

Trends and research on Covid-19 and farmers using VOSviewer

Ramírez-Vásquez, J. Daniel¹; Figueroa-Rodríguez, Katia A. ^{1*}; Velasco-Velasco, Joel¹; Aguilar-Rivera, Noe²

¹ Colegio de Postgraduados Campus Córdoba. Carretera Córdoba-Veracruz. Congregación Manuel León, Municipio de Amatlán de los Reyes km 348, Veracruz, México. C.P. 94946.

² Universidad Veracruzana Facultad de Ciencias Biológicas y Agropecuarias, km 1 carretera Peñuela-Amatlán, 94945, Córdoba, Veracruz, México.

* Correspondence: fkatia@colpos.mx

ABSTRACT

Objective: The aim of this study was to use bibliometric analysis to provide an overview of the empirical and theoretical research that has been carried out regarding COVID-19 focusing on scientific publications on the topic of farmers.

Design/methods/approach: The global literature on COVID-19 and agricultural producers (farmers) published between 2019 and 2022 (August 8), was obtained from the SCOPUS database, comprising a total of 665 documents. VOSviewer was used to perform a bibliometric analysis of these papers.

Results: The two countries that published the most research related to the terms studied were the United States and India. Research conducted in these countries was found in the most cited studies. The studies focused on five major topics: agriculture, epidemiology, psychology, economic impact, as well as rural areas and risk determination. The evolution of the topics over time showed that the research originally began with health-oriented studies, and that once the protocols for the return to normal were generated, studies were carried out to visibilize the producers and their challenges during the pandemic in addition to the support strategies that were generated and the impact that the pandemic had on them, as well as on the local, regional, national, and global economy.

Limitations/implications: The documents analyzed are exclusive to the SCOPUS database, so literature was excluded from other sources such as Google Scholar or Web of Science, which could contain important information on the subject in relation to other disciplines.

Findings/conclusions: This type of study makes it possible to better understand the current state of the art regarding the effect of COVID-19 on the agri-food sector, thus allowing researchers to visualize the relevance of, and guide, their research on the topic.

Keywords: bibliometric analysis; resilience; farming; SARS-CoV-2; pandemic; farm workers.

INTRODUCTION

In January 2020, the WHO defined SARS-CoV 2 as a new disease caused by the coronavirus or COVID-19 (Radulova *et al.*, 2020). This disease spread rapidly among the population, causing symptoms similar to those of atypical pneumonia (Shirani and Toghyani, 2020). It became a global pandemic that led to the greatest economic, social, and health crisis of the modern era. It is estimated that at least 10% of the world population contracted the disease (Mora-Alvarado, 2022), causing the governments of each country as well as international organizations to urgently implement various strategies to mitigate the effects and adapt to this new reality and global emergency (Davila *et al.*, 2021).

The COVID-19 pandemic resulted in movement restrictions and changes in consumption habits (González-Alejo *et al.*, 2020), which socioeconomically affected the

Citation: Ramírez-Vásquez, J. D., Figueroa-Rodríguez, K. A., Velasco-Velasco, J., & Aguilar-Rivera, N. (2022). Trends and research on Covid-19 and farmers using VOSviewer. *Agro Productividad*. <https://doi.org/10.32854/agrop.v15i11.2412>

Academic Editors: Jorge Cadena Iñiguez and Libia Iris Trejo Téllez

Received: October 24, 2022.

Accepted: November 19, 2022.

Published on-line: December 20, 2022.

Agro Productividad, 15(11). November. 2022. pp: 165-176.

This work is licensed under a Creative Commons Attribution-Non-Commercial 4.0 International license.



population and various sectors around the world (Lopez-Ridaura *et al.*, 2021). The agri-food sector was no exception (Lopez-Ridaura *et al.*, 2021). Agribusiness, the supply of inputs, and sales of agricultural products were interrupted (Amjath-Babu *et al.*, 2020). The restrictions on ports and borders, the curfews, as well as social distancing reduced productivity and therefore the competitiveness of the agri-food sector (Rahimi *et al.*, 2022). Agricultural producers were one of the most vulnerable actors because in some cases they did not stop their activity, putting themselves at risk. At the same time, those who limited social contact in their capacity as food suppliers caused a negative effect (Triana *et al.*, 2021).

Due to the importance of this global phenomenon, unprecedented scientific research related to COVID-19 was conducted in various countries (Lou *et al.*, 2020). The literature on COVID-19 is relatively recent (since 2019), but abundant, with over 350,000 publications in the Scopus database. Nearly 10% are literature reviews. This type of publication allows scientists to learn about general aspects of the disease (Lai *et al.*, 2020) and its impact on the global population (Nicola *et al.*, 2020).

Bibliometric analysis is a method that determines scientific activity by quantitatively analyzing scientific publications (Soytas, 2021). One of the first bibliometric analyses regarding COVID-19 was carried out by Al-Zaman (2020), who concluded that the most numerous articles were those related to medicine. Zyoud *et al.* (2022) found that studies related to clinical research were the most frequent. Other very recent bibliometric analyses regarding COVID-19 focused on topics such as: business and management (Verma and Gustafsson, 2020); supply chains (Fabeil *et al.*, 2023); agrifood chains (Das and Roy, 2022); nutrition (Zyoud *et al.*, 2022); tourism (Viana-Lora and Nel-lo-Andreu, 2022); agricultural production and food security (Okolie and Ogundeji, 2022); social sciences (Singh and Verma, 2022); education (Zhang *et al.*, 2022); and nanotechnology (Lunardi *et al.*, 2022). Despite the availability of previous reviews, there are, to our knowledge, no publications that address the topic of farmers. Hence, the objective of this study was to use bibliometric analysis to provide an overview of the empirical and theoretical research that has been conducted on COVID-19 with an emphasis on scientific publications that address the topic of farmers.

