Analysing export performance in Spanish agro-food auxiliary companies: The role of eco-innovation

Maria del Carmen Galera-Quiles*, Laura Piedra-Muñoz**, Emilio Galdeano-Gómez**, Angel Carreño-Ortega***

DOI: 10.30682/nm2303d
JEL codes: Q17, Q18

Abstract

The main objective of this study is to contribute to the existing debate on the link between export activity and eco-innovation at a microeconomic level, using Spanish agro-food auxiliary companies as case study. For that purpose, a cluster analysis has been carried out and two groups of companies have been identified, that is low and high export performance. The languages spoken in the company, export revenues, export experience, international promotion expenses and positioning strategies are the variables that most contribute to distinguishing these groups. The results also show that the age of the management is a key factor in being more export-oriented, as are the control of inputs through information and communication technologies, the implementation of environmental innovations, and partnerships with universities and research centres. The main contributions of this study are: firstly, to broaden the sectoral scope of the research, which was previously focused on the industrial sector; secondly, to analyse the factors that can influence strategic decision-making; finally, the results provide information of interest to companies that wish to increase their eco-innovative processes through export orientation.

Keywords: *Export performance, Environmental innovation, Cluster analysis, Agro-food sector, Auxiliary industry.*

1. Introduction

R&D activities are vital in providing a competitive advantage for any activity and economic sector. In the case of the agro-food sector, several studies have demonstrated the relevance of these activities as one of the main factors for growth and achieving a more solid competitive position in both national and international markets (Capitanio *et al.*, 2009). This point is becoming increasingly decisive in an agro-food context characterised by progressively globalised competition and a higher level of demand (Baamonde, 2009).

Moreover, economic internationalisation has led to an ever-growing loss of local markets, with a resulting increase in transport distances between growers, industry and consumers, with repercussions on social and environmental costs (Notar-

* Foundation for Ancillary Technologies for Agriculture (TECNOVA), Almería, Spain.
** Department of Economics and Business, Mediterranean Research Center on Economics and Sustainable Development, CIMEDES, Agrifood Campus of International Excellence, ceiA3, University of Almería, Almería, Spain.
*** Department of Engineering, Mediterranean Research Center on Economics and Sustainable Development, CIMEDES, Agrifood Campus of International Excellence, ceiA3, University of Almería, Almería, Spain.
Corresponding author: acarre@ual.es

nicola *et al.*, 2012; Reisch, 2013). In this context, the search for sustainable production and consumption in the agro-food sector has stimulated the creation of many international initiatives and strategies designed to reduce environmental impacts, forcing companies to increase their productivity and export capacity through eco-innovative processes. The relationship between internationalisation and innovation is more widely studied in the literature (e.g. Freixanet, 2014; Shearmur *et al.*, 2015; Bıçakcıoğlu-Peynirci *et al.*, 2020). On the contrary, specific studies on eco-innovation are more limited (de Jesus Pacheco *et al.*, 2017). Numerous authors agree that international trade can have a positive effect on actions aimed at improving environmental performance (Triguero *et al.*, 2017; Galbreath, 2019).

Along these lines, several studies analyze export performance (EX) and eco-innovation (EI) relationship (e.g. Choi and Yi, 2018; Horbach and Jacob, 2018; Muñoz-Pascual *et al.*, 2019), but the conclusions drawn offer a very generalised view. At a microeconomic level, only 25% of theses works examine whether EI helps companies increase EX. Nevertheless, most of them (75%) analyze the influence of EX on EI, confirming mostly a positive effect (Sorroche-del-Rey *et al.*, 2022). Moreover, it can be observed that most of the analyses have focused on the industrial sector, and the evidence in the agro-food sector is very scarce.

In this context, the present study examines this issue in greater depth, taking Spanish agro-food auxiliary companies as a reference. Specifically, we examine the relationship between export performance and organisational and technological eco-innovations, identifying the characteristics, variables and dimensions that contribute towards setting firms apart. In addition, this study also shows how export performance indirectly influences EI through control variables, the main objective being to understand how the export performance affects adoption of sustainable innovation strategies in this sector.

To this end, a cluster analysis of agro-food auxiliary companies is performed. The results highlight the existence of two groups of companies according to their export orientation. The differences between the two groups depend to a large extent on export experience, export revenues, the amount of importance placed on lowering environmental impact, control of inputs through ICT and external collaboration. All of these show that there is a positive dependence relationship between the export performance and the EI variables.

Thus, this paper complements the scarce literature available regarding the interrelationships between these variables on the agro-food sector, making an empirical contribution.

The rest of the paper is structured as follows. Section 2 contains a review of the literature. Section 3 describes the methodology and materials used. Section 4 explains the estimates and results of the descriptive analysis and the cluster analysis. Section 5 deals with the main discussions. Finally, section 6 presents the conclusions drawn from the research.

2. Literature review

Environmental sustainability has become a priority in recent years, not only for polluting countries, but also for those with greater environmental awareness and commitment. This has led researchers to study how innovations carried out at an environmental level affect export activity and internationalisation processes and vice versa (Chiarvesio *et al.*, 2015; Pozzobon Palma *et al.*, 2018; Muñoz-Pascual *et al.*, 2019; Galera-Quiles *et al.*, 2021).

Today, world population growth along with demographic changes, globalization, andchanges in eating habits are putting upward pressure on the demand for food.This has resulted in profound changes in food production and consumption patterns. The main concerns are to provide enough food, in the quantity and quality required to meet the nutritional needs, while conserving natural resources (Alexandratos and Bruinsma, 2012; Valls *et al.*, 2021). As a result, production is becoming increasingly globalised and industrialised, leading to standardisation. Agricultural practices, especially in developed countries, have intensified in order to increase crop yields as much as possible. At the same time, new production practices are being implemented that foster improved levels of food safety, such as

biological control and the implementation of traceability (Barth *et al.*, 2017). In this regard, Galdeano-Gómez *et al.* (2017) show how innovations in biological control minimise the use of fertilisers and plant protection products in order to promote sustainability in Spanish agricultural production.

The agro-food sector totals approximately 1.3 billion tons annually with a cost of more than 1000 billion dollars per year (Esposito *et al.*, 2020). It has been severely affected by problems such as resource scarcity, food loss and waste generation along the world's supply chain. The mismanagement of resources and processes represents one of the causes of such problems. The food industry also has a negative impact on the environment in terms of energy use, CO_2 and hazardous waste, among others, accounting for 64% of European industrial pollution. As a result, there is a need to find out whether measures are being taken by agro-food companies to promote EI and how this affects their competitiveness and profitability (García-Granero *et al.*, 2020).

Furthermore, greener production and processes must go hand in hand with organisational and commercial eco-innovation as a way of mitigating the environmental externalities of agriculture and the subsequent related international food crises, from a multidimensional approach (Galera-Quiles *et al.*, 2021). In line with the above, it requires the implementation of new green practices that favour the improvement of food safety, towards healthier and more natural products (Arfaoui *et al.*, 2022) and sustainability levels throughout the supply chain. Key factors could be the promotion of EI in different areas (products, processes, planning, technology and R&D); the cooperation between researchers and enterprises (Petruzzella *et al.*, 2020), cooperation between stakeholders in the effective implementation of EI (Kulak *et al.*, 2016), environmental attitudes, perceptions and intentions of decision-makers; environmental concern at management and staff level and the implementation of greener organisational business models (Barth *et al.*, 2017; Drejeris and Miceikienė, 2018).

Accordingly, as these are essential goods, studies in this area should be stepped up because of the implications, not only for the environment, but also for society.

