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Wine law, sustainable innovation and the emergence of a wine constitution

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Abstract

Innovation is essential for addressing the current challenges of the wine sector and ensuring its sustainable future. Law plays a pivotal role in fostering and disseminating innovation. At the same time, innovations can present legislators with significant challenges and cause legal disruption. This paper evaluates the innovativeness of European Wine Law in light of the ongoing sustainability transformation. The focus of EU regulations is wine quality and authenticity, mainly through the protection of Geographical Indications (GIs). In Regulation (EU) 2021/2117, the EU legislator recently introduced new rules on fungus-resistant grape varieties, de-alcoholised products, and digital labelling. We describe the effects of these rules on the respective innovation systems and assess how, vice versa, these innovations exert disruptive pressure on wine law. While the legal framework shows remarkable flexibility, a reconfiguration seems necessary at the level of GIs. The sustainability transformation implies an openness to innovation even for traditional producers. Regulatory Sandboxes in GI product specifications could allow for more experimentation without compromising heritage. A wine constitution could guide the transformation towards a more resilient and sustainable wine system.

Keywords: wine regulation, innovation systems, fungus-resistant grape varieties, de-alcoholised wines, digital labelling

1. Introduction

«Se vogliamo che tutto rimanga com'è, bisogna che tutto cambi» (Everything must change, so that everything stays the same) - Giuseppe Tomasi di Lampedusa, Il Gattopardo, 1958

Innovating is essential for the sustainability of the European Wine Sector. New technologies and practices can help with current challenges of climate change, disease pressure and shifting demand. They are also critical to minimize the environmental and health impact of wine production and consumption in the context of the ongoing transformation of food systems [1]. European Wine Law is an essential factor for turning terroir into economic value. It is also critical for the development and diffusion of innovation, especially in "mission-oriented" innovation systems characterized by strong directionality and high urgency [2], [3]. At the same time, innovation can present legislators with significant challenges and might even require a "reinvention" of the existing legal framework [4]. In

this contribution, we seek to assess the effect of European Wine law on innovation system development as well as its adaptive capacity in light of the sector's current challenges.

The European Union is the most significant wine-producing region in the world. It is also the most regulated wine market [5]. EU wine law, i.e., the current Common Market Organization (CMO) Regulation (EU) 1308/2013 and its various delegated and implementing acts, mainly focus on wine quality and fraud prevention, especially with regard to Geographical Indications (GIs) [6]. GIs are seen as central to creating economic value and distributing it fairly by enabling the build-up of collective reputation [7]. GIs may benefit public interests such as rural development or environmental sustainability, although such a contribution is not automatic [8], [9], [10]. The EU promotes the GI system worldwide through bilateral and multilateral agreements [11]. Through its case law, the European Court of Justice has accorded GIs a very high level of protection [12].

EU regulations also cover aspects such as mandatory schemes of authorizations for vine plantings, national vineyard registers, accompanying documents and certification for all wine transport and grape must in the EU, inward and outward registers, compulsory stock, and harvest declarations (cf. Reg. (EU) 2018/273), as well as an EU-wide isotopic database for authenticity control (cf. Implementing Reg. (EU) 2021/1007). The Delegated Regulation (EU) 2019/934 specifies ingredients, additives, enrichment, and specific oenological practices. All of these regulations into a complex international legal architecture. The CMO aligns with the International Organisation of Vine and Wine (OIV) standards. Concrete rules on names, controls, etc., are set out in national or sub-national laws.

In addition, the production of grapes and wine is also subject to general agriculture and food regulations. This includes sectoral interventions in the framework of national strategic plans of the new Common Agricultural Policy (CAP), which strongly focuses on innovation and sustainability. The CAP Strategic Plan Regulation (EU) 2021/2115 contains various related general (Art. 5 lit a and b) and specific objectives (Art 6 (1) lit b, d, e, f, i), as well as the cross-cutting objective of « *fostering and sharing of knowledge, innovation and digitalisation in agriculture* ». For the wine sector, Art. 57 and 58 offer a selection of specific objectives and related interventions, including, for example, varietal conversions related to climate change (lit. a i) or tangible and intangible investments in innovation of various kinds (lit. e).

2. Assessing the innovativeness of European Wine Law

Innovation, according to Schumpeter's classic definition, can be described as a new *combination* of resources or institutions [13]. In that sense, many processes are ongoing in the wine sector ranging

from viticulture (e.g. breeding, pest control, precision viticulture) and oenology (e.g. sulphur alternatives, new yeast strains, CO_2-recuperation) to marketing (e.g. blockchain, digital marketing) and wine tourism. These innovations simultaneously affect and are affected by the regulatory system.

