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Mapping Sweden as a wine country

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Mapping Sweden as a wine country

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Abstract

The beverage industry is currently the fastest growing sector in Sweden, including the wine industry, which began in 1999. The aim of this study was to conduct an overview of the wine industry in Sweden and to understand the individual contributions but also the combined impact and potential of Swedish vineyards as a wine-producing unit. The study used an exploratory research design with two phases, responses guided by predetermined questions and a semi-structured interview. The key findings reveal that of a total around 200 vineyards in Sweden, most of them are located in Skåne. Sweden's cold climate challenges grape cultivation and wine production, but the microclimate gives good opportunities. Solaris, Muscaris, Sauvignier gris, Pinot noir, and Rondo are the most common grape varieties that result in the wine styles white, sparkling, rosé, red, and orange wines. Notably, while 15% of the vineyards hold an organic certification, most of the vineyards use sustainable practices. Despite lack of wine traditions, Swedish wines have won medals for their unique flavors, characteristics, and sustainability. The events at the vineyards further boost their appeal. The findings of this study suggest that Sweden has the potential to become a significant player in the global wine industry.

Keywords

Sweden, Wine, Vineyard, Mapping, Wine country, Grape varieties, Wine styles

Abstrakt

Dryckesindustrin är för närvarande den snabbast växande sektorn i Sverige och därmed även vinindustrin som startade 1999. Syftet med denna studie var att göra en kartläggning över vinindustrin i Sverige och att få insikter om svenska vingårdars roll och potential som vinproducerande enheter. Studien använde en explorativ forskningsdesign med två faser, svar styrda av förutbestämda frågor och en semistrukturerad intervju. De viktigaste resultaten visar att av totalt cirka 200 vingårdar i Sverige ligger de flesta i Skåne. Sveriges kalla klimat utmanar druvodling och vinproduktionen, men mikroklimatet ger också goda möjligheter. Solaris, Muscaris, Sauvignier gris, Pinot noir och Rondo är de vanligaste druvsorterna som resulterar i vinstilar vitt, mousserande, rosé, rött och orange vin. Noterbart är att medan 15 % av vingårdarna har en ekologisk certifiering, använder de flesta av vingårdarna hållbara metoder. Trots brist på vintraditioner har svenska viner vunnit medaljer för sina unika smaker, egenskaper och hållbarhet. Evenemang på vingårdarna ökar deras attraktionskraft ytterligare. Resultaten av denna studie tyder på att Sverige har potential att bli en betydande aktör i den globala vinindustrin.

Sökord

Sverige, Vin, Vingård, Kartläggning, Vinland, Druvsorter, Vinstilar

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Preface

As I reflect on my journey, I can attest that my varied experience has given this work diverse perspective. Rooted in a bachelor's degree in chemistry with a focus on Food Science, complemented with practical experience as a laboratory assistant in microbiology and as a food inspector, as I approached the final stage of my master's program in food and meal science, I have written this thesis with a unique set of lenses through multifaceted points of view.

Exploring Sweden as a wine country has been interesting and instructively. The novel subject has also been challenging and therefore it has also been stimulating and demanding.

I want to express my appreciation to my supervisor Karin Wendin for your support in the process of this thesis. I also want to thank K Felix G Åhrberg, the winemaker & oenologist at Kullabergs vineyard for generously sharing your insights and expertise during the interview process. The valuable perspectives have significantly enriched the depth and quality of this study.

Lovisa Bjenning

Introduction

The beverage industry is currently the fastest growing sector in the Swedish food industry, encompassing a diverse range of products such as beer, wine, cider, and distilled beverages. In 2010, there were approximately 90 beverage companies operating in Sweden. However, by late 2022, this number had surged dramatically to 750, marking an astonishing increase of 733% (Livsmedelsföretagen, 2023).

Grapes are relatively new to Swedish agricultural landscape (Nordmark et al., 2016; Mårtensson et al., 2013). In 1999, Sweden was designated as a wine country by the European Union (EU), becoming the youngest and most northerly wine country (Rauhut Kompaniets, 2022). It was not until Sweden became a wine country in 1999 that it was allowed to make wine on grapes grown in Sweden to sell commercially (Säfwenbergs, 2019). The wine industry has mirrored the overall growth of the beverage industry especially in the last five years. In the mid-1990s, there were no commercial vineyards in Sweden (Livsmedelsföretagen, 2023). In 2020, there were around 200 vineyards, both commercial and hobby, and approximately 30 % of these were planted between the years 2015 and 2020 (Garrido-Bañuelos et al., 2020). Notably, more than half of these producers are located in Skåne, a province in southern Sweden. In the end of 2022, most of the vineyards had an area between 1 to 10 hectares and all the vineyards had a total of approximately 100 hectares which gave 13 000-14 000 bottles a year (Livsmedelsföretagen, 2023). One of the main factors driving the significant increase in the beverage sector is climate change. While many wine-producing countries face challenges due to climate change, particularly in vine growth and winemaking processes, the impact differs in cooler climates like Sweden. The rise in temperature has emerged as a key factor influencing the expansion of the beverage industry in Sweden, creating a more favorable environment for grape cultivation and contributing to the growth of the wine sector. Nevertheless, it is essential to note that in several traditional wine countries, climate change has posed challenges, adversely affecting vineyards and the winemaking process (Rauhut Kompaniets, 2022).

Due to Sweden's northern location, the weather varies depending on the season. In general, the climate is colder with less sun hours in contrast to a traditional wine country (Nordic Vineyards, n.d.-a). As a result, Sweden falls into zone A, which is the coolest zone according to EU's wine-growing zone division (Nordic Vineyards, n.d.-b). Together with climate change, Sweden is turning into a country with warmer weather and longer growing seasons. This shift has opened other opportunities for cultivation and new grape varieties to adapt to the climate but also an increase for wine production (Euronews Green, 2013).

Despite the growing interest of the wine industry in Sweden, there is a noticeable research gap in the literature regarding Sweden as a wine country. Previously studies have given valuable insight into various aspects of Swedish wine production, but it remains a noticeable research gap regarding a comprehensive overview of the viticulture as a whole. By systematically mapping Sweden's vineyards, this study aims to bridge the research gap and provide the field with understanding of the characteristic of vineyards across Sweden. This research seeks to delve into factors that drives the development and expansion of the wine industry in Sweden. Furthermore, this study contributes with valuable insights to both academia and wine makers, this aims to form further research and foster sustainable growth in Sweden's wine sector.

Aim and Research Question

This study will examine the wine industry in Sweden by gaining insight on the vineyard's role and Sweden as a potential wine-producing country. The overall aim for this study is to conduct an overview of the wine industry in Sweden by collecting data on vineyards in order to understand the individual contributions but also the combined impact and potential of Swedish vineyards as a wine-producing unit.

To research this aim this study is following these research questions.

1. How does the geographic location and climate affect the Swedish grape cultivation and wine production?
2. Which grape varieties are predominantly cultivated in Sweden?

