

## **SUSTAINABLE WINEMAKING IN THE REPUBLIC OF MOLDOVA: STRATEGIES FOR REDUCING ENVIRONMENTAL IMPACT AND ORGANIZING RESPONSIBLE EVENTS**

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**Abstract:** *This study analyzes strategies for sustainable development of the wine industry in the Republic of Moldova, focusing on the role of cultural events such as VinOpera in promoting environmentally responsible behavior. The work identifies key environmental challenges in the industry, including excessive consumption of water and energy resources, pollution associated with the use of agrochemicals, and difficulties in waste and packaging management. A review of international sustainable practices such as biodynamic viticulture, the use of renewable energy sources and the introduction of carbon labeling are reviewed. Special attention is paid to the specifics of Moldovan winemaking, its potential in the context of sustainable development, as well as successful examples of environmentally oriented approaches implemented by leading wineries in the country. In a separate section, the case of the cultural event VinOpera is discussed: its sustainable components are analyzed and its impact on the formation of environmental culture and behavioral patterns of the audience is assessed. In conclusion, practical recommendations aimed at strengthening the sustainability of both the wine industry and related cultural initiatives are presented. Suggested measures include the development of certification mechanisms, educational programs, ecotourism and effective environmental communication strategies. The paper emphasizes the importance of integrating environmental and cultural factors in shaping the sustainable development of the wine industry in the Republic of Moldova.*

**Kywords:** *Sustainable Winemaking, Environmental Impact, Moldova, Eco-Events, Biodynamic Agriculture.*

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**Classification JEL:** Q01, Q13, Q56.

### **1. Introduction**

*The relevance of the research topic.* In the context of global climate change, growing environmental threats and increasing public demand for responsible consumption, the issues of sustainable development are of particular relevance. The wine industry, despite its significant cultural and gastronomic value, is one of the most resource-intensive areas of the agricultural and tourism sectors. Wine production involves significant consumption of water, energy and agrochemicals, and is accompanied by high levels of carbon dioxide emissions, packaging waste and soil pollution. In this context, the transition to sustainable winemaking models is now seen as an indispensable element of agricultural sustainability and responsible tourism development. The Republic of Moldova, despite its small size, plays an important role on the wine map of Eastern Europe. Moreover,

winemaking is not just an economic activity, but also a significant part of the national identity, cultural heritage and international image of the country. In the context of increasing competition on global markets, as well as growing demand for environmentally friendly and organic products, sustainable winemaking is becoming a strategic direction for the development of Moldovan agribusiness and tourism industry.

In addition to the production sector, the principles of sustainability are also being actively implemented in the tourism sector of the wine industry. The organization of environmentally responsible events such as festivals, wine tours and cultural events helps to promote sustainable practices, create environmental awareness among consumers and promote the country's image as a “green” destination. One prominent example of this approach in the field of wine festival organization is VinOpera, a unique cultural event held on the grounds of Castel Mimi winery that combines music, winemaking and sustainability principles.

*The present study aims* to comprehensively analyze the current state and prospects of sustainable winemaking in the Republic of Moldova. Special attention is paid to case studies, including the experience of leading wineries and analysis of the organization of responsible activities. The paper examines the environmental challenges facing the industry, analyzes the sustainable strategies applied, assesses the influence of cultural events on the formation of perceptions of sustainability, and offers concrete recommendations to further promote the ecological transformation of the Moldovan wine sector.

Therefore, this study combines ecological, social and cultural approaches based on the concepts of sustainable development, wine and rural tourism, and event management. This determines the relevance of the study from both scientific and practical points of view.

