




Risk Management of Agri-Food Value Chains—Exploring Research Trends from the Web of Science



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Abstract Risk management has always been considered of high importance when approaching the topic of agri-food value chains. By design, the management of agricultural and food systems is challenging. This is due to the high degree of uncertainty involving the success of making profit from carrying out small-scale agricultural activities with less performance of innovative technologies compared to multinational corporations. In this field, the literature is broad—there are numerous risk management studies focused on methods designed to prevent and mitigate the negative effects of threats that could significantly affect activities carried out with the aim of adding value along the agri-food chains. The aim of this research was to explore emerging research trends concerning risk management approaches in the literature related to agri-food value chains. In this regard, a comparative bibliometric analysis was carried out based on the research papers indexed in the Web of Science before and after the year 2015. Results show a paradigm shift caused not only by the need for a sustainable approach of risk management in the case of the global agri-food value chain but results also show a paradigm shift concerning the management of creating and co-creating value along the agri-food chains.

Keywords Risk management · Agri-food value chains · Value creation · Research trend · Bibliometrics · Competitiveness

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1 Introduction

In the global agri-food value chain, risk has always been a constant. With the intensification of the open global market, food safety issues emerged at many levels: inside and outside Europe, referring to regulation, management; food quality being often-times doubted (Houghton et al. 2008). Managing agri-food supply chains is certainly challenging and consumer safety should always be a priority.

The proper functionality of agri-food supply chains is influenced by many factors: raw material availability, land use (Chivu et al. 2021), energy—referring to the associated environmental and economic costs, climate change (Istudor et al. 2019; Petrariu et al. 2021), exchange rates and many others factors (Stone and Rahimifard 2018), starting from the first production steps, continuing with manufacturing and distribution of food until the final step—consumption (Ignat and Constantin 2020). In such a complex and dynamic global chain, there are various risks associated with specific product vulnerabilities, e.g., food perishability (Wang et al. 2019).

The beginning of the third decade of the twenty-first century is marked by the interest intensification in the field of blockchain technology and its application in the agri-food chain (Shahid et al. 2020; Tian 2017), especially if considering the rapid growth of internet-based information technologies and their utility in constructing traceability systems—instruments that can help manage and mitigate food chain risks, as well as consolidate resilience throughout various layers (Min 2019).

In this paper, risk management of agri-food value chains was placed in the spotlight of research. Risk management involves a process of carefully considering alternatives through the lens of the result of evaluations or risks assessment(s), as well as selecting and even implementing and monitoring activities carried out in the direction considered appropriate for a particular issue. The literature is rich on papers based on risk assessment methodologies in the agri-food sector, at many levels: analysis on the impact of heavy metals in the soil-vegetable system on human health (Liu et al. 2013); dietary exposure to copper (Sadhra et al. 2007); soil and groundwater contamination (Fan et al. 2010); genetically modified foods (Varzakas et al. 2007) and many other types of risk assessment.

Yet, this particular research is much rather focused on the quantitative aspect of the scientific interest regarding the topic of risk management of agri-food value chains, especially in connection with the ardent need for action in accordance with United Nations' 2030 Agenda for Sustainable Development. Published in September 2015, this document aims to efficiently harmonize socio-economic progress and environmental protection (United Nations 2015). As far as the agri-food sector is concerned, the goals of the 2030 Agenda converge with other European strategies and policies with respect to agriculture and rural development (Constantin et al. 2021; Dinu et al. 2020; Stoian and Caprita 2019; Orîndaru et al. 2021). The reason why the topic of risk management of agri-food value chains was analyzed while taking the 2030 Agenda for Sustainable Development as the main reference point is because the aim of this research was to assess the impact of the need of a paradigm shift in the approach of the supply chain: switching from the traditional vision to a modern and sustainable vision of the agri-food supply chain.

Genovese et al. (2017) explained that risk management becomes “cleaner” in the case of the desirable agri-food supply chains grounded in the principles of circularity. By reducing the negative consequences on the natural capital and the use of the environment “as a sink” for managing residuals, the nature of risk itself is different and much more complex than the one specific to a linear type of food supply chain.

