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**The stakeholder's roles in risk management related to food supply chain recalls**  
*a systematic literature review*

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# **The stakeholder's roles in risk management related to food supply chain recalls: a systematic literature review**

## **Abstract**

**Purpose** – Food supply chains (FSCs) are becoming increasingly complex and vulnerable to recall risks due to quality failures. Measures for supply chain risk management can minimize these recall risks. However, this responsibility must be shared by all stakeholders in the chain. This study aims to analyze the roles of different stakeholders in managing risks in the events of food recalls.

**Design/methodology/approach** – A systematic literature review was carried out, and 110 articles were explored to identify risk management actions and to link them to the role of stakeholders involved in FSC recall.

**Findings** – The study found that nine stakeholders were responsible for 25 hazard management actions related to food safety and traceability systems, regulatory and preventive measures, and control and response mechanisms for food recalls in the FSC.

**Originality** – This article contributes to the literature by proposing an explanatory map associating risk management actions to different stakeholders in food recall. The actions were grouped according to whether they were prevention actions to avoid a food recall or contention actions to limit the negative economic effects and maintain the health of the population.

**Keywords** Food recall; Food supply chain; Risk management; Stakeholder theory.

## **1. Introduction**

Food has natural characteristics of changing quality over time, which makes it a challenge to ensure food safety and quality. Moreover, low visibility and limited control due to the global nature of food supply chains (FSCs) have made them very complex (Chaudhuri *et al.*, 2016). Hence, FSCs face multiple vulnerabilities, such as perishability, risk of intentional or unintentional tampering and/or targeting of terrorist threats (Marucheck *et al.*, 2011), difficulties in maintaining appropriate temperature during transportation and storage, thereby affecting the quality and freshness of food products (Duan *et al.*, 2020).

The above aspects make risk management difficult for FSCs which can cause food safety incidents resulting in food recalls (Soon *et al.*, 2020). Major recalls can result in a company going bankrupt, harm other manufacturers and distributors (Mohr, 2016) and also affect human health or even cause loss of life. Furthermore, food safety not only safeguards basic human needs but also supports the national economy, trade and sustainable development (Lu *et al.*, 2020). Table I presents five high-impact food recalls around the world.

[Table I here]

Table I. Recalls in food supply chains around the world

Product	Location	Cause	Year	Consequence	Authors
Peanut butter	United States	<i>Salmonella</i> outbreak	2007	Peanut ingredients affected approximately 3,900 products at over 200 firms and are confirmed to have caused 9 deaths and over 700 illnesses	Hall and Johnson-Hall (2017)
Milk powder	China	Food materials adulterated with melamine	2008	More than 290,000 people were poisoned and at least six babies were confirmed to have died from ingesting the melamine-contaminated infant milk powder	Xiu and Klein (2010)
Fresh vegetables	Europe	<i>Escherichia coli</i> outbreak	2011	More than 3,100 cases of diarrhoea and more than 850 of the haemolytic uremic syndromes were reported during the outbreak; there were 53 confirmed deaths	Raupp (2014)
Meat	United States	<i>Salmonella</i> outbreak	2011	<i>Salmonella</i> outbreak associated with ground turkey sickened 136 individuals and resulted in 1 death. In response to this outbreak, 36 million pounds of ground turkey were recalled	Bearson <i>et al.</i> (2017)
Beer	Brazil	Contamination by mono ethylene glycol and diethylene glycol	2020	Nineteen people got contaminated with the toxic substance Mono and Diethylene Glycol, from drinking craft beer. Four people died	De Oliveira (2020)

A food product recall can originate from foodborne illness, food poisoning, poor quality of food, counterfeit products or incorrect labels, and undeclared ingredients after production (Duan *et al.*, 2020). They can have negative effects for intermediate and end-customers in a chain due to the complexity of connections (Bernon *et al.*, 2018). Among these effects, are compromised performance of operations, stoppages and disruptions, reduced brand value, damaged reputation, and revenue and market share losses (Bernon *et al.*, 2018), in addition to changing consumer demands and future market prices (Potter *et al.*, 2012).

An opportunity to minimize and avoid food recall lies in risk management actions. Recalls are usually the result of multiple risks that propagate across the supply chain (Chaudhuri *et al.*, 2016). Thus, an organization needs to develop proactive risk management plans to respond to an external failure (Chaudhuri *et al.*, 2016) by internally implementing tools, techniques, strategies, external coordination and collaboration with supply chain members. Risk management can reduce vulnerability and ensure the continuity and competitive advantage of a supply chain (Fan and Stevenson, 2017). Nakandala *et al.* (2017) highlight the use of sound risk management actions in FSCs to ensure food safety. Moreover, for the actions and responsibilities of actors in food safety systems to be effective, one needs to take into account how stakeholders understand their roles and share responsibilities throughout the chain (Chang, 2014; Erdem *et al.*, 2012). Busse *et al.* (2017) point out that stakeholders can act by assisting, developing policies, evaluating, monitoring and identifying the potential for improvement in a supply chain.

In summary, studies on recall and risk management actions in FSCs have identified risks and their impacts on the supply chain. For instance, Kumar and Budin (2006) identify control systems as a possible preventive measure to reduce recalls. Roth *et al.* (2008) present a quality management framework in FSCs that involves traceability,

transparency, testability, time, trust and training as actions to preserve food safety. Chammem *et al.* (2018) discuss the challenges of food safety, as well as differences in the regulatory framework of government food control agencies in different regions of the world. Soon *et al.* (2020) analyze the factors that cause global food recalls between 2008 and 2018. In addition, Wowak *et al.* (2021) study the uncertainties and variability of food recalls through two manifestations of complexity - upstream and downstream. Although studies on this subject have advanced, little is known about the roles of different stakeholders in managing risks of food recalls. Furthermore, there are few studies in the area of food supply chains addressing the use of stakeholder theories (Shnayder *et al.*, 2016; Shankar *et al.*, 2018).

