



Towards sustainable wine: Comparison of two Portuguese wines

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ABSTRACT

A correct definition of the most adequate strategies and/or course of action to improve the sustainability of the wine industry must start with an evaluation, as objective and accurate as possible, of the sustainability performance of its products and processes. The main goal of this work is to perform a comparative sustainability evaluation of two Portuguese wines: a high market value “terroir” wine produced in small quantities, using grapes from a single vineyard, and a branded wine with lower market value, produced in large quantities using grapes from various regions. The evaluation follows a life cycle perspective and is based on seven sustainability indicators, selected taking into account the main issues pertinent to the wine industry. The functional unit is 0.75 L of wine produced that is the most common capacity of the wine bottles. The environmental and economic information used for the evaluation is mainly primary data obtained from the company, and complemented whenever necessary with secondary data from the literature or life cycle inventory databases. Results show that the main differences between the two wines are their water intensity and wastewater generated, being the values of the branded wine more than double those of the “terroir” wine, which is attributable to differences in the winemaking process, in particular the need to remove the SO₂ added in the branded wine production. The calculated values for the carbon emissions are in good agreement with literature works. Some recommendations for improvement of the process sustainability are given.

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1. Introduction

The last decades have witnessed an increased awareness of the environmental impacts of human activities, mainly the result of current patterns of consumption and production. Although already recognized as fundamental to the future of humankind, it was from the publication of the Brundtland Report “Our Common Future” (WCED, 1987) and the 1992 Rio Conference on Sustainable Development that sustainability was placed at the center of the main international, national and even regional agendas. Currently, many strategies or policies exist to promote or facilitate the transition to a more sustainable development, at global, national or regional scales, or specially designed for particular areas of activity. Examples at a global scale include the UN Sustainable Development Goals (UN, 2015) and at a regional level, the European Union

Strategy for Sustainable Development (CEC, 2009a). The strategies and/or policies to be successful must take into account the specific regional and local aspects from a geographic point of view, or sectorial aspects if aimed to specific areas of activity. Some of the key aspects include the competing goals of the various stakeholders, resources availability, specific local environmental and/or climatic conditions, consumer behavior towards sustainability, production process' operational parameters, among others.

The wine industry has a role to play in the path towards a more sustainable development, taking into account its specificities, the environment and the stakeholders with which it operates (Martins et al., 2016, 2017). Words such as green, biologic, biodynamic and organic wine have become increasingly popular around the world, denoting an increasing understanding of vine growers and wine-makers about the impact their practices have on the environment and the need to improve them. Besides, legislation and the necessity to comply with specific regulations, stakeholders and customers are giving increasing importance to the sustainability related issues, compelling companies to react and change the way

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they do business at every level of their activities (Petti et al., 2015).

Nevertheless, the concepts of sustainable viticulture and wine-making are currently underdeveloped and there is a need for guidelines and/or standards to support winemakers improve their sustainability performance. This has encouraged several organizations representing the wine growers and producers (Dodds et al., 2013), as for example the International Organization of Vine and Wine, OIV, the largest multilateral international organization operating in the wine sector, to provide information and tools to facilitate the adoption of production processes in line with the principles of sustainable development. A key problem is the need for tools that allow the quantification, as accurately as possible, of the sustainability or the contribution to sustainable development of a product/service or process. This measure is crucial to ensure that a proper management of sustainability issues is done, allowing the identification of the most effective course of action and of the aspects to be dealt with firstly, or if there is a real improvement and even new strategies and policies that are necessary.

Hence, this work first briefly reviews the current state of the art concerning the sustainability evaluation in the wine sector, considering not only the works available in the literature but also how industry understands the concept and how it is considered. Second, it presents and discusses a case study of a comparative sustainability assessment of two Portuguese wines, a small volume production “terroir” wine and a large volume production branded wine, both produced by the same company. The study uses mainly primary data from process operation obtained from the company, complemented when necessary with data from the literature and life cycle inventory databases. The evaluation follows a life cycle thinking approach, based on the calculation of selected indicators adequate to the wine industry. It allows to identify if the wines market positioning, production volume, and specific details in the production process, have a significant impact in their sustainability performance and to propose some solutions for improvement of the wines sustainability.