Within the observed heterogeneity, most of the EI in the agro-food industry focuses on products or processes such as the following: cleaner technologies, energy efficiency and renewable energy (Sala *et al.*, 2017); better management of material and other resource flows (van Bommel, 2011; Salomone *et al.*, 2016); greener inputs and raw materials (Salomone *et al.*, 2016; Silalertruksa *et al.*, 2017); food waste levels (Sala *et al.*, 2017); and recycling (Salemdeeb *et al.*, 2017). Other types of EI are included in the organisational dimension, such as improved greener networks as well as inter-organisational cooperation and interaction (Kulak *et al.*, 2016), sharing of regulatory and interpretative schemes (Van Bommel, 2011), guidance on environmental management, sustainability-minded staff and the involvement of environmental experts (do Canto *et al.*, 2021). Finally, ecolabels and quality certifications are also prominent (Goossens *et al.*, 2017). When there is an effective channel leader with influence over the other players, eco-innovation can spread from one company to another as a result of increased collaboration (Hall, 2006).

Implementing eco-innovative processes helps companies solve existing externality problems, in doing so, improving their image with national and international customers (Chiarvesio *et al.*, 2015), and allowing them to increase their profitability and be more competitive as part of a global positioning strategy. In addition, leaders within companies influence strategy and culture. They expand and refine product and process development, and also determine levels of strategic action, including those related to EI (Galbreath, 2017).

In the present study, through the empirical analysis conducted, we tried to include as many of the variables mentioned is possible, in order to determine their influence on the EX and EI relationship in the particular case of the agro-food auxiliary companies.

3. Methodology

The design of our methodology has been divided into several parts. Firstly, we identified the variables and indicators most commonly used in studies on this topic. Secondly, a questionnaire was devel-

oped as a tool to collect the necessary data. Thirdly, a statistical analysis of data including a cluster analysis (k-means procedure) and a chi2 analysis (Piedra-Muñoz *et al.*, 2017) was carried out to determine the influence of the different variables on EX and EI activity interrelationship.

3.1. *Definition of the variables*

As part of the analysis of export performance, EX, a series of the most frequent indicators used in this line of study have been considered (see Table 1): income received from exports, international trade missions and fairs, export experience, the budget allocated for foreign promotion and the degree of establishment in the international market (Valdiviezo, 2012; Chiarvesio *et al.*, 2015; Freixanet, 2014).

In terms of EI, most papers analyse variables related to the expenditure made on eco-innovation by the firm (Galbreath, 2017), the importance of EI in organisations (García-Granero *et al.*, 2020), the use of technologies and activities that help reduce environmental damage and input consumption, as well as the use of recycled packaging (Rodríguez and Wiengarten, 2017;

Table 1 - Variables included in the analysis and scale.

Name of variable	*Description*	*Measurement scale*	*References*
Characteristics of the managing director			
Age	Age of the managing director	Natural number	Sousa *et al.*, 2008
Education	Managing director's level of education (1=no education, 2=primary, 3=secondary, 4=higher education, 5=university)	Liker scale (1-5)	Contractor *et al.*, 2005
Managing director's Gender	Gender of the managing director (=0 male; =1 female)	Dichotomy	Galbreath, 2017
Characteristics of the firm			
Employment	Number of employees	Natural number	Sousa *et al.*, 2008; Chiarvesio *et al.*, 2015
Total income	Total annual income	Thousands of €	Chiarvesio *et al.*, 2015
Education level of employee	Average educational level of company staff (1=no education, 2=primary, 3=secondary, 4=higher education, 5=university)	Liker scale (1-5)	Sousa *et al.*, 2008
Export performance variables			
Languages	Number of languages spoken in the company	Natural number	Sousa *et al.*, 2008; Bianchi *et al.*, 2018
Export Income	Export revenues received as a percentage of total revenues	Percentage	Salomon & Shaver, 2005; Chiarvesio *et al.*, 2015; Freixanet, 2014
Trade Misions	Number of international trade missions carried out in 2019	Natural number	Freixanet, 2014
International Fairs	Number of international trade fairs attended in 2019	Natural number	Freixanet, 2014
Export years	Number of years the company has been exporting	Natural number	Salomon & Shaver, 2005
International promotion	Expenditure on international promotion campaigns (1=€0-15.000; 2=€15.000-30.000; 3=€30.000-45.000; 4=€45.000-60.000, 5= +€60.000)	Liker scale (1-5)	Valdiviezo, 2012
International establishment	Method of establishment abroad (1=does not export, 2=online channel, 3=directly, 4=local sales office, 5=subsidiary)	Liker scale (1-5)	Chiarvesio *et al.*, 2015; Freixanet, 2014

García-Granero *et al.*, 2020); the introduction of external environmental audits (Zailani *et al.*, 2012; Chiarvesio *et al.*, 2015; García-Granero *et al.*, 2020) and collaboration with EI research centres (Chiarvesio *et al.*, 2015; Doloreux and Kraft, 2019).

With respect to the control variables regarding company characteristics, several factors have been taken into account, namely: the number of employees, frequently used as a measure of firm size (Sousa *et al.*, 2008; Chiarvesio *et al.*, 2015), total annual revenue (Chiarvesio *et al.*, 2015) and employees' level of education (Sousa *et al.*, 2008). Also, the main characteristics of managing directors have been considered, such as age (Sousa *et al.*, 2008) and educational level (Contractor *et al.*, 2005).

3.2. *Data collection and sampling*

The southeast of Spain has become the principal horticultural supplier in Spain and Europe. This area includes the world's largest concentration of greenhouses (35,000 ha) to produce fruit and vegetables. The success of this model is not only due to the agriculture

Name of variable	*Description*	*Measurement scale*	*References*
Eco-innovation variables			
EI implementation	If the company has carried out EI (0 =no; 1 = yes)	Dichotomy	Galbreath, 2017
EI expenditure	Percentage of total expenditure spent on EI measures (1: <2.5%, 2: >2.5% <5%; 3: <5% <10%; 4: >10% <15%; 5: >15%)	Liker scale (1-5)	Galbreath, 2017; García-Granero *et al.*, 2020
EI areas	Areas in which EI has been carried out (1=product, 2=process, 3=management, 4=marketing, 5=not done)	Liker scale (1-5)	Doran & Ryan, 2016; García-Granero *et al.*, 2020
Input control	Extent to which input control is carried out using ICT tools.	Liker scale (1-5)	Kante *et al.*, 2016 Rodríguez & Wiengarten, 2017
Initiatives to reduce environmental damage	Extent to which action is taken to reduce environmental damage	Liker scale (1-5)	Rodríguez & Wiengarten, 2017; García-Granero *et al.*, 2020
Clean technologies	Extent to which clean or zero residue technologies are used	Liker scale (1-5)	Rodríguez & Wiengarten, 2017; García-Granero *et al.*, 2020
Suppliers with EI culture	Extent to which suppliers with an eco-friendly culture are selected	Liker scale (1-5)	Lawson *et al.*, 2015; Kulak *et al.*, 2016
Solutions to reduce water, energy, plant protection or fertiliser consumption	Extent to which solutions to reduce the consumption of water, pesticides, energy and/or fertilisers are developed.	Liker scale (1-5)	Rodríguez & Wiengarten, 2017; García-Granero e*t al.*, 2020
Use of recycled packaging and materials	Extent to which recycled packaging is used	Liker scale (1-5)	Rodríguez & Wiengarten, 2017; García-Granero *et al.*, 2020
Research centres	Extent of collaboration with universities or research centres	Liker scale (1-5)	Chiarvesio *et al.*, 2015; Doloreux & Kraft, 2019
ISO 14001 Certification	If 14001 certified (0=no; 1=yes)	Dichotomy	Chiarvesio *et al.*, 2015
Environmental auditing	If environmental auditing is carried out (0=no; 1=yes)	Dichotomy	Chiarvesio *et al.*, 2015; García-Granero *et al.*, 2020

Source: Compiled by the authors.

but also to all the synergies that it has originated in auxiliary companies.