Hence, this article aims to understand the different roles of stakeholders in the risk management process for food recall. The question guiding this study is: *Who are the main stakeholders and what are their roles in recall risk management in the food supply chain?*

To answer the research question, a systematic literature review was carried out, followed by a content analysis of 110 selected articles, where nine stakeholders were identified as being responsible for 25 hazard management actions related to food safety and traceability systems, regulatory and preventive measures, and control and response mechanisms for food recalls in the FSC. This article contributes to enhancing knowledge on the understanding of each stakeholder's role using an explanatory map that associates risk management actions to the different stakeholders involved in food recalls.

## **2. Method**

In this study, the systematic literature review (SLR) methodology was chosen as it ensures that no relevant research was overlooked to validate the findings, maintaining the rigour of the study and minimizing bias (Tranfield *et al.*, 2003; El Baz *et al.*, 2018). Following

the stages proposed by Tranfield *et al.* (2003), the present SLR was based on four research questions defined through a scoping review on the focus themes. Afterwards, the SLR protocol (Table II) was developed to ensure the objectivity of the study by providing an explicit description of the activities to be carried out (Denyer and Tranfield, 2009).

[Table II here]

Table II. SLR protocol

Steps	Details
<b>Formulation of questions</b>	1) What are the main causes of recalls in food supply chains? 2) What are the risk management actions in food supply chains? 3) How do risk management actions minimize the occurrence of food recalls? 4) Who are the key players in risk management actions related to food recalls?
<b>Locating studies</b>	- Research in the Scopus, Web of Science, EBSCO, ProQuest/ABI databases - Searches until December 2021, without any restrictions to start
<b>Selection and evaluation of the study</b>	- 1st selection: title, summary and screening of keywords - 2nd selection: introduction, conclusion and analysis of inclusion and exclusion criteria, and - 3rd selection: reading and evaluation of complete articles
<b>Analysis and synthesis</b>	- Carefully read the articles - Use the StArt software to exclude duplications and classify articles; and QDA Miner to code and analyze the content based on what is intended to be answered from the survey questions

The first step was to build the search strings to conduct the search on the databases (Table III). The EBSCO, Scopus and Web of Science databases were chosen as they are regularly updated and cover a wide range of scientific disciplines (Chadegani *et al.*, 2013). In addition, ProQuest ABI-Inform was added as it has publications in the management area (Rüling, 2005).

[Table III here]

Table III. SLR questions, keywords and strings

Questions	Keywords	Strings
<b>1) What are the main causes of recalls in food supply chains?</b>	Food recall Food supply chain	((("supply chain*" OR "supply net*" OR "value chain*") AND ("recall*" NEAR/5 ("food*"))))
<b>2) What are the risk management actions in food supply chains?</b>	Risk management Food supply chain	((("supply chain*" OR "supply net*" OR "value chain*") NEAR/5 ("food*")) AND ("risk*" NEAR/5 ("mitigat*" OR "practic*" OR "management*" OR "reduc*" OR "diminish*" OR "minimiz*"))))

<b>3) How do risk management actions minimize the occurrence of food recalls?</b>	Food recall Risk mitigation Risk management	((“recall*” NEAR/5 (“food*)) AND (“risk*” NEAR/5 (“mitigat*” OR “management*” OR “reduc*” OR “diminish*” OR “minimiz*” OR “practic*”)))
<b>4) Who are the key players in risk management actions related to food recalls?</b>	Food recall Risk management Key actor Stakeholder	((“recall*” NEAR/5 (“food*)) AND (“risk*” NEAR/5 (“mitigat*” OR “management*” OR “reduc*” OR “diminish*” OR “minimiz*” OR “practic*”)) AND (“stakeholder*” OR “actor*” OR “agent*” OR “player*” OR “collaborator*” OR “partner*” OR “shareholder*”))

The first search returned 829 articles (448 duplicates) in total. After reading the title, abstract and keywords, 188 articles were then selected. For the second filter, inclusion and exclusion criteria were defined to ensure methodological rigour (Tranfield *et al.*, 2003). This has been conducted to ensure that all selected articles were focused on risk management and/or recall actions in the context of organizations or the food supply chain. Table IV presents the inclusion and exclusion criteria used in the selection of articles.

[Table IV here]

Table IV. Inclusion and exclusion criteria

<b>Criteria</b>	<b>Inclusion</b>	<b>Exclusion</b>
<b>Access</b>	Be written in English or Portuguese	Not having access to work. Not getting the article directly from the author, via ResearchGate and other means. It must not be written in English or Portuguese.
<b>Document Type</b>	Peer-reviewed scientific journal	Business newspapers, current magazines, books, conferences, reports and websites.
<b>Focus</b>	Recall and risk management concepts in a context of operations management and/or food supply chain	Concepts related to sociology, medicine, nursing, arts and environment
<b>Unit of analysis</b>	Food supply chains or organizations	Communities or unrelated to organizations

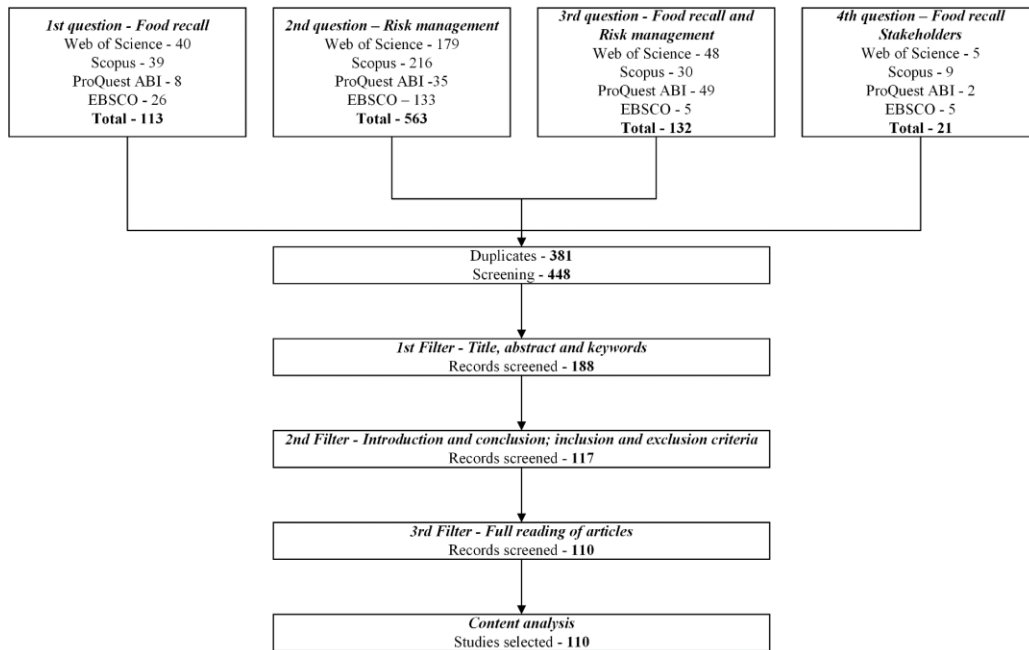
After the third filter, a total of 110 articles was achieved to be read and critically analyzed. Figure 1 shows the PRISMA flowchart of this study. Although the first selected article is from 2003, most of them are published in 70 journals between 2016 to 2021



