

# THE IMPACT OF CLIMATE CHANGE ON WINE TOURISM FROM THE PERSPECTIVE OF HUNGARIAN ORGANIC WINERIES

## VPLYV ZMENY KLÍMY NA VINÁRSKY CESTOVNÝ RUCH Z POHLADU MAĎARSKÝCH BIO VINÁRSTIEV

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### I Introduction

The study's topic is climate change's impact on wine tourism from the perspective of organic wineries. The topicality of the topic is unquestionable, as average temperatures are rising throughout Hungary, regardless of the season, and are projected to rise by up to 1°C by 2050, with a possible temperature rise of up to 4°C by the end of the century<sup>(1)</sup>. Vineyards are sensitive to climate, and climate change could lead to rethinking the entire sector<sup>(2)</sup>.

<sup>1</sup> Ministry of Innovation and Technology (2018).

<sup>2</sup> Hannah et al. (2013).

The paper defines the concept of climate change, followed by a description of its causes and the consequences that have already been observed and are expected. The role of tourism in climate change is then reviewed, and the importance of climate and weather in tourism is highlighted. The second part of the literature review will outline the situation of Hungarian wine tourism in light of climate change.

The empirical research will focus on the impact of climate change on wine tourism, with a special focus on organic wineries. Qualitative research was carried out based on five examples of organic wineries in different wine regions to investigate the signs, the positive and negative aspects of climate change and their impact on wine tourism. The second phase

#### Abstract (EN)

The study aims to investigate the impact of climate change on wine tourism from the perspective of Hungarian organic wineries. During the qualitative research, we examined the perceptible signs, the positive and negative aspects of climate change and its impact on wine tourism based on the example of five organic wineries in different Hungarian wine regions. We focused on organic production and explored why the interviewees use this method and how it affects wine tourism. In addition, we examined the sustainability efforts and plans of the wineries. It can be concluded that organic wineries have perceived the effects of climate change for about 10–15 years in wine production and wine tourism; the weather has become more unpredictable. The wineries protect against adverse effects by planting other grape varieties and introducing new procedures. Climate change did not induce organic production, but sustainable management is essential for the examined companies.

#### Abstrakt (SK)

Cieľom štúdie je preskúmať vplyv zmeny klímy na vinársky turizmus z pohľadu maďarských organických vinárstiev. Počas kvalitatívneho výskumu sme skúmali badateľné znaky, pozitívne a negatívne aspekty zmeny klímy a jej vplyv na vinársky turizmus na príklade piatich organických vinárstiev v rôznych maďarských vinárskych regiónoch. Zamerali sme sa na organickú produkciu a skúmali sme, prečo respondenti používajú túto metódu a ako ovplyvňuje vinársky turizmus. Okrem toho sme skúmali úsilie a plány vinárstiev v oblasti udržateľnosti. Možno konštatovať, že organické vinárstva pociťujú vplyv zmeny klímy už približne 10 – 15 rokov vo výrobe vína a vinárskom turizme; počasie sa stalo nepredvídateľnejším. Vinárstva sa chránia pred nepriaznivými účinkami výsadbou iných odrôd hrozna a zavádzaním nových postupov. Zmena klímy síce nevedla k organickej produkcii, ale udržateľné hospodárenie je pre skúmané spoločnosti nevyhnutné.

#### Keywords (EN)

wine tourism, organic wineries, climate change, Hungary

#### Kľúčové slová (SK)

vínna turistika, bio vinárstva, klimatické zmeny, Maďarsko

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of interview questions focused on organic production, exploring why the interviewees adopted it and how it impacts tourism. In addition, we looked at the wineries' sustainability efforts and plans to date.

### 1.1 Defining Climate Change, its Causes, and Consequences

Climate change refers to long-term changes in temperature and weather patterns. These shifts may be natural, for example, due to changes in the solar cycle, but the primary driver of climate change is human activity<sup>(3)</sup>.

The Earth has become noticeably warmer in the past five decades compared to the period before that<sup>(4)</sup>. Global surface temperatures have risen faster since 1970 than in any other 50-year period in the previous 2000 years<sup>(5)</sup>. Records show that the period between 2011 and 2020 was the warmest on record<sup>(6)</sup>. Human activity is estimated to have caused a global warming of about 1°C above pre-industrial levels, with global warming projected to reach 1.5°C between 2030 and 2052 if current rates continue<sup>(7)</sup>.

Large-scale energy production, reckless deforestation, pollution from transport, and over-consumption that requires mass production of goods and food all harm our environment<sup>(8)</sup>. As a consequence of human actions, in addition to naturally occurring gases in the atmosphere, vast amounts of greenhouse gases are being released into the atmosphere, increasing the greenhouse effect and global warming<sup>(9)</sup>. The consequences of climate change include, among others, intense droughts, water scarcity, severe fires, sea level rise, floods, melting Arctic ice, storms with catastrophic consequences and loss of biodiversity<sup>(10)</sup>, which depend on the magnitude and rate of warming, geography, level of development and vulnerability, and the choice and implementation of adaptation and mitigation solutions<sup>(11)</sup>.

Climate change is affecting the world, with some regions experiencing more frequent extreme weather events and rainfall while others experiencing more extreme heat waves and droughts<sup>(12)</sup>. Vulnerable people are displaced as climate change causes volatile

weather and rising sea levels, threatening food security and livelihoods. New risks, such as food and water insecurity and resource competition, are emerging, leading to conflicts. The number of 'climate refugees' is expected to increase in the future<sup>(13)</sup>. Between 2010 and 2019, weather-related events displaced an average of 23.1 million people per year. Refugees come from countries that are the most vulnerable and least able to adapt to the impacts of climate change<sup>(14)</sup>.

### 1.2 The Role of the Tourism Sector in Climate Change

The ecological footprint of mass tourism providers is increasing year by year, so the environmental burden of tourism is significant<sup>(15)</sup>. Tourism is a major contributor to the greenhouse effect and thus also plays a vital role in climate change. The most considerable emissions are related to transport, which accounts for 75% of tourism-related pollution, with aircraft and cars accounting for a significant share<sup>(16)</sup>.

