepmann, Laura; Nicholas, Kimberly A.	German winegrowers' motives and barriers to convert to organic farming	Sustainability	2018	Germany	questionnaire and semi-structured interviews	8	qualitative	n.d.
18	Anunziata, Eleonora; Pucci, Tommaso; Frey, Marco; Zanni, Lorenzo	The role of organizational capabilities in attaining corporate sustainability practices and economic performance: Evidence from Italian wine industry	J. of Cleaner Production	2018	Italy	questionnaire adressed to CEOs	357	quantitative: structural equation modelling	2
19	Ratten, V	Eco-innovation and competitiveness in the Barossa Valley wine region	Competitiveness Review	2018	Australia	questionnaire: semi-structured interviews	16	qualitative: exploratory case study approach	2
20	Baird, T; Hall, CM; Castka, P	New Zealand Winegrowers Attitudes and Behaviours towards Wine Tourism and Sustainable Winegrowing	Sustainability	2018	New Zea.	questionnaire	145	qualitative: explorative survey	2
21	Junquera, B; Barba-Sanchez, V	Environmental Proactivity and Firms' Performance: Mediation Effect of Competitive Advantages in Spanish Wineries	Sustainability	2018	Spain	questionnaire (Computer Assisted Telephone Interview addressed to company managers or environmental manegers)	142	quantitative: structural equation modelling (SEM) methodology with the partial least squares (PLS) technique	1
22	Pereira, A; Turnes, A; Vence, X	Barriers to shifting to a servitized model of crop protection in smallholding viticulture	J. of Cleaner Production	2017	Spain	questionnaire: semi-structured interviews	10	qualitative: exploratory case study	n.d.
23	Aldecoa, María José Fernández; Vaillant, Yancy; Lafuente, Esteban; Gómez, Jorge Moreno	The renaissance of a local wine industry: The relevance of social capital for business innovation in DOQ El Priorat, Catalonia	Wine Economics & Policy	2017	Spain	1) semi-structured interviews to wine producers 2) direct observation and 3) analysis of documentary sources	25	qualitative: case study technique of exploratory-descriptive scope	n.d.
24	Graca, AR; Simoes, L; Freitas, R; Pessanha, M; Sandeman, G	Using sustainable development actions to promote the relevance of mountain wines in export markets	Open Agriculture	2017	Portugal	Criteria-based self-assessment (fulfilled by an in-house multidisciplinary team)	1	qualitative	1
25	Fiore, M; Silvestri, R; Conto, F; Pellegrini, G	Understanding the relationship between green approach and marketing innovations tools in the wine sector	J. of Cleaner Production	2017	Italy	structured online questionnaire	204	quantitative: Pearson's Correlation matrix, explorative case study	n.d.
26	Olarte-Pascual, C; Oruezabala, G; Sierra-Murillo, Y	Innovation ecosystem: A trigger for new product development? Exploring the acceptance of a sparkling red wine amongst Spanish small business actors	Int. J. of Entrepreneurship And Small Business	2017	Spain	questionnaire: semi-structured interviews	13	qualitative: empirical study	2

#	Authors	Article Title	Journal	Year	Region	Research method	Sample	Type of analysis	Profit effect
27	Muscio, A; Nardone, G; Stasi, A	How does the search for knowledge drive firms' eco-innovation? Evidence from the wine industry	Industry & Innovation	2017	Italy	questionnaire (CATI survey addressed to company managers)	330	quantitative : probit regressions and one zero-inflated negative binomial (hereafter ZINB) regression	n.d.
28	Golicic, SI; Flint, DJ; Signori, P	Building business sustainability through resilience in the wine industry	International J. of Wine Business Research	2017	USA, Australia, New Zealand, Italy, Germany, France	questionnaires and in-depth interviews, observations and archival documents	141	qualitative: standard grounded theory, constant comparative method	2
29	Schimmenti, E., Migliore, G., Di Franco, C.P., Borsellino, V.	Is there sustainable entrepreneurship in the wine industry? Exploring Sicilian wineries participating in the SOSTain program	Wine Economics & Policy	2016	Italy	questionnaire (direct interviews with managers)	3	qualitative: descriptive survey	1
30	Stasi, Antonio; Muscio, Alessandro; Nardone, Gianluca; Seccia, Antonio	New Technologies and Sustainability in The Italian Wine Industry	Agriculture & Ag. Science Procedia	2015	Italy	questionnaire (Computer Assisted Telephone Interview addressed to company managers)	334	quantitative: logit regression	n.d.