3. Which are the most common wine styles that are produced in Sweden?
4. Are any specific production methods used in Swedish winemaking?
5. How are Swedish wines evaluated in competitions, and what factors contribute to their perceived quality?

Background

Climate

Sweden is located in northern Europe on the eastern part of the Scandinavian Peninsula. The country is divided into three major lands, Götaland, Svealand and Norrland with 25 provinces (Figure 1).



Figure 1 Map over the three major lands (Götaland in blue, Svealand in yellow and Norrland in beige) and the provinces in Sweden (https://commons.wikimedia.org/wiki/File:Sverigekarta-Landskap.svg#/media/File:Sverigekarta-Landskap_Text.svg)

The climate is a temperate humid climate but differs from region to region, with warmer temperatures in the south and colder temperatures in the north (Nationalencyklopedin, n.d.-a). Due to Sweden's northern location, the weather varies depending on the season (Nordic Vineyards, n.d.-a). Because of the closeness to the Atlantic Ocean and Baltic Sea, this induces an abundant rainfall and rather small difference in temperature between summer and winter (Nationalencyklopedin, n.d.-a). In general, the climate is colder with less sun hours in contrast to a traditional wine country (Nordic Vineyards, n.d.-a). The biggest challenges are the cold temperature and the risk for frost in the winter and spring (Garrido-Bañuelos et al., 2020).

Climate change together with the increased knowledge about grape variety hybrid is opening up new and more possibility for commercial wine cultivation in Northern Europe (Nordmark et al., 2016; Mårtensson et al., 2013).

Soil

In studies, it is confirmed that soil properties and wine have a direct link to each other (Ferretti, 2019). Grapevines, being long-lived perennials, exhibit a vast root system that goes deep into the soil and supplies the vines with water and nutrients. The interaction between grapevines and the soil is important, establishing a symbiotic relationship conducive to harmonious coexistence. Consequently, it is crucial to maintain a good soil condition incorporating aspects of both physical as well as biological properties (White, 2003, Chapter 1).

Sand is hard to cultivate in because it is not as effective good at retaining water and nutrients. Clay contributes to poor drainage but maintains a good water level in the soil. Soil containing limestone or other minerals indicate distinctive physical properties that provide a structured environment that improves the water supply to the roots but also drainage. These properties are good for cultivation in cooler climates (Grainger & Tattersall, 2016). These geological components are commonly encountered in soils situated on slopes. Slopes are also considered

great sites for grape cultivation because of the increase of sun exposure and temperature (White, 2003, Chapter 9).

Wine

People have extracted wine from grapes for thousands of years, but today it is an industry and is produced all over the world. About 95% of all wine is produced from grapes, the rest of the wine is made from other fruits (Gibson, 2010). Wine can be defined in many ways depending on the area of use, but for this study I will use the definition from the International Organisation of Vine and Wine. Wine is defined as a beverage containing fresh grapes that are alcoholic fermented. The wine can be made of crushed grapes or not, or grapes must. The alcohol content should not be below 8.5% vol. (International Organisation of Vine and Wine, n.d.).

Grape varieties

The green grapes are ripened more easily and therefore make a great choice for cultivation in Sweden. The most used grape variety in Swedish vineyards is Solaris. However, Sweden also produces red and rosé wines with Rondo being the most common grape for these styles. Both Solaris and Rondo are considered PIWI grapes (Nordic Vineyards, n.d.-a). PIWI stands for pilzwiderstandsfähig and is a German word meaning fungal resistant and are therefore known for their fungus, insects and disease resistance properties (Nationalencyklopedin. n.d.-c). This advantage reduces the need for treatment and pesticides for vineyards. Furthermore, these grapes do manage the cold weather, making them well-suited for northern wine countries (Nordic Vineyards, n.d.-a).

Wine varieties

There are different types of wine including white, red, rosé, sparkling and orange wine. White wine does usually vary in color from yellow to gold (Swami et al., 2014) and is typically made of green grapes, although red grapes can also be used. Red wines, on the other hand, must be produced by red grapes because of the skins pigment that gives the red and dark color to the wine. Sparkling wine could be both white and rosé and is usually produced using the traditional method.

(Gibson, 2010). Rosé, made from red grapes, and orange wine, made from green grapes, gets the color from the skin pigment, like red wines (Gibson, 2010; Systembolaget, n.d.-b).

Organic and natural wine

The wine needs to meet several requirements to be classified as organic. Chemical pesticides and fertilizers containing nitrogen are not allowed (Systembolaget, n.d.-a). According to the European Commission, organic wine must be produced by organic grapes and yeast, it is forbidden to use sorbic acid and desulphurisation and sulphites levels must be lower than their conventional equivalent. (European Commission, n.d.). To get a certification, the vineyard must operate organic for at least a period of three years. The requirements for organic grape cultivation and wine production are the same for all the countries in the EU and controlled and certified by an independent organization. The first EU regulations broke through 1991. In 2018, 3.5% of the world's winegrowing area was organic and 90% of these was located in EU (Systembolaget, n.d.-a).

Unlike organic wine, natural wine does not have any certification and is more used to describe the wine. Therefore, anyone can brand their wine as natural wine. Nevertheless, natural wines are often associated with organic practices and small-scale production, aiming to have as little impact on the environment as possible (Systembolaget, n.d.-c).

The concept of “Terroir”

The term *terroir* is defined as a concept in winegrowing that encompasses how the physical and biological environment interacts with vitivincultural practices. This interaction is suggested to give a unique characteristic for wine in that specific region (International Organisation of Vine and Wine, 2010). The term is originated from the French word *terroir*, derived from the Latin word *terra* but lack a direct translation into English, it holds a significant meaning, especially in discussions about wine and soil (Pretorius, 2020; White, 2003, Chapter 1). *Terroir* includes distinct elements such as soil composition, topography, climate, landscape attributes, and biodiversity features (International Organisation of Vine and Wine, 2010). But it is also known that the human factor influence *terroir*, for

example choosing location for the vineyard and knowledge about wine making. Because all these factors interact with each other, the concept of *terroir* is a difficult topic to study. In both European vineyards and New World wine producing countries, *terroir* is important and set the quality and style for the wines (Leeuwen, 2022).

Additionally, *terroir* is also known for its association with the social and culture meaning of the geographic place of the vineyard (Capitello et al., 2021). Each wine region has their own *terroir* which gives a strong connection between vineyard and location, but also the characteristic of aroma and taste of the wine (Rauhut Kompaniets, 2022; Nationalencyklopedin, n.d.-b). Because the concept of *terroir* includes many important factors, it is a great way to explain how and why wine has its unique taste (Trubek, 2008, Chapter 2).

