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Internationalization and open innovation in SMEs from the horticultural sector in Colombia

Internacionalización e innovación abierta en PYMES
del sector hortofrutícola en Colombia

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Abstract

This study empirically assesses the relationship between open innovation, exploration, and exploitation activities in the context of the internationalization process of SMEs in the fruit and vegetable sector from Northern Valle del Cauca, Colombia. Considering that SMEs generally lack the resources and skills to arrange the entire innovation process, they must be open to external sources to innovate and seek internationalization strategies. The exercise has been based on a sample of 102 SMEs and the determination of a partial least squares structural equation model (PLS-SEM) to test a series of research hypotheses. The findings confirm a positive and significant relationship between exploration and exploitation activities with open innovation, with this relationship being much more robust in exploitation activities. However, a relationship between open innovation and internationalization could not be verified. These findings suggest that internationalization is not a consequence of open innovation but instead finds enablers in public policies and the consolidation of the National Agricultural Innovation System (NAIS) regarding the case discussed here. In the literature, there is a lack of studies in the field of research.

Keywords: Open innovation; Internationalization; SMEs; Exploration; Exploitation.

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Resumen

El presente estudio evalúa de manera empírica la relación entre la innovación abierta, las actividades de exploración y explotación en el contexto del proceso de internacionalización de las PYMES del sector hortofrutícola del Norte del Valle del Cauca en Colombia. Teniendo en cuenta que las PYMES generalmente carecen de los recursos y las competencias para organizar todo el proceso de innovación, deben estar abiertas a fuentes externas para innovar y buscar estrategias de internacionalización. El ejercicio se ha basado en una muestra de 102 PYMES y la determinación de un modelo de ecuación estructural de mínimos cuadrados parciales (PLS-SEM) para probar una serie de hipótesis de investigación. Los hallazgos confirman que existe una relación positiva y significativa entre las actividades de exploración y explotación con la innovación abierta, siendo mucho más fuerte esta relación en las actividades de explotación. No obstante, no se pudo comprobar una relación entre la innovación abierta y la internacionalización. Estos hallazgos sugieren que la internacionalización no es una consecuencia de la innovación abierta; sino que encontraría dinamizadores en las políticas públicas y la consolidación del Sistema Nacional de Innovación Agrícola (SNIA), para el caso aquí tratado. En la literatura se evidencia una escasez de estudios frente al campo de investigación.

Palabras Clave: Innovación abierta; Internacionalización; PYMES; Exploración; Explotación.

1. Introduction

Developing countries are trying to boost their horticultural industry to increase export earnings and benefit rural communities. The horticultural industry is a strategic sector for the productive development of Colombia. According to Asohofrucol (2019), this sector accounts for 17% of the country's total agricultural sector production. Between 2010 and 2019, the planted area had a sustained average growth of 3% per year. The departments with the highest participation in the sector are Antioquia (11%), Santander (10%), Meta (8%), Arauca (7%), Valle del Cauca (7%), and Cundinamarca (6%), which gather 49% of the total production (Asohofrucol, 2019).

Asohofrucol (2019) points out that in terms of exports, they totaled more than 264 thousand tons in 2019, and transactions' worth amounted to more than 409 million dollars, a 14% increase compared to 2018.

The main products in terms of exported volume in 2019 were banana (39%), avocado (15%), prepared or preserved mangoes (8%), other edible fruits (7%), cape gooseberries (6%), and fresh mangoes (5%). These six products account for 80% of total sales. The central destination countries for those exports are the United States (32%), the United Kingdom (18%), the Netherlands (15%), Belgium (5%), and Spain (4%) (Asohofrucol, 2019). These reasons, among others, offer an understanding of the particular interest that the government has placed in designing public policies that promote this sector's activities.

Although the horticultural sector is considered strategic in developing countries, obstacles prevail derived from the scarcity of financial and human resources, the degradation of natural resources, an uncertain climate, and a very dynamic panorama of markets and consumer demands (Dehnen-Schmutz, Holdenrieder, Jeger, and Pautasso, 2010). These and other difficulties can be overcome by forming networks to benefit from shared knowledge and enhanced capabilities, two fundamental vectors in open innovation.

Indeed, open innovation is defined as the set of efforts deployed by SMEs to seek knowledge and innovate beyond their organizational limitations (Chesbrough, 2003). The objective of open innovation is to open the innovation process to other organizations in order to explore and exploit knowledge flows both inside and outside (Santoro, Vrontis, Thrassou, and Dezi, 2018). Several studies have regarded exploration and exploitation as antecedents of open innovation; however, few have focused on horticultural sector managers' exploration and exploitation activities as determinants of open innovation (Ali, Ali, Malik, Hamza, and Ali, 2020).