## **2. Literature Review: Environmental Challenges and Global Trends in Sustainable Winemaking**

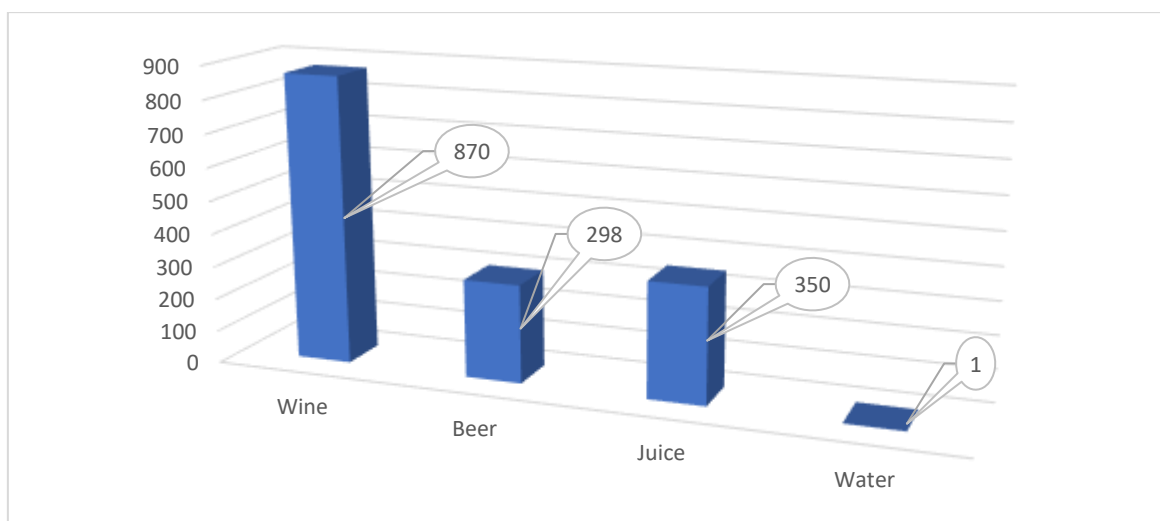
Having conducted various studies on the conceptual literature in the field of winemaking [1]; [3]; [4] as well as statistical studies, the main problems in the research area were substantiated.

Contrary to the romanticized notion of winemaking as a craft inextricably linked to nature, modern winemaking puts significant pressure on the environment. The environmental load is formed at all stages of the value chain: from vineyard cultivation to bottling, logistics and organization of related activities.

The main *environmental problems* of the industry can be classified as follows:

- *Water consumption*: according to studies, the production of one glass of wine can use up to 117 liters of water, including irrigation, equipment washing and tank cleaning. In regions where water resources are scarce, this becomes a critical sustainability factor. Figure 1 shows water consumption by type of beverage.

As can be seen from the chart, the highest consumption is inherent in wine, with juices following closely behind, and then beer.