In recent years, innovation research and policy increasingly look at how innovation contributes to solving environmental and societal challenges [2]. The goal is to achieve "better" innovation [14]. The innovativeness of wine law, therefore, must be considered in light of the transformation towards sustainable food systems, as proclaimed by political and scientific actors in high-level fora and strategic documents, such as the 2021 UN Food Systems Summit and the EU's Farm-to-Fork-Strategy. The food system approach calls for a holistic consideration of environmental and social aspects, including effects on climate, biodiversity, public health, and working conditions; it also implies a meaningful involvement of all stakeholders [1].

Starting from Schumpeter [13], evolutionary economics has described the complexity and non-linearity of innovation processes, characterized by a co-evolution of knowledge, organizational structures and institutions. To analyse the impact of regulation on this process, one must adopt a systemic perspective that captures both direct and indirect influences.

An intuitive and pragmatic heuristic tool of analysis is provided by the Technological Innovation Systems (TIS)-framework [15]. The TIS-framework is connected to other analytic frameworks on sustainability transformations, such as the Multi-Level Perspective or Strategic Niche Management [16] and has been applied in a range of sectors, including innovations related to food systems. At its core, the TIS-framework proposes a systematic analysis of the "functional dynamics" of an innovation system, i.e., seven processes that are seen as essential for the system's performance: Knowledge Development and Diffusion, Guidance of Search, Entrepreneurial Experimentation, Market Formation, Resource Mobilization, Legitimation and Development of Positive Externalities. In this contribution, we employ the TIS-framework to analyse the effects of the European wine law on the functionality of the innovation system.

In the following, we employ the TIS-framework to assess the impact of European Wine Law on three innovations that have been subject to recent legislative intervention in Regulation (EU) 2021/2117 [17]: Fungus-resistant grape varieties; (partially) de-alcoholised wines; and digital labelling. These innovations cover the diverse areas of viticulture, oenology and marketing and exemplify various dimensions of the food system transformation.

2.1 Fungus Resistant Grape Varieties

Fungal diseases are responsible for high economic losses as well as costs and environmental

implications of disease control [18]. The advancement of climate change may increase the relevance of fungal diseases even further. Although reduced precipitation can reduce disease pressure in some regions, increasing temperatures at the beginning of the year counteract the expected benefits of declining rainfall, creating a more welcoming environment for diseases to spread [19].

Fungus Resistant Grape Varieties (FGRV) result from interspecific crossbreeding between Mediterranean, American and Asian species, with the latter being more resistant to fungal diseases [20]. The first-generation FGRV stemming from efforts in the late 19th and early 20th century resulted from direct crossbreeding. They were usually deemed inferior due to unwanted organoleptic qualities [21]. In the following decades, successful reverse crossbreeding led to tolerant varieties, such as Regent, carrying a significant part of Vitis Vinifera genetics. Numerous fungus-resistant varieties have been admitted into the official European varieties catalogue [22], containing up to 99% *Vitis Vinifera* genome [23]. FGRV could help achieve a more sustainable and resilient wine industry [24], [25]. Wine is one of the most plant-protection-intensive products, especially regarding fungicides [26]. Pesticide reduction is a key objective of the Farm-to-Fork Strategy. Literature suggests that many consumers increasingly ask for sustainable products [27], [28]. At the same time, FGRV, are yet to be showcased widely to consumers [21] who might therefore have reservations about wines made from FGRV, that need to be alleviated through better education on the topic [20], [29].

Whilst using FGRV for wine production was already legal, their use for GIs has only been allowed by Regulation (EU) 2021/2117. This regulation explicitly acknowledges the potential sustainability benefits of crossbred *Vitis vinifera* species as they are better suited to climatic changes and more disease resistant (see recital 28 of Reg.). It amends Art. 93 of the Common Market Organization by broadening the term "designation of origin" and "geographical indication" to include crossbred *Vitis* varieties. The regulation, however, does not automatically allow producers to use GIs for wines made from FGRV. It must be specifically allowed in the respective GI product specification drafted by each producer organisation (i.e. *consorzio*, *interprofession*, *Schutzgemeinschaft*, etc.).