2019 there were 38.9 million flights, but the coronavirus epidemic reduced this number to 16.9 million in 2020<sup>(17)</sup>. Measures to control the spread of the COVID-19 pandemic and travel restrictions have resulted in a 56% drop in international tourist arrivals in the first five months of 2020 compared to the same period the previous year. Arrivals to Asia and the Pacific have fallen by 60%, and these regions have been the first to suffer the consequences of the virus's spread. The second largest decline was recorded in European countries, with 58% fewer arrivals<sup>(18)</sup>. The use of digital solutions (e.g., virtual reality, online platforms) in tourism has become widespread due to travel restrictions in other countries. Still, tourism professionals have quickly realised that these tools are not an immediate and all-encompassing solution to the sustainability challenge<sup>(19)</sup>.

Demand for transport has been on a precarious recovery path following the coronavirus outbreak, but this calls into question the reliability of forecasts<sup>(20)</sup>. A 2019 forecast shows that the number of tourist trips is expected to reach 37.4 billion in 2030, bringing total tourism emissions from transport to 1,998 million tonnes of CO<sub>2</sub>. This will account for 23% of total projected transport emissions and 5.3% of total anthropogenic

<sup>3</sup> United Nations (n.d., a).

<sup>4</sup> Mátyás (2022).

<sup>5</sup> Intergovernmental Panel on Climate Change (2021).

<sup>6</sup> United Nations (n.d., a).

<sup>7</sup> IPCC.hu (2018).

<sup>8</sup> United Nations (n.d., b).

<sup>9</sup> European Commission (n.d., a).

<sup>10</sup> United Nations (n.d., a).

<sup>11</sup> IPCC.hu (2018).

<sup>12</sup> European Commission (n.d., a).

<sup>13</sup> European Commission (n.d., b).

<sup>14</sup> United Nations (n.d., b).

<sup>15</sup> Climate Refugees. (n.d.).

<sup>16</sup> Kaszás, Keller and Birkner (2022).

<sup>17</sup> Máhr, Keller, and Birkner (2022).

<sup>18</sup> Salas (2022).

<sup>19</sup> United Nations World Tourism Organization (2020).

<sup>20</sup> Boros, Hegedüs and Kiss (2022).

emissions<sup>(21)</sup>. Continued economic growth and global population growth will lead to an overall increase in demand for transport, with resulting CO<sub>2</sub> emissions projected to increase by 16% by 2050, even if current decarbonisation commitments for transport are fully implemented<sup>(22)</sup>.

In addition, tourism reduces biodiversity through the use of key resources and increases solid waste and wastewater<sup>(23)</sup>.

### 1.3 The Importance of Climate and Weather for Tourism

The climate is “the set of significant weather changes that occur almost as a matter of law at almost the same time and in almost the same way at a given place from year to year.” Most tourists prefer temperate climates, but some seek unusual climates, such as visiting a subtropical desert zone or experiencing a cold zone<sup>(24)</sup>.

Climate change is also felt in Hungary in everyday life and tourism. For some tourism products, such as waterfront or active tourism, the extension of the high season has a positive effect, as warmer temperatures can extend the season from May to September. The length of the winter season is thus shortened<sup>(25)</sup>.

A location's positive and negative climatic conditions limit the range of tourism activities that can be developed and influence the development of the resulting tourism offer<sup>(26)</sup>. Operators experience the downside of climate change for activities requiring low temperatures, such as skiing or ice-skating, while warmer weather benefits water-based tourism. Variable and erratic weather is a disadvantage in some cases (e.g. for hiking or sightseeing) but can be a positive for indoor swimming areas<sup>(27)</sup>. Cultural and natural attractions are the basis for tourism competitiveness, but they are also being damaged by climate change, which is causing problems for the sector<sup>(28)</sup>.

The climate and weather conditions of tourist destinations can also majorly impact tourists' travel decisions<sup>(29)</sup>. Climate change is expected to change demand, affecting tourism businesses and related sectors such as agriculture. In countries where tourism is a significant part of the economy, fewer tourist

arrivals could lead to severe unemployment, resulting in reduced economic welfare<sup>(30)</sup>.

### 1.4 Review of the International Wine Tourism

Until the 1980s, the world's area under vines increased steadily, but this process began to decline due to several factors. After the break-up of the Soviet Union, large-scale grubbing-up of vines took place in the successor states, and the European Union introduced a ban on vine planting, which mainly affected France, Spain, and Italy as major wine-producing countries. In turn, vineyards were planted outside Europe on previously unused land<sup>(31)</sup>.

Today, wine is produced in most parts of the world. Europe boasts the longest history of wine production, often referred to as ‘old world’ wine regions. So-called ‘New World’ wine-producing countries include Australia, New Zealand, South Africa, Chile, Argentina, and the United States of America<sup>(32)</sup>.

In 2023, Italy, France and Spain produced the most wine among European wine-producing countries<sup>(33)</sup>. Spain has the largest vineyard area in the European Union, followed by France in second place and Italy with the third largest vineyard area<sup>(34)</sup>.

Spain's enotourism boomed in 2019, with more than three million tourists arriving in the country. Still, the coronavirus epidemic has caused the number of wine tourists visiting the region to fall by more than 70 per cent in 2020 compared to the previous year<sup>(35)</sup>. In France in 2019, enotourists arriving in the Bordeaux region chose the region as their destination mainly to explore the landscapes and wine-producing villages, followed by tasting the wine and other alcoholic beverages offered in the region<sup>(36)</sup>. A survey in 2021 showed that the beauty of the landscape was the main criterion for tourists visiting Italy when choosing a wine destination, but that the culture and traditions of the place and the food and wine typical of the region also played an important role<sup>(37)</sup>.

Organic wine production represents 6.2% of vines worldwide<sup>(38)</sup>. It represents 17 % of the national vineyard area in France, playing a significant role in revitalising

<sup>21</sup> International Transport Forum (2021).

<sup>22</sup> Boros, Hegedüs and Kiss (2022).

<sup>23</sup> World Tourism Organization & International Transport Forum (2019).

<sup>24</sup> United Nations Environment Programme (n.d.).

<sup>25</sup> Michalkó (2016).

<sup>26</sup> Ministry of Innovation and Technology (2018).

<sup>27</sup> Fejes et al. (2018).

<sup>28</sup> International Transport Forum (2021).

<sup>29</sup> Németh et al. (2020).

<sup>30</sup> Hegedüs, Kiss and Kovács (2023).

