

# Sustainability practices and challenges in the meat supply chain: a systematic literature review

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## Abstract

**Purpose** – This study comprehensively depicts the state of the art on sustainability research in the meat supply chain to advance the debate on challenges and issues associated with developing sustainable supply chain management practices.

**Design/methodology/approach** – The authors conducted a systematic literature review of 333 articles published in peer-reviewed journals and organized the extant literature into five areas of supply chain management practices: strategic orientation, continuity, collaboration, risk management, and proactivity.

**Findings** – Since 2016, the meat supply chain has received increasing scholarly attention. The literature shows the diffusion of highly heterogeneous sustainability practices related to multiple management areas and levels of analysis (institutional, industry, firm). The need for integrated, multilevel initiatives involving different stakeholders becomes increasingly crucial to the transition towards more sustainable meat supply chains.

**Practical implications** – This study highlights the importance of regulatory and stakeholder pressures in the sustainability transition. Beyond setting regulatory requirements, policymakers may facilitate the establishment of collaborations within the meat supply chain and foster the development of support services that help firms to integrate sustainability in their business models. The review also alerts entrepreneurs and managers to the benefits from cooperating with their supply chain partners to navigate the industry transition and thus more effectively respond to the demands of stakeholders and to the increasing customers' awareness of sustainability issues.

**Originality/value** – This study is the first to systematize the corpus of knowledge on the sustainability of the meat supply chain by adopting a comprehensive approach to analyze relevant management and agriculture literature.

**Keywords** Meat production, Supply chain, Sustainability, Systematic literature review

**Paper type** Literature review

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## 1. Introduction

Sustainability principles and practices are increasingly central to the agendas of both managers and policymakers (e.g. [Jansson \*et al.\*, 2017](#); [Sharma \*et al.\*, 2022](#)). One of the key areas in which adopting more sustainable ways of ‘doing business’ produces major effects is managing the supply chain ([Ashby \*et al.\*, 2012](#); [Chevrollier \*et al.\*, 2023](#); [Müller \*et al.\*, 2009](#)). Sustainable supply chain management approaches are highly industry-specific ([Cagno \*et al.\*, 2023](#)). Industry differences inevitably lead to specific challenges in adopting sustainability practices, making it impossible to address sustainability issues without considering them ([Allievi \*et al.\*, 2015](#); [Khalid \*et al.\*, 2015](#); [Schaltegger \*et al.\*, 2023](#)).

Among others, the food sector is considered a relevant case of a supply chain in which sustainability transition and changes in managerial practices towards a more sustainable paradigm are emerging as particularly important to face the consequences of climate change ([León-Bravo \*et al.\*, 2019](#); [Smith and Gregory, 2013](#)). As noted by [Yakovleva \*et al.\* \(2012, p. 1299\)](#), “the food sector is constantly innovating with alternative strategies to decrease burdens on the natural environment and improve social and ethical issues in supply chain through various production, marketing, labelling, accreditation schemes and initiatives”. However, further heterogeneity within the food sector can be observed in terms of the drivers of sustainable innovation and sustainability-oriented managerial practices ([Kharola \*et al.\*, 2022](#); [León-Bravo \*et al.\*, 2019](#)) because food products show substantial differences, such as price volatility, level of vertical integration, price transmission mechanisms, and dependence on imports in countries’ trade balance.

Among food products, meat production attracts particular interest from scholars and practitioners due to its environmental impact ([Hübel and Schaltegger, 2022](#); [Kumar \*et al.\*, 2022](#)). Such impact has also made the analysis of the meat supply chain an increasingly relevant research context, on which several studies have focused. For instance, [Leroy and Praet \(2015\)](#) highlight the relevance of meat production traditions and their cultural role in food production systems; other scholars focus on the role of the institutional environment in improving the efficiency of the supply chain ([Tereszczuk and Mroczek, 2014](#)) and the variety of products resulting from its different stages ([Amicarelli \*et al.\*, 2021a, b](#)). In addition, a few studies have focused on consumer behavior and awareness ([Amfo and Ali, 2021](#)) and, specifically, on the effects of the increasing perception of meat products as having a high impact on climate change ([Spendrup \*et al.\*, 2019](#)). Recent studies have investigated issues related to biodiversity protection ([Leone, 2021](#)), the effects of substitute products ([Collier \*et al.\*, 2021](#)), and the impact of COVID-19 on the meat industry ([Ijaz \*et al.\*, 2021](#); [Riahi Dorcheh \*et al.\*, 2021](#)).

While research on the sustainability of meat supply chains has expanded significantly, especially in recent years, it has flourished in a fragmented manner. Contributions vary largely, for instance, concerning the steps of the supply chain investigated and the strategic and operational aspects of sustainability. Our study explored this heterogeneous and evolving research domain. Through a systematic literature review, we sought to address two questions:

Q1. How has research on meat supply chain management sustainability evolved?

Q2. What sustainability practices have been adopted in meat supply chain management?

Our study analyzed over 25 years of research on sustainability in the meat supply chain by reviewing 333 articles published in academic journals in the management and agricultural domains. We offer a comprehensive picture of the state-of-the-art sustainability literature in the context of meat production. In addition, we present promising avenues for future research in each of the five areas of sustainability practices in which we systematize the extant

knowledge. Our study also provides implications for practice by furthering our understanding of the sustainability practices and approaches currently adopted and helping to identify the key challenges in the transition of the meat supply chain towards greater sustainability. An integrated approach focusing on the entire supply chain, rather than single steps, and involving multiple stakeholders is increasingly needed to promote such a transition (Stindt, 2017).

The remainder of this paper is organized as follows. Section 2 describes the methodology. Section 3 presents the evolution of the literature and descriptive results. Section 4 analyzes the managerial practices for sustainable meat supply chains by organizing the selected articles into five areas corresponding to the following categories of sustainable supply chain management practices: strategic orientation, continuity, collaboration, risk management, and proactivity. Finally, Section 5 discusses the avenues for future research and Section 6 presents the concluding remarks and practical implications.

## 2. Methodology

The review included only articles published in peer-reviewed journals, thus excluding books, book chapters, and other non-refereed publications, as the review process can be considered a mechanism that guarantees the quality of the contributions. The search was guided by the following steps.

First, we searched the Scopus database for academic articles containing keywords in the title or abstract without using any time frame but only selected English as the language of publication. Keyword selection plays a key role in determining the reliability of a systematic literature review (Snyder, 2019). “Meat” and “supply chain” were the two primary keywords searched in the papers’ titles and abstracts. Then, “food supply chain” was also selected as a further and more inclusive keyword to be applied in the title and abstract screening; in this case, “meat” and “meat supply chain” were applied as keywords for the full-text analysis. To embrace a broad perspective in analyzing the relevant literature and offer a richer, comprehensive, and state-of-the-art picture, the search was conducted in the subject areas of “Business, Management and Accounting” and “Agricultural and biological sciences.”

The second step was to scrutinize the titles and abstracts to assess the relevance of the articles for our analysis. This process led to a total of 333 papers, 313 of which belong to “Business, Management and Accounting” and 20 to “Agricultural and biological sciences” (the Appendix reports the distribution of the articles by journal).