New world

Sweden is included as a country in the “New World” of wine production together with United States, Australia, South Africa and more. These countries challenging the “old world” like France, Italy and Spain (Garrido-Bañuelos et al., 2020). The old world has used the same places for vineyards and methods for grape cultivation and wine production for centuries. This long period without changing the techniques has resulted in a lot of knowledge and experience but also that, for example, some methods “belong” to some regions and not others. These wines have been marketing with their *terroir* and therefore have gotten a strong attachment to their own places and characteristics. On the other hand, we have a new world that encourages development and experimentation. Instead of the old world’s conservatism, intervention is important. A certain method or varieties is not bounded to a region, instead its free to use oenological techniques. The wine industry in the new world has grown fast and therefore the quality improves and the wines become more established. Critics claim that the new world is more of an industry and lacks knowledge, expertise and *terroir* (Banks & Overton, 2010).

Selling wine in Sweden

One challenge for vineyards in Sweden is the state alcohol retail monopoly (Rauhut Kompaniets, 2022). The store is called “Systembolaget” and is the only place to purchase alcoholic beverages in Sweden (Nordmark et al., 2016).

Due to Sweden's alcohol policy, the government has giving Systembolaget a retail monopoly on alcohol, without profit-driven motives. The primary objective is to mitigate the adverse effects of alcohol consumption and regulate overall alcohol intake. Aligned with the guidelines set by the World Health Organization (WHO), pricing, restricted access, and regulations on marketing are the three key measures to minimize the harms associated with alcohol. Systembolaget effectively meets these criteria, contributing to the promotion of public health by safeguarding against excessive alcohol consumption. It is in part of the monopoly that Sweden currently has a lower average alcohol intake than the rest of Europe (Systembolaget, n.d.-d).

As we know, consumers are now more aware and prone to purchase local, handcrafted products with good quality. Together with the significant role of wine tourism, vineyards have a big opportunity for evolvement and for Sweden to become a more significant wine country. Since Sweden became a wine country, in 1999, it has been nominated for and won international awards (Rauhut Kompaniets, 2022).

Material and methods

Choice of method

This study used an exploratory research design to explore the new subject of “Sweden as a wine country”. Exploratory research is especially useful to gathering information as a first study (Kotler & Armstrong, 2018, Chapter 4). This design allows new insights into the current situation surrounding the topic. By employing this methodological approach, it provided opportunities to thoroughly explore Sweden as a wine-producing unit and adding fresh perspective to our understanding of this growing area.

The data were collected in two different ways. Phase 1 involved collecting data through answering predefined questions (see appendix 1) by using websites as the data source. And Phase 2, which involved collecting data through a semi-structured interview. The research methodology was structured with both quantitative and qualitative methods. The quantitative method gave data for statistical analysis and a perspective of generalization, and the qualitative method captured a deeper understanding and new insights (Singh, 2007, Chapter 3).

Literature search

To conduct a review of the existing literature related to Swedish wine production a systematic literature search was made. This process included different steps to ensure relevant studies and publication.

Firstly, electronic databases such as PubMed, Google Scholar, the Kristianstad University online library and the Umeå University online library were used. I searched for peer-reviewed articles, academic journals and books. The keyword and search term that I included was "Swedish wine industry," "Swedish viticulture," "wine production in Sweden," "vineyards in Sweden," and variations of these. Furthermore, manual searches were made by reviewing reference lists of relevant articles, books, reports, official documents from governmental and organizations such as SBOV Sveriges Branchorganisation för Oenologi & Viticultur or "Sweden's Industry Organization for Oenology & Viticulture"). This enabled additional sources that what not captured through electronic database searches.

Inclusion Criteria for Vineyards

This study exclusively focuses on the analysis of commercial vineyards that produce grape wine. The vineyards should currently be running and geographical bounded to Sweden. Additionally, they should produce grape wine intended for commercial sale, distribution and/or through sales at the vineyards or to restaurants.

Data Collection

Phase 1

Phase 1 of the study was guided by predetermined questions (see appendix 1). These questions were strategically designed and chosen after an extensive search across both scientific literature and media sources focused on older wine countries and international vineyards. The selection involved identifying themes that are common when describing and comparing wine regions with each other. The key topics that were identified and that the questions are based on are *location and climate, grape varieties, wine styles, production methods, quality and reputation and tradition and history*. These topics do have connections with the term “terroir” that includes soil composition, topography, climate, landscape attributes, and biodiversity features.

This phase served as the foundation for the comprehensive analysis, laying the groundwork for the consecutive phase of the research. After the questions were formulated, the commercial vineyards were identified. And the data were systematically gathered from multiple sources, including the official websites of the vineyards, relevant articles featuring the vineyards, and their respective social media platforms. This comprehensive data collection approach ensures a holistic and multifaceted understanding, allowing for rigorous analysis and robust insights into the various dimensions of the examined commercial vineyards. The data were frequently collected from secondary research such as available literature, data and articles.

In cases where the data to answer a specific question was not available, we moved on to the next question for that specific vineyard. For some of the questions the answer could be calculated with the assistance of other data, as demonstrated below.

The data for total area of the vineyards were calculated from total grapevines, with each hectare consisting of 3 000 vines (Equation 1). The number of grapevines per hectare was based on information from literature (Mårtensson et al., 2008).

$$\text{Hectares} = \frac{\text{Number of grapevines}}{3\,000} \quad (1)$$

The data for produced liters wine per year were calculated from 1.1 kilogram grapes per 0.75-liter wine (Equation 2). The number of grapevines per hectare were based on information from the literature (Decanter, 2010), where L stands for number of liters wine.

$$L = \frac{1.1 \times \text{kilogram grapes}}{0.75} \quad (2)$$

Phase 2

Phase 2 took place after the analysis of phase 1 was done. In phase 2, the qualitative component involved conducting a semi-structured interview with one wine maker and oenologist. The interview was strategically designed based on the outcome of the analysis conducted in phase 1, aiming to provide a deeper insight obtained from the quantitative phase.

A semi-structured interview is a mix between structured and unstructured interview which means that there are a few key questions prepared before and depending on the answers, it is possible to ask follow-up questions which makes it possible to get more information (Gill, et al., 2008). This approach will serve to provide a deeper understanding of Sweden as a wine-producing country and the role of the vineyard.

The interview was based on the same set of questions as those used in phase 1 (see appendix 1), this together with the results from phase 1 gave more understanding and made it easier to ask follow-up questions. The interviewee was selected based on their expertise as a wine maker at one of Sweden's largest vineyards. But also, their background as an educated oenologist which provides knowledge about biology and chemistry about vine and wine. The interviewee is also a board member in SBOV and have knowledge and information of other vineyards in Sweden as well. The interview was conducted over the phone and lasted approximately 1 hour.

The data from the interview were coded into the different themes that the pre-determined questions were based on. The identified themes were thereafter interpreted in relation to the questions and an analysis was made to understand the meaning and connection to the data. The questions and themes could thereafter be compared to the results from phase 1 and other literature.

