VITIVINICULTURE, ENVIRONMENT AND BIODIVERSITY: SUSTAINABILITY ACTIONS

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ABSTRACT

The rational use of resources is currently a widely discussed topic in any organization, although it takes on greater importance in those of productive scope. Measures of different levels – strategic, tactical or operational – are increasingly being implemented, so it is pertinent to analyze their effect on the distinct dimensions of sustainability: environmental, economic and social. Any strategic process must go through those that are considered the four crucial stages: analysis, formulation, implementation and control. The perfect knowledge of the environment and its emerging needs and concerns along with an in-depth survey of the internal situation of the organizations will allow us to achieve truly differentiating levels of excellence. This research, carried out in a wine-producing organization – *Adega Cooperativa de Mangualde* – identifies its crucial activities, the main strategic, tactical and operational actions that have been implemented in the last eight years, fits them into the above-mentioned dimensions of sustainability and determines its relative weights. Particular emphasis is placed on grapes suppliers – the capital holders –, as regards their mode of production and its impact on biodiversity and the environment. Raising public awareness of this issue is of great importance and people should be encouraged to alter their behaviour by changing some attitudes in everyday life. This awareness to achieve sustainable development becomes even more important insofar as it is a cooperative institution with a management model of well-defined specific characteristics.

KEY WORDS: strategy, sustainable vitiviniculture, environment, biodiversity.

1. INTRODUCTION

The production and rational use of resources form the basis of many of the environmental problems we face, including climate change. Thus, its correct and efficient use calls for economies that lead to benefits ranging from a global (national or world) scale to a partial one (at the consumer level), with consequent cost reduction and increased competitiveness.

The idea of sustainability is based on the economic activity, the environment and the global well-being of society. It enables a type of development capable of responding to the present needs without compromising the growth capacity of the future and future generations and it aims to improve the individuals living conditions, while preserving the environment in the short, medium and, especially, long term. Sustainable development is based on a triple objective (economically efficient, ecologically sustainable and socially equitable) that can only be achieved if these three dimensions evolve harmoniously, irrespective of the business area. (Initiative, Global Reporting, 2012)

In May 2001, the European Union adopted a strategy for sustainable development, revised in 2005, with the aim of giving it new dynamism. The World Partnership for Sustainable Development, adopted by the Commission in 2002, has given it an important external dimension. Integrating environmental issues into the definition and implementation of other policies is an essential element in achieving the goals.

In order to promote sustainability, public authorities and organizations should take appropriate measures to limit the harmful effects of transport and health risks, to improve the management of natural resources, including their consumption, to combat social exclusion and climate change, and limit its consequences. (Almeida, 2005)

Of the set of actions to implement, energy concern plays a major role due to the direct and indirect impact on the environment, although it is sometimes relegated to the background. The weight of the energy bill in the operating costs of a company in the industrial sector is usually low when compared to other factors of production, such as labor and raw material. Energy management is therefore

often neglected, which generates significant waste and contributes to the reduction of the competitiveness of companies. (Gaspar, 2013)

The concept of Rational Use of Energy, which emerged following the so-called oil shocks, has decisively altered the way of facing energy, demonstrating that it is possible to grow without increasing consumption or affecting the quality of production. While the competitiveness argument naturally remains the most responsive to managers, increasing environmental pressure has reinforced the need for efficient energy use. It is unanimously accepted that, eventually, market policy instruments, such as environmental taxes, will introduce the polluter pays principle, which will make the least-prepared companies heavily penalized. (Gaspar, 2013)

The objective of the present work is to frame and understand the effects of several actions implemented for eight years in a winemaking organization: the Adega Cooperativa de Mangualde. It begins with a brief "Literature Review", which addresses the issue of sustainability and energy and describes the target organization of the study. The "Methodology" topic includes an explanation of how information has been collected and treated and an exhaustive identification of the developed actions. Finally, in "Results", we present the relative weights of the actions for the different dimensions and the comparative metrics.

2. LITERATURE REVIEW

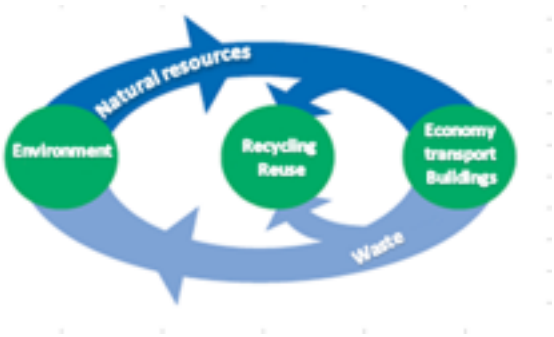
2.1. Environmental, economic and social sustainability

The concept of sustainability emerged at the end of the 20th century, stating that economic development must also take into account the ecological balance and the preservation of the quality of life of human populations at the global level. The idea of sustainable development is based on the principle that man must spend natural resources according to their capacity of renewal in order to avoid their exhaustion (Figure 1). Thus, sustainable development is understood as meeting the needs of the present without compromising the possibility of future generations to do the same. (Almeida, 2005)

Sustainability is based on the following principles or rules of resource management:

- the exploitation of renewable resources must not exceed regeneration rates;
- emissions of pollutant waste must be kept to a minimum, not exceeding the absorption capacity and regeneration of the ecosystems;
- non-renewable resources must be exploited in an almost sustainable way, limiting their rate of depletion to the pace of the creation of renewable substitutes;
- wherever possible, waste from the use of non-renewable resources should be reused and recycled. Waste from some economic activities can serve as raw materials for other.

