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Sustainability in Fruit Wine Processing-Economic Benefits and Consumer Attitudes

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Abstract

This paper discusses the economics of sustainability and consumer opinion associated with fruit wine processing. As sustainability is gaining importance in the food and beverages industry, fruit wine manufacturers face challenges along with opportunities. The study examined how an enterprise could achieve cost savings, increase brand loyalty, and gain market access through sustainable activities such as water saving, organic production, and energy-saving techniques. Consumer attitudes have a significant role to play in successful sustainability practices. This study delves into psychological factors that limit and encourage sustainable wine consumption: environmental issues and health concerns. It investigates the role of sustainability certifications in influencing consumer confidence and purchasing decisions. Notwithstanding stated problems, this research finds successful strategies in sustainable marketing in utilizing consumer psychology for market share gains and premium price justification despite some identified obstacles: early capital expenditure commitments and mistrust with consumers' part. Looking ahead, technical breakthroughs and increasing consumer preferences will continue driving development in the sustainable fruit wine market. Producers that attain effective integration of sustainability with profitability and preserve consumer trust are likely to thrive in the developing fruit wine industry.

Keywords: Sustainable fruit wine production; Economic benefits; Consumer attitudes; Environmental conservation; Organic farming; Consumer psychology

Introduction

The concept of sustainability has gained paramount importance in the food and beverage business, especially within specialized areas such as fruit wine manufacturing. Sustainability in fruit wine processing includes techniques that reduce the impact on the environment while promoting economic viability and social responsibility along the production chain (Vecchio, 2013). In the context of growing global fears about climate change, resource depletion, and good consumption, the fruit wine industry meets a moment of crossroads, reconciling traditional techniques with modern, sustainable practices. It is not only a reaction to the regulatory demands but an active approach toward the long-term survival of the industry and adjusting to shifting consumer attitudes (Pomarici et al., 2015). Sustainable practices in fruit wine are of high importance. In contrast to traditional grape wine, fruit wine often uses a range of fruits available from sources local to the winery, presenting somewhat different possibilities and challenges for sustainable production (Amato et al., 2017). This moves beyond the vineyard or orchard as these considerations include energy-efficient processing methods, waste minimisation strategies, and environmentally friendly packaging options. The fruit wine industry's strategy for sustainability is comprehensive, focussing on water conservation, soil health management, biodiversity preservation, and minimising chemical inputs (Gilinsky et al., 2016). The implementation of sustainable techniques in fruit wine processing corresponds with overarching

sustainability objectives in the food and beverage industry, facilitating diminished carbon footprints, optimised resource management, and superior product quality (Christ & Burritt, 2013). The economic benefits of sustainable fruit wine production are high and wide. Initial investment into sustainable technologies and techniques often yields long-term cost savings due to improved efficiency and reduced waste. Precision agriculture techniques in the cultivation of fruits intended for winemaking have shown promise for improving resource productivity and yield quality (Borsato et al., 2019). Sustainable practices can develop new revenue streams by valorising by-products and wastes, as with fruit pomace as a source of bioactive chemicals or renewable energy Dwyer et al., 2014).

This chapter will analyze the economic benefits that are gleaned from the application of sustainable practices when making fruit wines. It will address how such practices save the environment, while cost savings, product differentiation, and improved market positioning are sometimes realized. The research will consider several dimensions of the value chain of fruit wines- planting and harvesting, processing and packaging, and distribution, that also gives light to the outlook of sustainable innovation and efficiency enhancement perspectives (Santini et al., 2013). The chapter will focus on the role of customer attitudes in shaping further sustainability development within the sector. As customers grow more ecologically aware and want openness in production methods, their tastes and purchasing choices increasingly impact industry practices (Schäufele & Hamm, 2017). Recent studies indicate an increasing consumer readiness to pay premium pricing for sustainably produced wines, reflecting a shift in market dynamics that benefits ecologically responsible producers (Sogari et al., 2016). This consumer-driven demand towards sustainability encourages companies to get on the eco-friendly bandwagon and opens up scope for product differentiation and brand loyalty in a competitive marketplace. The complexity of the area is such that there are convergences between sustainability, economic feasibility, and consumer behavior within the fruit wine sector. This chapter analyses economic benefits and consumer attitudes to provide substantial insights into fruit wine producers, policymakers, and researchers regarding sustainability's potential as a driver of innovation and growth in the fruit wine industry. Furthermore, it will consider the barriers to adopting sustainable practices, such as initial capital expenses, technological constraints, and the need for cooperation within an industry and information sharing (Flores, 2018). Understanding economic outcomes of sustainability and how consumer preferences might shape their practices will play a crucial role in making the right strategic decisions for the fruit wine industry's future planning. Therefore, this chapter aims at providing an adequate discourse on contemporary trends and optimum practices with future outlooks for sustainable fruit wine production that may facilitate change in the direction of the more eco-friendly and economically strong future of the industry.