Therefore, managers should explore new options and exploit their resources and internal knowledge to lead the horticultural sector to adopt an open innovation approach into its processes and make SMEs more profitable and competitive in international markets. Moreover, since SMEs generally lack the resources and competencies to arrange their entire innovation process, they

must be open to external sources to innovate and internationalize (Ferraris, Santoro, and Papa, 2018).

Nevertheless, it is necessary to point out that some researchers (Santoro, Mazzoleni, Quaglia, and Solima, 2019) sustain that internationalization and open innovation have been analyzed under the fact that innovation activities affect company capacity for international expansion. One of the responses to this finding comes from Love and Roper (2015), who argue that innovation ecosystems and National Innovation Systems (NIS) are needed where there are SME public policies to stimulate innovation and internationalization. However, other researchers (Battisti, Gallego, Rubalcaba, and Windrum, 2015; Kumar, 2009; Yi, Wang, and Kafouros, 2013) did not find a causal relationship between the two variables.

This study identified a research gap in the analysis of exploration, exploitation, open innovation, and internationalization in horticultural SMEs. The studies in the literature deal with international business theories, which characterize SME internationalization as the ability to exploit competitive advantages and the desire to explore resources that strengthen global company competitiveness (Villar, Pla-Barber, and Ghauri, 2020; Silva, González-Loureiro, and Braga, 2021). Meanwhile, (Lee and Hemmert (2021) pointed out that, in general, the existing literature suggests that innovation activities increase the likelihood of exporting and that exporting SMEs are more prone to innovate.

As already mentioned, horticultural SMEs represent a significant share of the productive vocation in Colombia and Valle del Cauca. Therefore, analyzing this company typology is relevant both for academic research and for political and managerial implications. Consequently, this paper presents the results of a survey aimed at managers of SMEs in the horticultural sector in Valle del Cauca. It seeks to determine whether managers' exploration and exploitation activities affect open innovation in SMEs and if open innovation determines propensity to export. The hypotheses that support this research were tested with the modeling of partial least squares structural equations (PLS-SEM).

Consequently, this paper is structured as follows: initially, the most relevant aspects of the review of the existing literature on concepts of open innovation in SMEs in the horticultural sector will be presented (the relationship between internationalization and open innovation); then, the paper will show how exploration and exploitation influence open innovation; lastly, there will be the development and testing of the model built for this study. In the end, the research conclusions will be presented, clarifying implications for the future and stressing the areas in need of further empirical research as a contribution to the bank of experiences in akin areas of knowledge.

2. Open innovation in SMEs in the horticultural sector

The open innovation model recognizes that smaller companies hold an increasingly prominent role in the contemporary innovation landscape (Van de Vrande, De Jong, Vanhaverbeke, and De Rochemont, 2009). In Chesbrough's early studies (2003), he argues that SMEs begin to adopt open innovation practices to some extent.

Thus, open innovation is relevant for the horticultural inasmuch as, firstly, SMEs represent the most of the business fabric in these activities; consequently, they bring together all the elements that limit their financial, labor, and infrastructure capabilities to innovate autonomously (Van de Vrande *et al.*, 2009). Secondly, horticultural products must be subject to international regulations when meant for exporting and, therefore, innovation must also be subject to international benchmarks. Thirdly, some production processes originate in more traditional methods, making it difficult for these companies' managers to get positioned products to follow market trends (Fortuin and Omta, 2009).

Although the studies on open innovation and the horticultural sector are incipient, most focus on the agricultural sector. Among them, the research by Fielke, Botha, Reid, Gray, Blackett, Park, and Williams (2018) stands out. They recognize that open innovation is contextual, and each actor in the Innovation System (IS) pursues their

own interests due to mistrust prevailing among actors. Joffre, Klerkx, Dickson, and Verdegem (2017) managed to identify that open innovation in the agricultural sector seeks to create better products and new business opportunities, and they also point out that the role of institutions and regulatory frameworks is to guide the behavior of actors within the IS, generating a more reliable context for liaisoning.

As an illustration of the above, Fertő, Molnár, and Tóth (2016) demonstrated that open innovation is a natural practice of these SMEs when studying 300 agricultural SMEs in Hungary. This is because the entire chain behaves like a mature industry where incremental innovations are taking place. Other authors, such as Schut *et al.* (2015), created the Rapid Assessment of Agricultural Innovation Systems (RAAIS) model in Tanzania and Benin and demonstrated that the interactions in an agricultural system present problems in its ability for innovation. For their part, Klerkx and Nettle (2013) sustain that, without strong institutional support for innovation co-production processes, agricultural sector stakeholders are less capable of effectively operating in innovation co-production roles, hence the importance of this study. It lays down some fundamental grounds for constructing an institutional synergy favorable to open innovation in the horticultural sector in Colombia.