1.1 Problem Statement

Expressing risk management questions and concerns is one of the many managerial responsibilities aiming to ensure that goals are met under maximized odds for success. These questions aim to help transpose the utility of risk assessment(s) into practice through relevant actions designed to mitigate risks.

Risks assessments are intended for practical use, as their purpose is to spot and fully define a risk, in order to establish the foundation for a managerial decision regarding the actions needed with respect to the identified risk: Does it need to be contained, eliminated, avoided? Or is the risk small enough to be considered acceptable, insignificant and ignored? However, risk comparison and ranking are much more complex and require a solid framework of analysis. Figure 1 contains the main components of any risk analysis.

The risk cycle encompasses minimum interdependent stages of any risk analysis, relevant no matter the nature of the risk. As suggested by the caption of Fig. 1, the process is phased and iterative—additional revision is always welcome with the aim of a better mitigation of identified risks.

1.2 Research Questions and Research Aims

This paper answers the following research questions: (a) Which are the emerging research interests concerning the topic of risk management of agri-food value chains?; (b) How did the paradigm shift with respect to agri-food value chains risk management after the 2030 Agenda for Sustainable Development was published in 2015?; (c) Did researchers focus more on the sustainability factor of solutions?

Therefore, the objective of this research was to comparatively study the scientific papers published on the topic of risk management of agri-food value chains and indexed in the Web of Science database before and after the year 2015, focusing on exploring emerging research, as well as tapping into research interest convergence and divergence points in the specialized literature.

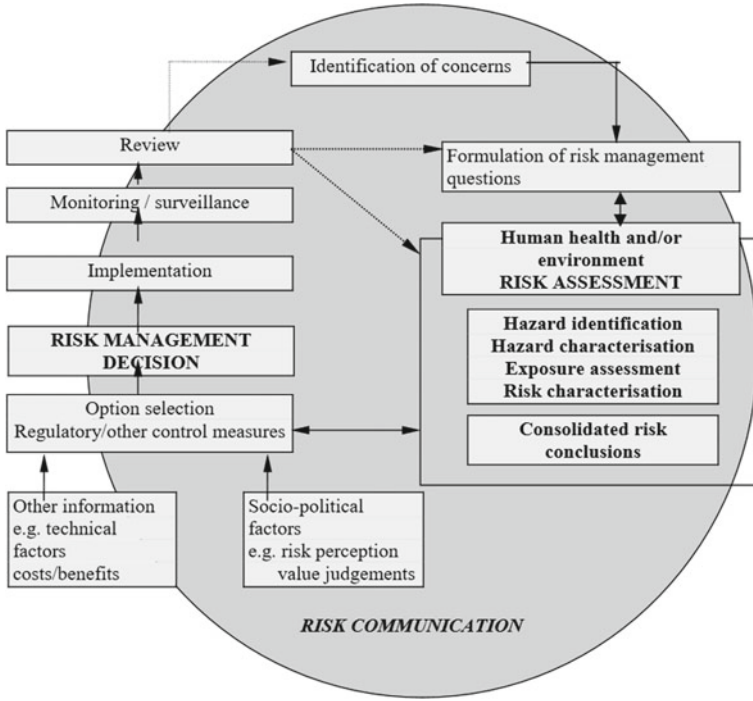


Fig. 1 The visual representation of a “risk cycle”. Source European Commission (2000)

2 Methodology

Taking the aim of this research into account, the need for a quantitative method was implicit: the bibliometric analysis, which was considered optimal for developing this study on the scientific papers in which the topic of risk management of agri-food value chains was treated. As a science, bibliometrics involves resorting to a set of various quantitative techniques designed to monitor and assess scientific resources (Hood and Wilson 2001), thus making it a perfect tool for carrying out a comparative analysis based on the research papers published before and after the year 2015 (due to taking the 2030 Agenda for Sustainable Development as the point of reference).

