

Supply Chain Wine - Evaluation of sustainability criteria in the context of wine quality of global and regional supply chains

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ABSTRACT

The global wine market is highly competitive and has a structural overproduction. As a result, buyers (commercial and end customers) are becoming more demanding in terms of quality. As domestic demand is stagnating or declining in many producing countries, an increase in the volume traded globally has been visible for more than a decade. (OIV 2024)

As one of the largest import markets in the world, the German wine market is also highly competitive and is causing structural changes. The overall size of the wine and sparkling wine market in Germany has remained more or less the same over the last two decades; the total volume of wine produced in Germany has also remained more or less the same. What has changed, however, is the share of German wines in the overall market, which has fallen from 48% in 2000 to 39% in 2018, meaning that the share of imports has increased. At the same time, exports of German wine have also fallen. As a result, the production structures of grape and wine production have changed. There have also been shifts on the consumption side in the shares of wines sold via the respective sales channels.

Competition has therefore increased significantly in recent years, with the result that producers and importers are increasingly on the lookout for further opportunities to differentiate themselves. In this context, it is not surprising that "sustainability" is being considered more intensively as a means of differentiation.

The aim is to discuss sustainability criteria in the context of wine quality along the various stages of the value chain and to derive differentiation strategies for the relevant companies. The sustainability criteria as well as their potentials and trade-offs for the very heterogeneous wine market are shown and they are compared and supplemented with the sustainability criteria of various standards and certification systems, such as Global Gap, organic and in particular Fair'n Green. The analysis of the criteria is carried out with the help of the essence analysis, so that an evaluation of the sustainability criteria is carried out. This is used to evaluate the "wine" supply chains. The results are then used as a basis for optimizing the "wine" value chain in terms of sustainability.

Keywords: supply chain wine, sustainability, certification standards

1 Introduction

The global wine market is a market with a high competitive. Global and regional supply chains exist. Germany is one of the markets with the highest wine import. The overall size of the wine and sparkling wine market in Germany has remained more or less the same over the last two decades; the total volume of wine produced in Germany has also remained more or less the same. What has changed, however, is the share of German wines in the overall market, which has fallen from 48% in 2000 to 39% in 2018, meaning that the share of imports has increased. At the same time, exports of German wine have also

fallen. As a result, the production structures of grape and wine production have changed. There have also been shifts on the consumption side in the shares of wines sold via the respective sales channels. Sustainability is an important criteria also for the wine production and also wine producers are certified in sustainability standards. The aim of the analysis is the comparison of global and regional supply chains. Sustainability criteria from three different sustainability standards are the basis for this analysis. These criteria are evaluated with the materiality analysis and a comparison is made between global and regional value chains.

2. Development of international and national wine market

2.1 Global wine market

The world wine market has developed dynamically in the last two decades. On the one hand the EU – as the main producer of wine – has decreased its vineyards until mid-2010's and increased its share on quality wine continuously. On the other hand, countries such as China or Georgia have significantly increased the surface under vine (Richter et al, 2021). Even though the total acreage of vineyards has not changed dramatically over the years, the wine production (volume) has huge volatility making forecast extremely difficult. However, the tendency indicated an average global wine harvest of about 260 mio hl. However, for the year 2022 the OIV states a harvest of about 247 mio hl and forecast for the year 2023 a harvest of 237 mio hl. (OIV 2024)