MATERIALS AND METHODS

The data used in this paper was obtained from the Scopus database (www.scopus.com), one of the largest indexed databases in the world (Hamidah *et al.*, 2020). The words entered in the Scopus search engine on August 8, 2022 were 'COVID-19' and 'farmers'^[1]. Of the 710 documents found, only articles, reviews, conference papers, and book chapters were considered in the study, because they have the greatest scientific impact. In the end, 665 documents were retained.

In order to improve the consistency of the results, the database was homogenized (Niñerola *et al.*, 2019); for example, the word COVID-19 was used for all words related

¹ The word 'farmers' was used in order to represent agricultural producers.

to the disease such as: ‘coronavirus’, ‘coronavirus disease’, ‘coronavirus infection’, ‘sars-cov-2-19’, ‘betacoronavirus’, and ‘covid-19 pandemic’; plural words were replaced by the singular, for example ‘coping strategies’ by ‘coping strategy’, ‘fruits’ by ‘fruit’, and ‘animals’ by ‘animal’.

Content analysis

VOSviewer version 1.6.9 (Centre for Science and Technology Studies, 2018) was used for metadata analysis. This software builds and visualizes bibliometric networks (van Eck and Waltman, 2010). An analysis of the co-occurrence of keywords and academic terms in the titles and abstracts of the publications was carried out, using the co-occurrence method, showing only related elements, and using the association strength (AS) normalization method, a resolution of 1.00, a visualization scale of 100%, TLS weight, a label variation size of 50%, and a kernel width of 30% (van Eck and Waltman, 2010). For the analysis, only those that coincided at least 5 times in the count were considered. Of the 3996 results, only 205 were below this threshold. Generic words such as ‘COVID-19’, ‘human’, ‘pandemics’, ‘farmer’, ‘survey’, and ‘article’ were removed from the software base.

RESULTS AND DISCUSSION

A total of 665 documents were analyzed, of which 78% were articles, 13% were conference papers, 7% review articles, and 3% book chapters. The aim was to use the bibliometric analysis to visualize the empirical and theoretical research that has been conducted regarding COVID-19 with an emphasis on those that have addressed the topic of farmers.

Performance analysis

Table 1 presents the 10 main scientific journals and the countries with the highest number of publications related to COVID-19 and farmers. A total of 367 documents were found. The source with the highest number of publications was IOP Conference Series: Earth and Environmental Science, which has an SJR-2021 indicator of 0.20. It should be noted that these are conference papers, which makes sense due to the time required to publish in scientific journals, providing the scientific community with information on the subject in a shorter amount of time. It is also consistent with the fact that these conference papers have been cited 22,362 times. The topics addressed by the main sources, which, except for the case described above, are scientific journals, focus on aspects related to health sciences, sustainability, and the agri-food sector, in addition to multidisciplinary topics. The journals with topics related to health sciences were: *Journal of Agromedicine*, *Frontiers and Public Health*, and *International Journal of Environmental Research and Public Health*; those with topics related to sustainability were *Sustainability*, *Frontiers in Sustainable Food Systems*, and *Food Security*; those with topics related to the agri-food sector were *Agricultural Systems* and *Indian Journal of Animal Sciences*; finally, the multidisciplinary scientific journal *PLOS ONE*.

192 countries were listed, of which 108 had at least one publication, with the United States, India, and China being the most productive (Figure 1). The United States was the country with the highest number of documents, with 19% of the total publications; this is because it is a leading country in science and innovation. Regarding affiliation, the documents came from 676 different affiliations, none of which was outstanding in terms of the number of publications.

Table 2 shows the ten most cited documents. Of the total number of documents, 401 were cited at least once, accumulating a total of 4395 citations. Only three documents had

Table 1. Performance analysis: number of publications by source and country.

Rank	Source	NPs	Country	NPs
1	IOP Conference Series: Earth and Environmental Science	36	USA	125
2	Sustainability	25	India	118
3	Agricultural Systems	29	China	75
4	Journal of Agromedicine	12	Indonesia	74
5	Frontiers in Sustainable Food Systems	10	United Kingdom	47
6	Food Security	10	Australia	27
7	Indian Journal of Animal Sciences	10	France	23
8	PLOS ONE	8	Germany	22
9	Frontiers in Public Health	8	Netherlands	22
10	International Journal of Environmental Research and Public Health	7	Nigeria	22

NPs: number of publications. Source: Own elaboration with SCOPUS data (August 8, 2022).

