



The environmental impact of a Sardinian wine by partial Life Cycle Assessment

Graziella Benedetto*

Department of Science for Nature and Environmental Resources University of Sassari, Sardinia, Italy

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Abstract

Purpose: The aim of this study was to evaluate the environmental emissions associated with the production of a typical white wine produced in Sardinia, with particular reference to CO₂ emissions. The main objective is to determine the main environmental impacts of the overall production process and to identify what steps have the greatest level of criticality.

Methods: An attributional and partial Life Cycle Assessment analysis was used with GaBi software.

Results: The analysis shows that the main problems were the production and combustion of diesel in the viticulture phase, above all during the vine planting phase, and the production of glass bottles in the phase of wine bottling within the winery processes.

Conclusions and recommendations: To overcome these critical points, some suggestions come from the most recent literature, such as the use of biofuels in the first case and the use of lighter bottles in the second. More in-depth analysis is needed to compare these alternatives in order to assess the effective reduction of environmental emissions.

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Keywords: Viticulture; Wine; LCA; CO₂ emission; Sardinia

1. Introduction

Food production, as detailed in the study conducted by [Horrigan et al. \(2002\)](#), has quite an impact on the environment; the use of fertilizers, pesticides, soil and land, water and energy¹, as well as pollutant gas emissions, contribute to the phenomenon of climate change and global warming. Infact, according to estimates by the Intergovernmental Panel on Climate Change (p. 448) agriculture has been noted to be directly responsible for approximately 20% of greenhouse gas

emission. Similarly, the wine business and the process of transforming grapes into wine and marketing them, all take their toll on the environment. These agricultural and industrial practices seem particularly harmful not only for Global Warming Potential (GWP) but also for other impact categories such as Abiotic Depletion (ADP), Acidification Potential (AP) and Eutrophication Potential (EP) (e.g. the use of fertilizers or electricity for irrigation). These negative externalities are transferred from the private to the public sphere as environmental costs that society has to bear ([Colman and Paster, 2009](#); [Idda et al., 2007](#)).

Simultaneously, over the past two decades, worldwide environmental awareness has been growing dramatically ([Barber et al., 2009](#)). The effect has been the increasing involvement of all those who, for various reasons, are interested in the production and consumption of food and beverages. Consumers have introduced environmental concerns into their purchasing processes, selecting producers who show sensitivity towards the environment ([Barber et al., 2009](#); [Hardie, 2000](#)); distribution chains have responded promptly to

*Tel.: +39 079229355; fax: +39 079229356.

E-mail address: gbenedet@uniss.it

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¹“The food production system accounts for 17% of all fossil fuel use in the United States, and the average is 3 kcal of fossil energy in producing 1 kcal of food energy” (p. 448).

this request [e.g. the British Tesco, (Rigby et al., 2007) and Wal-Mart (Finnveden et al., 2009)]; the world wine market includes countries which are particularly sensitive to the issue of environmental emissions associated with the production and transport of wine up to the final consumer such as the United Kingdom, the United States, Australia, New Zealand, South Africa and France (Waye, 2008).

From the supply side, producers' associations, individual companies, local government institutions involved in protecting large areas (e.g. the *Lodi Rules* in California and the spread of the *Bilan Carbone* in France) have shown a remarkable sensitivity to this issue (CIVB, 2010). The effects of such business policies at the international level have been surprising and able to motivate the research activities developed around the solution of various aspects relating to specific environmental issues.

Important decisions will be taken in assessing environmental emissions of wine, such as the International Wine Carbon Calculator (IWCC) in Australia, USA, New Zealand and South Africa, Bilan Carbone in France, Carbon Trust in the UK, Huella de Carbon and Ita.Ca respectively in Spain and Italy; the OIV (International Organisation of Vine and Wine) Protocol currently the OIV is being validated. Similarly the Life Cycle Assessment (LCA) approach became a key reference for the international scientific community (Zamagni, 2012) involved in the sustainability assessment of economic activities.