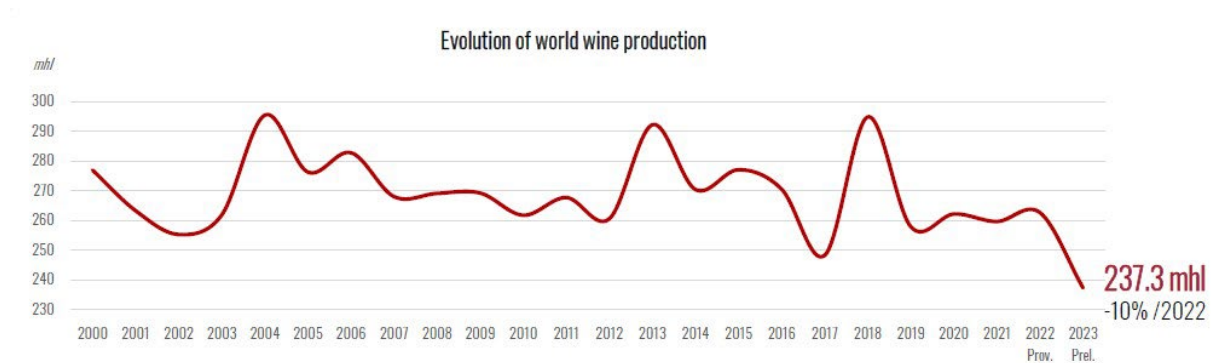


Figure 1: Evolution of worl wine production (OIV 2024)

Up to the 2007 the global wine consumption had been constantly increasing. However, due to the global economy crisis since that the consumption is falling. Today the OIV states a consumption of 232 mio hl; for 2022 and predicts a consumption of 221 mio hl. For the global consumption a change in wine style is observable. For total consumption the portion of red wine is decreasing; rose is more or less stable while white wine is gaining in market share. Furthermore, the percentage of quality wine is increasing which might be due to the fact that the EU is incentives the production of quality wine. (OIV 2024).

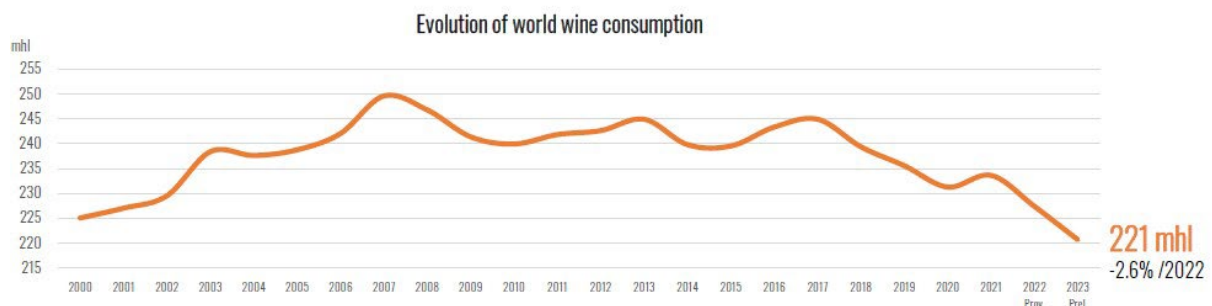


Figure 2: Evolution of world wine consumption (OIV 2024)

The OIV data also shows that the total amount of exported wine is steeply increasing for more than two decades – both in volume as well as in value. This increase indicates on the one hand that there the global interest in wine is rising (particularly in countries that are not producing grape wine) but on the other

hand it also indicates that those countries that are producing wine face decreasing wine consumption domestically (eg Spain). (OIV 2024)