<sup>31</sup> Könyves (2015).

<sup>32</sup> Moscovici et al. (2022).

<sup>33</sup> statista.com (2024).

<sup>34</sup> Wine, International Organisation of Vine and Wine Intergovernmental Organisation (2022).

<sup>35</sup> López (2021).

<sup>36</sup> statista.com (2022a).

<sup>37</sup> statista.com (2022b).

<sup>38</sup> Moscovici, D. et al. (2022).

wine regions. Younger buyers are more willing to pay a premium for organic wine than older cohorts<sup>(39)</sup>,<sup>(40)</sup>.

Karagiannis and Metaxas<sup>(41)</sup> identified organic certification as a significant differentiating factor influencing individuals' decisions to visit wineries. Therefore, organic certification may serve as an effective differentiation strategy within the marketing efforts of wine producers. Nevertheless, its impact on consumer attraction is contingent upon its interaction and alignment with other influential factors – most notably, brand identity – which collectively shape consumer perception and decision-making<sup>(42)</sup>.

### 1.5 Review of the Situation of Hungarian Wine Tourism in the Light of Climate Change

In 2021, 61,796 hectares were under wine grape production in Hungary<sup>(43)</sup>. Hungary has 223 wine grape varieties, 70% of which are white grapes, and the rest are blue grapes. Native, typical Hungarian varieties are grown in the vineyards, as well as world varieties planted abroad<sup>(44)</sup>.

It can be seen that the supply side of Hungarian wine tourism is developing rapidly, with more and more wineries creating hospitality spaces, wine hotels, and wine museums. The supply side includes wineries and other catering establishments, wine routes, wine regions, and wine districts<sup>(45)</sup>. Hungary has 6 wine regions and 22 wine districts, each with different topographical, soil, climatic, and historical characteristics.

Travellers may not be well informed about the location of wine regions and may be unfamiliar with the wine tourism services available there. For this reason, it is important for wine tourism operators to inform visitors to wine regions better, improve infrastructure for easy access and train staff to enhance the guest experience<sup>(46)</sup>. It is essential that the service providers of wine regions belonging to the same wine region cooperate, for example, by creating a joint website or by sharing a social media presence<sup>(47)</sup>.

Over the past century, wine production has emerged in more and more countries due to technological

advances and global climate change<sup>(48)</sup>. Climate change is expected to reshape current wine production, as vineyards will be displaced from some areas and may be planted in previously unsuitable regions due to climate change. In Hungary, warming and changes in precipitation patterns are forecast to affect vine production<sup>(49)</sup>. The most sensitive periods for viticulture are spring and autumn, when weather conditions are becoming increasingly unpredictable: late spring frosts are becoming more frequent and can destroy entire vineyards<sup>(50)</sup>.

Viticulture is sensitive to climate, so warming could lead to planting vineyards at higher altitudes, increasing the impact on mountain ecosystems and changing natural vegetation. To maintain the quality of wine grapes, it is necessary to protect against warming by irrigating and humidifying the plant, but this increases the use of fresh water, which can cause further problems<sup>(51)</sup>.

Climate change is reducing the acidity of grapes, which helps the wines to keep, but increasing the sugar content, which affects the alcohol content. In Hungarian wine production, efforts should be made to plant character grape varieties that are more resistant, provide higher yields, and improve the varieties. The production of sweet wines is declining worldwide as the climate for vinification is becoming less suitable<sup>(52)</sup>.

Grapes from the Mediterranean region of the warm temperate (subtropical) belt are favoured by the natural conditions of the Carpathian Basin<sup>(53)</sup>. The warming in Hungary may mean a decline in the production of white wines, but may result in higher quality and competitiveness of red wines. Consumers will also have to become more flexible, as they cannot expect constant quality, taste, and quantity from Hungarian wineries, as all this is affected by the variability of the weather<sup>(54)</sup>. These expected changes cannot be avoided, but in the long term, with the right strategy and by adapting to the specific conditions of the region, they could lead to a recovery and survival of Hungarian wine tourism<sup>(55)</sup>.

The drive for sustainability can benefit wineries by positively impacting the relationship with consumers, helping to build consumer trust and satisfaction, and improving relationships with service providers and

<sup>39</sup> Ibid.

<sup>40</sup> Braune, E., Boncori, A.-L. and Dana, L. P. (2025).

<sup>41</sup> Karagiannis and Metaxas (2020).

<sup>42</sup> Dominici, Boncinelli, Marone and Casini (2025).

<sup>43</sup> Hegyközségek Nemzeti Tanácsa (2022).

<sup>44</sup> Bor.hu. (n.d.).

<sup>45</sup> Magyar Turisztikai Ügynökség [Hungarian Tourism Agency] (2017).

<sup>46</sup> Magyar Turisztikai Ügynökség [Hungarian Tourism Agency] (2021).

<sup>47</sup> Gál (2020).

<sup>48</sup> World Tourism Organization. (2018).

<sup>49</sup> Könyves (2015).

<sup>50</sup> Moscovici et al. (2022).

<sup>51</sup> Hannah et al. (2013).

<sup>52</sup> statista.com (2024).

<sup>53</sup> Wine, International Organisation of Vine and Wine Intergovernmental Organisation. (2022).

<sup>54</sup> López (2021).

<sup>55</sup> statista.com (2022a).

**Table 1** Limits to sustainable operation

| Grouping of barriers          | Barriers                                                                                                                                                                                  |
|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Economic and Financial</b> | <ul style="list-style-type: none"> <li>– high initial capital costs</li> <li>– total lack of investment capital</li> <li>– lack of financial and trade incentives</li> </ul>              |
| <b>Technical</b>              | <ul style="list-style-type: none"> <li>– obsolete machinery and tools</li> <li>– infrastructure problems</li> <li>– lack of technical skills</li> <li>– lack of skilled labour</li> </ul> |
| <b>Cultural</b>               | <ul style="list-style-type: none"> <li>– resistance to change</li> <li>– lack of environmental knowledge and training</li> </ul>                                                          |
| <b>Legal</b>                  | <ul style="list-style-type: none"> <li>– ignorance of regulations</li> <li>– non-compliance with rules</li> </ul>                                                                         |
| <b>Government</b>             | <ul style="list-style-type: none"> <li>– lack of incentives and supportive policies</li> </ul>                                                                                            |
| <b>Organisational</b>         | <ul style="list-style-type: none"> <li>– management and employee disinterest</li> </ul>                                                                                                   |

Source: own ed. based on Neto et al. (2017)

suppliers. In the medium and long term, it promotes efficient operations and cost reduction, enhances profitability, and increases productivity<sup>(56)</sup>. However, sustainable operations have limitations, which can be grouped into six categories (Table 1).

