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The resilience factors of the agri-food supply chain: An integrative review of the literature in the context of the COVID-19 pandemic

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Abstract

Purpose: During the COVID-19 global pandemic, a very significant change has occurred in the demand for basic goods, resulting from the change in the consumer needs of the population in light of a large-scale health and economic crisis. This has revealed the true importance that the agri-food supply chains (ASC) have in the design of business strategies, especially at exceptional times, when the logistics process must be robust enough to continue to ensure the supply of products. In this context, the article presents a qualitative review of the academic literature, with the aim of extracting those factors that have the greatest influence on the degree of resilience of the ASC.

Design/methodology: The methodology used is the integrative review of scientific publications, with a closer focus on those specialized in the supply chain, in order to perform a critical analysis and demonstrate theory based on the existing evidence. Both the document search and the content analysis abide by rigorous, explicit criteria.

Findings: The bibliographic analysis reveals that there are at least three business strategies that can be considered critical factors in the degree of resilience of the ASCs. These three strategies are: a customer-oriented business awareness; distribution models based on proximity; and cooperative practices among the factors that make up the value chains.

Originality/value: In such an important historical moment as the Coronavirus pandemic, it is very appropriate to look back in order to analyze all the scientific literature that could help us to better understand the current situation. It is even more important to do so in those areas of knowledge that do not yet have a consolidated academic trajectory, such as in the case of the resilience of supply chains.

Keywords: Supply chain, Agri-food, COVID-19, Logistics, Proximity, Cooperation, Customer, Resilience

Jel Codes: M11, N70, O31, R41

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1. Introduction

The supply chain has become a key element during the management of the global Coronavirus pandemic, as the procurement of basic products proved to be essential once the crisis started to have such far-reaching social and economic implications.

In this context of hardship, where logistic processes have been subjected to a high level of tension, strengths and weaknesses have emerged with regard to the different supply chain models that have been built in recent years. For example, it is well know that at the start of the pandemic, the medical supply system was collapsed as a result of a sudden sharp increase in demand, which completely depleted the stocks of such necessary elements as face masks, hydroalcoholic gel and respirators (Derqui, Filimonau & Matute, 2021). On the other hand, the agri-food supply chains (ASC) consistently showed a remarkable level of resilience, since in spite of also suffering significant alterations in demand, they were able to resist the onslaught and overcome difficulties in order to maintain the supply of products (Matthews, 2020).

The aim of this article is to review the literature to confirm how, in situations of high demand, the resilience of the supply chain can become an important element of competitive advantage, as it directly affects the pillars of the business model and, as a result, ends up determining the level of strength of said model (Chunsheng, Wong, Yang, Shang & Lirn, 2020). Specifically, the bibliometric analysis is intended to identify the factors that increase the resilience capacity of the supply chain, in order to deal with exceptional times.

In order to do this, our point of reference has been the academic literature on the agri-food sector, since it is one of those that have generated the greatest scientific debate in terms of logistic resilience, due to both the features of the market in which it operates, and the very characteristics of the products that it supplies (Zhao, Liu & Lopez, 2017).

But before exploring these factors, the article presents a short critical review of the term 'supply chain', given that there is no consolidated consensus as to its definition, or concerning the quantitative and qualitative scope of the processes involved. This exercise provides context to help to conceptually situate the subject being studied.

Accordingly, the article starts with the introduction of the main concept; continues with the results of the bibliometric analysis in order to respond to the question that synthesizes the objective; and ends with a discussion of the results, as well as the conclusions of the work and the limitations that are derived from it.