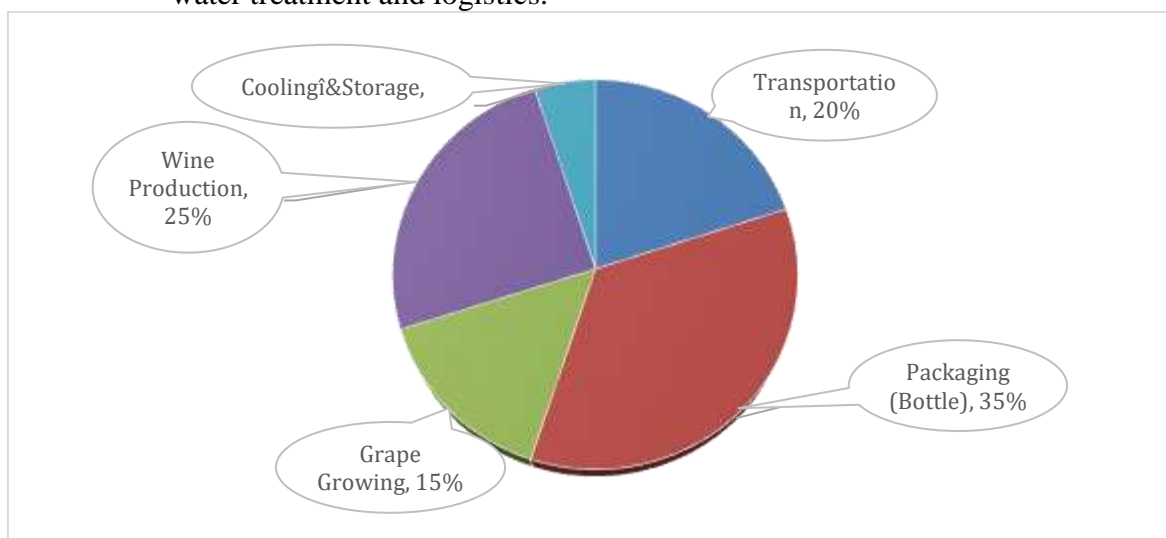


**Figure 1. Water Consumption per Liter of Beverage**

Source: developed by the authors on the basis of  
<https://www.washingtonpost.com/food/2023/11/09/lighter-wine-bottles-carbon-footprint/>

The following diagram shows the distribution of the carbon footprint during wine production by stage of production in terms of CO<sub>2</sub> emission. As can be seen, the greatest amount of CO<sub>2</sub> is emitted into the environment during packaging. Although the other stages account for slightly less emissions, the amount is still significant. [5]

- **Greenhouse gas emissions:** the main sources of CO<sub>2</sub> emissions in the wine sector are the production and transportation of glass bottles (up to 30% of the total carbon footprint), energy inputs for fermentation and cooling processes, water treatment and logistics.

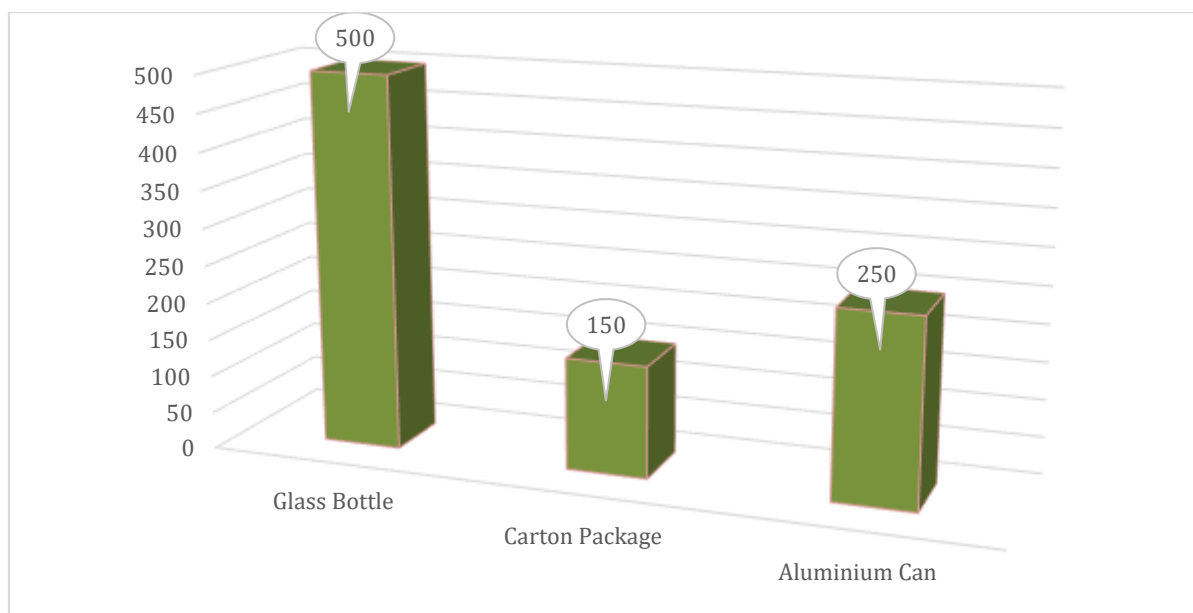


**Figure 2. Carbon Footprint Distribution Across Wine Production Stages**

Source: developed by the authors on the basis of <https://www.wineaustralia.com/news/articles/wine-australias-climate-change-investments-for-the-sector>