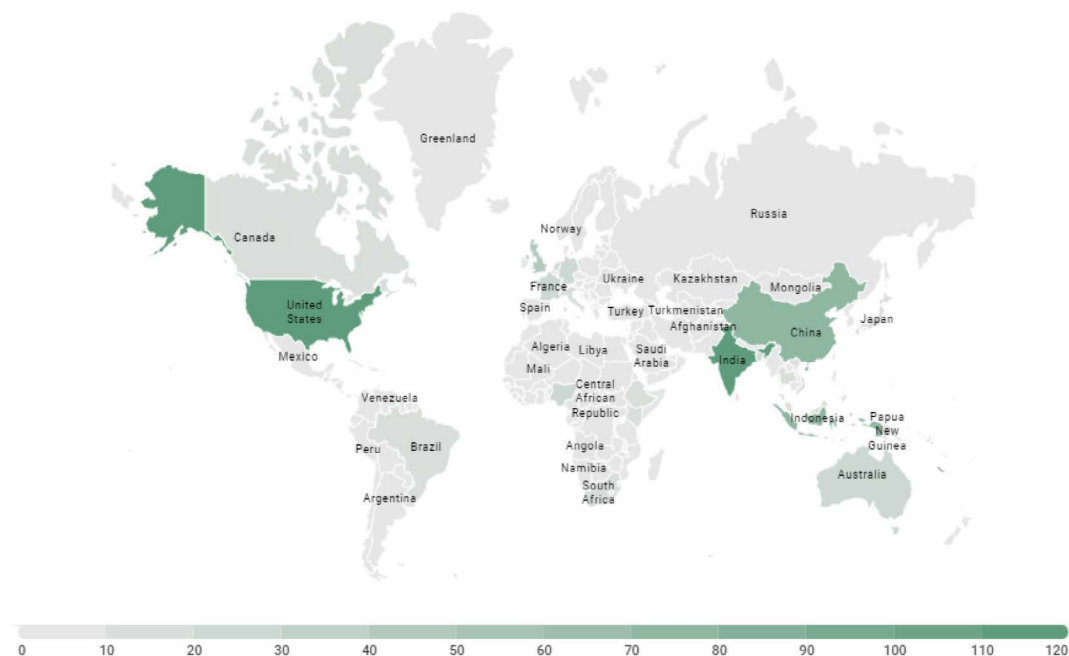


Figure 1. Worldwide distribution of publications related to research on COVID-19 and farmers. Source: Own elaboration with SCOPUS data (August 8, 2022).

more than 100 citations. Among the most cited documents, seven correspond to research articles and three to literature reviews. The articles deal with various topics; some do not involve farmers but rather the general population, for example, Di Renzo *et al.* (2020) studied the impact of the pandemic on eating habits; Kansime *et al.* (2021), evaluated the effects of the pandemic on household income and food security; Li *et al.* (2020) determined the behavior of consumers purchasing grocery products; and Abedin *et al.* (2021) identified trends in the public's willingness to be vaccinated. The articles that focused on the topic of farmers were as follows: Harris *et al.* (2020) evaluated the impact of the pandemic on the livelihoods and dietary effects of vegetable producers; Ceballos *et al.* (2020) determined the impact of the pandemic on farmer income; and finally one article focused on the agri-food sector: Mahajan and Tomar (2021) analyzed the disruption of food supply chains due to the economic shutdown caused by COVID-19.

Table 2. Most cited documents on COVID-19 and farmers (August 8, 2022).

#	Title	Document type	Authors (year)	Source	Citations
1	Eating habits and lifestyle changes during COVID-19 lockdown: An Italian survey	Article	Di Renzo <i>et al.</i> (2020)	Journal of Translational Medicine	815
2	Impact of COVID-19 on the food supply chain	Literature review	Aday and Aday (2020)	Food Quality and Safety	203
3	COVID-19 implications on household income and food security in Kenya and Uganda: Findings from a rapid assessment	Article	Kansime <i>et al.</i> (2021)	World Development	138
4	Challenges to the poultry industry: current perspectives and strategic future after the COVID-19 outbreak	Literature review	Hafez and Attia (2020)	Frontiers in Veterinary Science	80
5	Food system disruption: initial livelihood and dietary effects of COVID-19 on vegetable producers in India	Article	Harris <i>et al.</i> (2020)	Food Security	77
6	Impacts of a national lockdown on smallholder farmers' income and food security: Empirical evidence from two states in India	Article	Ceballos <i>et al.</i> (2020)	World Development	71
7	Changing grocery shopping behaviours among Chinese consumers at the outset of the COVID-19 outbreak	Article	Li <i>et al.</i> (2020)	Tijdschrift voor Economische en Sociale Geografie	70
8	COVID-19 and supply chain disruption: evidence from food markets in India	Article	Mahajan and Tomar (2021)	American Journal of Agricultural Economics	65
9	Willingness to vaccinate against COVID-19 among Bangladeshi adults: Understanding the strategies to optimize vaccination coverage	Article	Abedin <i>et al.</i> (2021)	PLOS ONE	64
10	Preliminary report of an outbreak of SARS-CoV-2 in mink and mink farmers associated with community spread, Denmark, June to November 2020	Literature review	Larsen <i>et al.</i> (2021)	Eurosurveillance	56

Source: Own elaboration with SCOPUS data (August 8, 2022).

The literature reviews also focused on various topics; the most cited review addressed a more general topic. In other words, it focused on the impact of COVID on agrifood chains (Aday and Aday, 2020); another review addressed the challenges of the poultry industry in the face of the pandemic (Hafez and Attia, 2020); and the topic of the third was mink-farm-owning producers in Denmark and how COVID-19 spread between farms (Larsen *et al.*, 2021).