The third step involved coding and analysis. Two authors independently performed qualitative content analysis to classify the articles across various dimensions defined consistently in prior studies. We used an Excel datasheet in which descriptive information and research aims, methods, main findings, and contributions were reported for each article.

Articles were classified as either theoretical/conceptual or empirical; the latter were further categorized as quantitative if they were based on large-scale data collection and used statistical and econometric analytical methods, or qualitative if they used case studies or other qualitative methods. In addition, we report information on the research setting for empirical papers, including the country where the data were collected or the cases analyzed.

Notably, 22 out of the 333 papers selected are literature reviews. They were then analyzed to identify the relevant elements. For instance, the farming step of the supply chain is at the core of the literature review that focuses on sustainable pig production and animal welfare (Gunnarsson *et al.*, 2020). Paciarotti and Torregiani (2021) reviewed the literature on the logistics of short food supply chains, whereas Reisch *et al.* (2021) focused on consumer

behavior by reviewing the literature on demand-side policies that affect food consumption and waste. Generally, these reviews focus on specific steps in the supply chain and sustainability practices. Globally, these studies suggest that it is vital to consider the steps in the supply chain and the variety of sustainability practices managers may implement (Cagno *et al.*, 2023). Therefore, for each paper reviewed, we also collected information on the step (or steps) of the supply chain that was investigated by distinguishing between the farming level (production and management of the livestock phase), transformation level (abattoir, sectioning, and/or seasoning phase), and the distribution and consumption level (including commercialization and promotion to the final consumer and the analysis of meat consumer behavior).

Moreover, we classify sustainable supply chain management practices into different categories. We used the model proposed by Beske and Seuring (2014), which classifies managerial practices related to sustainable supply chain management into five categories. The word “category” is intended as “an umbrella term to group and sort the different practices and link them to relevant issues of SSCM [sustainable supply chain management] and SCM [supply chain management], respectively. It is typically used in this manner in approaches that build, e.g. on content analysis, to group different items (here practices) into one related category” (Beske and Seuring, 2014, p. 323).

The categories we apply to offer state-of-the-art literature on the mean supply chain are defined as follows: (1) strategic orientation, (2) continuity, (3) collaboration, (4) risk management, and (5) proactivity.

*Strategic orientation* refers to top management and how sustainability principles are linked to a company’s values, culture, and mindset. Studies focusing on top managers’ commitment to the triple bottom line to integrate sustainability goals and dimensions into supply chain management fall under this category.

The *Continuity* category refers to how partners work together to improve a supply chain’s overall performance. Practices associated with this area relate to supply chain partner selection and long-term relationships.

The *Collaboration* category includes all practices aimed at enhancing communication and information flow and increasing supply chain transparency. Logistics and technological integration and IT interoperability among partners represent key dimensions in this area.

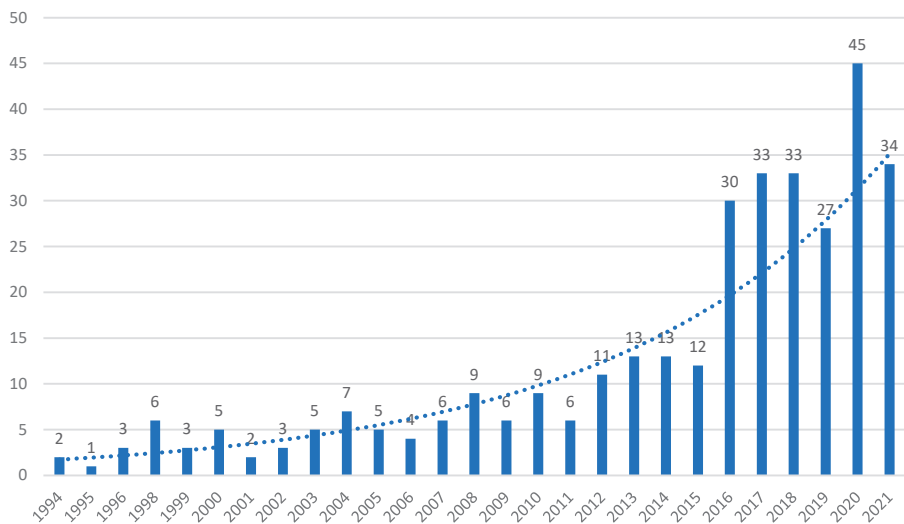
*Risk management* includes practices that reduce the risk of supply chain disruption. From this perspective, standards and certifications play a major role, as they increase the legitimacy of a business and are useful in establishing relationships with stakeholders, thus contributing to making the supply chain more environmentally and socially responsible. Risk-reducing practices include managing relationships with pressure groups (such as NGOs) and sharing information with supply chain partners for monitoring purposes.

*Proactivity* refers to proactive communication with stakeholders, sharing information on buyer behavior and social trends, and, more generally, activities that improve stakeholder management and foster sustainability-oriented innovation and learning.

### 3. Evolution of the literature and descriptive results

This section presents the distribution of 333 selected papers over time and a descriptive analysis of the literature along the aforementioned dimensions. The literature covered a period of 27 years, from 1994 to 2021 (Figure 1). Three periods were observed in the analysis of the annual distribution of articles.

The first period (1994–2021) was characterized by low research interest, with a mean of nearly three articles per year. It is worth noting that only five papers were published in 1998, one year after the adoption of the Kyoto Protocol. The second wave was the 2002–2015 period when the yearly mean number of articles grew to 6.5. During this period, increasing attention



**Figure 1.**  
Number of articles  
by year

Source(s): Authors' elaboration

was fostered by international policy events on sustainability and climate change, which contributed to making sustainability issues more central to businesses and society. Interest in the topic increased in 2016, which can be considered the beginning of the third wave (from 2016 to today), with the publication of, on average, 32 papers per year and a peak of 45 publications in 2020. The promotion of the SDGs in 2015 further increased scholarly attention toward sustainability and, in particular, towards sustainable food supply chain management.

Considering the article type, 79 out of 333 articles (23.7%) were conceptual and included 22 literature reviews. The 254 empirical articles included large-scale data collection based mostly on case studies (178). In terms of the steps of the meat supply chain covered by the analysis (farming, transformation, and consumption), 169 (50.7%) articles focused on only one step of the supply chain: 83 on the farming level, 23 on transformation, and 63 on consumption. These results suggest that research has tended to adopt a narrow focus on a single step. Only a limited number of studies (66 out of 333, corresponding to 19.8%) have considered all three steps in the supply chain. Moreover, in 77 papers (23.1%), the focus on meat was part of a broader analysis of food production supply chains (77), whereas in other studies, a tighter focus on a limited number of farmed species was adopted. Specifically, greater attention has been paid to animals that are predominant in Western farms, such as beef (80 studies), pork (56), and poultry (38). Concerning the geographic scope of the data in the empirical papers, the vast majority of the studies analyzed the European area (177), with a prevalence in Italy (25), the United Kingdom (24), and Spain (19). Other research settings are distributed as follows: 43 Asia, Oceania, and Far East; 39 North America; 20 Latin America; 10 Africa.

#### 4. Managerial practices for sustainable meat supply chain

As discussed in the methodology section, to deal with the large variety of practices identified in the literature on the sustainability of meat production, we organized the selected articles into five groups based on [Beske and Seuring's \(2014\)](#) categories of sustainable supply chain management practices. In this section, we describe the main topics that were investigated.