3. Open innovation and internationalization in SMEs

In an increasingly globalized world, company internationalization is one of the most critical factors that determine the competitiveness of a country. Lim, Sharkey, and Kim (1991) defined internationalization as a business innovation process because both phenomena unfold in an uncertain environment where information is lacking, and both are carried out to control and minimize risk. Both internationalization and innovation are processes that unfold by stages that develop in incremental steps (Moreno and Casillas, 2014). Regarding SME internationalization, the same encounters barriers and difficulties such as limited resources and international contacts,

unfavorable environmental factors, as well as a lack of information and qualified human resources. In this sense, open innovation can be harnessed to reduce negative factors and thus help SMEs' internationalization efforts.

Open innovation can be a suitable alternative for SMEs to create value, generate new products and processes with external networks at an international level and thus gain access to new international markets. The literature assumes that the relationship between internationalization and innovation is two-way (Moreno and Casillas, 2014) because innovative activities improve a company's productivity and international competitive advantage. This way, innovation, and internationalization may be complementary or substitute strategies (Lee and Hemmert, 2021).

Thus far, there is a shortage of studies that assess the relationship between open innovation and internationalization processes in SMEs (Santoro *et al.*, 2019) in the horticultural sector; therefore, it is in an embryonic state. However, research such as that by Golovko and Valentini (2011) demonstrated that product innovation encourages SMEs' export activities. Zucchella and Siano (2014) demonstrated a positive relationship between innovation and internationalization in a regional SME system in the textile industry.

Currently, the studies by Santoro *et al.* (2019) stand out, who empirically proved a positive relationship between an external knowledge supply strategy and internationalization in 135 SMEs in Europe. Yoon and Ryu (2020) established that international networks are essential for SMEs because they help establish and intensify and optimize international performance. Ryu, Baek, and Yoon (2021) found that technological innovation capacity significantly influences international performance. Moreover, adding to this experience, Lee and Hemmert (2021) determined that SMEs must balance their exploratory and exploitative orientation within and across innovation domains and market reach to improve their performance.

In contrast, there are studies where no positive relationship was found between internationalization and open innovation.

Kumar (2009) found a negative relationship between product innovation and international markets. Battisti, Gallego, Rubalcaba, and Windrum (2015) did not find a positive effect between the intensity of the knowledge supply and foreign sales. On the other hand, Yi, Wang, and Kafouros (2013) showed that internationalization depends on a company's innovative capabilities and its institutional characteristics, the institutional environment, and the location in which it operates. Thus, even in this context, it is still advisable that the NIS and the innovation policy be oriented to promoting and further supporting SME internationalization (Omta and Fortuin, 2013) because external knowledge is not spontaneous; it is the result of public policies and the National Innovation Systems (NIS) of the countries (Chesbrough and Vanhaverbeke, 2018).

Vrontis, Thrassou, Santoro, and Papa (2017) point out that SMEs in the horticultural sector need open innovation to innovate as well as to pursue internationalization strategies. For this reason, the prevailing formulation in this study is that open innovation holds a positive relationship with internationalization because it engages different actors in the innovation process. This can help develop innovative processes and activities that are globally appreciated. Consistent with the above, the following research hypothesis is set forth:

Hypothesis 1: Open innovation positively influences export propensity.

4. Exploration and exploitation activities in SMEs

As concerns this study, open innovation can be understood as the set of practices that allow companies in the horticultural sector to collect ideas from their external environment, unleash those ideas in innovation processes, and, thereby, increase company competitiveness. However, the manager's ability to explore and exploit the available knowledge is essential to collect, systematize, categorize, disseminate and exploit the knowledge that may stem from external sources (O'Connor and Kelly, 2017); without such managerial skills, relevant knowledge is incapable of being generated.

The first theorist to conceptualize exploration and exploitation at the managerial level was March (1991), who considered that exploration is related to search, discovery, variation, risk-taking, experimentation, and flexibility. For March (1991), the essence of exploration is to expand the existing knowledge base through a search for new forms, routines, and organizational systems, experimenting with new approaches and technologies, and adopting a long-term focus, and reconsidering existing beliefs and decisions (Mom, Van Den Bosch, and Volberda, 2009).