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The following diagram (number 3) provides information regarding the difference in CO<sub>2</sub> emissions depending on the type of packaging. [6]



**Figure3. CO<sub>2</sub> Emissions by Packaging Type (per unit)**

Source: developed by the authors on the basis of <https://www.wineaustralia.com/news/articles/wine-australias-climate-change-investments-for-the-sector>

- Agrochemical pollution: the use of synthetic pesticides, herbicides and fertilizers
- negatively affects biodiversity, contaminates soil and aquifers, and reduces the resilience of agroecosystems to climatic stresses. [7]
- Packaging and waste: glass and plastic containers, corks, cardboard boxes and pallets generate significant amounts of waste, much of which is not recycled. The disposal of organic waste generated during the fermentation process also requires environmentally friendly solutions.
- Energy consumption: the use of fossil fuels to power wineries (fermentation chambers, cooling systems, pumps) contributes significantly to climate change.

The most vulnerable stages of the wine life cycle are:

- Grape growing (significant water and chemical consumption);
- Wine production (high energy and water consumption);
- Packing and packaging (material-intensive and transportation costs);
- Distribution, especially export (transportation emissions). [8]

### 3. Methodology

The article uses various methods: analysis of theoretical sources and statistical publications, synthesis of the presented data; induction, i.e. the transition from private examples from wineries' experience to general ones and deduction, translation of general conclusions to private practices.

The method of grouping and typologisation was also used. Content analysis and observation methods were used as empirical research. Graphical analysis was used to present the researched data. The Case Study method was also used to provide a case study in the wine sector.

#### **4. Results and Discussion: Specific Patterns of Sustainable Winemaking in the Republic of Moldova**

The Republic of Moldova is one of the oldest wine-producing regions in Eastern Europe. Viticulture here has a history of more than 5000 years, and winemaking is an integral part of the national cultural code. Currently, vineyards cover an area of over 140,000 hectares, and wine exports account for a significant share of the country's GDP, especially in rural regions. There are about 200 registered wine producers in the country, of which about 50 are actively developing enotourism and adopting sustainable technologies.

Factors contributing to the development of sustainable winemaking in Moldova:

- ***Rich agro-climatic resources***: the regional terroir is favorable for growing both local and international grape varieties characterized by low water consumption.
- **Cultural heritage**: Wine is an important component of Moldovan traditions, festivities and everyday life, which creates a sustainable platform for the development of enotourism.
- ***Governmental and international support***: European Union programs (e.g. CEFTA, EU4Environment), national initiatives for transition to sustainable development, as well as investments from USAID, FAO and GEF are being implemented.
- ***Increased consumer awareness***: young Moldovan winemakers are advocating biodynamic and organic farming practices. [8]

However, there are also barriers to sustainability, such as insufficient infrastructure for recycling, a poorly developed certification system and limited access to green finance.

Below are examples of wineries that have integrated the principles of environmental responsibility into their production processes and development models:

- **Castel Mimi**: The winery combines tradition and innovation by using solar and geothermal energy, rainwater collection and filtration system, separate waste collection and recycling, and organizing environmentally responsible events (see VinOpera).
- **Purcari Wineries Group**: The largest exporter of Moldovan wine with a strong focus on environmental sustainability. The company has implemented certified organic and biodynamic farming methods, installed photovoltaic panels, and implemented an underground irrigation system that has reduced water consumption by 25%. In 2023, the company achieved a record waste recycling rate of 65.79%, in collaboration with Ecosmart Union SA.
- **Et Cetera Winery**: A family-owned organic farm located in the southern part of the country. The company has eliminated the use of pesticides, uses natural fermentation methods and develops agritourism, integrating guests into the “wine culture”.
- **Fautor Winery**: The winery focuses on terroir conservation, uses drip irrigation, grows autochthonous grape varieties such as Feteasca Neagra and Rara Neagra, and develops landscape sustainability through the use of cover crops.
- **Casa Vinicola Luca**: The company implements innovative sustainable energy solutions, including the use of solar panels for lighting and heating, rainwater harvesting and reuse, and the conversion of organic waste into biogas used for cooking and lighting.