Figure 1. Use of natural resources



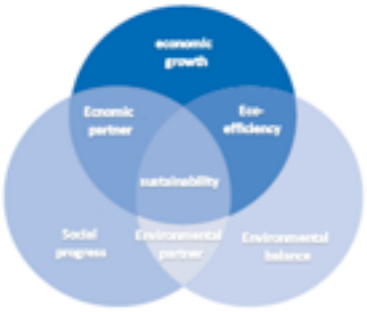
Source: A. T. Almeida, "*Manual de boas práticas de eficiência energética*", 2005

The environmental concern should not only affect the production process, but should also extend to the vineyards, through a viticulture in contact and focused on the preservation of natural resources, respecting the practices of protection and integrated production. Viticulture constantly strives for a balance between the use of technology and concern for the environment, such as drip irrigation (making it possible to consume less water), non-mobilization of soils (keeping a vegetation cover that retains moisture, benefiting plant and animal life and biodiversity, and a lower water requirement) and fertilization with by-products (the grafting of the grapes and the organic matter of pruning). (Félix & Cavaco, 2009)

Economic activity, the environment and the overall well-being of society form the basis of sustainable development. This can only be achieved if the three axes evolve harmoniously. Thus, the concept of sustainable development can be represented by Figure 2, in which the three circles represent the associated environmental, economic and social dimensions, and the following aspects must be emphasized:

- economic, social and environmental processes are strongly interlinked;
- sustainable development goes beyond environmental preservation;
- the activities carried out in the present medium-term should guarantee the global satisfaction of the needs of future generations;
- sustainable development calls for long-term structural changes in the economy and the social system so that a reduction of the consumption of natural resources is possible while maintaining economic potential and social cohesion. (Almeida, 2005)

Figure 2. Environmental, economic and social dimensions of sustainable development



Source: A. T. Almeida, "*Manual de boas práticas de eficiência energética*", 2005

2.2. Sustainable energy

The World Energy Council (WEC)[1] has been at the forefront of the energy debate for almost a century, influencing thought and stimulating global action to ensure sustainable and accessible energy for all. It contributes to global, national and regional energy strategies through the organization of high-level events, the publication of benchmarking studies and the work of its extensive network of members, facilitating the dialogue leading to the definition of energy policies. Independent and inclusive, WEC's work covers all nations and all sectors of energy - from fossil fuels to renewable resources (Council, World Energy, 2014).

2.2.1. World fuel production and consumption

In the last 15 years, there has not been a large percentage change in the different types of fuel sold for primary energy, although there has been a slight decrease in the oil level (Figure 3).

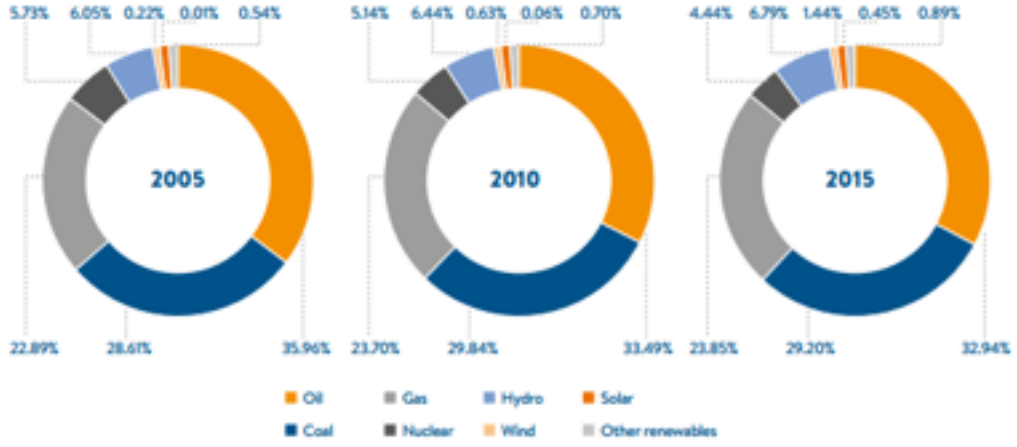
The growth of world oil production in 2015 significantly outpaced the growth in consumption of this fuel for the second consecutive year (Figure 4). Production increased by 2.8 million barrels per day (b/d), led by increases in the Middle East (+1.5 million b/d) and North America (+0.9 million b/d). World oil consumption increased by 1.9 million b / d, almost twice the 10-year average, with above-average growth driven by OECD countries. The Asia-Pacific region accounted for 74% of global growth, with China contributing to the largest national growth in world oil consumption (+770,000 b/d). (Dudley, 2016)

