LIFE HAPROWINE: WINE SUSTAINABLE PRODUCTION.

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ABSTRACT

One of the most ambitious goals of the European project LIFE HAproWINE (LIFE08/ENV/E/000143) is to achieve sustainable production both in the vineyard and at the winery. In this sense, a set of technological alternatives has been identified and assessed from an environmental and economic point of view, with the aim of establishing a prioritization to determine 'the sustainable production'. Thus, a new methodology has been developed in order to get the prioritization of diverse techniques and alternatives for different processes.

All this work is based on the information collected from the participating wineries in the project, located in Castilla y León region (Spain), and from the members of the HAproWINE Stakeholders Advisory Committee.

INTRODUCTION

The sustainability of vineyard and wine elaboration processes can be improved by using techniques which are able to optimize the energy efficiency and to reduce the inputs, as well as the outputs leading to a reduction in volume of waste for recuperation or recycling. In order to obtain environmental benefits, old equipment can be replaced by new one. However, any renewal is likely to entail additional costs for many wineries, not only due to the possible economic investment required for its implementation but also to costs associated with updating the production line or because of new training needs related to changes in the processing operations. Therefore, when evaluating the different techniques it is necessary to achieve a sustainable balance between the industrial process, product quality, economic development and consumption of resources (economic costs, time of adequacy, etc.).

The purpose of this study is to carry out a prioritization or sequential classification of the technologies involved in the wine making process. In order to define sustainable production in the vineyard and at the winery, technologies that are currently available in the market, and technologies established in Castilla y León have been analysed from an environmental and economic point of view.

The compiled information has allowed the analysis of environmental feasibility of the best available techniques (BATs), which were identified on the basis of the most significant environmental aspects and "in situ" winery data. BATs are defined in Directive IPPC. Art.3.10. (The European Parliament, 2010) as the "*most effective and advance stage in the development of an activity and its methods of operation, which indicate the practical suitability of particular techniques for providing, in principle, the basis for emission limit values designed to prevent or eliminate or, where that is not practicable, generally to reduce an emission and its impact on the environment as a whole*".

A study of the environmental load for each of the considered techniques is carried out, using for this purpose commercial environmental databases. Thus, the environmental profile of each technique is obtained through the evaluation of different impact categories, by applying the Life Cycle Assessment (LCA) methodology. On the other hand, economic load has been quantified, taking into account both investment and annual operating costs, for each one of the techniques and on the basis of information collected in 2010 from diverse collaborators in Castilla y León.

MATERIALS AND/OR METHODS

Environmental methodology
The impact assessment of the selected techniques is carried out applying the LCA methodology to the inventory data. Inventory flows are classified according to their potential effect on the impact categories and the indicator results for these categories are calculated at the characterization stage. The optional stages of normalization and weighting are not considered, because they bring subjectivity to the study.

LCA study has focused on the use phase, excluding infrastructure, of each analysed process in order to define indicators which allow the prioritization of best available techniques (Figure 1). The work team has selected CLM 2001 (Guinée, 2002) as evaluation method at the software SimaPro 7 and has used the environmental information gathered in Ecoinvent database (Frischknecht et al., 2005).

Economic methodology
The economic load for each technique was calculated considering investment in machinery and equipment as well as costs incurred during their use or maintenance in the first year. This economic information was provided by Spanish suppliers of the wine sector.

BATs Prioritization methodology
The prioritization methodology is based on the results of applying both economic and environmental methodologies. For the environmental assessment, only "global warming" category has been considered, given the current importance of carbon footprint indicator. This category assesses the impact of the greenhouse gases quantified in kilograms of carbon dioxide equivalent.