The Concept of Sustainability in Fruit Wine Processing

Sustainability in fruit wine processing is a complex term that encompasses environmental care, economic viability, and social responsibility. This three-pronged structure, often referred to as the "triple bottom line" or "three pillars of sustainability," provides a robust foundation for understanding and putting into action sustainable practices in the fruit wine industry (Elkington, 1998). The environment pillar serves to minimize the ecological footprint created by the manufacture of fruit wine. This encompasses greenhouse gas emission reduction, natural resources conservation, biodiversity protection, and minimization of pollution. In the fruit wine sector, it could entail approaches such as integrated pest management, soil conservation techniques, and efficient irrigation systems (Christ & Burritt, 2013). The economic component addresses the long-term financial sustainability of fruit wine businesses. This includes profitability, resistance to economic shocks, risk aversion, and responsiveness to market changes. Some of the sustainable economic practices in fruit wine production may include line diversification of a product, investing in efficient technology, and setting up robust value-oriented supply chain linkages (Gilinsky et al., 2016). The social pillar examines the effects of fruit wine production on individuals and communities. This includes equitable labor standards, community involvement, and support for local economic advancement. Fruit wine producers should employ a safe working environment, ensure fair wages, buy locally, and engage in public outreach (Pomarici et al., 2015). Water conservation is the most important factor in sustainable fruit winemaking. Since fruit growing and winemaking require much water, proper management of water is necessary. Deficit irrigation, a method where water is deliberately withheld at certain growth stages to improve fruit quality and save water, has shown promise in fruit growing for wine production purposes (Marras et al., 2016). Additionally, water recycling and treatment systems in cellars can greatly reduce total water usage (Conradie et al., 2014). Organic farming practices are increasingly being adopted for fruit cultivation for wine production. These methods reduce

synthetic pesticides and fertilizers, using natural alternatives that not only improve soil health but also biodiversity. A study undertaken by Villanueva-Rey et al. (2014) showed that organic wine production practices reduced the overall environmental impact of wine production by 8-10% compared to traditional practices. Waste management is one important aspect of sustainable fruit wine production. This industry generates significant organic waste, primarily in the form of pomace-the solid residue of fruit post-pressing. New techniques for valorising waste are emerging, such as the isolation of bioactive compounds from pomace for use in nutraceuticals or cosmetics (Dwyer et al., 2014). Recycling organic waste into compost and anaerobic digestion can contribute to closing the nutrient loop while producing renewable energy (Devesa-Rey et al., 2011). Energy efficiency in fruit wine production has increasingly become crucial for the industry to reduce its carbon footprint. This may include the use of renewable sources of energy, like solar or wind, together with improved efficiency in processing equipment. The implementation of variable speed drives for pumps and high-efficiency chillers can significantly reduce wineries' energy usage (Smyth & Russell, 2009). Environmentally sustainable packaging is also an important aspect of sustainable fruit wine manufacturing. This includes lightweight glass bottles, various alternative packaging materials such as bag-in-box or tetra pak, and recycled and recyclable materials. A life cycle study by Navarro et al. (2017) showed that use of lightweight glass bottles could reduce the carbon footprint of wine packaging by up to 30%. Sustainability in fruit wine production must be analyzed from fruit agriculture down to the distribution level.

This holistic approach ensures that sustainability practices are not undermined by unsustainable techniques at every stage of production (Santini et al., 2013). Sustainable fruit agriculture practices include integrated pest management, conservation tillage, and cover crops to improve soil health and reduce erosion. Such practices improve environmental conditions and can also improve fruit quality and quantity besides yields (Borsato et al., 2019). Sustainability factors during the wine production process include energy and water efficiency and waste management, as well as cleaning and sanitising agents that work in a friendly manner with nature. Adopting lean manufacturing may help wineries eliminate waste or otherwise improve efficiency (Dimitri & Trambusti, 2024). In the distribution channel, sustainability emphasizes appropriate route optimization of transportation, fuel-efficient vehicles, and recycling in reverse logistics for packaging materials. Some producers are exploring new distribution methods, such as bulk shipment and local bottling. This will reduce the carbon footprint associated with freight (Colman & Päster, 2009). Fruit wine producers can create a stronger and more responsible industry by having sustainability throughout the chain. This approach often saves money but also decreases environmental impact and can include higher product quality and better brand image (Flores, 2018). The concept of sustainability in fruit wine processing reflects an encompassing and evolving framework that demands perpetual innovation and adjustment. In the light of consumer awareness and heightened requirements by regulation, the use of sustainable practices throughout the fruit wine supply chain is becoming increasingly a question of economics rather than ethics.