2.2.2. Rational use of energy

Rational Use of Energy (RUE) aims to provide the same level of production of goods, services and comfort through technologies that reduce consumption compared to conventional solutions. The RUE may lead to substantial reductions in energy consumption and emissions of pollutants associated with their conversion. In many situations, it can also lead to high savings in the life cycle costs of energy-using equipment (initial cost plus lifetime cost of operation). Although generally more cost-effective in terms of up-front cost, more efficient equipment consumes less energy. This leads to lower operating costs and presents other additional advantages. (Almeida, 2005)

One of the most significant impacts of primary energy use through the RUE, in addition to reducing costs associated with energy bills, is to contribute to the mitigation of emissions of pollutants associated with energy conversion. Energy efficiency technologies often offer other non-energy benefits that are not offered by supply side alternatives. From the perspective of many consumers, it is the non-energy benefits that are largely at the origin of the decision to use technologies that are more efficient. Some examples of non-energy benefits are increased comfort, safety, work productivity and employment, noise reduction, improved process control, water saving and waste reduction.

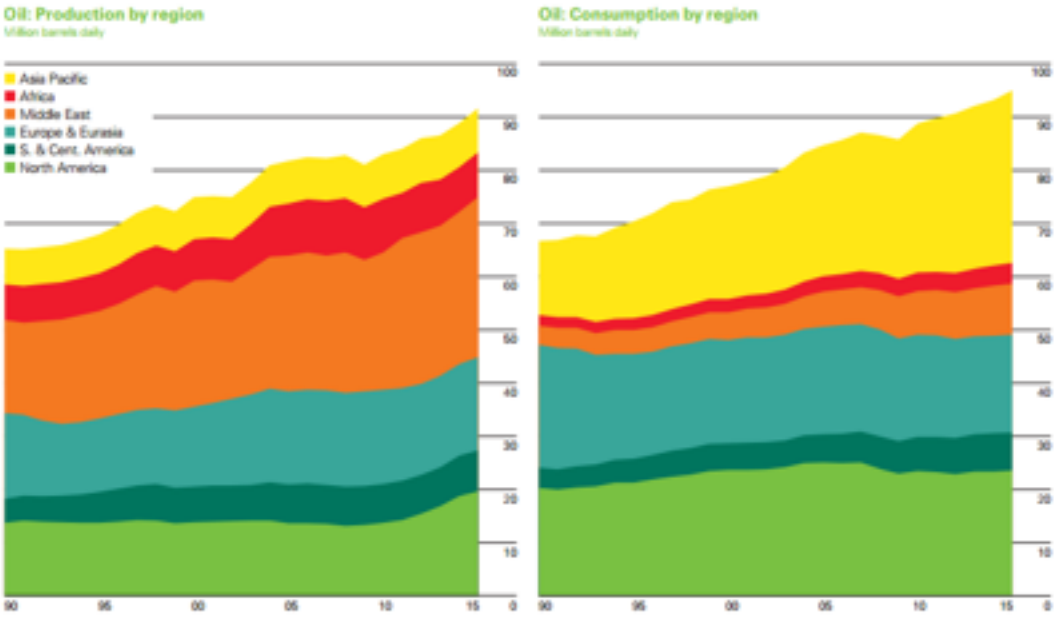
Figure 3. Five-year evolution of the percentage of different types of fuel sold for primary energy



Source: World Energy Council /Oliver Wyman, 2016

[1] Institution of the energy area accredited by the United Nations (UN), representing more than 3,000 organizations - public and private - from almost 100 countries.

Figure 4. Oil production vs world consumption



Source: World Energy Council /Oliver Wyman, 2016

2.3. Sustainability indicators

Indicators allow the acquisition of information on the environmental, economic and social performance of a particular organization and the one associated with a specific product, providing a more complete assessment of sustainability. The Global Reporting Initiative (GRI)[2] has pioneered and developed an understandable and accessible Sustainability Reporting Framework, currently in use throughout the world. This guide enables companies and organizations to be able to measure and report on their environmental, social and economic performance, these being the three pillars of sustainability.

The set of indicators suggested by the GRI are structured to reflect the inputs, outputs and types of impact that an organization has on the environment. Energy, water, and materials represent the three main types of standard inputs used by most organizations. These inputs result in outputs of environmental relevance, which are represented in the form of emissions, effluents and waste. Both the Transport and the Products and Services also represent areas in which an organization can cause environmental impacts, often indirectly through third parties, such as customers or suppliers of logistics services (Initiative, Global Reporting, 2012).

Energy indicators comprise the most important areas of energy use by the organization, which include direct and indirect energy. The direct use of energy consists of the energy consumed by the organization and its products and services. Indirect energy consumption, on the other hand, is the energy that is used by third parties that serve the organization. The outputs correspond to sets of indicators that include different types of pollutants, representing emissions to the air, effluents and solid wastes.

Some indicators used to assess sustainability in the wine industry are identified below.