2. The supply chain concept

There are different versions of the origin of the term "logistics". On one hand, it is related to the Greek word logistikos (meaning "related to the calculation"), but the theory also exists that it derives from the French word loger (which we can traduce as "accommodate"). Even though no decisive conclusion has been reached about this etymological issue, a certain consensus exists when it comes to situating the conceptual roots of contemporary logistics in the military field, which is where processes began to be described in relation to the provisioning and distribution of troops. Specifically, Baron Antoine-Henri Jomini (Jomini, 2005) is considered to be the first person to make reference to military logistics in his work "Compendium of the Art of the War", first published in 1838 (Rouquet, 2018). From then on, logistics has been consolidated in the collective imagination as the group of people, methods, machines and facilities that are combined together to ensure the provisioning of goods and services. In the academic realm, Professor Servera-Francés (Servera-Francés, 2010) acknowledges that initially the study of the logistics was limited to a technique perspective, which sought models that would allow for the planning of distributions and cost optimization, at a time when this was considered a minor activity within business management. But from the mid-20th century on, thanks to the impulse from economic globalization and the emergence of the marketing postulates, logistics adopts a new customer-oriented approach that is embodied in specific strategies to meet their needs. From then on, logistics starts to be treated as a strategic activity, capable of providing competitive advantages that differentiate the company from the competition.

However, despite this consensus regarding logistics as a functional and differentiating element of business, starting in the 1990s, and much more intensively after 2000, a term explodes on the scene that would find its fortune in the sector. This concept is that of the supply chain, the origin of which dates back to a Financial Times interview with consultant Keith Oliver in 1982. With its success, it has gradually occupied spaces seemingly reserved for logistics, in everything from publications to training courses, and including all types of discussions and conferences (Stock, 2009).

In the same line, companies also gradually adopted the concept of the supply chain and started to introduce it into the jargon of their organizations. In fact, an exercise as simple as looking for leadership positions on the social network LinkedIn is enough to show that in Spain, there are as many Logistics Directors as there are Supply Chain Managers (more than 40,000 in both cases).

Supply chain is a concept that appears with the intention of transcending the inherent limits to the classic conception of logistics, i.e., to make a qualitative leap forward in the management of the entire value chain, providing a more global view of the parties that form part of it. Its vocation is to make up for those deficiencies and dysfunctions characteristic of logistics, which have kept it from developing its full potential and becoming an authentic network of dynamic interconnections between companies (Christopher & Peck, 2004).

A paradigmatic example of this new ambition of the logistics sector is reflected in this quote by Luis Herrero Riaño (Herrero, 2010, pg.10): "The new decade will have economic and social components, with important changes as compared to recent history, which will shape significant changes in the distribution of the production and logistics networks. The new paradigm will require building more flexible, more elastic and more efficient supply chains. The organizational work models and the technological advances will serve professionals who work in the supply chain field to facilitate these changes. In order for this to occur, organizations will need to introduce the necessary changes in the cultural models and behaviors, and these aspects may ultimately constitute one of the most important keys to success in the future.

As can be seen through the example, there are seven new qualitative supply chain requirements: greater agility, greater flexibility, high levels of efficiency, organizational models, technology advances, cultural change and new professional profiles.

And apart from a more qualitative improvement, the concept of the supply chain also involves a leap forward on a quantitative level, as it intends to expand the limits that define the boundaries of logistics actions, incorporating activities such as supplier purchasing, the anticipation of the demand and the last mile. The book "Supply Chain Management" (Chavez & Torres Rabello, 2012, pg. 16) explains this as follows:"Supply chain management is the comprehensive management of key business processes, in which the logistics process constitutes the central axis, from the end client to the first relevant suppliers, in order to provide goods and services that contribute value to the end client."In the same vein, the Council of Supply Chain Management Professionals (CSCMP, 2013) defines the supply chain as "the chain that covers the management and planning of all activities related to supply and acquisition, conversion and all logistics management activities."

In short, this article is based in a conceptual framework where traditional logistics management is giving way to the new supply chain management, which has emerged with the intent of integrating more processes and contributing more value.

3. Methodology

The methodology used is a bibliometric review that gathers the results of research, using interpretative and critical criteria, to allow the understanding of the relevant problems and the definition of new concepts. It is a methodology in the qualitative tradition that permits simultaneously including both empirical and theoretical studies, making it very appropriate for investigating emerging areas like supply chains (Grant & Booth, 2009).

This review has been carried out in four phases:1) Establishment of a guiding question; 2) Definition of the inclusion criteria; 3) Collection of all the information and 4) Critical analysis of the collected contents (Silva et al., 2017).