(60,91%) (Figure 2). Additionally, it is observed that 42% (46 articles) of them are based on primary data (e.g case study, survey or mixed methods), whilst 58% (64 articles) used theoretical methods, literature review or modelling).

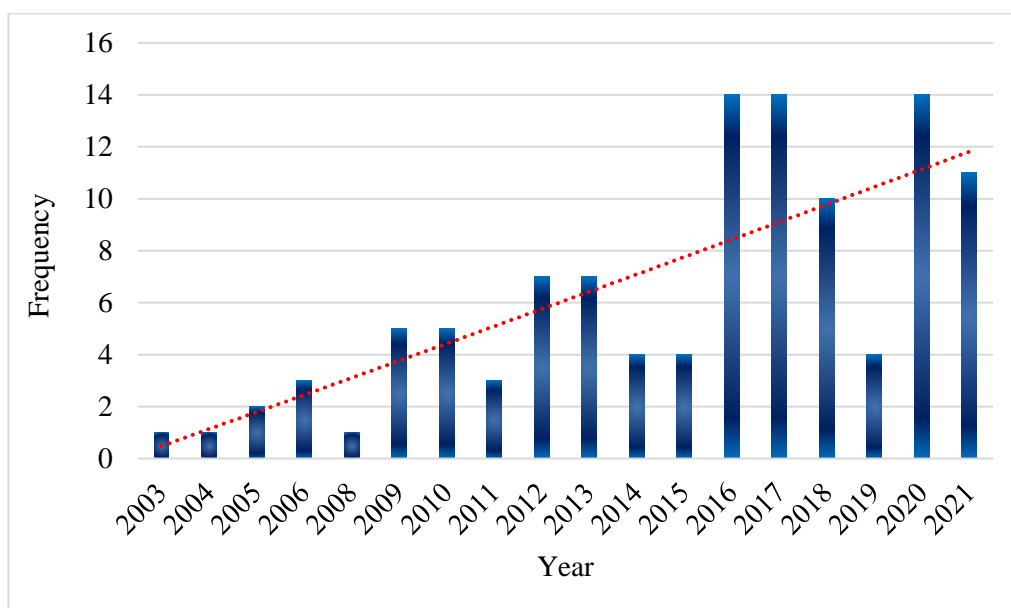
[Figure 1 here]

Figure 1 – PRISMA Flowchart



[Figure 2 here]

Figure 2 - Distribution of articles per year



The analysis and synthesis were conducted based on the content analysis method, following Bringer (2006) and Krippendorff (2013). This is recommended to facilitate the rigorous exploration of complex issues in the field of management (Douriau *et al.*, 2007). After reading the texts in full, the selected articles were inserted into the QDA Miner software for further analysis. Afterwards, the available data were categorized and coded, following the basic requirements proposed by Krippendorff (2013), according to which categories are mutually exclusive and exhaustive. For more details about the categorizing and coding process in content analysis, see Gibbs (2009).

For the analysis, the following tools were used: coding frequency, variable coding and co-occurrence. The coding frequency allowed the visualization of numerical information about the codes used, such as the coding frequency, the number of words in the segments and the percentage of articles with respective codes, thus enabling us to construct graphics with this information. Variable coding allowed us to relate the existing coding in relation to the variables. This tool was useful for identifying potential similarities and the relationship between codes and variables. Co-occurrence is used aiming to establish a numerical correlation between significant terms to map certain areas. By default, a co-occurrence is said to occur whenever two or more codes appear in the same file/article. This analysis consists of information about the proximity or co-occurrence of encodings, making it possible to identify relationships between codes or between articles (Krippendorff, 2013).

### **3. Recall in food supply chains**

Ringsber (2014) states that recalls of food products occur as a result of poor control of production conditions (for example, presence of microbial agents or chemical additives,

inappropriate processing and packaging), of food quality attributes (for example, temperature, humidity, contamination) or by adulterations that can be associated with economic or terrorist reasons (Lu and Koufteros, 2017). The reasons for recalls can be classified into three major groups of risks: biological, operational and chemical (Potter *et al.*, 2012; Le Vallee and Charlebois, 2015; Johnson-Hall, 2017; Soon *et al.*, 2020). Recalls of operational products were the most frequent (55%), followed by biological risks (36%) and chemical risks (9%) (Potter *et al.*, 2012).

[Table V here]