- Percentage of materials used that are recycled as input materials.
- Energy used.
- Energy purchased and consumed through renewable energy sources.
- Energy saved due to conservation or increased efficiency.
- Initiatives to promote energy efficiency or energy renewal based on products, services, and reductions in energy requirements because of these initiatives.
- Initiatives to reduce indirect energy consumption and improvements achieved.
- Amount of water used.
- Water resources significantly affected by water consumption.
- Water treatment and reuse.
- Proximity of lands occupied/used in protected or high biodiversity areas.
- Description of significant impacts of activities, products and services in protected areas and areas of high biodiversity outside protected areas.
- Total Greenhouse Gases (GHG) emitted.
- Initiatives to reduce GHG emissions and achieved improvements.
- Quantity of water discharge by quality and destination.
- Amount of waste by type and method of disposal.

[2] Non-profit organization, founded in Boston in 1997, which brings together efforts to promote a sustainable global economy by providing guidelines and indicators for sustainability reporting.

- Initiatives to mitigate environmental impacts of products and services.
- Percentage of materials sold (bottles or packaging) that are collected.
- Fines/sanctions for non-compliance with environmental laws or regulations.
- Investments and expenses in environmental protection/ care. (Santos, 2012)

2.4. *Adega Cooperativa de Mangualde*

2.4.1 Historical contextualization

Integrated in the Dão Demarcated Region[3], the Adega Cooperativa de Mangualde (ACM) was founded on December 4, 1963, a decade marked by the valorization, expansion and implementation of the spirit and cooperative values in Portugal. It received the first 629 tonnes of grapes produced by its members on 18 October 1971. (Mangualde, Adega Cooperativa, 1963)

In the 70's, the winery, with its own headquarters, was producing, for the first time, approximately half a million kilos of grapes from its cooperators. In the 90's, a process of investment and modernization began, both at the level of facilities, and at the level of laboratory equipment and quality control of wines. The Winery used state and community funds, in order to build a winemaking and stabilization center for wines and invested in a bottling line of its own. At the human resources level, there was a focus on the training and hiring of qualified personnel in the oenology and management areas, and partnerships were developed with local entities and institutions.

The Adega Cooperativa de Mangualde has as its mission the production and bottling of common and liqueur wines, from the grapes coming from the vineyards of its associates, and its distribution through the various channels in the national and international markets. It promotes, in parallel, all the wine culture and traditions through the Interpretative Center of Vine and Wine (ICVW)[4]. Its vision is to achieve standards of efficiency and improvement of wine-growing, encouraging and assisting wine-grower associates, providing expert support, field monitoring of their vineyards and promoting training actions appropriate to the needs and evolution of the sector; to produce wines according to demand and market requirements; to distribute the wines nationally and internationally; to contribute to the sustainable development of the environment; to develop wine tourism at the local, regional and national levels. (Mangualde, Adega Cooperativa, 2016)

2.4.2 Production process

The ACM production process is divided into the reception, vinification, stage, blending, and preparation for bottling / filling, bottling / filling and storage sections. (Mangualde, Adega Cooperativa, 2015)

Receiving

It is at this stage that the winery receives the grapes from its members. In the reception process, the grapes are weighed, separated by grape varieties and the first laboratory tests are carried out to identify the associated alcoholic content, so that the amount to be paid to each member is determined. The grapes are then inspected for their phytosanitary status and subsequently discharged into the receptacles. It is here that the first oenologicals that will act throughout the process of transformation until the obtaining of the wine masses that follow to the process of vinification are added.

At the time of the phytosanitary analysis, some grapes may not meet the minimum requirements, and the partners are given the option to bring the grapes back or to be sent to stall. In this case, a token payment is made to help transport expenses.

Winemaking

Following the production process, there is the vinification. At this stage, the wine masses are received from the reception and a set of operations is performed whose purpose is to convert the juice from the crushing of the grapes into wine. As in the previous process, winemaking is processed by vine varieties. For each type of wine, the oenological and other constituents necessary for its finishing, such as, for example, liqueur wines, are added. At the end of the winemaking process, the resulting bulk wine follows distinct paths: one part is for sale in bulk and the remainder goes to stage.

Stages

At this stage, the wine in bulk rests in stainless or cement deposits and wood chips are added, so that the wine absorbs the characteristic flavor of the American oak. The length of this proceeding depends on the need and specificity of each type of wine. Thus, from the moment the wine presents the desired conditions, it goes to a new process.

Allotment

Allotment does not represent a productive process per se, but the moment when the winemaker decides which lots to create for the respective year. Thus, at this stage, two or more wines from different deposits are joined, in order to obtain a batch with the desired physical-chemical and organoleptic characteristics.

Preparation for bottling/filling

The next step will be to prepare the wine to be bottled. It is at this moment that the oenological joints are made, in order to guarantee the physical-chemical and microbiological stabilization of the lots to be bottled and/ or packaged in bag-in-box.

[3] Located in the center of the country, the Dão Demarcated Region was the second to be created in Portugal in 1908. In 2017, it occupies 14,647 hectares of vineyard, having recorded/presented an average production of 339,000 hectoliters in the last 14 years.)

[4] The construction of the ICVW, in 2013, made it possible to rehabilitate the old cellar. It allows enotourists, through the visit and a multimedia presentation, to feel and perceive the whole process of the cycle of the vine and wine, as well as the flavors, with a wine tasting at the end.

