
CHAPTER 4

Dynamics of grapevine production and wine export performance in Ukraine

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Abstract

This paper analyzes the dynamics of grape production and yield in Ukraine from 2000 to 2023. The average gross harvest amounted to 397,2 thousand tons. Ukraine possesses significant potential for grape cultivation and wine production, which is determined by favorable soil and climatic conditions, the presence of unique autochthonous grape varieties, and the commitment of producers who continue to develop and advance this sector despite numerous challenges. A comparative analysis of the gross grape harvest and the export of grape wines during the study period was conducted. The results indicate that grape wine exports account for an average of 17.1%. However, there is considerable potential to increase this indicator due to the country's rich winemaking history, favorable climatic conditions, fertile soils, and the existence of specialized viticulture regions. The study also reveals opportunities for further development of the industry, particularly through successful marketing strategies implemented in recent years and the growing demand for white and sparkling wines. Based on the results obtained, priority directions for the development of the Ukrainian wine industry in the context of its positioning on the international market have been identified.

Ukrainian winemaking has significant potential due to its rich historical traditions, favorable climatic conditions, fertile soils, and the presence of specialized viticulture regions. However, despite this potential, the industry currently operates below its full capacity. In addition, consumer skepticism toward Ukrainian wines continues to limit the sector's development. At the same time, new opportunities for growth are

emerging, particularly due to successful marketing strategies implemented in recent years and increasing demand for white and sparkling wines.

Keywords

Grapes, vineyard area, gross grape harvest, yield, wine exports, grape wines, international market positioning.

4.1 Introduction

The potential of Ukrainian agricultural production is not limited solely to cereals and industrial crops [1, 2]. Changes in climatic conditions and the intensification of integration processes in recent years have become important factors transforming the viticulture and winemaking market. The main changes are linked to rising average annual temperatures, more frequent droughts, uneven rainfall distribution, and an increase in the number of extreme weather events. All of this presents both risks and new opportunities for the agricultural sector [1, 2]. These processes contribute to the expansion of territorial potential and to changing opportunities for grape cultivation both in traditional and non-traditional areas. For Ukraine, this implies a gradual increase in the sum of active temperatures, an extension of the vegetation period, and a higher potential for sugar accumulation in grapes, which creates favorable conditions for producing wines with improved quality characteristics.

However, climate change can have a significant impact on grapes. Warming temperatures are helping to expand wine-growing regions northward, allowing vineyards to be established in new parts of the country; however, excessive heat and prolonged summer droughts can negatively affect berry quality and alter the sugar and acidity levels of the grapes, which is important for winemaking.

Deepening cooperation with the European Union has also contributed to the harmonization of quality standards, the introduction of modern technologies for grape cultivation and processing, and the expansion of wine export opportunities. The adaptation of the regulatory framework to European requirements has stimulated production modernization, increased product competitiveness, and fostered the development of a new wine consumption culture.

Thus, the combination of climate change and integration processes creates a complex effect: on the one hand, it generates new opportunities for the industry, and on the other hand, it drives structural transformations of the market in accordance with international standards. As a result, viticulture and winemaking are increasingly gaining strategic importance as components of the agricultural economy and the country's export potential.

It is generally believed that grape cultivation in Ukraine dates back approximately four thousand years before our era. On the southern coast of Crimea, archaeological findings include winemaking presses and other tools used in wine production. Ancient Greeks introduced their grape varieties to the region and actively engaged in winemaking, from where viticulture gradually spread to other parts of Ukraine [3]. However, archaeologists have discovered grape seeds in clay amphorae at the sites of Trypillian settlements located near the border of present-day Ukraine and Moldova. These amphorae resemble those found in Georgia, where winemaking traditions date back around eight thousand years. Therefore, it can be assumed that winemaking in Ukraine may have emerged even before Greek colonization [4–6].

Unfortunately, much of Eastern Europe is characterized by climatic conditions that are too cold for large-scale wine production. Therefore, when wine is referred to as "Eastern European", it usually denotes wines produced in the southeastern part of the region, particularly in Romania, Georgia, Bulgaria, Hungary, and Ukraine. Other Eastern European countries such as Latvia, Estonia, Lithuania, and Poland are traditionally better known for beer production, although in recent years they have also begun developing their own winemaking sectors.

Geographically, Ukraine belongs to the so-called "New Old World" of wine production and, despite having a relatively young modern wine industry, remains faithful to long-standing traditions [7]. The main winemaking regions of Ukraine include Bessarabia, the Black Sea region, Transcarpathia, Zaporizhzhia, and Crimea.

It should be noted that due to climate change, the areas suitable for grape cultivation in Ukraine are gradually expanding, and viticulture zones are shifting northward. Today, Podillia can already be considered one of the most promising emerging wine regions in Ukraine.

The varietal characteristics of grapes significantly influence the profitability of production, the efficiency of cultivation, and the possibilities for mechanization and automation of vineyard management, including fertilization and plant protection against pests and diseases. Therefore, autochthonous grape varieties, which are best adapted to specific local conditions, are particularly valuable both from an economic perspective and in terms of regional and national image [7], as they define the uniqueness and identity of wine production.

Indigenous varieties, which have evolved over a long period of natural and selective breeding, are typically characterized by a high degree of adaptability to the specific climatic and soil conditions of the region. Such varieties often demonstrate greater resistance to local diseases and pests, which helps reduce production risks and increase yield stability. The use of indigenous varieties also allows for reduced

vineyard maintenance costs and optimizes the use of water resources, fertilizers, and plant protection products.

In addition to economic and technological advantages, indigenous Ukrainian varieties play a crucial role in shaping the unique style of Ukrainian wines. It is these varieties that are best able to fully reflect the natural characteristics of the region – climate, soil, and other factors that shape the character of the wine. As a result, such wines acquire a distinct personality and can be successfully positioned in domestic and international markets as products with a clearly defined origin.