Table V. Reasons for food recall

Groups of risks	Reasons for food recall
<b>Biological</b>	Recalls of food products due to biological risks occur due to contamination of pathogens, fungi (biotoxins and mycotoxins), mold and transmissible biological diseases (Potter <i>et al.</i> , 2012; Johnson-hall, 2017). Soon <i>et al.</i> (2020) points out that 40.11% of all food recalls are due to biological types. Contamination by pathogens occurs due to the presence of bacteria and strains causing food poisonings, such as Salmonella, Staphylococcus aureus, Shigella sonnei, Listeria and Escherichia coli (Potter <i>et al.</i> , 2012). Mycotoxins and biotoxins are substances that are toxic substances produced by various fungi that can contaminate the food supply chain (Baines <i>et al.</i> , 2018). On the other hand, recalls for transmissible biological diseases occur due to infectious agents such as viruses and prions, such as foot-and-mouth disease and avian flu (Whitworth <i>et al.</i> , 2017).
<b>Operational</b>	In the study by Potter <i>et al.</i> (2012), recalls of food products for operational reasons were the most frequent type, corresponding to 55% of all recalls analyzed. This type included incorrect labels and packaging, physical contamination in products (e.g., plastic, glass and metals), as well as food fraud, whether economically motivated or terrorist (Potter <i>et al.</i> , 2012; Bogadi <i>et al.</i> , 2016; Do <i>et al.</i> , 2018). Potter <i>et al.</i> (2012) also found that recalls for operational reasons mainly occurred due to incorrect labelling or undeclared ingredients and production contamination, together accounting for 79% of all recalls in this category. Soon <i>et al.</i> (2020) highlights that 57.64% of all food recalls were due to operational causes, 46.18% are due to allergens, 2.25% physical risks and 2.15% were incorrect packaging.
<b>Chemical</b>	Bioaccumulation of chemicals in the food chain constitutes an environmental and health issue because of their toxicity to plants, animals, humans, and their lack of biodegradability (Marini <i>et al.</i> , 2021). Although food recalls due to chemical contaminants make up the smallest proportion of total food recalls, they cover a broad variety of risks, ranging from dyes, drugs and medicines, dioxins, irradiation, pesticides and heavy metals, to chemicals that are harmful to health, such as melamine and polycyclic aromatic hydrocarbons (Potter <i>et al.</i> , 2012; De Leo <i>et al.</i> , 2021).

A co-occurrence analysis (Figure 3) was developed to identify the recall groups and the most common reasons for recall. For this purpose, the text analysis software QDA Miner was used based on the Jaccard's coefficient, which is calculated from a fourfold

table as  $a/(a+b+c)$ , where (a) represents cases where both items occur, and (b and c) represent cases where one item is found but not the other. In this coefficient, equal weight is given to matches and non-matches (McCormick *et al.*, 1992). It is highlighted in Figure 3 that the larger the circle, the higher the number of occurrences of the reason in the analyzed articles; and the shorter the distance between the bubbles, the greater the level of co-occurrence of the reasons. Thus, the greater the proximity, the greater the potential to identify the group of reasons for recall. The purpose of this figure is to present the reasons for recalls to validate the proposed classification, and to highlight the reason most cited in the literature, making it possible to identify gaps in the literature for future studies.

[Figure 3 here]

Figure 3 – Reasons of recall by group

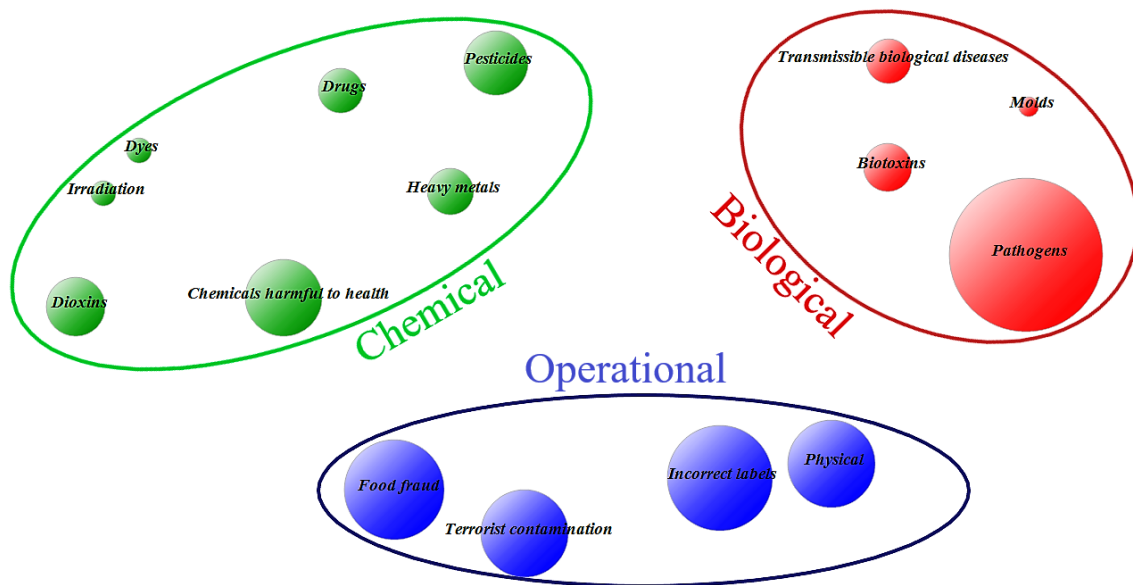


Figure 3 shows that the main reason for the recall is the risk of the presence of pathogens in food products, which has the greatest representation in the category of biological reasons. In the category of operational reasons, it is observed that the risks are similar emphasising the risk of incorrect labels and packaging, which has the greatest representation in this category. In addition, the operational reason represents the largest portion of the categories of reasons of recall in the literature, when adding the citations

of individual risks. On the other hand, the category of chemical reasons represents the lowest fraction of citations in the literature in which few authors have studied this theme, compared to the other two categories. Therefore, these analyses converge with the study by Potter *et al.* (2012) and Soon *et al.* (2020) by demonstrating, by analyzing the literature, that the category of operational reasons is the most frequent in food recalls while the chemical reasons represent the smallest proportion.

There is an increasing global trend in the number of recalls and safety incidents in the FSC (Soon *et al.*, 2020). The Rapid Alert System for the Food and Feed (RASFF, 2019) report shows that there was a 5.5% increase in the number of food product alerts with serious health risks in 2019, compared to 2018, in the European Union. It is noteworthy that the increase in alerts is significant for the sixth consecutive year (RASFF, 2019). The Food and Drug Administration (FDA) points out that there were 1076 food recalls in the United States between 2010 and 2019 and that the average number per year rose from 106 cases to 108 (FDA, 2020). In Brazil, data from the National Consumer Secretariat (SENACON) indicates the occurrence of 40 food recalls between 2004 and 2020, 21 of which were carried out between 2015 and 2020 (SENACON, 2020). In this global scenario, developing risk management plans to prevent and contain the impacts of a recall in the FSCs is required.