Scientific mapping

The VOSviewer results established 3996 keywords, of which those with co-occurrences greater than five were retained, forming a total of 5 clusters with 205 links. Figure 2 shows these clusters as follows: the first (red) refers to agriculture; the second (green) to epidemiology; the third (blue) brings together topics related to psychology (occupational and mental health, poverty, and migration); the fourth (yellow) deals with economic impact; and the fifth (purple) covers topics related to rural areas and risk determination.

Figure 3 shows that the publications on research related to COVID-19 and farmers are recent. They began in 2019, a few months after the appearance of the disease, which is an indicator that the scientific community quickly started publishing information about the disease and assessing the impact that COVID-19 had on the population and the world economy.

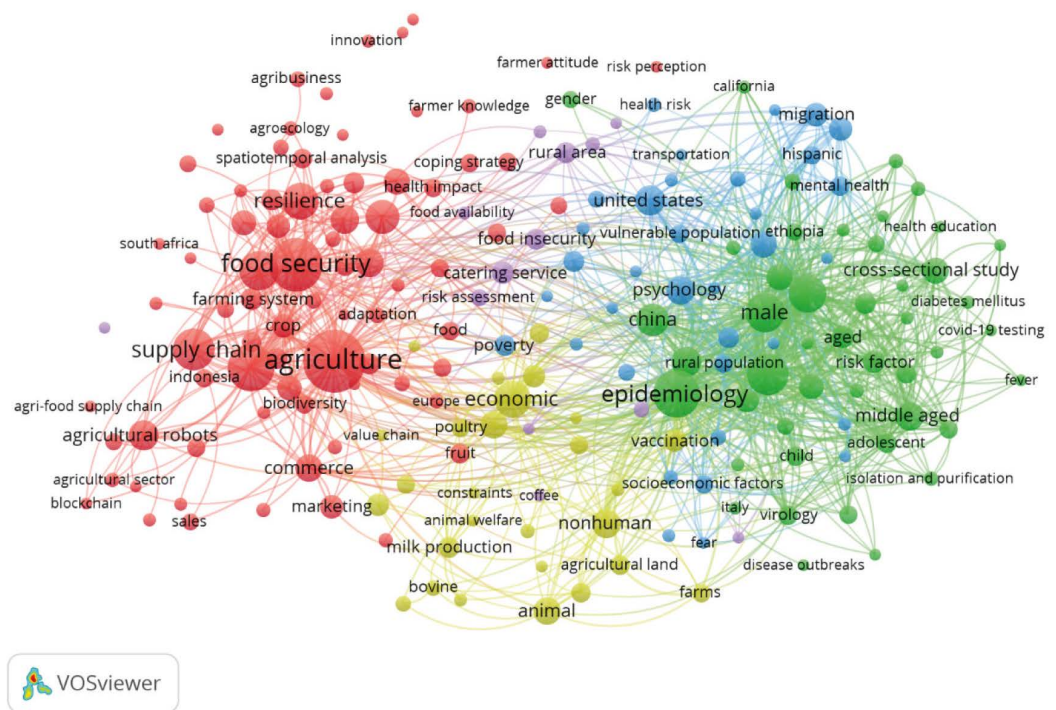


Figure 2. Network visualization of COVID-19 and farmers (665 documents) using the VOSviewer program. The following terms were removed: ‘COVID-19’, ‘human’, ‘article’, ‘farmer’, ‘pandemic’, and ‘survey’. Source: Own elaboration with SCOPUS® data (August 8, 2022).

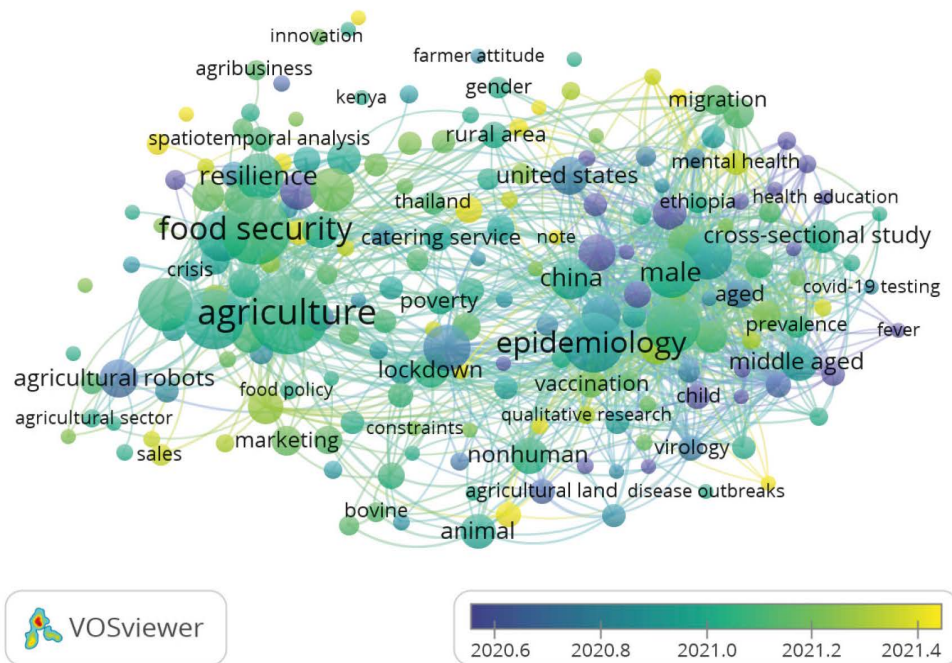


Figure 3. Overlay visualization of COVID-19 and farmers (325 documents), using the VOSviewer program. The following terms were removed: ‘COVID-19’, ‘human’, ‘article’, ‘farmer’, ‘pandemic’, and ‘survey’. Source: Own elaboration with SCOPUS® data (August 8, 2022).

