The value of supply chain integration in the Latin American agri-food industry: trust, commitment and performance outcomes

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Abstract

Purpose – This paper aims to explore the antecedents and performance outcomes of supply chain integration in the agri-food industry in Latin America, a context that the literature on supply chain management has not extensively addressed. The quinoa supply chain, an industry that has encountered a boost in market demand in the past year, is selected as the unit of analysis. Supply chain integration dynamics are analyzed to provide recommendations about integration strategies and benefits in the agricultural sector.

Design/methodology/approach – A conceptual model was designed in this study, which includes the drivers (i.e. trust and commitment) and outcomes (i.e. operational and economic performance) of supply chain integration. The relationships were verified through a unique survey, the data of which were collected from 79 respondents operating at different levels of the Peruvian quinoa supply chain (i.e. suppliers, producers and customers). The proposed hypotheses were tested through the partial least squares (PLS) regression.

Findings – The results underscore the relevance of trust and commitment as enablers of supply chain integration initiatives in the agri-food industry. These factors are particularly essential for involving the farmers who are the most upstream actors in the supply chain and characterized by unstructured organizations. A high level of integration in these types of supply chain enhances the capacity to improve operational performance, which in turns positively affects the main economic indicators.

Originality/value – This study contributes to the discussion of supply chain integration in the agri-food industry, which remains unexplored thus far. It relies on a multitier collection of responses, which is extended to all the levels of the quinoa supply chain, thereby providing the study with a unique depth of analysis. Furthermore, this work contributes to the ongoing discourse on the performance impact of supply chain integration, which several SCM scholars have recently questioned.

Keywords Agri-food supply chain management, Supply chain integration, Supply chain performance

Paper type Research paper

1. Introduction

Supply chain management (SCM) refers to the integration of key business processes from end users to suppliers, providing products, services and information that add value to customers and other stakeholders (Lambert and Cooper, 2000; Mentzer *et al.*, 2001). This definition recognizes the importance of "integration between partners" for a successful SCM, and this topic has been extensively addressed by the SCM literature (e.g. Frohlich and Westbrook, 2001; Richey *et al.*, 2009; Chen *et al.*, 2011; Leuschner *et al.*, 2013; Ralston *et al.*, 2015; Shou *et al.*, 2018; Wiengarten *et al.*, 2019; Mora-Monge *et al.*, 2019).

Flynn *et al.* (2010) define supply chain integration (SCI) as "the degree to which a manufacturer strategically collaborates with its SC partners and collaboratively manages

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intra- and inter-organizational processes, in order to achieve effective and efficient flows of products and services, information, money and decisions, to provide maximum value to the customer." According to this perspective, SCI represents a possible form of collaboration between the actors in the chain, aimed at establishing intrafirm and interfirm connections through the alignment of objectives, information transparency and linkages between process flows (Lii and Kuo, 2016). In modern markets characterized by intense pressure to exceed customer expectations, integration with supply chain partners becomes a critical element for achieving sustained competitive advantages, as the ultimate goal of SCI is to maximize the value delivered to the customers through the facilitation of a seamless flow of materials and information across the supply chain (Kim, 2009; Prajogo and Olhager, 2012).

Several authors have focused on the dynamics of SCI, including different levels of integration (e.g. Wiengarten and Longoni, 2015; Robinson *et al.*, 2018), drivers and enablers (e.g. Richey *et al.*, 2011; Alfalla-Luque *et al.*, 2013; Leuschner *et al.*, 2013; Zhao *et al.*, 2013; Mora-onge *et al.*, 2019) and an extensive discussion of the links between SCI and performance (e.g. Fabbe-Costes and Jahre, 2008; Zhao *et al.*, 2015; Ataseven and Nair, 2017; Feyssa *et al.*, 2019).

Considering the richness of the theoretical and practical findings provided by the literature, SCM scholars are challenged to discover the other aspects that can be discussed about integration in supply chain networks.

Wiengarten *et al.*'s (2019) recent contribution attempts to respond to this challenge by providing additional insights into this topic. The authors raise the question that the principle stating that a "higher SCI equals performance improvement" might not always be true; SCI is a complex and multifaceted process, and the relationship between SCI and performance has different nuances that are connected to several contingent factors, such as the competitive priorities of companies in the network and the nature of the industry. For the former, the recent discussion in the SCM literature is largely focused on the relationship between SCI and the capacity of the supply chain to achieve sustainability objectives (e.g. Brockhaus *et al.*, 2013). The creation of sustainable supply chains requires an alignment of objectives between all the partners in the network, who must operate their processes following shared environmental, social and ethical principles (e.g. Wu, 2013; Herczeg *et al.*, 2018). This process in turn entails a strict integration and interconnection between intracompany processes. Recent studies (e.g. Wiengarten and Longoni, 2015; Shee *et al.*, 2018; Kang *et al.*, 2018) explicitly demonstrate that the development of a certain level of SCI represents a necessary condition for designing and operating in supply chain networks in which profitability and environmental and social effects are balanced.