Allowing GIs for FGRV wines can positively affect the functionality of the innovation system. Most importantly, it can contribute to legitimate FGRV in the eyes of all stakeholders, laying the ground for market formation. National regulators can provide additional support, for example, by mobilizing specific resources or strengthening knowledge diffusion. However, all these effects require, that producer groups actually open the rules of their GI. In practice, some producer groups are still hesitant to allow (significant amounts of) FGRV or exclude them from the highest traditional quality terms, although FGRV do not necessarily alter the product identity [30]. Table 1 summarizes the effects on the innovation system for FGRV:

Table 1: Impact of wine regulations on the innovation system for FGRV

Function	Regulatory Impact
Knowledge Diffusion (KD)	Some transparency on FGRV use through the official eAmbrosia database of GI specifications (however, it is not very user-friendly!). Some national projects to increase transparency on FGRV use (cf. the French Observatoire national du déploiement des cépages resistants).
Guidance of Search (GS)	Strong "external" guidance through increased restrictions on pesticide use. Some guidance towards FGRV through national legislation.
Entrepreneurial Experimentation (EE)	The possibility of experimenting within GIs depends on individual product specifications. New marketing efforts specifically focusing on FGRV.
Market Formation (MF)	Integration in some famous GIs increases the market relevance of FGRV. Significant improvement of the market for breeders (FGRV are currently out of stock at many breeders).
Resource Mobilization (RM)	More resources through integration into cuvées and sparkling wines. Access to specific subsidies.
Legitimation (LEG)	Lighthouse GIs (e.g. Champagne) increase legitimation with producers and consumers. Alignment with green values and the sustainability transformation of food systems. Corresponds to increasing desire for variety in the wine sector.
Development of Positive Externalities (PE)	Better environmental performance. Opening up the GI system to such innovations.

2.2 De-alcoholised Wines

De-alcoholisation methods have existed for more than 100 years [31]. The demand for (partially) de-alcoholised wines has recently increased [32]. The new interest in the market has several reasons, e.g., religion or health [31]. Several techniques exist to reduce/remove the alcohol from wine. As de-alcoholisation is a rather complex and technology-intensive process, some new business models are evolving (e.g. groups of small producers creating joint de-alcoholised products).

Reg. (EU) 2021/2117, for the first time, contains rules for de-alcoholised wine products at the EU level. Recital 40 explicitly acknowledges the increasing consumer demand for innovative grapevine products with lower actual alcoholic strength than the minimum alcoholic strength set out for grapevine products in the CMO. To fulfil the requirements of the regulation, as a first step, an unfortified winegrowing product as defined by the CMO (e.g., wine or sparkling wine) must be produced, which is then de-alcoholised. Annex VIII, Part I, Sec. E of the CMO allows partial vacuum evaporation, membrane techniques and distillation to reduce part or almost all of the ethanol content in grapevine products. The de-alcoholisation processes used shall not result in organoleptic defects of the grapevine product. Also, eliminating ethanol in grapevine products shall not be done in conjunction with enrichment. Unlike alcohol-reduced beer, (partially) de-alcoholised wine cannot be produced by prematurely stopping alcoholic fermentation or using yeast strains that synthesize less

alcohol. The use of GIs is only authorized for partially de-alcoholised wines and only if the product specification contains a description of the specific oenological practices to be used for de-alcoholisation.

From an innovation systems perspective, the new regulation has mixed effects. Whilst it may contribute to *legitimizing* de-alcoholised wines in member states, where they did not exist before, the various restrictions limit further technological innovation, market formation and resource mobilization. The incomplete permission to use GIs will probably drive producers away from the GI system, instead of incentivising highly visible frontrunners to explore opportunities in this market (for example de-alcoholised champagne). In some countries, e.g., Germany, the new regulation even presents new restrictions compared to the previous status quo, which had tolerated de-alcoholised wines as long as the general Food Information Regulation (EU) No 1169/2011 requirements were fulfilled.

Table 2: Impact of wine regulation on the innovation system for de-alcoholised wines

Function	Regulatory Impact
Knowledge Diffusion (KD)	Transparency through eAmbrosia (see above).
Guidance of Search (GS)	Some "external" guidance towards de-alcoholized products through stricter alcohol regulations [e.g., warning signs in Ireland].
Entrepreneurial Experimentation (EE)	Technological restrictions (only technology-intensive processes are allowed, and no chaptalization is allowed for de-alcoholized wines, creating problems for producers who usually apply this technique). GIs are only available for partially dealcoholized products and only if expressly permitted.
Market Formation (MF)	Better access to younger customers, who drink less alcohol, and new customers, e.g., Middle East (but without GI!). GI restriction prevents development of a premium market for dealcoholized products.
Resource Mobilization (RM)	Potentially better access to subsidies. Permitted de-alcoholization techniques are relatively expensive and know-how intensive. Not feasible for most producers.
Legitimation (LEG)	Explicit legal framing and integration into GIs can raise legitimation of dealcoholized wines with producers and consumers. In line with ongoing political ambition to "turn down the alcohol flow" (WHO). Sustainability issues (energy-intensive).
Development of Positive Externalities (PE)	De-alcoholization strongly linked with broader food innovation, e.g., aroma recuperation [46]. Opening up the GI system to innovation and replacement products (replacement products are becoming more relevant in other areas too, e.g., vegan); however, restrictions remain, e.g., for fully de-alcoholized products.