#### **4. Risk management actions in the FSCs**

Food safety risk management actions require infrastructures, such as food safety standards (public and private), laws, regulations and policies that facilitate food safety controls, regular inspection and oversight, effective emergency response mechanisms, import and export controls, and monitoring of food safety risks (Le Vallee and Charlebois, 2015). This article classifies risk management actions for food recalls in terms

of their approach to risk prevention, containment and, simultaneous prevention and containment. Actions with a preventive approach aim to avoid the occurrence of recall through the ability to provide information to make necessary adjustments to avoid the occurrence of the risk. Containment actions aim to limit or reduce negative impacts along the supply chain in the event of a recall. Simultaneous prevention and containment refer to actions that perform the preventive and containment approach at the same time (Zsidisin and Wagner, 2010; Chang *et al.*, 2015).

This review has identified 25 risk management actions in FSCs in the literature, 16 actions with a prevention approach, 3 with containment and, 6 simultaneous prevention and containment. Table VI presents the risk management actions in their respective approaches, followed by a brief explanation.

[Table VI here]

Table VI. Risk management actions in the food supply chain

Risk management actions	Description	Authors
<b>Prevention</b>		
<b>Agricultural controls</b>	Measures aimed at preventing risks before-, during and post-harvest	Duvenage and Korsten (2017); Aber <i>et al.</i> (2018)
<b>Allergen control</b>	Control to detect and prevent the presence of allergens in food	Do <i>et al.</i> (2018)
<b>Contractual penalties</b>	Mechanism to encourage a proactive reduction in the number of supplier failures, which can be imposed through contractual fines and reimbursement of expenses	Hall and Johnson-hall (2017); Hu <i>et al.</i> (2020)
<b>Control of packaging and labelling</b>	Control of packaging material to prevent oxidation and changes in product quality parameters. The information on the labels can facilitate tracking, communicating information in the FSC, and indicating potential allergens	Jacxsens <i>et al.</i> (2010); Ali <i>et al.</i> (2018)
<b>Government inspection/oversight</b>	Verification of national and imported food products and inspections of companies in the supply chain to assess compliance with legislation	Walker <i>et al.</i> (2016); Chammem <i>et al.</i> (2018)
<b>Governmental laws aimed at food safety</b>	National and international regulatory measures to mitigate risks and ensure food safety	Wang <i>et al.</i> (2012); Shinbaum <i>et al.</i> (2016)
<b>Hazard Analysis and Critical Control Point (HACCP)</b>	A preventive food safety system in the supply chain was developed by applying the seven principles identified in the Codex Alimentarius guidelines	Manning (2013); Allata <i>et al.</i> (2017); Aber <i>et al.</i> (2018)
<b>Hygiene control</b>	Measures to ensure the safety and integrity of the food must be taken at all stages in the supply chain	Lee <i>et al.</i> (2016)
<b>Internal audits</b>	Process of auditing-imposed requirements to determine to what extent the criteria are in compliance	Manning (2013); Hall and Johnson-hall (2017)
<b>International standards</b>	Legal standards and guidelines for international trade, generally used as a basis for national food safety legislation	Aung and Chang (2014); Gianni <i>et al.</i> (2016); Baines <i>et al.</i> (2018)
<b>Quality certifications</b>	Accredited standards, such as ISO 22000 and British Retail Consortium, to manage food safety requirements and quality improvements	Song <i>et al.</i> (2010); Ringsberg (2014); Lu <i>et al.</i> (2020)
<b>Sampling and testing</b>	Testing samples of a batch of food products to detect risks	Dodd and Powell (2009); Baines <i>et al.</i> (2018); Wang <i>et al.</i> (2020)
<b>Sizing manufacturing lots</b>	Sizing manufacturing batches to reduce negative impacts on a recall. Large batches increase the risk of cross-contamination due to mixing between raw materials from different batches	Anne-Marie Donnelly <i>et al.</i> (2012); Piramuthu <i>et al.</i> (2013)
<b>Storage control</b>	Measures that aim to guarantee quality safety in food product storage	Rong and Grunow (2010); Allata <i>et al.</i> (2017); Baines <i>et al.</i> (2018)

<b>Transport control</b>	Aims to ensure quality and safety in the transport of food products. Decisions related to infrastructure, flow management and environmental conditions	Robinson <i>et al.</i> (2013); Srivastava <i>et al.</i> (2015)
<b>Vaccination and medication control</b>	Used to reduce and control pathogens in animals or during the production process	Sperber (2005); Mohan <i>et al.</i> (2009)
<b>Containment</b>		
<b>Communication of recall events</b>	Disseminate information to government officials and the public to reduce the likelihood of consumption of affected products	Kumar <i>et al.</i> (2015); Bamgboje-Ayodele <i>et al.</i> (2016)
<b>Notification by regulatory bodies</b>	Notification of recalls, alerts or irregularities by regulatory bodies to consumers and importing or exporting countries	Baines <i>et al.</i> (2018); Chammem <i>et al.</i> (2018)
<b>Crisis management committee</b>	The crisis management committee is called upon to define the scope and extent of the problem and determine the recall management procedure, how to establish channels of collaboration and communication with stakeholders in the FSC	Dani and Deep (2010); Lawson <i>et al.</i> (2019)
<b>Prevention and containment</b>		
<b>Food defense</b>	The process to protect FSC from intentional contamination, including preventive measures, surveillance, incident notification and control	Bogadi <i>et al.</i> (2016); Guntzburger <i>et al.</i> (2020)
<b>Investment in information technology</b>	Use of information technology for rapid detection and recall decisions, in addition to real-time traceability information	Bumblauskas <i>et al.</i> (2020); Duan <i>et al.</i> (2020)
<b>Processing planning and control</b>	To avoid accidental contamination and improper food handling practices	Manning (2013); Allata <i>et al.</i> (2017)
<b>Traceability</b>	Registration and tracking of parts, processes and materials used in production. It allows storing and transmitting information about a product in all stages of the FSC	Aung and Chan (2014); Qian <i>et al.</i> (2018); Hall and Johnson-Hall (2021)
<b>Training of employees</b>	Process of developing knowledge, skills and attitudes towards international standards of quality, food safety and manufacturing practices	Roth <i>et al.</i> (2008); Shinbaum <i>et al.</i> (2016)
<b>Information management</b>	Information management refers to the transparency and visibility of the supply chain, introducing accountability and responsibility among members. Through information management, there is a systematic availability of information about products and processing in the FSC that are necessary to track and manage recalls	Roth <i>et al.</i> (2008); Robinson <i>et al.</i> (2013); Duan and Aloysius (2019)



Actions related to the exchange of information between members of FSC, such as communication of recall events, crisis management committees, information management and traceability are important mechanisms to reduce information asymmetry between stakeholders (Wieland and Wallenburg, 2013), which ensures greater food safety and effective and fast response in a recall process (Qian *et al.*, 2018). On the other hand, actions aimed at controls, inspections and product quality guarantees throughout the FSCs are used to prevent possible risks that will affect the safety of food products and, consequently, the health of consumers (Shinbaum *et al.*, 2016).