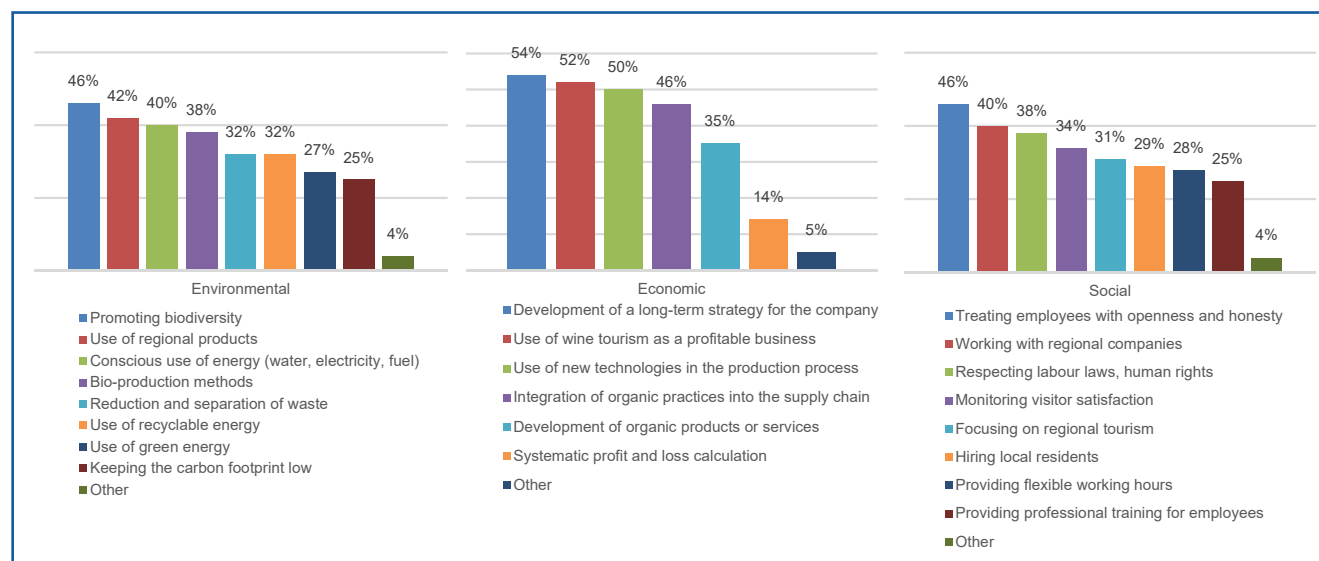
In November 2021, WineTourism.com and the University of Geisenheim conducted a sustainability survey online with 1,579 wineries from more than 40 countries<sup>(57)</sup>. The responses showed that sustainability plays a key role in the lives of wineries. The survey asked respondents to assess the three dimensions of sustainability: environmental, economic and social. For

wineries, the ecological dimension is the most important, followed by the economic and social dimensions. The researchers also asked about the measures to promote sustainable wine tourism (Figure 1).

Among the measures planned by the wineries, the most important are, from an environmental point of view, the conscious use of energy, from an economic point of view, the development of a long-term strategy for the business, and, finally, from a social point of view, cooperation with regional actors. The main obstacles to sustainable wine tourism are financial resources, human capital, infrastructure, and information. Where sustainability is mentioned, good practices are often part of the communication on wine tourism. 62% of winery representatives surveyed said that sustainable practices in wine tourism are essential for visitors, and

<sup>56</sup> statista.com (2022b).

<sup>57</sup> Karagiannis and Metaxas (2020).



**Figure 1** Measures planned for sustainable wine tourism  
Source: own ed. based on Szolnoki et al. (2022)

87% of wineries believe this will become more important in 5 years<sup>(58)</sup>.

There is a growing interest in environmentally friendly production methods in the wine sector, mainly due to consumers becoming more health-conscious and environmentally conscious<sup>(59)</sup>. Organic farming refers to agricultural production systems that aim to provide consumers fresh, tasty and authentic food while respecting the natural life cycle<sup>(60)</sup>. The words organic and bio mean essentially the same thing, but they differ in origin, the former being mainly German and the latter mainly Anglo-Saxon<sup>(61)</sup>. The advantages of the rules are greater transparency and consumer recognition<sup>(62)</sup>. Conversion of vineyards to organic production is often a complex task and requires a considerable degree of adaptation. Weather events, among other things, can force producers to abandon organic certification, reducing the size of organic vineyards<sup>(63)</sup>.

## II Material and Methods

The empirical research examines the impact of climate change on wine tourism, with a special focus on organic wineries. The study involved individual, in-

depth interviews with experts to obtain the opinions and experiences of people with professional knowledge of the research topic. The qualitative, unstructured method is justified by providing the most detailed information possible on the climate change phenomena affecting the wineries under study in an exploratory manner. Judgmental sampling was used in the research, in which the researcher selects a sample based on their judgment, which they believe is representative of the population<sup>(64)</sup>.

During the research, we interviewed representatives of five organic wineries located in different wine regions, which are more exposed to climate change than conventional wineries and have different experiences and approaches in other parts of Hungary. The participating wineries (Table 2) were selected based on several criteria: they have been certified organic for at least 5 years and are listed on the wine.hu website.

Within each winery, people who are actively involved in the winery's tourism activities were interviewed (Table 3). Three are owners; one interviewee is engaged as a vineyard and winery manager, and one is an estate manager. They all have at least 10 years of experience in viticulture.

The in-depth interviews were conducted between 15 September and 15 October 2022 and lasted between 30 and 60 minutes. Contact was made in writing, by email and by telephone. Interviews were conducted by phone and online.

<sup>58</sup> Dominici, A., Boncinelli, F., Marone, E. and Casini, L. (2025).