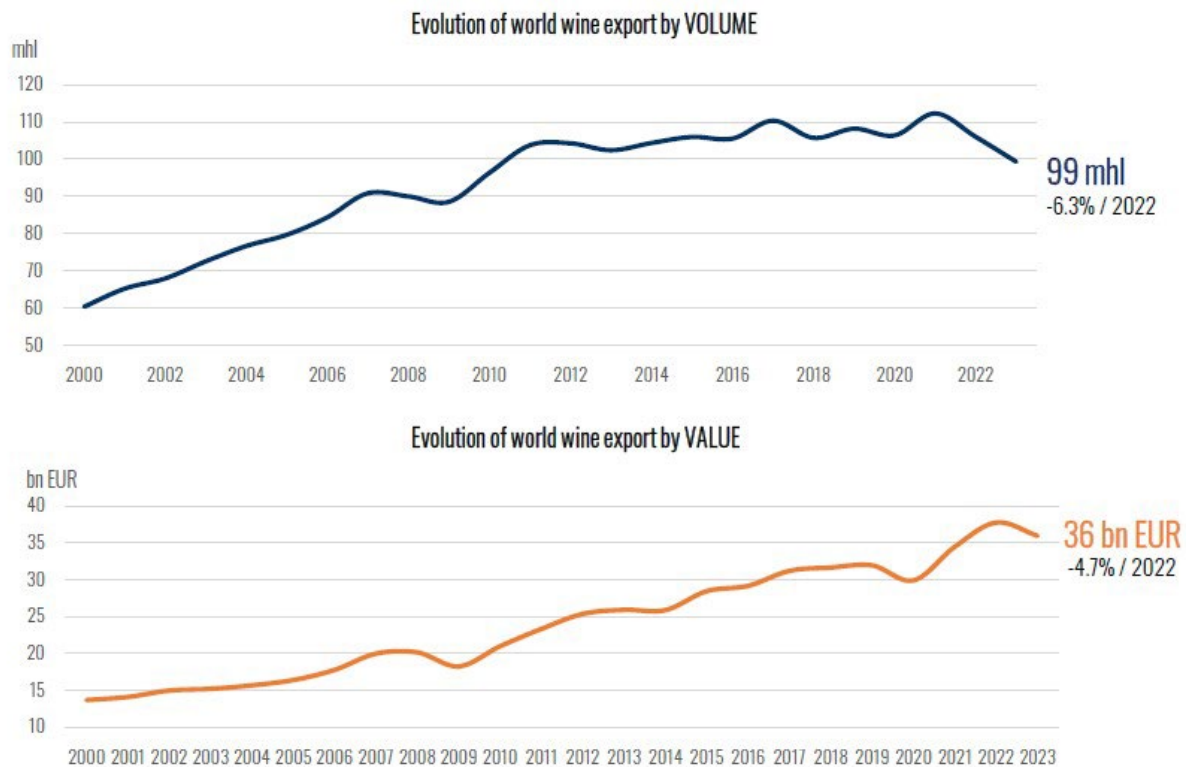


Figure 3: Evolution of world wine exports (OIV 2024)

All-in-all the global wine market can be characterized as an oversupplied market which has a very high level of competition; up to a point of being ruinous competition.

2.2 The German wine market

The total volume of wine marketed in Germany amounted to around 20 million hectolitres (hl), of which around half, 10 million hl, was attributable to German wine production. Germany imported more than 14 million hl and is the world leader. Around 3.7 million hl of wine were (re-)exported Quelle. The three most important distribution channels for domestic marketing are discount stores (50% market share), retail (28%) and direct sales (11%). Seven percent of the total volume is marketed via specialist retailers and four percent via online retailers. (Richter et al, 2021)

Discounters have gained market share in recent years, while retail sales in supermarkets have remained stable and direct sales have declined. Average prices per liter of wine have continued to fall. Consumers spent an average of EUR 3.39/l on a German wine, while the average price for all wines sold in retail stores was EUR 3.09/l in 2018. This means that imported wines have a lower average price in German retail than wines from Germany. (Deutsches Weininstitut, 2024)

3. Supply Chain Wine

Consumers have high expectations when it comes to wine quality. Even cheap wine must be of acceptable quality. Producers have to meet the demands of their customers (trade customers and end consumers). When working with discounters and supermarkets, producers are often confronted with certain requirements regarding delivery conditions and minimum quantities (Hanf et al, 2009). Due to these requirements, only a few large wineries, large cooperatives (including secondary cooperatives) and producer groups are able to supply the major retailers on a national level. However, recent developments

show that there is a growing number of independent retailers belonging to the retail cooperatives Edeka Group and REWE Group (Bitsch et al (2020)). As these often offer a wide range of wines from regional producers and receive their goods via direct deliveries from the wine producers, this represents an attractive sales channel for private vineyards, wineries and smaller cooperatives. This also gives smaller players in the sector the opportunity to sell smaller quantities via the retail trade than is the case with discount chains and supermarkets. In order to secure the quantities and grape qualities required for this distribution channel, vineyards and wineries are now increasingly reliant on cooperation with grape producers.

The structure on the demand side of the market also has a strong influence on the supply side. In the past, there were mainly mixed farms that produced other agricultural products in addition to winegrowing. At that time, the area under vines per farm was rather small. In the course of structural change in agriculture, the average area under cultivation and total production per farm increased with increasing specialization. Viticulture is attractive for both full-time and part-time farmers, as they have high labor capacities and even winegrowers with small vineyards often have simple equipment for viticulture (Hanf et al, 2009).

