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ORIGINAL ARTICLE

Rural areas receptivity to innovative and sustainable agrifood processes. A case study in a viticultural territory of Central Spain

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Abstract

The objective of this work is to determine the perception, in terms of sustainability, of stakeholders involved in an innovative process developed in a rural area. The innovative process focuses on the introduction of green technologies and low carbon emissions linked to the product and the process in the context of a circular economy model. The methodology is based on a variation of the MESMIS evaluation framework through which *ex ante* sustainability is analysed following the participatory process using focus group techniques. The results show that acceptance is conditional on obtaining positive economic results from farmers and wineries. The local scale of implementation of the project and the identification with technology based on the use of endogenous resources such as microalgae by the label of origin of the wine are factors that favoured the interest of the participatory process to address the sustainability of innovative technology.

KEYWORDS

focus group, participatory processes, rural territories, sustainable development, wine sector innovation

JEL CLASSIFICATION
Q51; Q56

1 | INTRODUCTION

The rural environment has consistently been one of the central aspects of European construction and therefore, numerous efforts have been made by diverse community institutions to develop these areas (Moyano, 2005). Historically, rural environments have been isolated from innovative processes (Audretsch & Feldman, 2004), which have tended to consider the needs and resources available in urban areas (Dinis, 2006). This marginalization of the spaces has contributed to an increased isolation and abandonment of many of its territories (Agnoletti, 2014). As a result, rural areas are currently facing profound changes related to the emergence of post-productivist rural economies, increases in environmental constraints and growing dependence on urban areas (Lennert & Robert, 2007).

In response to these challenges, the European Union proposes solutions aimed at improving the competitiveness of the agricultural sector as the backbone of rural areas, the sustainable management of natural resources and the attainment of a more balanced territorial development of rural areas (Esparcia, Escribano, & Rubio, 2012). The Europe 2020 decennial growth strategy establishes that Europe should convert itself into a smart, sustainable and inclusive economy. Consequently, to reduce regional differences, especially between central and peripheral regions, and as a response to the low rates of innovation and productivity in rural areas, the promotion of research, innovation and knowledge in said territories has been proposed (Barca, 2008; Foray, David, & Hall, 2009, 2011). This proposal has been named "smart rural development" (Naldi, Nilsson, Westlund, & Wixe, 2015) and determines that innovation should be the engine of sustainable development of rural spaces, as well as the key element for social and territorial cohesion. This consolidates the idea that a sustained innovation effort, understood as the capacity to generate and incorporate knowledge to provide new and creative answers to the problems linked to the challenges posed by the fight against climate change, is now a key factor, both for improving the competitiveness of companies and to promote the development of territories, not only in terms of economic growth but also in terms of improved quality of life for the rural inhabitants (Moseley, 2000; Méndez, Michelini, & Romeiro, 2006; Pyburn & Woodhill, 2014).

However, the need to innovate in rural territories should go further, with a sustainable innovation or eco-innovation being essential (Doloreux, Dionne, & Lapointe, 2007; Horbach, 2008; Levidow, 2015; Galliano, Gonçalves, & Triboulet, 2017). This link between innovation, the proper use of natural resources and action against climate change, rural areas and the agricultural sector, will materialize in new European policies. Rural development policies within the current 2014–2020 programming period, financed by EAFRD European funds, propose a series of priorities in the resource assignment. Of these priorities, the fifth is of special significance, as it considers the efficient use of resources through the support of low-carbon economies in agricultural, food and forest sectors (European, 2011). In this sense, and as the European Commission itself establishes, the rural development policy becomes an instrument for the implementation of the objectives established by the 2020 Strategy. In this context, the agricultural sector is considered a key factor in the fight against climate change, as it is a potential agent for CO_2 fixation and, therefore, an active contributor to the reduction of GHG emissions.

In social terms, the technological transfer of knowledge and innovation to rural areas is also an important challenge since accumulated experience tells us of the limited capacity of local actors in acquiring knowledge, social resistance to change and a lack of participation of civil society in decision-making (Chambers, 1994; Storper, 1995). In this sense, and also considering the accumulated experience in similar processes, decentralization and the creation of appropriate governance patterns, they appear as emergent forms in the processes of regulation of territorial dynamics (Torre & Wallet, 2015). Therefore, a common project vision is considered appropriate, taking into account both the objectives of the local populations and the policies and directives established in contexts outside the territories (Leeuwis, 2000). In short, it is about applying bottom-up logic (Naldi et al., 2015), the basis of the design and implementation of certain actions that the European rural development policy has been advocating for more than 30 years, which forms the basis of the second pillar of Common Agricultural Policy (CAP) (OCDE, 2001).

The interpretation and application of the concept of intelligent, sustainable and inclusive growth in a regional context that advocates the 2020 strategy, has been highlighted in several works (Barca, McCann, & Rodríguez-Pose, 2012; Bilbao-Osorio & Rodríguez-Pose, 2004; Combes & Overman, 2004; McCann & Ortega-Argilés, 2013; Rodríguez-Pose, 2002). This literature agrees that generic models of regional policy must be reformulated into policies based on place and knowledge (Tödtling & Trippl, 2005; Foray et al., 2011; Camagni & Capello, 2013; Boschma, 2014). Smart development is not a unique concept and the complexity of its application in rural contexts requires the implementation of local experiments (Rallet & Torre, 2017), since global innovations are not easily applicable locally. Initiatives that pursue the development of the territory must be based on concrete experiences (Torre & Wallet, 2015), as well as on the consideration of the behaviours and strategies of private or public actors and associations. This encourages the creation of groups of actors, consideration of conflict resolution methods based on protocols and guidelines for action that promote both the adaptation of existing or potentially available endogenous resources, such as local social capital and its external connections (Woolcock & Narayan, 2000; Westlund, Larsson, & Olsson, 2014).

Taking as premises the conclusions of previous works on innovation in the rural environment presented above, this work is presented with the objective of testing the viability of a specific initiative developed within the framework of the LIFE+ Integral Carbon project, assessing the perception of sustainability of the action by the actors that directly or indirectly participate in it. Through this work, the aim is to respond to issues that arise when implementing an innovative initiative, such as the implementation of a sustainable model of grape and wine production based on a low-carbon circular economy scheme in a rural environment, in the context associated with territories in a phase of depopulation and with a lack of social and territorial cohesion. It is based on the hypothesis that participatory processes should be that which links the innovative initiative and its adaptation to the territory.

To achieve this goal, after this introduction, the theoretical framework will be analysed to assess the sustainability of innovative, sustainable agricultural initiatives, implemented under a circular economy scheme like the one proposed here. Afterwards, the object of the case study is presented, focusing on the most innovative aspects of the initiative. Then the method followed is set forth, which is based on an adaptation of the MESMIS method (given that it is not possible to obtain tangible results linked to the start-up of the project), which is based on an analysis of perceptions through participatory methods from several focus group sessions with the agents involved. The method followed aims to perform the selection of indicators by the agents, their evaluation and the discussion of ideas and strategies. The sixth section will discuss the main results in which the limitations and potentialities of the initiative will be highlighted, bearing in mind the idiosyncrasies of the wine sector and the territory where the vineyards and wineries are located. Finally, the last section will present the main conclusions of the work.