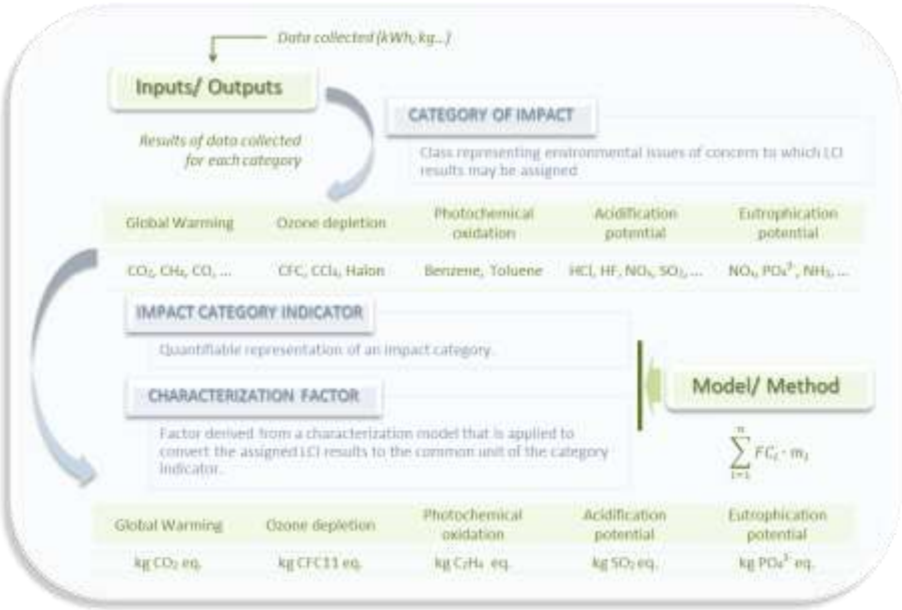


Figure 1. Scheme of the characterization process (CTME, 2012).

To apply the prioritization methodology, it was necessary to establish the reference techniques for each process, which is defined as the most common and usual technique in the sector, regardless the size of the winery. For this process, information collected from wineries and from meetings with the Stakeholder Group of the LIFE HAproWINE project, together with bibliographic information, was used. Each selected technique was compared with the reference technique with the objective of identifying those that improve the reference values and those less favoured according to the set of environmental and economic criteria. Mathematically, this methodology can be described as shown below.

N, set of k alternatives; P, set of i processes and R, set of reference techniques

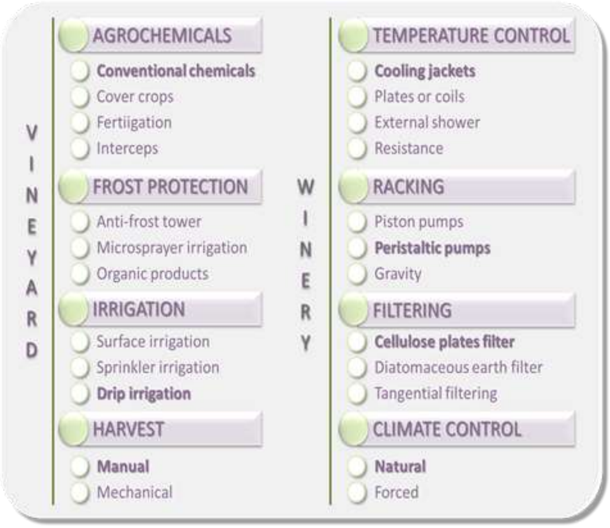
$$\forall\ i \in P\ is\ selected\ k\ \in N, and$$

$$\left(\frac{€_i}{\sum_{i=1}^{n} €_i} \times 100 + \frac{CO_{2\,i}}{\sum_{i=1}^{n} CO_{2\,i}} \times 100\right)_{Ref} - \left(\frac{€_i}{\sum_{i=1}^{n} €_i} \times 100 + \frac{CO_{2\,i}}{\sum_{i=1}^{n} CO_{2\,i}} \times 100\right)_{k} \rightarrow\ T_i$$

Prioritization of the alternatives is achieved based on the obtained values of T_i, where T_i is the rating obtained by each technique.

$$T_{k1} \geq T_{k2} \geq T_{k3} \geq \cdots \geq T_{kn}$$

Figure 2 presents the studied techniques and the reference technique for each process. The reference technique is highlighted in bold, except in the category “frost protection”, where the Reference Technique is “no technique”.