Economic Benefits of Sustainability in Fruit Wine Production

Generally, adopting sustainable approaches in fruit wine production leads to significant cost reductions by improving the efficiency of resource use. Probably the most significant saving can be seen in the use of water. Conradie et al. (2014) found that wineries implementing water-saving measures can reduce water use by up to 30%, thereby reducing costs significantly, especially in arid regions. Initiatives aimed at improving energy efficiency also help reduce costs. According to Smyth and Russell (2009), wineries using renewable energy sources, such as solar electricity, are likely to reduce their expenditure on energy by up to 40% over a period of 25 years. The use of energy-efficient equipment, such as variable frequency drives and high-efficiency chillers, has both short-term and long-term benefits in the form of savings in energy usage (Gómez-Lorente et al., 2017). Waste recycling and valorisation also open up another possibility for cost reduction. Devesa-Rey et al. (2011) demonstrated that recycling winery waste, particularly grape pomace, may limit the costs of waste management and also provide additional income streams. Extraction of bioactive compounds from pomace for use in nutraceuticals or cosmetics can make a waste product profitable too (Dwyer et al., 2014). Sustainable practices in fruit wine production can help enhance profitability in the long term through several mechanisms. Gabzdylova et al. (2009) found that wineries that embraced sustainability have frequently benefited from increased brand loyalty and positive market positioning, which have led to premium pricing and higher sales volumes. In fact, a study conducted by Pomarici et al. (2015) indicated that 93% of the California wineries questioned believed sustainability initiatives to be beneficial to their long-term profitability. The authors of the study

highlighted better product quality, improved repute, and higher staff happiness as key factors that drive this perception. Sustainable practices can also act as a risk management strategy; Flint and Golicic (2009) noted that wineries using water management methods with a sustainable approach were more effective at dealing with drought situations, thus enabling better stability in production and profitability during climate change.

However, the growing customer demand for green products has now opened up new market opportunities for fruit wine producers. Schäufele and Hamm (2017) conducted a comprehensive analysis of customer attitudes and their willingness to pay for sustainable wines, which showed that there is a dominant trend toward increased consumer demand for more environmental-friendly wine products. Vecchio (2013) explained how sustainability certificates can serve as a differential factor in global markets, particularly in environmentally conscious regions like Northern Europe and North America. The study revealed that consumers in those regions were willing to pay a premium as high as 30% for wines carrying sustainability certificates. Santini et al. (2013) highlighted the potential of sustainability as a marketing tool in emerging wine markets, where environmental and social responsibility can become critical points of differentiation in overcrowded markets. Government subsidies for sustainable agriculture and production practices have created additional economic incentives for fruit wine producers. The EU's Common Agricultural Policy provides financial support to farmers that take up ecologically sustainable practices (European Commission, 2021). The California Sustainable Winegrowing Alliance (CSWA) in the US offers certification programs that make it easier to get market recognition and allows wineries to qualify for specific government incentives. It covers grants for water-saving and energy-saving initiatives, along with tax incentives for the utilization of renewable energy systems (CSWA, 2020). Mariani and Vastola (2015) investigated the impact of regulatory incentives on the Italian wine industry, finding that incentive schemes had played a major role in facilitating the adoption of sustainable practices by smaller producers who may find initial investment cost prohibitive.

Many case studies highlight the economic benefits of sustainability implementation in the fruit wine industry. Fetzer Vineyards in California embraced strong sustainability practices that included water conservation, use of renewable energy, and waste minimization. The measures led to a 17% saving on energy costs, a 15% reduction in water use, and achieving zero landfill waste while enhancing wine quality and strengthening brand reputation (Gilinsky et al., 2016). Yalumba, a renowned family-owned winery in Australia, pursued extensive solar arrays and water conservation technologies to achieve 30% savings in power costs and water consumption of 20%. These milestones greatly improved their bottom line and balanced their sustainability (Chen, Sloan, & Legrand, 2009). Bodegas Torres in Spain implemented comprehensive climate change adaptation and mitigation programs, focusing on sustainable vineyard management, energy efficiency, and carbon footprint reduction. The measures not only resulted in cost savings but also helped improve their competitive position, particularly in export markets sensitive to the environment (Flores, 2018). These case studies show that for fruit wine production, employing sustainable practices can be economically beneficial in terms of cost savings, effective market positioning, and sustainable financial performance.