In Germany, grape production is dominated by small producers; there are more than 43,300 wineries. Of these, around two thirds cultivate an area of less than one hectare. Only 7%, around 2,900 farms, produce grapes on more than 10 hectares (Deutsches Weininstitut, 2024). These figures show that viticulture in Germany often takes place on smaller farms.

Similar to the structural change in agriculture, the concentration process also continued in the wine industry. It is reflected in the figures from the Federal Statistical Office (Statistisches Bundesamt, 2017). Overall, the number of farms with a vineyard area ≥ 0.5 ha fell by 20.5% to 15,151 between 2010 and 2020. Smaller farms are increasingly being forced to close down. In particular, the number of farms with a vineyard area of less than 10 ha has decreased. The average vineyard area per farm increased from 5.1 to 6.6 hectares between 2010 and 2020. (Deutsches Weininstitut, 2024)

4. Quality and sustainability criteria as characteristic of wine

It is generally accepted that wine quality is difficult to define because of its nature as a multi-dimensional construct (e.g. Charters and Pettigrew, 2006). In literature, it is often the perspective of the consumer that is chosen to be the relevant vantage point, from which it ought to be considered. Yet, wine compared to other products presents some unique challenges. The quality of most products is a combination of intrinsic and extrinsic elements. Intrinsic cues refer to physical properties that cannot be modified without changing the nature of the product itself such as the color of wine or its particular sensory characteristics (Charters and Pettigrew, 2006). Extrinsic aspects of wine are the design of the bottle, its label, the name of the winemaker and, most importantly, price. Price is often used as an instrument to measure the quality of wine as it is seen as the most powerful contributor to the overall perception of a product such as wine (Mastrobuoni et al, 2014).

Many studies (e.g., Oczkowski and Doucouliagos, 2014) suggest that wine experts are better at evaluating the quality attributes of wine than novice consumers. They argue that wine ratings are particularly good indicators of product quality, because: (1) there is high convergent validity among ratings of different evaluators, and (2) this convergent validity is not based on "external cues" like "regional origin, producer, or price" but on "aesthetic properties of the wine itself." Overall, experts have high reliability overall and the rating of wines is highly systematized, which the authors attribute to the use of scientific methods, a strict classification system, and the development of terminologies particularly for use in wine evaluation (Ballester et al., 2008).

Assessing wine from other dimensions regarding its quality in respect of legal or compliance requirements or for the sake of food safety, the need for objectivity is adhered to through official analysis by national or regional bodies according to the rules of the respective jurisdiction. Acknowledging the relationship of wine quality and vineyard practices and wine making procedures, these tests employ chemical and sensory analysis (Lesschaeve and Noble, 2022). Tasting formats that serve as the basis of assessments such as the OIV-recommendations for sensory analysis (https://www.oiv.int/sites/default/files/2022-09/review-on-sensory-analysis-of-wine_en.pdf) or the score sheet developed by UC Davis also rely on subjective attributes of wine such as its perceived intensity or harmonious persistence (Lesschaeve and Noble, 2022).

Next to wine quality sustainability will and is also more and more important of the wine supply chain. Currently, viticulture is valued above all for its economic importance in wine production and for the scenic attractiveness it offers for tourism and enjoyment. However, like many other forms of intensive

agriculture, viticulture has a significant environmental impact, particularly through the intensive use of pesticides. In most wine-growing regions around the world, conventional viticulture uses herbicides for the soil and synthetic pesticides to control diseases and pests (Springman et al. 2018). Although there is increasing opposition to these traditional cultivation methods in society, the proportion of land cultivated with them has hardly changed (Wasley et al. 2020; Muller et al. 2017).

According to Gilinsky (2016) by adopting a sustainable strategy in the wine business, future generations may reap the benefits of expansion, long-term profitability, and enduring success in the wine sector. The content of these studies is that green strategies will give improvements in the production of wine and also for the society (Picon et al. 2022; Marco-Lajare et al. 2022). Moreover, in this business, sustainability may be a market driven strategy and improvement of competition of global and regional supply chains (Fiore et al. 2017; Marco-Lajare et al. 2022).