Bibliometrics has become a popular tool for exploring research trends (Ignat et al. 2020; Pătărlăgeanu et al. 2020; Popescu 2020). This research was conducted by resorting to the VOSviewer 1.16.16 software tool, designed by Ness Jan van Eck and Ludo Waltman. Widely used in the bibliometric analysis (van Eck and Waltman 2010), VOSviewer facilitates the construction of networks, maps, heatmaps, and other relevant graphical representations that express the density and connection between keywords and word structures associated with the results (publications) identified based on querying specific databases. Publication metadata acts as the “raw materials” needed to design, construct and project bibliometric networks and maps.

This particular bibliometric analysis was carried out based on the Web of Science database. Consequently, the Web of Science database provides the necessary “raw materials” for the proper development of bibliometrics analysis of the papers elaborated on the topic of risk management of agri-food value chains. Therefore, the Web of Science database was queried in the following manner: TOPIC: (“risk management”) AND TOPIC: (food chain) Timespan: All years. Indexes: SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC. Performed in May 2021, this query led to the identification of 415 publications indexed in the Web of Science database at that time. The identified 415 publications contained the "risk management", “food” and "chain" word structures in their title, abstract or keywords. Mixing these three structures in the same query represented the premises for identifying and analyzing only the scientific publications specific to the topic of risk management of agri-food value chains.

3 Results Findings

Early studies published on the topic of agri-food value chains risk management were identified at the end of the second millennium: 21 papers were published starting from the year 1992, up to the year 2000, as displayed in Fig. 2. Regarding the nature of work, Van Leeuwen et al. (1996) developed a risk assessment of chemicals in European Communities with respect to consumer implications; Miles and Ross (1999)

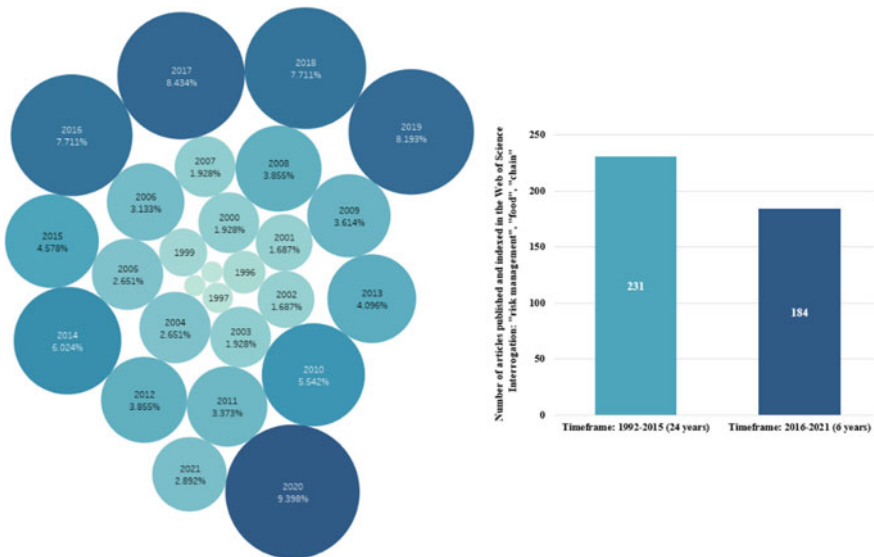


Fig. 2 The number of scientific papers identified by publication year. *Source* Authors’ processing in Table 2021.1, based on the Web of Science results

proposed improving risk evaluation by bringing forward the concept of “quantitative microbial risk assessment” in the context of quantifying risks in a food production chain; Kruse (1999) argued that regional differences in the prevalence of food-borne pathogens need be considered in the risk management process of international food trading, in the context of intensified globalization.

From a quantitative perspective, before the 2030 Agenda for Sustainable Development was published (1992–2015), 231 papers were published and identified based on the performed query (55.66% from the total of 415 papers). After 2015, the scientific interest has intensified and has shifted toward the necessity of tackling the topic of risk management of agri-food value chains by placing the sustainability factor into the spotlight of research. In this regard, recent studies were focused on: overcoming the challenges specific to global food security (Andrei et al. 2021; Constantin et al. 2021) through research and solidarity in a sustainable manner (Barrett 2021); the impact of the agri-food sector on meeting the Sustainable Development Goals (McElwee et al. 2020; Pătărlăgeanu et al. 2021); strengthening climate-resilient and sustainable food supply systems (Ebi et al. 2020).