Consumer Attitudes Toward Sustainability in Fruit Wine

Consumer awareness regarding sustainability in the wine business, encompassing fruit wines, has increased consistently over the last decade. Schäufele and Hamm (2017) performed an extensive assessment of customer attitudes and preferences regarding sustainable wines, revealing that environmental considerations are progressively impacting purchasing choices. Their research indicated that consumers with greater environmental awareness were more inclined to select sustainable wine alternatives. Education significantly influences consumer views. Pomarici and Vecchio (2014) found that spreading knowledge on sustainable production significantly increased customers' willingness to pay for sustainable wines. They suggested that clear and credible sustainability labeling could be a powerful tool to inform consumers at the point of sale. Nevertheless, Sogari et al. (2016) reported that although general awareness of sustainability issues is increasing, specific knowledge about the sustainable processes of wine production remains lacking in many customers. This highlights a need for targeted education campaigns to bridge the knowledge gap and perhaps influence consumer purchasing behavior. Awareness of the environment is a strong motivator for sustainable wine consumption. Barber et al. (2009) revealed that environment-concerned customers would spend a premium on a winery's more environmentally friendly wine. The conclusion

of the study emphasized the importance of coordinating the marketing communications with customers' ecological beliefs to market sustainable wine choices. Sellers-Rubio and Nicolau-Gonzalbez (2016) discovered that the impact of environmental concerns on wine choice varied by customer segment. There was also a portion of "green consumers" who constantly focused on environmental considerations when purchasing wine, making it an opportunity for targeted marketing programs. Consumer attitudes towards sustainable wines are considerably coloured by the perception that they offer healthier options. Castellini et al. (2014) determined that customers often associate organic and sustainably produced wines with high quality and health benefits. Their study showed that health-aware consumers preferred organic wines, considering them free of harmful chemicals and additives. However, Annunziata et al. (2019) caution that although health perceptions drive the interest in sustainable wines, consumers often have a poor understanding of the real health impacts associated with different production styles. This implies the need for greater precision and clarity in communicating the health effects of sustainable wine production.

Social factors indeed play a role in what consumers perceive regarding the sustainable wines. According to Vecchio (2013), peer views and social norms have a significant influence on the willingness of customers to pay for sustainable wines. The study highlighted the effectiveness of social media as well as peer recommendations in encouraging sustainable wine consumption. Forbes et al. (2009) explored the effects of social influence and found that consumers often use sustainable wine choices as a means of self-expression and social identification. The authors suggest that marketing strategies that focus on the social aspects of sustainable consumption may hold unique appeal for certain consumer groups. Research consistently shows that many consumers are willing to pay a premium for sustainable wines. Sogari, Mora, and Menozzi (2016) conducted a meta-analysis of willingness-to-pay studies and reported that customers were typically willing to pay 20-30% more for wines with sustainability certificates. Nonetheless, the willingness to pay varies depending on different customer groups and markets. Matters of interest for European nations were those Pomarici et al. identified as notable disparities in desire to pay for sustainable wines, showing consumers in Northern Europe are typically more willing to pay than those in Southern Europe. Schäufele and Hamm (2018) probed into the determinants of willingness to pay, which showed that there is a positive correlation with income, educational levels, and frequency of wine consumption. The quality of the perceived wine was ranked a critical factor, revealing that premium pricing for sustainable wines can only be granted if they meet the high quality requirements. Barriers to the uptake of sustainable wines are still prevalent despite growing demand. The main challenge is the lack of consumer education, according to Capitello and Sirieix (2019). There are many labels and certifications of sustainability that confuse customers to doubt it. Furthermore, perceived higher costs create another challenge. While many consumers report willingness to pay more for sustainable wines, Vecchio and Annunziata (2015) found that price elasticity, particularly among occasional wine drinkers, limits actual purchasing. Lack of confidence in the effectiveness of sustainability initiatives also limits adoption. Delmas and Gergaud (2021) noted that there are some consumers who doubt the true environmental impact of these practices, suggesting that improved transparency about sustainability's benefits could be helpful. Pomarici et al. (2018) concluded that limited availability of sustainable wine in mainstream channels is the practical barrier. Though consumers' attitudes towards sustainability are becoming ever more positive, issues such as education, cost considerations, and availability need to be addressed to facilitate wider acceptance of sustainable wines.

Sustainability Certifications and Labels: Economic and Psychological Impacts

Many economic implications accrue to fruit wine producers with sustainability certifications and labeling. They may impact marketability, pricing strategies, and volumes of sales. Certification programs can enhance the marketability of fruit wines by creating a unique differentiating factor. Schäufele and Hamm (2017) found that wines with sustainability certificates had a competitive advantage in markets where consumers were environmentally conscientious. Their research indicated that certified sustainable wines were more frequently available at retail outlets and featured on wine lists in luxury restaurants. Delmas and Grant (2014) performed a comprehensive analysis of the California wine market, examining more than 13,000 wines. Research indicated that eco-certified wines were more likely to be exported, implying that sustainability certifications can create new commercial prospects, particularly in ecologically aware international markets. The sustainability certificates can allow producers to receive a premium rate. Vecchio (2013)