5. Certification standards: Requirements - Examples

In the following, the sustainability criteria of selected standards and certification systems are shown and compared in the context of wine quality along the stages of the value chain. The final materiality analysis (Chapter 6), which must be determined individually for each company, can then be used to optimise and differentiate the wine value chain in terms of sustainability and wine quality.

A total of four (five) standards and certification systems are selected in the area of sustainability: Fair'n Green, which was developed specifically for viticulture, covers all three dimensions of sustainability (economic-ecological-social) and works with a clear number of sustainability indicators. Other certification systems that were not specifically designed for viticulture can be adapted accordingly: Fair Trade, which also covers all three dimensions of sustainability, records a clear number of sustainability indicators, but here the focus is on the producer countries in the Global South, such as Argentina and South Africa. For the European and national level, the following should be mentioned: EU Bio label (organic food) and, for example, the German BIO label. Both certification systems include a large number of roughly identical criteria. These can be found in various legal texts, are implemented on the basis of (implementing) regulations and are constantly updated. In addition, the GlobalGAP certification system is included, especially for fruits and vegetables, with around 200 sustainability criteria.

A detailed comparison shows the following picture

- Fair Trade – ‘sustainable development of producer organisations in countries of the global South’ (<https://www.fairtrade-deutschland.de/was-ist-fairtrade/fairtrade-standards>; <https://www.fairtrade.net/us-en.html>) with the following sustainability indicators and a strong focus on the social dimension
 - Social sustainability criteria: Empowerment of smallholders and workers: organisation in democratic communities (in cooperatives), promotion of trade union organisation (on plantations), regulated working conditions, ban on exploitative child labour, ban on discrimination.
 - Ecological sustainability criteria: environmentally friendly cultivation, protection of natural resources, ban on hazardous pesticides, no genetically modified seeds, promotion of organic cultivation through the organic premium.
 - Economic sustainability criteria: Requirements for traders and manufacturers: payment of a Fairtrade minimum price and a Fairtrade premium, proof of flow of goods and money, guidelines for using the label, Transparent trade relations.
- GlobalG.A.P. (GlobalGAP 2024) fruits and vegetables with mutual recognition of GLOBALG.A.P. Standard - QS-GAP Standard. In total, there are 95 critical mandatory criteria (must be met 100%) and 117 non-critical mandatory criteria in the areas of central requirements for food safety, traceability of products, compliance with animal welfare requirements, compliance with legal

requirements for environmental protection, consideration of biodiversity, strengthening labour safety and the social concerns of employees, application of integrated crop management (ICM), integrated crop protection controls (IPC), quality management system (QMS) and HACCP (Hazard Analysis and Critical Control Points).

- EU BIO seal for organic farming (EU Organic Farming Regulation and its implementing provisions for organic farming and food safety, mandatory since 2010 (BMEL 2024). The certification system covers the entire value chain. The products must consist of at least 95% organic ingredients. In addition, strict requirements apply to the remaining 5 %. Furthermore, the same ingredient may not be present as both an organic ingredient and a non-organic ingredient.

Minimum standards for animals and plants apply. The summarised criteria areas and e.g. compiled according to <https://utopia.de/siegel/eu-bio-siegel/> are Avoidance of synthetic chemical pesticides and fertilisers, approval of only around 70 additives (there are around 400 for conventional products), more species-appropriate forms of husbandry, maximum permitted number of animals per hectare, organic feed, ban on preventative antibiotics, ban on genetic engineering, ban on irradiation, Ban on sweeteners (except erythritol), stabilisers, synthetic colourings, preservatives and flavour enhancers, no added vitamins and minerals (except for products where this is required by law)

In addition to the mandatory EU Bio label, national certification in accordance with the state-run German Bio label has been possible since 2001. It applies to all pre-packaged, organically produced food from the EU <https://www.bmel.de/>. It is based on the EU criteria as well as additional national criteria.