On the contrary, according to March (1991), exploitation is related to refinement, choice, production, efficiency, implementation, and execution. The essence of exploitation activities is to build trust through experience and deepen the existing knowledge base in the manager (Mom *et al.*, 2009). The exploitation activities carried out by the administrators include using and perfecting their existing knowledge, its application, improvement, and expansion of existing skills, technologies, processes, and products, focusing on production and under a short-term focus while building on existing beliefs and decisions (Vrontis, Culasso, Giacosa, and Stupino, 2019).

Exploitation activities expand knowledge and reinforce existing skillsets and processes (Jansen, Van Den Bosch, and Volberda, 2006); that is, they refine existing procedures and derive value from what is already known (Evald, Clarke, and Boyd, 2020). Therefore, exploitation is linked to the notion of incremental innovation (Sun, Liu, and Ding, 2020). For its part, exploration is associated with future-oriented activities; as managers develop new capabilities, experiment with new technologies, and seek new customers and markets, they can reach disruptive innovation (Sun *et al.*, 2020).

Exploration and exploitation have generally been studied at the company level (Lubatkin, Simsek, Ling, and Veiga, 2006) or business unit level (Jansen *et al.*, 2006). However, conceptual understanding and empirical validation of exploration and exploitation at the managerial level are lacking (Ali, Ali, Malik, Hamza, and Ali, 2020). In the literature, there are some studies aimed at evaluating

how exploration and exploitation activities influence business performance (Arif and Hasan, 2021), creativity, research, employee development and product innovation (Munoz-Pascual and Galende, 2020), the generation of patents, and the performance of innovation (Park and Seo, 2018), and the degree of innovation (Vrontis *et al.*, 2019). However, studies specific to the horticultural sector are incipient.

Concerning small farmers, exploration activities consist of searching for new ways of doing things to address their problems in communities formed with relatives and neighbors or NAIS actors (Meissner and Carayannis, 2017). On the other hand, exploitation allows horticultural sector managers to adapt to existing environmental requirements, constantly test new alternatives, update processes and technology to meet transformation needs, and improve existing capacities (Sun *et al.*, 2020).

According to the literature, exploration and exploitation impact open innovation (Sun *et al.*, 2020). In the context of the horticultural sector, Zakić, Bugarčić, and Milovanović (2017) found that both exploration and exploitation influence the propensity for open innovation. Cillo, Rialti, Bertoldi, and Ciampi (2019) found that being capable of knowledge exploitation and exploration is an enabler for open innovation strategies in agri-food companies.

This confirms the approach of Perdomo, Farrow, Trienekens, and Omta (2016) in that open innovation offers new ways of producing knowledge and allows the stakeholders to address the contextual and structural challenges faced by small producers. Consequently, per these approaches, the objective of this research is to verify whether the horticultural managers' exploration activities, such as searching, discovering, creating, and experimenting with new opportunities (Mom *et al.*, 2009) and exploitation activities, such as selecting, implementing, improving and refining existing certainties (Mom *et al.*, 2009) play a role in the successful implementation of open innovation. Hence, to support this argument, the following hypotheses were raised.

Hypothesis 2. The manager's exploration activities positively influence open innovation.

Hypothesis 3: The manager's exploitation activities positively influence open innovation.

5. Methodology

This research involves information from 102 SMEs in the horticultural sector of Northern Valle de Cauca, Colombia. The data were collected through a questionnaire prepared and validated on the basis of a careful literature review, the application of which was directed to SME owner-managers and administrators in charge of making critical company decisions as a way to avoid common method bias. Gathering the information took about six weeks.

In order to reach the horticultural sector managers, it was necessary to work together with the National Agricultural Innovation System (NAIS) parties (Aprocol, Asohofrucol, Agrosavia, ELIA, Cattleya, Ministry of Agriculture and Rural Development). Firstly, a pre-test was carried out with ten producers. However, due to the Sars-CoV2 pandemic health emergency, the questionnaire could not be applied in the field, wherefore 90% of the companies answered the questionnaire by phone call and the rest online. As a complement to the above, a cycle of online conferences was held to socialize the instrument. A total of 152 companies participated in the study, but 102 questionnaires were used nevertheless.

The constructs were evaluated using 7-point Likert-type scales ranging from 1 (strongly disagree) to 7 (strongly agree). The Open Innovation scale was created from the Chesbrough principles (2003, p.26) and was measured using ten items. The Export propensity scale addressing was based on Moreno and Casillas (2014) with a dichotomous variable that takes the value one if the company does export and 0 if no exports in 3 years. Regarding the exploration and exploitation variables, the Mom, Van Den Bosch, and Volberda (2009) scale was adapted to the administrators' context with seven items per construct. The exploration

scale determines the extent to which a manager engaged in exploration activities in the last three years, while the exploitation scale determines the extent to which the manager engaged in exploitation activities in the last three years.