#### 4.1 Strategic orientation

The *Strategic orientation* category of sustainability practices comprised 85 articles. “This “orientation” emphasizes top-management support as a key factor for reaching the full potential of SSCM [sustainable supply chain management]. Being part of the strategic values of a company, orientation also implies to integrate sustainability in the organization’s strategy and strategy formulation for reaching a competitive advantage” (Beske and Seuring, 2014, p. 324). A representative list of publications in this area is presented in Table 1.

The adoption of a sustainability strategic orientation as an enabler of supply chain ecologic transition is widely discussed with reference to several themes (Kumar *et al.*, 2022): the use of sustainable performance metrics (Petit *et al.*, 2018); the resources allocation for animal welfare improvements (Trejo-Pech and Thompson, 2020); the procurement policies oriented to minimize emissions through the use of alternative protein sources for animal feed (Allegretti *et al.*, 2018); the development of specific strategies to achieve sustainable competitive advantages (Ferry *et al.*, 2013; Heikkurinen and Forsman-Hugg, 2011); more recently, firms’ pursuit of internationalization strategies to preserve premium-price for their sustainability-oriented products (Tanasiichuk *et al.*, 2020). Value appropriation strategies in the supply chain are also debated (Petit *et al.*, 2018).

More recently, an increasing interest in analyzing local food systems emerged (e.g. Fernández-Barcala *et al.*, 2017; Jarzębowski *et al.*, 2020). Scholars have investigated how the strategies of local food systems reinforce the identity of a territory (Berti and Mulligan, 2016) and affect consumer loyalty (Fernández-Ferrín *et al.*, 2021). Local food system strategies have been analyzed in association with the social dimension of sustainability, focusing on both the positive and negative effects on local communities (Petit *et al.*, 2018). Several studies have underscored small farms’ role as part of regional and local agri-food systems (Berti and Mulligan, 2016) and short food supply chains (Paciarotti and Torregiani, 2021).

Within this research domain, we have also included 24 papers that analyze the case of “protected designation of origin” and “protected geographical indication” products as increasingly important market segments. In terms of the research setting, most of these studies (18) focused on Spain (Fernández-Ferrín *et al.*, 2021; Gracia, 2006; Gracia *et al.*, 2011) and Italy (Poponi *et al.*, 2021). These studies indicate that these geographic indications can be considered as elements of a “niche strategy” that contributes to the development of local, legally protected sustainable food systems. A firm-level analysis of strategic orientation towards sustainability has also investigated the differences between family and non-family firms in green innovation adoption, focusing on their varying motivations and pressures on production system transition (Dangelico *et al.*, 2019; Hübel, 2022).

#### 4.2 Continuity

Twenty-one papers were identified in the *Continuity* category of sustainability practices. These studies predominantly focused on the transformation of the supply chain (18 papers, corresponding to 85%). In a few cases, the analysis focuses on the long-term relationships among farmers to improve product quality and between farmers and distributors to offer products labeled as regional selections (e.g. Gracia, 2006). These studies suggest that high product quality is a prerequisite for establishing long-term relationships to increase supply chain sustainability. Research in this area also highlights that in the specific context of short food supply chains, entrepreneurs’ competencies play a crucial role in developing network contacts (Broderick *et al.*, 2011).

Financial considerations and related factors, such as issues related to value appropriation and negotiation power, have traditionally been identified by supply chain management studies as the primary source of pressure in partner selection (Riahi Dorcheh *et al.*, 2021). However, more recently, studies on network collaborations have highlighted a broader

Studies	Typology of study	Aim of the study	Main findings
Díaz-Gaona <i>et al.</i> (2021)	Empirical (quantitative – survey)	Propose an assessment of the Sustainability of Extensive Livestock Farms on the Common Grasslands in Spain	<ul style="list-style-type: none"> <li>No significant differences in sustainability between organic and conventional farms</li> <li>Herd grazing plays an essential role in maintaining environmental equilibrium in the grasslands</li> </ul>
Dorcheh <i>et al.</i> (2021)	Empirical (qualitative – single case study)	Identify and analyze red meat supply chain strategies by considering the impact of the COVID-19 pandemic in Iran	<ul style="list-style-type: none"> <li>Analyzing the links among different market levels of the beef supply chain is crucial</li> </ul>
León-Bravo <i>et al.</i> (2019)	Empirical (qualitative – multiple case study)	Analyze two innovative strategies for sustainable development: forward-looking innovation and retro-innovation	<ul style="list-style-type: none"> <li>Both the analyzed strategies increase sustainability performance and improve food quality and healthiness</li> </ul>
Navarrete-Molina <i>et al.</i> (2019)	Empirical (quantitative – secondary data)	Quantify the economic impact of the Water Stress Index, water footprint, and carbon footprint as indicators of the sustainability of the beef cattle fattening industry strategies and compare them with the economic value generated by that system	<ul style="list-style-type: none"> <li>The comparison between the average annual economic value of the production and the economic cost of the water footprint and the carbon footprint unveils a relevant environmental and economic impact of the beef cattle fattening industry</li> <li>Different mitigation strategies are proposed with respect to water use and emissions</li> </ul>
Petit <i>et al.</i> (2018)	Empirical (qualitative – single case study)	Combine eco-social and environmental indicators to assess the sustainability performance of the pork value chain in France	<ul style="list-style-type: none"> <li>Establishing a common strategy framework among supply chain actors is crucial</li> <li>The barriers and bottlenecks for the implementation of strategies are analyzed</li> </ul>
Dillard and Pullman (2017)	Empirical (qualitative – single case study)	Analyze the organizational core values for an economic sustainability strategy in the US	<ul style="list-style-type: none"> <li>Responsible people, as well as land and animal management, are central elements in the process of sustainable prioritization of operations</li> </ul>
Rodríguez-Ortega <i>et al.</i> (2017)	Empirical (quantitative – survey)	Analyze the intensification strategies in relation to efficiency and sustainability performances in Spain	<ul style="list-style-type: none"> <li>Specialized pasture-based sheep system had both the lowest intensity and efficiency but also the highest sustainability</li> <li>Further support for agricultural development based on local and renewable natural resources and best practices is necessary to ensure long-term farming sustainability and social welfare</li> </ul>

**Table 1.** Representative studies on the *Strategic orientation* category of sustainability practices in the meat supply chain

(continued)

Studies	Typology of study	Aim of the study	Main findings
<a href="#">Berti and Mulligan (2016)</a>	Conceptual	Analyze the competitiveness of small farms and their role in reconstructing Italy's regional and local agri-food systems	<ul style="list-style-type: none"> <li>• One of the strengths of the re-territorialization strategy is the “transparency,” which allows the re-connection between producer and consumers</li> <li>• The “quality” and “healthiness” of the locally sourced products are at the base of the differentiation strategy from which the premium price is derived</li> </ul>
<a href="#">Golini et al. (2017)</a>	Conceptual	Analyze the main sustainability issues at the meat supply chain level in relation to actions undertaken by meat supply chain processors and the upstream and downstream effects in Italy	<ul style="list-style-type: none"> <li>• Sustainability issues are transversal to the meat supply chain and are often shared by multiple players, so requiring joint effort and coordination</li> <li>• As environmental practices are often associated with cost reduction, they are more easily diffused or self-initiated, while social practices often require the support of pivotal companies</li> <li>• The most diffused practices among industrial processors focus on their strategic issues, although initiatives in the other stages may improve the quality and sustainability of the final product</li> </ul>
<a href="#">Jie et al. (2016)</a>	Empirical (quantitative – survey)	Offer an integrated framework that links management action to supply chain processes and then to competitive advantage in Australia	<ul style="list-style-type: none"> <li>• A strong link exists between certain supply chain practices and competitive advantage, with trust and information quality playing a key role in that link</li> </ul>