The relevance of studying the potential of the Ukrainian wine market is driven not only by the intensification of integration processes with the European Union [8] but also by the consequences of Russia's military aggression. Agricultural products and their processing create opportunities for generating foreign currency revenues and strengthening the national economy, while simultaneously creating significant risks for the development of Ukrainian viticulture and winemaking.

The war in Ukraine has severely affected regions that traditionally specialized in grape cultivation and wine production, particularly in the southern part of the country (Kherson, Mykolaiv, and Odesa regions). The aggressor has destroyed enterprises, looted unique wine collections, and barbarically devastated vineyards. For example, in 2022 alone, approximately 500 hectares of vineyards were destroyed in the Mykolaiv region. The Kherson region remains partially occupied. The renowned winery "Prince Trubetskoy Winery" (currently Stoic Winery) was looted and destroyed during the occupation at the beginning of the war; it was later liberated by the Ukrainian army in the summer of 2022 but subsequently suffered flooding after the destruction of the Kakhovka Hydroelectric Power Plant in 2023, as its vineyards were located on the slopes of the Kakhovka reservoir. Additionally, the legendary Artemivsk Champagne Wine Factory (now Artwinery) in the city of Bakhmut, known for its unique underground galleries used for producing sparkling wines according to the classical method, was completely destroyed.

Currently, some wine-producing regions in the south, particularly Kherson and Zaporizhzhia regions, remain partially occupied. Nevertheless, Ukrainian farmers continue to establish new vineyards. In recent years, viticulture and winemaking have expanded beyond traditional regions and are increasingly developing further north, including Podillia, Ternopil, Chernihiv, Kyiv, Khmelnytskyi regions, and central parts of Ukraine.

Despite four years of war, Ukraine is experiencing a revival of its wine industry. Ukrainian winemakers are actively increasing production and exports, participating in wine fairs, promotional tours, and international tastings.

However, it may take several decades before Ukraine secures a well-deserved place on the global wine map. Therefore, research on the conditions for grape cultivation in Ukraine, the identification of development opportunities, the expansion of domestic market participation by local winemakers, and their entry into European and global markets remain crucial tasks for Ukrainian grape producers and winemakers.

4.2 Material and methods

The aim of this paper is to analyze grape production and the export potential of wine in Ukraine, to identify the relationship between gross grape harvest, grape yield, and wine exports, and to develop recommendations for assessing the effectiveness of Ukrainian wine exports, their market capacity, and opportunities for further growth in connection with the expansion of vineyard areas and the transition to modern cultivation technologies under conditions of climate change.

The starting point of the study was the year 2000, while the final point was 2023. Thus, the research covers a period of 24 years. The study is based on data obtained from the State Statistics Service of Ukraine [9], the official statistical database of the European Union [10], and the Foreign Agricultural Service of the United States Department of Agriculture [11].

The research included a comparative analysis of vineyard area, gross grape harvest, and grape yield over the study period. The results revealed an increase in vineyard areas and grape yields prior to the outbreak of the war. The study also analyzes the factors that led to the decline in vineyard areas, as well as the drivers of development and recovery of the Ukrainian wine industry.

A comparative analysis of gross grape harvest and wine exports as a processed product of grapes was conducted for the studied years. The results indicate growing interest among foreign consumers in Ukrainian wines, particularly those produced from autochthonous grape varieties.

To calculate dynamic indicators and construct graphical representations, statistical and mathematical methods were applied using Microsoft Excel software [12].

4.3 Results and discussion

Of all the factors that determine whether grapes can be grown for winemaking in a particular area, climate is the most important. It is the climatic conditions that determine the range of grape varieties that can be grown in a given region [13].

More than 200 grape varieties are cultivated in Ukraine. In addition to widely known varieties introduced from Europe and Asia, Ukraine has developed several local and autochthonous varieties, including Telti-Kuruk, Sukholymanskyi Bilyi, Citronnyi Magaracha, Kokur, Odeskyi Chornyi (Alibernet), Ekim Kara, and Magarach Bastardo [14]. Ukrainian viticulturists and winemakers work with a wide range of international and European grape varieties and also produce high-quality and elegant wines from PIWI varieties such as Sauvignier Gris, Solaris, Muscaris, Johanniter, and Cserszegi. However, the number of autochthonous varieties in Ukraine remains limited, as many traditional varieties were lost during the Soviet period.

In addition to local varieties, Ukrainian producers successfully cultivate well-known international varieties such as Chardonnay, Cabernet Sauvignon, Merlot, and Pinot Noir, producing wines of competitive quality [15, 16].

In Europe, the 46th parallel is often considered the unofficial boundary of optimal viticulture. Ukraine is located between the 44th and 52nd parallels, which provides favorable geographical conditions for the development of the wine industry [17]. However, Ukrainian growing conditions differ from those in Spain, France, or Italy due to specific agroclimatic factors. Among the most important indicators are the sum of active average daily air temperatures above +10°C during the vegetation period (from bud break to berry ripening) and soil moisture availability.

Latitude determines the amount of sunlight, the length of daylight hours, and indirectly influences one of the key climatic parameters – air temperature. In practice, the suitability of an area for grape growing is most often determined by the range of the average monthly air temperature during the growing season, which should fall between 12 and 22°C [14]. This is entirely consistent with Ukraine's temperature norms; for example, in the Steppe, which covers a significant part of the country, this figure ranges between 15–20°C. However, due to the varied terrain and the country's vast size, climatic conditions can differ significantly and be more or less favorable for wine production.

However, the climate changes currently taking place are altering the conditions for growing crops in general and grapes in particular. Due to climate change (rising temperatures and reduced rainfall), the suitability of significant areas for grape growing is expected to change. According to current projections [15], with global warming not exceeding 2°C (low-emission scenario), most traditional wine-growing regions will not experience significant changes that could substantially affect the sector. However, in southern Europe, the risks of drought (against a backdrop of water shortages for cultivation) and losses (both in quantity and quality) due to sunburn of the grapes [18] will increase significantly, which will undoubtedly affect the quality of the wine produced.