2 | THEORETICAL FRAMEWORK

The concept of sustainable agriculture emerges as a relatively recent response to the loss of quality of natural resources, as a consequence of the development of the productive model in the agricultural sector (Altieri, 2002). The sustainability of agrarian systems is complex in itself because from a holistic point of view it implies fulfilling several objectives simultaneously: namely productive, ecological or environmental, social, cultural, economic and temporary objectives. It is, in short, an integrated analysis of food systems that take into account their ecological, economic and social dimensions (Francis et al., 2003), and which therefore needs a multidisciplinary approach (Sarandón & Flores, 2009). In this sense, the new currents of agriculture which are respectful of the environment analyse the sustainability of food production systems in a holistic way, but are based on knowledge accumulated through the study of local alternatives in favour of forms of supply and access to the most socially just and economically viable foods (Giraldo & Rosset, 2018).

After the concept of sustainability was accepted in the 1990s (Goodland, 1995) many authors tried to assess agricultural sustainability in different scales of analysis (at the farm, landskape, ecosystem, regional or national level) by developing indicators. At the farm level, several methodological proposals focused on different agrarian systems can

be considered Abbona, Sarandón, Marasas, & Astier, 2007; Bockstaller, Girardin, & van der Werf, 1997 Bockstaller, Guichard, Keichinger, Girardin, Galan, & Gaillard, 2009; Darnhofer, Fairweather, & Moller, 2010; De Fernandes Lúcio André & Woodhouse, 2008; Flores & Sarandón, 2004; Flores, Sarandón, & Vicente, 2007; Gómez, Swete Kelly, Syers, & Coughlan, 1996; (Izac & Swift, 1994; Lefroy, Bechstedt, & Rais, 2000; Pacini, Wossink, Giesen, Vazzana, & Huirne, 2003; Sarandón, Marasas, Dipietro, Belaus, Muiño, & Oscares, 2006; Sarandón, Zuluaga, Janjetic, & Negrete 2006; Tellarini & Caporali, 2000, Van der Werf & Petit, 2002, Viglizzo, Frank, Bernardos, De Buschiazzo, & Cabo, 2006). In general, they focus on the use of synthetic indicators based on a multi-criteria analysis, where the weighting of basic indicators measuring each dimension is carried out and, subsequently, they are aggregated into a single value based on the normalization of the indicators and the obtaining of the weight associated with each dimension (Gómez-Limón & Riesgo, 2008; Nardo, Saisana, Saltelli, & Tarantola, 2005; Nardo, Saisana, Saltelli, Tarantola, Hoffman, & Giovannini, 2005). The most recent methods for assessing the sustainability of agro-ecosystems take into account participatory processes, following the guidelines recommended by the bottom-up approach. That is, focusing on local models at a small scale, and considering the knowledge and learning of the actors involved. One of the greatest advances in this type of approach is that carried out by the Interdisciplinary Group of Appropriate Rural Technology, in developing the Framework for the Evaluation of Natural Resource Management Systems incorporating Sustainability Indicators (or also called MESMIS evaluation framework), which constitutes a proposal for systemic, participatory, interdisciplinary and flexible evaluation of sustainability in rural communities (López-Ridaura, Masera, & Astier, 2002; Masera, Astier, & López-Ridaura, 2000). It is a mixed method in which indicators for each dimension are constructed in the first phases, based on the characterization of agro-ecosystems and the identification of critical points. The multi-criteria analysis for obtaining the synthetic indicator is carried out through participatory processes in order to obtain a value judgment on the resource management systems and provide suggestions and points of view aimed at improving its socio-environmental profile. Sustainability, in this methodology, is conceived in a dynamic and specific way from a specific socio-environmental context, and is analysed, in a participative way, from the interaction of multiple elements (Astier, García-Barrios, Galván-Miyoshi, González-Esquivel, & Masera, 2012). In short, the participatory methods of evaluating sustainability aim to support social learning among the participants (Garmendia & Stagl, 2010). However, there are several authors who are critical of the results obtained from this process, since there is a disconnection between the results obtained through it and the science that encompasses sustainability. However, there is little published peer-reviewed material on how to assess the extent to which rhetoric about the benefits of participatory research is achieved in practice, particularly with respect to participatory research for sustainability. At this point it would be necessary to add the additional effect that involves dealing with innovative processes of scarce implantation such as the one dealt with here in relation to the uncertainty in the applicability of results obtained from the participatory process.

Based on this theoretical framework, the current state of the art is also analysed in terms of the relationship between production models based on the circular economy, as proposed by this work and which will be explained in the case study, and their sustainability. Based on the recent bibliometric analysis carried out in this field by Geissdoerfer, Savaget, Bocken, and Hultink (2017), it can be said that there are only 67 works that link these two aspects. Most of the papers highlight the positive relationships between the two concepts, highlighting the circular economy as a motor of economic development in rural areas (Yuan, Bi, & Moriguichi, 2006) or as a solution to environmental pollution problems and waste presented by conventional agriculture (Ma, Huang, Peng, Zhai, & Liu, 2005; Sun & Sun, 2006; Xiang-hong, 2006). Although there are some authors, including Murray, Skene, and Haynes (2015), which show how social aspects are not considered in the design of productive models based on the circular economy, and therefore its impact on sustainability from this point of view can't be considered positive. Some of the conceptualizations that have been made of the circular economy exclude the social dimension, emphasizing in the economic aspects and simplifying the environmental perspective.

For these authors, this can be a problem in the transition phase towards a sustainable economic system, because the conservation of productive resources must have a "bottom-up" holistic approach, as stated in this section (Allwood, Cullen, & Carruth, 2012; Bakker, den Hollander, van Hinte, & Zljlstra, 2014).

The study methodology of this work is based on the application of the MESMIS evaluation framework incorporating the principles of participatory action research (PAR), which was the basis for the integration of multi-criteria analysis and the tools for the study and evaluation of sustainability (Masera et al., 2000; Sepúlveda, 2002; Baumann, 2004; Venegas, 2004). With this approach, we intend to make a contribution to the social aspects of sustainability and the circular economy, which may well be one of the key factors for improving the link between innovation and rural territories, as previously mentioned (Figure 1).

3 | THE CASE STUDY

The denomination of origin (DO) Uclés wine growers extends over a total of 28 municipalities in the western part of the provinces of Cuenca and Toledo, in the Spanish autonomous community of Castilla-La Mancha. These municipalities occupy some 435,000 acres of plains and middle mountains (with altitudes of between 500 and 1,200 m) of which, 4,250 acres are used for winegrowing. Currently, the DO consists of five processing wineries and 660 wine growers, having a mean annual wine production of approximately 30,000 hectoliters. In view of this data, it is considered to be a small Spanish DO.