<sup>59</sup> Hegyközségek Nemzeti Tanácsa. (2022).

<sup>60</sup> Bor.hu (n.d.).

<sup>61</sup> Magyar Turisztikai Ügynökség [Hungarian Tourism Agency] (2017).

<sup>62</sup> Magyar Turisztikai Ügynökség [Hungarian Tourism Agency] (2021).

<sup>63</sup> Hegyközségek Nemzeti Tanácsa (2022).

<sup>64</sup> Gál (2020).

**Table 2** Characteristics of the wineries participating in the research

| Winery                                         | Wine Region                  | Wine region           | Organic certification |
|------------------------------------------------|------------------------------|-----------------------|-----------------------|
| <b>Bukolyi Marcell Organic Wines</b>           | Wine Region of Upper Hungary | Eger wine region      | Since 2016            |
| <b>Gilvesy Winery</b>                          | Balaton Wine Region          | Badacsony wine region | Since 2012            |
| <b>Count Degenfeld Vineyard</b>                | Tokaj Wine Region            | Tokaj wine region     | Since 2009            |
| <b>Malatinszky Mansion Organic Wine Estate</b> | Pannonian Wine Region        | Villány wine region   | Since 2009            |
| <b>Steigler Winery</b>                         | Upper Pannonian Wine Region  | Sopron wine region    | Since 2016            |

Source: own research, 2022

**Table 3** Characteristics of the interviewees in the research

| Name                     | Winery                                  | Current position                 |
|--------------------------|-----------------------------------------|----------------------------------|
| <b>Marcell Bukolyi</b>   | Bukolyi Marcell Organic Wines           | owner                            |
| <b>Róbert Gilvesy</b>    | Gilvesy Winery                          | owner                            |
| <b>Csaba Malatinszky</b> | Malatinszky Mansion Organic Wine Estate | owner                            |
| <b>Balázs Sulyok</b>     | Count Degenfeld Vineyard                | viticulture and oenology manager |
| <b>Tamás Varga</b>       | Steigler Winery                         | estate manager                   |

Source: own research, 2022

### III Results and Discussion

#### 3.1 Climate Change

Climate change is expected to reshape wine production. Most winemakers surveyed reported that they have felt the effects of climate change over the past 10–15 years and that these effects have intensified in recent years. They have observed that the weather is becoming more unpredictable, with extreme sunshine and frequent droughts, but that when the rainfall arrives, it falls in large quantities that the land cannot store. “The weather is hectic, which means that when the rain arrives, it rains very intensively; when the sun shines, the UV radiation is high and burns the plant” (Count Degenfeld Vineyard).

Protection against heavy rainfall is provided by planting hedges, either with cover crops or grass, so that heavy rain does not wash away good-quality soil. A central solution has been developed in the Upper Hungary wine region to protect against the hailstorms that often occur in summer and to preserve the harvest. “At the wine-growing region level, protection against hailstorms is achieved by using an ion cannon to release silver iodide into the atmosphere, which can be used to precipitate ice crystals even in the higher layers” (Marcell Bukolyi Organic Wines).

Plants can be protected from intense UV radiation by using natural practices. In the case of vines, shoot selection is usually done: the excess is removed, but some leaves should be left for protection. “I can protect the vines by removing the big old cover leaves to allow sunlight to reach the crop, whereas in the past we didn’t do that, now we just leave the morning side.” (Steigler Winery) The reason is that the sun is not so intense in the morning, so the fruit can ripen but is protected from the harmful rays of the afternoon. Another possible way to protect against UV radiation is to use natural formulations. “There are plant protection products or plant conditioners that have a UV-filtering effect when sprayed” (Marcell Bukolyi Organic Wines).

Drought was observed in all wine regions, causing problems for young plants. “Our 4–5-year-old vines had dried clusters; the plant was trying to survive the drought. Our 22-year-old planting had the same yield as last year, and the year before, the vegetation there did not sense the lack of rainfall” (Steigler Winery).

In Hungary, there is a severe water deficit in the soil due to low rainfall, which will be exacerbated by the dry summer of 2022. “The soil is missing 1,000 mm of precipitation in a 5-year period, which is how little rainfall there has been in eastern Hungary.” (Marcell Bukolyi Organic Wines) The idea of water replenishment before 2022 only occurred for young plantations. “We are not watering at the moment, but

if we need to, the cost will be huge. The investment cost of the irrigation system is also high, but irrigation, pumping capacity, and water supply all require huge budgets” (Count Degenfeld Vineyard).

Thanks to the rise in average temperatures, the development stages of the vine are constantly being brought forward. As a result, the vines fade earlier and are more exposed to spring ground frosts. The warm weather means the grapes ripen earlier, and the harvest date is earlier in all wine regions. “I can remember when we used to harvest in mid to late October, but for years now, we’ve been finishing the harvest in the first week of October” (Gilvesy Winery). Several interviewees pointed out the 2018 harvest was carried out exceptionally early to avoid over-ripening the grapes. “In 2018, we had the earliest harvest here in the north; we harvested in early August, with temperatures around 40 degrees” (Count Degenfeld Vineyard).

The current vine varieties are planted to adapt to the continental climate, but the climate is changing, and these vines cannot adapt. This requires a change in the attitude of winegrowers, taking inspiration from other countries with drier climates and planting new varieties. “We need to switch to drought-tolerant varieties, like in Portugal, where beautiful vines exist. We need to have as wide a range of varieties as possible and experiment to see which ones are better adapted to climate change” (Steigler Winery).

A positive result of the warmer weather is that the late-ripening Tokaj or Upper-Hungary wine regions are also ripening, and production is safer than in previous years when autumn rains could damage the crop. “We can say with greater confidence that we have a better chance of harvesting ripe grapes than in the 1990s or before, when there were successive years when late-ripening varieties failed to ripen because it was not warm enough” (Marcell Bukolyi Organic Wines). From a tourism point of view, there is also a positive impact, as the harvest festivals take place in autumn, so as the weather is warmer and friendlier, more tourists visit the events. When the weather is good, more visitors visit the wineries to taste the wine, walk in the vineyards, and even book accommodation if available. “People like the fact that we harvest in August, and they can see the process, drink fresh must, and eat grapes. When we have a few weeks of warmer weather, we typically see an increase in traffic” (Count Degenfeld Vineyard).