## **5. The influencing role of stakeholders in actions concerning risk management of food recalls**

A stakeholder is defined as any group or individual — internal or external to the firm - that affects or is affected by the execution of an organization's objectives (Freeman, 1984). Whereas internal stakeholders include shareholders, staff, and direct service providers, external ones are those who are outside a business, such as suppliers, customers, government, and the media (Freeman, 1984). The concept in stakeholder theory (ST) is that companies have obligations to other groups of stakeholders (Freeman, 2015) and that companies should focus on serving a broader set of interests than just accumulating wealth for shareholders (Miles, 2012). The main function of the ST is to understand organizations in a dynamic world (Karlsson *et al.*, 2018), distinguishing the different needs among stakeholders and, subsequently, identifying the appropriate tasks to address their necessity (Cui *et al.*, 2018).

The stakeholder theory aims to make business policy and strategy more effective (Freeman *et al.*, 2019). To that end, stakeholders act based on an explicit or implicit agreement of mutually recognized rights and obligations, to obtain a mutual benefit or

avoid harm (Lamberg *et al.*, 2008). Therefore, stakeholders in a supply chain need to establish two-way relationships to be successful (Soundararajan *et al.*, 2019). Busse *et al.* (2017) point out that stakeholders can act to assist, develop policies, evaluate, monitor and identify the potential to improve a supply chain.

Unlike in the past, when food supply chains were characterized by the autonomy and independence of their actors (Chammem *et al.*, 2018), today these have evolved towards internationally interconnected systems and are linked by varied and complex relationships. Hence, recalls tend to be increasingly global, and effective response will only be achieved by proper coordination and preparation of all stakeholders involved (Chammem *et al.*, 2018). Given this, the stakeholder theory (ST) proves to be very useful in crisis management in supply chains (Ulmer, 2001) as it helps to understand the influence of each actor before, during and after recall events.

In this context, this review identified nine stakeholders involved in food recall actions. Table VII summarizes this information, a brief description of each one and the main authors.

[Table VII here]

Table VII. Stakeholders involved in food recalls

<b>Stakeholders</b>	<b>Description</b>	<b>Authors</b>
<b>Producers</b>	Responsible for cultivating (agriculture) or raising (livestock) raw material	Dagg <i>et al.</i> (2006); Mattevi and Jones (2016)
<b>Suppliers of productive inputs</b>	Companies that supply raw materials and/or production inputs for processing companies	Mattevi and Jones (2016)
<b>Processing company</b>	Companies that carry out activities to add value to the raw material, such as processing and packaging. They are focal/central companies in the supply chain	Mattevi and Jones (2016); Chammem <i>et al.</i> (2018)
<b>Logistics Operators</b>	They store and move products between industrial producers and distributors	Robinson <i>et al.</i> (2013); Mattevi and Jones (2016)
<b>Distributors</b>	Market sector companies (wholesaler, distribution center, retailer) responsible for the distribution/sale of food products to consumers	Kumar <i>et al.</i> (2015)
<b>Consumers</b>	Actors who purchase and consume the final product	Erdem <i>et al.</i> (2012)
<b>Media</b>	Responsible for the source and dissemination of information	Chaturvedi <i>et al.</i> (2014)

<b>Non-governmental organizations (NGOs)</b>	Non-profit intergovernmental or private institutions that work to establish guidelines, protocols, certifications and international requirements to guarantee the quality of food products	Septiani <i>et al.</i> (2016); Chammem <i>et al.</i> (2018)
<b>Government agencies</b>	They have the role of ensuring food safety through regulatory mechanisms, inspections and punishments	Kumar (2014); Chammem <i>et al.</i> (2018)

### *Producers and Suppliers of productive inputs*

Recall events caused by suppliers can be costly for customers as the distribution channels will be held accountable and suffer negative pressure from consumers (Sun *et al.*, 2017). Hence, distribution channels force suppliers to adopt traceability tools and quality assurance in production processes (Sun *et al.*, 2017). In turn, producers and suppliers influence the upstream supply chain to adopt good agricultural practices and processes, such as vaccination control, agricultural control, traceability and implementation of quality certifications to inhibit risks to safety or raw material quality of food products.

### *Processing company*

A processing company is primarily responsible for ensuring food safety (Erdem *et al.*, 2012; Chammem *et al.*, 2018), and developing action plans for an agile and effective response to a recall in the chain (Kumar and Budin, 2006). This stakeholder focuses on developing immediate measures to implement effective recall and communication strategies for members of the supply chain in case a potential risk is detected (Kumar, 2014). In addition, the processing company must maintain all training and production records that enable the retrieval of information, thus facilitating responses to interested parties and allowing an effective recall (Chammen *et al.*, 2018).

### *Logistics operators*

Logistics operators play a vital role in ensuring the safe and efficient movement of food products using information management and transportation controls (Robinson *et al.*, 2013). This stakeholder plays a preventive role by implementing transport controls that ensure the quality of food products, such as refrigeration of food (Nakandala *et al.*, 2017). In addition, logistics operators are responsible for actions aimed at implementing traceability systems, information management and mechanisms to prevent deliberate contamination (Robinson *et al.*, 2013).

### *Distributors*

Distributors bridge the gap between manufacturing and sales of the product to the final consumer (Kumar *et al.*, 2015). These stakeholders are responsible for performing actions aimed at proper packaging of products in storage, traceability and control of storage specifications (Sun *et al.*, 2017). In addition, distributors must also have well-tested incident control procedures that allow quick decisions and actions, as well as systems that allow actions to be simultaneous and consistent (Walker *et al.*, 2018).