It should be noted that only two wineries have their own vineyards, while the rest of the vineyards belong to farmers who also grow other crops, such as cereals and oilseeds. On the other hand, there is an important difference between the two actors. Wineries are more active and risky because their main objective is to differentiate their wines in order to be more competitive. Farmers are mainly risk averse and their outcomes and decisions are dominated by the inertia of receiving direct subsidies from the CAP. The area enjoys a continental climate, with major thermal fluctuations between the day and night and between seasons and receiving little precipitation. Traditional wine production is carried out, using predominantly low vine plantations with low densities, mostly rain-fed. The lack of soil fertility, their low greenhouse gas (GHG) retention capacity and the erosion problems, are the main problems of soils in the region.

Like most rural territories in the Spanish interior, this area is characterized by a worrisome process of demographic vacuum, ageing and masculinization. In 2017, the population of the region was little more than 37,000 inhabitants, 10% less than ten years previously. High rates of ageing and the resulting levels of mortality as compared to birth rates and migratory flows resulting from the region's proximity to Madrid are some of the main causes explaining this major demographic decrease in such a short period of time. On the other hand, a considerable degree

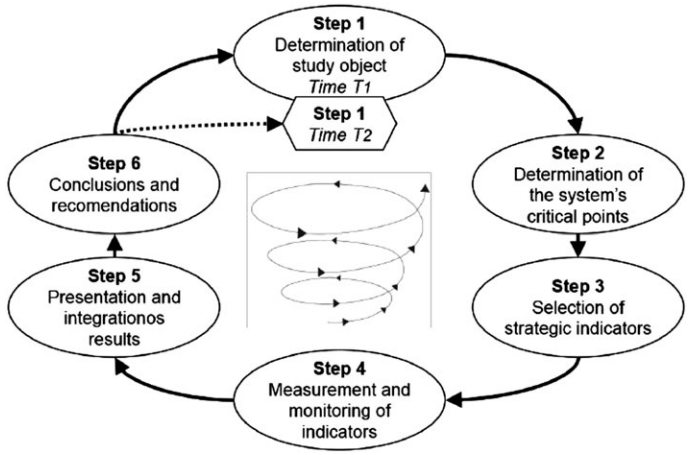

FIGURE 1 Steps of the MESMIS evaluation framework
Source: Masera et al. (2000).

of masculinization is detected in the age ranges having the greatest productive and reproductive potential, hindering couple relationships, the increase in births and the area's settlement.

In terms of labour, the area's inhabitants work primarily in the service sector (63%) and to a much lesser extent, in the agriculture (15%), industry (11%) and construction (11%) sectors. However, given that a large part of the companies of the service and industry sectors are related to the primary sector (workshops, consultancies, commerce, agro-industry, etc.) it may be said that agriculture continues to play a major role in the area's economy, albeit with a decreasing degree of importance.

The unemployment rate of the overall population was around 9% in 2017, approximately one point above the regional mean. Thus, this data masks some major structural problems, given that unemployment mainly affects women and youth, so there is a large group of unemployed individuals among those with low levels of education and qualifications.

Based on this reference framework, the development of a winegrowing DO, even a small one, permits the agricultural diversification and rural economy of this region. Traditionally, the autonomous community of Castilla-La Mancha has been characterized by the production of large quantities of wine but with a very low quality level. The Uclés DO is focused on obtaining a distinguished wine, of a high quality and that offers added value services to its own territory and its family style wine cellars.

Therefore, this business structure in the wine sector is very suitable for the introduction of industry process and product innovations, such as that being analysed in this work. Specifically, the innovative procedure studied is based on the pilot experience carried out in one of the main wine cellars of the DO, where two modules were installed. Module 1 is an anaerobic digestion plant capable of generating biogas from the pruning residue and from the first fermentation of the grapes taking place in the wine cellar. Furthermore, this module generates a residue that is rich in organic materials that are suitable for the fertilization of the vineyards and for the feeding of module 2 or the bio-fertilizer generator. This fertilizer is produced through the growth of native micro algae present in the region's soils and serves as a biological improver of the lands for these same vineyards. The effects of this improvement are visible two or three years following their initial functioning (Marks et al., 2017). In Figure 2, the procedure used for the process is detailed, and it is evident that this is a circular process that closes both the material (upon using the residue

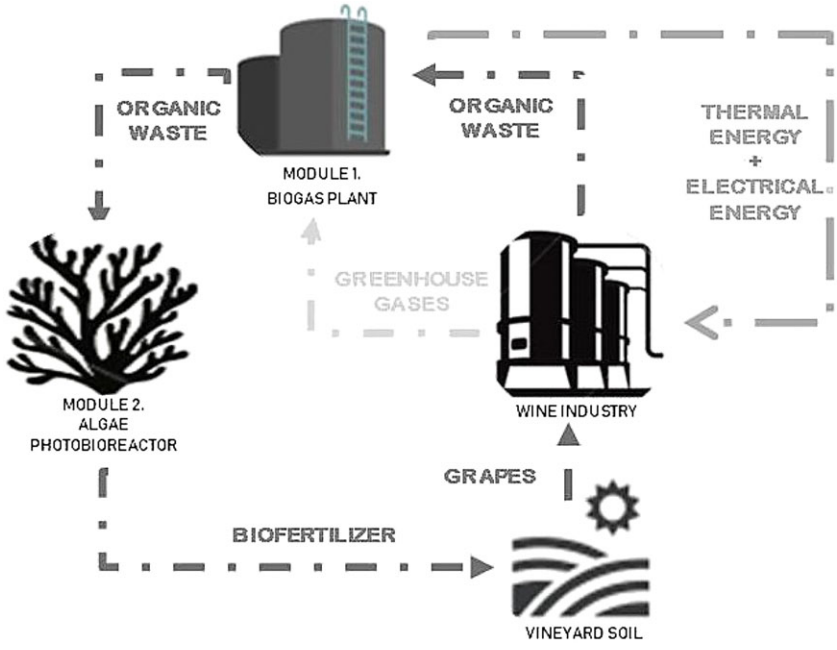

FIGURE 2 Productive process of the carbon sequestration initiative in the wine growing sector

generated in the wine cellar to produce bio-fertilizer that is returned to the ground) and energy cycles (upon incorporating the energy produced in the very wine cellar system). In conclusion, the differential aspects of the implementation of this project should be noted: the reduction in energy and fertilizer costs and the possibility of mitigating the carbon footprint by 6.20% of the emissions after three years of the plant's stable functioning (Losada & Gomez-Ramos, 2016).

4 | METHODOLOGY

The methodological basis of this work follows the MESMIS evaluation framework already mentioned that is developed to holistically evaluate the sustainability of a new resource management system. Given the temporary duration of the LIFE+ Integral Carbon project, it is not possible to obtain tangible results on improving the sustainability of resources in the area of application, with this work being focused on the construction and discussion of sustainability indicators in the three areas through participatory processes carried out through the technique of the Focus Groups. In the following scheme (Figure 3), each of the methodological process phases is included together with the preliminary results from each of these phases. The methodological process is based on a readaptation of the six steps established in the MESMIS framework (Masera et al., 2000).