In connection with this aspect and the aforementioned second factor, the volume of sectoral studies in the SCM literature has grown, specifically research on the role of integration in sustainable supply chains, with consideration of project-based industries such as construction (e.g. Dallsega and Rauch, 2017; Zeng *et al.*, 2018). However, less attention has been given to the agri-food industry where the intense pressure to "be sustainable" in purchasing, production and logistics increases the need for integration with other supply chain members (Beske *et al.*, 2014; Mena *et al.*, 2014). In this context, SCI is difficult to achieve due to environmental uncertainty (e.g. unforeseen climate changes and water scarcity), market complexity (e.g. price volatility and high fluctuations in demand), process complexity (e.g. perishable products, risk of logistical interruptions and limited capacity), need to coordinate between a large set of heterogenous actors (e.g. isolation of producers from markets) and multiple operational and regulation objectives (Jraisat *et al.*, 2013; Bourlakis *et al.*, 2014; Sharma *et al.*, 2017; Dania *et al.*, 2018). Findings on supply chain network integration in the agri-food industry are limited, and they either adopt a theoretical perspective or consider the influence of integration on performance (e.g. Hobbs and Young, 2000; Doukidis *et al.*, 2007; van Donk *et al.*, 2008; Eksoz *et al.*, 2014; Tan *et al.*, 2017; Kumar *et al.*, 2017). Nonetheless, in the agri-food industry, the improvement of the integration of actors in the networks and the identification of the expected benefits are on top of supply chain managers' agenda; in fact, several initiatives favor the increased integration of supply chains, as illustrated by the undertaking of the International Foodservice Manufacturers Association (Pfeiffer, 2017).

A further contribution to the SCI literature could be made by combining the previous aspects to examine integration dynamics in companies. Firms are characterized by competitive priorities (i.e. sustainability) that drive the need to integrate with other supply chain actors within industries such as agri-food, which have been relatively under examined from this viewpoint.

This study therefore considers agri-food supply chains as the unit of analysis to explore the dynamics of partner integration and answer the following research question: *What are the specific drivers of integration between supply chain actors in the agri-food industry, and how do they affect performance?*

We focus on a typology of supply chain, quinoa production and select Latin America as the geographical context; Latin America is a leading region in the production of agri-food commodities, but its investigation in the SCM literature is inadequate (Ruiz-Torres *et al.*, 2012; Fritz *et al.*, 2018). Through the analysis of survey data collected from 79 actors operating in this supply chain, we test the relationships between SCI and its antecedents (i.e. trust and commitment) and the impact on performance (i.e. economic and operational aspects).

The paper is organized into several sections. Section 2 reviews the main literature about SCI and the characteristics of the agri-food industry and supply chain. Section 3 presents the research model and the main hypotheses. Section 4 details the survey characteristics, construct measures and data collection process. Section 5 presents the results of model testing, whereas Section 6 discusses their implications. Finally, Section 7 summarizes the major research contributions and future developments.

2. Theoretical background

2.1 Classification dimensions of supply chain integration

The definition of the level of integration between actors in the network is a critical issue for SCM (Alfalla-Luque *et al.*, 2013; Huang *et al.*, 2014; Zhao *et al.*, 2015; Lii and Kuo, 2016; Qi *et al.*, 2017), as it is able to create advantages over competitors through cost reduction or the creation of superior value for the customer, which is associated with a company's superior performance (e.g. Zhao *et al.*, 2013; Alfalla-Luque *et al.*, 2015; Chang *et al.*, 2016). A highly integrated supply chain allows the attraction, selection and retention of chain members (Huang *et al.*, 2014).

From a theoretical perspective, the SCM literature has defined the concept of SCI from different standpoints, in terms of the breadth (e.g. Flynn *et al.*, 2010; Wong *et al.*, 2011) and depth of the integration (e.g. Leuschner *et al.*, 2013; Wiengarten and Longoni, 2015).

The breadth of the integration refers to its nature: *external* integration occurs between customers and/or suppliers (Huo, 2012; Ataseven and Nair, 2017), whereas *internal* integration transpires between departments (Braunscheidel and Suresh, 2009; Turkulainen and Ketokivi, 2012). Internal integration specifically pertains to the collaboration between various functions of an organization, such as operations, logistics, marketing and sales, to achieve the objectives of the supply chain (Chang *et al.*, 2016; Feyssa *et al.*, 2019). By contrast, external integration denotes the degree to which a company can partner with the key members of the supply chain to structure its interorganizational strategies, practices, procedures and behaviors in integrated, synchronized and manageable processes (e.g. Huo, 2012; Zhao *et al.*, 2013; Cao *et al.*, 2015; Qi *et al.*, 2017). Internal integration should generally precede external integration, as the processes within an organization require an alignment before driving the participation in information exchange and collaboration activities with external partners in the supply chain (Pradabwong *et al.*, 2017; Feyssa *et al.*, 2019).

The depth of the integration also signifies the focus of the collaboration and constitutes three levels: *information*, *operational* and *new product development* (NPD) integration (Liu *et al.*, 2016; Wiengarten *et al.*, 2019). Information integration denotes the sharing of different types of information (e.g. production plans, inventory levels and demand data) across the supply chain to increase visibility (e.g. Somapa *et al.*, 2018; Busse *et al.*, 2017). Operational integration refers to the efforts to improve the interconnections between operational processes across the supply chains, and it includes practices such as vendor-managed inventory, continuous replenishment programs, just-in-time inventory and joint forecasting (e.g. Hill *et al.*, 2018; Singhry and Abd Rahman, 2019). Finally, NPD integration connotes the integration of suppliers and/or customers in the management and execution of internal product development activities (Yan and Dooley, 2014; Lii and Kuo, 2016), to access further sources of knowledge and ensure the improved alignment of the supply chain during the development and launch of innovations (Feng and Wang, 2013).