2.3 Digital Labelling

Digital labelling refers to the use of digital technologies (e.g. QR codes) to display food labels on user devices [33]. Digital labelling may bring several improvements compared to conventional labelling practices. It allows for the display of precise information in several languages. Information can be easily modified so that products do not have to be destroyed when mislabelled. Combining physical and digital information might also allow for a more immersive and informed consumer experience that integrates ongoing initiatives in digitalising wine marketing and wine trade, although certain questions remain [33]. An example of digital labels is the "U-Label" proposed by the European wine industry's main representative body, the Comité Européen des Entreprises Vins (CEEV), which provides a technological platform for establishing digital labels in the wine and spirits sector.

Until 2023, an ingredient list and a nutrition declaration were not mandatory for wine under EU food law (Art. 16 IV of the Food Information Regulation (EU) No 1169/2011). However, from December 2023, because of the changes in the CMO under Regulation (EU) 2021/2117, wine labels must include a nutrition declaration and a list of ingredients (see Rec. 80). Details are spelled out in Commission Delegated Regulation (EU) 2023/1606, in particular the use of the terms "grapes" and "concentrated grape must" in the ingredient list. At the same time, Art. 119 II of the reformed CMO Regulation now offers wine producers the unique opportunity to limit the nutrition declaration and omit the list of ingredients on the label if this information is available electronically. Restrictions apply, however, most notably that only mandatory particulars may be linked through the QR code. In November 2023, the European Commission issued Commission notice C/2023/1190 to clarify implementation details, some of which are still subject to debate. For example, the CEEV has criticized the Commission's position on how to inform about the content of the QR-Code on the label [34].

The reformed wine law provides the first use case for digital labels in all of EU food law. It sets a strong incentive for producers to use digital labels, but also legitimizes them amongst consumers, who – for the first time – receive information on nutrition values and ingredients of wine. Positive effects on the functionality of the innovation system would be even greater, if the use of digital labels was permitted beyond mandatory information, for example to back up sustainability claims.

Table 3: Impact of wine regulation on the innovation system for digital labelling

Function	Regulatory Impact
Knowledge Diffusion (KD)	Already established for prepacked food (cf. Regulation (EU) No 1169/2011). It could allow for tracking and statistics.
Guidance of Search (GS)	The regulation strongly incentivises the use of digital labels for nutrition and content.
Entrepreneurial Experimentation (EE)	Only mandatory information may be shown.
Market Formation (MF)	Only minor changes to existing labelling. Easy to update and display different languages possible. Uncertainty remains regarding the exact content labelling requirements.
Resource Mobilization (RM)	Some costs for a subscription to a digital label provider (like U-Label). Easier to use a digital label than putting all information on the bottle to keep the label simple and not change much on the bottle label.
Legitimation (LEG)	Potentially high legitimation with producers (compared to alternatives). Provides few obstacles and some benefits. Potentially high legitimation with consumers. Those interested in the information can access it quickly, and those uninterested need not check for it. Transparency is in line with the general values of the food system. However, the digital label is mainly perceived as a tool for obfuscation rather than transparency.
Development of Positive Externalities (PE)	Potential to align with requirements regarding sustainability information and the green claims regulation.

3. Dynamic Perspective: Adaptation and Legal Disruption

Our analysis shows that the dense framework of EU wine law poses several obstacles to innovation, especially with regard to the "entrepreneurial experimentation" and "market formation" functions. At the same time, we also find positive impacts on innovation system performance, particularly for the "legitimation" function: regulatory endorsement of innovations like FGRV or de-alcoholised wine on all levels from OIV to GIs can contribute to consumer and producer acceptance. This, in turn, positively affects "market formation" and "resource mobilization." The "guidance of search" function, which could in principle be a key channel for regulatory impact, seems relatively unaffected by wine law *stricto sensu*.

In a dynamic perspective, wine regulation shows a relatively high adaptiveness to change, as witnessed by frequent legislative changes and quick reactions to new developments. EU and national wine regulations already contain several experimental clauses, e.g., oenological practices. The adaptive capacity of wine regulation is particularly noticeable compared to other agri-food regulations, such as the novel food or organic regulations or the CMO's marketing standards (cf. the ECJ decision C-422/16 TofuTown that forbids the use of any milk-related terms for vegan alternatives). By contrast, wine law actively facilitates products that could be considered more

sustainable (FGRV) or "healthy" (de-alcoholised wine).