4.1 | Phase 1: selection of the stakeholders involved in the focus group

As previously stated, the methodology used in this work is based on the focus group research technique. Focus groups are considered to be collective discussion spaces whose main focus is on the interaction between members in order to generate common conclusions based on the debate of specific topics (Domínguez & Dávila, 2008). This working group dynamic is capable of generating synergic capital and, therefore, is of great use for this type of demonstrative experiences, in that it achieves a collective view regarding the project scope, its advantages and disadvantages and the requirements necessary for its implementation (Marradi, Archenti, & Piovani, 2010).

The definition and selection of stakeholders or agents related to any type of sector is a very complex task. Freeman (1984) defined stakeholders as individuals or a group of individuals that can affect or be affected by the achievement of objectives that are pursued by a specific organization. This definition, in the broadest possible sense, may permit the entry of any individual and, therefore, it is possible for an infinite number of stakeholders to exist. However, and based on operating logics, in an analysis of this type, those agents who are the most closely linked to the studied organization or phenomenon should be used. The analysis of stakeholders has been traditionally used in business environments to determine how they influence the interests of each group in the organization's decision making process. This methodology has been successfully used in other areas as well, such as in the strategic planning of natural resources (Buchy & Hoverman, 2000; Dwivedi & Alavalapati, 2009; Grimble & Chan, 1995; Harrison & Qureshi, 2000). Thus, in this work, the panel of agents has been determined based on the available bibliography and by attempting to ensure that it is the most representative set of economic and social actors involved in the winegrowing sector of the studied DO. So, a total of 16 agents were selected from the following interest groups: (i) primary sector: wine growers; (ii) agro-industrial sector: wine cellars, environmental companies and certifiers; (iii) technical and academic sector and (iv) institutional sector. In Table 1, the composition of each group is described.

4.2 | Phase 2: definition and presentation of the innovative project

The innovative project and its possible implementation in the area were presented through a technical conference aimed at the selected stakeholders. During the workshop, the scope of LIFE+ Integral Carbon project was announced, as well as its environmental and socioeconomic impacts. Of this workshop, and after several discussions with the

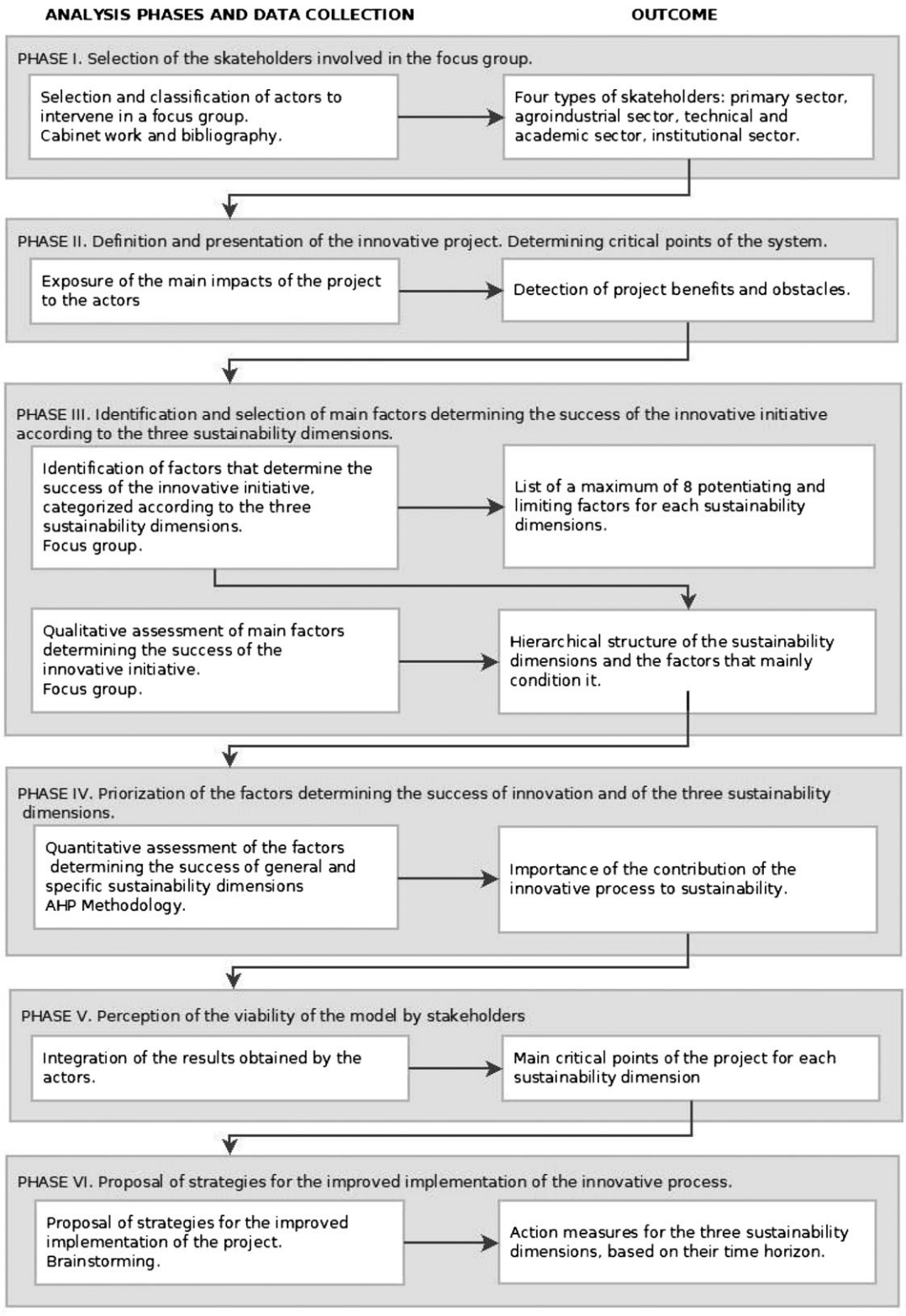

FIGURE 3 Methodological process phases and outcomes

TABLE 1 Description of participants of the focus group carried out in the Vinos de Uclés DO. Tarancón, 2016

Sector	Position
Primary sector	Independent wine grower Cooperativist wine grower Wine grower belonging to the "denomination of origin" Arable crops farmer
Agroindustrial sector	Winemaker Waste treatment plant technician Sustainable development technician Environmental consultant technician
Technical and academic sector	Soils science researcher Technician of the Regional Institute of Research and Agri-Food and Forestry Development Agronomy researcher Social economics researcher
Institutional sector and civil society	Local town hall representative Ministry of Agriculture, Environment and Rural Development responsible Local Action Group representative Representative of organization in defense of the environment

agents arose the first opinions about it. From the application of a semi-structured questionnaire, the participants highlighted the critical points and limitations of the system.