The published research on COVID-19 and farmers has focused mainly on five aspects: the first being issues related to agriculture, the second to epidemiology, the third to economic impact, the fourth to livestock, and the fifth to the rural population and food insecurity.

Agriculture, food security, and resilience

The publications analyzed in this cluster focus mainly on the effects of the pandemic on food security, supply chains, and the role of resilience in agricultural systems as well as for farmers.

Food security refers to physical and economic access to sufficient, safe, and nutritious food (Rozaki, 2020). The application of strict measures during the pandemic caused significant repercussions on agriculture and therefore on food security (Kansiime *et al.*, 2021). This crisis exposed the fragility of the farmers’ livelihoods, threatening their food security and well-being (Kumar *et al.*, 2020). As agriculture is one of the main components of agri-food supply chains, the analysis of the negative effects of COVID-19 on these chains became relevant (Kumar and Kumar Singh, 2021).

With regard to resilience, Ahmed *et al.* (2020) defines this term as the capacity of a system to absorb disturbances and maintain the same structure and functions. Studies on resilience focused mainly on agricultural systems (Dixon *et al.*, 2021; Middendorf *et al.*, 2021), agricultural markets (Varshney *et al.*, 2020), and the creation of adequate public policies in order to mitigate the effects caused by the COVID-19 crisis (Kumar and Kumar Singh, 2021).

Epidemiology

Since COVID-19 is an infectious disease, one of the biggest challenges was understanding how transmission occurred between humans and whether animals were also transmitters or at what points in agricultural and market activities humans could become infected. The most cited study in this cluster was that of Larsen *et al.* (2021), who implemented an epidemiological surveillance system around mink farms in order to determine infections in the community. They found that the minks were infected and developed a COVID-19 strain that could in turn be retransmitted to humans. Other studies related to the topic have been carried out in countries such as China (Li *et al.*, 2020), the United States (Quandt *et al.*, 2021), and India (Ceballos *et al.*, 2020).

Psychology, mental health, and vulnerable populations

The publications that belonged to this cluster analyzed the impact that COVID-19 had on different aspects of human life; for example, on mental health (Paul *et al.*, 2021), access to health services (Quandt *et al.*, 2021), resilience (Dixon *et al.*, 2021), and consumption habits (Paul *et al.*, 2021).

Later studies focused on agricultural workers who continued to work when carrying out essential activities, so the researchers reported them as invisible and unprotected workers who needed to be visibilized and studied (Dudley, 2020). Once the impact of COVID-19 on the sector was established, researchers began to propose support models for farmers and inhabitants of rural areas (Ramos *et al.*, 2020).

In a third phase, and as vaccines were developed, a series of studies focused on understanding the reluctance of farmers and inhabitants of rural areas to be vaccinated, in order to propose strategies that would allow for the optimization of vaccination coverage (Abedin *et al.*, 2021).

Economic impact

The documents in this cluster focused on analyzing the impact that COVID-19 had on the economy at the global, national, and individual levels with an emphasis on the agri-food sector. At the global level, Mohapatra *et al.* (2020) described the impact on the agricultural sector and on the economy in general. At the national level, for example, Pan *et al.* (2020) determined the impact on China's agricultural economy; Varshney *et al.* (2020) evaluated the impact on the price of agricultural products and on market chains in India; and Dokić *et al.* (2020) conducted a study on the impact on Croatia's trade balance. At the individual level, Jaacks *et al.* (2021) evaluated whether there was an effect on farmer income, and Quandt *et al.* (2021) determined whether there were negative effects on the incomes of Latino families in urban and rural areas, just to mention some of the studies.

Rural areas and risk determination

The smallest cluster grouped few concepts, the most relevant of which was rural areas. This included aspects related to rural inhabitants such as agricultural workers, agribusiness, and agrifood chains. These studies highlighted the fact that the population in rural regions was particularly vulnerable to infection by COVID-19 due to misinformation or the need

to work, while adults whose children had migrated to cities were more likely to suffer from isolation (Meredith *et al.*, 2020). In some cases related to agrotourism, the negative impact of the pandemic was reported, along with strategies recommended for owners in order to create alternative sources of income (Zanetti *et al.*, 2022).

Risk was a topic related to rural areas. The studies addressed aspects such as resilience and risk factors for transmission of COVID-19. For example, in one study conducted in a market in China (Li *et al.*, 2021), the authors observed that most of the positive samples were found in the aisles of the market, with multiple microspheres in various routes, as well as on bathroom handles and other frequently touched surfaces. They also found positive samples on products for sale (aquaculture, soy-based products), so transmission occurred through droplets or fomites (passive vectors such as viruses, fungi, or parasites). This type of study allowed governments to establish disinfection policies and maximum capacity in public spaces, and also make general recommendations for the population to stay at home and disinfect the products they purchase in the market.