Bottling/filling

The last process concerns bottling/filling. At this stage, the parcels of each lot, which are intended to satisfy an order or constitute stocks, are fed into the bottling and filling lines. Corks, labels, CVR[5] and IVV[6] certification seals, as well as all other components necessary to obtain the final ready-to-market product are also added. It should be noted that, at this stage, bottles that are intended for the stage in bottles might still be bottled, without label. These bottles are the so-called "reserves".

Storage

In this last stadium, the bottles are stored in appropriate places, according to the typology of each wine, and can remain there for a few days or a few years.

3. METHODOLOGY

The study was conducted at the *Adega Cooperativa de Mangualde*. It focused, in a first phase, on the survey of the strategic, tactical and operational actions developed in the period 2009 to 2016, included in the Activity Reports approved by the General Meeting. (Mangualde, Adega Cooperativa, 2009/2016)

In a first phase, the actions were grouped according to the anchor activities of the Supply Chain Suppliers (Development, Production and Operations, Equipment and Infrastructures, Customer Service, Stock Management/ Procurement, Transport/Storage and Information Management) (Carvalho, 2010). Then, its relative weight was calculated for each of the dimensions of sustainability (environmental, economic and social) (Almeida, 2005) and Rational Use of Energy.

Supplier development

- Proximity of suppliers of grapes (cooperating).
- Technical support in the preparation of projects and submission of applications.
- Protocol for the application of plant protection products.
- Accomplishment of courses for protection and integrated production.
- Short supply chains through the option of local suppliers.
- Management of pallets with suppliers.
- Larger orders made to the container (carton, bottles).

Production and operations

- Definition of the production process for the various types of wine.
- Optimization of productive capacity.
- Management of the temperature control system.
- Production of packaged goods planning.
- Daily optimization of productive capacity.
- Compliance with the rules of HSW[7], namely risk products storage.
- Elimination of the diesel generator to supply energy in the grape harvest.
- Replacement of pipes for cold supply and insulation of existing ones.

Equipment and infrastructures

- Periodic maintenance of equipment.
- Wastewater treatment.
- Assembly of condenser batteries.
- Use of stainless steel tanks (less energy consumption in washes and less water consumption, therefore less water to be treated).
- Glazing of cement deposits (objective equal to the previous one and more thermal stability in wines conservation).
- Replacement of asbestos cover by isothermal sheet in the carton store (to avoid excess moisture on the carton).
- Optimization of layouts, in order to use natural light.
- Reduction of own fleet and replacement of the most polluting vehicles.
- Creation of open space, where the various departments work.
- Replacement of 110 existing luminaires by ponds.
- Placement of presence detectors.
- Placement of emergency lighting.
- Assembly of new electrical boards at the entrance and in the meeting room.
- Start-up of the new transformer substation
- Automation of the WWTP[8].

Customer service

- Vinification in conjunction with the storage of the partners (to avoid transport and wines circulation between warehouses).
- Compliance management quickly and seamlessly.
- Winemaking by order, according to the client's intention.
- Provision of packaging services in bottles or Bag-in-Box.
- Provision of laboratory services.

Inventory management

- Reuse of raw materials, whenever possible (legally and technically).
- Anticipation of the sale of wines in bulk (smaller stocks).
- Definition of safety stocks in finished product.
- Definition of minimum and maximum stocks of raw material.
- Use of picking for custom orders (exports from China, Brazil, etc.).
- Standardization of primary packaging.

[5] *Comissão Vitivinícola Regional*
[6] *Instituto da Vinha e do Vinho*
[7] HSW (Health and Safety at Work)
[8] WWTS (Wastewater treatment station)

- Uniform type of bottles for various brands.
- Computerization of the raw material stock management process.
- Computerization of the stock management process of finished products.

Transport/storage

- Routing of waste to recycling centers.
- Optimization of the layout and circulation inside the warehouse (shelves, smaller distances).
- Replacement of the stacker by an electric forklift.
- Handling of products inside the warehouse (pallet holder).
- Carrying grapes in suitable trailers (more safety, fewer trips, less carbon footprint, less paper handling in data handling).
- Rapid discharge (less pollution, economic gain for the cooperant).
- Direct deliveries "to the pallet," by own fleet, for shorter distances.
- Subcontracting of the physical distribution of products over long distances.
- Route optimization and order grouping.
- Reuse of pallets.

Information management

- Use of new technologies for managing flows.
- Integration of oenology into production.
- Use of electronic invoices (SAPHETY platform).
- Electronic receipts.
- Wine information to the cooperators trough SMS (the cooperators became the "pilots" of their villages).
- General meetings operation.
- Use of the site for customer information.
- Use of the website to provide information to members.
- Use of facebook for disclosure of shares.
- Computerization of orders from customers and suppliers.
- Elaboration of industrial costing.
- Creation of procedures manuals.

In a second phase, in order to understand the impact of the main actions, some indicators were used (Initiative, Global Reporting, 2012) which allowed the elaboration of tables for each of the dimensions of sustainability, comparing the performances at the beginning and at the end of the study's target period.

The reliability of the information was validated through the direct collection of the data, made by the authors of the work from official documents, made available by the entity in which the study was carried out.