Source(s): Authors' elaboration

Table 1.

perspective ([Tronstad and Unterschultz, 2005](#)) by acknowledging the increasing role of “*governance structures and coordination mechanisms*” ([Martins et al., 2017](#), p. 511) and multi-actor governance in the adoption of a circular economy approach ([Poponi et al., 2021](#)). Long-term stable partnerships within the supply chain are particularly effective if promoted by the organized distribution ([Bremmers et al., 2007](#)). Therefore, the focus of the analysis has shifted from the economic aspects and transparency of supply chain mechanisms to multidimensional assessments and governance approaches ([Cagno et al., 2023](#)). This shift has enriched the complexity of the dimensions and variables involved in empirical studies ([Hötzel and Vandresen, 2022](#)).

Concerning the environmental aspect of sustainability, the implementation of an environmental management system is seen as an initiative pursued at the network level rather than at the firm level because it requires joint efforts by the actors in the supply chain as a whole ([Müller et al., 2009](#)). Furthermore, best practices of long-term partnerships have



been identified in both the context of bio-districts and short food supply chains (Poponi *et al.*, 2021; Vittersø *et al.*, 2019) or in the pursuit of strategies oriented to the achievement of a premium price market positioning (Perez *et al.*, 2009; Broderick *et al.*, 2011). These studies also have relevant implications for policymakers who are called upon to design initiatives that can stimulate the establishment of such partnerships.

In summary, we observe an increasing research scope from operational transaction analysis to multilevel governance and closed-loop models. Table 2 lists representative papers in this area.

#### 4.3 Collaboration

The *Collaboration* category included 48 papers that focused on practices aimed at enhancing communication and transparency within the supply chain. The representative papers in this category are listed in Table 3.

Regarding communication, scholars initially analyzed food security and safety (Zadernowski *et al.*, 2002; Farooq *et al.*, 2016) and international regulation (Schwägele, 2005) as drivers of more transparent relationships within the supply chain and with markets. Research interest in this topic has grown with the emergence of health crises at the livestock level, and the pressure toward globalization and market integration has increased (Manning and Baines, 2004).

Several studies have highlighted the crucial role of technology in monitoring meat supply chains (Kumar *et al.*, 2022). From this perspective, research has investigated the automation of data collection, specifically regarding near-field communication (Pigini and Conti, 2017) and radio frequency identification (Farooq *et al.*, 2016), the development of more informed logistics decision-making, and the integration of sustainability practices into industry 4.0 processes (Ojo *et al.*, 2020). Governance structures and collaboration mechanisms within the supply chain may also affect the adoption of these practices (do Canto *et al.*, 2021; Martins *et al.*, 2017). Similarly, because information asymmetries are barriers to developing trust-based relationships (Rosales *et al.*, 2019), common infrastructure technology may be necessary for reducing such asymmetries (Lees *et al.*, 2020; Ji *et al.*, 2017). Technology can foster inter-company information management (Pigini and Conti, 2017) to promote quality and transparency in supply chain relationships (Lees *et al.*, 2020).

Finally, the role of focal firms as facilitators in adopting sustainability practices has been explored (Miemczyk *et al.*, 2012). Specifically, this role has been investigated in terms of logistics integration and food integrity preservation along the supply chain (Mohammed and Wang, 2017a, b). Once they establish a set of relationships with key partners, focal firms tend to design broader and more integrated forms of collaboration (Ji *et al.*, 2017), thus fostering external stakeholder engagement (Caracciolo *et al.*, 2016).

#### 4.4 Risk management

The *Risk management* category includes studies investigating practices to reduce the risk of supply chain disruption. A total of 67 papers were coded relative to this area (Table 4 lists representative articles).

A highly relevant research topic in the *risk management* category is the role of standards and certifications, which has been largely investigated across geographical areas and years. However, evolution over time can be traced (Vittersø *et al.*, 2019), and various themes emerge depending on the different research settings. In the European context, interest has gradually shifted from the application of business-to-business general standards (e.g. ISO) to consumer-oriented standards, such as GMO-free production (Ghozzi *et al.*, 2016), animal-welfare assurance (Marescotti *et al.*, 2020), and organic or fair-trade labels (Sheridan and Mote, 2018). In Asia, Oceania, and the Far East, halal certification is strongly tied to cultural identity

Studies	Typology of study	Aim of the study	Main findings
Poponi <i>et al.</i> (2021)	Empirical (qualitative – single case study)	Analyze an Italian Bio-District model characterized by innovative multi-actor governance in Italy	<ul style="list-style-type: none"> <li>The Bio-District can overcome the problems associated with large-scale systems and to develop firms' inter-organizational exchanges of resources with benefits in terms of productivity and sustainability</li> </ul>
Vitterso <i>et al.</i> (2019)	Empirical (qualitative – multiple case study)	Analyze short food supply chains as a sustainable alternative to European industrial production	<ul style="list-style-type: none"> <li>Relevant spatial and actors' heterogeneity exist among the 12 analyzed cases of European short food supply chains in six countries</li> <li>Both organizational forms of short food supply chains and regional and territorial characteristics play an important role</li> </ul>
Knoll <i>et al.</i> (2017)	Empirical (qualitative – multiple case study)	Identify the main sources and channels Brazilian beef packers use to obtain information on the Chinese market	<ul style="list-style-type: none"> <li>Neither the size nor the export experience of the beef packing firms nor the foreign direct investment seems to significantly influence the quality of the knowledge they hold on referred to the Chinese beef market</li> </ul>
Fattahi <i>et al.</i> (2013)	Empirical (qualitative – single case study)	Design a model for measuring the performance of the meat supply chain in Iran	<ul style="list-style-type: none"> <li>A model for assessing the performance of industrial slaughterhouses, cold rooms, factories, and supermarkets is proposed</li> </ul>
Broderick <i>et al.</i> (2011)	Empirical (qualitative – multiple case study)	Analyze producer-driven marketing channels in Australia	<ul style="list-style-type: none"> <li>Producer-driven marketing may be feasible for new brands and a profitable alternative to supplying generic products to the mainstream when costs are controlled</li> </ul>
Perez <i>et al.</i> (2010)	Empirical (qualitative – multiple case study)	Develop a conceptual model as a tool to assess the Catalan pork supply chain	<ul style="list-style-type: none"> <li>The pork sector has actively adopted more efficient production techniques</li> <li>The structure of the specific chain in the Catalan pork sector is suitable for implementing lean supply chain relationships</li> </ul>
Perez <i>et al.</i> (2009)	Conceptual	Highlight the main factors in the Catalan pork supply chain affecting the quality of products	<ul style="list-style-type: none"> <li>Supply chain agents benefit from long-terms relationships, which enable them to become more competitive relative to 'isolated' agents and without a global perspective of the whole supply chain</li> </ul>