For this reason, this study focuses on the Spanish southeast agrifood auxiliary companies, which provide the necessary technologies and services within the value chain to produce fruit and vegetables, such as manufacturers of greenhouses, plastics, containers and packaging, fertirrigation systems, agricultural machinery, climate control, seeds, nurseries, substrates, plant nutrition or integrated pest control. The major destinations are Spain, European Union and developing countries, located mainly in North Africa, Latin America or Asia. In this region, agricultural activity has a major impact on the environment, as it involves an intensification in the use of natural resources (mainly land and water), together with the generation of large amounts of waste (Tolón-Becerra *et al.*, 2013). These negative factors have led to the development of eco-innovative actions (García-Granero *et al.*, 2020).

Data for this study was collected by means of a survey designed specifically for this purpose. The questionnaire was devised taking into account the measures and indicators shown in Table 1 (Evans *et al.*, 2008) and was geared towards the management and technical staff of the companies, as key informants in having an overview of what is really happening in their organisations (Glick *et al.*, 1990). The questionnaires were sent by email and respondents were subsequently contacted by telephone to verify the responses received.

The questionnaire was sent out from August to November 2020 to the 144 agrifood auxiliary companies located in the southeast of Spain. The percentage of responses was quite high. Seventy-one surveys were received, although some were discarded due to incompleteness. Thus, the final sample consisted of 63 surveys which were considered valid for the analysis. This represents a response rate of 43.7%, which is highly satisfactory. According to Menon *et al.* (1996), the average top management survey response rate is in the range of 15-20 percent. In addition, there was a response from all the subsectors. Thus, we consider that the sample is adequate in terms of size and representativeness.

3.3. *Methods*

The cluster methodology was used to identify the number of groups, maximising the heterogeneity between them (Kobrich *et al.*, 2003). We firstly tested the influence of EI on EX and clusterized based on EI, but the results were not satisfactory, in line with those obtained by Mao (2022), for example. As most of the studies found in the literature on this topic (Sorroche-del-Rey *et al.*, 2022), we then studied the influence that export performance could have on the eco-innovative behavior and this analysis showed a positive relationship, expanding the evidences in the less-analyzed agri-food field.

The hierarchical method (Ward's method) was applied to separate the sample into two homogeneous groups: Group 1 (non or low export-oriented companies) and Group 2 (high export-oriented companies), according to the data shown in the dendogram. Subsequently, k-means clustering (Setyaningsih, 2012) was applied, choosing Euclidean distance as the distance measure (Hair *et al.*, 2006). The data was divided into k clusters at random to calculats the centroid of each cluster, assigning each case to the closest cluster. The new centroids were then calculated and firms reassigned to the one closest to the new cluster. This process was repeated until no more reassignments could be made (Piedra-Muñoz *et al.*, 2017). In addition, an analysis of variance (one-way ANOVA) was carried out to identify statistical differences between the groups (Kuswardhani *et al.*, 2014).

Finally, Chi2 tests were carried out to verify the relationship between the two groups together with the following variables from the socio-economic profile: age, educational level and gender of the managing director, number of employees, qualifications and total income.

4. Results

The main results obtained by applying descriptive statistics, cluster analysis and the Chi2 test are presented below.

4.1. *Descriptive statistics*

Table 2 shows a brief description of the main variables that we have considered in the study, in order to provide a profile of the companies.

Table 2 - Summary of statistics for the main variables of the study.

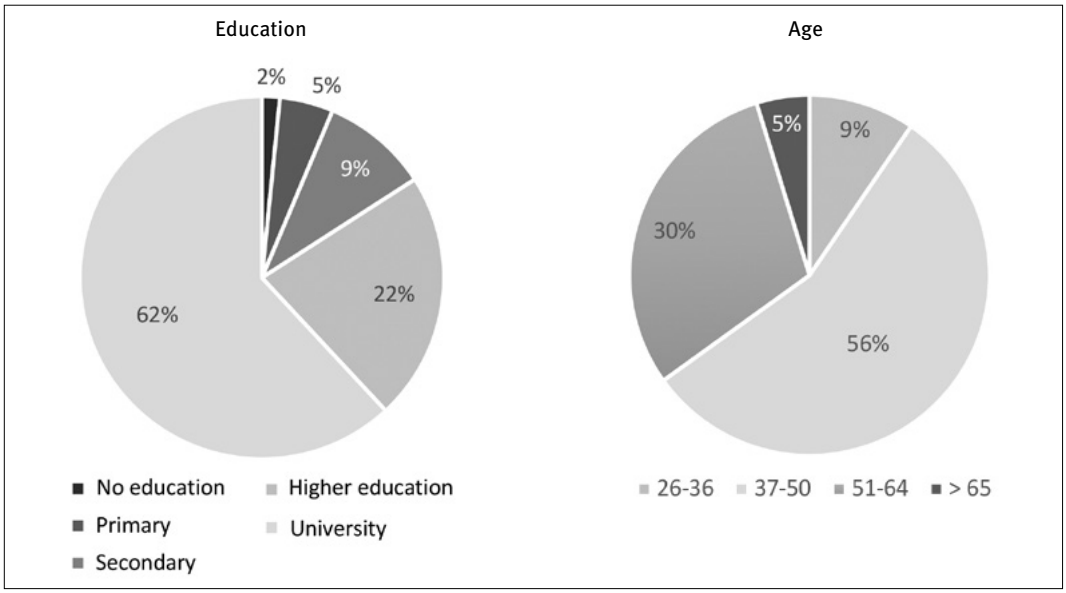
Variable	*Mean*	*Std. Dev.*	*Minimum*	*Maximum*
Personal Attributes of the managing director				
Age	48.29	9.4	26	73
Education	4.38	0.96	1	5
Managing director´s Gender	0.14	0.35	0	1.00
Characteristics of the firm				
Employment	51.63	56.91	4	261
Total Income	10,574.88	19,447.57	268.77	120,000.00
Education of employees	25.19	40.98	1.00	261.00
Export performance variables				
Languages	3.21	1.94	1.00	10.00
Export Income	15.73	21.49	0	77.00
Trade misions	3.30	1.36	1.00	5.00
International Fairs	3.44	1.42	1.00	5.00
Export years	8.06	8.55	0	30.00
International promotion	0.95	1.40	0	4.00
International establishment	1.67	1.50	0	4.00
Eco-innovation variables				
EI Implementation	0.67	0.48	0	1.00*
EI expenditure	1.87	1.90	1	5.00
EI areas	1.08	0.79	1	5.00
Input control	2.41	1.34	1.00	5.00
Initiatives to reduce environmental damage	3.03	1.29	1.00	5.00
Clean technologies	3.02	1.31	1.00	5.00
Suppliers with EI culture	2.83	1.28	1.00	5.00
Solutions to reduce water, energy, plant protection or fertiliser consumption	3.30	1.60	1.00	5.00
Use of recycled packaging and materials	2.89	1.35	1.00	5.00
Research centres	2.94	1.58	1.00	5.00
ISO 14001 Certification	0.27	0.45	0	1.00*
Environmental auditing	0.35	0.48	0	1.00*

(*) Dichotomous variables, 0 or 1. Source: Compiled by the authors.

The results show that the managing directors of the companies surveyed are relatively young, with an average age of 48 years. With regard to their level of education, we found that the vast majority of them have a university education (84%) (Figure 1). Only 14.2% are women, which may be due to the fact that these are agro-food auxiliary activities where women have been under-represented for many years and this has only started changing over the last decade. The average number of employees per company is 51.6, with the level of university studies of the workers being 50.8%, while the average income of the firms is € 10.5 million, so they are mainly small and medium-sized companies.