Authors have often presented their conceptualization of SCI in connection to firm performance (e.g. Leuschner *et al.*, 2013; Mackelprang *et al.*, 2014; Demeter *et al.*, 2016; Shou *et al.*, 2018), mostly with the idea that an increase in integration practices enhances performance (Yu *et al.*, 2013; Chang *et al.*, 2016; Ataseven and Nair, 2017; Kim and Schoenherr, 2018). However, recent contributions have started to question this relationship in terms of nonlinearity and dependency on contextual factors (Zhao *et al.*, 2015; Wiengarten *et al.*, 2019). These contrasting views have intensified the research interest in the possible antecedents for an effective SCI, with the SCM discussion shaped around two classes of drivers: information technologies (e.g. Bruque-Cámara *et al.*, 2016; Vanpoucke *et al.*, 2017; Shee *et al.*, 2018) and relationship characteristics (e.g. Zacharia *et al.*, 2011; Cai *et al.*, 2013; Zhang and Huo, 2013; Tsanos *et al.*, 2014; Mora-Monge *et al.*, 2019).

2.2 Supply chain integration in agri-food supply chains: the case of Latin America

In the past decades, an ample volume of studies have investigated the dynamics of SCI in several manufacturing sectors (e.g. Pati *et al.*, 2016; Sabet *et al.*, 2017), with a growing focus on industries under increasing sustainability pressure, as SCI apparently represents a prerequisite for the achievement of the desired environmental, social and ethical standards. Within this discussion, scant attention has been given to the dynamics of SCI in the agri-food industry (Gold *et al.*, 2017), which is surprising in the context of the SCM characteristics (Anastasiadis and Poole, 2015).

The agricultural sector is currently under intensifying two-fold pressure: first, the demand to be sustainably managed to meet the needs of the present generation without compromising the ability of future generations to achieve their own ends (Rueda *et al.*, 2017), and second, the pressure to provide food, energy and industrial resources to meet the requirements of a growing world population (Borodin *et al.*, 2016). These pressures are amplified by the difficulty of achieving an effective coordination between members in these networks, in which structured and unstructured (e.g. farmers) organizations coexist; furthermore, the focal manufacturing companies need to manage a heterogenous set of relationships (and relationship approaches; Handayati *et al.*, 2015). These factors prompt manufacturing companies to make a key decision: whether to mainly source their basic products from selected intermediary companies – at higher prices but through an easy relationship or to directly procure from farmers – at lower prices and transaction costs as well as a higher quality (Dania *et al.*, 2018). In addition, to secure the supply, suppliers usually request a long-term timeline to ensure business continuity (Beske *et al.*, 2014).

For all these reasons, the capacity to achieve integration among supply chain partners has become pivotal to the success of SCM in the agri-food industry (Sancha *et al.*, 2016). However, actual integration seems to be difficult to achieve due to the abovementioned asymmetric relationships that characterize the agri-food supply chain (e.g. Sanfiel-Fumero *et al.*, 2012).

Exploring this aspect becomes particularly interesting if the focus is on developing countries, such as the ones in Latin America, where the agri-food industry represents one of the most important economies. In these contexts, governments expect the agri-food supply chain to respect and adhere to environmental sustainability standards, support the local economy and generate more and better jobs (Serrano and Pinilla, 2014); meanwhile, international trade and supply chain globalization present a vital challenge to agricultural companies in terms of the appropriate use of finite natural resources (e.g. land; Jabbour and Jabbour, 2014). In many regions, biodiversity is also the basis of food sovereignty, with many local communities that maintain and support agro biodiversity as part of their social and natural heritage (Bedoya-Perales *et al.*, 2018).

To effectively address these contemporary challenges, supply chains need to establish integrated processes between farmers, food processors and distributors, which signifies companies' necessity to collaborate and become increasingly integrated (Gomez-Luciano *et al.*, 2018). These considerations allow for the relevant analysis of the SCI dynamics in this context: on the one hand, connecting the processes of the agri-food supply chain actors represents a challenge; on the other hand, this approach is the primary means of creating alignment, improving efficiencies and delivering high value to both customers and society (Stone and Rahimifard, 2018).

2.3 Research model and hypotheses development

To explore the antecedents and outcomes of SCI in the agri-food supply chains in Latin America, this paper analyzes the conceptual model presented in Figure 1.

At the center of the model is SCI which, in line with Wiengarten *et al.* (2019), incorporates all the investments, mechanisms and practices that actors in the agri-food supply chain can implement to strengthen collaboration, cooperation and coordination and ultimately increase the strategic alignment. The left side of the conceptual model displays the effects of two behavioral antecedents of integration, namely the level of trust and commitment of supply chain partners; these SCI drivers are extensively considered in the literature (e.g. Zhao *et al.*, 2008; Alfalla-Luque *et al.*, 2015; Mora-Monge *et al.*, 2019), although rarely together. Given the unit of analysis in the present study (i.e. agri-food industry in Latin America), the IT drivers are excluded due to the low diffusion in this context.

The right side of the conceptual model includes two types of performance: operational and economic. We contribute to the discussion of the impact of SCI on performance by linking the integration efforts made by actors in the agri-food supply chain to operational performance (e.g. Prajogo and Olhager, 2012; Mackelprang *et al.*, 2014; Bruque-Cámara *et al.*, 2016). To obtain a complete representation of supply chain performance, operational performance resulting from integration is linked to economic performance (e.g. Leuschner *et al.*, 2013). The model relies on four hypotheses that are further analyzed in the succeeding sections.