conducted experimental auctions to test the consumers' willingness to pay for sustainable wines. In this study, it was found that the consumers were willing to pay a premium of up to 30% if the wines carry sustainability certificates, with the biggest premiums related to organic certifications. This price premium would most likely vary by the type of certification and market conditions. Pomarici et al. (2018) found that organic certification consistently provided pricing premiums in multiple European markets, while other forms of sustainability certifications had a more mixed impact on pricing depending upon the specific market and consumer category. The net effect of sustainability certifications on sales volumes is generally positive but can be complex. Delmas and Grant (2014) discovered that although eco-certified wines commanded premium prices, the certification did not result in an increase in sales volume when promoted on the bottle. Their assertion indicated that the enhancements in quality linked to sustainable practices, rather than the certification per se, were the catalysts for sales growth. In contrast, a study by Sogari, Mora, and Menozzi in the Italian market of 2016 found that sustainability certificates lead to higher sales volumes, mainly through younger consumers and in metropolitan areas. Therefore, it shows that the effect on sales volumes may change depending on the specific market context and demographic consumer characteristic.

Sustainability certifications and labels have psychological effects on consumers to a great extent by building up trust, quality perception, and buying intention. Eco-labels are heuristic indicators that efficiently convey environmental qualifications of wine to customers. Barber et al. (2009) found that eco-labels built consumer trust and developed purchase intentions positively, especially for environmentally concerned consumers. Their findings suggested that environmental labeling is a risk-reduction tool offering consumers confidence about their purchases and related environmental impacts. In fact, the effectiveness of environmental labels can be determined to rely on consumer awareness and skepticism. Dekhili and Achabou (2014) found that while eco-labels generally increased trust, consumers with strong environmental awareness were more likely to challenge the particular claims that such labels make, meaning transparency and verification of environmental claims are likely to be necessary. While less common in the wine industry than other drinks markets, fair-trade certification can have a strong psychological impact when it is present. Annunziata et al. (2019) found that fair-trade labels on bottles of wine significantly increased purchase intent among the socially conscious consumers. The study found that fair-trade labels exploit consumers' ethical consumption attitude, thereby increasing the perceived social value of the product. Organic certification significantly impacts consumers psychologically in the fruit wine sector. Castellini et al. (2014) reported that organic seals on wine labels were associated with perceptions of higher quality, more healthful and ecologically friendly. In addition, their study indicated that the organic seal had the most positive effect in relation to purchase intentions compared to other types of sustainability-related seals related to wine. Schäufele and Hamm (2018) found that the effect of organic seals depends on the consumer's past experience and belief. Research showed that while organic seals usually increased consumer trust, some consumers associated organic wines with inferior quality or less desirable flavor, yet the challenge is to be addressed by producers through effective marketing and educational campaigns. The sustainability certification context for wine business is rapidly growing; there are significant regional differences in this environment. There have been growths of sustainability certification systems within wine business over the last twenty years. Flores (2018) undertook a cross-national analysis of wine sustainability frameworks, which realized over 50 different certification schemes in existence across the globe. The research found a trend for greater sustainability certifications that include the environment, social, and economic aspects of the process. of the fruit wine market have been growing certifications tailored for local conditions and specific fruit types. Mariani and Vastola (2015) provided a history of establishing sustainability certifications for cider production in the UK and France, including the different environmental impacts of apple farming and processing. Consumer responses to sustainability labels are largely diversified by region. Pomarici et al. (2018) performed a comparison analysis across various European nations, revealing that customers in Northern European countries typically exhibited more awareness and appreciation of sustainability labels than their Southern European counterparts. Sustainability certificates are gaining acceptance in new wine markets, however they encounter hurdles. Yu et al. (2009) explored the Chinese wine market and found that, while interest is growing in sustainable and organic wines, particularly among younger urban customers, there is a still relatively poor understanding of different certification schemes. They suggested that education and effective communication techniques play a vital role in the attainment of sustainability certification in those markets, as the said certification and labeling have a high economic and

psychological impact in the fruit wine industry. They can enhance marketability, make premium pricing easier, and influence consumer confidence and buying intent. However, their effectiveness varies in different markets and customer segments, which makes the call for personalized strategies applicable in different locations. Sustainability is the word on the lips of the world's wine business, with producers and governments establishing and refining certification systems to meet diverse needs of farmers and consumers.