This is an internationally recognised activity in those countries that are developing or want to develop their agriculture through the implementation

Figure 1 - Personal attributes of the managing directors.



of high-yield greenhouse technology. This must be the reason why 66% of the companies participate in international trade fairs and trade missions, even though they only speak 3.2 languages on average (the maximum being 10), which tells us that they are open to the rest of the world, where language has not been a barrier to breaking into foreign markets where they can sell their technology.

Export revenues as a percentage of the total, amount to an average of 15.7%, the highest figure being 77%. As a result, the companies are highly skewed in terms of its level of exports, with 70% invoicing less than 15% internationally and only 11% invoicing more than 50% abroad.

The average expenditure on promotion abroad is less than € 45,000 in more than 83% of the cases (Figure 2), which makes it difficult for companies to establish themselves internationally.

Figure 2 - Foreign promotion budget and % exports.

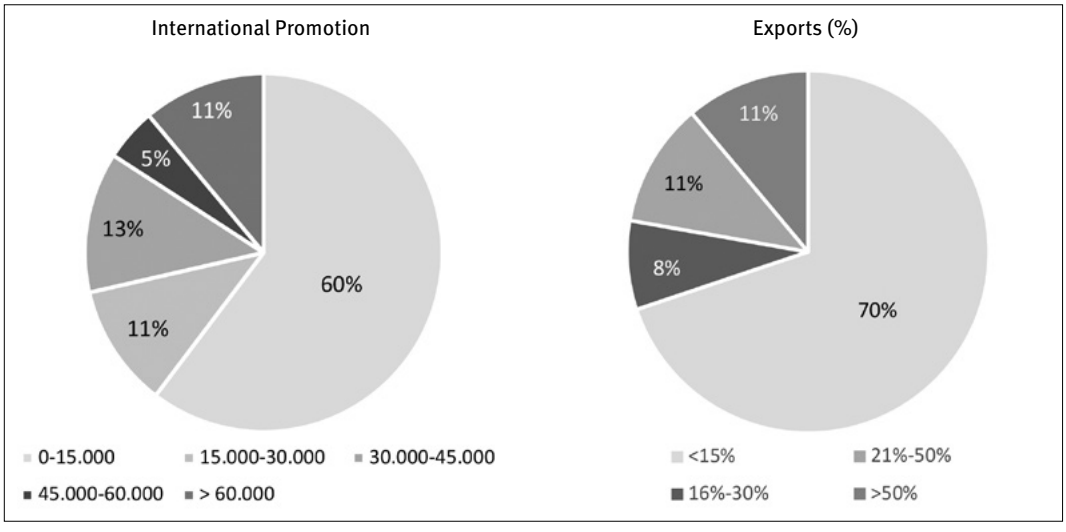
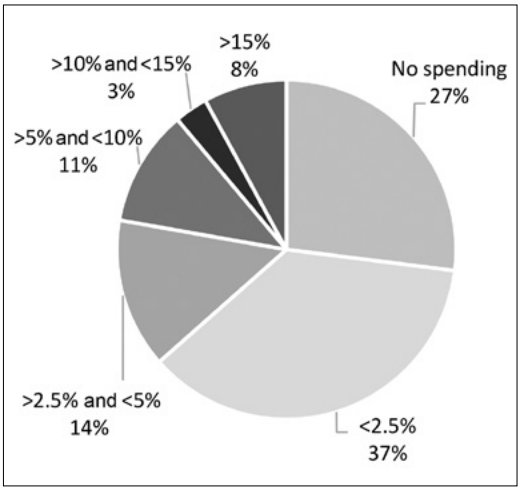


Figure 3 - Percentage of expenditure on EI.



The level of importance given to EI both at company level (4.1) and by managing director is quite high: 4.05 out of 5. More than half (67%) report having undertaken EI actions in their company, although the percentage of expenditure on EI is still too low, with 71% spending less than €30,000 per year (Figure 3). The extent of implementating environmental management systems is 27% in terms of certifications and 35% in terms of audits, despite the fact that they should optimise the use of fertilisers, water and energy consumption, recycling and waste management, both in terms of environmental impact and the costs involved.

Cluster analysis. Types of companies with respect to export performance

The results obtained in the dendogram (Appendix B) determined two groups to be the best solution, as they showed the lowest p-values for a one-way analysis and represented the most significant difference of each variable between the groups. Finally, two homogeneous groups were identified by applying cluster analysis: Group 1 (non or low export-oriented companies) and Group 2 (high export-oriented companies). Subsequently, an analysis of variance (one-way ANOVA) was performed to find statistically significant differences in the means of the variables that comprise each group (Piedra-Muñoz *et al.*, 2017).

The results are shown in Table 3 where the values of the main variables can be observed. The variables that differ significantly between groups with a probability level of 5% (p-value<0.05) and also contribute most to the differentiation between groups, are "Languages", "Export Income", "Export years", "International Promotion" and "International Establishment". These are followed to a lesser extent by "Control of inputs using ICT tools", "Number of collaborations with universities and research centres", "Initiatives to reduce environmental damage", "Eco-innovation has been carried out" and "Age of managing director".

Each of the groups analysed has a set of variables that allow us to characterise each group:

- Group 1. This group corresponds to the companies with lowest export orientation and accounts for 69.8% (44 observations) of the total analysed. The average age of the manager is 46 years (13.2% lower than the age of the other group). The companies in this group have an income level of almost € 8m (€ 7.6m), have been exporting for less than 5 years (4.3), with 5.7% of revenue coming from exports, and speak less than three languages. They have a very low budget for promotional activities (0.4 out of 5), and are 3 times less established abroad than Group 2. With regard to the indicators for EI, we found that only half of the companies in this group carry out activities of this type of innovation, are concerned with carrying out meaures to reduce environmental damage or collaborate with universities and research centres; and less than half undertake input control using ICT.
- Group 2. Corresponds to the companies with highest export orientation and represents 28.6% (18 observations) of the companies analysed. The average age of the manager is over 53 years old. The companies in this group have an average income of almost €18m (17.9m), of which more than 40% (40.6%) corresponds to sales abroad, have extensive export experience of more than 17 years (17.3) and speak more than 5 languages. They have a promotional budget almost 6 times higher than that of the companies that export the least (5.8), and are 3 times more established abroad than companies in Group 2. An analysis of the indicators for EI

Table 3 - Characteristics of identified clusters and test statistics of one-way ANOVA.

	Group 1 N= 45		*Group 2 N=18*			
	Low export performance		*High export performance*			
Variable	*Mean*	*Std. Dev.*	*Mean*	*Std. Dev.*	*F*	*p-Value*
Personal Attributes of the manager						
Age	46.20	9.260	53.50	7.748	8.719	*0.004*
Education	4.356	1.004	4.444	0.856	0.109	*0.742**
Managing director's Gender	0.156	0.367	0.11	0.323	0.201	*0.655**
Characteristics of the firm						
Employment	43.492	50.782	72.000	67.242	3.349	*0.072**
Total Income	7,618.81	14,323.91	17,965.08	27,701.08	3.804	*0.056*
Education employee	53.79	31.38	43.75	24.818	1.463	*0.231**
Export performance Variables						
Languages	2.360	1.111	5.330	1.970	57.803	*0.000*
Export Income	5.750	9.339	40.690	23.135	74.033	*0.000*
Trade Misions	3.311	1.474	3.278	1.074	0.008	*0.931**
International Fairs	3.220	1.444	4.000	1.237	4.028	*0.049*
Export years	4.360	5.661	17.330	7.515	55.728	*0.000*
International Promotion	0.400	0.889	2.333	1.495	40.268	*0.000*
International Establishment	1.111	1.318	3.056	0.938	32.447	*0.000*
Eco-innovation Variables						
EI Implementation	0.578	0.499	0.889	0.323	5.951	*0.018*
EI expenditure	1.756	2.047	2.167	1.505	0.595	*0.444**
EI areas	0.978	0.866	1.333	0.485	2.681	*0.107**
Input control	2.067	1.232	3.278	1.227	12.449	*0.001*
Initiatives to reduce environmental damage	2.733	1.286	3.778	1.003	9.516	*0.003*
Clean technologies	2.933	1.355	3.222	1.215	0.618	*0.435**
Suppliers with EI culture	2.733	1.372	3.056	0.998	0.816	*0.370**
Solutions to reduce water, energy, plant protection or fertiliser consumption	3.067	1.629	3.889	1.410	3.521	*0.065**
Use of recycled packaging and materials	2.711	1.456	3.333	0.907	2.831	*0.098**
Research centres	2.556	1.470	3.889	1.491	10.492	*0.002*
ISO 14001 Certification	0.222	0.420	0.389	0.502	1.807	*0.184**
Environmental auditing	0.289	0.458	0.500	0.514	2.543	*0.116**