During the research, some interviewees did not consider climate change the leading cause of current phenomena, but argued that every year is different. “There have been similar periods going back at least 100 years, although there is no doubt that the Earth is now in a near-polar orbit, which makes summers warmer” (Malatinszky Mansion Organic Winery).

### 3.2 Organic Production

Organic farming is an agricultural activity that respects the natural life cycle and offers consumers quality food<sup>65</sup>. In organic vineyards, the grapes are not treated with artificial substances; the plant defends itself with its immune system. "All our vines are chemical-free, never exposed to synthetic pesticides, fertilisers, or herbicides. We are talking about a vine with a strong immune system, not infected or weakened by absorbable agents" (Marcell Bukolyi Organic Wines). To prevent the development of infections or the proliferation of pests, the vines are protected with natural products such as orange oil sprayed on them, which helps the copper and sulphur used in grape treatment to stick. "In conventional viticulture, when insects appear, they spray the whole thing with insecticide, even though there are also bugs that are useful to us. Prevention is essential because we can do nothing once the pathogen has spread, so we try to make it impossible for them to live" (Steigler Winery). Warmer weather and less rainfall are not favourable for the pests because they cannot reproduce. "Organic farming is somewhat easier the drier the climate is because the humidity and rain are conducive to diseases" (Gilvesy Winery).

The wineries interviewed did not decide to go organic because of climate change, but because of other factors, such as returning to their roots. "We know very well that about 70 years ago, everything was grown organically; there were no chemicals in agriculture" (Malatinszky Mansion Organic Wine Farm). The switch to organic farming is always an inner motivation because we are exposed to many harmful effects in our everyday lives that we cannot protect ourselves against; at least in the case of food, we should strive to make it as healthy as possible. "There was no question that if we were growing grapes and making wine, it had to be organic because we were treating ourselves and our loved ones" (Steigler Winery). It is also a matter of conscience to protect the planet during production, strive for the smallest possible production footprint, and reduce negative impacts so that future generations can enjoy it. "The heritability of the soil and the productive medium is influenced by and linked to the footprint we leave around us" (Marcell Bukolyi Organic Wines). Gróf Degenfeld Vineyards strives to produce as sparingly as possible, as the estate is part of the family heritage. They switched to organic farming partly because they knew it was already quite common in countries further west. "One of our owners is of Hungarian origin, and her husband is German, and he was the one who said that this was the future because, in Austria and Germany,

organic farming had been practised for many years" (Gróf Degenfeld Vineyard).

The wineries will also organise wine tastings to increase tourists' knowledge of organic production practices and the tangible effects of climate change. "More people are realising that if you cover the soil, it doesn't blow away and collect dew. In this respect, everyone gets a little education during a wine tasting" (Steigler Winery). However, interviews revealed that guests visiting organic wineries are not always interested in the cultivation or the impact of climate change. "Many guests are not interested in farming practices, but sometimes we do touch on such topics; it depends on the company" (Gilvesy Winery).

The interviews revealed a noticeable increase in the number of educated, informed visitors, especially among younger visitors. In the future, it is expected that organic products will continue to gain ground and that the number of conscious guests seeking organic food will be even higher. "Many people come to us because we are an organic winery" (Marcell Bukolyi Organic Wines). The organic label can be an extra attraction, making it competitive with other conventional wineries, which people visit because of the good location. "At Lake Balaton, the big attraction is the water, and for us, it's the organic approach" (Gróf Degenfeld Vineyard).

Some conscious visitors are repeat customers of a winery, either in person or via the webshop, and the fact that they can buy organic wine plays a vital role in their purchasing decisions. Other winery representatives, however, believe that organic is an extra call to action, but that is not why they visit a winery or choose a particular brand of wine; rather, it is because of its high quality or reputation. "Organic is not the main adjective, but it is organic, too! The brand of the winery is much higher than just being organic" (Malatinszky Kúria Organikus Borbirtok). Several winemakers pointed out that it is not a decisive factor for most guests if a wine comes from an organic winery in Hungary. Still, it influences decisions in countries with a developed wine culture. "Abroad, in a more advanced wine-growing country, wineries must practice organic farming. In the West, it is already accepted and sought after here; it is more of a curiosity" (Steigler Winery).

The clientele of the surveyed wineries consists mainly of Hungarian visitors, but there are also tourists from abroad, mainly from European countries, particularly from neighbouring countries. The representative of Malatinszky Kúria Organikus Borbirtok pointed out that foreigners, mostly from Anglo-Saxon countries, also come to Hungary, mainly to Budapest. There are also visitors from America, Russia, and Japan, but far fewer than from Europe. The impact of the Russian-Ukrainian war was felt in this respect, and the coronavirus epidemic reduced the number of tourists from Asia,

<sup>65</sup> Gál (2020).

which has not recovered since. “Before the war broke out, we had a lot of Ukrainian visitors. Asians also love sweet wine, but since the COVID-19 outbreak, there have been very few arrivals, whereas before, there were many of them” (Count Degenfeld Vineyard).

Wineries use the organic label in their marketing activities, giving them a competitive advantage. Wineries that believe it is essential to highlight organicity include it in their communication, both in online platforms such as social media and websites and in offline publications such as wine magazines, brochures, and leaflets. “We always explicitly ask that the term ‘organic Sopron’ is used everywhere, along with a picture of the beautiful flowering vineyard” (Steigler Winery).

The organic certification logo must be included on the label, but opinions are divided on how it should appear. The winemaker at Gróf Degenfeld Vineyards said that their wines are labelled organic on the front and back labels in a relatively colourful way to attract attention. However, they want to get the word organic associated with the estate over time. On the other hand, other wineries only put it on the back label because they think the winery’s name is more important, and they think that’s why people will buy the wine, not because it’s organic. “I think the name and reputation of the winery should be more important on some level, so my name is more important than what I stand for” (Gilvesy Winery).

The number of organic wineries is very small, so it is important to have cohesion between the different wineries. Many decisions have long-term consequences that cannot be reversed, so it is important to exchange experiences, even with conventional wineries, to minimise mistakes. “There is a close collaboration with estates with whom we can work, including organic ones. However, this is not the case in the last 1–2 years; it has always worked” (Gróf Degenfeld Vineyards). The main theme of the annual Wine Conference 2023 was organic wines, where several organic wineries gave presentations and had the opportunity to meet each other. There are other training courses, conferences, and master classes on this topic, which also provide a platform for sharing experiences.