More pessimistic warming scenarios (exceeding 2°C) suggest that a significant part of the Mediterranean region and parts of the Black Sea region may become unsuitable for grape growing. Wine production south of 45° N will be under threat [19]. Conversely, a significant expansion of vineyards north of 46° N is expected [20]. Of course, such forecasts do not take into account the influence of soil composition and quality, the number of sunny days, the timing of spring and autumn frosts, or the spread of diseases and pests. However, to some extent, these processes are already observing within Ukraine.

While thermal resources determine the possibility of full grape ripening, sufficient soil moisture allows plants to grow without stress. Although the sum of active temperatures in Ukraine is generally comparable to that of France, it is lower than in Italy and Spain, and the level of moisture availability is significantly lower [21].

Each region of Ukraine is interesting in its own way from the perspective of viticulture and winemaking, and each is unique. This is due to the diversity of natural and climatic conditions, soil types, and historical traditions of grape growing. For instance, the South, particularly the Black Sea region, is characterized by a warm climate, a significant number of sunny days, and fertile soils, creating favorable conditions for growing table grape varieties and producing various styles of wine. It is here that a significant portion of the country's commercial vineyards is concentrated and large winemaking enterprises operate.

At the same time, Western Ukraine has its own specific characteristics of viticulture development. A mild climate, moderate humidity, and mountainous terrain create favorable conditions for growing aromatic and white grape varieties. Small-scale family winemaking and craft wine production are actively developing here, focusing on local traditions and the unique characteristics of local terroirs. This contributes to the diversity of Ukrainian wine styles and enhances their appeal to tourists and wine connoisseurs.

In addition, grape-growing areas are gradually expanding in Central Ukraine. Thanks to climate change and the adoption of modern agricultural technologies, vineyards are beginning to appear in regions previously unsuitable for this crop. This opens up new prospects for the development of winemaking, allowing for experimentation with different grape varieties and the creation of new regional wine styles. As a result, Ukrainian winemaking is becoming increasingly diverse and competitive, reflecting the natural and cultural richness of the country's various regions.

Among the regions traditionally recognized as wine-producing areas in Ukraine are Bessarabia, the Black Sea region, Transcarpathia, and Crimea.

Bessarabia is located in southern Ukraine between the Dniester, Danube, and Prut rivers, with the Odesa region serving as its central hub. This sunny region is

known for its ancient winemaking traditions originating from Greek and Thracian settlements. In addition to fertile chernozem soils, the region is characterized by loamy soils with a high mineral content [9, 16]. Well-known varieties such as Cabernet Sauvignon, Merlot, and Pinot Noir are cultivated here, along with autochthonous varieties such as Telti-Kuruk and Odeskyi Chorny. The National Scientific Center "V. Tairov Institute of Viticulture and Winemaking" currently serves as the leading research institution in the field of viticulture in Ukraine. The institute contributes to industry development by compiling vineyard cadasters, improving technologies for certified clonal planting material, and implementing them in the largest nurseries in the country. In terms of latitude, Bessarabia corresponds to the northern region of Italy – Piedmont.

The Black Sea region includes parts of Odesa as well as Mykolaiv and Kherson regions. Wine production here is influenced by a more continental climate. The mineral character of wines is largely associated with proximity to estuaries, bays, and lakes. The regional assortment mainly consists of light white wines, full-bodied red wines, and sparkling wines produced using the Charmat–Martinotti method [16].

The Odesa, Mykolaiv and Kherson regions lie at the same latitude as the legendary Bordeaux region of France. The 45th parallel runs right through them. However, the annual rainfall is almost half that of Bordeaux, whilst the number of sunny days is slightly higher. Under such conditions, the grapes develop higher sugar content and a more concentrated flavor. The problem of insufficient rainfall is addressed through the use of drip irrigation systems. Nevertheless, the lower rainfall does offer certain advantages. Frequent rainfall and high humidity in Bordeaux trigger the widespread development and significant damage caused by grape diseases such as mildew or downy mildew (*Plasmopara viticola* Berl. et de Toni), oidium or powdery mildew (*Uncinula necator* Burrill) and grey mold (*Botrytis cinerea* Fr.). In the drier conditions of southern Ukraine, these diseases are less damaging.

It is also worth noting that Dobruja, the leading region for Romanian wine production, borders the Odesa region and has identical climatic conditions.

Zaporizhzhia region, located on the coast of the Azov Sea, also belongs to this region and represents one of the smallest winemaking centers in Ukraine. This region primarily focuses on the cultivation of table grape varieties. However, a large part of the region has been occupied by Russia since 2022.

Crimea has historically been the pearl of Ukrainian winemaking, hosting some of the oldest wine enterprises in the country. Viticulture in Crimea dates back to ancient times. Due to its unique climate and diverse soils ranging from foothill zones to the southern coastal areas, Crimea is divided into several viticultural zones. These conditions result in a wide diversity of wine styles, from light table wines to refined

fortified and dessert wines. The southern coast of Crimea, protected by mountains from cold winds, has a sub-Mediterranean climate ideal for growing heat-demanding varieties and producing fortified wines such as sherry-, port-, and Madeira-style wines. Meanwhile, areas around Sevastopol and Bakhchisarai, characterized by cooler climates and limestone soils, are well suited for the production of still and sparkling wines from varieties such as Chardonnay and Pinot Noir.

Until 2014, the Institute of Viticulture and Winemaking "Magarach" served as the leading research institution in Ukraine in this field. The institute operated several experimental farms in Crimea that functioned as laboratories for the preservation and breeding of rare grape varieties. Its research activities included plant protection and physiology, molecular genetics, agronomy, microbiology, vineyard zoning, grape breeding and genetics, wine and brandy technology, analytical research on innovative technologies, metrology, and patent studies. Crimea has historically preserved the richest varietal composition among Ukrainian wine regions, with more than one hundred grape varieties.