Source: Prepared by the authors.

shows that 88.9% of the companies carry out activities related to this type of innovation and more than 75% are concerned with carrying out measures to reduce environmental damage or collaborate with universities and research centres, as well as undertaking input control using ICT.

Chi-squared tests

To understand the differences between the two groups analysed and the characteristics that determine each of them, a chi-squared analysis was performed. With an error of less than 5%, the analysis shows in the pertinent sections, the areas in which EI has been carried out (Table

Table 4 - Observed and expected frequencies for EI Areas in Groups 1 and 2.

Areas in which EI has been carried out			*1*	*2*	*3*	*4*	*5*	*Total*
Group	*1*	*Observed*	14.0	20.0	10.0	0.0	1.0	45.00
		Expected	10.0	22.9	11.4	0.0	0.7	45.00
	2	*Observed*	0.0	12.0	6.0	0.0	0.0	18.00
		Expected	4.0	9.1	4.6	0.0	0.3	18.00

Pearson's chi-squared test: 7.875; df = 3; p = 0.049.

4), as well as the observed and expected frequencies in groups 1 (Low export performance) and 2 (High export performance). The number of companies determined in Group 2 is higher than expected for the areas in which they have performed EI for values 2 and 3 (they perform some EI for processes and management), meaning they are influenced by factors that drive them to export more.

Tables 5 and 6 show the observed and expected frequencies for firms engaging in EI or not and the % of expenditure spent on EI in both groups. The observed number of firms in Group 2 that implement EI and the observed number in group 1 that spend more than 5% on EI is higher than the expected number, indicating that these firms are influenced by factors that push them to export more in the first case and less in the second, i.e. the higher the EI spending, the less influence there is on their export capacity.

Tables 7 and 8 illustrate the observed and expected frequencies for the degree of importance of both controlling inputs using ICT tools as well as taking action that reduces environmental damage. The observed number of companies in Group 2 is higher than the expected number, for values 4 and 5 in both cases, which indicates that the companies placing great importance on these two eco-innovative actions, are influenced by those factors that drive them to be more export-oriented.

Tables 9 and 10 report the observed and expected frequencies for the use of packaging and recycled material, as well as for collaboration with universities and research centres. The observed number of companies in Group 2 is high-

Table 5 - Observed and expected frequencies for *Engaging in eco-innovation* in Groups 1 and 2.

Engage in eco-innovation			*Do not engage in eco-innovation*	*Engage in eco-innovation*	*Total*
Group	*1*	*Observed*	19.0	26.0	45.0
		Expected	15.0	30.0	45.0
	2	*Observed*	2.0	16.0	18.0
		Expected	6.0	12.0	18.0

Pearson's chi-squared test: 5.600; df = 1; p = 0.018.

Table 6 - Observed and expected frequencies for *% Cost eco-innovation* in Groups 1 and 2.

% cost eco-innovación			*0%*	*1%*	*3%*	*4%*	*5%*	*6%*	*Total*
Group	*1*	*Observed*	16.0	14.0	7.0	1.0	2.0	5.0	45.0
		Expected	12.1	16.4	6.4	5.0	1.4	3.7	45.0
	2	*Observed*	1.0	9.0	2.0	6.0	0.0	0.0	18.0
		Expected	4.9	6.6	2.6	2.0	0.6	1.3	18.0

Pearson's chi-squared: 19.723; df = 5; p = 0.001.

Table 7 - Observed and expected frequencies for *Degree of importance* in Groups 1 and 2.

Degree of importance of controlling inputs with ICT			*1*	*2*	*3*	*4*	*5*	*Total*
Group	*1*	*Observed*	21.0	9.0	8.0	5.0	2.0	45.0
		Expected	16.4	8.6	7.9	9.2	2.9	45.0
	2	*Observed*	2.0	3.0	3.0	8.0	2.0	18.0
		Expected	6.6	3.4	3.1	3.8	1.1	18.0

Pearson's chi-squared test: 12.359; df = 4; p = 0.015.

Table 8 - Observed and expected frequencies for *Extent of taking action to reduce environmental damage* in Groups 1 and 2.

Extent of taking action to reduce environmental damage			*1*	*2*	*3*	*4*	*5*	*Total*
Group	*1*	*Observed*	11.0	7.0	14.0	9.0	4.0	45.0
		Expected	7.9	7.1	11.4	12.9	5.7	45.0
	2	*Observed*	0.0	3.0	2.0	9.0	4.0	18.0
		Expected	3.1	2.9	4.6	5.1	2.3	18.0

Pearson's chi-squared test: 12.285; df = 4; p = 0.015.

er than expected for the use of packaging in levels 3 and 4, which indicates that only the use of certain recycled packaging is influenced by the factors that drive them to be more export-oriented. Regarding collaboration with universities/research centres, the observed number of initiatives is higher in Group 2 and level 5, which indicates that the most export-oriented companies are influenced by the various initiatives they carry out with research centres.

Table 9 - Observed and expected frequencies for *Use of recycled packaging and materials* in Groups 1 and 2.

Use of recycled packaging and materials			*1*	*2*	*3*	*4*	*5*	*Total*
Group	*1*	*Observed*	14.0	6.0	11.0	7.0	7.0	45.0
		Expected	10.7	5.0	13.6	10.0	5.7	45.0
	2	*Observed*	1.0	1.0	8.0	7.0	1.0	18.0
		Expected	4.3	2.0	5.4	4.0	2.3	18.0

Pearson's chi-squared test: 10.094; df = 4; p = 0.039.

Table 10 - Observed and expected frequencies for *Collaboration with universities and research centres* in Groups 1 and 2.

Collaboration with universities and research centres			*1*	*2*	*3*	*4*	*5*	*Total*
Group	*1*	*Observed*	17.0	5.0	10.0	7.0	6.0	45.0
		Expected	13.6	5.0	8.6	6.4	11.4	45.0
	2	*Observed*	2.0	2.0	2.0	2.0	10.0	18.0
		Expected	5.4	2.0	3.4	2.6	4.6	18.0

Pearson's chi-squared test: 13.068; df = 4; p = 0.011.

5. Discussion

Most works that analyze the influence of export activity or internationalization on environmental performance confirm a positive effect (Sorroche-del-Rey *et al.*, 2022). Nevertheless, it should be highlighted that a few of these studies show inconclusive results. For example, Gómez-Bolaños *et al.* (2020) found that firms' level of internationalization had a positive effect on their environmental management, whereas its effect on environmental performance was not found to be significant. In our case study the results showthat there is a positive relationship between EX and EI variables. As such, it can be deduced that export activity contributes towards increasing EI, these results being in line with other studies (Galbreath, 2019; Triguero *et al.*, 2017; Choi and Yi, 2018; Horbach and Jacob, 2018; Muñoz-Pascual *et al.*, 2019).