CONCLUSIONS

Bibliometric studies are a powerful tool that make it possible to systematize large amounts of research to determine trends and establish the relevance of different lines of research. In this study, we conducted a bibliometric analysis of the terms ‘COVID-19’ and ‘farmers’, using data from the titles, abstracts, and keywords of articles published in major journals and other peer-reviewed documents, available in the SCOPUS database from 2019 to 2022 (August 8). The two countries that published the most research related to the terms studied were the United States and India. Research conducted in these countries was found in the most cited studies.

The studies focused on five major topics: agriculture, epidemiology, psychology, economic impact, as well as rural areas and risk determination. The evolution of the topics over time showed that the research originally began with health-oriented studies, and that once the protocols for the return to normal were generated, studies were carried out to visibilize the producers and their challenges during the pandemic in addition to the support strategies that were generated and the impact that the pandemic had on them, as well as on the local, regional, national, and global economy. This type of study makes it possible to better understand the current state of the art regarding the effect of COVID-19 on the agri-food sector.

The limitation of the study is the fact that the documents analyzed are exclusive to the SCOPUS database, so literature from other sources such as Google Scholar or Web of Science, which could contain important information on the subject, was excluded. Therefore, it is suggested that further studies analyzing these databases be conducted and that other, more multidisciplinary approaches be taken.

REFERENCES

- Abedin, M., M. A. Islam, F. N. Rahman, H. M. Reza, M. Z. Hossain, M. A. Hossain, A. Arefin, and A. Hossain. 2021. Willingness to vaccinate against COVID-19 among Bangladeshi adults: Understanding the strategies to optimize vaccination coverage. *PLoS ONE* 16.

- Aday, S. and M. S. Aday. 2020. Impact of COVID-19 on the food supply chain. *Food Quality and Safety* 4: 167-180.
- Ahmed, S., S. M. Downs, C. Yang, L. Chunlin, N. ten Broek, and S. Ghosh-Jerath. 2020. Rapid tool based on a food environment typology framework for evaluating effects of the COVID-19 pandemic on food system resilience. *Food Security* 12: 773-778.
- Al-Zaman, M. S. 2020. Bibliometric analysis of COVID-19 literature. medRxiv: 2020.2007.2015.20154989.
- Amjath-Babu, T. S., T. J. Krupnik, S. H. Thilsted, and A. J. McDonald. 2020. Key indicators for monitoring food system disruptions caused by the COVID-19 pandemic: Insights from Bangladesh towards effective response. *Food Security* 12: 761-768.
- Ceballos, F., S. Kannan, and B. Kramer. 2020. Impacts of a national lockdown on smallholder farmers' income and food security: Empirical evidence from two states in India. *World Development* 136.
- Das, N. K. and A. Roy. 2022. COVID-19 and agri-food value chain: a systematic review and bibliometric mapping. *Journal of Agribusiness in Developing and Emerging Economies* 12: 442-462.
- Davila, F., R. M. Bourke, A. McWilliam, S. Crimp, L. Robins, M. van Wensveen, R. G. Alders, and J. R. A. Butler. 2021. COVID-19 and food systems in Pacific Island Countries, Papua New Guinea, and Timor-Leste: Opportunities for actions towards the sustainable development goals. *Agricultural Systems* 191.
- Di Renzo, L., P. Gualtieri, F. Pivari, L. Soldati, A. Attinà, G. Cinelli, C. Leggeri, G. Caparello, L. Barrea, F. Scerbo, E. Esposito, and A. De Lorenzo. 2020. Eating habits and lifestyle changes during COVID-19 lockdown: An Italian survey. *Journal of Translational Medicine* 18.
- Dixon, J. M., J. Weerahewa, J. Hellin, M. F. Rola-Rubzen, J. Huang, S. Kumar, A. Das, M. E. Qureshi, T. J. Krupnik, K. Shideed, M. L. Jat, P. V. V. Prasad, S. Yadav, A. Irshad, A. Asanaliev, A. Abugalieva, A. Karimov, B. Bhattarai, C. Q. Balgos, F. Benu, H. Ehara, J. Pant, J. M. P. Sarmiento, J. C. Newby, J. Pretty, H. Tokuda, H. Weyerhaeuser, L. N. Digal, L. Li, M. A. R. Sarkar, M. Z. Abedin, P. Schreinemachers, Q. Grafton, R. C. Sharma, S. Saidzoda, S. Lopez-Ridaura, S. Coffey, S. P. Kam, S. S. Win, S. Praneetvatakul, T. Maraseni, V. Touch, W.-I. Liang, Y. S. Saharawat, and J. Timsina. 2021. Response and resilience of Asian agrifood systems to COVID-19: An assessment across twenty-five countries and four regional farming and food systems. *Agricultural Systems* 193: 103168.
- Dokić, D., M. Gavran, M. Gregić, and V. Gantner. 2020. The Impact of Trade Balance of Agri-Food Products on the State's Ability to Withstand the Crisis. *HighTech and Innovation Journal* 1: 107-111.
- Dudley, M. J. 2020. Reaching Invisible and Unprotected Workers on Farms during the Coronavirus Pandemic. *Journal of Agromedicine* 25: 427-429.
- Fabeil, N. F., K. H. Pazim, J. Langgat, R. Asid, R. Mahmud, and N. Daut. 2023. Supply chain resilience: Exploring the research trends through a bibliometric approach. *Lecture Notes in Networks and Systems*. pp: 1173-1184.
- González-Alejo, A. L., B. Ajuria, P. Manzano-Fischer, J. S. Flores, and D. S. Monachon. 2020. Alternative food networks and the reconfiguration of food environments in the time of covid-19 in Mexico. *Finisterra* 55: 197-203.
- Hafez, H. M. and Y. A. Attia. 2020. Challenges to the poultry industry: Current perspectives and strategic future after the COVID-19 outbreak. *Frontiers in Veterinary Science* 7.
- Hamidah, I., S. Sriyono, and M. N. Hudha. 2020. A bibliometric analysis of Covid-19 research using vosviewer. 2020 5: 8.
- Harris, J., L. Depenbusch, A. A. Pal, R. M. Nair, and S. Ramasamy. 2020. Food system disruption: initial livelihood and dietary effects of COVID-19 on vegetable producers in India. *Food Security* 12: 841-851.
- Jaacks, L. M., D. Veluguri, R. Serupally, A. Roy, P. Prabhakaran, and G. V. Ramanjaneyulu. 2021. Impact of the COVID-19 pandemic on agricultural production, livelihoods, and food security in India: baseline results of a phone survey. *Food Security* 13: 1323-1339.
- Kansiime, M. K., J. A. Tambo, I. Mugambi, M. Bundi, A. Kara, and C. Owuor. 2021. COVID-19 implications on household income and food security in Kenya and Uganda: Findings from a rapid assessment. *World Development* 137.
- Kumar, A., A. K. Padhee, and S. Kumar. 2020. How Indian agriculture should change after COVID-19. *Food Security* 12: 837-840.
- Kumar, P. and R. Kumar Singh. 2021. Strategic framework for developing resilience in agri-food supply chains during COVID 19 pandemic. *International Journal of Logistics Research and Applications*: 1-24.
- Lai, C. C., T. P. Shih, W. C. Ko, H. J. Tang, and P. R. Hsueh. 2020. Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and coronavirus disease-2019 (COVID-19): The epidemic and the challenges. *International Journal of Antimicrobial Agents* 55.