Marketing Sustainability: Economic and Psychological Strategies

Developing a brand identity centred on eco-consciousness has emerged as an effective method for appealing to environmentally conscious consumers in the fruit wine sector. Sustainability branding transcends product characteristics to include the overall corporate ethos and activities. Santini et al. (2013) discovered that wineries who effectively included sustainability into their brand identity had enhanced brand equity and consumer loyalty. Their research underscored the importance of authenticity for sustainable branding, noting how consumers quickly recognize and reject superficial or misleading sustainability claims. Gabzdylova et al. (2009) studied drivers for sustainability branding within New Zealand's wine industry. They found that while environmental values were the driving force, many wineries viewed sustainability branding as an opportunity to differentiate themselves in an overcrowded marketplace and to protect their businesses from changing consumer preferences and governmental regulations. Borra et al. (2014) cautioned that sustainability branding should be used wisely in conjunction with other brand attributes. Their work on Italian vineyards indicated that while sustainability did increase brand impression, the classic factors in consumer preference were taste, quality, and origin. They suggest that sustainability branding should add lustre rather than overshadow these defining characteristics. Sustainability packaging has become a critical component of fruit wine sustainability marketing, significantly shaping consumer perception in terms of what is overall sustainable. Barber et al. (2009) carried out a study on consumer attitudes toward eco-friendly wine packaging. Their research found that environmentally conscious customers would pay a premium for wines in sustainable packaging, and lightweight glass bottles, recycled materials, and alternative formats such as bag-in-box were especially favored. The life cycle consequences of many wine packaging solutions were examined by Moraga et al. (2022). It was found that such alternative formats like bag-in-box and TetraPak proved to be significantly more environmentally friendly than a traditional glass bottle. These researchers suggest that such environmental benefits can be communicated to the consumer as a winning marketing strategy, particularly for everyday drinking wines. Wiedmann et al. (2014) noticed that customer acceptance of alternative packaging formats varied significantly between diverse market segments. Their study found that young consumers remained primarily open to innovative, environmentally friendly packaging, whereas older, traditional wine customers often associated alternative packaging with a decrease in quality. The need for focused marketing strategies that address particular concerns and interests of consumers is thus realized.

Diverse psychological approaches could be used to facilitate effective sustainable wine marketing, including green branding, narrative building, and emotional appeals. According to Delmas and Grant (2014), it was observed that the wines with the eco-label required an impressive price premium, interestingly becoming much higher when the eco-certification was not appearing on the bottle. They argued that though eco-certification improves production methods and therefore wine quality, intense eco-labeling may be interpreted by some as an indicator of poor product quality. It points out how complex the process of green labeling schemes can be and shows the need for innovative strategies. Mora and Livat (2013) studied the use of storytelling in wine marketing. They asserted that stories related to sustainability and to the environmental commitment of the winery significantly increased brand attitudes and purchase intent. They particularly emphasized the importance of authentic and rich narratives to support consumer emotional connectivity with the sustainable path of the brand. Sogari et al. (2016) studied the effectiveness of various emotional appeals in sustainable wine marketing. Evidence also showed that positive emotions such as pride and satisfaction from the choice of ecological-friendly decisions were stronger than negative emotions like shame or dread. The findings from their study suggest that marketing communications that communicate the benefits of choosing sustainable wines may be particularly strong. The economic implications of sustainable marketing in the fruit wine industry are substantial and potentially lead to increases in market share, price premiums, and customer loyalty. Pomarici et al. (2018) studied the market performance of eco-friendly wines in different European countries. Sustainably promoted wines often gained market share, particularly among young consumers and in urban centers. The study suggested that sus-

tainable marketing may be a viable strategy for expanding the customer base of a brand. Vecchio (2013) used experimental auctions to measure the willingness of customers to pay a premium for sustainable wines. Findings of the study were that properly marketed sustainable wines could command price premiums as high as 30%, while organic wines garnered the largest bonuses. However, the research suggested that such benefits were contingent upon the wine meeting quality standards, implying that sustainability will have to be balanced by other attributes for the product. Capitello and Sirieix (2019) explored the impact of sustainable marketing on consumers' loyalty in the wine industry. Research found that customers aware and appreciating the sustainability activities of a brand demonstrated higher brand loyalty as well as a higher likelihood of repurchase. The study found sustainable marketing can be a viable tool for developing long-term client relationship. Schäufele and Hamm (2017) cautioned that economic benefits of sustainability marketing vary significantly in different market segments and regions. Their consumer perception and willingness to pay for sustainable wines analysis exposed significant variability and called for individualized marketing approaches addressing the different values and concerns that each different consumer segment embodies. Marketing sustainability in the fruit wine industry involves an interaction of branding, packaging, psychological tactics, and economic factors. Although the potential advantages are considerable, successful sustainable marketing requires an elaborate understanding of target consumers and stringent alignment with other characteristics of the brand. As consumers become increasingly aware of environmental issues, sustainability marketing is expected to play a more significant role in the future of the fruit wine business.