As a part of the international wine market and a country which has played a key role in the history of wine, Italy, with its deep rooted tradition, is one of the top exporters in the world. Sardinia plays a secondary role in the national wine sector and, according to figures from Istat (2010), its vineyards and wine production stood at 3% and 1% respectively.

However, this is a sector which has an important historical, cultural, environmental, economic and social role in the regional context. The Sardinian viticulture produces many positive benefits (*recreational*, associated with the maintenance and management of the land in and around the vineyard; *social*, related to the maintenance of the agricultural population in areas where it can be a source of income support; *environmental*, aimed at preserving the countryside) as well as a negative environmental impacts; for the reasons given, it is useful to monitor and evaluate the extent of such adverse effects. The goal is to introduce the use of eco-friendly farming practices and ensure the agriculturist broadens horizons in terms of yield quantity and quality.

The main objective of this study is to assess the multiple environmental impacts of a typical white wine (Vermentino di Sardegna) produced by a Winery, located in the north of Sardinia, so as to identify the main hot-spots and improvement opportunities within the product process.

2. Background and aims

The scientific context of this study looks at the relationship between development economics, environmental economics, with specific reference to the problems generated by over-estimates of production activities on the availability of environmental resources and international trade. Infact, the

progressive development of productive activities in general, particularly associated with the agri-food, was accompanied by an increasing growth in emissions pollutants impairing the quality of renewable resources, such as air. Globalization has also proceeded to aggravate this process of deterioration.

The connection with the theme of sustainable development is inevitable as is its evolution from the well known Brundtland Report, not to mention the impact it has had on international environmental policy since 1992.

From a theoretical viewpoint, the reference is to the “*tragedy of the commons*” (Hardin, 1968) by moving the field of observation from the traditional category of *commons* to those that include the *global commons*: “*areas outside the jurisdiction of any nation or group of nations*” (Clancy, 1998, p. 603) including the atmosphere, outer space, water, high seas, deep sea beds, forestry, and so on. On several occasions, Hardin's theory has been adapted to different categories of common goods from those to which the author refers to in his famous example of pastures: a call to the *global tragedy of the commons* is also to be found in Colman and Paster (2009) with reference to the wine industry and its externalized costs such as Carbon dioxide emissions, chemical effluent and other wastes.

Wine is considered to be one of the agricultural practices affected by climate change although to a lesser extent.

For this reason studies have been considered from two points of view: the impact of climate change on the global wine industry and on viticulture (see among others Tate, 2001; Jones et al., 2005; Jones, 2006, 2007; Anderson et al., 2008; Ramos et al., 2008; White et al., 2009; Mira de Orduna, 2010; Bernetti et al., 2012), on the one hand; the analysis of how wine contributes to climate change, on the other hand, by the identification and application of tools which are able to estimate only one impact, the effect on global warming (International Wine Carbon Calculator, Bilan Carbone), or multiple impacts (LCA) (e.g. Zabalza et al., 2003; Notarnicola et al., 2003; Aranda et al., 2005; Montedonico, 2005; Carta, 2009; Fearne et al., 2009, Barry, 2011; Gonzalez et al., 2006; Ardente et al., 2006; Petti et al., 2006; Rugani et al., 2009; Schlich, 2010; Gazulla et al., 2010; Bosco et al., 2011; Pattara et al., 2012a, 2012b; Point et al., 2012; Vázquez-Rowe et al., 2012; Comandaru et al., 2012; Neto et al., 2013; Vázquez-Rowe et al., 2013).

This contribution is part of the line of study and research focused on this second aspect.

Infact, the aim of this study is to assess the multiple environmental impacts of one of the most important wineries operating in northern Sardinia, with reference to a category of white wine of great importance within the company's product portfolio. This is only an exercise to test the potential of an instrument such as LCA: its application within a specific wine company will highlight any problems (e.g. in data collection due to the precision with which inputs should be considered for quantity and quality). It will also be possible to describe the major categories of environmental impacts, as well as identify the stages of the production process that are most responsible for each impact category. The ultimate goal is to promote the spread of this methodology in Sardinia, as this is poorly implemented in the wine sector.

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