PHASE 1: As presented in the introduction to the article, the aim of this literature review is to search for and present the critical factors that favor the resilience of supply chains, using the agri-food sector as a reference, as it has proven to be very strong, even when faced by the extraordinary challenges that arose from the COVID-19 pandemic. Accordingly, the specific question selected to guide this research work is: What are the factors that have a positive effect on the resilience of agri-food supply chains (ASC)?

PHASE 2: With regard to the inclusion filters, the first one has to do with the quality of the information, and so only the two databases that currently best ensure the scientific rigor of their contents were used: Web of Science (WOS) and Scopus (Pranckutė, 2021).The articles were extracted in February 2022, searching for the three main study concepts:"supply chain", "resilience" and "agri-food" (or "agrifood") in any document that included them in the title, abstract or key words. This exercise permitted us to access a total of 100 articles (49 in Scopus and 51 in Web of Science).

PHASE 3: Once the first results were obtained, 38 duplicates were identified and eliminated. The 62 remaining articles were then passed through three exclusion filters:

- Year of publication: Articles prior to 2016 were discarded, as it was understood that a 5-year period is sufficiently representative and has the necessary validity in order to identify success strategies.Result:1 article was excluded.
- Subject area: Articles were discarded that formed part of the knowledge areas that are the furthest from economic and business management, such as biochemistry, computer science and veterinary medicine. Result: 8 articles were excluded.
- Type of document: Information from books and conferences was disregarded in order to focus on the research in academic articles published in scientific journals. Result:12 articles were excluded.

PHASE 4: The previous steps produced 41 articles that, a priori, fulfilled the purposes of this research. Following this, the next step was to read the abstract, the introduction and the conclusions of each document, with the objective of carrying out a qualitative evaluation. This resulted in 7 articles being discarded and 34 articles being selected, which provided the content for the present study.

The latter selection was performed according to the criteria of correspondence with the ultimate purpose of the research work, in other words, selecting only those texts that provided relevant information in terms of explaining which factors influence the resilience of agri-food supply chains.

Once the main results were obtained from the selected databases, and in an effort to obtain additional scientific evidence, secondary searches were conducted in Google Scholar. This exercise made it possible to detect and analyze specific cases of success in terms of the resilience of the ASC, thus enriching and confirming the conclusions drawn from the comprehensive literature review.

Along the same lines, the research includes some significant studies from both official institutions (National Institute of Statistics) and business associations (Spanish Commercial Coding Association), which also intend to strengthen the methodological framework and provide it with complementary elements in an effort to provide deeper knowledge in the fields of economics and business.

In all reality, comprehensive reviews go beyond the mere description of the identified articles by including a certain level of analysis and conceptual innovation. A review of this type presents an analysis and synthesizes materials from different sources. It is a work that often helps reconceptualize the vision of a problem and contributes to advancing the discipline (Guirao Goris, 2015).

4. Results

Resilience in the ASC is a relatively new phenomenon in the scientific literature. In fact, as we can see in Figure 1 (showing the articles found in the Scopus database), the academic production is concentrated particularly in the years 2020 and 2021, which represent 77.5% of the total. On the contrary, during the 8 previous years, the

volume of documents on this topic was non-existent or very residual, with a maximum of 4 articles published in 2018.