4.3 | Phase 3: identification and selection of main factors determining the success of the innovative initiative according to the three sustainability dimensions

Having created the focus groups, the different dynamics related to open space technology were developed (Owen, 2008), directed by a facilitator who was an expert in the methodologies implemented as well as in the study topic. In the first of these dynamics, qualitative information was collected regarding the positive and negative factors that would determine the success of the analysed innovation, according to the participating agents. These factors were grouped together based on the three dimensions determining sustainability: economic, environmental and social.

Subsequently, and in order to reduce the number of proposed factors, each stakeholder was asked to offer an assessment of each factor, using a Likert scale from 1 (no influence) to 5 (great influence). Based on this quantification, they could select the factors determining the success of the innovative initiative for each dimension, to be subject to a more precise quantitative prioritization in the following study phase.

4.4 | Phase 4: prioritization of the factors determining the success of the innovation and of the three sustainability dimensions

The objective of this fourth phase was the quantitative assessment and prioritization of each of the factors that determines the success of the innovation, grouped together according to the three dimensions of sustainability, as well as their own dimensions. For this, the analytic hierarchy process (AHP) was used, a multi-criteria assessment technique. The AHP method is a quantitative methodology structured to make decisions in a multi-criteria context (Saaty, 1980, 2001). The advantage of this method is that it allows for the obtaining of significant results with only a sample of individuals or groups of individuals who are experts on the subject of the study (Ananda & Herath, 2003; Dwivedi & Alavalapati, 2009), as opposed to other statistical techniques that require large samples in order to obtain relevant results.

The methodology is based on the formalization of complex decision problems using a hierarchical structure. For this study, this hierarchy consists of three sustainability dimensions (economic, environmental and social), each at the same level. The factors determining the success of the innovation depend on each of these factors and they were the most valued in the previous methodology phase. Within this hierarchical structure, the relative importance or weight of the factors of each dimension is obtained from a series of pairwise comparisons, which determine the intensity of the preference between each of the considered options. For this, as Saaty (1980) proposed, a numeric scale was used, ranging from 1 (equal importance amongst factors) to 9 (absolute importance of one factor over the other). Thus, in order to determine the relative importance of each of the proposed determinant factors, the interviewed individuals should make two types of comparisons: pairwise comparisons between the three sustainability dimensions (which is its degree of importance for the sake of the success of the innovation) and pairwise comparisons between the determinant factors within each dimension.

The procedure proposed by Saaty (1980) includes the detection of inconsistencies caused by potential contradictory responses from the interviewed agents, for which a calculation was proposed for the so-called consistency ratio (CR). Thus, according to Saaty's criteria (Saaty, 2003), for 3 × 3 matrices, the maximum CR shall be established at 5% and for 4 × 4 matrices, it shall be less than 9% (the two cases proposed in this study). Therefore, it has been verified that the values of the distinct CR for each of the consulted experts is inferior to the established limits, validating the resulting weights obtained.

Originally, this AHP technique was created for individual decision makers, but it was quickly extended as a valid technique for group decision making (Easley, Valacich, & Venkataramanan, 2000). In this sense, Forman and Peniwati (1998) propose the geometric mean to add the weights obtained for each individual *k* in order to estimate the representative weights of the group as a whole in the social field:

$$w_i = \sqrt[m]{\prod_{k=1}^{k=m} w_{i\_k}}. \tag{1}$$

With w_i being the added weight (of the *m* agents) of each of the determinant *i* factors belonging to each dimension and (w_{i_k}) being the individual weight of each agent *k* for each of the factors *i*.

4.5 | Phase 5: perception of the viability of the model by stakeholders

By presenting the results obtained after the qualitative and quantitative assessment of the different indicators, stakeholders synthesize the main critical points of the project. An integration of the evaluations is carried out, based on the perceptions and future projections of the results of the project, in order to improve the sustainability of the wine production in the area. Since there is still no tangible results from the experimental phase, experts and producers analyse the benefits of the initiative and its possible limitations.

4.6 | Phase 6: proposal of strategies for the improved implementation of the innovative process

The last phase has been developed based on the Brainstorming methodological technique, so that once the participating agents in the focus group had declared their views on the potentiating and limiting factors for the innovation implementation, they could declare the action measures that each entity could put into place so as to overcome any obstacles and take advantage of the process' opportunities. This technique is a group work tool that facilitates the emergence of new ideas regarding a specific topic or problem in a relaxed environment (Rawlinson, 2017). The Brainstorming process is developed in three application phases: (i) discover the facts or topic to be dealt with beforehand; (ii) produce ideas, which is the brainstorming phase in itself, where alternatives are applied and (iii) discover solutions, where a definitive list of strategies is created and the most interesting ones are selected.

5 | RESULTS

In the first meeting with the stakeholders, which took place with the presentation of the project in the study area, the general opinion of the participants was positive regarding the advantages of the application of the products and processes that the project supports. They showed a desire to learn more about the scope of the project were receptive to co-operating in the process of social participation and were favourable towards the possibility of replicating it.

On the one hand, the institutional sector and the technical sector emphasize the need to generate strategies for the mitigation of the agriculture impact on climate change, and in particular, by the proposed optimization of the nutrient cycle described in the project. The primary sector and the institutional sector value trade differentiation, improving competitiveness and increasing the value added of their products through the modification of the productive sector. All the sectors emphasize in the promotion of the transfer of knowledge and results, taking the project as an example of applied research, model of work and learning, communicative in the media and improvement of the relation region-territory. On the other hand, obstacles and difficulties arise in the possible implementation of the project, as well as future needs in terms of possible aspects to be introduced. Table 2 defines the obstacles and future needs described by the participants of the technical workshop.

5.1 | Factors determining the success of the innovative initiative

Regarding the methodological process, the results obtained regarding the perceptions of each group of stakeholders on the distinct factors affecting sustainability in the implementation of a carbon sequestration initiative in the wine sector were described. The assessment of the sustainability is carried out by means of the prioritization of the impact generated by each one of the determinants factors of the process, collected in the Table 3.

The focus group participants assessed the importance of each of the factors using a Likert scale that ranged from 1 (no influence) to 5 (great influence). The average of the assessments per stakeholder group for each determinant factor has been included in Figure 3, based on the three sustainability dimensions.

In light of the opinions of the distinct groups of stakeholders who were consulted, a disparity is observed in the assessments made for each dimension. The determinant factors having the greatest disparity of opinions amongst the expert groups were E1, E2 and E3 in the economic dimension, N3 and N7 in the environmental dimension and S1 and S8 in the social dimension, all highly regarded. On the other hand, the determinant factors that obtained more homogenous assessments were E5, E6, E8, N1, N2, N4 and N6.

TABLE 2 Definition of obstacles and future needs in terms of the implementation of the project

Sector	Obstacles	Future needs
Primary sector	Sectoral economic culture Market inflexibility	Incentives and public aid Short-term profitability
Agroindustrial sector	Projects duration Financing barriers	Economic and financial quantification Organization of workshops and working groups
Technical and academic sector	No homogeneous measuring tools Difficulties of applying the technique in other edaphic conditions Project duration (initial cost and final savings)	Increased data collection (in terms of replicating in other experiences)
Institutional sector and civil society	Major involvement Company-Government-Society Low dissemination	Promote participation Population introduction to circular economy

Source: own elaboration based on the application of semi-structured questionnaires to participants of the project presentation workshop. *Finca La Estacada, Tarancón. 2015*.