Following the conceptual framework for open innovation in SMEs proposed by Lopes and de Carvalho (2018), the model used the following control variables: company size, company age, formalization, range of sales, type of innovation, number of formal and informal employees. In addition, administrator demographics such as educational attainment and gender were included.

The literature yielded descriptive studies mostly, showing how Covid-19 affected global agricultural chains and intensified food insecurity worldwide (Tougeron and Hance, 2021). It also triggered a labor shortage in plantations, decreased sales and production, distribution problems, market performance alterations, and increased phytosanitary measures in exports (Van Hoyweghen, Fabry, Feyaerts, Wade, and Maertens, 2021). Therefore, the dichotomous control variable on the impact (YES/NO) of COVID-19 was included because the pandemic could change producers' perceptions about open innovation. Descriptive results are shown in Table 1.

Table 1. Sample characteristics

Sex	# Persons	Percentage	Type of innovation	# SMEs	Percentage
Female	24	24%	Processes	84	82%
Male	78	76%	Products	9	9%
Grand Total	102		Administrative processes	6	6%
Educational attainment	# Persons	Percentage	Marketing	3	3%
High School Diploma	39	38%	Grand Total	102	100
Elementary School	21	21%	Ranges	# SMEs	Percentage
University	16	16%	Less than one million pesos	41	40%
Technologist	14	14%	Between one and three million pesos	30	29%
Technician	7	7%	Between three and five million pesos	14	14%
Postgraduate	4	3%	More than ten million pesos	8	8%
No educational attainment	1	1%	Between eight and ten million pesos	7	7%
Grand Total	102		Between five and eight million pesos	2	2%
Company age	# SMEs	Percentage	Grand Total	102	100
Over eight years	83	81%	# Employees	# SMEs with formal Employees	# SMEs with Informal Employees
Between 1 and 3 years	7	7%	0	57	18
Between 3 and 5 years	5	5%	1	20	23
Between 5 and 8 years	5	5%	2	11	26
Less than one year	2	2%	3	7	14
Grand Total	102		4	2	6
Any commercial registration?	# SMEs	Percentage	5	1	3

No	81	79%	6	2	4
YES	21	21%	7	0	1
Grand Total	102	100	8	0	1
Belongs to any association?	# SMEs	Percentage	9	1	1
No	20	20%	10	1	1
Yes	82	80%	20	0	1
Grand Total	102	100	30	0	1
Effect of Covid-19	# SMEs	Percentage	48	0	1
No	32	31%	110	0	1
Yes	70	69%	Grand Total	102	102
Grand Total	102	100			
Any exports?	# SMEs	Percentage			
No	84	82%			
Yes	18	18%			
Grand Total	102	100			
Source: Author's own elaboration.					

6. Analysis of results

The statistical processing of the data uses a Partial Least Squares (PLS) model through the SmartPLS software, which allows, from the structural model, to show the relationships between independent variables and dependent variables. The PLS-SEM was used for its predictability capacity at the exploratory level and small sample sizes (Hair, Hult, Ringle, Sarstedt, Castillo, Cepeda, and Roldán, 2019). The first step to validate the model is to analyze the reliability for each factor. The study presents reflective constructs with a factorial load equal to or >0.5 (Hair, Anderson, Tatham, and Black, 1998). However, five open innovation items, two exploitation, and two exploitation items were discarded.

The assessment of the reflective pattern is analyzed through Cronbach's alpha composite reliability index (IFC) and the average variance extracted (AVE) (Table 2). Nunnally and Bernstein (1994) suggest a

minimum value of 0.70 for Cronbach's alpha, while Fornell and Larcker (1981) suggest values above 0.70 for IFC and 0.5 for AVE. For open innovation, the AVE is close to the minimum expected value; however, Fornell and Larcker (1981) point out that if the AVE is less than 0.5, but the composite reliability is greater than 0.6 (CR = 0.812 for open innovation), the convergent validity of the construct is still adequate. It should be noted that the composite reliability of the Export Propensity variable is one because there is only one indicator to it (Hair *et al.*, 2019).