A key factor for this adaptiveness probably lies in the wine sector's integrated yet inclusive governance architecture. GIs provide for bottom-up decision-making and play an essential role in producer organizations, extending to various intermediate organizations [35]. At the international level, the OIV achieves a high level of representation of actors from the private sector, science and even civil society. Most stakeholders appear to be interested in creating a system that works for the benefit of both producers and consumers. Some existential cleavages (e.g., between large and small producers or producer and consumer countries) are less pronounced than in many commodity sectors (e.g., the polarized International Cocoa Organization ICCO). The mandate of the OIV explicitly includes promoting scientific and technical research, making it a functional part of a global Knowledge and Innovation System.

Despite this adaptiveness, we see some potential for legal disruption in the medium term, especially with regard to the GI system. The innovations discussed in this contribution may currently not be very significant on the market. However, they relate to key aspects of the food system transformation that will become increasingly relevant in the future. The restrictions for using GIs for FGRV or de-alcoholised products already lead to evasion strategies by market actors. For example, the German association "*Zukunftsweine*" focusses its marketing exclusively on using FGRV regardless of the geographical origin. Similarly, many producers of de-alcoholised wines do not follow the origin-related quality pyramid envisioned by EU regulation. Especially for sparkling wines, as the most critical market segment of de-alcoholised products, brands provide a way to circumvent GI restrictions.

This evasion weakens the power of GIs for consumer orientation and, hence, the effectiveness and relevance of wine law altogether. The erosive effect will become increasingly pronounced as innovative producers specifically target the next generation of wine consumers. Building a regulatory cage may also cause some of the most innovative producers to leave the GI system. Parallels might be drawn to the so-called Super-Tuscans of the 1980s [36] or the disenchantment of some of the most progressive actors with the organic framework [37].

The case of FGRV wines also points to the legally disruptive effect of climate change [38]. Climate change will drastically affect most of the current wine production areas. Some of the most famous areas will have to adapt their wine profiles completely [39], [40]. New breeding techniques could potentially help with climate adaptation and sustainability, by introducing targeted genomic changes [41] while preserving the typicity of popular varieties [42]. However, the availability of such products is still unclear [14]. Consumer acceptance would also not be automatic, and would probably require an active promotion policy e.g. through educational campaigns [43].

4. Conclusions: Regulatory Sandboxes and a Wine Constitution

Through its bottom-up and multi-stakeholder elements, the governance of the wine system already corresponds to important demands regarding a food system transformation. This has allowed the wine system to respond relatively quickly to sustainability issues (e.g., the OIV principles for sustainable viticulture OIV-CST 518-2016, its implementation guidelines as well as many other recent OIV resolutions). The inclusive governance structures and some of the recent regulations might even be considered a model for other sectors.

The dense regulation, however, also creates significant barriers to individual innovations and the sustainability transformation at large. This is especially true for the rigid rules of many GIs which petrify a certain status quo in the interest of some producers.

An enabling framework for (sustainable) innovation at a local scale can be seen as an essential element of future-proof GIs. This implies a reconfiguration of GIs and the underlying idea of tradition and heritage. To design future-proof GIs, actors must ensure openness to new developments and consider all conditions for a healthy wine sector at a concrete location (e.g., changing climatic conditions and disease pressures). Such an approach would probably be more aligned with the conditions under which some of the most valuable GIs developed, namely by constantly improving technology and marketing [45]. Petrifying specific production patterns works for the short-term interests of certain actors but not necessarily for the long-term interests of all affected stakeholders.

In many areas, from finance to health and AI, experimental regulation in the form of "regulatory sandboxes" has become a key policy instrument. Sandboxes are an integral part of the EU's Better Regulation Toolbox. The European Council (13026/20) defines them as "*concrete frameworks which, by providing a structured context for experimentation, enable where appropriate in a real-world environment the testing of innovative technologies, products, services or approaches […] for a limited time and in a limited part of a sector or area under regulatory supervision ensuring that appropriate safeguards are in place.*" In our opinion, such they could also be created at the level of individual GI product specifications. Product specifications could also set clear sustainability targets to ensure that new approaches actually imply broader benefits. The new GI regulation (EU) 2024/1143 sets a general frame for such an approach but requires active efforts at the level of each producer group.