### *Consumers*

The increase in the number of cases of food poisoning emphasized the need for better security and management practices for control and information systems (Erdem *et al.*, 2012). Consumers can pressurise food manufacturers, distributors and retailers to ensure the safety of food products (Roth *et al.*, 2008). Consumers are discovering that the brand does not guarantee security. Hence, consumer protection groups and food manufacturers can insist on regulators to develop standards, take more stringent actions against offenders, and demand regulations for food safety (Roth *et al.*, 2008).

### *Media*

Kumar *et al.* (2015) point out that the complexity of recalls becomes more difficult if the items under recall have been purchased by consumers. In this situation, the company works closely with distributors and the media (television, radio, newspapers, magazines, blogs and social media) to recover the items. In addition, the company can use the customer service department to ask consumers to return them. Thus, the media plays an important role as a source of information (Chaturvedi *et al.*, 2014) and publicizes the problem to the public (Kumar, 2014). Failure to comply with appropriate communication protocols can have an impact on the reputation of the company and on its brand (Kumar, 2014).

### *Non-Governmental Organizations*

Non-Governmental Organizations (NGOs), such as the Food and Agriculture Organization of the United Nations (FAO) and the Codex Alimentarius Commission (CAC), operate within a global setting to establish guidelines for a food risk categorization and improve food safety, thereby strengthening food inspection systems in countries (Septiani *et al.*, 2016). These institutions introduce protocols of good agricultural/production practices and quality certification schemes to introduce transparent requirements and standardized systems (Gianni *et al.*, 2016). In addition, they establish international regulations that can provide support during emergencies and serve as an information repository (Chammem *et al.*, 2018).

### *Government agencies*

Government agencies, on the other hand, have a role in facilitating preventive food safety through voluntary and regulatory mechanisms (Manning *et al.*, 2005) by

determining legislation and standards for the food companies to operate in the interests of the public (Dani and Deep, 2010) and establish import and export requirements (Dagg *et al.*, 2006). According to Chaturvedi *et al.* (2014), if a recall occurs, the immediate objective of the government agencies involved is to minimize the spread of risk.

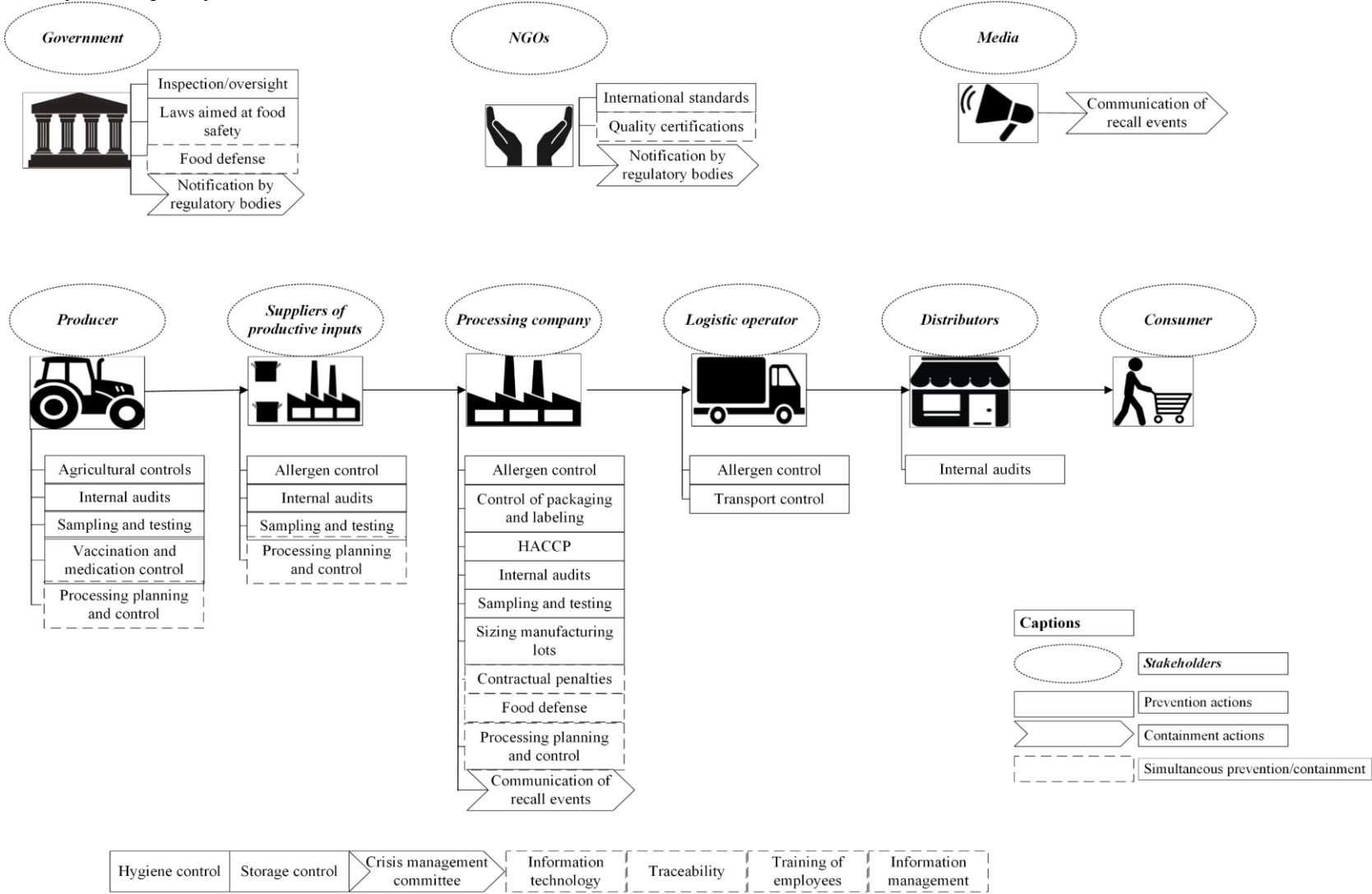
#### *Stakeholder actions in recalls in the food supply chains*

Figure 4 presents a map, which illustrates the stakeholders and the actions to be developed and applied by them to manage a recall event in an FSC. As presented in the literature, the map demonstrates that government agencies work by developing laws, inspecting and notifying FSC companies (Johnson-Hall, 2017). NGOs operate by developing international standards and certificates (Septian *et al.*, 2016). In turn, media acts in the dissemination and communication of risks and is an important means of information for consumers (Chaturvedi *et al.*, 2014). These three stakeholders have their own actions and influence over the chains.