The Fornell and Larcker (1981) criteria and the HTMT matrix are employed to assess the discriminant validity. According to Fornell and Larcker (1981), a construct has discriminant validity if its AVE is greater than the squared correlations between this construct and the others (Table 3). Furthermore, Table 4 presents the relationship of heterotrait-monotrait correlations (Henseler, Hubona, and Ray, 2016) to assess discriminant validity

Table 2. Scale reliability analysis

Items	Correlation coefficient
EXPLOITATION $\alpha = 0.758$; CR = 0.836; AVE = 0.509	
EXPLOT3: Activities in which existing customers are served with existing services or products.	0.600
EXPLOT4: Activities whose handling is clear to you.	0.787
EXPLOT5: Activities focused mainly on achieving short-term goals (One month).	0.676
EXPLOT6: Activities appropriately performed using existing skills.	0.674
EXPLOT7: Activities that can be adjusted to those that already exist in the company.	0.807
SCAN $\alpha = 0.835$; CR = 0.883; AVE = 0.601	
EXPR2: Evaluate various options for products/services, processes, or markets.	0.767
EXPR3: Focus on renewing products/services or processes or markets.	0.762
EXPR5: Activities that require a great ability for adaptation on your part.	0.781
EXPR6: Activities that require learning new skills.	0.768
EXPR7: Activities that do not yet exist in your company.	0.799
OPEN INNOVATION $\alpha = 0.712$; CR = 0.812; AVE = 0.464	
INNA2: We need to work with innovative people inside and outside our company.	0.656
INNA4: The company needs to apply external ideas to complement internal innovation works.	0.644
INNA5: We do not have to produce research to take advantage of it.	0.651
INNA6: To build a good business model, the company needs to harness some ideas obtained from outside the company.	0.690
INNA10: We should buy the knowledge developed by others whenever it represents an advancement for our company.	0.759
EXPORT PROPENSITY $\alpha = 1,000$; CR = 1,000; AVE = 1,000	
PROEXPO1 <-PROPENSITY	1.000
Source: author's own elaboration.	

Table 3. Fornell and Lacker criterion

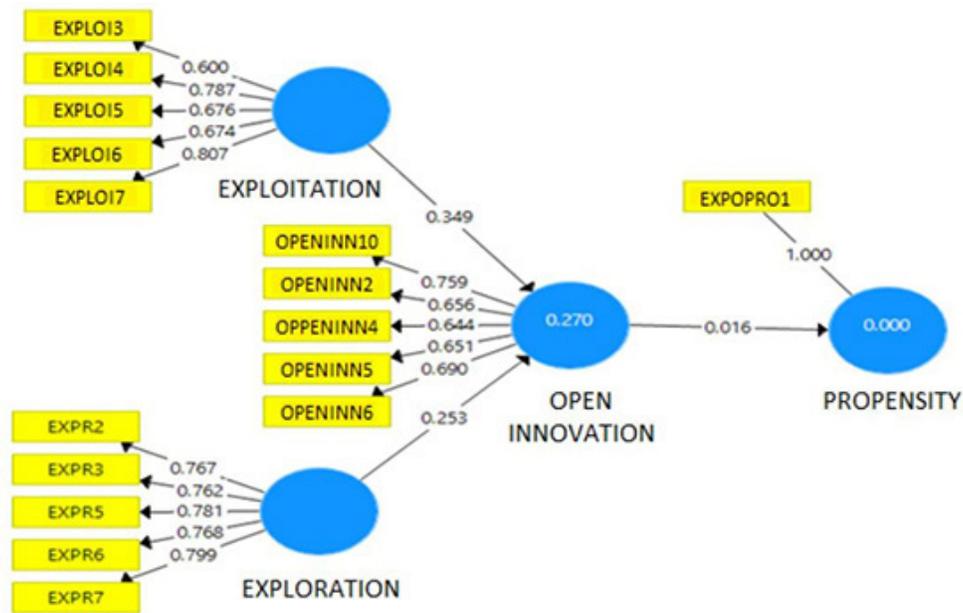
	Exploration	Exploitation	Open innovation	Propensity
Exploration	0.775			
Exploitation	0.477	0.713		
Open innovation	0.419	0.470	0.681	
Propensity	0.087	0.024	0.016	1.000
Source: Author's own elaboration.				

Table 4. HTMT discriminant validity criteria

	Exploration	Exploitation	Open innovation
Exploration			
Exploitation	0.580		
Open innovation	0.529	0.602	
Propensity	0.094	0.097	0.112

Source: Author's own elaboration.

Figure 1. Model with T-Statistics values



Source: Author's own elaboration.

better. If the HTMT value is greater than the HTMT value of 0.90, there is a discriminant validity problem. Discriminant validity was achieved under both criteria. Likewise, the model's Fit is considered acceptable as it meets the SRMR indicator, a goodness-of-fit measure for PLS-SEM that can be used to avoid incorrect model specifications. Although Hu and Bentler (1999) sustain that it should be 0.08, Hu and Bentler (1999), in a more conservative version, accept a value below 0.10 or 0.08. The SRMR for this study is 0.10 and the Chi-Square 269.124.