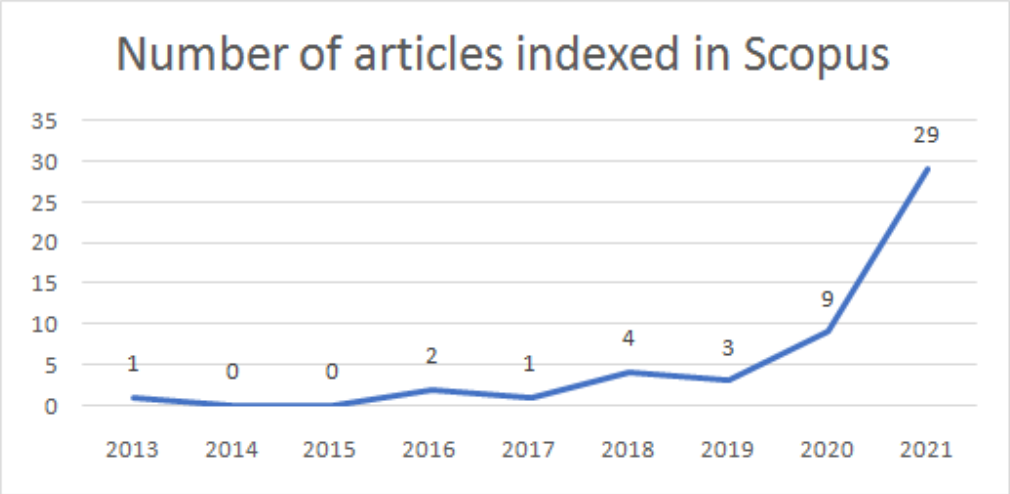

Figure 1. Articles published between 2013 and 2021 on the resilience of the ASC (Scopus)

Since it is a topic with little academic history, it is necessary to start this presentation of the results by clearly specifying what is understood by the resilience of the ASC. In this sense, the present article uses as a reference the conceptual framework provided by the researchers Stone and Rahimifard (Stone & Rahimifard, 2018, pg.16). Through a strict systematic review of 137 articles, they managed to delimit the meaning of resilience, defining it as "the collective capacity of the parties interested in the agri-food supply chains to ensure the acceptable, sufficient and stable food supply, at the required times and places, through the precise anticipation of interruptions and the use of strategies that delay the impact, aid in the fast recovery and allow for cumulative learning following the interruption."

Once the term has been delimited, it should be noted that the academic articles included in this literature review confirm that the ASCs have shown a very important degree of resilience around the world, especially during the COVID-19 pandemic, when the provisioning of food was successfully maintained at all times, in spite of all the sudden unexpected changes, such as the unpredictable nature of the demand, the confinement of workers or interruptions in logistics around the world (Dixon et al., 2021; Hobbs, 2021; Matthews, 2020).

What factors made this resilience possible in the agri-food sector? The analysis of the 34 articles selected makes it possible to identify at least three business management strategies that have a positive effect on the resilience of the ASC. They are: a customer orientation, local distribution and cooperation among agents.

Table 1 shows the three strategies that appear cited in the academic literature as factors of resilience. Specifically, it can be seen how the distribution of proximity is the most commonly mentioned factor, appearing in 18 of the articles analyzed (52.9%).Close behind is the cooperation among agents, with 17 publications (50%).And in third place are customer orientation strategies, with 10 documents (29.4%).

	Customer Orientation	Local Distribution	Cooperation Among Agents
Zhao, Liu, Lopez, Chen, Lu Mangla and Elgueta (2020)			X
Zhao, Liu, Lu, Lopez and Elgueta (2018)			
Sacchi et al. (2018)	X	X	
Stone and Rahimifard (2018)	X		X
Hernandez, Mortimer and Panetto (2021)		X	X
López-Santos, Sánchez-Partida and Cano-Olivos (2020)	X	X	
Bhavani and Gopinath (2020)		X	X
Trivellas, Malindretos and Reklitis (2020)			X
Sá, Miguel, Brito and Pereira (2020)			X
Abu Hatab, Lagerkvist and Esmat (2021)	X		
Ebata, Nisbett and Gillespie (2021)		X	
Kumar and Kumar Singh (2021)			X
Gupta, Kaur and Singh (2021)	X		
Xu, Elomri, El Omri, Kerbache and Liu (2021)		X	X
Barbosa (2021)		X	
Zollet et al. (2021)		X	
Tarra, Mazzocchi and Marino (2021)		X	
Coluccia, Agnusdei, Miglietta and De Leo (2021)		X	
Coopmans et al. (2021)	X		
Stojcheska, Nacka and Tuna (2021)			X
Rivera-Ferre et al. (2021)		X	
Michel-Villarreal, Vilalta-Perdomo, Canavari and Hingley (2021)		X	
Zielińska-Chmielewska, Mruk-Tomczak and Wielicka-Regulska (2021)		X	X
Chi Ffoleau and Dourian (2020)		X	
Hobbs (2021)	X		
Jensen and Orfila (2021)		X	
Dixon et al. (2021)		X	
Rosales, Oprime, Royer and Batalha (2020)			X
Boyacı-Gündüz, Ibrahim, Wei and Galanakis (2021)	X	X	X
Kangogo, Dentoni and Bijman (2020)	X		X
Joshi and Sharma (2021)		X	X
Mwangi, Despoudi, Espindola, Spanaki and Papadopoulos (n.d.)	X		X
Pereira, Scarpin and Neto (2021)			X
Sá et al. (2020)			X