2.4 Antecedents of supply chain integration

The agri-food supply chain typically comprises different communities with diverse backgrounds and educational characteristics, which necessitates flexibility in

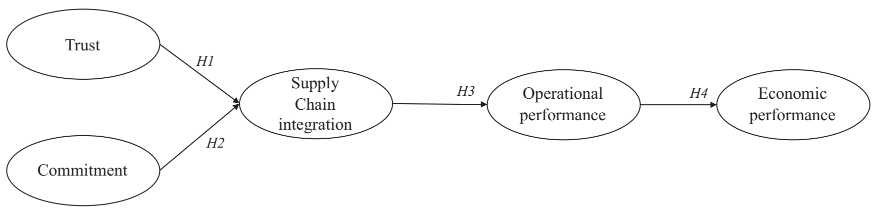

Figure 1. Proposed conceptual model

communication and interaction. In this condition, establishing and nurturing *trust* among farmers, food manufacturers and distributors constitutes a critical element for achieving effective SCM (Dania *et al.*, 2018). Trust can be defined as the "*firms' expectation that their partners will act to benefit their (firms') interests regardless of their ability to monitor such behavior*" (Kwon and Suh, 2005). Trust facilitates the exchange of information between partners by reducing the risk associated with opportunistic behavior (Zhang and Huo, 2013; Wu *et al.*, 2014). Several SCM scholars have indicated that trust is a powerful antecedent of effective supply chain collaboration (e.g. Fawcett *et al.*, 2012; Tsanos *et al.*, 2014; Capaldo and Giannoccaro, 2015), more specifically SCI (e.g. Cai *et al.*, 2010, 2013; Tsanos and Zografos, 2016). Trust is even more important in the context of the agri-food supply chain, considering the natural distrust of farmers to place the products in the hands of a third-party (Jraisat *et al.*, 2013); the major producers' tendency to select reliable entrepreneurial farmers, with established capabilities to run agricultural businesses (Fu *et al.*, 2017), and the extent to which the members' positive reputation can help in attracting other stakeholders in the food supply chain (De Sousa *et al.*, 2018). These arguments reinforce the idea that trust is a relevant antecedent of SCI in agri-food supply chains. Thus, we propose the following hypothesis:

H1. Higher trust between members positively affects the level of integration in the agri-food supply chain.

Commitment is the second behavioral factor considered in the SCM literature. Commitment refers to "*an exchange partner believing that an ongoing relationship with another is so important as to warrant maximum efforts at maintaining it; that is, the committed party believes the relationship endures indefinitely*" (Kwon and Suh, 2005). The presence of commitment drives the implementation of several collaborative initiatives in the supply chain, including better integration between intrafirm processes (Chen *et al.*, 2011; Richey *et al.*, 2011; Bezuidenhout *et al.*, 2012; Wu *et al.*, 2014). As integration implies the exchange of information and interconnection between operational and strategic activities, commitment becomes the prerequisite for assuring both the appropriate level of involvement and obligation from the counterpart and the proper alignment of goals (Tsanos *et al.*, 2014; Zhang *et al.*, 2015). In the agri-food sector, farmers often suffer from uncertainties related to agricultural and food production, which are associated with seasonal changes, logistical interruptions and demand variations that generate fluctuations in the prices of agricultural products (Dania *et al.*, 2018). These factors increase the farmers' reluctance to participate in collaboration and integration initiatives. Supply chains in which manufacturers, cooperatives and wholesalers demonstrate commitment in the relationship with members at all levels of the network, as well as willingness to share the business risks with smallholder farmers, are capable of achieving a higher level of integration. Thus, we formulate the following hypothesis:

H2. Higher commitment between members positively affects the level of integration in the agri-food supply chain.

2.5 Outcomes of supply chain integration

SCI requires investments, as partners in the supply chain need to operate to interconnect processes in the form of information sharing or mutual involvement in operational and strategic activities (Flynn *et al.*, 2010; Wong *et al.*, 2011; Wiengarten and Longoni, 2015; Liu *et al.*, 2016). These efforts are implemented with the aim of influencing several forms of supply operational performance (i.e. quality, delivery, cost and flexibility; Gimenez *et al.*, 2012; Vanpoucke *et al.*, 2017) through better coordination and alignment. Several studies have established either a negative or no relationship (e.g. Flynn *et al.*, 2010; Boonitt and Wong, 2011; Mackelprang *et al.*, 2014) between SCI and performance, thus raising the question on the possible "darkside" of SCI.

Using the Latin American agri-food supply chain as the unit of analysis, we deem that our assumptions fall within the first group of studies. Considering the typical unstructured coordination mechanisms adopted in this context, higher integration is capable of generating a higher capacity to manage environmental variables such as unforeseen climate changes, water shortages, perishable products, price volatility and isolation from market producers (Wong *et al.*, 2011; Bezuidenhout *et al.*, 2012; Jraisat *et al.*, 2013; Fu *et al.*, 2017). This aspect implies that investments in more intensive information sharing, process integration and collaborative NPD can help these supply chains to discover some means of increasing their responsiveness, optimizing inventory levels, synchronizing processes and improving their understanding of market needs. Thus, we posit the following hypothesis:

H3. Higher level of integration in the agri-food supply chain positively affects operational performance.

Improved operational performance is also a driver of enhanced economic performance. Higher production efficiency, market responsiveness and capacity to innovate improve the use of resources (i.e. reduced costs) and the satisfaction of customer needs (i.e. increased sales), which have palpable effects on major economic indicators such as return on investment (ROI) and market share (Zhao *et al.*, 2015). Furthermore, in industries with sustainability as a competitive priority (including the agri-food sector),a supply chain with improved operational excellence as a consequence of higher SCI is capable of reducing the impact of the supply chain on the environment, creating better conditions for employees and enhancing the production and logistics capability to operate within predefined standards (Silvestre, 2015). SCI can ultimately improve the social and environmental footprint and boost the economic and market performance of agri-food companies (Ortas *et al.*, 2014). Thus, we postulate the following hypothesis:

H4. Higher operational performance of an integrated agri-food supply chain positively affects supply chain economic performance.