4. RESULTS AND DISCUSSION

4.1. Environmental, economic, social and RUE environment

At the level of "Supplier Development" (Table 1), all actions are directly related to the environmental dimension, highlighting the importance given to the relationship with the main and only suppliers of grapes, the main raw material.

Table 1. Framework of Supplier Development actions

1. Supplier development		Environmental	Economical	Social	RUE
		100%	71%	71%	43%
1.1	Proximity of suppliers of grapes (cooperating)	x	x	x	x
1.2	Technical support in the preparation of projects and applications	x	x	x	
1.3	Protocol for the application of plant protection products	x	x	x	
1.4	Courses for protection and integrated production	x		x	
1.5	Short supply chains	x	x	x	x
1.6	Management of pallets with suppliers	x			
1.7	Bulk orders made to the container	x	x		x

Source: Authors

The activity "Production and Operations" is the most striking in this type of organization. The economic and RUE dimensions are the most important ones, with 88% (Table 2). The elimination of the electric power supply through the generator at harvest time was the measure with the greatest environmental impact, although it was economically penalizing, in the short term.

Table 2. Context of the actions of Production and operations

2. Production and operations		Environmental	Economical	Social	RUE
		25%	88%	13%	88%
2.1	Definition of the production process for different wines		x		x
2.2	Optimization of productive capacity		x		x
2.3	Management of the temperature control system		x		x
2.4	Packing production planning		x		x
2.5	Daily optimization of productive capacity		x		x
2.6	Compliance with HSW rules	x		x	
2.7	Elimination of diesel generator	x	x		x
2.8	Replacement and insulation of cold pipes		x		x

Source: Authors

The activity "Equipment and Infrastructures" registered the largest number of actions (15), most of them with environmental and social concerns (Table 3). The use of stainless steel tanks and the glazing of existing cement tanks are measures that will bring great benefits to any of the three dimensions considered, in the medium term.

Table 3. Framing of the actions of Equipment and infrastructures

3. Equipment and infrastructures		Environmental	Economical	Social	RUE
		67%	53%	67%	60%
3.1	Periodic maintenance of equipment		x		x
3.2	Waste water treatment	x		x	
3.3	Assembly of condenser batteries	x	x		x
3.4	Use of stainless steel tanks	x	x		x
3.5	Glazing of cement tanks	x	x		x
3.6	Elimination of asbestos cover	x		x	
3.7	Optimization of layouts for use of natural light	x	x	x	x
3.8	Reduction of own fleet and replacement of vehicles	x	x		x
3.9	Creation of open space for the various departments			x	
3.10	Replacement of lamps	x	x	x	x
3.11	Placement of presence detectors			x	
3.12	Emergency lighting placement			x	
3.13	Assembly of new electrical switchboards			x	
3.14	Start-up of the new PT	x		x	x
3.15	Automation of the WWTS	x	x	x	x

Source: Authors

In relation to the "Customer Service" activity, it was the one with the lowest number of shares, which is also the one where there is a lower percentage of actions with environmental implications (20%), as can be seen in Table 4. Personalization and Great flexibility in relation to customers, translated into the establishment of pre-harvest partnerships, are an innovative factor compared to the one practiced in the region.

Table 4. Framework of Customer Service actions

4. Customer service		Environmental	Economical	Social	RUE
		20%	80%	60%	40%
4.1	Vinification in conjunction with storage to partners	x			x
4.2	Quick and seamless compliance management		x	x	
4.3	Winemaking on demand		x		x
4.4	Packaging services provision		x	x	
4.5	Laboratory services provision		x	x	

Source: Authors

In the "Inventory Management/Procurement", all actions implemented targeted the economic dimension and 78% the environmental dimension (Table 5). The picking and standardization adopted for the bottles and the boxes are important environmentally measures, also providing energy savings both upstream and downstream of the process.

Table 5. Stock management framework / procurement actions

5. Inventory management		Environmental	Economical	Social	RUE
		78%	100%	11%	44%
5.1	Reuse of raw materials	x	x		x
5.2	Anticipation of the sale of wines in bulk		x	x	
5.3	Definition of safety stocks in finished product		x		
5.4	Definition of minimum and maximum stocks of raw material	x	x		
5.5	Use of picking for custom orders	x	x		x
5.6	Primary packaging uniformisation	x	x		x
5.7	Uniformisation of the type of bottles for various brands	x	x		x
5.8	Computerization of the PM stock management process	x	x		
5.9	Computerization of the PA stock management process	x	x		

Source: Authors

Regarding the "Transport and storage" activity, 90% of the actions have an impact on the RUE and 80% on the environmental dimension (Table 6). All actions are of significant importance, especially as they are significant in the environment preservation.

Table 6. Transport/storage actions framing

6. Transport/storage		Environmental	Economical	Social	RUE
		80%	60%	50%	90%
6.1	Routing of waste to recycling centers	x		x	
6.2	Layout optimization and circulation within the warehouse		x	x	x
6.3	Replacement of the combustion truck by electric	x			x
6.4	Product handling inside the warehouse	x	x		x
6.5	Transport of grapes in suitable trailers	x	x	x	x
6.6	Download speed	x	x	x	x
6.7	Direct "pallet" deliveries for short distances	x			x
6.8	Subcontracting of the distribution over long distances		x		x
6.9	Route optimization and order grouping	x	x		x
6.10	Pallets reuse	x		x	x

Source: Authors

The last activity considered, "Information management", was the second most important in terms of the implemented actions number (12). It should be noted that the environmental and economic dimensions are the most important, with 83% and 75%, respectively, against only 50% in RUE (Table 7). The abandonment of the role in many of the procedures is a practice that is recorded and praised. The way the general assemblies work and the associated pedagogical aspect allow a strong social scope, typical of this type of organization.