TABLE 3 Factors determining the success of the innovation according to the sustainability dimensions

Sustainable development dimensions	Factors	
Economic dimension	E1	Economic savings from energy production
	E2	Economic savings from revalorization of waste
	E3	Economic savings from self-production of high-value organic fertilizer
	E4	Public financing problems
	E5	Lack of immediate profitability
	E6	Economic conditions of the market
	E7	Technical constraints
	E8	Increase in sales due to the improvement of the corporate image
Environmental dimension	N1	Use of renewable energy and energy efficiency
	N2	Sustainable waste management, pollutants reduction and nutrients recovery
	N3	Contribution of organic matter fertilizer instead of synthetic chemical fertilizer
	N4	Reduction of GHG emissions and carbon sink
	N5	Research and Development: native algae
	N6	The cycle closure of materials and processes, produce a global improvement
	N7	Applicability in other conditions: water and soil
	N8	Incorporation of the environment into production processes
Social dimension	S1	Establishment of the population in rural areas
	S2	Greater collaboration between the value chain agents (wine growers-wineries-research)
	S3	Change of corporate and the primary sector image, as an image of social and environmental responsibility.
	S4	Population's lack of environmental awareness and education
	S5	Lack of political commitment on regional and local level
	S6	Farmers conservative behavior
	S7	Lack of professionalization and advising the producers
	S8	Promotion of territorial cohesion

The primary sector offered a very balanced assessment of the three sustainability dimensions. In the economic dimension, E2 and E8 were the most highly assessed positive determinant factors; and the negative factors were: lack of profitability (E5) and public financing problems (E4). The environmental dimension is very highly valued by this group, as seen by the determinant factors N2, N3, N4 and N5. In the social dimension, the most valued positive determinant factors were the establishment of the population (S1) and the promotion of territorial cohesion (S8); and the negative were: the lack of political commitment on a regional and local level (S5) as well as the lack of professionalization and advising of the producers, through mechanisms responding to their demands (S7).

The agro-industrial sector also gave the best assessment to the determinant factors E4, E5 and E8 for the economic dimension, having a special concern for the lack of immediate profitability due to the high initial investment costs and the long maturity period of the final product. For the environmental dimension, the determinant factors that were the most highly valued were: N2, N4 and N7, suggesting the perfecting of the process application to improve the structure and quality of the grounds. Similarly, in the social dimension, the initiative was positively assessed via S2 and S8, and a high score was revealed for the S4 determinant factor, on the population's lack of environmental awareness and education.

The technical and academic sector highly values the economic savings of the initiative as included in E1 and E3. However, this sector, like the others, displays uncertainty with regards to the determinant factor E4 and E5. The environmental factor is highly valued both for waste management (N2) and emissions (N4), as well as for the inclusion of the environment in the productive processes (N8). However, the N7 determinant factor is also highly valued. As for the social dimension, the increased collaboration between the value chain agents (S2) is positively assessed, but demand is found with regards to resistance to change (S6) and the lack of professionalization (S7) of the agriculture sector.

Finally, the institutional sector values the most positive determinant factors of the three dimensions as follows: economic savings from energy production (E1), revalorization of waste (E2) and auto-production of organic fertilizer (E3) in the economic sector. Along with sustainable waste management (N2), the provision of organic materials (N3) and the use of native algae as innovation in the CO_2 capture technology (N5), are valued in the environmental dimension. The most highly valued determinant factors in the social dimension are the same as those previously described for the other groups: S1, S2 and S3 (Figure 4).

5.2 | Prioritization of the determinant factors of innovation for the sake of global sustainability

As noted in the fourth phase of the methodological process, a multi-criteria analysis has been carried out in order to prioritize the factors that determine the success of the innovative initiative and its contribution to achieving the three dimensions of sustainability. The results obtained are described in Figure 5. Thus, based on the pairwise comparisons conducted between the factors of their corresponding dimension and between types of dimensions, the mean relative importance of each of these has been obtained from the interviewed agents, as revealed by the obtained weights.

From these results it may be deduced that, in general terms, the factors that are the most influential in determining the success of this innovation project, according to the participating agents, are related to the environmental benefits of the project, through improved waste management, the use of organic fertilizer and the use of renewable energies.

5.3 | Validation of the model by stakeholders and strategy proposal

The sharing of the assessments (qualitative and quantitative) that were made for each of the sustainability axes, highlights diverse critical points that should be analysed and responded to with clear and concrete strategies. The strategies proposed for each of the sustainability dimensions are presented below (Table 4).

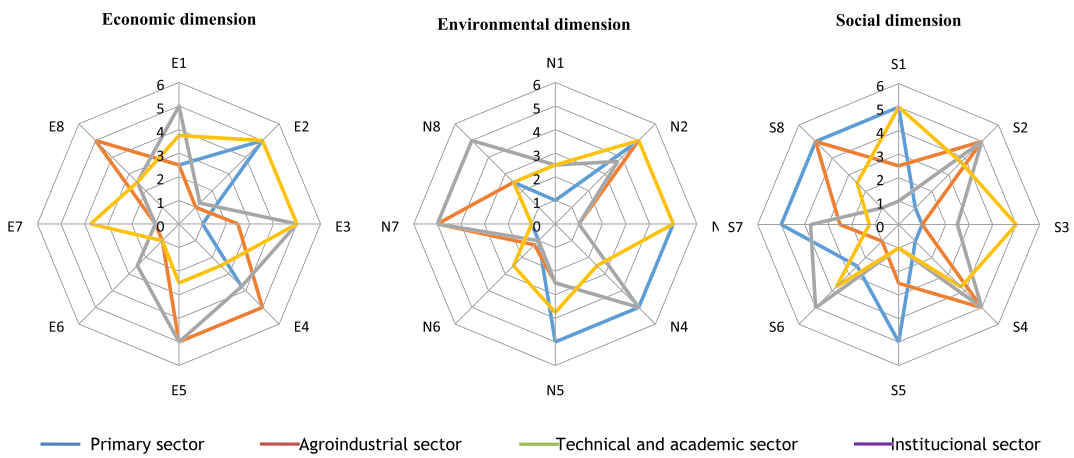

FIGURE 4 Qualitative assessment of the economic, environmental and social sustainability of a carbon sequestration initiative in the wine sector, according to stakeholders