The general principles of sustainable winemaking implemented in Moldovan wineries include switching to biofertilizers and avoiding herbicides, implementing energy-saving technologies, using packaging with reduced CO<sub>2</sub> emissions and developing tourism with a low carbon footprint.

### ***Case Study: Vinopera: The Role of Cultural Events in Promoting Sustainability***

In today's world, cultural events are becoming increasingly important not only as a form of leisure, but also as a platform for transmitting values and shaping social consciousness. Wine festivals, tasting evenings and music and gastronomic events have the potential to become a powerful mechanism for creating environmental awareness and promoting sustainable lifestyles. They combine elements of education, emotional impact and engagement, making them particularly effective in communicating and popularizing the principles of sustainable development.

According to scientific research [1] events contribute to:

- dissemination of knowledge on biodiversity, terroir characteristics and climate risks;
- promotion of environmentally friendly goods and services;
- stimulating local economies by supporting small producers;
- development of eco-tourism and the concept of “slow travel”.

In this way, the events serve not only as an entertainment venue, but also as an educational platform, acting as a “green bridge” between producers and society.

VinOpera is a unique annual event held at the Castel Mimi winery that brings together art, environmental responsibility and wine culture. The event serves as a model example of the successful integration of sustainability principles into a mass festival format.

Key sustainable practices implemented at VinOpera:

#### **Eco-design and cyclicity of materials:**

- Guests receive reusable fabric bracelets that are later used to garter the vines, symbolizing the cyclical nature of the processes.
- Using natural decorations and maximizing the use of recycled materials.

#### **Green logistics:**

- Organizing the transfer of guests by electric buses and coaches allowed a significant reduction in CO<sub>2</sub> emissions, equivalent to removing 400 cars from the streets of Chisinau for one day.

#### **Localization of production and support for local producers:**

- All food and wine presented at the festival is made exclusively from local ingredients, helping to reduce the carbon footprint associated with transportation of products.
- Organization of an artisan market with local farmers, artisans and winemakers to support the local economy.

#### **Social and cultural inclusion:**

- Performances by artists from Moldova and Romania, emphasizing cultural commonalities and contributing to the strengthening of interregional dialogue.
- Active use of elements of traditional Moldovan heritage, including national costumes, folklore and music.

#### **Responsible consumption:**

- Offering guests tasting portions and providing information on “wine etiquette” to foster a culture of conscious and moderate wine consumption.

#### **Partnerships and Sustainable Management:**



- Actively engage environmental non-profit organizations, local governments and international donors in the project, forming a multi-stakeholder ecosystem of sustainable engagement. [9]

The aesthetic design of an event, combined with ethical principles, is a key factor in ensuring the long-term impact of such events. VinOpera is not just a festival, but a model case of event sustainability, demonstrating that it is possible to integrate sustainability principles into large-scale cultural events. Its impact goes far beyond a one-day event:

- Improving the environmental literacy of participants by involving them in the practice of conscious consumption and familiarizing them with concrete examples of sustainable practices.
- Formation of a new image of the Republic of Moldova as a country that successfully combines a rich cultural heritage with a commitment to ecology.
- Formation of sustainable behavioral patterns among visitors. According to the surveys conducted by Castel Mimi, about 40% of visitors started to use reusable accessories in their daily life and to show more interest in environmentally friendly products.