Producers, suppliers of productive inputs and logistics operators are responsible for actions along the supply chain, which are related to the movement of products. It is noteworthy that storage control, hygiene control, traceability systems, information technology, crisis management committee, training of employees and information are actions inherent to all active stakeholders in the chain (Roth *et al.*, 2008; Erdem *et al.*, 2012; Robinson *et al.*, 2013; Sun *et al.*, 2017). The processing company (supply chain focal company) operates both internally and in the chain, and is responsible for actions that aim to ensure food safety during processing and minimize possible recalls (Aung and Chang, 2014; Shinbaum *et al.*, 2016). Finally, consumers are the stakeholders who impose improvements in the chain safety through pressure on stakeholders in the supply chain (Roth *et al.*, 2008).

[Figure 4 here]

Figure 4 – Explanatory map of stakeholders’ actions in recall events





From Figure 4, it can be seen that the government has an influence on the FSC by establishing laws and inspecting other stakeholders to comply with procedures to ensure the safety and quality of food products. NGOs are responsible for establishing norms that will serve as the basis for national and/or international laws, which influence government bodies and companies to follow parameters defined by these organizations. The media stakeholder, on the other hand, influences the supply chain, and especially consumers by being the main source of public information and in case of needing a recall.

Producers and suppliers influence the upstream supply chain to adopt good manufacturing and processing practices that aim to ensure the safety and quality of raw materials. The processing company, which is mainly responsible for managing a recall in FSC, influences the entire supply chain to adopt practices aimed at mitigating risks, product traceability and establish effective action plans if there is a need to carry out a recall. The logistics operators, responsible for moving products along the chain, are influenced through contracts and audits to adopt practices that guarantee safe and quality transport. In the same sense, distributors are influenced to guarantee the quality of food products in storage and influence the chain to adopt traceability systems as this stakeholder can be held responsible in the event of a recall. Finally, consumers have the influence over the supply chain stakeholders to adopt practices that guarantee the safe supply of food, at the risk of a drop in demand.

## **6. Conclusion**

The results of this study contribute to the ongoing investigations about recalls, risk management and, the role of different stakeholders in the context of FSCs, by clarifying which risk management actions are used by stakeholders to manage a food recall process. Although the literature has identified the main causes of recall and addressed management

actions in the FSCs, no research to date explored the different roles of stakeholders in the risk management process in food recall events. The identification and categorization of stakeholders in crisis management can assist managers in decision making (Karlsson *et al.*, 2018). In addition, the application of stakeholder theory proves to be useful in crisis management in supply chains (Ulmer, 2001). Once the different needs, obligations and duties of stakeholders are identified, it is possible to determine the appropriate tasks they must engage in to reduce the risk of recalls (Cui *et al.*, 2018)

This research is based on the principle that ensuring the safety and quality of food products is a shared responsibility among all stakeholders present in the supply chain (Aung and Chang, 2014). Hence, nine relevant stakeholders, involved in the management of a food safety incident, and 25 risk management actions (of prevention and /or containment) related to recalls in FSC were identified. Thus, we were able to elaborate an explanatory map of the actions performed by the stakeholders in recalls in the food supply chain.

### *Theoretical implications*

The results found in this research contribute to the literature by proposing an explanatory map that relates risk management actions by stakeholders involved in recalls in the food supply chain. Although Kumar and Budin (2006), Roth *et al.* (2008), Chaudhuri *et al.* (2016) and Johnson-Hall (2017) have identified prevention and mitigation actions related to recall in FSCs, there was no mapping of actions and how each FSC stakeholders can help in the mitigation process. In addition, the application of stakeholder theory is an important step towards implementing food safety systems, traceability systems, determining regulations and mechanisms for preventing, controlling and responding to recall events in food supply chains (Le Valle and Charlebois, 2015).

### *Managerial implications*

The results can help companies, professionals and health agencies to understand their role and influence in FSCs. First, the explanatory map can be applied in practice to take appropriate risk management actions to prevent or limit different types of food recalls. It is noteworthy that, in the explanatory map, different representations were used for prevention actions, which aim to avoid recalls, and containment actions, used to minimize the negative effects of recalls. Furthermore, the influence that stakeholders exert on the FSC is presented and is an important step to identify shared responsibility and bi-directional relationships between stakeholders during a recall process.

Identifying responsibilities, actions and influences that stakeholders must exercise in food recall management make it possible, in practice, to effectively and efficiently manage the recall. Effective management of the food recall process is important for companies and the government, as these events incur high costs due to the direct costs of recovering the product in the chain, and in increasing future risks of human diseases or deaths (Pozo and Schroeder, 2016) and falling stock prices of the involved companies.

### *Limitations and future research*

Three main limitations of this study are highlighted here. First, it focused on food chains; other supply chains can be analyzed in future research as recalls occur in several other supply chains, such as automotive, pharmaceuticals, toys, and electronics. Second, our results proposed an explanatory map for a generic FSC. However, some segments of the food industry, such as dairy products, meat, fruits and vegetables, and condiments, may require actions and greater responsibility from different stakeholders, at multiple levels in the supply chain. Third, it is important to recognize that specific and regional regulations can impact on each stakeholder's role in managing recalls in food supply

chains and hence need to be studied. As directions for future studies, the research opportunities which can be pursued include the following:

- Empirically validate or enhance the developed model for different food industry segments and assess the different degrees of responsibility and stakeholder involvement in these specific chains.
- The results show limited research on recalls due to chemical causes and specific actions to manage this risk, compared to the other two categories of recall risks. Additional research can be developed to close this gap, adopting the Resource Dependence Theory, to analyze the interorganizational behaviour between the processing company and suppliers to manage the quality of inputs, such as risks of the presence of heavy metals above the legal limits in food products.
- Institutional theory can be applied to investigate how stakeholders respond to pressures to ensure the safety of food products and responsibilities during a recall process.

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