### 3.3 Sustainability

Organic wineries are fundamentally more sustainable than conventional wineries in terms of their environmental impact because they do not use toxic chemicals that would cause damage. Regarding energy use, all the wineries surveyed have solar panels or are planning to install them. They also try to save water in their operations by using yeast that does not need to be steeped in water, but also by using other modern solutions that can cut water use by up to a quarter

in a single operation. “Instead of the old-style sprayers that used about 800 litres of water per hectare, we now have modern tiny drippers that use 400 litres, and next year we plan to buy one that uses only 200 litres” (Count Degenfeld Vineyard).

Selective waste collection is part of the life of every winery. Opinions were mixed on the lighter bottles, but the majority said that the content, i.e., the wine, was important, not the outside. However, in the higher price segments, consumers would not accept this, as they want to buy a premium wine and consume it later, so appearance is also essential. In Western countries, lightweight bottles are entirely accepted, and in some countries, it is not even a condition that the wine is sold in a glass bottle. “In Scandinavia, lightweight bottles are explicitly expected, and it is even possible to pour wine in plastic bottles because they require a fraction of the energy to produce compared to glass bottles and can be recycled” (Marcell Bukolyi Organic Wines).

Wineries use screw caps or cork stoppers to close the bottles. The latter is particularly environmentally friendly, as it protects the cork oak. “Every year, we receive from our cork manufacturers how many cork oaks stoppers we have saved that year by using cork stoppers instead of screw caps or any other alternative closure. If we did not buy cork stoppers, all these oaks would be cut down because they have no other use” (Steigler Winery). Recycled cardboard boxes are used to transport the wines, except for premium wines. At Steigler Winery, all wines are filled in the same bottle for easier packaging, and Gróf Degenfeld Vineyard buys boxes made by people with disabilities. This winery has also considered improving waste management, such as using marc or other by-products from production.

The short supply chain also plays a vital role in the life of a winery, especially in terms of building relationships with other service providers. “There is a bakery opposite us where we buy sourdough bread for the tastings, so we try to support them” (Steigler Winery). Malatinszky Mansion Organic Winery tries to produce everything it needs. “We have a 2,000 square metre garden full of herbs and aromatic plants, and we make our tea from it. We also grow fruit, which we eat fresh or store in jams and preserves for the winter. And we make our pesticides from lavender” (Malatinszky Mansion Organic Wine Estate).

All the winery representatives said they are open to new sustainable trends, not primarily driven by financial reasons but by internal motivation and the potential to reduce costs. “If it’s very well thought out, there is the potential to save money, but you have to think about it and put it into practice” (Gilvesy Winery).

Sustainability is also reflected in catering and the various wine events. We use “DropStops” or “drip

stops“ to prevent the wine from dripping during the pouring process. It’s a flat device that can be folded and washed away“ (Gróf Degenfeld Vineyard). Disposable and biodegradable solutions, such as cutlery and plates made of wood or cane, are available. Still, because of the premium quality, they are not always allowed, so food is served on ceramic or porcelain plates, which can be consumed with metal cutlery. Re-glasses are very popular and widespread at festivals, including the Sopron Wine Festival, but premium wines are always served in glass glasses. “In our region, a decilitre of wine can cost up to eight thousand forints. We can’t imagine pouring it into anything other than a stylish, high-quality crystal glass“ (Malatinszky Mansion Organic Wine Estate).

There are barriers to sustainability, the most significant of which is the financial constraint. Organic farming is more costly, as the vines must be tended more often than in conventional vineyards. There is also a high-cost implication for introducing modern technologies, such as installing renewable energy equipment. “We would like to install solar panels in the cellar in the foreseeable future, which we cannot do on our own, especially in the current financial climate“ (Marcell Bukolyi Organic Wines). The lack of physical space and the fact that wineries and vineyards are located on hillsides may pose a problem, as not all conditions are met for certain activities. “There are physical limitations in the winery, so I have another site where I have already moved some activities, as it is easier to work there“ (Gilvesy Winery). The last barrier mentioned is the lack of sustainability in the different wineries and the lack of a common ethos, which makes it difficult for businesses that want to be environmentally friendly.

At the end of the interview, all the winery representatives said that there is always room for improvement and that they are open to introducing new things as long as they are helpful and can benefit in some way. The Steigler Winery would like to increase the size of their vineyards in the future, as they have seven hectares of land available, and they believe that selling the wine made from the grapes grown on the new land would not be a problem.

There is a desire to stimulate cultural life, with local artists performing and tasting wine, especially when wine tourism is not popular. “The idea is to open a gallery downstairs in the cellar, giving any budding or established Sopron artist a chance to show their work. These start between November and February, when almost everyone sits at home“ (Steigler Winery).

### 3.4 Proposals

The interview responses show that many conscious consumers are determined to seek out chemical-free, organic wines. In contrast to Western countries, public awareness of high-quality organic wines is not nearly as widespread in Hungary, and even fewer consumers know what this means. Educating and informing the public would be worth organising an organic wine exhibition. Visitors could choose between different types of tickets, depending on the wine they want to taste. All organic wineries would be invited to participate as exhibitors. It would be held in Budapest for the first time and, if successful, could be organised in other cities in the country (e.g. Győr, Pécs, Debrecen, Szeged), with the winemakers of the respective wine regions playing the role of hosts. In addition to providing education, this would be a good publicity and sales opportunity for the wineries and encourage tourists to visit the wineries in person.

Wineries could also emphasise their sustainability efforts in the name and design of their wines: wine names can be considered brand names, and the name itself and the characteristics of the name convey information about the wine and thus influence consumer decisions (cf.). A brand name – or a design combined with a brand name – that (also) refers to sustainability could, therefore, contribute to consumers’ awareness of the sustainability efforts of the wine or winery by evoking the correct associations (cf.<sup>(66)</sup>,<sup>(67)</sup>).