In this way, VinOpera acts as a "sustainability ambassador", effectively integrating sustainability principles into an emotionally rich cultural experience.

## 5. Conclusions

Based on the analysis of production practices, event formats and cultural dynamics, it is possible to identify key areas that will contribute to increasing the sustainability of Moldova's wine sector and promote the country as a "green" wine destination in Eastern Europe.

*Expansion of the organic certification system.* Although individual wineries have already obtained or are seeking organic certification, there is a need to develop and implement a national certification incentive program:

- Implementing and supporting EU Organic, ISO 14001 and Demeter standards;
- Creation of an accessible audit and certification mechanism for small and medium producers;
- Development of grant programs and tax incentives to facilitate the transition to sustainable technologies.

*Expected results:* certification will not only increase consumer confidence in products, but will also open access to premium markets in the European Union and Scandinavia, which will increase export opportunities for Moldovan winemakers.

*Development of National Recommendations for Green Events.* Currently, Moldova lacks uniform standards for organizing sustainable events. Therefore, it is proposed to develop a National Code of Green and Cultural Events, including the following elements:

- Clear criteria on logistics, catering, waste management, energy consumption and community involvement in event organization;
- Establishing minimum requirements for event partners, including mandatory use of eco-friendly tableware and avoiding the use of plastic products;
- Introduce a system of certification of events by level of environmental responsibility ("Eco-friendly", "Green", "Carbon-aware"). [10]

The role of the Ministry of Culture and National Agency of Tourism is crucial to successfully promote this initiative and ensure its wide acceptance. Staffing is a key factor

in the successful transformation of the industry. In this regard, there is a need to implement comprehensive staff development and training programs:

- Developing and conducting courses on sustainable agro-management, water efficiency and waste management for wine industry employees;
- Creation of specialized programs for wine tourism guides with a focus on developing skills in environmental storytelling and local interpretation;
- Integration of sustainable development topics into the curricula of agrarian higher education institutions and technical schools;
- The creation of an online platform with open access to educational materials will ensure scalability of training and broad stakeholder outreach.

It is proposed to combine wineries, natural sites and cultural centers into integrated eco-routes that comply with the following principles:

- Minimizing carbon footprint (e.g. bicycle tours and use of electric transport);
- Promoting local cuisine and organic products;
- Providing a high level of interactivity for tourists, including organizing workshops, participating in harvesting and specialized tastings.

An example is the development of the “Green Wine Route: from Fautor to Castel Mimi”, passing through scenic woodlands, local farms and wineries, and equipped with QR codes with detailed information for tourists.

Promoting Sustainable Storytelling. The environmental efforts of wineries must not only be realized, but also effectively communicated to consumers. In this regard, it is recommended that:

- Developing an eco-branding strategy and promoting a visual identity that reflects sustainability values (e.g., using specific eco-labels on labels and packaging, creating a specialized section on the company's website).
- Active use of stories and symbols that emphasize the connection between the product and the environment (e.g. the example of VinOpera fabric bracelets, which are subsequently used to girdle vines).
- Engaging influencers and travel bloggers with specialized training in sustainable narratives as brand ambassadors for the country's brand on the international stage.

The transition to sustainable winemaking in the Republic of Moldova is not just a technological modernization of the industry, but a deep cultural transformation that combines environmental, social and economic aspects. Analysis of the practices of leading wineries demonstrates the existence of successful models of ecologically and socially responsible wine production in the country. The VinOpera event format deserves special attention, as it serves as an example of effective integration of sustainable development principles into cultural events and promotes environmental education and involvement of the general public. To ensure a sustainable future for the Moldovan wine industry, it is necessary not only to scale up already implemented initiatives, but also to implement systemic approaches covering a wide range of areas, from certification and specialized training of personnel to the development of sustainable tourism and effective communication of values. In this way, sustainable winemaking becomes an integral part of the national image and contributes to the global sustainable development goals.



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