Table 7. Context of the actions of Information management

7. Information management		**Environmental**	**Economical**	**Social**	**RUE**
		67%	53%	67%	60%
7.1	Use of new technologies for the management of flows		x		x
7.2	Integration of oenology into production	x		x	
7.3	Use of electronic invoices (SAPHETY Platform).	x	x		x
7.4	Sending receipts by electronic means	x	x		x
7.5	Wine information to donors trough SMS	x	x		x
7.6	Operation of general meetings	x		x	
7.7	Use of the site for customer information	x	x	x	x
7.8	Use of the site to provide information to members	x	x		x
7.9	Use of facebook for stock disclosure			x	
7.10	Computerization of orders from customers and suppliers	x	x	x	x
7.11	Elaboration of industrial costing			x	
7.12	Creation of procedures manuals			x	

Source: Authors

When looking at data presented in Table 8, it can be seen that in the "Equipment and Infrastructures" activity, the largest number of actions (23%) was implemented, with "Customer Service" on the opposite side, with only 8%. As regards the different dimensions, it is clear that the "economic dimension" is of the highest importance, with a weighted average of 73%, followed by the "environmental dimension", with 68%.

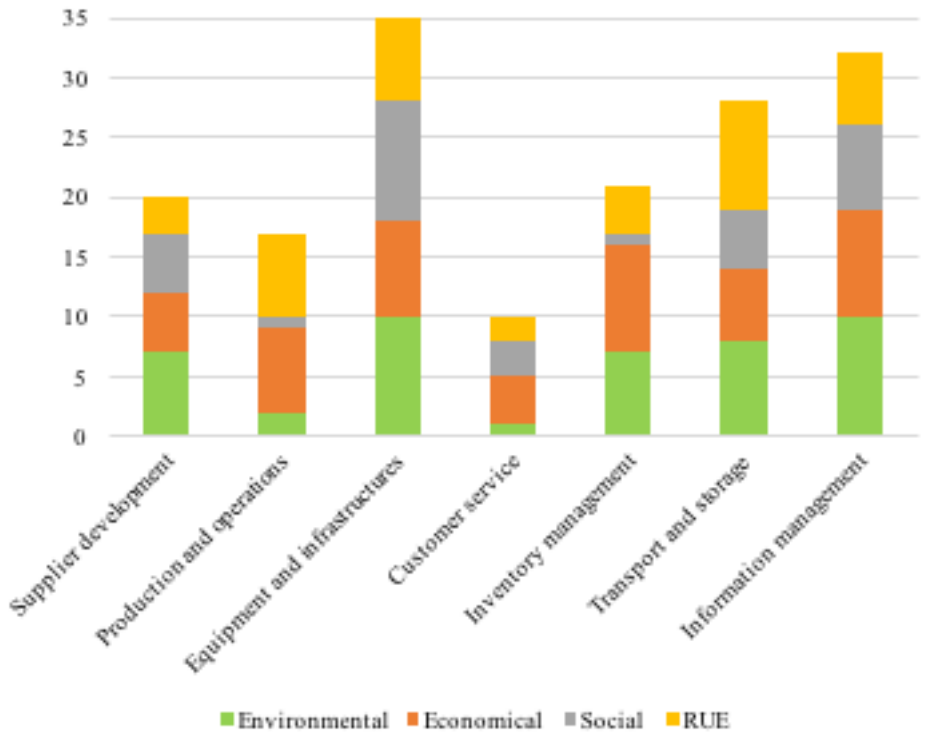
Table 8. Table summarizing the weight of activities and dimensions

	Activities	**Qt.**	**Weight**	**Environmental**	**Economical**	**Social**	**RUE**
1	Supplier development	7	11%	100%	71%	71%	43%
2	Production and operations	8	12%	25%	88%	13%	88%
3	Equipment and infrastructures	15	23%	67%	53%	67%	60%
4	Customer service	5	8%	20%	80%	60%	40%
5	Inventory management	9	14%	78%	100%	11%	44%
6	Transport and storage	10	15%	80%	60%	50%	90%
7	Information management	12	18%	83%	75%	58%	50%
		66	**100%**	**68%**	**73%**	**48%**	**61%**

Source: Authors

The stacked column chart, shown in Figure 7, shows the number of actions for each of the anchor activities considered in the study, allowing a better understanding of the values of the table, in Table 8. From its reading, it is emphasized that it is in "Equipment and Infrastructures" and "Information Management "that the dimensions considered have a greater balance.

Figure 5. Number of shares per activity and size



Source: Authors

4.2. Metrics for the years 2008 and 2016

Complementing all that was mentioned in the previous topics, some indicators (Santos, 2012) considered relevant for sustainability in the approached three dimensions (environmental, economic and social) were identified and the values recorded at the beginning and at the end of the period under analysis were collected.