3. Methodology

To test the relationships in the conceptual model in Figure 1, the analysis of data collected through a survey was selected as an appropriate methodology, as this technique was extensively used in the past to explore issues related to SCI, antecedents and performance (e.g. Zhang and Huo, 2013; Zhao *et al.*, 2013; Mora-Monge *et al.*, 2019). As anticipated, we used the agri-food industry in Latin America as the unit of analysis. Moreover, among the different types of supply chains, we decided to include the quinoa supply chain, as this industry gained worldwide importance in the past decade due to the global increase in market demand for quinoa products, thereby necessitating a higher SCI. This choice does not affect the generalizability of results to the entire industry as, in line with Nakandala *et al.*'s (2017) conclusion, the structure and relationships in different agri-food supply chains are similar.

In the quinoa production scenario, Peru has become one of the most important manufacturing markets globally (Bedoya-Perales *et al.*, 2018; see also Figures A1 and A2 in Appendix for the structure of the quinoa supply chain and data about quinoa production in Peru). To keep up with this growing demand, the introduction of collaboration and integration mechanisms is vital to empower farmers, particularly the ones in communities or cooperatives of low socioeconomic status. As key players in the supply chain, farmers often experience limitations in entrepreneurship orientation, managerial skills and supply chain mindset and largely focus on their own operations instead of forming an integrated collaboration system. A push into more integrated processes could facilitate farmers' access to resources and identify operations improvement opportunities that would benefit all the other stakeholders in the supply chain, which would ultimately improve the quality and availability of quinoa products in the market (Mercado and Ubillus, 2017). In addition, with a higher SCI, actors can improve their ability to handle uncertainties related to agricultural and food production, which are associated with seasonal changes, logistical interruptions and fluctuations in demand, thereby requiring considerable flexibility in supply chain processes. In conclusion, realizing an integration effort between farmers and producers can facilitate access to profitable and high-value markets, while reducing the risks, costs and effects on the environment (Dania *et al.*, 2018).

3.1 Questionnaire design and measures

A questionnaire was designed specifically with the objective to test the conceptual model in Figure 1. It included items that were directly driven by or readapted from the literature (see Table 2).

To measure *trust*, we used three items adapted from Wei *et al.* (2012), Cai *et al.* (2013) and Fu *et al.* (2017). The items asked the respondents about the extent to which supply chain members take decisions considering common benefits, seek common goals and solve problems with coordinating with each other.

To measure *commitment*, we used three items adapted from Tsanos *et al.* (2014) and Fu *et al.* (2017). The items asked the respondents about the extent to which the supply chain members are characterized by willingness to maintain relationship over time and invest in collaboration, as well as commitment to achieve common goals.

To measure SCI, we used four items in line with Wiengarten *et al.* (2019) and Liu *et al.*'s (2016) recommendations. Wiengarten *et al.* (2019) conclude that SCI can be measured through coordinative (i.e. information sharing) and collaborative integration items; these items are conceptualized based on Liu *et al.*'s (2016) four key components: information integration, operational coordination, synchronized planning and strategic partnership. In line with this representation, we asked the respondents about the extent to which the supply chain members share information, promptly solve problems via this visibility, rely on communication plans and collaborate on NPD projects.

To measure supply chain *operational performance*, we included the traditional dimensions of cost, quality and time (in line with Zacharia *et al.*, 2011). We asked the respondents about the extent to which the supply chain is capable of improving production and inventory costs, product performance, product conformity to specification and on-time delivery.

Finally, to measure *economic performance*, we followed Yu *et al.*'s (2013) recommendations. We asked the respondents to rate the extent to which the supply chain is capable of improving its ROI, return on assets and sales growth.

All the survey questions consisted of five-point Likert scales ranging from 1 ("strongly disagree") to 5 ("strongly agree"). In addition to the main constructs in the model, we included two relevant control variables of financial performance, namely *type of supply chain actor* and *company size* (in terms of revenues), which were operationalized through dummy variables.

3.2 Sampling and data collection

Data collection occurred between 2018 and 2019 and entailed the gathering of the perspectives of all the actors in the quinoa supply chain. Information was obtained from suppliers (farmers), producers (processors) and customers (cooperatives, wholesalers, retailers and exporters).

Data were collected in the Andean regions of Peru, mainly located in Puno and Trujillo, between 3,500 and 4,000 m in altitude. Therefore, the use of technology for interviews was limited, and data were collected through the distribution of a paper-based survey. We were able to contact all 180 actors in the quinoa supply chain, but only 79 completed the full survey (43.8% response rate). Table 1 summarizes the characteristics of the sample.

Descriptive	Freq	%	Descriptive	Freq	%
Revenues ($)			*Employees*		
<25,000	45	*57*	<25	70	*88.6*
25–50,000	17	*21.5*	25–50	7	*8.9*
>50,000	22	*27.8*	>50	2	*2.5*
Role in the supply chain			*Respondent's role*		
Producer (processor)	48	*60.7*	Operations	43	*54.4*
Supplier (farmer)	17	*21.5*	Manager/ executive	29	*36.7*
Industrial customer (wholesaler, retailer and exporter)	14	*17.8*	Other type	7	*8.9*
Total	79	*100*		79	*100*

Note(s): Italicized value is the percentage on the total

Table 1. Characteristics of the sample

3.3 Bias control and approach for data analysis

Potential biases were considered in the survey and protocol design and data analysis. Several approaches (e.g. direct contact by phone, multiple mailings and assurance to share the results) were adopted to ensure the highest response rate and avoid a nonresponse bias (Frohlich, 2002). We conducted nonparametric tests to confirm that no significant differences existed in the distribution of company size (number of employees) and in the role in the supply chain. Social desirability was reduced through the assurance of confidentiality and via questions pertaining to the behavior of the organization and its members in general rather than about direct personal behaviors. As the institutional items themselves neither relate to personal behaviors nor performances, they are less likely to be affected by a social desirability bias. Furthermore, the common latent factor technique was applied to address a common method bias (Podsakoff *et al.*, 2003). Through this analysis, we determined that the common latent variable has a linear estimate of 0.531. This value indicates a variance of 0.281, which is below the threshold of 0.50.