Among the major wineries historically associated with Crimea are the state enterprise "Massandra", known for producing high-quality fortified and dessert wines and maintaining a unique wine collection. Another important enterprise is the "Novyi Svit" sparkling wine factory, renowned for its classical sparkling wines produced using the *méthode champenoise*. In northern Crimea, large enterprises such as the vintage wine and brandy plant "Koktebel" operated, while the western coast hosted enterprises such as the Inkerman Vintage Wine Factory and the agricultural company "Zolota Balka", both producing sparkling and still wines. Until 2014, these enterprises represented Ukraine at international exhibitions and served as important symbols of Crimean winemaking.

The varietal composition of grapes in Crimea is highly diverse. Among technical grape varieties, muscat varieties (white, pink, and black) occupy a special place, forming the basis of the famous dessert wines of Massandra. The Kokur Bilyi variety is a unique autochthonous Crimean grape used for producing both dry and dessert wines, particularly in the Sudak region [23].

As can be seen, the Crimea is quite diverse and even unique in terms of its climate and soil quality. For this reason, it is difficult to compare it with other European wine-producing regions. However, its Mediterranean-type climate, with hot summers and mild winters, is most similar to that of southern France (Provence, Languedoc), parts of Italy (Tuscany, Sicily) and Portugal (Madeira).

Transcarpathia, located in western Ukraine and separated from the rest of the country by the Carpathian Mountains, is another important wine region. The vineyards here are dominated by Riesling and Traminer varieties used to produce

light white wines. Full-bodied red wines are also produced using Merlot and Cabernet Sauvignon. Additionally, the regional variety Cserszegi is cultivated in this area [16, 24].

Hungary and Slovakia border Transcarpathia, so the local wine-growing industry is geographically and climatically linked to the renowned Tokaj region. Thanks to the protection of the Carpathian Mountains, a unique humid microclimate is created here. This is the only region in Ukraine where rainfall is comparable to that in such renowned wine-growing locations as Piedmont or Bordeaux.

Podillia represents one of the emerging and less traditional wine regions of Ukraine. This region stretches from the Carpathians toward the central part of the country and includes territories of Ternopil, Khmelnytskyi, and Vinnytsia regions, as well as the Podilski Tovtry area. It belongs to the forest-steppe zone. The main river of Podillia is the Dniester, and warm microclimatic zones are formed on its slopes and along tributaries, creating favorable conditions for grape cultivation [8]. White grape varieties such as Johanniter, Solaris, Muscaris, Traminer, and Dublianskyi are mainly cultivated here, along with red varieties including Dunai, Merlot, Cabernet, and Odeskyi Chornyi. Among the emerging wine areas in this region, Bakota stands out as a relatively young but highly promising wine-growing zone. Its cooler climate contributes to the production of high-quality white wines with pronounced acidity and aromatic rosé wines.

Thus, Ukraine possesses significant natural and human resources for the development of viticulture and winemaking. Favorable soils, suitable climatic conditions, and the dedication of local producers create strong foundations for further development of the industry.

4.4 Analysis of vineyard area, gross harvest, and grape yield

An analysis of key indicators of viticulture development is crucial for assessing the state and operational efficiency of the industry, as well as for forecasting its future development. Key indicators that characterize the level of viticulture development include vineyard area, gross grape harvest, and grape yield. These indicators allow for an assessment of the scale of production, the productivity of vineyards, and the efficiency of land use in viticultural enterprises.

An analysis of changes in vineyard area makes it possible to identify trends in the sector's development, detect changes in the structure of vineyards, and assess the impact of economic, natural-climatic, and social factors on the sector. At the same time, the gross grape harvest indicator reflects total production volumes, which is

directly linked to the level of raw material supply for the wine industry and the grape processing and storage sectors.

The grape yield indicator is a comprehensive measure that characterizes the efficiency of crop cultivation and the level of application of modern agricultural technologies. An analysis of changes in this indicator allows to assess the impact of technological, climatic, and organizational-economic factors on vineyard productivity. Thus, it is possible to comprehensively assess the state of the industry, identify the main trends in its development, and outline the prospects and opportunities for further growth.

The dynamics of vineyard area and gross grape harvest in Ukraine over the period 2000–2023 are presented in **Fig. 4.1**.

In 2000, the total vineyard area amounted to 109,6 thousand hectares, of which 99,4 thousand hectares were of fruit-bearing age, representing 90.7% of the total vineyard area. During the following three years, the vineyard area slightly decreased and in 2003 reached 99,3 thousand hectares, of which 85,5 thousand hectares were fruit-bearing, accounting for 86.1% of the total area.

In subsequent years, the vineyard area continued to gradually decline. By 2010, the total vineyard area had decreased to 87,0 thousand hectares, including 66,7 thousand hectares of fruit-bearing vineyards, which represented 77.7% of the total area. As can be observed, the proportion of fruit-bearing vineyards also declined during this decade, from 90.7% to 77.7%, indicating an increase in the share of newly planted vineyards that had not yet reached productive age.

After 2010, a major turning point for Ukraine occurred in 2014 when Russia annexed Crimea. In that year, the total vineyard area decreased to 48,7 thousand hectares, of which 44,2 thousand hectares were fruit-bearing, accounting for 90.8% of the total area. Compared with 2013, when vineyard areas amounted to 75,1 thousand hectares prior to the annexation, the vineyard area decreased by 26,04 thousand hectares in 2014. Consequently, the area of fruit-bearing vineyards declined by 22.9%.

By the end of the decade, vineyard areas continued to decrease gradually. In 2020, the total vineyard area amounted to 39,1 thousand hectares, of which 37,2 thousand hectares were fruit-bearing, representing 95.1% of the total area. Thus, during this period most vineyards had reached productive age, with relatively few new plantings being established.