N={conventional chemicals, interceps, cover crop, fertigation, without any frost protection system, anti-frost-tower, micro-sprinkler, organic products for protection against frost, without irrigation system, surface irrigation, sprinkler irrigation, drip irrigation, manual harvesting, mechanical harvesting, cooling jackets, plates – coils, external showers, resistances, piston pump, peristaltic pump, gravity, cellulose plates, diatomaceous earths, tangential filtering, natural climate, forced climate}

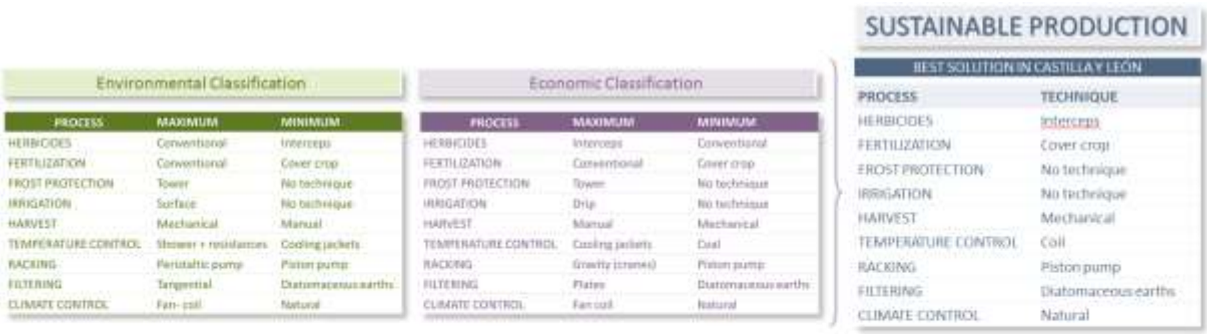
P={agrochemicals, frost protection, irrigation, harvesting, control of temperature in tanks, racking, filtering, climate control}

R={conventional chemicals, no technique frost protection, drip irrigation, manual harvesting, cooling jackets, peristaltic pumps, filter plates, natural climate}

Figure 2. Studied techniques - Wine sector of Castilla y Léon (CTME, 2012).

RESULTS AND CONCLUSIONS

Techniques responsible for minimising the impact were determined, considering techniques with minimum values in the economic and in the environmental evaluation at the same time (Figure 3).



Environmental Classification

PROCESS	MAXIMUM	MINIMUM
HERBICIDES	Conventional	Interceps
FERTILIZATION	Conventional	Cover crop
FROST PROTECTION	Tower	No technique
IRRIGATION	Surface	No technique
HARVEST	Mechanical	Manual
TEMPERATURE CONTROL	Shower + resistances	Cooling jackets
RACKING	Peristaltic pump	Piston pump
FILTERING	Tangential	Diatomaceous earths
CLIMATE CONTROL	Fan- coil	Natural

Economic Classification

PROCESS	MAXIMUM	MINIMUM
HERBICIDES	Interceps	Conventional
FERTILIZATION	Conventional	Cover crop
FROST PROTECTION	Tower	No technique
IRRIGATION	Drip	No technique
HARVEST	Manual	Mechanical
TEMPERATURE CONTROL	Cooling jackets	Coil
RACKING	Gravity (cranes)	Piston pump
FILTERING	Plates	Diatomaceous earths
CLIMATE CONTROL	Fan coil	Natural

SUSTAINABLE PRODUCTION

BEST SOLUTION IN CASTILLA Y LEÓN	
PROCESS	TECHNIQUE
HERBICIDES	Interceps
FERTILIZATION	Cover crop
FROST PROTECTION	No technique
IRRIGATION	No technique
HARVEST	Mechanical
TEMPERATURE CONTROL	Coil
RACKING	Piston pump
FILTERING	Diatomaceous earths
CLIMATE CONTROL	Natural

Figure 3. Sustainable vineyard and wine elaboration processes (CTME, 2012).

In conclusion, it can be said that the principal benefits, as expected, fall on those techniques that can be avoided and therefore, that are not present in all wineries, such as frost protection systems, irrigation systems and climate control systems. Thus, it is also observed that there are not significant changes based on the size of wineries.

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