Ethical considerations

When doing the study, it is important that the interviewed people feel safe and respected. An informed consent from the participants could eliminate this dilemma. The informed consent should include the purpose of the study, their involvement and how the data will be used. It is important that all the data is handled in the right way and if there is any personal or sensitive data this should be kept confidential. The data should be used in an honest way to avoid manipulation and misrepresentation of the findings.

Results

The results of the two phases are presented separately.

Phase 1

A total of 46 commercial vineyards were systematically identified but only 39 did qualify, according to the inclusion criteria, and were included in the study. The distribution of vineyards showed that 38 of the 39 commercial vineyards are located in Götaland across eight different provinces and one vineyard is located in Svealand, Södermanland (Figure 2). More than half of the vineyards (58%) is located in Skåne, while the remaining vineyards is distributed across the eight other province in the lower half of Sweden.

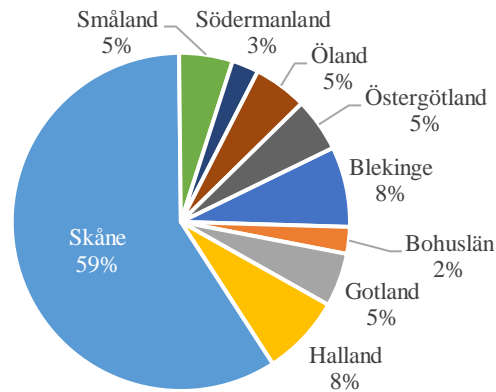


Figure 2 Geographic distribution of vineyards in percent in Sweden by provinces

The hectares of the surveyed vineyards were found for 17 vineyards and calculated for 22 vineyards. The total area of all the 39 vineyards in Sweden is 126 hectares with a mean area of 3.3 hectares. The vineyard sizes varied from 0.2 to 23 hectares. These vineyards were established between the years 1994 and 2022, with most of them starting in 2009.

Among the 39 surveyed vineyards, 25 are situated close to an ocean or a big lake. Where 22 of them are close to the ocean and three are close to Sweden's second largest lake, Vättern. These locations result in a milder climate for the vineyards. Additionally, 11 of the vineyards are positioned on a south or south-west slope, resulting in an increase in sun exposure and warmer temperature. Four of the vineyards have mountains to protect against hard and cold winds, and one has cultivated a barrier. Other things that could affect the climate are that one vineyard is located on the old ocean bottom and one of the vineyards are located on limestone foundation.

The soil type data were found for 27 out of the total 39 vineyards (Figure 3). Among the total 27 vineyards, 16 (59%) have sandy soil. Clayey soils are found in 12 vineyards (44%) and limestone in 13 vineyards (48%). The category "mineral-rich" specified vineyards with soil containing minerals except limestone, encompassing granite, gneiss, flint, moraine and slate. Most of the vineyards have a mixed soil consisting of sand, clay and limestone or other minerals.

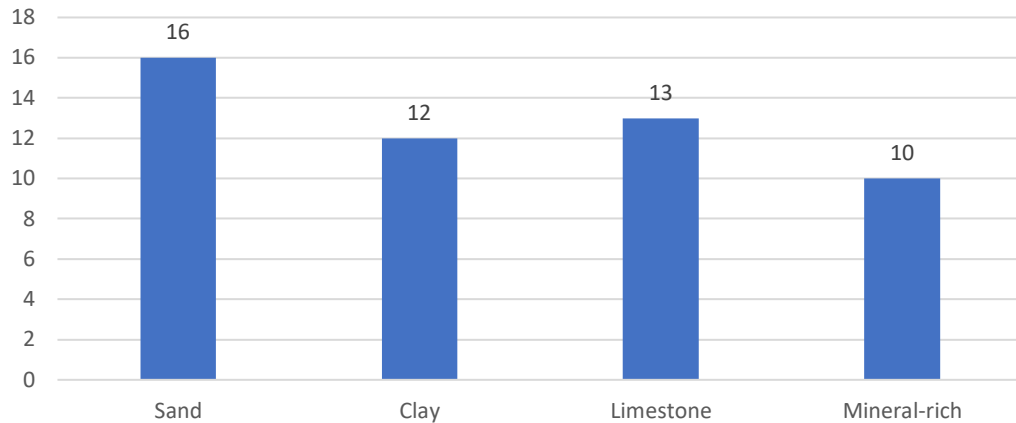


Figure 3 The different soil types present in the vineyards, along with the total number of vineyards with each soil type

The most common green grape varieties include Solaris, Muscaris, Phönix, Chardonnay, Seyval blanc and Sauvignier gris (Figure 4). The figure shows that Solaris is cultivated in 34 of 39 vineyards (87%). Muscaris, Phönix and Chardonnay are each used by 6 vineyards (15%). Seyval blanc is used by 5 vineyards (13%) and Sauvignier gris is present in 4 vineyards (10%). The “Other” category includes grape varieties used by one or two vineyards.

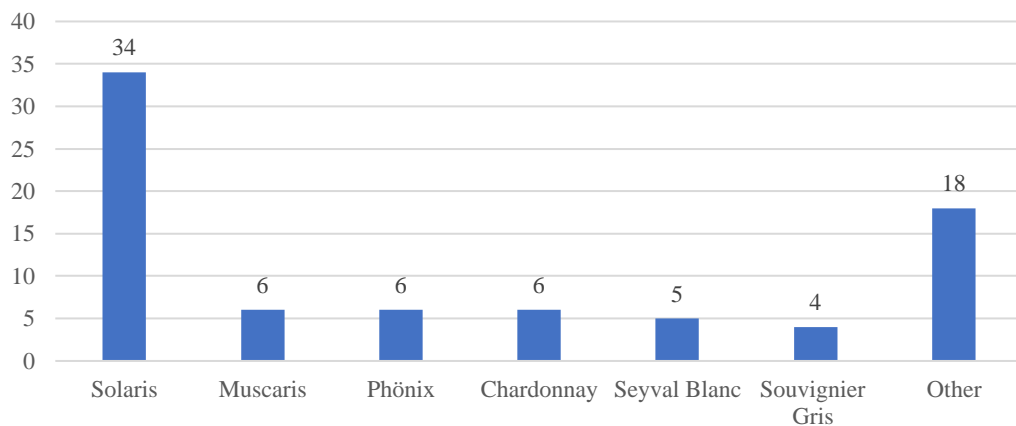


Figure 4 The dispersal of green grape varieties across vineyards, this chart illustrates the number of vineyards dedicated to the most common green grape varieties

The most common red grape varieties are in order Rondo, Cabernet Cortis, Regent, Pinot Noir and Leon Millot (Figure 5). The figure showed that Rondo is cultivated in 20 of 39 vineyards (51 %). Cabernet cortis is used by 12 vineyards (31%). Regent is used by 9 vineyards (23%), Pinot noir is presented in 8

vineyards (21%) and Leon millot is used by 6 vineyards (15%). The “Other” category includes grape varieties used by one or two vineyards.