(continued)

**Table 2.**  
Representative studies on the *Continuity* category of sustainability practices in the meat supply chain

Studies	Typology of study	Aim of the study	Main findings
Insch (2008)	Empirical (qualitative – single case study)	Analyze triggers and processes of value creation in Australia's chicken meat industry	<ul style="list-style-type: none"> <li>• Four major phases in the evolution of Australia's long-term relations have been identified in the context of the chicken meat supply chain</li> <li>• Long-term supply relationships encouraged joint product planning and development to respond to changing consumer preferences</li> <li>• Bargaining power differences between retailers and food suppliers do not prevent collaborative relationships</li> </ul>
Cox <i>et al.</i> (2007)	Empirical (qualitative – multiple case study)	Investigate the adoption of lean organizational strategies in beef, lamb, and pig UK supply chains	<ul style="list-style-type: none"> <li>• Lean strategies require the adoption of partnership approaches that are easier to reach for the pig supply chain than for the lamb ones</li> <li>• The pig supply chain experiences an increase in operational efficiency but with limited commercial incremental returns</li> </ul>
Tronstad and Unterschultz (2005)	Empirical (qualitative – single case study)	Demonstrate how the high-quality strategies of the selected companies in North America at the supply chain level have effectively produced desirable beef attributes to meet consumer beef demand	<ul style="list-style-type: none"> <li>• The small size of many cow-calf owners may prevent them from making appropriate genetic progress unless they pool their resources</li> <li>• New alliances at the cow-calf level (with a seed stock producer or a third party) could identify superior genetics from a pooled population of smaller producers' herds</li> </ul>

**Table 2.** Source(s): Authors' elaboration

(Farouk *et al.*, 2016) and has recently been associated with blockchain technology (Tan *et al.*, 2022; Sander *et al.*, 2018).

Studies focusing on North America cover more heterogeneous topics, such as the role of organic certifications that emerged in the analysis of firms' niche strategies (Marshall and Standifird, 2005), the disruptive entrance of new participants into the meat supply chain (Sheridan and Mote, 2018), and the increased efficiency of sustainable systems compared to conventional ones (Pérez *et al.*, 2019). Research in the African context analyzes the mechanisms that can reinforce the role of regional product certifications (Van der Merwe *et al.*, 2019). The advantages of these certifications have also been associated with the identification of consumer niche targets for upgraded meat standards and their relative willingness to pay (Amfo and Ali, 2021). The growing number of certifications represents a valid risk-avoidance mechanism in the meat supply chain, although the high fragmentation of standards decreases the homogeneity of controls.

Studies	Typology of study	Aim of the study	Main findings
Lees <i>et al.</i> (2020)	Empirical (quantitative – survey)	Examine the impact of relationship quality on supplier performance in the context of the red meat supply chain in New Zealand	<ul style="list-style-type: none"> <li>Relationship quality is essential in procurement relationships with suppliers; it positively affects performance and increases replication barriers</li> </ul>
Ojo <i>et al.</i> (2020)	Empirical (qualitative – single case study)	Analyze the interconnections within Industry 4.0 and sustainable food manufacturing and supply chain	<ul style="list-style-type: none"> <li>Industry 4.0 is an opportunity to manage production and services more efficiently</li> <li>Some food manufacturers have employed innovative strategies related to Industry 4.0 to meet up with this sustainability</li> </ul>
Cloutier <i>et al.</i> (2020)	Conceptual	Analyze the collaborative mechanisms for sustainability-oriented supply chain initiatives	<ul style="list-style-type: none"> <li>Collaboration is useful in improving supply chain sustainability</li> <li>Contextual variables of specific sustainability-oriented initiatives influence the types of collaborative mechanisms needed to ensure successful implementation</li> </ul>
Trivellas <i>et al.</i> (2020)	Empirical (quantitative – survey)	Explore the relationship between green supply chain management practices in Greece and three different performance aspects: supply chain, environmental and business performance, controlling for environmental dynamism	<ul style="list-style-type: none"> <li>Information sharing, logistics networking, and transportation are the most potent factors that impact sustainable businesses and supply chain performance</li> <li>The link between green packaging to financial and social performance is shown</li> <li>Green warehousing and logistics emissions failed to influence performance</li> </ul>
Akaichi <i>et al.</i> (2019)	Empirical (quantitative – survey)	Assess the use of animal welfare and nutritional information to increase the demand for and the competitive power of organic foods	<ul style="list-style-type: none"> <li>Demand for organic animal products could be improved not only by focusing on their sustainability superiority but also by promoting animal welfare and nutritional content</li> <li>Producers and marketers of organic animal products should be fully aware of the potential advantages in terms of competitive power and product demand</li> </ul>
Mohammed <i>et al.</i> (2018)	Empirical (quantitative – secondary data)	Propose an integrated methodology to solve a sustainable two-stage supplier selection and order allocation problem for a meat supply chain, considering economic, environmental, and social criteria	<ul style="list-style-type: none"> <li>This methodology can be used for solving the sustainable supplier selection and order allocation problem; it can also be applied by livestock and processed meat suppliers to improve sustainability by evaluating their current criteria</li> </ul>

(continued)

**Table 3.**  
Representative studies  
on the *Collaboration*  
category of  
sustainability practices  
in the meat  
supply chain

Studies	Typology of study	Aim of the study	Main findings
<a href="#">Hooks <i>et al.</i> (2018)</a>	Empirical (qualitative – single case study)	Analyze how a new producer organization legislation is operationalized by industry stakeholders in the context of the Irish meat supply chain	<ul style="list-style-type: none"> <li>Stakeholders have not fully explored the benefits of interbranch organizations, which involve vertical collaboration with other chain actors such as processors and retailers</li> <li>Irish stakeholders have not identified the differentiation and premiumness potential of their products</li> </ul>
<a href="#">Pigini and Conti (2017)</a>	Empirical (quantitative – secondary data)	Propose a solution to gather information throughout the entire food supply chain and bring it directly to the consumer through radio-frequency identification technology	<ul style="list-style-type: none"> <li>The radio-frequency identification technology increased customer fidelity and provided additional services</li> <li>Costs, security, and ecological aspects are important drivers for its implementation</li> </ul>
<a href="#">Mohammed and Wang (2017a)</a>	Empirical (quantitative – secondary data)	Develop a multi-objective possibilistic programming model based on three-echelon meat	<ul style="list-style-type: none"> <li>This model could be applied in supply chain management to minimize the total transportation cost by reducing the required number of vehicles and optimizing the delivery time</li> </ul>
<a href="#">Mohammed and Wang (2017b)</a>	Empirical (quantitative – secondary data)	Investigate a proposed RFID-based meat supply chain to monitor the quality and safety of meat products we purchase from supermarkets	<ul style="list-style-type: none"> <li>A fuzzy multi-objective programming model is developed to cope with the uncertainty in costs, demands, healthiness percentage of livestock, and freshness percentage of meat products</li> <li>This model solves the multi-criteria optimization problem by a meta-heuristic algorithm that may be useful for handling large-sized problems</li> </ul>
<a href="#">Ji <i>et al.</i> (2017)</a>	Empirical (qualitative – single case study)	Analyze the establishment of a large integrated pig production cooperative in an innovative Chinese supply chain	<ul style="list-style-type: none"> <li>The long-term relationship between cooperatives and farmers plays a vital role in making both parties commit to achieving mutual benefits</li> <li>The benefits of collaborations are related to the information channel established within farmers, higher logistic efficiencies, and more bargaining power in negotiations</li> </ul>

