

Bibliometric Analysis of Agri-Food Supply Chain and Short Agro-Food Chain

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Abstract

The paper presents a bibliometric analysis about the papers of the research papers written in the scientific field that use one of the two notions "food supply chain" (SCI) - agri-food supply chain and "short food supply chain" (SFSC), the notion of "local food systems" (LFS) will be found also.

The database queried was the Web of Sciences platform containing journals, articles with scientific content from several publications. Web of Science information databases were then processed with VOSviewer software [3].

The results of research in Web of Science confirm the growing scientific interest in studying the subject of the "agri-food supply chain". Out of the total of 2702, 2622 records for SCI and 80 records for SFSC. The first article was published in 1995, then their number increased to 59 articles published in 2012 and 2013. In the next period, the interest for the scientific study of this subject increased from 254 in 2018, to 327 in 2019, and in 2020 the number of articles on the subject of SCI was 390, reaching 404 in 2021.

Keywords: *product chains, agri-food supply chain, short agri-food chain, local product, sustainability, bibliometric analysis, VOSviewer.*

JEL classification: Q 01, R 15, Q 13, Q56.

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1. Introduction

Under the new conditions created on the EU market, the pandemic crisis showed the interest of the authorities but also of the producer groups to intensify the development of mechanisms on product chains, in order to capitalize on raw materials, the development of short chains for two purposes: the development of quality schemes. to increase the value added of the raw material and through information campaigns to increase the consumer's interest in such guaranteed products. At the same time, the interest of public policies was directed towards finding solutions to eliminate some barriers on the short supply chain. Solutions in which interactions between farmers, processors, consumers should be avoided but also measures in which traders, carriers, logistics and human activities continue to allow exports, so as not to disrupt the supply chain.

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An FAO Report published in 2020, "COVID-19 and the risk to food supply chains: How to respond?" [1], reveals that COVID-19 and the risk to food supply chains: How to respond? Governments around the world have been concerned with identifying measures to intervene in the food supply chain. Identifying solutions to avoid bottlenecks (between agricultural producers, processing units, transporters, retailers, labour force employed on various links in the supply chain, other logistical obstacles) have become topics of scientific research in the agri-food chain worldwide.

Among the topics of interest in scientific research we have identified the imposition of measures to maintain the flow of food, which in the long run will not have a negative impact (as a significant reduction in the consumption of fresh vegetables and fruits). The topics addressed have as a priority the health of workers in the sector, but especially the health of the population by identifying the best solutions for testing, isolation, country-specific measures, for example to combat the pandemic.

The aim of the bibliometric analysis is to determine the interest in the area of scientific research [2], on the topics of the agri-food supply chain versus the short agri-food supply chain. At present, these issues are proving to be of global importance, in the context in which the aim is to orient policies towards protecting the health of the population, the environment and sustainable economic development. However, it is clear that interest has not always been the same, but has been more pronounced in the context of the recovery of local products, in recent pandemic conditions and the global barriers imposed by the spread of the covid virus.

At present, these issues are proving to be of global importance, in the context in which the aim is to orient policies towards protecting the health of the population, the environment and sustainable economic development.

In 2011, 11 organizations AIM, CEJA, CELCAA, CLITRAVI, Copa Cogeca, ERRT, EuroCommerce, Euro Coop, FoodDrinkEurope, SMEunited (former UEAPME) and Independent Retail Europe (former UGAL) adopted a set of principles for the supply chain with agri-food products. This initiative by food and beverage industry has led to a set of good practice principles being adopted at EU level between 2013 and 2019 for business that respects freedom of contract and ensures competitiveness. Promoting fair trade practices in the food supply chain is based on the three pillars of sustainability (economic, social and environmental). (<https://www.supplychaininitiative.eu/sites/default/files/entr-2013-00308-00-00-ro-tra-00final.pdf>)

In 2013, Regulation (EU) no. 1305/2013 defining the conditions for financial support for rural development in the EAFRD in which the definition of "short supply chain" (SFSC) appears. SFSC means a supply chain involving a limited number of economic operators engaged in local economic cooperation and development activities, as well as close geographical and social relations between producers, processors and consumers.

Using the quantitative research method, using the software in the field of bibliometrics, VOSviewer (version 1.16.13) [4], by querying the Web of Science

database [6], the first scientific paper published in this collection of scientific articles was obtained, books, journals on the keywords mentioned.

Why did we propose an analysis of this topic? First of all, will we know how this topic - supply chain with agri-food products - was approached in scientific research? What answers / recommendations have emerged from the research with recommendations to decision makers with economic, social or environmental impact? How was the short chain of agri-food products approached in the context of the Coronavirus pandemic, what were the approaches to scientific research?