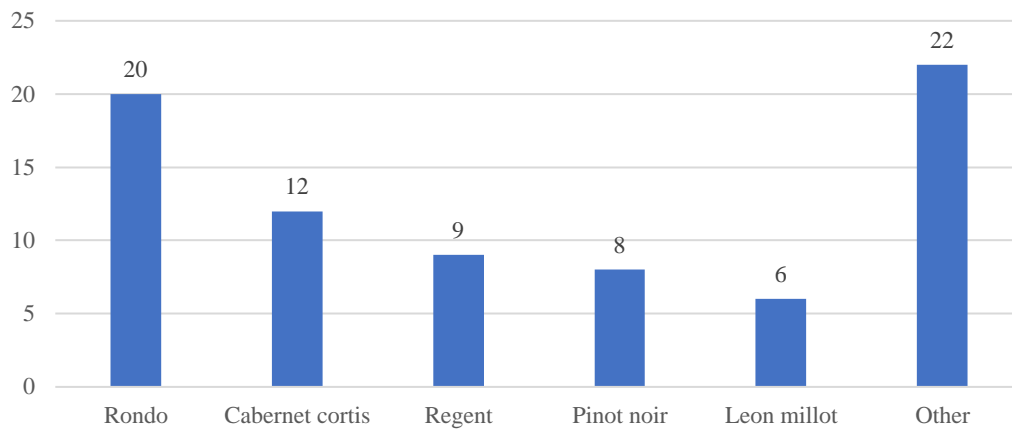


Figure 5 The dispersal of red grape varieties across vineyards, this chart illustrates the number of vineyards dedicated to the most common red grape varieties

About 237 000 (236 746) liters of wine is produced per year with a mean value of approximately 8 200 liters produced wine per year per vineyard. There are five different types of grape wine that is produced in Sweden which are white, red, rosé, orange and sparkling wine (Figure 6). The figure illustrated that the most common wine type to produce is white wine, with 35 of the total 39 surveyed vineyards (90%). Following that, the order of prevalence is sparkling wine (64%), rosé (59%), red wine (56%) and orange wine (21%).

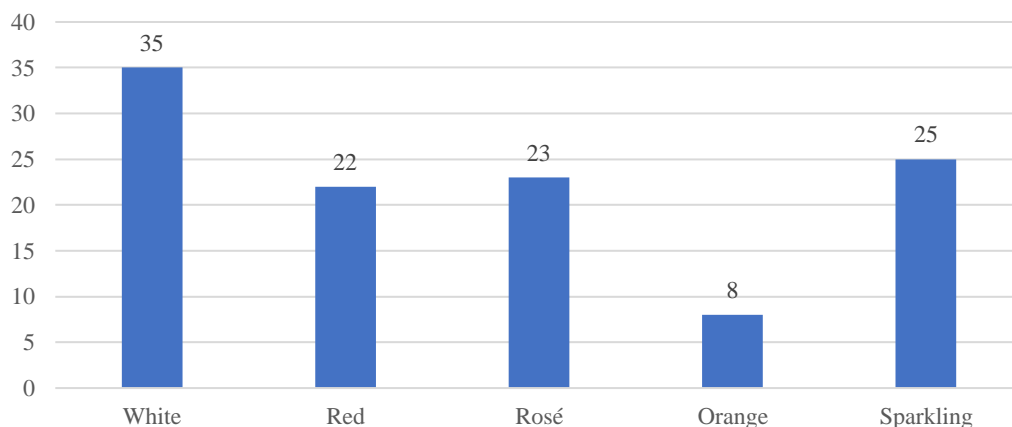


Figure 6 The dispersal of wine varieties across vineyards, this chart illustrates the number of vineyards dedicated to each specific wine type

Six of the 39 vineyards (15%) are organic certified, while 15 vineyards (38%) wrote that they used an organic and sustainable approach for cultivation and wine production, seven vineyards (18%) are producing natural wine. There were 10 vineyards (26%) that produced sparkling wine according to the method traditional which is the method most of the wine countries are using. No specific methods are used for storage. There are 29 vineyards (74%) that sold their wines on Systembolaget, and 11 vineyards (28%) sold their wine in their own restaurant or bar and the same amount (28%) sold their wine to other restaurants.

Out of the 39 surveyed vineyards, 12 (31%) have got a gold, silver or bronze medal in at least one competition. The competitions included participation in Austrian Wine Challenge, International Wine Challenge, Piwi Wine Award, International wine & spirits award, Catavinum World Wine & Spirits Competition, International Wine Award Spain, PAR Wine Award International and Decanter World Wine Awards. Two vineyards (5%) have got at least one star from Austrian Wine Challenge and therefore current star winery.

It is 19 out of the total 39 vineyards (49%) that do have a philosophy regarding organic and/or sustainable production, almost half of the vineyards. The philosophy varied in order of simplicity. Most of the vineyard's philosophy is about cultivating organic and naturally without using chemicals such as pesticides and fertilizers and instead used PIWI grapes and natural fertilizer. It was also important with a biodiversity approach, minimal climate impact, recycling, sustainable decisions that were made based on nature and to follow global goals.

It is common for vineyards to engage in other business and activities (Figure 7). The figures show that 26 of the total 39 vineyards (67%) had guided tours, 25 (64%) had wine tasting, 14 (36%) had a restaurant or bar, 8 (21%) had a hotel or bed and breakfast and 9 (23%) had other activities on their vineyard. The "Other" category included activities like wedding party, ability to book a culinary chef or a sommelier to any location, wine course, harvest festival, store with local products, beekeeping and apple growing. Two of the vineyards take help from other people. One vineyard called this for wine-friend, people can volunteer and help the vineyards with tasks like preparation before and harvesting, bottling, labeling

etcetera. Another vineyard has a society with events for people that are interested in wine.

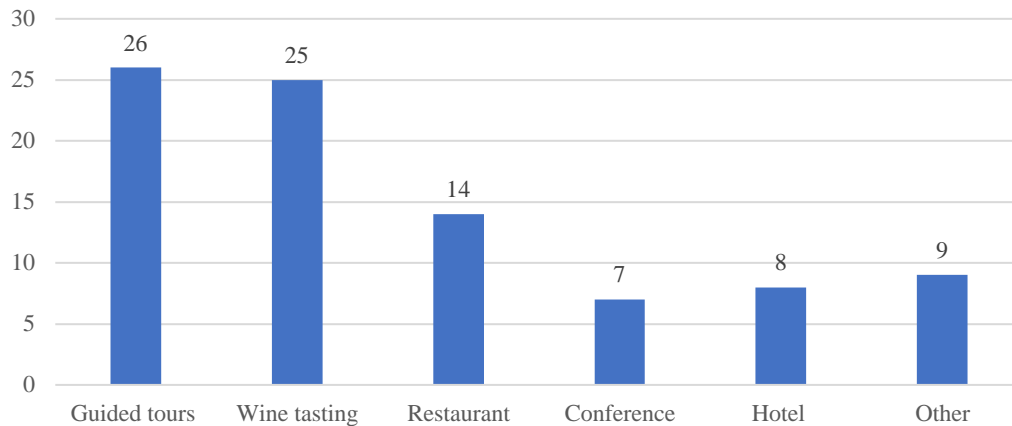


Figure 7 This chart illustrates the number of vineyards that have other business and activities at the vineyard

Phase 2

The interviewee expressed that most of Swedish commercial vineyards are located in north-west of Skåne where each hectares holds around 3 000 to 4 000 grape vines. He continued with some history, wine has been around for several hundred years and some of the Swedish vineyards have been existing since 17th century. Wine started to be produced in monastery and for personal use, but it is in the last five years that the industry has grown the most.