In the last pre-war year, 2021, the total vineyard area amounted to 36,6 thousand hectares, including 34,7 thousand hectares of fruit-bearing vineyards (94.8% of the total area).

In 2022, the total vineyard area decreased further to 30,2 thousand hectares of which 29,0 thousand hectares were fruit-bearing (96.0% of the total area).

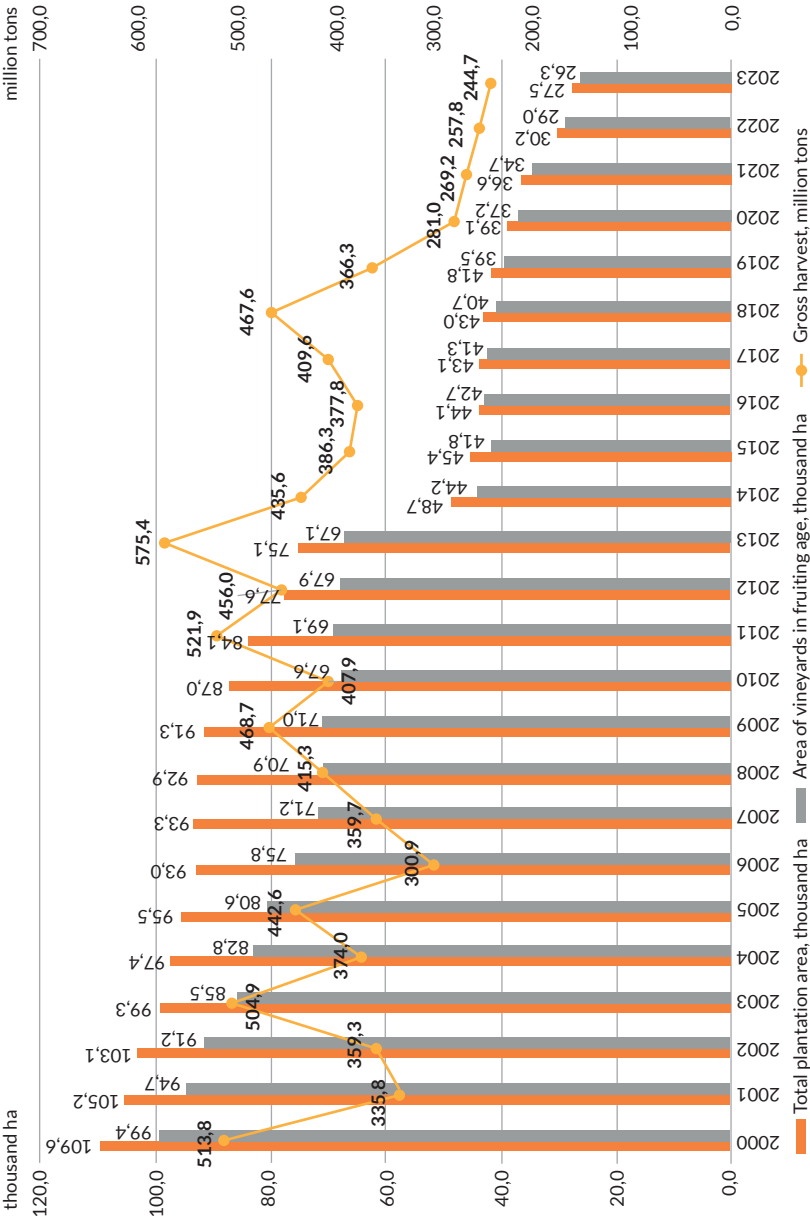


Fig. 4.1 Dynamics of total vineyard area, fruit-bearing vineyard area, and gross grape harvest in Ukraine (2000–2023)
Note: since 2014, due to the military invasion by Russia and the illegal seizure of Crimea, there are no data for that region

In 2023, the vineyard area amounted to 27,5 thousand hectares, including 26,3 thousand hectares of fruit-bearing vineyards (95.6% of the total area).

A comparison of the data for 2000 and 2023 shows a significant reduction in vineyard areas. Over this period, the total vineyard area decreased from 109,6 thousand hectares (including 99,4 thousand hectares of fruit-bearing vineyards) to 27,5 thousand hectares (including 26,3 thousand hectares of fruit-bearing vineyards). Thus, the total vineyard area declined by 82,1 thousand hectares, or 74.9%. The area of fruit-bearing vineyards decreased by 73,1 thousand hectares, or 73.5%. Overall, the vineyard area in Ukraine decreased almost fourfold during the study period.

This decline can be attributed to a range of factors, both political and natural. Among the objective reasons are the annexation of Crimea, the ongoing Russian-Ukrainian war, the occupation of certain territories, and the ecological disaster caused by the destruction of the Kakhovka Reservoir. In addition, several years were characterized by unfavorable weather conditions.

Despite these challenges, in recent years both domestic and international interest in Ukrainian wines has increased, as Ukrainian producers are increasingly capable of competing with global wine producers. However, certain issues related to product quality and market positioning remain. Ukraine possesses significant potential for high-quality wine production: the viticulture sector currently uses less than 1% of the country's agricultural land, which indicates substantial opportunities for vineyard expansion. Moreover, the industry generates considerable tax revenues for the national budget and provides employment for thousands of people [8].

The gross grape harvest for the studied period 2000–2023 had different values according to different weather and climatic conditions and political problems. The average gross harvest is 397,2 thousand tons. As is seen, there is a certain instability of the gross harvest indicators starting from 2000 with the value of the gross harvest – 513,8 thousand tons and the value – 335,8 thousand tons in the lean year 2001. In 2002, the gross harvest was obtained at the level of 359,3 thousand tons. The largest value of the gross harvest for the studied period fell on the harvest year 2013 – 575,4 thousand tons. After 2014, which was the year of the annexation of Crimea, the data no longer take into account the indicators of the harvested crop on the peninsula. For the period from 2014 to 2021, the largest grape harvest was harvested in 2018 – 467,6 thousand tons. The period from 2020 to 2023 was characterized by very low gross harvest indicators: 2020 – 281,0 thousand tons, 2021 – 269,2 thousand tons, 2022 – 257,8 thousand tons and 2023 – 244,4 thousand tons. It was in 2023 that the smallest gross harvest was obtained – 244,7 thousand tons. Small values of the gross grape harvest were obtained for various

reasons, but the greatest influence, in addition to political reasons, on reducing the indicator is spring frosts, which are a systemic climatic risk that determines the instability of grape yields in Ukraine. In the context of climate change, this problem becomes no less, and sometimes even more urgent, since the combination of early vegetation and the preservation of the risk of cold snaps increases the likelihood of production losses.