31	Barba-Sanchez, V; Atienza-Sahuquillo, C	Environmental Proactivity and Environmental and Economic Performance: Evidence from the Winery Sector	Sustainability	2016	Spain	questionnaire (Computer Assisted Telephone Interview addressed to company managers or environmental managers)	312	quantitative: structural equation modelling (SEM) methodology with the partial least squares (PLS) technique	1
32	Galbreath, J; Charles, D; Oczkowski, E	The Drivers of Climate Change Innovations: Evidence from the Australian Wine Industry	J. of Business Ethics	2016	Australia	survey questionnaire	207	quantitative; descriptive statistics and multivariate statistics: factor-analysis	1
33	Alonso, AD; Bressan, A	Micro and small business innovation in a traditional industry	Int. J. of Innovation Science	2016	Italy	questionnaire	211	quantitative: cluster-analysis	n.d.
34	Vrontis, D	Tradition and innovation in Italian wine family businesses	British Food J.	2016	Italy	questionnaire: semi-structured interviews, direct observations,	1	qualitative: case study (Double-level codification, categorization, and contextualization)	2
35	Hatak, I; Floh, A; Zauner, A	Working on a dream: sustainable organisational change in SMEs using the example of the Austrian wine industry	Review of Managerial Science	2015	Austria	Delphi method	13	qualitative Delphi method	n.d.
36	Bellia, C; Pilato, M	Competitiveness of Wine Business within Green Economy: Sicilian Case	Quality-Access To Success	2014	Italy	questionnaire - face to face interviews	25	qualitative: SWOT-analysis, positioning matrix	2
37	Forbes, S.L; Cullen, R; Grout, R	Adoption of environmental innovations: Analysis from the Waipara wine industry	Wine Economics & Policy	2013	New Zealand	structured questionnaire	14	qualitative	0
38	Leenders, MAAM; Chandra, Y	Antecedents and consequences of green innovation in the wine industry: the role of channel structure	Tech. Anal. & Strategic Management	2013	USA, Canada, South Africa, Australia, New Zealand	international survey, questionnaire	123	quantitative; multivariate statistics: factor-analysis, regression analysis	1
39	Giuliani, E	Clusters, networks and firms' product success: an empirical study	Management Decision	2013	Chile, Italy	structured questionnaire	73	quantitative	n.d.
40	Atkin, T; Gilinsky, A; Newton, SK	Environmental strategy: does it lead to competitive advantage in the US wine industry?	Int. J. of Wine Business Research	2012	USA	questionnaire: web-based survey	98	quantitative: multivariate statistics	1
41	Barba-Sanchez, V; Martinez-Ruiz, MP; Jimenez-Zarco, AI; Megicks, P	Good environmental practices in a traditional wine producer: An opportunity for global competition	Int. J. of Business & Globalisation	2012	Spain	questionnaire - in dept interviews	1	qualitative: case study	2

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42	Saint-Ges, V; Belis-Bergouignan, MC;	Ways of reducing pesticides use in Bordeaux vineyards	J. of Cleaner Production	2009	France	questionnaire and multivariate statistics	753	quantitative	0
43	Gilinsky, A; Santini, C; Lazzaretti, L; Eyler, R	Desperately seeking serendipity Exploring the impact of country location on innovation in the wine industry	Int. J. of Wine Business Research	2008	USA, Italy	questionnaires and in-person interviews		qualitative	1
44	Ohmart, C	Innovative outreach increases adoption of sustainable winegrowing practices in Lodi region	California Agriculture	2008	USA	questionnaire: mail and telephone survey Total Design Method	>700	qualitative: descriptive study	n.d.
45	Smith, K.; Marsh, I.	Wine and economic development: Technological and corporate change in the Australian wine industry	Int. J. of Technology & Globalisation	2007	Australia	descriptive study		qualitative	n.d.