- Larsen, H. D., J. Fonager, F. K. Lomholt, T. Dalby, G. Benedetti, B. Kristensen, T. R. Urth, M. Rasmussen, R. Lassaunière, T. B. Rasmussen, B. Strandbygaard, L. Lohse, M. Chaine, K. L. Møller, A. S. N. Berthelsen, S. K. Nørgaard, U. W. Sønksen, A. E. Boklund, A. S. Hammer, G. J. Belsham, T. G. Krause, S. Mortensen, A. Bøtner, A. Fomsgaard, and K. Mølbak. 2021. Preliminary report of an outbreak of SARS-CoV-2 in mink and mink farmers associated with community spread, Denmark, June to November 2020. *Eurosurveillance* 26.
- Li, J., A. G. Hallsworth, and J. A. Coca-Stefaniak. 2020. Changing grocery shopping behaviours among chinese consumers at the outset of the COVID-19 outbreak. *Tijdschrift voor Economische en Sociale Geografie* 111: 574-583.
- Li, X., Q. Wang, P. Ding, Y. Cha, Y. Mao, C. Ding, W. Gu, Y. Wang, B. Ying, X. Zhao, L. Pan, Y. Li, J. Chang, C. Meng, J. Zhou, Z. Tang, R. Sun, F. Deng, C. Wang, L. Li, J. Wang, C. R. MacIntyre, Z. Wu, Z. Feng, S. Tang, and D. Xu. 2021. Risk factors and on-site simulation of environmental transmission of SARS-CoV-2 in the largest wholesale market of Beijing, China. *Science of the Total Environment* 778.
- Lopez-Ridaura, S., A. Sanders, L. Barba-Escoto, J. Wiegel, M. Mayorga-Cortes, C. Gonzalez-Esquivel, M. A. Lopez-Ramirez, R. M. Escoto-Masis, E. Morales-Galindo, and T. S. García-Barcena. 2021. Immediate impact of COVID-19 pandemic on farming systems in Central America and Mexico. *Agricultural Systems* 192.
- Lou, J., S. J. Tian, S. M. Niu, X. Q. Kang, H. X. Lian, L. X. Zhang, and J. J. Zhang. 2020. Coronavirus disease 2019: A bibliometric analysis and review. *European Review for Medical and Pharmacological Sciences* 24: 3411-3421.
- Lunardi, C. N., F. L. Subrinho, M. P. F. Barros, R. C. Lima, A. C. M. Q. Melo, D. M. Barbosa, L. G. de Negreiros, B. S. Rodrigues, M. S. Neiva, J. V. R. Linhares, G. F. D. Costa, and A. J. Gomes. 2022. Bibliometric analysis: Nanotechnology and COVID-19. *Current Topics in Medicinal Chemistry* 22: 629-638.
- Mahajan, K. and S. Tomar. 2021. COVID-19 and supply chain disruption: evidence from food markets in India. *American Journal of Agricultural Economics* 103: 35-52.
- Meredith, D., J. McNamara, D. van Doorn, and N. Richardson. 2020. Essential and Vulnerable: Implications of Covid-19 for Farmers in Ireland. *Journal of Agromedicine* 25: 357-361.
- Middendorf, B. J., A. Faye, G. Middendorf, Z. P. Stewart, P. K. Jha, and P. V. V. Prasad. 2021. Smallholder farmer perceptions about the impact of COVID-19 on agriculture and livelihoods in Senegal. *Agricultural Systems* 190: 103108.
- Mohapatra, S., V. Priyanka, S. Mohapatra, I. Kohli, and R. K. Mishra. 2020. Impact of corona virus covid-19 on the global economy. *International Journal of Agricultural and Statistical Sciences* 16: 771-778.
- Mora-Alvarado, D. A. 2022. Sindemia de la "COVID-19" en el mundo. *Revista Tecnología en Marcha* 35: Pág. 107-119.
- Nicola, M., Z. Alsafi, C. Sohrabi, A. Kerwan, A. Al-Jabir, C. Iosifidis, M. Agha, and R. Agha. 2020. The socio-economic implications of the coronavirus pandemic (COVID-19): A review. *International Journal of Surgery* 78: 185-193.
- Niñerola, A., M.-V. Sánchez-Rebull, and A.-B. Hernández-Lara. 2019. Tourism research on sustainability: A bibliometric analysis. *Sustainability* 11: 1377.
- Okolie, C. C. and A. A. Ogundeji. 2022. Effect of COVID-19 on agricultural production and food security: A scientometric analysis. *Humanities and Social Sciences Communications* 9.
- Pan, D., J. Yang, G. Zhou, and F. Kong. 2020. The influence of COVID-19 on agricultural economy and emergency mitigation measures in China: A text mining analysis. *PLoS ONE* 15.
- Paul, A., T. K. Nath, J. Mahanta, N. N. Sultana, A. S. M. I. Kayes, S. J. Noon, M. A. Javed, S. Podder, and S. Paul. 2021. Psychological and livelihood impacts of COVID-19 on Bangladeshi lower income people. *Asia-Pacific Journal of Public Health* 33: 100-108.
- Quandt, S. A., N. J. LaMonte, D. C. Mora, J. W. Talton, P. J. Laurienti, and T. A. Arcury. 2021. COVID-19 pandemic among immigrant Latinx farmworker and non-farmworker families: A rural–urban comparison of economic, educational, healthcare, and immigration concerns. *New Solutions* 31: 30-47.
- Radulova, P., V. Dimitrova, and B. Slancheva. 2020. Coronavirus disease (COVID-19)-neonatal knowledge. Clinical cases. *Pediatrics* 60: 32-35.
- Ramos, A. K., E. Duysen, M. Carvajal-Suarez, and N. Trinidad. 2020. Virtual outreach: Using social media to reach spanish-speaking agricultural workers during the COVID-19 pandemic. *Journal of Agromedicine* 25: 353-356.
- Rozaki, Z. 2020. COVID-19, agriculture, and food security in Indonesia. *Reviews in Agricultural Science* 8: 243-260.