Challenges in Implementing Sustainable Practices

The adoption of environmentally friendly practices in the production of fruit wines often involves heavy front-end investment, which presents a severe financial challenge, especially to smaller-scale producers. Gilinsky et al. (2016) conducted an in-depth examination of sustainability practices across the global wine industry and found that the significant upfront costs of sustainable technology and infrastructure heavily held back many wineries from using them. These costs could include investments in energy-efficient equipment, water-saving technologies, and organic farm practices. Sogari et al. (2016) analyzed the barriers faced by small and medium-sized wineries in Italy towards sustainable adoption. The producers recognized the long-term benefits of sustainability; however, the short-term return on investment was often too uncertain to offset the upfront cost of investment. Pomarici et al. (2015) surveyed California wineries concerning their perceptions of costs and benefits of sustainability. Ninety-three percent of the wineries acknowledged long-term benefits from sustainable practices, although many voiced concerns over the amount of time needed to recover investments. This concern was particularly pronounced among smaller wineries that faced budgetary constraints. Christ and Burritt (2013) pointed out that bigger wineries tend to have the advantage of implementing sustainable practices primarily because they operate on economies of scale. They can spread the costs of sustainable technologies and certifications over larger quantities produced, making it more affordable per unit. Such is the challenge for small manufacturers, which may be hard-pressed to compete with the others on sustainability due to the lack of economies of scale. Applying sustainable practices in winemaking extends far beyond the winery, involving the entire supply chain. This broader scope creates other problems. Santini et al. (2013) looked at the challenges of sustainable sourcing within the wine industry. Their work showed that while many wineries were committed to sustainable practices, they often found it challenging to source suppliers of sustainably produced fruits, additives, and packaging materials. This created great challenges for fruit wine producers with several fruit varieties, each facing specific supply chain issues. Cholette and Venkat (2009) undertook an in-depth analysis of carbon footprint related to wine delivery systems. Studies revealed that transportation, especially intercontinental shipping, could be a large part of wine's total environmental impact. This poses an interesting dilemma for fruit wine manufacturers looking to reduce their carbon footprint without giving up opportunities for diversified markets. According to Flores (2018), sustainability frameworks within different wine-producing countries found that maintaining harmonious sustainable practices from cultivation to processing to distribution became increasingly challenging as the sizes of operations increase. This proved to be highly relevant to fruit wine companies employing many fruit varieties, each with their own preferred conditions for growth and processing. As the number of sustainability claims increased within the fruit wine industry, producers faced the challenge of resolving consumer skepticism and ensuring transparency in their sustainability claims. To address this, Delmas and Burbano (2011) examined greenwashing within the wine industry, whereby firms made false or unverified claims about environmental activities. Research shows that

as consumers become more environmentally conscious, they also become sceptical towards environmental claims, which means wine producers need to provide clear, verifiable information related to their sustainable practices. Schäufele and Hamm (2017) conducted an in-depth analysis of consumer perceptions of sustainable wines. Research suggested that while consumers were interested in sustainable products, they often did not know enough to verify sustainability claims. This marks the need for specific, standardized information about sustainability policies and their impact. Vecchio and Annunziata (2015) analyzed customer responses to different types of sustainability labels on wine bottles. According to the study, while customers appreciated detailed information about sustainability efforts, overly complex labels could lead to confusion and disbelief. This is an issue that fruit wine manufacturers face in effectively communicating their environmental endeavours without being too overwhelming for the consumer. Pomarici et al. (2018) examined consumer perception of sustainable wines in different European countries. Large differences in consumer awareness and valuation of sustainability claims were found, which means that fruit wine producers have to tailor their communication strategies according to the specific markets to fully overcome consumer skepticism. Despite growing interest in sustainability from the fruit wine industry, many challenges still accompany their implementation. Economic barriers, mainly the high upfront fixed-cost charges, are another substantial challenge, especially for smaller firms. The intricacy of the supply chain raises new challenges, requiring collaboration and commitment across the chain. Finally, overcoming consumer skepticism requires open, honest and verifiable communication of sustainability policies and their impacts. Solving problems related to the implementation of sustainable fruit wine production requires concerted action among manufacturers, industry associations, and policy makers. A workable solution would be the setting up of financial rewards or subsidies intended for smaller companies to invest in sustainable technologies. In addition, generic interventions would focus on the improvement of sustainable supply chain mechanisms with guarantees that sustainability is integrated from start to finish in the manufacturing process. Raising consumer confidence and understanding by standardizing sustainability certification and improving communication promotes consumer identification and even appreciation of sustainable products. In addition, investment in consumer education is critical to improve the understanding and appreciation of sustainable fruit wine production practices. As the sector moves forward, overcoming these challenges will be critical to achieving wide-scale adoption of sustainable fruit wine production practices.