Consulting the Web of Sciences collection, we find that the first article on the topic of "food supply chain" is from 1995 with the title "Contemporary food policy issues and the food supply chain", by the authors Henson, S; Loader, R and Traill, B, published in EUROPEAN REVIEW OF AGRICULTURAL ECONOMICS 22 (3), pp.271-281

And in 2002, the first article on the topic of "short food supply chain" was published by: Forsman, S and Paananen, J "Customer value creation in the short food supply chain: Theoretical aspects and exploratory findings", which highlights the importance of chains short supply chains (SFSCs) as alternatives to conventional food supply chains. Supporting short local food supply chains is a way to promote rural areas in a sustainable way and support the national food strategy.

The results of scientific research have shown an increased interest in the topic of "food supply chain", so by consulting the Web of Science database by country the number of articles is as follows: United Kingdom (407 articles), USA (400 articles), China (376 articles), Italy (299) and the Netherlands (150). While in Romania the scientific research on this field presents 31 articles, of which 12 articles come from Bucharest University of Economics.

2. Review of the literature

There is considerable interest in understanding the needs and opportunities of farmers and consumers in the food system. The development of (different types) of short food supply chains (ie direct sales by individuals and / or collective direct sales, partnerships - community-supported agriculture) is one of the approaches of the common agricultural policy to improve competitiveness in Europe.

The EU has allocated around € 1 billion to fund around 180 multi-stakeholder projects in agriculture, forestry and rural development over the seven years of Horizon 2020 (2014-2020) -H2020.

The year 2020 has proposed a new global approach through measures caused by the COVID-19 pandemic, thus funding EU-wide scientific research projects that aim to stimulate demand-side initiatives in short food supply chains, in order to improve competitiveness and encourage rural development using the multi-stakeholder approach. One of them is the SMARTCHAIN project has 43 partners from 11 countries involving entrepreneurs and farmers directly involved in the activities of short food supply chains, representatives of organizations concerned with supporting short food supply chains and a number of researchers

with different expertise who have briefly specialized in food supply chains, working together to find the best scientific and practical methods for finding solutions to practical problems. The results can be consulted at the link: <https://www.smartchain-h2020.eu/short-food-supply-chains/>, 18 case studies of short supply chains with social, economic and ecological impact will be monitored remarkable impact on rural, peri-urban and urban communities.

The central objective of the SMARTCHAIN project (external link) is to encourage and accelerate the transition to short supply chains (SFSCs) and, through specific actions and recommendations, to introduce new robust business models and innovative practical solutions that increase the competitiveness and sustainability of the European agri-food system.

In Romania, between September 1, 2018 - August 31, 2021, the transnational SUSCHOICE project took place in which 5 research teams from 5 different European countries (Italy, Norway, Sweden, Germany and Romania) participated. The ERA-Net SUSFOOD2 research project was part of theme 3 "Understanding consumer behavior and food choice". The project aims to inventory sustainable food and beverage choices among young European adults. at the same time, another objective was to highlight the way in which young consumers make choices towards sustainable food and drink and the desire to buy such products.

Among the objectives of SUSCHOICE we find recommendations of decision makers for the promotion of sustainable food and beverage production practices, but also an analysis of consumption options in Europe, determined by behavioral changes in recent years. Following the closure of the SMARTCHAIN project (31/08/21) another 5 new projects are being developed in H2020 (CO-FRESH, FAIRCHAIN & LOWINFOOD and & FOODRUS) which aim to continue and maintain scientific research in the area of interest and development of short supply chains.

EU-funded projects are also being funded to manage a collection of good practice examples to show effective market access, with a view to minimizing intermediate costs, integrating the needs of primary producers and consumers. Thus, the agroBRIDGES project involves 11 countries and 15 partners, with a budget of € 2,998,926 (<https://www.agrobridges.eu>) aims to identify best practices in stimulating short supply chains (SFSC). The results of the project will become a tool for assessing the sustainability of short supply chain business models, dedicated to manufacturers. More details about the agroBRIDGES project (www.https://www.agrobridges.eu). [7]