- Shirani, K. and A. Toghyani. 2020. COVID-19 pneumonia with scant respiratory symptoms. *Journal of Research in Medical Sciences* 25: 82-82.
- Singh, V. and S. Verma. 2022. Unearthing the response pattern of COVID-19 research in social sciences. *International Journal of Sociology and Social Policy* 42: 543-563.
- Soytas, R. B. 2021. A bibliometric analysis of publications on covid-19 and older adults. *Annals of Geriatric Medicine and Research* 25: 197-203.
- Triana, L., M. Mahdi, and R. Azhari. 2021. Impact of COVID-19 outbreak on horticultural farming in Tanah Datar Regency of West Sumatra Province, Indonesia. *IOP Conference Series: Earth and Environmental Science*.
- van Eck, N. J. and L. Waltman. 2010. Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics* 84: 523-538.
- Varshney, D., D. Roy, and J. V. Meenakshi. 2020. Impact of COVID-19 on agricultural markets: assessing the roles of commodity characteristics, disease caseload and market reforms. *Indian Economic Review* 55: 83-103.
- Verma, S. and A. Gustafsson. 2020. Investigating the emerging COVID-19 research trends in the field of business and management: A bibliometric analysis approach. *Journal of Business Research* 118: 253-261.
- Viana-Lora, A. and M. G. Nel-lo-Andreu. 2022. Bibliometric analysis of trends in COVID-19 and tourism. *Humanities and Social Sciences Communications* 9.
- Zanetti, B., M. Verrascina, F. Licciardo, and G. Gargano. 2022. Agritourism and farms diversification in Italy: What have we learnt from COVID-19? *Land* 11.
- Zhang, L., R. A. Carter, X. Qian, S. Yang, J. Rujimora, and S. Wen. 2022. Academia's responses to crisis: A bibliometric analysis of literature on online learning in higher education during COVID-19. *British Journal of Educational Technology* 53: 620-646.
- Zyoud, S. H., S. W. Al-Jabi, A. Koni, M. Shakhshir, M. Shahwan, and A. A. Jairoun. 2022. Mapping the landscape and structure of global research on nutrition and COVID-19: visualization analysis. *Journal of Health, Population and Nutrition* 41.