**Table 3.** Source(s): Authors' elaboration

Regarding the evolution over time, risk management practices were initially related to specific emergency prevention and monitoring measures, such as the Bovine Spongiform Encephalopathy crisis ([Van Dorp, 2003](#)) and product recalls ([Roth \*et al.\*, 2008](#)). In this scenario,

Studies	Typology of study	Aim of the study	Main findings
Hobbs (2021)	Conceptual	Consider the short, medium, and potential long-term implications of the pandemic for food supply chains with a focus on the US meat processing sector	<ul style="list-style-type: none"> <li>Scale economies in large processing firms offer significant cost and efficiency advantages</li> <li>Dispersed, smaller-scale firms with shorter supply chains may be more adaptable</li> <li>The pandemic accelerated the adoption of automation and digitalization</li> </ul>
Do <i>et al.</i> (2021)	Empirical (qualitative – multiple case study)	Delve deeper into the impact of Covid-19 on the supply chain agility practices in the UK food supply chain	<ul style="list-style-type: none"> <li>The analysis of sensing capability allows supply chains to quickly locate and assess the changes deriving from the COVID-19 crisis</li> </ul>
Bogataj <i>et al.</i> (2020)	Empirical (quantitative – secondary data)	Foster supply chain traceability to reduce perishability and waste risk in Slovenia	<ul style="list-style-type: none"> <li>Improvements can be achieved by the dynamic rerouting in real-time, based on the risk valuation</li> <li>The Internet of Things enables real-time reports and the monitoring of influencing variables</li> </ul>
Duvaleix <i>et al.</i> (2020)	Empirical (qualitative – multiple case study)	Analyze how quality labels compliance and producer organizations influence the adoption of less environmental practices in Greece and France	<ul style="list-style-type: none"> <li>Producers' organizations are getting more involved in the adoption of environmentally friendly practices while ensuing advisory services and sensibilization on farms</li> </ul>
Tan <i>et al.</i> , 2022	Empirical (qualitative – multiple case study)	Identify the current traceability challenges for the food supply chain in Malaysia to comply with Halal requirements through the use of Institutional and Agency theory	<ul style="list-style-type: none"> <li>A conceptual framework that integrates both Halal processes and Blockchain technologies is developed to improve Halal food supply chain traceability and ensure integrated monitoring</li> </ul>
Galuchi <i>et al.</i> (2019)	Empirical (qualitative – single case study)	Identify the main sources of reputational risks in Brazilian Amazon beef supply chains and the actions taken by slaughterhouses to manage these types of risks	<ul style="list-style-type: none"> <li>A set of risk management practices in the supply chains is proposed to manage risks through stakeholder engagement, government open data sources, and information sharing with direct suppliers</li> </ul>
Hou <i>et al.</i> (2020)	Empirical (quantitative – survey)	Study consumer demand for traceable meat-based food and market simulations that can adjust the production and supply chain structure to foster traceability in China	<ul style="list-style-type: none"> <li>A local pork traceability system certified by the government is recommended</li> <li>This comprehensive pork traceability system may include a combination of non-certified information and certified local information labels</li> </ul>

(continued)

**Table 4.** Representative studies on the *Risk management* category of sustainability practices in the meat supply chain

Studies	Typology of study	Aim of the study	Main findings
<a href="#">Knoll et al. (2017)</a>	Empirical (qualitative – single case study)	Map the risk detection capabilities in the Sino-Brazilian beef supply chain	<ul style="list-style-type: none"> <li>The study reveals a low degree of chain coordination from the Brazilian farm to the Chinese consumer, arising from an immature traceability mechanism, a limited flow of reliable information between the segments, and low trust between the actors</li> </ul>
<a href="#">Passuello et al. (2015)</a>	Empirical (qualitative – single case study)	Investigate the governance implications of non-genetically modified voluntary private standards on the private label poultry meat supply chain of the leading Italian retailer through the Transaction Cost Economics theory	<ul style="list-style-type: none"> <li>The creation of the non-genetically modified chain required investments by both the key actors involved and the establishment of a partnership based on trust and mutual dependence</li> <li>The retailer values the return on an image as a strategic asset and bears the extra costs of making non-genetically modified products</li> </ul>
<a href="#">Nguyen et al. (2012)</a>	Empirical (quantitative – survey)	Estimate consumers' willingness to pay and examine the determining factors influencing their willingness to pay for safe pork in Vietnam	<ul style="list-style-type: none"> <li>Consumers' awareness of the risk of unhealthy pork, household income, and expenditure are the drivers of the willingness to pay</li> <li>The amount of pork consumption per month negatively affected the willingness to pay more for shoulder and rib pork</li> </ul>

Table 4.

Source(s): Authors' elaboration

traceability reinforces the promotion of integrated and safe meat supply chains ([Van Dorp, 2003](#); [Roth et al., 2008](#); [Van der Merwe et al., 2019](#)). The preservation of product quality is another issue related to risk management and has been investigated at different levels of analysis, such as farming, consumption, and the entire supply chain ([Akaichi et al., 2019](#); [Duvaleix et al., 2020](#)).

Finally, it is worth noticing that plant-based products as a source of risk for the meat supply chain have received very limited attention although plant-based products could be considered as an emerging category of substitute products.

#### 4.5 Proactivity

Papers that were categorized into the *Proactivity* category investigate the specific “tools to foster innovation” in the supply chain and the management of supply chain partners and stakeholders in “the development phase of products” ([Beske and Seuring, 2014](#), p. 327). Eighty-four studies were included in this group. The majority of papers focus on “life-cycle assessment” (57), carbon footprint (22), and practices related to water management (12), as well as the related, recently adopted assessment methods, namely the life cycle inventory ([Saxe et al., 2018](#)) and material flow analysis ([Amicarelli et al., 2021a, b](#)). Similarly, the life cycle costing methodology was applied in Europe to a novel slaughterhouse model with a reduced

environmental impact (Valente *et al.*, 2020). These methods have recently been used to assess the environmental impact of farming and/or meat-based products and have been analyzed in 60% of the selected studies in this category.

Globally, research shows high heterogeneity in terms of geographic scope and analytical perspectives. A few studies adopted an economic perspective (Martinelli *et al.*, 2020) and focused on methods such as life cycle costing (Valente *et al.*, 2020). Many life cycle assessment analyses have been conducted in Europe (37), with a significant increase since 2010 (Ferronato *et al.*, 2021; Nguyen *et al.*, 2012). More recently, research has covered other regions, such as Asia, Oceania, and the Far East (4) since 2012, Latin America (4) since 2015, North America (7) since 2016, and Africa (1) in 2017. Carbon footprint analyses have recently been applied to beef production systems in several contexts, including Latin America (Florindo *et al.*, 2018), North America (Vergé *et al.*, 2018), and Africa (Gwiriri *et al.*, 2019). Life-cycle assessment has also been associated with other analyses, such as water footprint (Bragaglio *et al.*, 2018; Harding *et al.*, 2017) and life-cycle inventory (Saxe *et al.*, 2018). Table 5 illustrates the representative papers included in the *proactivity* category.