The environmental dimension includes some metrics related to energy, water and recycling, showing a very positive evolution for most of the metrics (Table 9). In addition, worthy of special mention is the decrease in reactive energy, the strong increase of products delivered for recycling and the amount of water treated in the WWTS.

Table 9. Environmental Dimension metrics for the years 2008 and 2016

ENVIRONMENTAL DIMENSION	2008	2016	VAR.
Total energy consumed (kwh)	103.012	141.403	27%
Reactive energy (kwarh)	50.450	11.629	-334%
Fuel (liters)	9.393	1.218	-671%
Amount of treated water (liters)	1.110.653	1.538.462	28%
Oenological products and other chemicals	35.534	43.132	18%
Delivered products for recycling (kg)	3.480	6.920	50%
Green dot (euros)	8.583 €	6.634 €	-29%

Source: Authors

The economic dimension is the one that registers greater visibility and objectivity, being therefore strongly valued by the stakeholders of any organization. The *ACM* registered a remarkable recovery from a situation of imminent insolvency to sustained growth, supported by the various indicators referenced in Table 10.

Table 10. Economic Dimension metrics for the years 2008 and 2016

ECONOMIC DIMENSION	2008	2016	VAR.
Sales	1.859.181 €	1.425.436 €	-30%
Cost with staff	262.875 €	205.476 €	-28%
Energy costs (including fuels)	24.204 €	22.154 €	-9%
Customers	458.157 €	123.583 €	-271%
Providers	308.652 €	131.081 €	-135%
Membership	1.822.938 €	1.615.845 €	-13%
Total liabilities	4.403.024 €	2.382.643 €	-85%
Financial Services	1.559.481 €	530.789 €	-194%
Gross Margin	37%	41%	10%
Received grapes (ton)	1.569.590	1.960.530	20%
Wine produced	1.268.000	1.605.900	21%
Provision of winemaking services (ton)	0	412.360	100%

Source: Authors

Regarding the Social Dimension, the third dimension analyzed, some items were considered that allowed to verify if the actions implemented in this scope caused significant differences in socially valued behaviors. Table 11 shows that all the indicators have evolved very satisfactorily, with particular emphasis on the increase in qualifications and on the protection and integrated production, very well accepted and valued by the current society.

Table 11. Social Dimension metrics for the years 2008 and 2016

SOCIAL DIMENSION	2008	2016	VAR.
Registered Members	736	786	6%
Active members (who deliver grapes)	341	220	-55%
Integrated protection and production (ha)	0	47,22	100%
Accession to phytopharmaceutical products (producer no)	0	95	100%
Christmas dinner for members and families (no. persons)	80	156	49%
Board of Directors average age	68,66	48,66	-41%
Workers	14	10	-40%
Workers average age	46,71	49,18	5%
Workers average academic qualifications	21% sup.	37% sup.	

Source: Authors

Table 12 shows the amount and percentage of metrics with a positive effect on the organization's performance. Of the 28 metrics selected, 20 contributed positively (71%), with the Economic Dimension influencing the most on management success, with 83%.

Table 12. Summary table of metrics with positive evolution

	TYPES OF DIMENSION	Qt.	Positive metrics	%
1	Environmental Dimension	7	4	57%
2	Economic Dimension	12	10	83%
3	Social Dimension	9	6	67%
		28	**20**	**71%**

Source: Authors

5. CONCLUSION

The accomplishment of this work made possible, in an initial phase, an exhaustive survey of the main strategic, tactical and operational actions implemented during the last 8 years in the *Adega Cooperativa de Mangualde*, a cooperative institution of the wine sector of the Dão Demarcated Region in Portugal.

Of the 66 actions implemented, 23% focused on "Equipment and Infrastructures", followed by "Information Management" with 18%. Regarding the relation between actions with the different dimensions of sustainability and the Rational Use of Energy, it can be seen that, in general terms, the greatest weight is for the "Economic Dimension", with 73%, and for the "Environmental Dimension", with 68%. Considering the seven activities in an individualized way, it is the "Suppliers Development", in the environmental component, and the "Inventory Management/Procurement", in the economic component, which have a 100% ratio.

In the second phase of the study, a comparative study was performed between some metrics considered relevant for the three dimensions of sustainability, allowing a better perception of the effects of the various actions implemented. The different dimensions segmented the 28 metrics considered, with 12 being the Economic Dimension, 9 the Social Dimension and 7 the Environmental Dimension. The study identified that 71% developed positively, with a distribution of 83%, 67% and 57%, respectively.

The effect of the accomplishment and presentation of this work among the ACM staff was rewarding, although there has been great difficulty in collecting the data, especially due to the limited time available for the intervention. The awareness of people on this topic was of great importance, and provoked behavioral changes in daily life. Because it is a cooperative institution, with a specific management model of specific characteristics, this awareness of sustainability becomes even more important. For future studies, it is necessary to monitor, with the different stakeholders, the effect of the different actions, as well as the validation of the main metrics used and their framing in the various dimensions of sustainability.

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