Of course, innovation will not accomplish the transformation by itself: resistant varieties may reduce some of the ecological footprint of wine production. However, their resistance may not be permanent. They are not available for all diseases and not relevant for some wine-producing regions. De-alcoholised wines theoretically represent a "healthy" alternative but will foreseeably remain a niche

product and do not address the root causes of problematic alcohol consumption. The de-alcoholisation procedures prescribed by EU law also imply an even bigger ecological footprint than alcoholic wines [46]. Digital labels increase transparency regarding contents, nutritional values and potential sustainability claims. However, they will hardly have a tangible impact on public health and are generally perceived as a tool to maintain secrecy rather than to enable consumers to make healthy and sustainable choices.

Overall, the transformation of the wine system requires a more explicit orientation towards fundamental values in the form of a *wine constitution*. This constitution need not be conceived as a new legal document. All the relevant principles are already prescribed by European primary law, national constitutions and public international law. National and European courts increasingly carve out the constitutional implications of sustainability in all its three dimensions and set clear obligations for states to address climate change. Wine regulators on all levels must recognize this constitutional dimension even when dealing with "technical" questions. This also implies a more consistent approach to overproduction, which lies at the heart of most of the current economic challenges of the European wine sector as well as its negative environmental and health impacts.

References:

[1] J. Von Braun, K. Afsana, L. O. Fresco, and M. H. A. Hassan, *Science and Innovations for Food Systems Transformation*. Springer Cham, 2023. doi: 10.1007/978-3-031-15703-5_1.

[2] M. P. Hekkert, M. J. Janssen, J. H. Wesseling, and S. O. Negro, 'Mission-oriented innovation systems', *Environ Innov Soc Transit*, vol. 34, pp. 76–79, Mar. 2020, doi: 10.1016/j.eist.2019.11.011.

[3] G. Cecere, S. Mancinelli, and M. Mazzanti, 'Waste Prevention and Social Preferences: The Role of Intrinsic and Extrinsic Motivations', *SSRN Journal*, 2013, doi: 10.2139/ssrn.2273477.

[4] N. Cortez, 'Regulating Disruptive Innovation', *SSRN Journal*, 2014, doi: 10.2139/ssrn.2436065.

[5] G. Meloni, K. Anderson, K. Deconinck, and J. Swinnen, 'Wine Regulations', *AEPP*, vol. 41, no. 4, pp. 620–649, Dec. 2019, doi: 10.1093/aepp/ppz025.

[6] J. M. Alston and D. Gaeta, 'Reflections on the Political Economy of European Wine Appellations', *Ital Econ J*, vol. 7, no. 2, pp. 219–258, Jul. 2021, doi: 10.1007/s40797-021-00145-4.

[7] S. Castriota and M. Delmastro, 'The Economics of Collective Reputation: Evidence from the Wine Industry', *Am J Agric Econ*, vol. 97, no. 2, pp. 469–489, Mar. 2015, doi: 10.1093/ajae/aau107.

[8] T. Reinhardt and Y. Ambrogio, 'Geographical Indications and Sustainable Viticulture: Empirical and Theoretical Perspectives', *Sustainability*, vol. 15, no. 23, Art. no. 23, Jan. 2023, doi: 10.3390/su152316318.

[9] S. Ponte, 'Bursting the bubble? The hidden costs and visible conflicts behind the Prosecco wine "miracle"', *Journal of Rural Studies*, vol. 86, pp. 542–553, Aug. 2021, doi: 10.1016/j.jrurstud.2021.07.002.

[10] G. Belletti, A. Marescotti, J. Sanz-Cañada, and H. Vakoufaris, 'Linking protection of geographical indications to the environment: Evidence from the European Union olive-oil sector', *Land Use Policy*, vol. 48, pp. 94–106, Nov. 2015, doi: 10.1016/j.landusepol.2015.05.003.

[11] M. Huysmans, 'Exporting protection: EU trade agreements, geographical indications, and gastronationalism', *Rev Int Polit Econ*, vol. 29, no. 3, pp. 979–1005, May 2022, doi: 10.1080/09692290.2020.1844272.

[12] A. Detry, 'GI Protection against Evocation in the EU - Assessment of the CJEU's Interpretation and Comparison with Reputed European Trademark Protection', *SSRN Journal*, 2022, doi: 10.2139/ssrn.4266440.

[13] J. A. Schumpeter, *The theory of economic development; an inquiry into profits, capital, credit, interest, and the business cycle*. Cambridge, Mass.: Harvard University Press, 1934.

[14] S. Pfotenhauer, 'From "More Innovation" to "Better Innovation"?', *Engaging Science, Technology, and Society*, vol. 9, Dec. 2023, doi: 10.17351/ests2023.1365.

[15] A. Bergek, M. Hekkert, and S. Jacobsson, 'Functions in innovation systems: A framework for analysing energy system dynamics and identifying goals for system-building activities by entrepreneurs and policymakers', in *Innovation for a Low Carbon Economy-Economic, Institutional and Management Approaches*.