However, Ukraine has enormous potential for grape growing and wine production, which consists of favorable soil and climatic conditions, the presence of interesting autochthonous varieties and, most importantly, enthusiasts who develop and drive this industry, despite all the difficulties. Improving the varietal composition, optimizing the location of vineyards and implementing active and passive frost protection systems is one of the strategic directions of the industry's development.

4.5 Grape wine export analysis

Let's analyze the indicators of the Ukrainian wine industry's foreign economic activity and the signs of its integration into the global market. Grape wine exports are an important indicator of the industry's competitiveness, product quality, and the effectiveness of winemaking companies' production and marketing strategies. Analyzing the structure and dynamics of exports helps identify the main trade routes, key markets, and priority product categories that are in demand abroad.

An analysis of export potential makes it possible to assess the impact of economic, political, and logistical factors on sales volumes outside the country. An important aspect is the level of recognition of Ukrainian wine among consumers in various countries.

Research into grape wine export trends allows for forecasting potential opportunities to expand the presence of Ukrainian producers in the global market, as well as identifying priority directions for the industry's development, taking into account global quality standards and demand. Collectively, such data serves as a vital tool for formulating an effective strategy for the development of winemaking and increasing the industry's economic weight within the national economy.

Analysis of the dynamics of grape wine production and its export (Fig. 4.2) for 2000–2023 in Ukraine shows that 17.1% of the wine produced is exported. Moreover, if to take into account that on average over the studied period, the gross grape harvest amounted to an average of 397,2 thousand tons, part of which is processed into wine and an average of 1764,7 thousand hl of wine is obtained, while an average of 302,0 thousand hl is exported [9, 11].

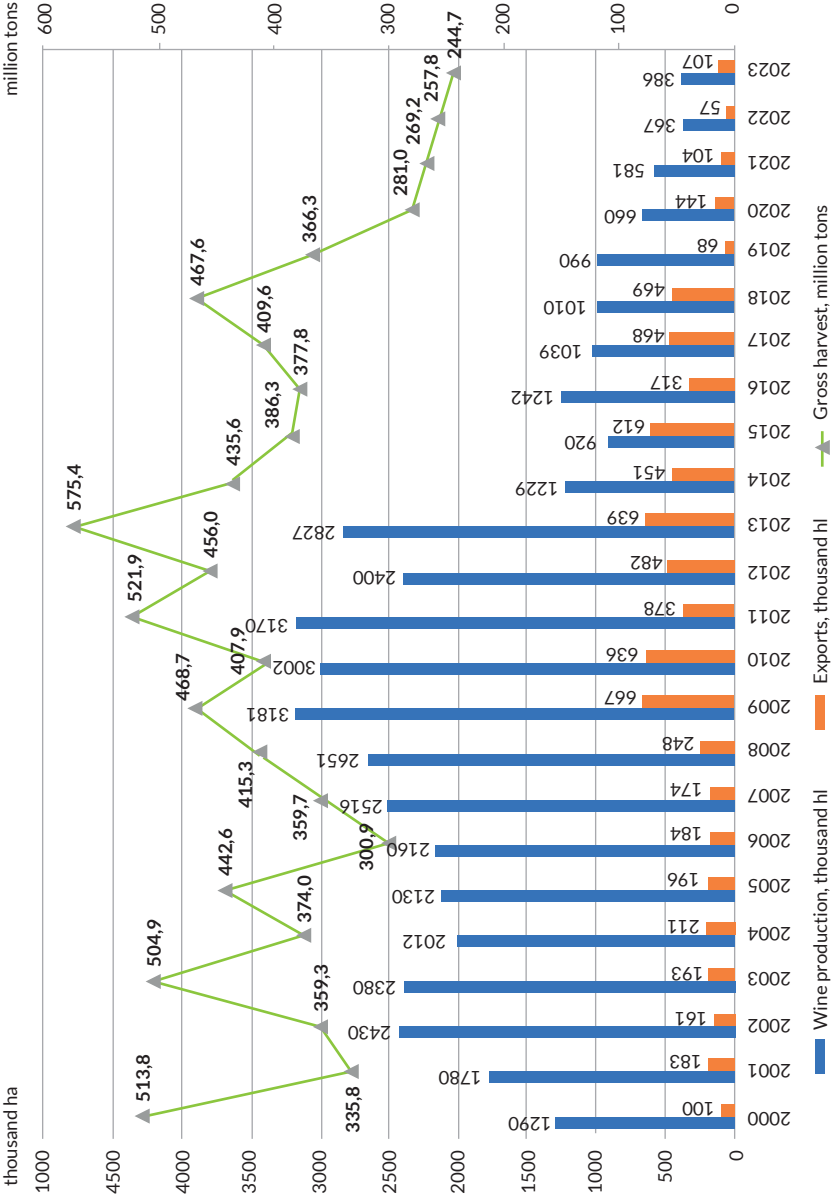


Fig. 4.2 Dynamics of gross grape harvest, wine production, and wine exports in Ukraine (2000–2023)

As shown in **Fig. 4.2**, a certain relationship can be observed between gross grape harvest and wine production. It should be noted that the wine produced in a given year is not necessarily derived from grapes harvested in the same year. Therefore, fluctuations in grape production tend to affect wine production in the following year, while for aged wines the effect may appear with a lag of up to two years.