## 5. Avenues for future research

We organized promising lines of inquiry using the framework of the five categories of sustainability practices discussed above: strategic orientation, continuity, collaboration, risk management, and proactivity.

First, with regard to the *Strategic orientation* category, future research might further analyze the factors at varying levels (product, firm, context, and regulation) that drive the adoption of sustainability practices in the meat supply chain and, in general, in food production. Analyzing the influence of regulatory pressures on the adoption of specific sustainability practices in the meat industry remains an important area of research (Schaltegger *et al.*, 2023). Firm-level factors include aspects related to the ownership and governance structure of the firm beyond the simple dichotomy between family and non-family firms, which has already attracted some research efforts (Dangelico *et al.*, 2019). This perspective opens up the hypothesis of comparing companies with respect to the level of vertical integration, degree of formalization for the development of sustainability plans, and different sensitivities to sustainability issues in the presence of generational transitions (Chevrollier *et al.*, 2023). In addition, while consumers' willingness to pay for sustainable meat-based products is considered a proxy for the attractiveness of sustainability-oriented strategies, further investigation would provide a deeper understanding of their relevance. To advance research from this perspective, studies are needed to delve deeper into the interplay among different levels of analysis. Large-scale, multi-country empirical studies have the potential to offer relevant contributions to the drivers of the transition towards a more sustainable approach to business. The level of development of the production context can also be key to promoting ecological transition pathways customized to the contexts and constraints of production practices.

Regarding the *Continuity* domain multilevel governance instruments and closed-loop models have recently emerged. However, we urge researchers to further our understanding of new models of sustainable procurement selection and governance that can include new categories of stakeholders, such as NGOs, in the definition of long-term goals. How firms can achieve greater stakeholder engagement should be addressed to identify the mechanisms leading to the implementation of new multilevel governance instruments and models. However, this model of co-creating targets and goals for improving the impact of productions clashes with divergent interests between internal and external stakeholders. The achievement of a balance of interests is particularly challenging (Sharma *et al.*, 2022). Qualitative research, case studies and in-depth interviews would be helpful to advance our understanding of these aspects.



Studies	Typology of study	Aim of the study	Main findings
<a href="#">Amicarelli et al. (2021b)</a>	Empirical (quantitative – secondary data)	Examine the EU uniform measurement of levels of food waste to test its reliability in sustainability assessments of the Italian meat industry	<ul style="list-style-type: none"> <li>• Food waste measurement through a mass balance approach facilitates the valorization of a material cycle and eco-efficiency indicators</li> <li>• The beef and pork industries increased their eco-efficiency by 28–30% from 2008 to 2018</li> <li>• There is a negative relationship between emission and distance to the feedlots</li> <li>• The link between beef production and uneven disease burdens along the supply chain is shown</li> <li>• Minority and lower-income communities are especially affected</li> </ul>
<a href="#">Chamanara et al. (2021)</a>	Empirical (quantitative – secondary data)	Propose a novel methodology that tracks corporate supply chains and identifies pollution hotspots in the US	<ul style="list-style-type: none"> <li>• 20 indicators to assess the sustainability impact of production are identified</li> <li>• The organic pork supply chain is more sustainable than its conventional counterpart when the assessment is based on indicators expressed per unit area (for nearly all the indicators)</li> </ul>
<a href="#">Zira et al. (2021)</a>	Empirical (quantitative – secondary data)	Assess the environmental, economic, and social sustainability of conventional and organic pork in Sweden	<ul style="list-style-type: none"> <li>• This tool offers early recognition of potentially harmful or beneficial stocks</li> <li>• It sets priorities according to environmental protection measures, resource preservation, and waste management</li> <li>• It allows the design of products, processes, and systems toward environmental sustainability</li> </ul>
<a href="#">Amicarelli et al. (2021a)</a>	Empirical (quantitative – secondary data)	Validate an attempt to measure resource consumption and waste generation toward companies' and policymakers' sustainable evaluations while enhancing consumers' education in the field of agri-food resilience and sustainability in Italy	<ul style="list-style-type: none"> <li>• The potential for supply chain integration for both energy and nutrients in red meat supply chains is underscored</li> <li>• The biomass scenario is identified as the best future energy supply option</li> </ul>
<a href="#">Colley et al. (2020)</a>	Empirical (quantitative – secondary data)	Assess the circular economy opportunities for small and medium enterprises in the New South Wales meat processing sector to reduce their environmental impacts	<ul style="list-style-type: none"> <li>• The human edible protein required in feed to produce 1 kg of human-edible protein was over 4 for all supply chains</li> <li>• Pork production is a net consumer of human-edible protein, while arable land use is a useful assessment metric</li> </ul>
<a href="#">Bonou et al. (2020)</a>	Empirical (quantitative – secondary data)	Complete a cradle-to-retailer life-cycle assessment of Danish export pork and provide a comparative assessment of six after-cooling technologies for the pork supply chain to three markets: Denmark, China, and Australia	

**Table 5.** Representative studies on the *Proactivity* category of sustainability practices in the meat supply chain

(continued)

Studies	Typology of study	Aim of the study	Main findings
Crenna <i>et al.</i> (2019)	Empirical (quantitative – secondary data)	Select 32 representative food products of consumption in the EU and calculate their environmental impacts through a process-based life-cycle assessment in the EU	<ul style="list-style-type: none"> <li>• A preliminary life-cycle assessment is conducted to evaluate the role of the EU food consumption system in biodiversity decline</li> <li>• Meat products, the underpinning land use for agricultural purposes, and climate change represent the main hotspots of impacts on biodiversity</li> </ul>
Gwiriri <i>et al.</i> (2019)	Empirical (quantitative – secondary data)	Evaluate the sustainability of eight custom feeding programs in Eastern Cape Province in terms of their ability to add value to smallholder cattle production and encourage market participation in South Africa	<ul style="list-style-type: none"> <li>• Communities with custom feeding programs achieved a 16.6% mean cattle off-take rate, while these cattle achieved, on average, a 17% higher selling price</li> <li>• Custom feeding programs face sustainability challenges, including inconsistent feed and water supplies, poor infrastructure, and high staff turnover</li> </ul>
Florindo <i>et al.</i> (2018)	Empirical (quantitative – secondary data)	Rank possible improvement actions that allow the reduction of the carbon footprint originating from Brazilian beef exports considering multiple criteria	<ul style="list-style-type: none"> <li>• A number of actions to reduce environmental impacts are identified, along with a set of measures that facilitate their implementation</li> </ul>
Sander <i>et al.</i> (2018)	Empirical (quantitative – survey)	Investigate meat traceability by outlining the different perspectives and opinions of meat supply chain stakeholders; it also evaluates the potential of acceptance of blockchain technology as a viable transparency and traceability system in Germany	<ul style="list-style-type: none"> <li>• Consumers are confused by the amount and complexity of certification labels</li> <li>• Transparency and traceability system appears to have a significant positive influence on consumers' purchasing decisions, mediated by consumers' quality perceptions</li> <li>• Reveal divergent perspectives of different stakeholders regarding the importance of a blockchain technology-based transparency and traceability system</li> </ul>

Source(s): Authors' elaboration

Table 5.