- Fair'n Green (2025) is a certification system for agriculture and food that has so far been developed specifically for viticulture. With a clear number of indicators, it covers all three dimensions of sustainability. In addition, the fourth pillar covers the sector-specific requirements, in this case the viticulture value chain with procurement, soil and nutrients, plant protection, biodiversity, cellar management, quality management as well as sales and transport. The sustainability indicators are divided into three areas
 - Economic sustainability (business plan, economic situation, key figures, investments & innovations, operational processes, digitalisation, marketing & communication)
 - Ecological dimension (life cycle assessment, energy use, GHG analysis, water use, resource use, recycling/waste, buildings/construction)
 - social dimension (society - corporate values, year-round employees, seasonal employees, training and further education, social commitment, social responsibility, cultural landscape)

The specific establishment and recommendations of the criteria are carried out in cooperation with the Save Climate climate protection initiative (Save climate 2014) among others. Verification is carried out by an independent inspection body (GUTcert 2025))

6. Maternity analysis

6.1 Introduction in maternity analysis

Materiality analysis is a concept from corporate and sustainability research that focuses on identifying and evaluating issues that are of critical importance to an organization and its stakeholders. It is particularly relevant in the areas of corporate responsibility, sustainability and non-financial reporting. The aim of materiality analysis is to determine the topics that are of most importance to both the company itself and its stakeholders (such as investors, customers, suppliers, society and regulatory authorities).

6.2 Scientific sources and theories

The materiality analysis is based on several scientific and theoretical concepts from different disciplines:

Stakeholder theory (Freeman, 1984): Stakeholder theory suggests that companies are not only committed to the interests of their shareholders, but also to the interests of other groups such as employees, customers, suppliers and society as a whole. This theory is the basis for materiality analysis as it provides a comprehensive perspective on the relevance of issues from different angles.

And the materiality analysis is an essential tool in Corporate Social Responsibility (CSR) reporting. CSR focuses on the responsibility of companies towards society and the environment. According to Carroll (1999), CSR goes beyond legal obligations and includes ethical, philanthropic and economic aspects. The materiality analysis helps to determine the focal points for CSR initiatives. The GRI Standards provide a framework for non-financial reporting and recommend that companies conduct a materiality analysis to determine the most relevant topics for their reporting (GRI, 2016). These standards are recognized worldwide and provide a sound methodology for conducting the materiality analysis.

6.3 Steps of the materiality analysis

The steps of the materiality analysis are the following:

1 Definition and objective of materiality analysis

The materiality analysis serves to identify material issues that are crucial for the company and its stakeholders. This can include environmental, social and governance (ESG) issues, but also specific business and production aspects that affect the company.

Materiality in the context of corporate reporting describes topics that are so important that they could have a significant impact on the financial and operational results of a company or that are of high importance in the perception of stakeholders.

Objective: The materiality analysis helps to focus on the most relevant topics and to ensure that the reporting covers both the material financial and non-financial aspects of the company.

2. Stakeholder identification and engagement: Identification of relevant stakeholder groups (e.g. investors, customers, NGOs, regulators) and obtaining their perspectives on the material issues.

3: Topic identification: Collection of topics that emerge from internal and external sources (e.g. industry reports, regulatory requirements, scientific studies).

4. Evaluation of importance: The topics are evaluated according to their relevance for both the company and the stakeholders. This is often done using interviews, surveys or focus groups.

5. Prioritization: A ranking is created, whereby the topics that are of high importance for both the company and the stakeholders are considered to be the most important.

7. Case studies

7.1 Sustainability of supply chains

This study includes two different case studies to identify different sustainability aspects of global and regional wine supply chains.

The first step of this analysis is the identification of relevant topics. The three quality and sustainability standards Fair'n green, globalGap and Fair Trade provide the basis for defining the relevant topics for the materiality analysis (see table 1). The three different standards have same requirements, but there are also differences. Fair'n Green focus on ecological and economics aspects, GlobalGap focus on all sustainable dimensions and the main focus of fair trade lies on the social aspects.

Sustainable dimensions	Identified criteria	Fair'n Green	GlobalGAP	Fair Trade
ecological	biodiversity	x	x	
	soil	x	x	
	water use	x		
social	fair working conditions		x	x
	strengthening of farmers		x	x
	no children work		x	x
	education	x	x	x
oeconomic	logistics	x	x	
	promotion/Communication	x		
	effective production process	x	x	
	digitalisation	x		
quality	no irradiation		x	
	no gentechnic engineering		x	x
	food safety		x	

Table 1: Relevant sustainability topics of wine supply chains

The second step is the stakeholder analysis. The main stakeholder of the wine supply chain are supplier, wine grower, wine cellar, storage, customer, marketing departments, finance, recycling and the society. These different stakeholders have different influences on sustainability along the wine supply chain. The influence of the wine grower, for example, comes from the soil, use of pesticides, the type of wine, plants, etc. The supplier influences sustainability in the value chain with bottles, caps, cork, carton, fertilizer etc. (see figure 4).