As displayed in Fig. 3, most of the identified papers were published under the Food Science Technology (128), Environmental Sciences (47), and Management (47) Web of Science categories, whereas the top 10 publishers were analyzed in Table 1.

Figure 4 was built based on the identified 251 publications during 1992–2015 and the authors’ computation of the Web of Science-extracted metadata, whereas Fig. 5 is based on the 184 publications during 2016–May 2021. Specific VOSviewer restrictions and filters were applied to the metadata: (i) type of analysis: co-occurrence, (ii) unit of analysis: all keywords, (iii) counting method: full counting, (iv) the minimum number of occurrences of a keyword in order to be displayed in Figs. 4 and 5: 3 occurrences in both cases.



Fig. 3 The Web of Science categories associated with the identified papers treating the topic of risk management of agri-food value chains. *Source* Web of Science, May 2021

Table 1 Top 10 publishers of research papers treating the topic of risk management of agri-food value chains

Top publisher	Journal	Published papers	Percentage of total (415) (%)	Cumulative share (%)
1	Food Control	13	3.13	3.13
2	British Food Journal	12	2.89	6.02
3	International Journal of Food Microbiology	8	1.93	7.95
4	International Journal of Production Research	8	1.93	9.88
5	Supply Chain Management. An International Journal	8	1.93	11.81
6	Acta Horticulturae	7	1.69	13.49
7	International Journal of Logistics Management	6	1.45	14.94
8	Journal of Cleaner Production	6	1.45	16.39
9	Risk Analysis	6	1.45	17.83
10	Food Policy	5	1.20	19.04

Source Authors' processing, based on the Web of Science results

Regarding Fig. 4, out of the 1,356 total keywords associated with the 251 publications, 113 keywords met the threshold (8.33%), and in the case of Fig. 5, out of the 1,258 total keywords associated with the 184 publications, 115 keywords met the threshold (9.14%).

Based on VOSviewer computation (Figs. 4, 5, and 6), results confirm a paradigm shift starting from 2016 as far as risk management of agri-food value chains is concerned. Research interests, quantified through the lens of the published and indexed scientific papers in the Web of Science database, converge in the direction of meeting risk management and economic performance in a sustainable manner, by fostering resilience, as well as the potential of bioenergy and traceability through information technology. Early papers elaborated on this topic did not include such approaches, as one can notice by comparing Fig. 5 with Fig. 4.

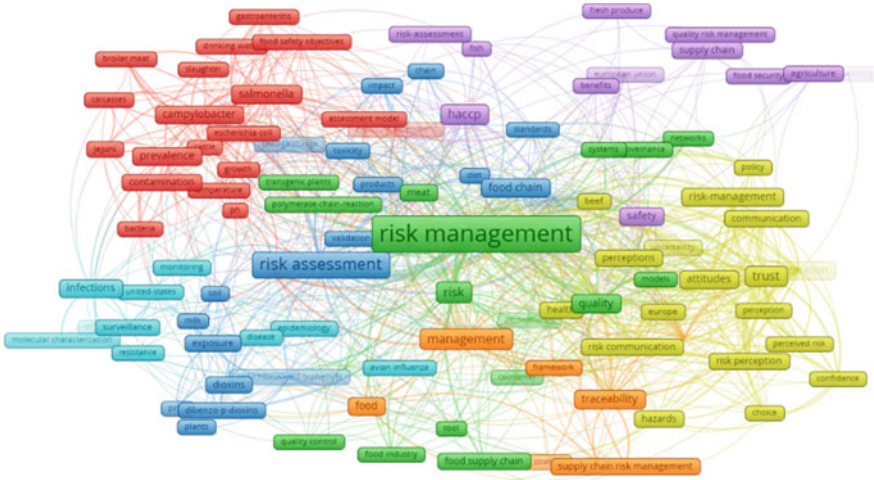


Fig. 4 Keyword cluster analysis (publications: 1992–2015). *Source* Authors’ processing in VOSviewer 1.16.16, based on the Web of Science results