Once the validity and reliability of the reflective model have been demonstrated, the structural model is assessed (Figure

1). To measure the relationships between variables, the beta coefficient (β) represents the strength of the relationship. For the level of significance, the T-Student test is obtained from a bootstrapping process in SMARTPLS.

Table 5 shows the results obtained through the structural model.

Table 5 shows the results obtained through the structural model. The correlation coefficient expresses the degree of linear dependence between two quantitative variables. The variable that best explains open innovation in SMEs in the horticultural sector is exploration activities, with a level of explanation of 34.9%. Thus, the exploration

Table 5. Hypothesis testing

HYPOTHESIS	Correlation coefficient	Mean	Deviation	T Statistics	P Values	2.5%	97.5%	S/NS
EXPLORATION -> OPEN INNOVATION	0.253	0.257	0.101	2.498	0.013	0.052	0.432	S
EXPLOITATION -> OPEN INNOVATION	0.349	0.373	0.094	3.697	0.000	0.197	0.553	S
OPEN INNOVATION -> PROPENSITY	0.016	0.031	0.123	0.134	0.894	-0.240	0.248	N.S

R2 Open innovation: 0.270; Export propensity: 0.000
S = Hypothesis Corroborated
NS = Hypothesis not corroborated

Source: Author's own elaboration.

activities variable explains 25.3% of open innovation. However, open innovation only explains 1.6% of the propensity to export. On the other hand, , the variation percentage of the response variable that explains its relationship with one or more predictor variables, is 0.270, which means that 27% of open innovation is explained by the manager's exploration and exploitation activities. However, the between open innovation and the propensity to export is 0%.

Lastly, the T-value and the P-value represent the level of significance of the hypothesis, considered significant in this case; the hypothesis is approved with a T-value >1.96 and P-value <0.05. This study demonstrated the positive and direct relationships between exploitation activities and exploration and open innovation, that is, hypotheses 2 and 3. However, it is impossible to corroborate a relationship between open innovation and the propensity to export because it is not statistically significant; therefore, our empirical research does not support hypothesis 1. Likewise, the model was confirmed not affected by any control variable.

7. Discussion

Thus far, research on open innovation has focused on large companies, and there have been few studies on open innovation practices in SMEs, particularly in the horticultural sector. Based on a sample of 102 SMEs from the horticultural sector in Valle

del Cauca (Colombia), it can be concluded, on the one hand, that SMEs in this sector are engaging in open innovation activities; and, on the other, that open innovation does not hold a significant relationship with internationalization. Managers' exploration and exploitation activities positively affect open innovation, and exploitation holds a more significant relationship with open innovation.

Innovation was found as not having a causal relationship with the propensity to export, a finding that coincides with Yi *et al.* (2013), who sustain that this relationship is not uniform but depends on the institutional environment in which the company operates and is context-specific. According to Kenny and Meaton (2007), the public sector is necessarily chiefly accountable for using knowledge. Consequently, the NAIS can influence the relationship between open innovation and internationalization. However, the findings reveal that only 11% of the producers know about the NAIS and, furthermore, these engage with few actors from the NAIS, 60% have engaged with up to three main actors (SENA, ASOHOFrucol, and the Associations). According to these figures, the NAIS is embryonic, and, as stated by Omta and Fortuin (2013), open innovation does not affect internationalization in countries with a weak NIS.

According to Battisti *et al.* (2015), there is the thesis of learning by exporting, and companies do benefit from the technical and managerial experience of foreign companies

or foreign liaisons. In the horticultural sector, exports are carried out by national and international intermediaries, accounting for the production link's 82% level of informality. Therefore, it is believed that SMEs do not associate the benefit of external knowledge (open innovation) with internationalization. In other words, open innovation may not be able to trigger the internationalization process because open innovation involves learning processes (Love and Roper, 2015).

Methodologically speaking, no model proposals were found to study the relationship between SMEs, open innovation, and the propensity to export; thus, our exercise may be regarded as an input in expanding knowledge in this regard. In addition, measuring internationalization as a dichotomous variable based on the model by Moreno and Casillas, 2014 shuts down the possibilities of delving into areas such as the propensity to export and its conditions.