Research on sustainability practices included in the category of *collaboration* practices has recently recognized the crucial role of technology in enabling firms to build long-term partnerships in the meat supply chain (Ojo *et al.*, 2020). Further studies are required to identify the best practices. Moreover, the shared development of information exchange platforms has been associated with the use of blockchain, but no application of artificial intelligence in the meat supply chain appears to have been analyzed despite explorative cases in other supply chains. One opportunity for further investigation may be mapping supply

chain traceability systems by proposing the development of a new system that combines different information sets into a single, integrated, and shared space. In this respect, future research could also develop conceptual contributions and frameworks.

Within the *Risk management* category, practices related to food safety and quality standards have been extensively investigated. However, it is increasingly relevant to analyze practices that ensure food safety and lead to premium prices, thus enabling firms to achieve sustainable competitive advantages and better meet the expectations of retailers and consumers. Moreover, research on risk management practices in the context of the meat supply chain cannot neglect the increasing importance of plant-based products as substitutes for meat, given their sustainability attributes. These products, which represent a market niche today, may raise barriers to developing sustainable meat-based products, thus becoming a source of risk for the entire meat supply chain. Within the scenario of a greater consolidation of plant-based alternatives, future studies may highlight the prospects for better positioning “sustainable” meat products on the market. Large-scale analyses on consumer behavior could offer valuable contributions to deepen our knowledge of this phenomenon. This in turn would encourage a greater spread of those managerial practices supporting sustainability-oriented meat production.

Our review also highlights the importance of *Proactiveness* and related practices that can lead to new pathways for reducing the environmental footprint of food production. The widespread application of life-cycle assessment and similar models demonstrates their importance. Specifically, the literature on meat supply chains has shown an expansion of managerial practices adopted to implement a more sustainable proactive orientation. However, scholars are called on to make further research efforts to develop frameworks and models that may more effectively guide ‘practitioners’ in turning sustainable proactiveness into action (Kumar *et al.*, 2022).

Furthermore, comparative analyses of meat and other food products (or other industries) could offer important insights and opportunities to integrate different approaches into a comprehensive framework for sustainable meat supply chains. It is also worth noting that most research efforts have focused on one step of the meat supply chain, while an integrated approach that analyzes the entire supply chain is less frequent. Because the transition towards a sustainable meat supply chain increasingly relies on initiatives and practices shared among all actors in the supply chain, the need for integrative frameworks appears to be even more critical. However, the heterogeneity of the products and production systems within the meat supply chain may constitute a barrier to these efforts.

Finally, it is also important to point out that the analysis of sustainability practices merely in terms of the adoption versus non-adoption dichotomy may lead to neglect the inherent processes and post-decision outcome. How the implementation of sustainability practices unfolds over time is an intriguing question that could be better addressed by studies paying attention to the temporal dimension and considering timing, pace and patterns of sustainability-oriented strategies. Scholars are therefore called on to investigate how sustainability is undertaken in a more process-based view. Process-based analyses would be particularly beneficial to delve deeper into the challenges, barriers and outcomes associated with a more sustainable approach to business.

## 6. Concluding remarks and practical implications

### 6.1 Concluding remarks

Research on sustainable practices in the meat supply chain has steadily increased over time and has shown substantial development in the last decade. Scholars have investigated various aspects related to how increasing pressures toward sustainability at the institutional,

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industry, and firm levels have affected the strategies and managerial practices of the actors involved in the meat supply chain. This study offers an overview of the extant literature by organizing the stock of knowledge on this topic around a few key dimensions of analysis and relevant categories of sustainability practices. Our review may be helpful to scholars interested in further investigating the areas for a more effective implementation of those practices, thus supporting the transition of the meat supply chain towards sustainability.

### *6.2 Managerial and policy implications*

This review has several practical implications. The increasing variety of managerial practices analyzed by the extant literature demonstrates that the sustainability-oriented transformation of the meat production poses several challenges and urges firms to transform their business models and organization. Although managers and entrepreneurs are increasingly aware of the benefits of adopting sustainability-driven innovations, they need to carefully consider the complexity and risks of the sustainability transition and its implications for the entire organization, especially in terms of resource and competence needs. For managers interested in adopting more sustainable business models, it is crucial to establish a long-term collaboration with their supply chain partners to jointly implement sustainability initiatives at both the process and product levels. Moreover, our study alerts managers to the fundamental role of technology as an enabling factor in reducing information asymmetry, improving efficiency, and developing trust-based relationships. This, in turn, increases the willingness and ability to embrace sustainability. This review also emphasizes the importance of a 'situational' approach to implementing different categories of practices, pointing out that profound distinctions must be attended to at different levels, such as geographical, social, environmental, cultural, and ethical.

Furthermore, our study has implications for policymakers because it underscores the importance of regulatory and stakeholder pressures in the transition toward sustainable supply chains. Indeed, it is increasingly acknowledged that individual firms' initiatives cannot be sufficient for promoting sustainable solutions in reactive and 'business as usual' contexts and for reconfiguring traditional business models. Therefore, the driving force of the regulations plays a major role. Policymakers may encourage the provision of support services that help firms to integrate sustainability principles and practices into their strategy. Beyond setting regulatory requirements, public actors and business associations may act as 'facilitators' for enhancing stakeholder engagement and the development of collaborations and initiatives involving local food production systems (e.g. bio-districts). In terms of regulatory/institutional intervention, European legislation may have a huge impact in driving further homogenization of production standards, which in turn would intensify even more the spread of sustainability-oriented managerial practices.

In sum, although a variety of practices have been developed and implemented, the transition towards more sustainable supply chains increases the need for integrated and extensive policy approaches that consider the multiple actors involved in the different steps and their specificities, including their organizational needs, competence gaps and barriers to the transformation of their business models. In this respect, the development of more refined tools and frameworks for the assessment of sustainability performance (Cagno *et al.*, 2023) would also be very helpful for two major reasons. First, it would facilitate the identification of the most relevant sustainability gaps within existing business models and increase firms' awareness of the areas in greater need for improvement. Second, such tools and frameworks would be highly supportive to effectively communicate the value of sustainability-oriented productions.

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## Appendix

Sustainable  
practices and  
meat supply  
chain

**4497**

**Table A1.**  
Number of selected  
papers by journal

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Journal	Selected papers
Journal of Cleaner Production	84
Sustainability	55
Journal of International Food and Agribusiness and Marketing	43
British Food Journal	30
Supply Chain Management: An International Journal	28
International Food and Agribusiness Management Review	23
Meat Science	15
Sustainable Production and Consumption	9
Business Strategy and the Environment	9
International Journal of Production Research	7
International Journal of Logistics Research and Applications	6
Organization and Environment	4
Corporate Social Responsibility and Environmental Management	4
European Journal of Sustainable Development	4
International Journal of Agricultural Sustainability	3
Social and Environmental Accountability Journal	2
Animal Production	2
Sustainability Accounting, Management and Policy Journal	2
Journal of Supply Chain Management	1
Journal of Strategic Innovation and Sustainability	1
International Journal of Integrated Supply Management	1
<i>Total number of selected papers</i>	333

**Source(s):** Authors' elaboration

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