To test the research model, the partial least squares (PLS) approach was adopted using the Smart PLS software, supported by a set of robustness checks according to Peng and Lai (2012). This methodology can be considered suitable for exploratory studies with reflective constructs (e.g. Hair *et al.*, 2012, 2014).

The dataset satisfies the criterion that the sample size should be at least 10 times larger than the largest number of structural paths directed at any of the constructs present (Chin, 2010).

4. Findings

4.1 Measurement model

The final measurement model (see Figure 1) consists of five multi-item constructs with 17 indicators and without any relevant cross-loading among different constructs.

Table 2 presents the results of the confirmatory factor analysis (CFA). Convergent validity was assessed through significant loadings from all the scale items on the hypothesized constructs as well as through the average variance extracted (AVE), composite reliability (CR) and Cronbach's alpha (CA) (Anderson and Gerbing, 1988). The CA and CR values range between 0.654 and 0.855, with the suggested threshold being >0.6; moreover, the AVE ranges between 55% and 69%, with the suggested threshold being 50%. Overall, the results confirm the robustness and validity of the construct measurement approach.

As an additional test for discriminant validity (Table 3), we compared the squared correlation between two latent constructs to their AVE estimates (Fornell and Larcker, 1981). According to this test, the AVE for each construct should be higher than the

Constructs	Items (corresponding to the survey questions)	Mean	SD	Loading	CA	CR	AVE
Trust	The decisions are made for the common benefit of all the supply chain partners	3.81	1.07	0.706	0.727	0.845	64.8%
	The promises are kept to seek a common goal through time	3.85	0.97	0.800			
	The problems are solved in coordination with the supply chain partners	3.62	1.25	0.896			
Commitment	The partners of the supply chain seek to maintain their relationship through time	3.80	1.08	0.841	0.747	0.855	66.3%
	The partners of the supply chain are predisposed to collaborate with each other	3.73	1.19	0.849			
	The partners of the supply chain commit and strive to achieve common goals	3.89	1.08	0.749			
Supply chain integration	The partners' information (i.e. inventory, production, delivery, sales and demand forecast data) is shared along the supply chain	3.84	1.16	0.737	0.732	0.832	55.3%
	The problems or difficulties of the partners are promptly addressed through the exchange of information	3.85	1.10	0.726			
	The supply chain partners rely on communication plans	3.82	1.04	0.768			
	The supply chain partners collaborate in the initiatives of new projects	3.74	1.01	0.744			
Operational performance	The supply chain has the capacity to improve production and inventory cost	3.95	0.97	0.685	0.773	0.854	59.5%
	The supply chain has the capacity to boost product performance	3.80	1.12	0.779			
	The supply chain has the capacity to enhance product conformance to design specifications	3.81	1.13	0.805			
	The supply chain has the capacity to improve on-time delivery	3.81	1.16	0.81			
Economic performance	The supply chain has the capacity to boost the return on investment	3.77	1.02	0.726	0.654	0.811	59%
	The supply chain has the capacity to improve the return on assets	3.76	1.05	0.849			
	The supply chain has the capacity to enhance sales growth	3.76	0.98	0.724			

Table 2. Measurement properties of the reflective constructs (CA = Cronbach's alpha; CR = composite reliability; AVE = average variance extracted)

squared correlation between each pair of constructs. This condition is valid for all the constructs.

Finally, discriminant validity was tested through the heterotrait-monotrait (HTMT) ratio as suggested by Henseler *et al.* (2014). Most HTMT ratios were lower than or near the most restrictive threshold of 0.9, indicating good discriminant validity properties (see Table 4).

4.2 Structural model

We assessed the proposed research model by examining the significance of the paths in the structural model. As the PLS method does not directly provide a test of significance and confidence interval estimates of path coefficients, we employed a bootstrap procedure with a bias-corrected interval at 97.5% to generate the t-statistics and standard errors (Kwong-Kay Wong, 2013). Table 5 presents the results of the first model, including the standardized path coefficients, with the significance based on two-tailed *t*-tests.

Model testing confirms our hypotheses: *trust* and *commitment* both have a positive impact on SCI (with $\beta = 0.309$ and $\beta = 0.493$, respectively), which in turn positively affects *operational performance* ($\beta = 0.662$). Finally, higher *operational performance* drives better *economic performance* ($\beta = 0.641$). Any of the control variables has a significant effect on economic performance. The implications of these results are discussed in the succeeding section.