On the other hand, this study showed that manager exploitation and exploration activities positively affect open innovation in companies in the horticultural sector. This finding coincides with other authors, such as Cillo *et al.* (2019), Laursen and Salter (2006), and Aloini, Pellegrini, Lazzarotti, and Manzini, 2015), who found that exploration and exploitation capabilities are relevant to improve SMEs' in the horticultural sector gearing towards open innovation.

This result reflects managers' ability and their ability to search, discover, create and experiment with new opportunities. In this way, SME managers can approach NAIS actors and learn from them. They can also select, implement, improve, and refine existing certainties, which will help them successfully implement open innovation. Exploitation activities were also found more influential because managers in the agricultural sector lean more towards incremental process innovation.

8. conclusions, limitations, and future research

This study showed that a consolidated NAIS is necessary for SMEs in the horticultural sector to engage in internationalization. If

SMEs do not place themselves in ecosystems that help them overcome information asymmetries and the costs of entering export markets, this process will not be successful. In the case of Valle del Cauca, there is a strong presence of multinational companies exporting fruits and vegetables that become the means whereby companies can export. However, foreign companies' influence can negatively impact knowledge management because SMEs do not learn by exporting, which might restrict them from pursuing innovation or export ambitions.

Another obstacle is the cost of internationalization. The research revealed that over 70% of the SMEs in the sector have an income of between 1 and 3 million pesos per month, a meager amount for contemplating expansion activities. In addition, more than half of the producers (59%) of the SMEs have elementary and secondary education. In this way, not having highly qualified workers affects R&D processes and harnessing external knowledge (Harris and Moffatt, 2011).

As for innovation exploitation activities, our data suggest that many SMEs benefit from the initiatives and knowledge acquired by managers. If both variables were reinforced, SMEs' capacity to explore and exploit the knowledge provided by NAIS actors would increase. Meanwhile, most SMEs attempt to engage the SENA, Associations, and Asohofrucol in innovation processes regarding exploration activities. In this way, producers can effectively combine exploitation and exploration to accelerate their innovation capabilities. This can afford companies a competitive advantage to identify new opportunities and improve their relationship with NAIS actors.

Our findings offer essential guidance for managers wishing to understand how internal resources and institutional factors improve export performance. The managers of horticultural SMEs must concentrate their efforts on adapting their strategies to the institutional environment in which their companies operate. Specifically, our research suggests that managers should strive to match competitive resources with various institutional factors, not just improve in acquiring innovation capabilities when

trying to improve export performance. This research confirms that the shift towards an “open innovation” paradigm allows SMEs in the horticultural sector to reduce their need for innovation-related capital investments because business innovation can become accessible.

Furthermore, although our model does not account for the incidence of the Covid-19 control variable, 69% of SMEs were affected by the pandemic, negatively affecting sales, income, generating a decrease in customers and increased costs. According to Chesbrough (2020), open innovation can mitigate this type of impact. The study by Benedek, Balogh, Baráth, Fertő, Lajos, Orbán, and Nemes (2020) reveals that horticultural producers saw advantages during the pandemic in Hungary because they were open enough to learn and make use of the opportunities that modern technology offered them. Likewise, Criado and Guevara-Gómez (2021) demonstrated that citizens cooperated with governments during the pandemic and progressed their innovative capacities, mainly in the digital sphere. Thus, the pandemic could generate an opportunity scenario to reconsider open innovation for the future of food production in Colombia, and the Agricultural Innovation System must be strengthened for that to happen.

The findings pave the way for future research. In order to better understand the relationship between open innovation and internationalization in the horticultural sector, the same must be addressed through quantitative studies and more empirical research in other departments of the country with a high horticultural and export vocation. Also, other variables need to be included: absorption capacity, entrepreneurial orientation, breadth and depth, cultural variables, business performance to account for open innovation.

More studies are needed to increase the knowledge of how horticultural SMEs can successfully work with open innovation in ways that allow them to exploit their current capabilities and, simultaneously, fundamentally explore competencies. On the other hand, to deepen the studies on open innovation and export capacity, the focus

should be placed on their formalization and organization, type of innovation generated, and the benefits accumulated in the company (Huggins and Thompson, 2017; Thompson and Zang, 2020).

This research may interest public policymakers in Latin America and the country because governments could address the limitations that horticultural SMEs face to innovate due to lack of resources. Future research should use data over a more extended period to assess the relationship between innovation and exports as Colombia’s business and institutional environment change. In addition, it must be borne in mind that this study focusing on horticultural SMEs may limit the generalization of the results. Therefore, examining the explanatory power of institutional factors in other emerging countries is a valuable way to expand the theorizing on the relationship between open innovation and internationalization.

9. Conflict of interest

The authors declare no conflict of interest.

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