2. Sustainability in the wine industry

Currently, there is a growing interest of the wine industry for improving its contribution to sustainable development. This is confirmed by the release of guidance documents from national or international organisms working in the wine sector (OIV, 2008; Vinos de Chile, 2012). Furthermore, in some wine production regions there was the launch of project groups and communities, as for example the California Sustainable Wine Growing Program (<https://www.sustainablewinegrowing.org>) and Sustainable Australia Winegrowing Maclaren Vale (<http://www.sustainableaustralia.info>). Moreover, there is an increasingly growing body of academic and industrial work in the area, the result of an increase interest in the area due to the increasing importance given to sustainability (Santini et al., 2013; Gilinsky et al., 2016). These activities aim to analyze and evaluate production processes, to set up specific sustainability programs, to develop best practices and ensure continuous improvement, to promote the benefits of sustainable winegrowing and producing practices, to communicate, both internally and externally, the performance achieved in terms of sustainability, and to take into account the goals of all the relevant stakeholders.

It is consensual that a proper assessment of a product or process' sustainability has to adopt a Life Cycle Thinking (LCT) perspective, considering all the life cycle steps involved in its production or operation (UNEP, 2011; Zamagni et al., 2013; Guinée, 2016). Besides ensuring a systemic view of a product/production system, facilitating the identification of hotspots for improvement, it avoids

burden shifts between different life cycle stages. Currently, sustainability assessment and certification schemes of products and processes in which agricultural production systems are a key part, are already based on a LCT approach (CEC, 2009b; Mata et al., 2011). In the case of wine production, this involves viticulture, wine making, bottling and final distribution. Thus, several areas must be accounted for when considering sustainability in the wine industry (Petronilho, 2015), including agriculture, marketing and logistics, waste treatment, regulatory compliance, among other aspects. This can make the analysis and improvement of the sustainability of wine production a daunting and difficult task, involving the input and expertise of various or different technological and scientific areas.

When evaluating sustainability, apart from the savings in reducing the use of certain inputs (e.g. energy, water and phyto-pharmaceuticals) due to changes in specific production steps, the focus should be given to continuous improvement. This is one of the cornerstones of most sustainability programs, which try to encourage implementation of more eco-efficient processes, opening the way to discover new and better forms of doing things. With reference to consumer interest in wine from sustainability oriented production systems, there is yet no clear evidence that the pursuit of sustainability enhances the perceived value of products and the tendency of consumers to buy sustainably produced wines (Sogari et al., 2016). This may be due to the lack of knowledge and the non-existence of specific information on wine bottle's labels or specific environmental labels. In spite of the lack of knowledge of consumers about more sustainable products, the public interest is on the rise (Zucca et al., 2009). Consumers are more willing to pay a premium price for a wine produced using environmentally friendly practices (Barber et al., 2009a; Forbes et al., 2009), but the price they are willing to pay remains an important question as the customers are not willing to pay a significant large premium for a certified sustainable wine (Berghoef and Dodds, 2011). Also relevant to the customer's choices, concerning the selection or not of a sustainable wine, are the questions concerning the perceived quality of the wine from a certain region (Delmas and Lessem, 2017) and the difficulty of transmitting the information to wine consumers, not familiar with the questions of sustainability though eco-labels (Ginon et al., 2014).

In the next subsections, a brief overview of the most relevant activities and works in this area are presented and discussed. More complete reviews can be found in literature (Petti et al., 2015; Flint et al., 2015; Santiago-Brown et al., 2014; Corbo et al., 2014). The first, deals with some of relevant institutional and certification schemes devised to assist winemakers to increase the sustainability of their activities.

2.1. Institutional initiatives on wine sustainability

The sustainable winegrowing concept began in the early 1990s, in particular in some of emerging wine regions of the world. One of the earliest examples is the Lodi-Woodbridge Winegrape Commission, in the California central valley, that in 1995 established demonstration vineyards, following sustainable winegrowing practices monitored over time (Zucca et al., 2009). These included for example, monitoring of pests and vineyard inputs such as water, fertilizers and pesticides. Later, several other regional winegrowing associations and regions in California adopted and adapted to their specific constraints the Lodi's sustainable winegrowing program. In 1994 the Sustainable Winegrowing New Zealand was established (SWNZ, 2016) program by the New Zealand Winegrowers organization. This programme, introduced in 1997, provided best practice models of environmental practices in the vineyard and winery, in order to guarantee quality from vineyard to bottle, and address

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