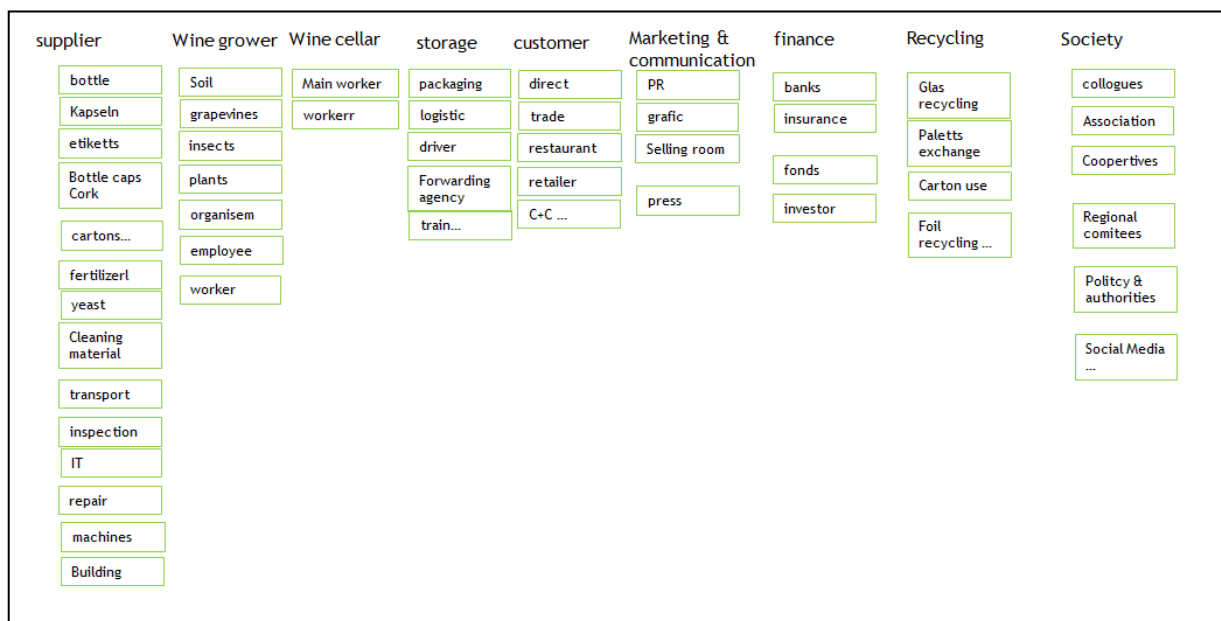


Figure 4: Stakeholder of the wine supply chain

The next step of the materiality analysis is the creation of an evaluation logic and the evaluation of relevant topics. There will be an individual assessment per relevant topic based on the four criteria severity, scope, reversibility and probability of occurrence. Figure 5 shows the double materiality analysis within the criteria biodiversity. The value within the assessment is classified from 1 (low) to 5 (high) and within an expert interview the results were analysed. This analysis was done for every sustainability criteria which was analysed during this research.

Double materiality	Severity	Scope	Reversibility	Probability of occurrence
Severity of real negative impact	4	4	3	
Severity of potential negative impact	4	4	3	3
Severity of real positive impact	5	4		
Severity of potential positive impact	5	4		3
Opportunities and risks	4	4		4

Figure 5: Double materiality sustainability analysis

The next step of the analysis is the visual presentation of the materiality analysis. Two case studies were carried out. Figure 6 shows the results for the regional supply chain and figure 7 shows the results for the global supply chain with the effects of the sustainability criteria on the company and also the effects of the criteria on CO₂ emissions.