In the context of a broader market orientation of the common agricultural policy (CAP), one of the specific objectives of the post-2020 CAP is to rebalance the position of farmers in the food chain [[https://ec.europa.eu/info/agricultură-alimentară-pescuit/politici-cheie/politică-comun-agricolă/viitor-cap_en]]. The food supply chain is vulnerable to unfocused and even unfair trading due to strong imbalances between small and large operators: often farmers and small operators in the food supply chain have almost no information or contact with the consumer to

improve their supply and adapt it to demand. A knowledge-based approach will strengthen the market orientation of the sector and increase its competitiveness, stimulating organizational innovation along the supply chain, triggered by new emerging technologies and evolving consumer demand [[https://ec.europa.eu/info/sites/info/files/food-farming-fisheries/farming/documents/amtf-report-improving-markets-outcomes_en.pdf]].(https://cordis.europa.eu/programme/id/H2020_RUR-05-2020)

The H2020_RUR- project aims to collect good practices from 12 geographical areas in Europe on a platform by analyzing supply chains, identifying supply chain needs and barriers. Thus, we want to create a network between producers, consumers, NGOs, academia, distributors.

In the context of the " Fermă la Furculiță " strategy, the SFSC concept introduces key economic, social and environmental benefits for sustainable development, such as:

- Rebalancing the market position of farmers and increasing their income.
- Better connecting farmers with consumers and reducing intermediaries.
- Meeting the societal demand for safe and quality local food supply.
- Reducing the impact of agriculture on the environment.

However, many farmers in the EU do not yet realize their economic potential and consumers do not cooperate in purchasing local agri-food products, although the trend after the pandemic crisis and the invasion of Ukraine have led to changes in the behavior of both agri-food products and consumption.

3. Research methodology

Bibliometrics is an analysis of books, articles, and other publications using statistical methods. These studies determine whether the analyzed field has a significant impact as an object of scientific research, the link with other fields of research, the countries and solutions proposed to address this topic.

Bibliometrics is a research method that involves developing an inventory of publishing activity at the level of countries or institutions and comparative analyzes can be made in the scientific field. Bibliometrics owes its systematic development mainly to DJD Price and Eugene Garfield, as founders (Volovici & Repanovici, 2015).

The analysis and visualization of bibliometric networks have several software tools that have been developed specifically to respond to the analysis of databases in Web of Science or Scopus files such as: CiteSpace (Chen, 2004, 2006) - <http://www.citnetexplorer.nl>, Sci2 - <https://sci2.cns.iu.edu> and VOSviewer (Van Eck & Waltman, 2010).

VOSviewer is an easy-to-use software tool that displays only the nodes in a bibliometric network, in which the nodes can be publications or researchers, who depending on their activity may have more connection than other collaborators. Visually VoSviewer provides a two-dimensional mapping of the network in a

two-dimensional logarithm presented by Van Eck and Waltman (2009) and a VOS mapping technique " vizualizarea asemănarilor - tehnica cartografierii " provided by Van Eck et al. (2010).

This mapping technique assigns a color and a node in a cluster network to each cluster around which are the link nodes between authors or keywords used in scientific research articles.

VOSviewer uses a variety of techniques to optimize the way networks are displayed. Nodes have labels, some node labels can be distinguished from other labels, identifying a priority of them.

VOSviewer provides zoom capabilities for exploring larger networks of hundreds or thousands of nodes. For example, nodes can be logs, and the color of a node can indicate how many times the log appears in the selection made.

Density visualization allows you to identify the area with the highest density and identify nearby nodes that create a closer connection (for example, on keywords).

VOSviewer can build clusters of citation and bibliographic links to publications, magazines, and VOSviewer text extraction capabilities to build co-occurring networks of terms extracted from English, textual data, such as titles and abstracts of publications (Van Eck & Waltman, 2011).

In order to be able to identify the interest of scientific research in the field of "short food supply chain", respectively "short supply chain" and to be able to determine its evolution, a bibliometric analysis was elaborated on the works published in the previously mentioned field.

The analysis was performed by querying the existing database in the Web of Sciences platform, which contains information on, scientific papers, scientific journals and articles. Web of Sciences is a product of the Institute for Scientific Information (ISI) and is currently updated by Clarivate Analytics, providing documents of scientific interest in various fields of activity. Website that provides subscription-based access to multiple databases. Following the selection made in the web of Sciences database, the information was processed using VOSviewer software (version 1.16.13), developed by Nees Jan van Eck and Ludo Waltman, at the University of Leiden.