Variables	1	2	3	4	5
1. Trust	*0.805*				
2. Commitment	0.651	*0.814*			
3. Supply chain integration	0.679	0.725	*0.744*		
4. Operational performance	0.645	0.652	0.662	*0.771*	
5. Economic performance	0.688	0.727	0.641	0.641	*0.768*

Note(s): The square root of the average variance extracted (AVE) is shown in italic on the diagonal. Correlations are in the lower triangle of the matrix

Table 3. Correlation matrix

Variables	1	2	3	4	5
1. Trust					
2. Commitment	0.914				
3. Supply chain integration	0.912	0.913			
4. Operational performance	0.868	0.906	0.865		
5. Economic performance	0.911	0.906	0.914	0.875	

Table 4. HTMT results

Dependent variables	Supply chain integration	Operational performance	Financial performance
Independent variables			
Trust	0.309** (2.630)		
Commitment	0.493*** (4.391)		
Supply chain integration		0.662*** (9.739)	
Operational performance			0.641*** (9.658)
Control variables			
Size: <25,000			0.178^{NS} (1.881)
Size: 25–49,999			0.030^{NS} (0.285)
Role: producer			0.201^{NS} (1.610)
Role: supplier			0.014^{NS} (0.126)
R^2	*0.567*	*0.438*	*0.411*

Note(s): ****p*-value < 0.001; ***p*-value < 0.01; **p*-value < 0.05; ^{NS}p-value > = 0.05; the values of *t* statistics are shown in brackets. Italicized values are the *R* square values

Table 5. Path analysis

5. Discussion

Statistical tests confirm the robustness of the theoretical framework and the reliability of each variable. The first two hypotheses (H1 and H2) are strongly supported, and both the hypothesized antecedents – trust and commitment – are the actual drivers of SCI in the quinoa supply chain. Overall, this result is in line with previous contributions focused on the drivers of integration (e.g. Bezuidenhout *et al.*, 2012; Cai *et al.*, 2013; Wu *et al.*, 2014; Tsanos and Zografos, 2016). These factors are identified as the most important relational antecedents for higher integration; however, they represent a unique finding for the agri-food context, in which integration is an issue (Doukidis *et al.*, 2007).

Agri-food supply chains in Latin America are confronted with a growing product demand, and they need to improve the organization of their supply chains to function in a coordinated manner and thus meet new customer expectations. Some actors such as farmers are characterized by informal and unstructured organizations; achieving a high level of trust and displaying a strong willingness to commit are fundamental to the success of integration initiatives. Farmers, processors, intermediaries and exporters need to trust each other and be reassured that all the parties are committed in the relationships when making SCI decisions. In this manner, traditionally adversarial relationships are turned into more long-term and cooperative ones, higher integration can be initiated and actors are able to better interoperate for the achievement of more strategic objectives (e.g. better environmental impact, health provisions and contribution to reducing poverty in the local regions; Jraisat *et al.*, 2013; Bourlakis *et al.*, 2014; Sharma *et al.*, 2017; Dania *et al.*, 2018).

The importance of these behavioral and relational antecedents is typical of the agri-food sector due to the nature of the supply chain, but similarities can also be found in other industries such as construction. In such industries, more upstream actors are characterized by less structured organizations, and trust and commitment aspects (more than formal tools such as information systems) are the key drivers for highly integrated project supply chains (e.g. Khalfan *et al.*, 2007). The agri-food industry shares with the construction sector the presence of government support (Borodin *et al.*, 2016). Governments prefer the maintenance or increase of production quantities, and they can incentivize supply chain actors to develop trustful and committed relationships to enhance integration and implement best practices for a sustainable agriculture (in terms of organic and quality certifications of quinoa grain and the impact of the infrastructure for warehousing and transportation).

Despite being the subject of debate in the SCM literature, the validity of the relationship between SCI and operational performance (H3) is indeed interesting for the context under examination. We are able to demonstrate that in the agri-food sector, SCI can boost the capability of the supply chain to increase operational performance.

According to the previous literature, integration efforts in agri-food supply chains are difficult to establish (Hobbs and Young, 2000; Doukidis *et al.*, 2007; Sanfiel-Fumero *et al.*, 2012); furthermore, the actual outcome of these collaborations is highly variable. In the past decade, the quinoa supply chain has been particularly flourishing in this aspect, as several producers have started working more closely with small farmers and suppliers to improve the management of production, work conditions and environmental risks; provide access to more advanced equipment, tools and better raw materials; deploy sustainable agriculture practices and boost operational performance. Some barriers that limit the interaction between actors, such as low education, diverse cultures and language differences, made these initiatives challenging. However, our evidence indicates that such barriers do not prevent successful integration initiatives to take place. Hence, the quinoa supply chain can be used as a reference for the benefits of SCI and the extension of these practices to other agri-food contexts, which constitutes an SCM challenge (Sancha *et al.*, 2016). The success of SCI is similarly favored by local governments that are investing time to facilitate the integration between small farmers and cooperatives by providing daily consultation and technical assistance to increase the operational excellence of production.

Finally, for the agri-food industry, the enhancement of operational performance contributes to the improvement of economic performance (H4), which is the key factor in convincing actors in supply chains to invest in and support integration initiatives (Ortas *et al.*, 2014; Zhao *et al.*, 2015). Improving operational performance ultimately signifies boosting the productivity and the capacity to serve the market, providing both large and small players with the opportunity to increase their revenues, profits and image via better and more sustainable operations. In the case of Latin America, higher economic performance also denotes that agri-food companies in the Peruvian, Bolivian and Ecuadorian regions – traditionally suffering from lack of capital resources – can now invest in better equipment and infrastructure, which in turn represents more resources to improve the integration with other actors and enhance performance, thus initiating a strong virtuous cycle.

6. Conclusions and future developments

In this paper, we used the quinoa supply chain as the unit of analysis to investigate the antecedents and performance outcomes of partners' integration in the agri-food industry. We developed a research framework connecting trust, commitment, SCI and performance and tested the relationship with a sample comprising 79 actors at different levels of the quinoa supply chain. Our empirical evidence highlighted the positive relationship between trust, commitment and SCI and indicated that higher integration resulted in better supply chain performance (operational and economic). These findings provide significant managerial and theoretical contributions.