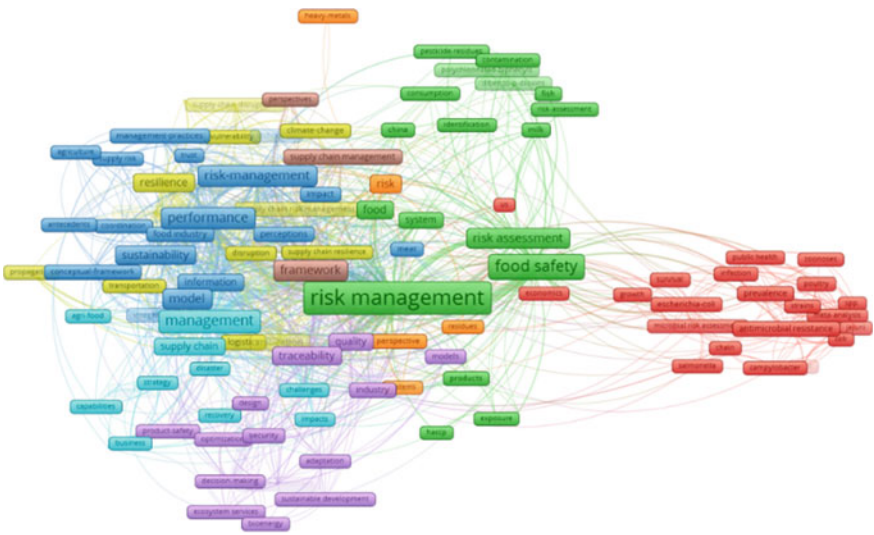


Fig. 5 Keyword cluster analysis (publications: 2016–May 2021). *Source* Authors’ processing in VOSviewer 1.16.16, based on the Web of Science results

4 Conclusions

Agri-food supply chain risk management is increasingly calling for more efficient and intensified collaboration among various actors in both private and public sectors in order to be able to provide “real-time” adaptive responses to constantly changing

specific to risk management of agri-food value chains. Additionally, the VOSviewer processing can also be improved by including relevant papers indexed in Scopus into the bibliometric computation. This would provide a more in-depth analysis of the scientific literature specific to the topic of risk management of agri-food value chains and would make paradigm shifts easier to be identified, by performing comparative bibliometric studies based on different publishing periods.

Acknowledgements This paper was developed through the institutional project entitled “Necesitate și posibilități de creare și dezvoltare a centrelor de achiziții, prelucrare, ambalare și livrare a produselor agroalimentare” [“Need and possibilities for the creation and development of centers for the acquisition, processing, packaging and delivery of agri-food products”], financed by Bucharest University of Economic Studies.