[16] J. Köhler *et al.*, 'An agenda for sustainability transitions research: State of the art and future directions', *Environ Innov Soc Transit*, vol. 31, pp. 1–32, Jun. 2019, doi: 10.1016/j.eist.2019.01.004.

[17] E. Pomarici, R. Sardone (2022). Is a new EU wine policy coming? The unexpected role of regu- latory measures. Wine Economics and Policy 11(2): 75-82. doi: 10.36253/wep - 13189'.

[18] J. Casanova-Gascón *et al.*, 'Behavior of Vine Varieties Resistant to Fungal Diseases in the Somontano Region', *Agronomy*, vol. 9, no. 11, p. 738, Nov. 2019, doi: 10.3390/agronomy9110738.

[19] M. Rienth *et al.*, 'Modifications of Grapevine Berry Composition Induced by Main Viral and Fungal Pathogens in a Climate Change Scenario', *Front Plant Sci*, vol. 12, 2021, doi: https://doi.org/10.3389/fpls.2021.717223.

[20] K. Pedneault and C. Provost, 'Fungus resistant grape varieties as a suitable alternative for organic wine production: Benefits, limits, and challenges', *Sci Hortic*, vol. 208, pp. 57–77, Aug. 2016, doi: 10.1016/j.scienta.2016.03.016.

[21] M. Borrello, L. Cembalo, and R. Vecchio, 'Consumers' acceptance of fungus resistant grapes: Future scenarios in sustainable winemaking', *J Clean Prod*, vol. 307, p. 127318, Jul. 2021, doi: 10.1016/j.jclepro.2021.127318.

[22] B. V. Sivčev, I. L. Sivčev, and Z. Z. Ranković-Vasić, 'Natural process and use of natural matters in organic viticulture', *J Agric Sci (Belgrade)*, vol. 55, no. 2, pp. 195–215, 2010, doi: 10.2298/JAS1002195S.

[23] R. Vecchio, E. Pomarici, E. Giampietri, and M. Borrello, 'Consumer acceptance of fungus-resistant grape wines: Evidence from Italy, the UK, and the USA', *PLOS ONE*, vol. 17, no. 4, p. e0267198, Apr. 2022, doi: 10.1371/journal.pone.0267198.

[24] S. Sillani, F. Marangon, G. Gallenti, S. Troiano, F. Nassivera, and M. Carzedda, 'Designation and Certification Strategies for Fungus-Resistant Grape Wines: An Exploratory Study in Italy', *Sustainability*, vol. 14, no. 22, Art. no. 22, Jan. 2022, doi: 10.3390/su142214871.

[25] C. Kiefer and G. Szolnoki, 'Consumer Acceptance of Fungus-Resistant Grape Varieties—An Exploratory Study Using Sensory Evaluation Tests among Consumers in Germany', *Sustainability*, vol. 15, no. 13, Art. no. 13, Jan. 2023, doi: 10.3390/su151310664.

[26] F. Mailly, L. Hossard, J.-M. Barbier, M. Thiollet-Scholtus, and C. Gary, 'Quantifying the impact of crop protection practices on pesticide use in wine-growing systems', *Eur J Agron*, vol. 84, pp. 23–34, Mar. 2017, doi: 10.1016/j.eja.2016.12.005.

[27] I. Schäufele and U. Hamm, 'Consumers' perceptions, preferences and willingness-to-pay for wine with sustainability characteristics: A review', *J Clean Prod*, vol. 147, pp. 379–394, Mar. 2017, doi: 10.1016/j.jclepro.2017.01.118.

[28] J. Brunin *et al.*, 'Do individual sustainable food purchase motives translate into an individual shift towards a more sustainable diet? A longitudinal analysis in the NutriNet-Santé cohort', *Clean Responsible Consum*, vol. 5, p. 100062, Jun. 2022, doi: 10.1016/j.clrc.2022.100062.

[29] L. Nesselhauf, R. Fleuchaus, and L. Theuvsen, 'What about the environment?A choice-based conjoint study about wine from fungus-resistant grape varieties', *Intcelo J Wine Bus Res*, vol. 32, no. 1, pp. 96–121, Jan. 2019, doi: 10.1108/IJWBR-09-2018-0049.