The representatives of the wineries do not plan any tourism developments or programmes that could be linked to climate change. It would be worthwhile, however, to give tourists an insight into the daily life of wineries by holding open cellar days every season, when visitors can follow the current work processes. This can be done on foot, but a jeep tour can also be organised if the vineyard is under construction. This would give visitors a first-hand experience of the signs of climate change, especially during the summer drought, and the care and work of making a bottle of wine. From a tourism point of view, this could increase the number of visitors and help sales, as tourists who have followed the production process will be curious to see the result.

Each winery has its own Facebook and Instagram profiles. Creating a typical social media profile for each wine region would be worthwhile, allowing them to reach more tourists and attract them to the area. These platforms could include prize draws and playful tests to raise awareness of the concept of organic wine and make it more widely known. Advertising individual

<sup>66</sup> Winetourism.com. (n.d.).

<sup>67</sup> Sallay et al. (2017).

winery programmes and creating and promoting joint events would also be possible. Tours could be organised between wineries in the same wine region, and buses or miniature trains could transport guests so that no one would have to abstain from drinking alcohol. There would be a central departure and arrival point, and connections could be made en route. A separate booking system for team-building events would operate. This would require collaboration between organic wineries.

## IV Conclusions

Climate change cannot be ignored; we are responsible for protecting the Earth, as human activity is the leading cause of a warmer climate, and mitigation is only possible through global action.

Over the last 10–15 years, especially since 2010, all the wineries surveyed have experienced warmer average temperatures than in previous periods. This is coupled with hectic weather, including infrequent but intense rainfall and dry periods with strong sunshine. The best way to protect against heavy rainfall is by planting and grassing the edges of the fields, which prevents the soil from being washed away. In order to prevent damage from UV radiation, the leaves that protect the crop from direct sunlight and thus from scorching are retained when the shoots are picked. To combat the summer drought, which is most damaging to young plantations, they do not currently have the technology to replenish water. They are not equipped to irrigate, but this year several wineries have considered this development,

which has a high cost. With the warmer weather, harvesting is being pushed back, so great care is needed in choosing the time of harvest to avoid picking grapes that are immature or overripe. To avoid this, new varieties of grapes that are more drought-tolerant should be considered. A positive result of early harvesting is that there is greater certainty that grapes will ripen in late-harvested wine-growing areas, which was often not the case in the 1990s. It also benefits tourism, with a typical increase in traffic in the autumn, tourists can walk the vineyards, eat fresh fruit and drink must, all adding to the visitor experience.

All the wineries surveyed have been practising organic farming for at least 5 years, using no artificial chemicals at any production stage and relying instead on the plants' natural immune systems. Prevention of diseases and pests is essential, and they try to prevent them from developing and spreading because it is much more challenging to treat them afterwards. All the wineries have chosen organic farming for a healthier way of life, aiming to preserve the environment for future generations and pass on arable land. In Hungary, unlike in countries further west, organic products are not yet as widespread and in demand, but there is a future for organic farming in our country. There is a growing number of conscious consumers, especially among the younger generation. The organic label is an extra call to action in sales and marketing, so it is worth communicating. Still, the name and reputation of the winery must have a stronger meaning. The aim is that when consumers hear the name of an organic

**Table 4** SWOT analysis regarding the Hungarian organic wine production

| Strengths                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Opportunities                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>– organic resilience: natural plant protection boosts vine immunity</li> <li>– eco-friendly management: solar energy, water-saving, and sustainable soil care support environmental goals</li> <li>– climate adaptation: techniques like shoot selection and hail protection mitigate weather extremes</li> <li>– sustainability appeal: organic labels attract young, eco-conscious visitors</li> <li>– harvest stability: warmer autumns improve late-ripening grape quality and yield security</li> <li>– tourism education: tastings promote awareness of organic farming and climate issues</li> </ul> | <ul style="list-style-type: none"> <li>– climate-resilient varieties: introducing drought-tolerant grapes from Mediterranean regions for long-term adaptability</li> <li>– growing sustainable tourism demand: eco-tourism and organic products boost marketing potential</li> <li>– collaborative synergies: knowledge-sharing and partnerships enhance innovation among wineries</li> <li>– favourable climate shifts: warmer conditions enhance productivity and tourism potential</li> </ul> |
| Weaknesses                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Threats                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <ul style="list-style-type: none"> <li>– high adaptation costs: irrigation and infrastructure require significant investment</li> <li>– low consumer awareness: organic label has limited influence on most visitors</li> <li>– early harvest challenges: faster ripening causes early harvests, risking over-ripening and logistical issues</li> </ul>                                                                                                                                                                                                                                                                                            | <ul style="list-style-type: none"> <li>– extreme weather: more droughts, hail, and UV damage reduce yields</li> <li>– soil water deficit: long-term rainfall shortages threaten vineyard health</li> <li>– domestic consumer indifference: organic label less valued by Hungarian buyers</li> <li>– economic barriers: high costs limit climate adaptation and organic scaling</li> </ul>                                                                                                        |

Source: own ed. based on own research

winery, they are reminded that it is a winery with a good name and that it is organic.

Organic production is essentially sustainable, as no environmentally harmful chemicals are used. The wineries in the study also strive to be sustainable in terms of energy use, for example, by installing solar panels, modernising machinery, and reducing water consumption. Selective waste collection is implemented in all wineries. Some bottling is done in lighter bottles, but not all the wineries surveyed follow this practice, as it is not considered acceptable for premium wines. Screw caps are used to close the bottles, but the most sustainable solution is to use cork stoppers. Recycled cardboard boxes are used for transport, and the Tokaj winery even buys boxes made by people with disabilities. The idea of using by-products more efficiently has been raised, but not all wineries do this, although there are examples of wineries that have gardens where they grow fruit to make jams and preserves or herbs to make tea. They use cutlery and plates made of biodegradable materials or traditional ones at events and catering. Wine tasting is always done by glass. The SWOT analysis of the Hungarian organic wineries can be seen in Table 4.

The study's most significant limitation was that most of the wineries in Hungary are not organic, so the number of possible interviewees was minimal. It would be worthwhile to extend the research to conventional wineries to find out their views on climate change, sustainability, and wine tourism and compare them with the responses from organic wineries, which would allow us to identify similarities and differences. It would also be worthwhile to conduct research in more advanced countries with more experience in organic farming. This research has focused on the service provider side. Still, it would also be helpful to understand consumers' views on the importance of making wine in a more environmentally friendly way and the impact of this on their motivation to buy and travel.

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