References

- Andrei, J.V., Chivu, L., Constantin, M., Subić, J.: Economic aspects of international agricultural trade and possible threats to food security in the EU-27: a systematic statistical approach. In: Erokhin V., Tianming G., Andrei, J.V. (eds.) *Shifting Patterns of Agricultural Trade*. Springer, Singapore (2021). https://doi.org/10.1007/978-981-16-3260-0_10
- Barrett, C.B.: Overcoming global food security challenges through science and solidarity. *Am. J. Agr. Econ.* **103**(2), 422–447 (2021)
- Chivu, L., Constantin, M., Privitera, D., Andrei, J.: Land grabbing, land use, and food export competitiveness: bibliometric study of a paradigm shift. In: Erokhin V., Tianming G., Andrei J.V. (eds.) *Shifting Patterns of Agricultural Trade*. Springer, Singapore (2021). https://doi.org/10.1007/978-981-16-3260-0_6
- Constantin, M., Radulescu, I. D., Andrei, J. V., Chivu, L., Erokhin, V. & Gao, T.: A perspective on agricultural labor productivity and greenhouse gas emissions in the Context of the Common Agricultural Policy exigencies. *Econ. Agric.* **68**(1), 53–67 (2021). <https://doi.org/10.5937/ekoPolj2101053C>
- Constantin, M., Strat, G., Deaconu, M.E., Pătărlăgeanu, S.R.: Innovative agri-food value chain management through a unique urban ecosystem. *Manag. Res. Pract.* **13**(3), 5–22 (2021). <http://www.mrp.ase.ro/no133/f1.pdf>
- Dinu, M., Pătărlăgeanu, S.R., Chiripuci, B., Constantin, M.: Accessing the European funds for agriculture and rural development in Romania for the 2014–2020 period. In: *Proceedings of the International Conference on Business Excellence*, vol. 14, no. 1, pp. 717–727 (2020). <https://doi.org/10.2478/picbe-2020-0068>
- Ebi, K.L., Harris, F., Sioen, G.B., Wannous, C., Anyamba, A., Bi, P., Boeckmann, M., Bowen, K., Cissé, G., Dasgupta, P., Dida, G.O., Gasparatos, A., Gatzweiler, F., Javadi, F., Kanbara, S., Kone, B., Maycock, B., Morse, A., Murakami, T., Capon, A.: Transdisciplinary research priorities for human and planetary health in the context of the 2030 Agenda for sustainable development. *Int. J. Environ. Res. Public Health* **17**(23), 8890 (2020)
- European Commission: *First Report on the Harmonisation of Risk Assessment Procedures. Part 1: The Report of the Scientific Steering Committee’s Working Group on Harmonisation of Risk Assessment Procedures in the Scientific Committees advising the European Commission in the area of human and environmental health*, pp. 24 (October 2000)
- Fan, C., Chen, Y., Ma, H., Wang, G.: Comparative study of multimedia models applied to the risk assessment of soil and groundwater contamination sites in Taiwan. *Journal of Hazardous Materials* **182**(1), 778–786 (2010)

- Genovese, A., Acquaye, A.A., Figueroa, A., Koh, S.C.L.: Sustainable supply chain management and the transition towards a circular economy: Evidence and some applications. *Omega* **66**, 344–357 (2017)
- Hood, W.W., Wilson, C.S.: The literature of bibliometrics, scientometrics, and informetrics. *Scientometrics* **52**(2), 291 (2001)
- Houghton, J.R., Rowe, G., Frewer, L.J., Van Kleef, E., Chrysoschoidis, G., Kehagia, O., Korzen-Bohr, S., Lassen, J., Pfenning, U., Strada, A.: The quality of food risk management in Europe: perspectives and priorities. *Food Policy* **33**(1), 13–26 (2008)
- Ignat, R., Constantin, M.: Short-term effects of COVID-19 pandemic on agri-food value chains in Romania. In: *Innovative Models to Revive the Global Economy*, pp. 578–588, Sciendo (2020). <https://doi.org/10.2478/9788395815072-058>
- Ignat, R., Lazăr, V., Costea, A.P.: Economic resilience: a bibliometric analysis of the concept. “Ovidius” Univ. Ann. Econ. **XX**(2), 355–361 (2020)
- Istudor, N., Ion, R.A., Petrescu, I.E., Hrebenciuc, A.: Agriculture and the twofold relationship between food security and climate change. Evidence from Romania. *Amfiteatru Econ.* **21**(51), 285–293 (2019)
- Kruse, H.: Globalization of the food supply—food safety implications: Special regional requirements: future concerns. *Food Control* **10**(4), 315–320 (1999)
- Liu, X., Song, Q., Tang, Y., Li, W., Xu, J., Wu, J., Wang, F., Brookes, P.C.: Human health risk assessment of heavy metals in soil-vegetable system: a multi-medium analysis. *Sci. Total Environ.* pp. 463–464, pp. 530–540 (2013)
- McElwee, P., Calvin, K., Campbell, D., Cherubini, F., Grassi, G., Korotkov, V., Hoang, A.L., Lwasa, S., Nkem, J., Nkonya, E., Saigusa, N., Soussana, J.-F., Taboada, M.A., Manning, F., Nampanzira, D., Smith, P.: The impact of interventions in the global land and agri-food sectors on Nature’s Contributions to People and the UN Sustainable Development Goals. *Glob. Change Biol.* **26**(9), 4691–4721 (2020)
- Miles, D.W., Ross, T.: Identifying and quantifying risks in the food production chain. *Food Aust.* **51**(7), 298–303 (1999)
- Min, H.: Blockchain technology for enhancing supply chain resilience. *Business Horizons* **62**(1), 35–45 (2019). <https://doi.org/10.1016/j.bushor.2018.08.012>
- Orîndaru, A., Popescu, M.-F., Căescu, Ștefan-C., Botezatu, F., Florescu, M.S., Runceanu-Albu, C.-C.: Leveraging COVID-19 outbreak for shaping a more sustainable consumer behavior. *Sustainability* **13**(11), 5762 (2021). <https://doi.org/10.3390/su13115762>
- Pătărlăgeanu, S.R., Dinu, M., Constantin, M.: Bibliometric analysis of the field of Green Public Procurement. *Amfiteatru Econ.* **22**(53), 71–81 (2020)
- Pătărlăgeanu, S.R., Constantin, M., Strat, G., Deaconu, M.E.: *Best Practices of Circular Activities in the Agri-Food Sector from the Netherlands and Romania*, Editura ASE: Bucharest, Romania, (2021). ISBN 978-606-34-0375-0. <https://www.ceeol.com/search/book-detail?id=949510>
- Petriariu, R., Constantin, M., Dinu, M., Pătărlăgeanu, S.R., Deaconu, M.E.: Water, energy, food, waste nexus: Between synergy and trade-offs in Romania based on entrepreneurship and economic performance. *Energies* **14**(16), 5172 (2021). <https://doi.org/10.3390/en14165172>
- Popescu, M.-F.: The link between innovation, digitalization and the energy sector. A bibliometric analysis. *J. Emerg. Trends Mark. Manag.* **1**(1), 306–318 (2020)
- Sadhra, S.S., Wheatley, A.D., Cross, H.J.: Dietary exposure to copper in the European Union and its assessment for EU regulatory risk assessment. *Science of the Total Environment* **374**(2), 223–234 (2007)
- Shahid, A., Almogren, A., Javaid, N., Al-Zahrani, F.A., Zuair, M., Alam, M.: Blockchain-based agri-food supply chain: a complete solution. *IEEE Access* **8**, 69230–69243 (2020). <https://doi.org/10.1109/ACCESS.2020.2986257>
- Stoian, M., Caprita, D.: Organic agriculture: opportunities and trends. In: Popescu, G. (ed.), *Agrifood Economics and Sustainable Development in Contemporary Society*, pp. 275–293, IGI Global (2019). <https://doi.org/10.4018/978-1-5225-5739-5.ch013>