When asking which the most cultivated grape varieties that are used in Sweden he answered, in order, Solaris, Muscaris and Sauvignier gris for the green grapes. For red grapes the most used varieties, in order, are Pinot noir and Pinot nova, the interviewee then expressed that it is only a small amount of Rondo, he continues, many vineyards are using rondo, but it is the small vineyards. The bigger vineyards use Pinot noir and/or Pinot nova for red and rosé wines and therefore the most used red grapes according to the area are these two. We did discuss the average produced wine per year, and he said that it is a challenging question because it varies, this depends on factors such as harvest condition for the year and the weather. However, it is around 200 000 bottle per year, which corresponds to 150 000 liter wine per year. He adds that it is possible to calculate the volume

of production based on the total number of vines, with an average of one bottle of wine produced per vine. When asking what the types of wine Sweden is producing, the answer was, mostly sparkling wine and thereafter white wine, rosé, red wine and orange wine. These sell through Systembolaget, selected restaurants and/or at the vineyards and some of the vineyards do also export their wine to other countries like England and Japan for example.

The interviewee expressed that Sweden has some vineyards with organic certification, but this is not so important for Sweden because the standard goes beyond standard cultivation. The vineyards in Sweden that do not have any certification do have a better sustainable and use less chemicals than an organic certified vineyard in other countries. One reason could be the use of PIWI grapes. He continued, a vineyard that uses PIWI grapes does have a decreased carbon dioxide emission, up to 150 kilograms per hectare per year less carbon dioxide than a conventional vineyard. Sweden does also produce natural wine. This could be because many people seek products that are made naturally. Therefore, there is a demand for natural wine and vineyards respond by producing them. It is not clear that natural wine is better, some of the characteristics may disappear.

To position Sweden as a top tier wine country, it is crucial to implement and refine the methods so the quality of the wine can evolve. Because Sweden does not have any specific production or storage methods. Instead, the commercial vineyards use the same methods as the large wine countries. The techniques that are used should be improved in terms of quality.

When asking the interviewee about international competition he answered that this is a thing that often is misleading. Some of Sweden's commercial vineyards do participate in international competitions. However, the quality standard may vary, in some competitions the opposition is not a top winemaker, and therefore it could be quite easy to win. In the current situation the relevant competition includes International Austrian Wine Challenge Vienna, International Wine Challenge, PIWI international and Decanter World Wine Awards.

Most of the vineyards do have additional activities at the vineyard such as restaurants, hotels, conferences and spas. He expressed that, in some cases, this

has become more important than producing a high-quality wine, possible due to the higher money generating potential.

Discussion

Results Discussion

Location and Climate

The largest numbers of commercial vineyards were located in the province Skåne, and the rest in the southern half of Sweden. This was logical because the warmer climate compared to the northern half of Sweden, which the grapevines thrive better in and gets a larger harvest. In the study by Karvonen (2014), it was described that vines thrive in a warm and light climate. Northern Europe, compared to wine countries in southern Europe, has a cooler climate but with higher sun exposure during spring. With climate change and global warming, the temperature is expected to rise, which benefits longer growing seasons in the north. As Sweden is a country in the northern Europe, the increased sun exposure along with the predicted increased temperature will enhance Sweden's wine production and wine culture. It also makes it possible to cultivate vines and produce wine further north in Sweden. Leeuwen (2022) also described that climate change is already visible and will continue over the next decades. Furthermore, the vineyards must adapt to these changes and that is a major challenge for some regions. Another previous research, (Garrido-Bañuelos et al., 2020), indicated that the increased temperature opens the possibility for an increased adaptation of the viticulture that gives the character to the wine.

The number of vines per hectare did differ between the literature and the interview from 3 000 to 3 500. When the area was calculated with each hectare consisting of 3 500 vines instead, the total area ended up to 120 hectares instead of 126 hectares. This means that it differs with 6 hectares calculating for 22 vineyards and potentially had a significant impact on the results, especially for larger vineyards. I used the number 3 000 because it had an anchorage to literature. The total area has grown from approximately 100 hectares in 2022 to 126 hectares, which indicates a growing industry. According to the research by Rauhut

Kompaniets (2022), most of the vineyards in Sweden are still in the exploration or start-up stage. This means that some vineyards are more established and developed than others. Such differences are likely affecting the size of the vineyard, contributing to the variations in range from 0.2 to 23 hectares.

The data that was collected regarding when the vineyards were established varied between when the company started, when the first grapevine was planted and when the first wine was produced. This has an impact on the outcome results, and it would be better to have data that were based on the same start. Another thing that could affect this result was if the vineyards had for example been bought up, then the year could be misleading.

For vineyards situated close to the ocean or a big lake, it significantly influences the vineyards climate. Both the ocean and big lake affect the temperature. In spring, the cold water affects the vines and delays the budburst and reduces the risk of frost damage. During the autumn, the heated water increases the air temperature and extends the growing season. This result was also found in the study by Karvonen (2014), vineyards that are located close to the ocean do have similar climate as in central Europe. Sweden's northern location implies longer days and an increase of sun exposure during growing season. This also contributes to a long season that makes the wine more characteristic. Moreover, Leeuwen (2022) describes that the longer growing season, when the grapes can be harvested later in the season, achieve a high *terroir* expression.

The south, south-west slope contributes to an increase of sun exposure as well. The limestone foundation, as one of the vineyards were located on, heating up during the day and keeps the heat into the night. This also helps to prevent frost damage. Some of the vineyards were located with a mountain as a barrier or had a cultivated barrier. This protects the vines against hard winds, especially the cold winds from the north. According to Gustavsson & Mårtensson (2005), sun radiation is increased when a vineyard is placed on a slope. They also discussed that regarding the poor macroclimate in Scandinavia, it is still a place with good opportunities for vineyards. This aligns with Lindén study (2014), emphasizing the importance of microclimates, that includes south facing slopes and wind protection, for vineyards in cooler climate. Moreover, Leeuwen (2022) and

Ferretti (2019) described, in previous research, the advantage of having the vines cultivated on slopes compared to vineyards in valleys where the risk of spring frost damage is larger.