In 2000, the gross grape harvest amounted to 513,8 thousand tons. In the same year, wine production reached 1,290 thousand hectoliters, while exports amounted to 100 thousand hectoliters, representing 7.8% of total production. These figures indicate that Ukrainian wines were gradually entering the global market and searching for their consumer base.

In subsequent years, wine production steadily increased. By 2009, production reached 3,181 thousand hectoliters, while exports amounted to 667 thousand hectoliters, accounting for 21.0% of total production. Ukraine's accession to the World Trade Organization in 2008 contributed to the adaptation of trade relations and stimulated the expansion of wine exports. In the following years, these indicators remained relatively stable, with the exception of fluctuations observed in 2011.

A particularly productive year was 2013, when the gross grape harvest reached 575,4 thousand tons. Consequently, in 2014 wine production amounted to 1,229 thousand hectoliters, with exports totaling 451 thousand hectoliters, representing 36.7% of production. However, 2014 was a particularly challenging year for Ukraine. The annexation of Crimea, historically one of the most important winemaking regions of the country, led to a sharp decline in wine production from 2,827 thousand hectoliters in 2013 to 1,229 thousand hectoliters in 2014. Thus, production decreased by approximately 2.3 times.

In the following years, vineyard areas gradually expanded in the southern regions of the country (Odesa, Kherson, and Mykolaiv regions), in Transcarpathia, and in non-traditional wine-growing regions such as Khmelnytskyi, Vinnytsia, and Kyiv regions. Notably, the period between 2014 and 2021 was characterized by the highest export indicators, with an average export share of 33.4%.

For example, in 2018 the gross grape harvest amounted to 476,6 thousand tons. As a result, in 2019 wine production reached 990 thousand hectoliters, while exports totaled 68 thousand hectoliters, representing 6.9% of production, the lowest indicator observed after the annexation of Crimea. The poor harvest of 2020, with a gross grape harvest of 281,0 thousand tons, led to a decline in wine production in 2021 to 581 thousand hectoliters, while exports amounted to 104 thousand hectoliters, corresponding to 17.9% of production.

It should be noted that global wine production in 2023 amounted to 237 million hectolitres, representing about 8% decrease compared to 2022 (258 million hl).

Ukraine is produced 386 thousand hectolitres of wine in 2023, which corresponds to approximately 0.16% of global wine production.

The most significant shock for the viticulture and winemaking sector, as well as for the entire country, occurred in 2022 with the outbreak of the full-scale war with Russia. Territories traditionally associated with viticulture and winemaking, including parts of the Kherson and Zaporizhzhia regions, were temporarily occupied. Viticulture in Odesa and Mykolaiv regions can now be considered highly risky, not due to climate change but because of constant missile attacks and drone strikes targeting these regions, which significantly complicate agricultural activities, including grape cultivation and wine production.

Despite these challenges, the Ukrainian wine industry continues to operate and adapt. These difficult circumstances have also stimulated the development of viticulture in regions that were previously not traditionally associated with winemaking.

As shown in **Table 4.1**, the average annual wine export over the study period amounted to 302,0 thousand hectoliters, while wine imports averaged 332,4 thousand hectoliters. Ukraine imports wine from many countries, with the main suppliers being Italy, France, and Spain. These countries are among the world's leading wine producers and remain key trade partners for Ukraine in this segment of the wine market.

In Mediterranean countries, wine is considered an important food product. In the domestic market of Ukraine, wine is subject to an excise tax, which increases the final retail price of the product. As a result, Ukrainian wines compete with imported wines under relatively equal conditions in the domestic market. Imported wines available on the Ukrainian market mainly originate from countries such as Italy, France, Georgia, Spain, and Moldova [25]. Together, these countries account for approximately 55% of wine consumption in Ukraine, effectively substituting a significant share of domestic demand.

At the same time, Ukrainian winemakers are gradually strengthening their market position by improving product quality, modernizing production technologies, and expanding their product range through both well-known producers and craft wineries. In the long term, the development of the wine industry in Ukraine could contribute to increased domestic production, reduced dependence on imported wines, and the creation of a positive image for Ukrainian wine on the international market.

Indeed, in recent years, Ukrainian wines have regularly won awards at prestigious international competitions, including the Decanter World Wine Awards, the Berliner Wine Trophy, the Gilbert & Gaillard International Challenge, and the Ukraine Wine & Spirits Awards.

Table 4.1 Gross grape harvest, grape wine exports, and the ratio of exports to gross harvest in Ukraine

Year	Gross harvest, thousand tons	Wine production, thousand tons	Wine export, thousand tons	Ratio of exports to wine production, %	Wine imports, thousand tons
2000	513,8	1290	100	7.8	58
2001	335,8	1780	183	10.3	119
2002	359,3	2430	161	6.6	114
2003	504,9	2380	193	8.1	155
2004	374,0	2012	211	10.5	113
2005	442,6	2130	196	9.2	224
2006	300,9	2160	184	8.5	438
2007	359,7	2516	174	6.9	549
2008	415,3	2651	248	9.4	409
2009	468,7	3181	667	21.0	167
2010	407,9	3002	636	21.2	327
2011	521,9	3170	378	11.9	500
2012	456,0	2400	482	20.1	333
2013	575,4	2827	639	22.6	346
2014	435,6	1229	451	36.7	307
2015	386,3	920	612	66.5	233
2016	377,8	1242	317	25.5	431
2017	409,6	1039	468	45.0	416
2018	467,6	1010	469	46.4	379
2019	366,3	990	68	6.9	450
2020	281,0	660	144	21.8	532
2021	269,2	581	104	17.9	639
2022	257,8	367	57	15.5	369
2023	244,7	386	107	27.7	369
Average value	397,2	1764,7	302,0	17.1	332,4

This confirms that Ukrainian wines are gradually strengthening their position in the global market and gaining recognition from international experts.