Table 1. The three resilience factors most frequently cited in the scientific literature (Scopus and WOS)

Other factors of ASC resilience also appear in the literature, but with less intensity than the three strategies presented above. For example, technology is a factor that is referenced in 5 articles, while personnel management is cited in 2.With this lack of academic consensus, they cannot be proposed as clear factors of ASC resilience, and so they have been disregarded.

The sections below explain in greater detail what the three factors consist of that improve ASC resilience and which, therefore, are the main contribution of this research work.

4.1. Customer orientation

"Conscious Capitalism" (Mackey & Sisodia, 2016) explains how the US company Whole Foods managed to consolidate a network of more than 500 food stores, thanks to a management model that proposes to attain efficiency through a procedure to provide value to the five agents that revolve around the company: customers, workers, suppliers, society and investors.

According to this model, the agents involved cannot be placated individually or in a segregated manner, rather this must be done in a synchronized fashion and with a pre-established order that starts with satisfying the customer and ends with shareholder benefits, following a logical sequence that does not work if you reverse it. It is therefore a management model that places the customer in the center of all decisions (Siva, Gremyr,

Bergquist, Garvare, Zobel & Isaksson, 2016), which conditions the commercial strategies and sets the rules of the supply chain game.

Going no further, the leading company in food distribution in Spain, Mercadona, is a clear example of a company aware that it structures the large part of its strategy around customer needs, which forces it to maximize service (Ton & Harrow, 2010) and establish a very robust supply chain, with daily deliveries to supermarkets and a level of stock of between 15 and 18 days (Fernández Acín, Fernández & Ortiz, 2017).

Zhao et al. (2020) analyze how the agri-food supply chains are highly vulnerable to various risks, which forces them to establish active resilience mechanisms, closely related to agility and flexibility of service. The study identifies several key factors when it comes to strengthening the supply of basic products, but it shows that the success of all of them is closely related to the degree of business awareness with regard to customer satisfaction. For example, having the entire product traceability under complete control (from the origin of the raw material to its final marketing) is a very relevant element of resilience on the supply chain, but its initial motivation must always be the need to ensure the confidence and food safety of customers.

Special attention paid to customers and the capacity to adapt quickly to their needs is no longer merely an option in the ASC, rather it has become an obligation for companies that wish to compete in this market, which is very conditioned by a demand with high standards of excellence. As Verdow explains it (Verdow, Beulens, Trienekens & Wolfert 2010, pg. 23): "The growing volatility and diversity of demand requires agri-food supply chains to be more driven by demand, in other words, to be sensitive and forthcoming with information for the end consumer. Companies that participate in these supply chains based on demand must manage a great variety and variability in order to meet the specific requirements of their customers."

Therefore, these strategies that are typical of customer-oriented business models, which focus on very good stock management to prevent losing out on sales (Perona, 2002), are not only valid in environments with commercial stability, they can also become differentiating factors in crisis situations, when the demand experiences unpredictable behaviors, and therefore reaching the target market in good conditions comes to depend on the parameters previously established to obtain favorable results in all phases of the process: provisioning, production and marketing (Nugent et al., 2019).

4.2. Local distribution

A good example of the paradigms on which the supply chains have been built in recent years can be found in Spain. The report "Spain in numbers 2019" (BOE, 2019), written by the National Institute of Statistics, shows that the industrial sector in this country only accounts for 16.1% of the GDP, while the EU recommends a minimum of 20% to ensure the good health of a modern economy.