The data on soil type showed that most of the vineyards consisted of sand, clay and limestone or other minerals. The sand is not so easy for cultivation, but clay maintains a great water level in the soil. The soil containing limestone was common in soil that also contained much sand and clay. Limestone improves water supply and drainage and is especially good for cultivation in cooler climates. This resulted in better thriving grapevines, furthermore, resulted in a larger harvest of grapes. In the research by Leeuwen (2022), it is known that the soil differs a lot between different wines of high quality. And therefore, it is challenging to say what soil combination is the most ultimate for vines.

Mårtensson et al. (2013) indicated that there has not been any official classification of Swedish soils and location. This studies analysis of soil type was based on Sweden as a unit. But it would have been interesting to analyze and compare the soli type in the different provinces and could be a further study. This would also favor further research on different regions and terroirs of Swedish wine. According to Rauhut Kompaniets (2022), every wine region has their unique landscape, climate and soil. This together creates the *terroir*. This aligns with a study by Wadha (2022), which described the vineyards unique combination and *terroir*.

Grape and Wine varieties

Comparing grape varieties between the two phases reveals both similarity and differences. In terms of green grape varieties, both phases identified Solaris, Muscaris and Sauvignier gris as the most common. The literature, websites and articles also identified Phönix, Chardonnay and Seyval blanc as common green grape varieties. For red grapes, the literature identified Rondo, Cabernet Cortis, Regent, Pinot Noir and Leon Millot as the most common red grape varieties, the interview with a winemaker assigned Pinot noir, Pinot nova and a small volume of Rondo. These differences may have been due to the literature sources focus was on the types of grape varieties without considering the volume of each variety. According to Wadha (2022), grape varieties that are suitable for cooler climates

have a tendency of higher quality, higher aroma and more balanced between sugar, acid and alcohol compared with grape varieties suitable for warmer climate. Additionally, these varieties are resistant towards fungal diseases which decrease the amount of usage of pesticides.

In the same manner as the grape varieties, the different types of wine differed between the literature sources and the interview. These differences may also be due to the literature sources focus was on the types of grape varieties without considering the volume of each wine type. In the study by Gustavsson & Mårtensson (2005), the result showed that it is common for countries with cooler climate to produce more good quality white wines than red wines because it is more susceptible for cold conditions. Lindén (2014) indicated the same thing, the wine makers are more likely to produce white wine because it is more likely to get a better quality than red wine. It was also pointed out that it is not impossible to produce red wine with good quality, the vine perhaps needs more time to mature before the wine is produced. During this time rosé is a good way to still use the red grapes and get a good quality wine.

The amount of wine produced per year from phase 1 was about 237 000 liter per year, differing from 150 000 liter per year reported from the interview. The interviewee also suggested that the volume could be calculated from the total number of vines, with an average of one bottle of wine produced per vine. This gave another answer of about 377 000 liter per year, which also differs. The first and second answer did differ a lot from each other. One reason could be that the number of vines from phase 1 was incorrect and therefore the calculation was also incorrect. When the result was compared to the production in late 2022 (Livsmedelsföretagen, 2023), which amounted to 13 000-14 000 bottles (equivalent to around 10 125 liters) per year, it differed a lot. One reason could be the increased vines and area, which produce more wine. This aligns with the research by Mårtensson et al. (2013), young vineyards and during the established years, the harvest is smaller. Additionally, yearly variations, as described by Leeuwen (2022), can impact vine behavior and grape harvests. Fluctuations in weather conditions lead to these variations, affecting the volume of harvested grapes and, consequently, the volume of produced wine from year to year.

It is 15% of Swedish vineyards that are organic certified. These organic certified vineyards occupy a total area of 11.8 hectares, which corresponded to 9% of the total area of all the 39 commercial vineyards. By comparison, in 2016, France also had 9% of its total vineyard area designated for organic cultivation (Merot et al., 2019). Globally, Provost & Pedneault (2016) reported in their research that 4.6% of the total grape production in the world are organic produced. Sweden's organic vineyard total area of 9% reflects the significant proportion of organic certified vineyards together with a broad commitment to a sustainable practice in the industry. I believe that it is important to point out that even if a Swedish vineyard does not have an organic certification, they usually use more sustainable and better cultivation methods than organic vineyards outside Sweden. As the interviewee said, the standard for Swedish vineyards goes beyond the standard cultivation for other countries vineyards. This results from using PIWI grapes that have resistance properties against fungus, insects and diseases. Furthermore, Swedish vineyards may not need as many or any chemicals at all. Natural wine is not common for Swedish wine. It is good to bear in mind that natural wines do not need any certification, meaning, any wine can be branded as natural wine.

Specific methods

According to the results from Phase 1, 10 out of the 25 vineyards that produce sparkling wine use the traditional method. The interviewee described that Sweden are not using any specific methods, instead, the Swedish vineyards use the same methods as the bigger wine countries, which includes the traditional method for sparkling wine. Therefore, I believe that almost all the 25 vineyards use traditional methods when producing sparkling wine. The interviewee also talked about the importance of a further improvement of Swedish production method and techniques. If Sweden wants to become a leading wine country the quality needs to be refined. This aligns with the research by Leeuwen (2022), a high-quality wine needs a larger technical knowledge and experience. This would not only increase the quality, but it would also increase the expression of *terroir*. I believe that this improvement could attract more consumers to buy Swedish, and the vineyards could therefore develop and expand. The research by Lindén (2014) indicates the same thing. Sweden do not have any tradition regarding wine

making because it is a very young wine country. Because of Sweden's developing phase, Swedish wine is still evolved and are not complete yet. Garrido-Bañuelos research (2020) showed that tradition and specific methods are associated together with *terroir*, because Sweden do not have these yet, Sweden's *terroir* is also something that can be developed. Additionally, Garrido-Bañuelos (2020) had this example, that it is still unclear how the typical Swedish Solaris wine should smell and taste like. I consider that this also indicates that Sweden's *terroir* is not set yet and can get developed in the future.

Competition and quality

Out of the 12 vineyards that has won a medal in a competition, eight have won a medal in some of the competition that the interviewee expressed as relevant: International Austrian Wine Challenge Vienna, International Wine Challenge, PIWI international and Decanter World Wine Awards. Thanks to the cold climate and the grapes, the wine is given a unique flavor and characteristic that together with sustainable production makes Sweden inimitable for competitors, according to Rauhut Kompaniets (2022).

Compared to other countries, Swedish wines are only sold at Systembolaget, 74%, to other restaurants, 28% or their own restaurant, 28%, and some are exporting their wine to other countries. Rauhut Kompaniets (2022) is discussing that Swedes are untaught in terms of local wines and that Swedish wines offer ecological and sustainable wines but still do not buy it. I believe that when and if yard sale will be available for wine, the consumers that will buy Swedish wine will increase. This change could benefit vineyards in a way that encourages more people to take the risk and establish a vineyard. Mårtensson et al. (2013) discussed the challenges of Systembolaget in their research. It is not certain that Systembolaget permits vineyards wine to sell, because of the small volume. The consumer then must order the wine, if it is available, which must be organized and planned. They also discussed the future possibility, that the vineyards maybe can sell their wine directly at the vineyards. This requires a change in the regulations.