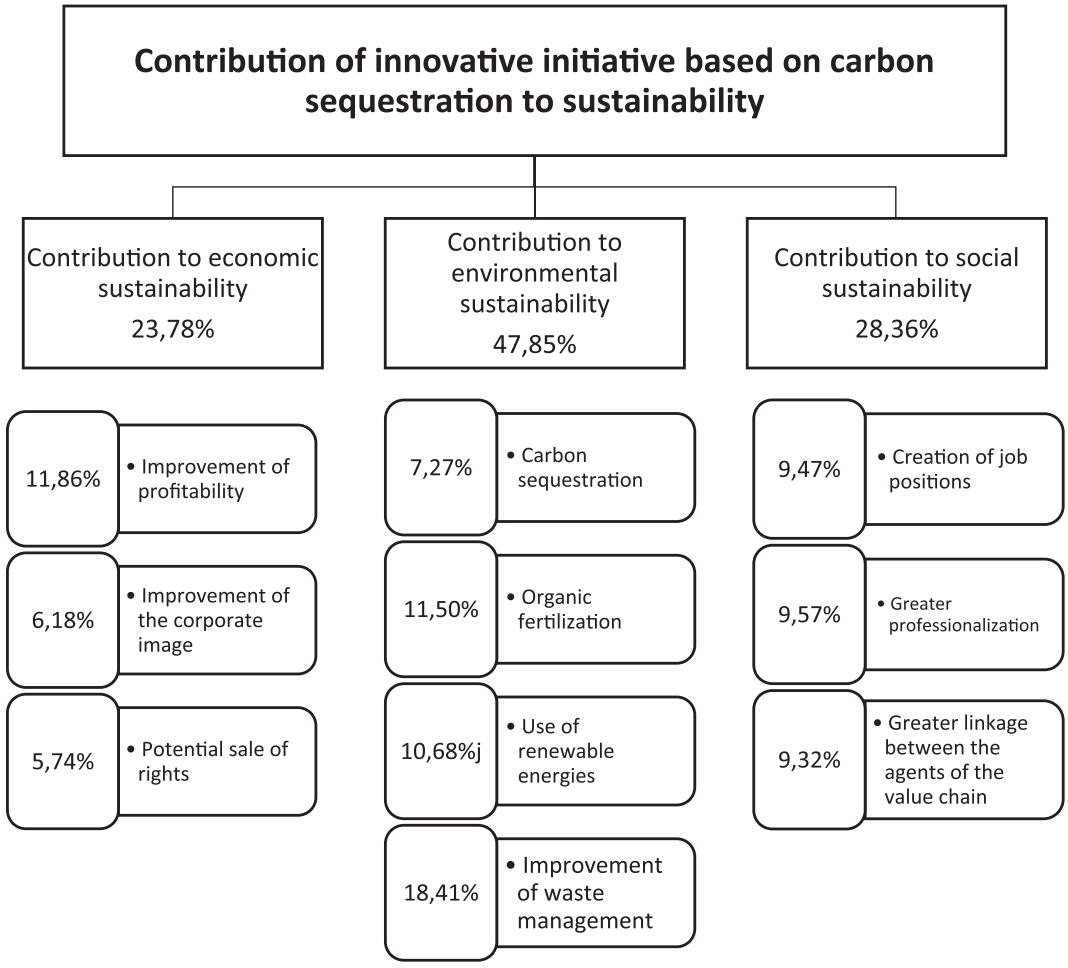

FIGURE 5 Importance of the contribution of an innovative initiative based on a carbon sequestration to sustainability

TABLE 4 Proposed strategies for the three dimensions of sustainability, based on their time horizon

	Short term strategies	Medium term strategies	Long-term strategies
Economic dimension	Optimize the process in relation to scale, location and technical complexity	Promote public assistance for investment and the incorporation of sustainable technologies in productive processes	Implement a collaborative business model
Environmental dimension	Improve the efficiency of the soil biofertilizer application system	Study in detail the agronomic value of the biofertilizer and its applicability according to soil type and crop yield	Carry out a long term environmental assessment of the process and comparison with eco-systemic models
Social dimension	Establish coordination between the ministries of agriculture and environment to avoid obstacles and support innovation in rural areas	Support the pioneer wine growers who decides to include technological processes of environmental improvement: economic and scientific support	Promote environmental education in schoolchildren and environmental awareness in adults through the mass media

5.3.1 | Economic dimension

The multi-criteria methodology developed has allowed us to establish that the contribution to the economic dimension of the sustainability project is the least valued. There is a generalized opinion by the members of the participative process, regarding the economic savings presented by the project, based on the revalorization of residue, energy production and the auto-production of bio-improvers. And there is a perceived increase in sales due to the improved corporate image. However, the lack of immediate profitability due to the high initial investment costs and the long tern of final product maturity for the prototype as well as the financing problems all generate a lack of confidence by the project recipients. To solve this problem, the stakeholders have proposed strategies that focus on: (i) implementing technology at an industrial scale, carrying out a process optimization study and a detailed study of the relationship between scale, location and technical complexity; (ii) support investment assistance and incorporate sustainable technologies in the productive processes, since the creation of more respectful industries with the environment reports a general benefit for the society that should be valued; and (iii) use a collaborative business model where the private initiative includes principles of collectivity, inherent in the social economy.

5.3.2 | Environmental dimension

The project's specific contributions to the environmental dimension of sustainable development are the most highly valued. According to the study participants, the innovative initiative is characterized by its capacity to integrate the environment into the productive processes, in order to obtain global improvements that follow the principles of the circular economy. The critical points detected in the environmental dimension refer to the lack of environmental regulations, as well as to technical limitations when applying the project in other circumstances.

The proposed strategies in this area include: (i) the final application of the biological improver for land through new cultivation techniques such as subrrigation, auto irrigation, buried pipes with less adhesions of algae, the cultivation of filamentous algae that are not suspended or the improvement in the concentration of the fertilizer; (ii) the detailed study of the agronomic value of the fertilizer and its applicability according to soil type and crop yield; and (iii) The long term environmental assessment and comparison with other models that include more simple ecosystemic processes.

5.3.3 | Social dimension

Finally, the social dimension was found to provide large contributions to the sustainability of the process. Specifically, the participating agents valued, almost equally, the creation of job positions (linked by some to the establishment of a population in the rural area and an increase in territorial cohesion), greater link between the agents of the value chain and greater professionalization of the primary sector. However, there is consensus in terms of the external limitations found in this dimension: the lack of environmental awareness and education, the current lack of professionalization of the producers as well as their resistance to change and a lack of political commitment.

Of the strategies proposed to overcome the social limitations are: (i) the promotion of environmental education in school children through a clear educational programme and promote environmental awareness in middle-aged people through mass media; (ii) the support of pioneer wine growers who decide to include technological processes of environmental improvement: economic support by the administrators and scientific support by the R&D&i institutions. So, the plans for rural development are great instruments for the transfer of knowledge from the private sector. Here, the importance of future so-called task force groups for this type of actions has been highlighted; and (iii) finally, coordination is proposed between the agriculture and environmental regional ministers in order to avoid obstacles and to support this type of initiatives.