Taking a closer look at the same report, two additional conclusions can be drawn that are of importance:

- The trend in recent years has been to build increasingly more value chains anchored in the low-cost production offered by some countries, since in 2000, the weight of the industry in Spain was 18.7%, two and a half points above its current level.
- There is an unequal following of this trend in the production sector, since food bears a considerable 16% of the industrial weight, while other agents, such as medical material manufacturing, barely appear on the map.

ACTIVITIES	% GDP
Services activity	66
Industry	16,1
Taxes	9,5
Construction	5,8
Primary Sector	2,6
TOTAL	100

Food industry	16,6
Vehicle manufacturing	12,1
Electricity production	11,9
Chemical industry	6,5
Metal product manufacturing	5,4
Oil refining	5,4
Iron product manufacturing	4,7
Plastic product manufacturing	3,4
Machinery manufacturing	3,2
Mineral product manufacturing	3,0
TOTAL INDUSTRY	100

Figure 2. Spanish GDP by activity sector, breakdown of the industrial sector.2019 (INE)

The agri-food industry (with the participation of the primary agricultural, livestock farming, fishing and forestry sectors) has a more relevant weight in the GDP and has earned a better grade in the management of the COVID-19 pandemic (AECOC, 2020). This is no coincidence, rather it explains a model of proximity that offers a greater capacity for reaction in adverse situations that can interrupt the normal functioning of a supply chain (Todorovic, Maslaric, Bojic, Jokic, Mircetic & Nikolicic, 2018).

With such an exceptional situation as the COVID-19 pandemic, the so-called short food supply chain has had important advantages, such as not being bound by the restrictions on international commerce, having fewer constraints on national mobility and offering very short delivery times (Cappelli & Cini, 2020). Local production, as the starting point of the supply chain, thus has been another key element for ensuring the population's access to food and thus avoiding social collapse.

In this sense, it is important to continue to balance the virtues of the globalizing process we have experienced in recent years with a certain regionalization of strategic supplies that any country might need (Kerr, 2020), given that proximity is necessary for both the proper private management of the supply chains and for the strengthening of the economic bases that underlie the well-being of people.

4.3. Cooperation among agents

In the critical review of the supply chain concept, it has been argued that there is an implicit vocation to transcend the boundaries of logistics and cover more management areas, which could range from the provisioning of raw materials to the delivery to the end customer, including operations related to purchasing, transport, warehousing and predicting demand.

It is precisely this cooperation implicit in the supply chain concept that makes it possible to establish stable synergies and for these to result in not only the optimization of resources, but also in greater service guarantees, as shown by the study by Eksoz, Mansouri, Bourlakis and Önkal (2019) based on data collected from 105 food manufacturers in Europe and America, showing that the strategic cooperative efforts in the food supply chain can provide an important competitive advantage in volatile commercial settings.

Companies like the BonÀrea Group (Amat Salas, Lagerkvist & Esmat, 2016), which work with an integrated concept of the different agents involved in their value chains, have managed to take advantage of two key factors in order to ensure the provisioning of their products:

- Prediction of shared demand: When all the agents involved in the supply chain share the same information system, which provides them with true data in real time, this facilitates them being able to plan their operations based on the same predictions of demand and with sufficient time to execute

them, thus minimizing the risks and dysfunctions typically found in those models in which each level of the chain operates in a disconnected manner, without sharing information (Xu & Dong, 2004).

- Cooperative transportation: Integrating transportation in the supply chain, either through one's own means or through stable agreements with trusted suppliers, becomes a very important element of strength when difficulties arise that trigger an imbalance in the relationship between supply and demand in the transportation market (Verdonck, Caris, Ramaekers & Janssens, 2013).

Leat and Revoredo (2013) also make a very important academic contribution in the area of cooperation and resilience, analyzing in detail one of the main supply chains for pork in Scotland. They draw the conclusion that "the reduction in the supply chain's vulnerability to risks arose through the horizontal cooperation among producers and the vertical cooperation with the processor and the retailer. Producers improve the security of the market, prices and livestock performance. For the processor and retailer, this cooperation generated greater security for a quality supply, better communication with suppliers and a reduced risk associated with demand, since it was possible to ensure quality, the well-being of animals and the origin of the product to consumers."