The results reveal that more than half of the companies (67%) report having undertaken EI actions, although this expenditure is relatively low in 71% of the companies. This may be because there is not yet enough pressure at market or regulatory level to force companies to invest more in taking action that contributes to reducing environmental damage (Keshminder and Chandran, 2017). In our analysis, the most export-oriented firms have a high eco-innovative awareness (Muñoz-Pascual *et al.*, 2019) but there is an inverse relationship when EI spending increases, in contrast to the results of Fonfría (1997), which show how spending on innovative activities raises the possibility of targeting foreign markets. This trend will have to change, as there is growing international environmental concern about pollution levels and input savings (Máté-Balogh and Jámbor, 2020), as well as increased consumer awareness in EU countries (Chiarvesio *et al.*, 2015). Thus, if companies want to be competitive, they will have to adapt to market changes and devote economic resources to developing more sustainable technology (Brunel, 2019), possibly supported by public funding to promote and finance part of these processes, especially in SMEs (Sung *et al.*, 2017), as they have fewer resources to do so.

Regarding the implementation of measures to reduce environmental damage, these are considered of great importance for more than 75% of the most export-oriented companies, which is in line with other works by Pozzobon Palma *et al.* (2018), which point out that the existence of raised social and environmental awareness helps EI to promote EX. Through sustainable product innovation and greener processes, firms' export performance levels increase (Jin and Scheepens, 2016; Carrillo-Labella *et al.*, 2017); along with the use of cleaner technologies, energy efficiency and renewable energy (Sala *et al.*, 2017), as well as better resource management, material flows (Salomone *et al.*, 2016) and recycling (Salemdeeb *et al.*, 2017).

The use of recycled packaging and materials has increased in recent years although its implementation is still very low (Ivanković *et al.*, 2017), despite a concerted awareness campaign to help its adoption (Verghese and Lewis, 2007). Our results show that it is carried out by 66% of Group 2 companies and 54.2% of Group 1 companies, in line with García-Granero *et al.* (2020) where most of the companies are SMEs, which show less propensity for EI, especially in the use of recyclable packaging.

With respect to the companies that carry out EI initiatives, the high percentage of companies in Group 2 (89%) that say they do so stands out, exhibiting a close direct relationship between the two variables, this figure being considerably lower in the companies that export less (58%). The results presented by Carrillo-Labella *et al.* (2017) disagree with ours, as they show that companies belonging to the Spanish olive sector show little voluntary environmental commitment, despite the requirements set out by foreign markets.

The results also reveal that more than 65% of the companies in Group 2 express a great interest in controlling inputs using ICT technologies, with lower figures for companies that export less. The use of ICTs acts as a tool highly valued by companies, as it can help them along the EI journey by providing a user-friendly system (Buttol *et al.*, 2012), playing a key role in providing growers with input information (Kante *et al.*, 2016).

Regarding collaboration with universities and research centres, we find that 77.7% of the most export-oriented companies (Group 2), state that

they do this when undertaking innovation actions. These results are in line with other studies that consider EI as a source of opportunities for exports through cooperation (Constantini *et al.*, 2018). Also Chiarvesio *et al.* (2015) and Doloreux and Kraft (2019) found that collaboration with research centers and universities is a variable used to measure EI since it allows smaller companies to access the necessary resources and increases the environmental knowledge to promote eco-innovations. In this line, Triguero *et al.* (2013) have found that universities and public research institutions are the main contributors to improving firms' EI performance. In this sense, EI requires more external sources of knowledge and information from universities than conventional innovation because the knowledge used in eco-innovation is more multidisciplinary than the knowledge needed in other innovations (Rennings and Rammer, 2011).

In terms of the control variables, age and educational level of the managing director, we find that age is a decisive factor, with the average age of the manager being above 53 years in the most export-oriented companies. It can therefore be deduced that experience influences the decision to export, unlike other studies such as Manolova *et al.* (2002), which concluded that there was no relationship with age. Although they do agree with these studies when it comes to the level of education, it is surprising that the size of the company (workforce and income) does not affect the relationship between EX and EI, unlike Triguero *et al.* (2017) where size plays a key role. In our case, this may be due to the fact that in the agro-food auxiliary companies, rather than depending on size (Chiarvesio *et al.*, 2015), the type of activity the company engages in will have an influence, since we find companies at different technological levels.

Our results also show that the gender of the managing director is not a limiting factor in the relationship between EX and EI, contrary to Galbreath (2019), Horbach and Jacob (2018), who identified a positive correlation between these variables, especially when managing directors are women. This may be because they demonstrate greater sensitivity to the natural environment, having higher moral and ethical standards than men (Galbreath, 2019) in innovative decision-making (Kassinis *et al.*, 2016).

6. Conclusions

The main objective of the study is to illustrate the factors that relate export performance to eco-innovation in the agro-food auxiliary companies. To this end, an empirical study has been carried out, taking Southeastern Spain as a reference, by means of a multivariate analysis using cluster methodology.

The results obtained show that export performance is one of the driving factors behind the increase in eco-innovative activity. This is evident in the degree of importance given to the control of inputs through ICT, when collaborating with universities and research centres and regarding the importance given to action taken that reduces environmental damage. However, it can also be seen that when companies spend more on EI, the impact of exports decreases considerably. This is similar for the use of recycled packaging, since companies report that it tends to be of interest as an innovation which improves environmental performance, but is not yet seen as a key export driver.

On the other hand, the group of less export-oriented companies is smaller in terms of both turnover and number of employees, as well as having less export experience. They show a lack environmental awareness, little commitment to reducing environmental damage and no control of inputs through ICT.

The analysis on the EX-EI relationship helps to guide companies around the factors that can help their international development strategy and the implementation of certain eco-innovative actions that improve environmental practices. The results also have certain repercussions and implications for policy makers, as they can help them to define environmental policies that promote greater sustainability in the agro-food activity.

Nevertheless, this study is not without its limitations, in particular, as it only examines agro-food auxiliary companies in Southeastern Spain, and it would be advisable to extend it to other regions or areas specialising in this activity. Futhermore, possible changes in incomes and exports before and after the introduction of eco-efficient

methods could be also an interesting future line of research. The results show the need for further research that includes other quantitative variables to measure the EX-EI interrelationship in the agro-food sector, allowing the generalisation of the results and assisting in the strategy and decision-making of company managing directors.

Acknowledgements

The authors would like to thanks for the support received from Tecnova Technological Centre and the Project SmartRed NO. UAL 2020-SJ-DO26 (UAL/Consejería E.C.E. y Universidad, Junta Andalucía/FEDER), "Adapting Intermodal Transport of perishables within an intelligent supply chain".

References

Alexandratos N., Bruinsma J., 2012. *World Agriculture Towards 2030/2050*. ESA Working Paper no. 12-03. Rome: FAO Agricultural Development Economics Division.

Arfaoui M., Erraach Y., Boudiche S., 2022. The performance of the Tunisian olive oil exports within the new distribution of world demand. *New Medit*, 21(2): 17-30.

Baamonde E., 2009. El cooperativismo agroalimentario. In: Lamo de Espinosa J. (ed.), *Mediterráneo Económico*. *El nuevo sistema agroalimentarioen una crisis global*. Almería: Fundación Cajamar, 15, pp. 229-246.

Barth H., Ulvenblad P.-O., Ulvenblad P., 2017. Towards a conceptual framework of sustainable business model innovation in the agri-food sector: A systematic literature review. *Sustainability*, 9(9): 1620.

Bianchi C., Carneiro J., Wickramasekera R., 2018. Internationalisation commitment of emerging market firms: A comparative study of Chile and Brazil. *Journal of Small Business and Enterprise Development*, 25(2): 201-221.