The Future of Sustainable Fruit Wine Processing

Due to technical breakthroughs, changing customer preferences, and a heightened focus on sustainability, the fruit wine production sector is experiencing immense transition. The progression in the industry is influenced by several critical aspects which pose problems as well as possibilities for the producers. Precision agriculture technologies have transformed sustainable fruit wine production through their inclusion. Satellite imaging and drone technologies now allow vintners to enhance irrigation systems and assess crop health with unparalleled precision (Matese et al., 2015). These technologies have resulted in water use reductions of up to 30% in certain vineyards, concurrently enhancing fruit quality. Smart sensors and Internet of Things (IoT) devices are integrated at every stage of the production process, including fermentation monitoring, and storage condition optimisation, which leads to enhanced resource efficiency and superior final products (Gonzalez Viejo et al., 2020). Renewable energy has witnessed tremendous uptake, with solar installations becoming increasingly common in vineyards. Research by Smyth in 2009 also showed that wineries using solar power systems cut their carbon footprint by an average of 40% and enjoyed long-term cost savings. Furthermore, intense improvements in waste valorisation mean that producers have been able to recycle grape pomace and other wastes into income-generating assets, all while avoiding environmental impact (Dwyer et al., 2014). Millennials and Gen Z are having a meaningful impact on the market for fruit wines through their consumption behavior and preferences. According to research by Qenani-Petrela, Wolf, and Zuckerman in 2007, 73% of the Millennials would be willing to pay premium prices for sustainably produced wines as compared to 58% of Generation X customers. This population shift has brought about a call towards transparency in industrial practices and environmental impact disclosures. Social media has significantly influenced these choices, with Nielsen (2022) indicating that 68% of Gen Z consumers discover sustainable wine options via digital platforms. The notion of "conscious consumption" has become essential in the purchasing decisions of younger customers, with sustainability certifications and environmentally friendly packaging greatly impacting brand selection (Castellini et al., 2017). The sustainable fruit wine business is set for significant expansion in the forthcoming decade. John-

son et al. (2023) undertook in-depth market research that suggests the global sustainable wine market will grow at a CAGR of 11.6% from 2024 to 2034, reaching a market size of $43.8 billion. This growth is attributed to increased environmental awareness, increased disposable incomes in emerging economies, and increased demand for organic and biodynamic wines. Regional imbalances in market growth are very marked, with Europe taking the lead in the sustainable production and consumption of wines. Fast growth is expected to come from Asia-Pacific markets, driven by the changing tastes of consumers and stricter environmental legislation that are driving demand for sustainable wines (Kim & Chen, 2021). Producers need to adopt ways that balance sustainability with profitability while sustaining consumer confidence to navigate through the changes effectively. Industry specialists view the promotion of circular economy ideas into production operations. Martinez-Carrasco et al. (2019) argue that wineries that apply circular techniques may reduce their production costs by up to 25% and maintain higher levels of sustainability credentials. Certification schemes with clear reporting and auditing requirements should be invested in. A study by Wong and Fischer (2022) found that those wineries with recognized sustainability certifications recorded average sales increases of 18% compared to their non-certified peers. However, the credibility of those certifications must be coupled with genuine sustainable practices to maintain customer trust. Producers are urged to focus on building strong direct-to-consumer relationships through online platforms. This tactic increases the bottom line and supports better communication of sustainability practices and brand values (Barber, Taylor, & Deale, 2010). In addition, cooperation at the sectoral level through shared knowledge networks and joint research ventures can help speed up the implementation of sustainable practices and spread the associated costs and risks. The future of sustainable fruit wine processing is characterized by technological innovation, changing customer needs, and substantial economic potential. Those producers who balance sustainability and profitability with providing for the demands of more discerning consumers will be best positioned in the long term as the market continues to evolve. Innovative technology in conjunction with environmental stewardship will ensure the long-term sustainability of the industry and its potential to thrive in an increasingly competitive world marketplace.

Conclusion

Sustainable techniques in fruit wine production offer considerable cost savings, such as minimized operation expenditure and increased resource utilization while allowing for a premium price. The benefits lie inherently with shifting consumer attitudes, as green-conscious consumers, particularly from the younger demographic, drive demand for sustainability. This shift in consumer behavior has created a business environment where sustainability is no longer an ethical choice but a strategic business imperative. The fruit wine industry stands at an important juncture. Companies that better integrate sustainability into their activities and communicate their efforts more credibly to customers will have a competitive advantage. As such, these advancements might hone sustainability practices and heighten regulatory demands on fruit wine processing in the future. This would represent a transformational change into greater eco-friendliness as well as changes in social responsibility in the production techniques of the industry.

Electronic supplementary information

NA.

Author contributions

The authors confirm contribution to the paper as follows: study conception and design: data collection: Durgeshwary Kolhe; analysis and interpretation of results; draft manuscript preparation: Arshad Bhat. All authors reviewed the results and approved the final version of the manuscript.

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Conflict of interest

The authors are well aware about the submission of this publication to the journal and declare that there is no conflict of interest among the authors.

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