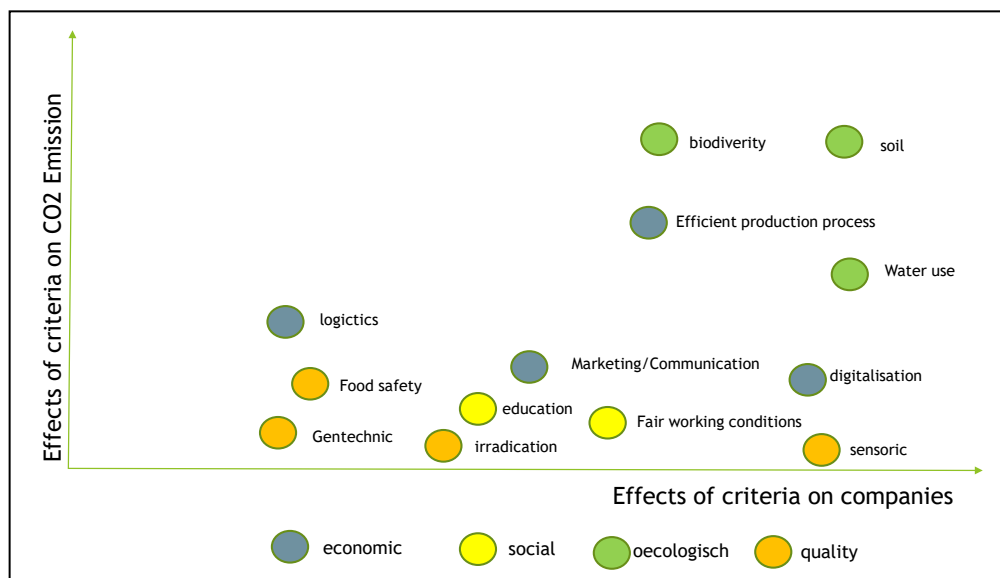


Figure 6 : 1. Case Study: Regional supply chain market wine

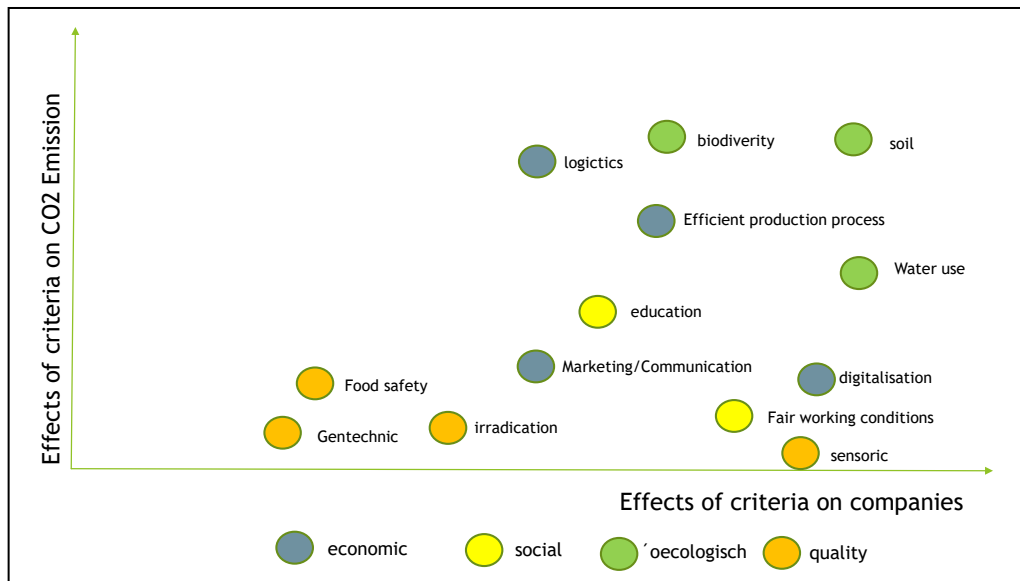


Figure 7: 2.Case Study: Global supply chain market wine

The comparison of these two materiality analysis shows that logistics, fair working conditions and education the main differences in sustainability between global and local supply chains are.

8. Conclusion

The materiality analysis is the central element of sustainability reporting. And the result of this analysis is that global and regional value chains face different challenges.

The next steps will be to create interviews with stakeholders to get more data for the analysis to carrying out more detailed materiality analysis of global and regional value chains.

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