6.1 Theoretical contributions

From a theoretical perspective, our study offers four relevant contributions to the SCM literature. First, we provide empirical evidence of the SCI dynamics in an industry – agri-food – to which the recent SCM literature has not dedicated a strong focus (e.g. Hobbs and Young, 2000; Doukis *et al.*, 2007). These supply chains are driven by competitive priorities linked to sustainability, thereby intensifying the need for integration. However, collaboration and integration remain a challenge (Jraisat *et al.*, 2013). From a statistical perspective, our findings demonstrate the value of SCI initiatives in this industry, using the example of a specific supply chain – quinoa – that can be adopted as a benchmark for other agri-food contexts in Latin America (Nakandala *et al.*, 2017).

Second, we contribute to the discussion about the antecedents of SCI (e.g. Chen *et al.* (2011); Chang *et al.*, 2016) by confirming the validity of the role of a specific class of antecedents – trust and level of commitment – in the case of agri-food supply chains. In doing so, we contribute to the recent discourse on the mitigation of the risk of integration initiatives within the context of heterogenous actors and against a background where obtaining trust and committed members is difficult (e.g. Tsanos and Zografos, 2016; Mora-Monge *et al.*, 2019).

Third, we respond to the question raised by Wiengarten *et al.* (2019) regarding the dependence of SCI effects on specific contingencies. In the context of agri-food supply chains, our study demonstrates that SCI contributes to performance improvement both at the operational and economic levels (in line with Tarifa-Fernandez and De Burgos-Jiménez, 2017; and Robinson *et al.*, 2018). Therefore, our contribution is the establishment of a positive and linear relationship for an industry characterized by specific competitive priorities.

Finally, we focus on the Latin American regions where SCM practices are typically unstructured and underdeveloped. This approach is contrary to the SCM literature that traditionally lacks focus on this subject (e.g. Ruiz-Torres *et al.*, 2012; Fritz and Silva, 2018).

6.2 Managerial contributions

Our findings also offer important practical implications. First, our results provide companies in the agri-food industries with evidence of the actual benefits of higher integration with external partners, both in terms of the achievement of operational excellence and the improvement of economic indicators. Managers should invest in information sharing, joint planning and collaborative product development because these efforts are ultimately repaid with higher performance at different levels. These improvements have a considerable relevance, given the agri-food supply chains' influence on sales and quantity exports, as well as on environmental, social and ethical issues. Latin America has a massive potential for improving the agri-food supply chain because some natural areas (e.g. in Andean and Amazon) are conducive to organic crops. A similar relationship between SCI and performance can be found for other types of crops such as coffee, bananas, grapes, blueberries, maca and kiwicha, in which Latin American countries are leaders in the global market. As SCI practices are transforming the production and economy in Latin America, managers should acknowledge that the success of these initiatives is facilitated by trust and commitment; hence, efforts in this direction are likewise required to create the conditions for a collaborative environment.

6.3 Limitations and future developments

The limitations of this study open venues for further research. First, this study measured SCI by adopting the measurement approach of the integration practices undertaken by supply chain members rather than the location of the integration (i.e. with a supplier and/or suppliers). Future studies could expand the scope by introducing alternative measures. Second, as the data were only collected in the quinoa supply chain in Latin America, future studies could test these relationships in other types of agri-food supply chains or other countries. Third, other variables could be added to the model; although the tested model identified trust and commitment as the sole antecedents, additional antecedents such as government support could be included. Finally, our small sample did not allow for testing the model from the perspectives of different actors in the supply chain. Thus, future studies could collect more data and identify the various perceptions of the relationships in the model.

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Further reading

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Appendix

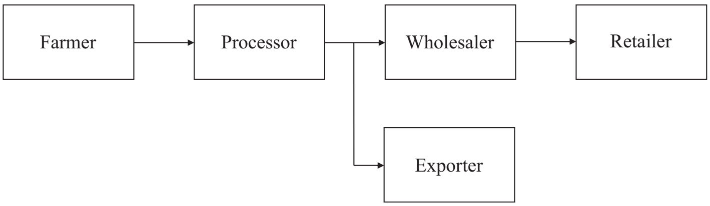
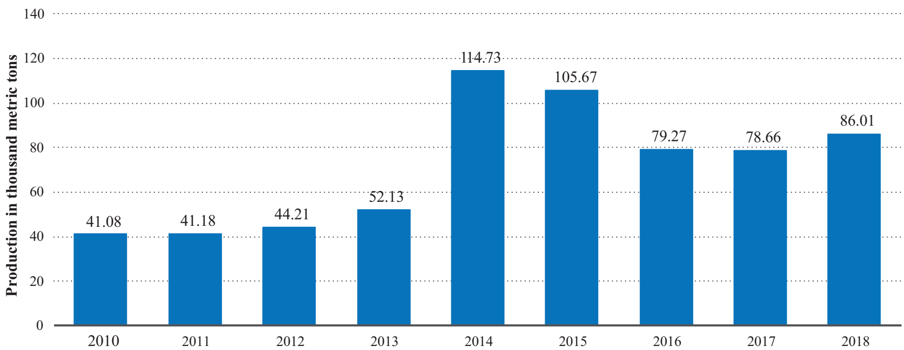


Figure A1. Structure of the quinoa supply chain



Source(s): USDA Foreign Agricultural Service; FAO

Figure A2. Production of Quinoa in Peru during 2010–2018

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