6 | DISCUSSION OF RESULTS

The results obtained in this case study allow us to affirm that the application of innovative processes in rural areas is complex and the impacts are not so immediate and effective as in other contexts, in which social cohesion is more evident, in large part because the effects of the environmental, social or even economic issues are more homogenous. The rural environment and, specifically, the one in which this case study was carried out, is characterized by a great separation from the problems affecting the agents carrying out their activities in it. Specifically, the primary sector is affected by the growing loss of profitability in its activity, causing a lack of continuity or even the abandoning of the same. The innovation that is implied by this type of initiatives is positively viewed, but wine growers consider it to be difficult to apply, since it does not respond to their demands since it does not offer an immediate response to their problems. The fact that the profitability of the investment (linked to an increase in performance) and the environmental improvements (linked to a reduction in emissions) are produced over the middle to long terms generates a lack of confidence in the process. Thus the factor that is most highly valued by the wine growing sector is the saving resulting in fertilizers and this sector demands institutional commitment. Furthermore, wine growers are aware of their lack of professionalism and training, leading to a certain aversion to anything new.

However, the agro-industrial sector and, specifically in this case, the wine cellars of the study region, are more receptive to this type of initiatives and very positively assess the environmental improvements and the reduction in emissions that result from the project implementation. For this sector, anything new implies a differentiation and improvement in its image as a brand. Specifically, the wine cellars that function as individual companies are the most collaborative, thanks to the immediate effects resulting from the project over the short term, both in energy savings as well as revalorization of waste. Over the middle-long term, there is compensation for sustainability improvements. Representatives of the wine cellars participating in the consultation offered very high assessments of the social cohesion and integration of all sectors in the value chain. This opinion is symptomatic of the deficiency of the study area where the cooperative movement has a limited presence and does not work completely. An output of this research is that wineries demand more territorial cohesion to add support and thus achieve better implementation and results from this innovative initiative.

The project assessment by academics and technicians is positive, especially in the environmental component, as they assume that the benefits of the revalorization of waste and emissions reduction shall lead to improved global sustainability of the territory. Furthermore, social aspects such as improvement of social capital, establishment of the population and integration of the value chain, are all well valued while it is clear that there is a lack of awareness in society. This position may be expected from someone who is virtually neutral in the project implementation process, and who supports all that contributes to global sustainability of the rural environment.

Institutions are initially receptive to the initiative, given that they very positively assess the project externalities since they benefit society in a global sense: waste reduction, energy savings, the development of a rural population and improved territorial cohesion. The other actors demand that this group have a greater implication since they consider that the generation of externalities must be compensated for given the delay in time of the economic, social and environmental benefits. In addition, the administration should be responsible for creating policies that lay the foundations for promoting the demonstration effect in the territory and the link between the investigative and business areas. The agents coincide in the versatility of the project given its easy adaptation to other territories and companies, but it is the institutions that should create the environment and the mechanisms to ensure that this adaptation is favourable.

The strategies proposed in this participative process differ based on the time horizon. Over the short term, major modifications are proposed, such as the application to the industrial scale to assess the real results of the project, improvements in efficiency in the application of fertilizer, through the use of techniques linked to fertirrigation and, finally, an increased coordination between the agents responsible for project implementation. Project follow-up over the middle term should be implemented by the institutions with the help of the directly implicated parties and with the technological support of the academic world. Long term proposals reveal the need to bring awareness

to the population, laying the foundations for the generalization of this type of initiatives that should be implemented when it is evident that the carbon reduction and sequestration results are as expected. The collaborative processes are those that make this action viable and understandable. In this context, we suggest a new approach to the rural policy implemented in each region, as current aid is not well designed, especially aid focused on climate change and the environment. Greater concreteness is needed, because otherwise aid is distorted and the farmer becomes disoriented. For this reason, the figure of the local agent is very necessary to make rural areas more dynamic and to promote this type of initiative in situ.

7 | CONCLUSIONS

This work has evaluated the degree of receptivity, in terms of sustainability, of a rural, agricultural and innovative initiative based on the principles of the circular economy. This analysis has been carried out through a well-structured participatory process in which the project has been presented in situ to the agents affected: wine growers, wineries, academia and local and regional institutions. The perceptions of this heterogeneous group of agents are very different, as long as they serve their own interests. However, the knowledge of each stakeholder's point of view will be very useful for the implementation of this type of process and it will also be useful to the policy-makers when establishing action measures that facilitate the adoption of innovations in the agricultural sector.

The in-depth analysis of this case has been carried out assessing the perception of the agents involved concerning the global sustainability of the process, so that those affected have been asked to qualitatively and quantitatively assess the different aspects that influence the contribution to a sustainable model of agricultural and agro-industrial production. In this process, the participants have selected the indicators that define the sustainability of the model following the scheme of the MESMIS evaluation framework. It has been an *ex ante* valuation since the expected results of the project—improvement of soil structure, carbon fixation, savings in fertilization, continuous generation of renewable energy, increased profitability of farms, improvement of the image of the quality brand linked to the territory or the stable creation of jobs—will not be visible until a few years later.

Overall, this project responds to the environmental problems of the agricultural sector and the agro-industrial sector, through both the improvement of the soil structure of the area and the efficient use of organic fertilizers, as well as the incorporation of the circular economy as a productive model in both sectors; which translates into an improvement in production.

The analysis of this case study shows that wine producers maintain the inertia of traditional dependence on institutional aid to commit to the idea, which, in the opinion of the authors, does not favour the model of social cohesion that this kind of innovative action implies. In this case, the primary sector and the agro-industrial sector demand immediacy in economic results that solve the most pressing problems, and which this type of initiative does not contribute in the short term. In this context of low involvement and lack of initiative we think that the proposal of a "collaborative business model"—in the financing of the investment and in the distribution of benefits—would provide an appropriate environment for the advancement of this type of initiative, insofar as the actors would identify and be involved with the project. In this context of collaborative economy the design of a system of compensations by society for the externalities generated by a model proven to be sustainable could be considered, as advocated by the European Commission in its outline of the reform proposal of CAP post 2020 (Pe'er et al., 2014).

Equally, identification with the territory and in particular with the protected designation of origin for wine implied in the initiative, helps the value that is contributed as a sustainable territory to be positively valued and generates a high degree of acceptance.

The analysis of this work reflects the importance of participatory processes in the evaluation of sustainability, as stated by Reed (2008), helps the science of sustainability to acquire a reflective scientific practice to reward the cogeneration of solutions that take into account the uncertainty and the multiple forms of knowledge, exercised and defined by each of the interested parties, creating organizational cultures that can facilitate evaluation processes where many limitations have to be overcome and results are necessarily uncertain. In this sense, participatory

processes may seem very risky, but there is growing evidence that, if well designed, these perceived risks may be worthwhile. This statement coincides with the contributions of Rallet and Torre (2017) that promulgate the need to extend the concept of innovation to non-technological dimensions, considering the participation of individuals as autonomous sources of knowledge and as a tool for innovation in themselves. Furthermore, it highlights the importance of innovations being local and small-scale, since the complexity of innovation requires the implementation of local experiments that are easily applicable and allow interaction with local actors.

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