Bıçakcıoğlu-Peynirci N., Hizarci-Payne A.K., Özgen Ö., Madran C., 2020. Innovation and export performance: a meta-analytic review and theoretical integration. *European Journal of Innovation Management*, 23(5): 789-812.

Brunel C., 2019. Green innovation and green Imports:Links between environmental policies, innovation, and production. *Journal of Environmental Management*, 248: 109290.

Buttol P., Buonamici R. Naldesi L. Rinaldi C., Zamagni A., Masoni P., 2012. Integrating services and tools in a ICT platform to support eco-innovation in SMEs. *Clean Technologies and Environmental Policy*, 14: 211-221.

Capitanio F., Coppola A., Pascucci S., 2009. Indications for drivers of innovation in the food sector. *British Food Journal*, 111(8): 820-838.

Carrillo-Labella R., Fort F., Parras-Rosa M., Murgado Armenteros E.M., 2017. Determining factors of voluntariness in sustainable environmental innovation (eco-processes) and their certification: Agri-food sector. In: Loue C., Ben Slimane S. (eds.), *Proceedings of the 12th European Conference on Innovation and Entrepreneurship*, 21-22 September, Paris, France. Sonning Common: Academic Conferences and Publishing International Ltd, pp. 125-132.

Chiarvesio M., De Marchi V., Di Maria E., 2015. Environmental Innovations and Internationalization: Theory and Practices. *Business Strategy and the Environment*, 24(8): 790-801.

Choi H., Yi D., 2018. Environmental innovation inertia: Analyzing the business circumstances for environmental process and product innovations. *Business Strategy and the Environment*, 27(8): 1623-1634.

Constantini V., Crespi F., Paglialunga E., 2018. The employment impact of private and public actions for energy efficiency: Evidence from European industries. *Energy Policy*, 119(C): 250-267.

Contractor F.J., Hsu C.C., Kundu S.K., 2005. Explaining export performance: a comparative study of international new ventures in Indian and Taiwanese software industry. *Management International Review*, 45: 83-110.

de Jesus Pacheco D.A., ten Caten C.S., Jung C.F., Ribeiro J.L.D., Navas H.V.G., Cruz-Machado V.A., 2017. Eco-innovation determinants in manufacturing SMEs: Systematic review and research directions. *Journal of Cleaner Production*, 142(4): 2277-2287.

do Canto N.R., Bossle M.B., Vieira L.M., De Barcellos M.D., 2021. Supply chain collaboration for sustainability: a qualitative investigation of food supply chains in Brazil. *Management of Environmental Quality*, 32(6): 1210-1232.

Doloreux D., Kraft L.A., 2019. Taxonomy of Eco-Innovation Types in SMEs: Exploring Different Firm Profiles in the Canadian Wine Industry. *Sustanaibility*, 11(20): 5776.

Doran J., Ryan G., 2016. The importance of the diverse drivers and types of environmental innova-

tion for firm performance. *Business Strategy and the Environment*, 25(2): 102-119.

Drejeris R., Miceikienė A., 2018. Multi-criteria measurement of sustainable innovativeness in farming organisations: Evidence from Lithuania. *Sustainability*, 10(9): 3347.

Esposito B., Sessa M.R., Sica D., Malandrino O., 2020. Towards circular economy in the agri-food sector. A systematic literature review. *Sustainability*, 12(18): 7401.

Evans J., Mavondo F.T., Bridson K., 2008. Psychic Distance: Antecedents, Retail Strategy Implications, and Performance Outcomes. *Journal of International Marketing*, 16(2): 32-63.

Fonfría A., 1997. *Factores tecnológicos y estructurales explicativos de la internacionalización de las empresas innovadoras*. Instituto de Análisis Industrial y Financiero. Documento de Trabajo n. 4.

Freixanet J., 2014. Innovation and internationalization: relationship and implications for management and public policy. *International Journal of Entrepreneurial Knowledge*, 2(2): 57-75.

Galbreath J., 2017. The impact of board structure on corporate social responsibility: A temporal view. *Business Strategy and the Environment*, 26(3): 358-370.

Galbreath J., 2019. Drivers of green innovations: The impact of export intensity, women leaders, and absorptive capacity. *Journal of Business Ethics*, 158(1): 47-61.

Galdeano-Gómez E., Aznar-Sánchez J.A., Pérez-Mesa J.C., Piedra-Muñoz L., 2017. Exploring synergies among agricultural sustainability dimensions: An empirical study on farming system in Almería (Southeast Spain). *Ecological Economics*, 140: 99-109.

Galera-Quiles M.C., Piedra-Múñoz L., Galdeano-Gómez E., Carreño-Ortega A., 2021. A review of Eco-innovations and exports interrelationship, with special reference to international agrifood supply chains. *Sustainability*, 13(3): 1378.

García-Granero E.M., Piedra-Muñoz L., Galdeano-Gómez E., 2020. Multidimensional Assessment of Eco-Innovation Implementation: Evidence from Spanish Agri-Food Sector. *Intenational Journal of Environmental Research and Public Health*, 17(4): 1432.

Glick W.H., Huber G.P., Miller C.C., Doty D.H., Sutcliffe K.M., 1990. Studying changes in organizational design and effectiveness: Retrospective event histories and periodic assessments. *Organization Science*, 1(3): 293-312.

Gómez-Bolaños E., Hurtado-Torres N.E., Delgado-Márquez B.L., 2020. Disentangling the influence of internationalization on sustainability development: Evidence from the energy sector. *Business Strategy and the Environment*, 29(1): 229-239. https://doi.org/10.1002/bse.2360.

Goossens Y., Berrens P., Charleer L., Coremans P., Houbrechts M., Vervaet C., De Tavernier J., Geeraerd A., 2017. Qualitative assessment of eco-labels on fresh produce in Flanders (Belgium) highlights a potential intention-performance gap for the supply chain. *Journal of Cleaner Production*, 140, part 2: 986-995.

Hair J.F., Black C.W., Babin J.B., Anderson E.R., Tatham L.R., 2006. *Multivariate Data analysis*. London: Pearson.

Hall J., 2006. Environmental supply chain innovation. In: Sarkis J. (ed.), *Greening the supply chain*. Berlin: Spinger.

Horbach J., Jacob J., 2018. The relevance of personal characteristics and gender diversity for (eco-)innovation activities at the firm-level: Results from a linked employer-employee database in Germany. *Business Strategy and the Environment*, 27(7): 924-934.

Ivanković A., Zeljko K., Talić S., Martinović-Bevanda A., Lasić M., 2017. Biodegradable packaging in the food industry. *Journal of Food Safety and Food Quality*, 68(2): 26-38.

Jin S., Scheepens A.E., 2016. Evaluating the sustainability of Vietnamese products: The potential of 'designed in Vietnam' for Vietnamese vs. Dutch markets. *International Journal of Technological Learning, Innovation and Development*, 8(1): 70-110.

Kante M., Oboko R., Chepken C., 2016. Factors affecting the uso of ICTs on agricultural input information by farmer in developing countries. *AIMS Agriculture and Food*, 1(3): 315-329.

Kassinis G., Panayiotou A., Dimou A., Katsifaraki G., 2016. Gender and environmental sustainability: A longitudinal analysis. *Corporate Social Responsibility and Environmental Management*, 23(6): 399-412.

Keshminder J.S., Chandran V.G.R., 2017. Eco-innovation in the chemical manufacturing firms: Insights for policy response. *Institutions and Economies*, 9(1): 21-42.

Kobrich C., Rehman T., Khan M., 2003. Typification of farming systems for constructing representative farm models: Two illustrations of the application of multi-variate analyses in Chile and Pakistan. *Agricultural Systems*, 76(1): 141-157.