It is clear that Sweden has a sustainable production, with 49% of the commercial vineyards cultivating and producing according to an organic and sustainable

philosophy. This aligns with the results from Wadha's study (2022). One reason is the PIWI grapes that make it able to use less pesticides. Additionally, less pesticides usage improves the quality of the soil and gives better and healthier vines, landscape preservation and plant resilience. Because of this, it protects the environment by reducing the quantity of pesticides and chemicals that are released.

A lot of Swedish vineyards are focusing to engage in other business and activities. In the research by Vo Thanh and Kirova (2018), they described tourism as common for vineyards. And also, the growing interest of these events. The activities differ from each vineyard, this study showed that the most common ones were guided tours and wine tasting. According to Lindén (2014) the activities benefit the vineyards and enable the consumers to meet the wine makers. Different touristic events, such as guided tours and wine tasting, increase the possibility that the participants will buy their products later on, either at Systembolaget or in a restaurant. Rauhut Kompaniets (2022) is also discussing the importance of activities at the vineyard in the research. Vo Thanh, & Kirova (2018) indicated the importance of tourism for the economic development of the wine regions. In the future, the tourists event together with the predicted yard sale could benefit the vineyards more thanks to the increase of reach and also unexpected customers. This increase of consumers could give opportunities for Sweden to become a more significant wine country.

In previous research by Leeuwen (2022), *Terroir* is known to be an important factor for quality and style in European vineyards but also for New World wine producing countries. Sweden belongs to both, and therefore, I believe that *terroir* is an important factor that need to be developed for the Swedish wines. *Terroir* includes soil composition, topography, climate, landscape attributes, and biodiversity features (International Organisation of Vine and Wine, 2010). In the research by Leeuwen (2022), it is clear that pointing out the ideal climate condition and soil composition is an impossible assignment. But natural factors like temperature, amount of rainfall, sun hours and soil composition are contributing to the expression of the wine's *terroir*. It is also said that cooler temperature gives the wine a positive characteristic. As said earlier, *terroir* also

influence by humans. It is not an accident that Sweden's commercial vineyards are located in the southern half of Sweden, together with the closeness to ocean and lakes, this is only some examples of the human influence. An important factor of human influence is knowledge and tradition.

Method Discussion

The methodology that was used in this study was an exploratory design to explore Sweden as a wine country. The following discussion provides insights of the methods and associated considerations.

The exploratory design made it possible to dig deeper into the novel subject, Sweden as a wine country. The choice of method allowed various aspects to be explored and provided with an insight and deep understanding into the wine industry in Sweden.

The data were collected in two different ways, partly by predetermined questions and by a semi-structured interview and both quantitative and qualitative methods were used. The predetermined questions covered aspects such as geographic location, climate conditions, grape varieties cultivated, wine styles produced, production methods employed, and the quality of Swedish vineyards and wine. This data provided opportunities to understand the subject and to set a foundation for the second phase, the interview. One challenge was that some data was not updated and contained old data and numbers or that the articles were written a couple of years ago and are therefore not up to date. When collecting data like this it is hard to collect real-time data. This may have affected the final result. Because Sweden is a relative new wine country, it was difficult to find all the commercial vineyards and data to answer all the questions. To address this problem, multiple sources were used. The data was then compared to each other, the newest and most accurate data was used. One of the benefits of this type of collection was that I collected a large amount of data and was therefore able to include all the commercial vineyards, which would not be possible if only using interviews. One potential methodology for this research could involve conducting a survey to hand out for the vineyards. However, such an approach presents inherent challenges like the difficulties of obtaining responses from all 39 vineyards. Particularly

small vineyards with smaller operations that could limited resources and could therefore result in a reduced sample size.

The interview gave a great insight and deeper understanding of the subject. It also gave the opportunities to understand the subject from a wine makers point of view. An improvement would be to interview some more wine makers, this would result in a greater insight, understanding and a broader range of perspective would be represented in this study. A bigger sample size could improve the validity. But it would also take more time with both the interviews and the analysis.

An improvement of the methodology would involve recording the interview, that was my original intention. But thankfully, I wrote all the answers down as we spoke and therefore got all the answers. Recording the interview would have made it easier and captured the answers better and simplified the data collection and analysis. This could have affected the results because of the risk of forgetting some details or misunderstanding the answers. Furthermore, a recorded interview would enable the opportunity to cite the answers in the results, which could give more power to the statements.

Further Research

This study aimed to provide an overview of the wine industry in Sweden by collecting data on various vineyards to gain insights into the collective role and potential of Swedish vineyards as a wine-producing entity. The results from this study could be further utilized for research where Sweden is compared to other established wine countries. This comparison could include factors such as geographical and climate conditions, grape variety and type of wine. Another interesting research would investigate deeper on how the winemakers are looking at Sweden as a wine country. Additionally, it would be interesting to investigate the area of how the climate change is affecting Swedish vineyards cultivation and wine production.

Relevance for the subject

Mapping a country as a wine country not only enhances knowledge and comprehension of its wine production in that specific country and the wine

regions but also enables comparison with wines from other countries. This could be beneficial for the wine industry, tourists and researchers. Additionally, mapping contributes significantly to the cultural and economic identity of both the region and the country as a whole. This industry appears to follow the previous trend that it is a fast-growing industry. Consequently, it is highly likely that wine production in Sweden will continue to expand and become even bigger in the future.

Conclusions

Sweden's vineyards are primarily located in the southern half of the country. While grape cultivation and wine production challenge with the cold climate, it benefits from microclimates like closeness to water and south-facing slopes position. Key grape varieties like Solaris, Muscaris, Sauvignier gris, Pinot noir, and Rondo thrive and lead to the production of white, sparkling, rosé, red, and orange wines. While 15% are organic certified, sustainable practices are important for most of the vineyards. Despite limited tradition, Swedish wines have won awards for their unique flavors and sustainability. Vineyard tourism further boosts their appeal, indicating Sweden's potential as a significant player in the global wine industry.

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Appendix 1, Questions for phase 1 and 2

1. Where is the vineyard located?
2. How many hectares is the vineyard?
3. What is the climate in the area where the vineyard is located?
4. How long has the vineyard been in existence?
5. What type of soil is it in the vineyards?
6. Which grape varieties are grown at the vineyard?
7. How many liters of wine does it produce per year? (average)
8. How many different types of wine are produced and which ones?
9. Are organic wines produced?
10. Is natural wine produced?
11. Are any specific production methods used in winemaking?
12. Are any specific storage methods used?
13. Does the wine produced by the winery participate in competitions and assessments? Which in that case? How has it been?
14. Where are the wines sold?
15. Does the vineyard have a philosophy regarding organic and sustainability?
16. Are there any additional activities at the vineyard? (Restaurant, conference, hotel, guided tours, etc.)