5. Discussion of the results

Taking into account the relevance of the health crisis we are currently experiencing and its great impact on logistics processes, it is appropriate to undertake this work on the elements of resilience that make it possible to minimize the risks of interrupting the product supply in exceptional situations. As a matter of fact, the strategies described might be extremely useful in the approach to success factors in the design and execution of supply chains.

The journey we have taken though the academic literature in the field of logistics, focusing especially on those articles that analyze the trends and distinguishing features of supply chains (both in stable environments and under exceptional circumstances), has enabled us to identify at least three business management strategies that have had a positive impact when it comes to ensuring the supply of basic products during the COVID-19 pandemic.

The agri-food chain has demonstrated a high level of very remarkable resilience during this crisis, providing an effective response to the great changes in demand that it has experienced as the result in the changing consumption patterns, as indicated by information from journalists, sector studies and the preliminary academic contributions in this regard. Therefore, the work has consistently been able to pivot around a favorable reference, key to extracting the elements that have had an important and specific weight in this exceptional situation.

First of all, we can say that the supply chains backed by business paradigms with a clear customer orientation have had the advantage of having a logistical structure designed to maximize service and adapt to a very urgent demand, which results in greater stock control and improved restocking frequencies, especially as compared to other supply models that have been built without such high demand standards, and with cost optimization as the primary goal.

Closely related to the previous point, the research results also indicate that local production and distribution are very significant variables in terms of equipping supply chains with the capacity to react. In fact, different reflections are starting to be made, such as those that are referenced in this article, on the appropriateness of balancing economic globalization with the regionalization of strategic goods.

Finally, COVID-19 has also confirmed the numerous academic and professional voices that have long clamored for greater business cooperation in the supply chains. Even though many of these petitions are framed within the desire to promote models optimizing resource management and improving environmental sustainability, the truth is that we now have evidence to associate this strategy with the capacity for greater resilience in light of adversities.

6. Conclusions and limitations

We can provide the following response to the question that appeared at the start of this article (What are the factors that have a positive effect on the resilience of agri-food supply chains?):

- There are at least three strategic factors that strengthen the pillars of the supply chain in the face of adversity: business awareness that situates the customer in the center of decision-making processes, distribution based on the criteria of proximity and cooperation models that join together the efforts of all the agents involved.

Along the same lines, the comprehensive review also enables us to draw another conclusion of great relevance in the field of business management, which is worth highlighting:

- The design and management of the supply chain can provide competitive advantages when it comes to dealing with exceptional situations that alter the behavior of demand (as shown by the agri-food sector during the COVID-19 crisis).

However, it is evident that this work has important limitations and does not address certain fundamental questions, such as the following, which could complement it in the future:

- Analyzing the other side of the coin, in order to identify the factors that have contributed to the failure of certain supply chains, such as that of medical supplies. This exercise should serve to corroborate the weakness of those models which, driven by efficiency, have been constructing increasingly longer and more narrow value chains, installing production in low-cost countries and opting for what has been called the "tight flow" strategy, which maintains very low stock levels. It would be interesting to study this, given that this conception of the supply chain could be directly responsible for the medical supply shortage we have suffered:

- Complementing the three factors identified with other variables that might also be found among the causes explaining the good response of the agri-food chain. For example, it would be interesting to evaluate what weight the culture of change within the organizations has when dealing with exceptional periods with guarantees, as well as the positive influence of the mechanisms of quick analysis and short-term adaptation that are being adopted in some logistics companies (Arana-Solares, 2012).

- Studying the role of environmental sustainability in supply chains, exploring the nexus with the trend toward proximity and the need to reduce the kilometers that products travel. Moreover, if we combine technological advances with sustainability, we enter a new scenario in which we opt to move more bits and fewer atoms (thanks to advances in data science, robotics and 3D printing), which would also very directly affect the robustness of the supply chain, under both normal and crisis conditions.

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