[30] E. Celotti, R. Valent, and E. Bellantuono, 'Varietà resistenti e tocai friulano-Incontro (possibile) fra tradizione e innovazione', *IL CORRIERE VINICOLO N. 33 VITE 19 Ottobre 2020*. Accessed: May 19, 2023. [Online]. Available: https://air.uniud.it/handle/11390/1195835?mode=full

[31] L. Liguori, D. Albanese, A. Crescitelli, M. Di Matteo, and P. Russo, 'Impact of dealcoholization on quality properties in white wine at various alcohol content levels', *J Food Sci Technol*, vol. 56, no. 8, pp. 3707–3720, Aug. 2019, doi: 10.1007/s13197-019-03839-x.

[32] Y. G. Akyereko, F. D. Wireko-Manu, F. Alemawor, and M. Adzanyo, 'Effects of Production Methods on Flavour Characteristics of Nonalcoholic Wine', *J Food Qual*, vol. 2021, pp. 1–10, Dec. 2021, doi: 10.1155/2021/3014793.

[33] K. L. Fuchs, J. Lian, L. Michels, S. Mayer, E. Toniato, and V. Tiefenbeck, 'Effects of Digital Food Labels on Healthy Food Choices in Online Grocery Shopping', *Nutrients*, vol. 14, no. 10, p. 2044, May 2022, doi: 10.3390/nu14102044.

[34] I. Sánchez Recarte, '20231019 CEEV Letter to J. Wojciechowski - Wine labelling and QR-codes', Oct. 19, 2023.

[35] K. Schober, R. Balling, T. Chilla, and H. Lindermayer, 'European Integration Processes in the EU GI System—A Long-Term Review of EU Regulation for GIs', *Sustainability*, vol. 15, no. 3, p. 2666, Feb. 2023, doi: 10.3390/su15032666.

[36] P. Corsinovi and D. Gaeta, 'Managing the Quality Wines beyond Policies and Business Strategies', *RCBR*, vol. 4, no. 1, 2015, doi: 10.15640/rcbr.v4n1a3.

[37] D. Mehta, 'EU proposal on CRISPR-edited crops is welcome — but not enough', *Nature*, vol. 619, no. 7970, pp. 437–437, Jul. 2023, doi: 10.1038/d41586-023-02328-8.

[38] E. Fisher, E. Scotford, and E. Barritt, 'The Legally Disruptive Nature of Climate Change: Climate Change and Legal Disruption', *MLR*, vol. 80, no. 2, pp. 173–201, Mar. 2017, doi: 10.1111/1468-2230.12251.

[39] L. F. Clark and W. A. Kerr, 'Climate change and terroir: The challenge of adapting

geographical indications', *J World Intellect Prop*, vol. 20, no. 3–4, pp. 88–102, 2017, doi: 10.1111/jwip.12078.

[40] M. F. Cardell, A. Amengual, and R. Romero, 'Future effects of climate change on the suitability of wine grape production across Europe', *Reg Environ Change*, vol. 19, no. 8, pp. 2299–2310, Dec. 2019, doi: 10.1007/s10113-019-01502-x.

[41] R. Töpfer and O. Trapp, 'A cool climate perspective on grapevine breeding: climate change and sustainability are driving forces for changing varieties in a traditional market', *Theor Appl Genet*, vol. 135, no. 11, pp. 3947–3960, Nov. 2022, doi: 10.1007/s00122-022-04077-0.

[42] E. Duchêne, 'How can grapevine genetics contribute to the adaptation to climate change ?', *OENO One*, vol. 50, no. 3, pp. 113–124, 2016, doi: 10.20870/oeno-one.2016.50.3.98.

[43] S. Romeo Lironcurti, F. Demaria, R. D'Annolfo, and R. Sardone, 'Consumer Evaluations of and Attitudes towards New Genome Editing Techniques: An Italian Case Study', *Agriculture*, vol. 14, no. 1, Art. no. 1, Jan. 2024, doi: 10.3390/agriculture14010051.

[44] E. Vandecandelaere *et al.*, 'The Geographical Indication Pathway to Sustainability: A Framework to Assess and Monitor the Contributions of Geographical Indications to Sustainability through a Participatory Process', *Sustainability*, vol. 13, no. 14, Art. no. 14, Jan. 2021, doi: 10.3390/su13147535.

[45] J. Simpson, 'Cooperation and Conflicts: Institutional Innovation in France's Wine Markets, 1870–1911', *Bus Hist Rev*, vol. 79, no. 3, pp. 527–558, Oct. 2005, doi: 10.1017/S0007680500081435.

[46] F. N. Schulz, 'Strukturanalyse des deutschen Marktes für entalkoholisierte Weine – Kleine Nische mit großer Zukunft?', *Berichte über Landwirtschaft - Zeitschrift für Agrarpolitik und Landwirtschaft*, Nov. 2023, doi: 10.12767/buel.v101i3.482.