Kulak M., Nemecek T., Frossard E., Gaillard G.,

2016. Eco-efficiency improvement by using integrative design and life cycle assessment. The case study of alternative bread supply chains in France. *Journal of Cleaner Production*, 112: 2452-2461.

Kuswardhani N., Soni P., Shivakoti G.P., 2014. Cluster analysis for classification of farm households based on socio-economic characteristics for technology adoption in agriculture: A case study of West Java province, Indonesia. *Journal of Food, Agriculture & Environment*, 12(1): 238-247.

Lawson B., Krause D., Potter A., 2015. Improving supplier new product development performance: the role of supplier development. *Journal of Product Innovation Management*, 32(5): 777-792.

Manolova T.S., Brush C.G., Greene P.G., 2002. Internationalization of Small Firms: Personal Factors Revisited. *International Small Business Journal*, 20(1): 9-30.

Mao X., 2022. Place-specific product relatedness and the environmental performance of non-polluting exports in China. *Environmental Science and Pollution Research*, 29: 24863-24877. https://doi.org/10.1007/s11356-021-17656-3.

Máté-Balogh J., Jámbor A., 2020. The Environmental Impacts of Agricultural Trade: A Systematic Literature Review. *Sustainability*, 12(3): 1152.

Menon A., Bharadwaj S.G., Howell R., 1996. The quality and effectiveness of marketing strategy: Effects of functional and dysfunctional conflict in intraorganizational relationships. *Journal of Academy of Marketing Science*, 24(4): 299-313.

Muñoz-Pascual L., Curado C., Galende J., 2019. The Triple Bottom Line on Sustainable Product Innovation Performance in SMEs: A Mixed Methods Approach. *Sustainability*, 11(6): 1689.

Notarnicola B., Tassielli G., Renzulli P.A., 2012. Modeling the agri-food industry with life cycle assessment. In: Curran M.A. (ed.), *Life Cycle Assessment Handbook*. New York: Wiley, pp. 159-184.

Petruzzella D., Antonelli A., Brunori G., Jawhar J., Roma R., 2020. Innovation ecosystems for youth agrifood entrepreneurship in the Mediterranean region. *New Medit*, 19(4): 99-115.

Piedra-Muñoz L., Godoy-Durán Á., Giagnocavo C., 2017. How to Improve Water Usage Efficiency? Characterization of Family Farms in A Semi-Arid Area. *Water*, 9(10): 785.

Pozzobon Palma E., Maffini Gomes C., Kruglianskas I., Marques Kneipp J., Barbieri da Rosa L.A., Frizzo K., 2018. Relationship between sustainable strategies and export performance: An analysis of companies in the Brazilian gems and jewelry industry. *Environmental Quality Management*, 27(4): 97-106.

Reisch L., 2013. The role of sustainable consumption in fostering a fundamental transformation of agriculture. In: Hoffmann U., Grothaus F., Bhalla P. (eds.), *Trade and Development Review 2013. Wake up before it is too late: Make agriculture truly sustainable noe for food security in a changing climate*. Geneva: United Nations University Press, pp. 95-101 (Trade and Environment Review).

Rennings K., Rammer C., 2011. The impact of regulation-driven environmental innovation on innovation success and firm performance. *Industry and Innovation*, 18(3): 255-283.

Rodríguez J., Wiengarten F., 2017. The role of process innovativeness in the development of environmental innovativeness capability. *Journal of Cleaner Production*, 142: 2423-2434.

Sala S., Anton A., McLaren S.J., Notarnicola B., Saouter E., Sonesson U., 2017. In quest of reducing the environmental impacts of food production and consumption. *Journal of Cleaner Production*, 140: 387-398.

Salemdeeb R., Zu Ermgassen E.K.H.J., Kim M.H., Balmford A.P., Al-Tabbaa A., 2017. Environmental and health impacts of using food waste as animal feed: A comparative analysis of food waste management options. *Journal of Cleaner Production*, 140: 871-880.

Salomon R.M., Shaver J.M., 2005. Learning by exporting: new insights from examining firm innovation. *Journal of Economics & Management Strategy*, 14(2): 431-460.

Salomone R., Saija G., Mondello G., Giannetto A., Fasulo S., Savastano D., 2016. Environmental impact of food waste bioconversion by insects: Application of Life Cycle Assessment to process using Hermetia illucens. *Journal of Cleaner Production*, 140: 890-905.

Setyaningsih S., 2012. Using cluster analysis study to examine the successful performance entrepreneur in Indonesia. *Procedia Economics and Finance*, 4: 286-298.

Shearmur R., Doloreux D., Laperrière A., 2015. Is the degree of internationalization associated with the use of knowledge intensive services or with innovation?. *International Business Review*, 24(3): 457-465.

Silalertruksa T., Gheewala S.H., Pongpat P., Kaenchan P., Permpool N., Lecks N., 2017. Environmental sustainability of oil palm cultivation in different regions of Thailand: Greenhouse gases and water use impact. *Journal of Cleaner Production*, 167: 1009-1019.

Sorroche-del-Rey Y., Piedra-Muñoz L., Galdeano-Gó-

mez E., 2022. Interrelationship between international trade and environmental performance: Theoretical approaches and indicators for sustainable development. *Business Strategy and the Environment* (in press). https://doi.org/10.1002/bse.3270.

Sousa C.M.P., Martínez-López F.J., Coelho F., 2008. The determinants of export performance: A review of the research in the literature between 1998 and 2005. *International Journal of Management reviews*, 10(4): 343-374.

Sung B., Yeom M., Kim J., 2017. Eco-efficiency of government policy and exports in the bioenergy technology market. *Sustainability*, 9(9): 1549.

Tolón-Becerra A., Lastra Bravo X., Fernández Membrive V.J., 2013. Huella hídrica y sostenibilidad del uso de los recursos hídricos. Aplicación al Poniente Almeriense. Estudios previos y medidas de eficiencia. *M+A. Revista Electrónic@ de Medio Ambiente*, 14(1): 56-86.

Triguero A., Cuerva M.C., Álvarez-Aledo C., 2017. Environmental Innovation and Employment: Drivers and Synergies. *Sustainability*, 9(11): 2057.

Triguero A., Moreno-Mondéjar L., Davia M.A., 2013. Drivers of different types of eco-innovation in European SMEs. *Ecological economics*, 92: 25-33.

Tukker A., Huppes G., Guinée J., Heijungs R., de Koning A., van Oers L., Suh S., Geerken T., Van Holderbeke M., Jansen B., Nielsen P., 2006. *Environmental Impact of Products (EIPRO). Analysis of the Life Cycle Environmental Impacts Related to the Final Consumption of the EU-25*. European Commission, Joint Research Centre (JRC), Institute for Prospective Technological Studies (IPTS).

Valdiviezo G.S., 2012. *Los determinantes de innovación de la conducta exportadora en España y México.* Tesis doctoral, Universidad Complutense de Madrid, Madrid.

Valls Bedeau J., Rezaei M., Pera M., Morrison J., 2021. Towards food systems transformation in the Mediterranean region: Unleashing the power of data, policy, investment and innovation. *New Medit*, 20(3): 5-16.

Van Bommel H.W., 2011. A conceptual framework for analysing sustainability strategies in industrial supply networks from an innovation perspective. *Journal Cleaner Production*, 19: 895-904.

Verghese K., Lewis H., 2007. Environmental innovation in industrial packaging: A supply chain approach. *International Journal of Production Research*, 45(18-19): 4381-4401.

Zailani S., Jeyaraman K., Vengadasan R., Premkumar R., 2012. Sustainable supply chain management (SSCM) in Malaysia: A survey. *International Journal of Production Economics*, 140(1): 330-340.