One example is the 57 awards won by Ukrainian wines at the world's most prestigious wine competition, the Decanter World Wine Awards. Ukrainian wines received one gold, 14 silver, and 14 bronze medals. The gold medal went to the 2018 Limited Edition Muscat Ottonel white wine from the Shabo brand.

In total, wines from 16 Ukrainian winemakers received awards. These include 46 Parallel, Beykush Winery, Biologist, Bogdan's Winery, Chateau Chizay, Chateau Edem, Father's Wine, Frumushika Nova, Leleka Wines, My Wine, Odesos Winery, Shabo, Terroir, Vintrest, and Zelenytsi Winery [17].

Successful performances at such competitions have significant marketing value. The awards received confirm the high quality of the wine, which helps build trust among international experts, importers, and consumers. For Ukrainian wineries, this creates additional opportunities to expand exports and strengthen their position in the global market. It is particularly important that many Ukrainian wineries work with indigenous grape varieties, which helps shape the unique identity of Ukrainian wine.

4.6 Conclusion

Ukrainian winemaking has significant potential due to its rich historical traditions, favorable climatic conditions, fertile soils, and the presence of specialized viticulture regions. However, despite this potential, the industry currently operates below its full capacity. In addition, consumer skepticism toward Ukrainian wines continues to limit the sector's development. At the same time, new opportunities for growth are emerging, particularly due to successful marketing strategies implemented in recent years and increasing demand for white and sparkling wines.

The gross grape harvest during the study period (2000–2023) fluctuated considerably depending on weather and climatic conditions as well as political challenges. The average gross harvest during this period amounted to 397,2 thousand tons. The lowest harvest was recorded in 2023, when 244,7 thousand tons of grapes were collected. In 2000, the gross grape harvest amounted to 513,8 thousand tons. In the same year, wine production reached 1,290 thousand hectoliters, while exports amounted to 100 thousand hectoliters, representing 7.8% of production. These figures indicate that Ukrainian wines were gradually entering the global market and seeking their consumer base. In subsequent years, wine production steadily increased; for example, in 2009 production reached 3,181 thousand hectoliters, while exports amounted to 667 thousand hectoliters, representing 21.0% of production.

Ukraine possesses favorable agroclimatic conditions for the development of viticulture. The sum of active average daily temperatures above +10°C during the growing season in southern, central, and northern regions of Ukraine is comparable to that of France, although somewhat lower than in Italy and Spain. While thermal resources determine the possibility of full grape ripening, the availability of productive soil moisture ensures normal plant growth without stress. However, the level of

moisture availability in Ukraine is significantly lower than in leading wine-producing countries. During summer, particularly in the steppe regions (Odesa, Kherson, and Mykolaiv regions), moisture availability is often extremely low, and drought conditions can inhibit vine growth in the absence of irrigation.

In recent years, vineyard cultivation has gradually expanded in southern regions (Odesa, Kherson, and Mykolaiv regions), Transcarpathia, and non-traditional wine-growing regions such as Khmelnytskyi, Vinnytsia, and Kyiv regions. Notably, the period between 2014 and 2021 recorded the highest export indicators, with an average export share of approximately 33.4%.

Analyzing current trends in the development of the domestic wine market, it should be noted that Ukrainian enterprises are gradually adapting to operating conditions under Russia's armed aggression against Ukraine. At the same time, strategies for the development of the wine industry as a promising business segment within the HoReCa sector are being adjusted, which positively affects the image component and improves the positioning of Ukrainian wine products on international markets.

Ukraine is not among the European leaders in grape growing and winemaking. However, its favorable geographical location (between the 44th and 52nd parallels of north latitude), diverse climatic conditions (ranging from sharply continental to sub-tropical), a significant number of sunny days, soils diverse in composition and quality, the presence of both flat and mountainous areas, and an extremely hardworking and resourceful people who know their craft and love their land above all else – all of these factors create vast opportunities for the development of viticulture and wine-making in the country, especially in the context of climate change.

Despite positive changes and increasing demand for Ukrainian wine abroad compared with previous periods, an important current step is the establishment of a clear state support mechanism for enterprises already exporting Ukrainian wine as well as those seeking to enter international markets. Such enterprises include craft producers who position themselves not only as manufacturers of high-quality wine but also as transmitters of Ukrainian authenticity and uniqueness. Unfortunately, during the Soviet period many autochthonous grape varieties were lost. Nevertheless, the local varieties that have survived represent a valuable element of authenticity that should be preserved and promoted. These local varieties form a key element of uniqueness that is essential for the further development of the Ukrainian wine industry.

The development of this sector can contribute not only to increasing the country's gross domestic product but also to creating the foundations for a new niche in domestic tourism. Wine tourism, in particular, can become an important instrument for strengthening national competitiveness and supporting Ukraine's integration into the European community.

The results of this study indicate that the key directions for increasing the export potential of Ukrainian wine enterprises under current conditions should include the development of a comprehensive state program to support the wine industry; the formation of regional wine clusters to enhance competitiveness through synergy effects; the creation of a favorable institutional environment through tax incentives and preferential credit mechanisms; and the active promotion of Ukrainian wine products on international markets. An important instrument for such promotion should be interagency cooperation involving the Ministry of Culture of Ukraine, the State Agency for Tourism Development of Ukraine, and the Ministry of Foreign Affairs of Ukraine in order to promote Ukrainian wine as an element of cultural diplomacy.

The implementation of these measures will strengthen the position of national producers in global markets, ensure the preservation of the wine industry, and create favorable conditions for its long-term development.

Conflict of interest

The authors declare that they have no conflict of interest in relation to this research, whether financial, personal, authorship or otherwise, that could affect the research and its results presented in this paper.

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Use of artificial intelligence statements

The authors have used artificial intelligence technologies. The authors bear full responsibility for the final manuscript. Generative AI tools are not credited and are not responsible for the final results.

Authors' contributions

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