- Stone, J., Rahimifard, S.: Resilience in agri-food supply chains: a critical analysis of the literature and synthesis of a novel framework. *Supply Chain Manag. Int. J.* **23**(3), 207–238 (2018)
- Tian, F.: A supply chain traceability system for food safety based on HACCP, blockchain Internet of things. In: 2017 International Conference on Service Systems and Service Management, pp. 1–6 (2017). <https://doi.org/10.1109/ICSSSM.2017.7996119>
- United Nations: Transforming our World: The 2030 Agenda for Sustainable Development A/RES/70/1 (2015).
- van Eck, N.J., Waltman, L.: Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics* **84**(2), 523–538 (2010)
- Van Leeuwen, C.J., Bro-Rasmussen, F., Feijtel, T.C.J., Arndt, R., Bussian, B.M., Calamari, D., Glynn, P., Grandy, N.J., Hansen, B., Van Hemmen, J.J., Hurst, P., King, N., Koch, R., Müller, M., Solbé, J.F., Speijers, G.A.B., Vermeire, T.: Risk assessment and management of new and existing chemicals. *Environmental Toxicology and Pharmacology* **2**(4), 243–299 (1996)
- Varzakas, T.H., Chrysochoidis, G., Argyropoulos, D.: Approaches in the risk assessment of genetically modified foods by the Hellenic Food Safety Authority. *Food Chem. Toxicol. Int. J. Publ. Br. Ind. Biol. Res. Assoc.* **45**(4), 530–542 (2007)
- Wang, Y., Yang, C., Hou, H.: Risk management in perishable food distribution operations: a distribution route selection model and whale optimization algorithm. *Industrial Management & Data Systems* **120**(2), 291–311 (2019)