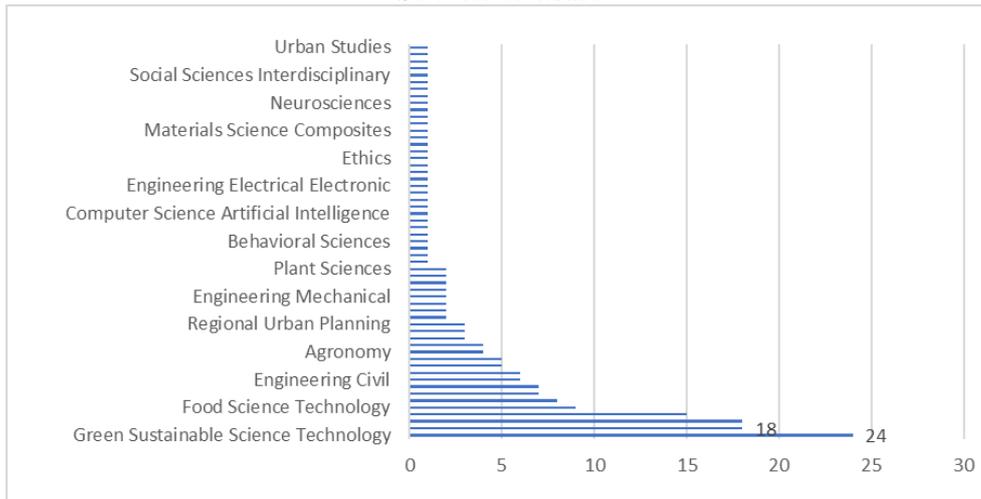
Table 1. Number of scientific papers containing the term "food supply chain" (SCI) in the title, abstract or keywords of existing documents in the Web of Sciences database

Web of Science domains:	Number of records	% of 2,619
Food Science Technology	633	24,17
Environmental Sciences	383	14,624
Green Sustainable Science Technology	263	10,042
Agricultural Economics Policy	257	9,813

Web of Science domains:	Number of records	% of 2,619
Management	246	9,393
Operations Research Management Science	221	8,438
Environmental Engineering	191	7,293
Environmental Studies	182	6,949
Industrial Engineering	176	6,72
Economics	164	6,262
Business	149	5,689
Engineering Manufacturing	131	5,002
Computer Science Interdisciplinary Applications	126	4,811
Computer Science Information Systems	105	4,009
Engineering Electrical Electronic	98	3,742
Agriculture Multidisciplinary	91	3,475
Nutrition Dietetics	85	3,246
Computer Science Theory Methods	66	2,52
Computer Science Artificial Intelligence	60	2,291
Telecommunications	57	2,176
Biotechnology Applied Microbiology	55	2,1
Agronomy	54	2,062
Multidisciplinary Engineering	53	2,024
Public Environmental Occupational Health	49	1,871
Materials Science Multidisciplinary	47	1,795

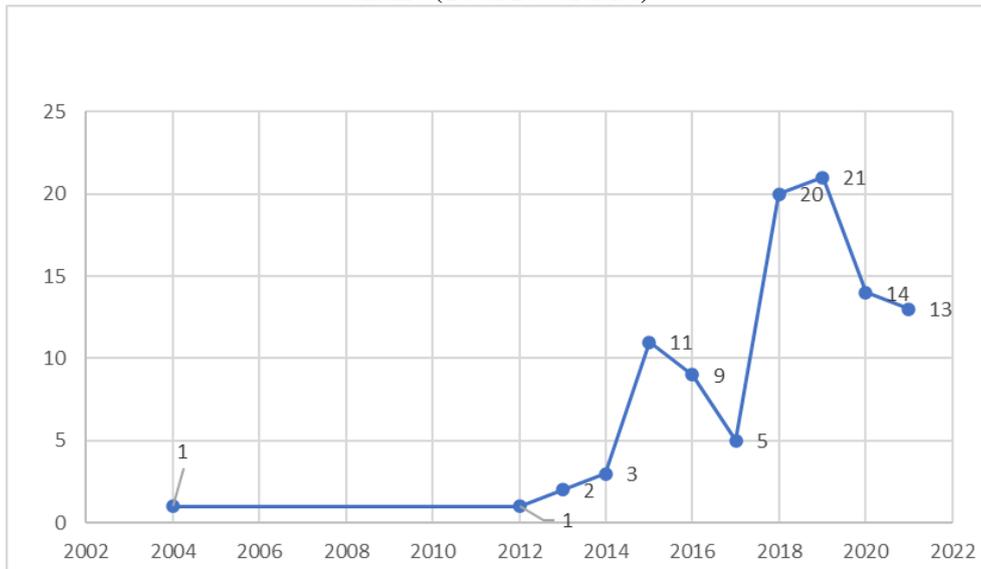
Source: Web of Science (accessed on September 15, 2021)

Figure 2. Number of scientific papers containing the term "short food supply chain" (SFSC), in the title, summary or keywords of existing documents in the Web of Sciences database



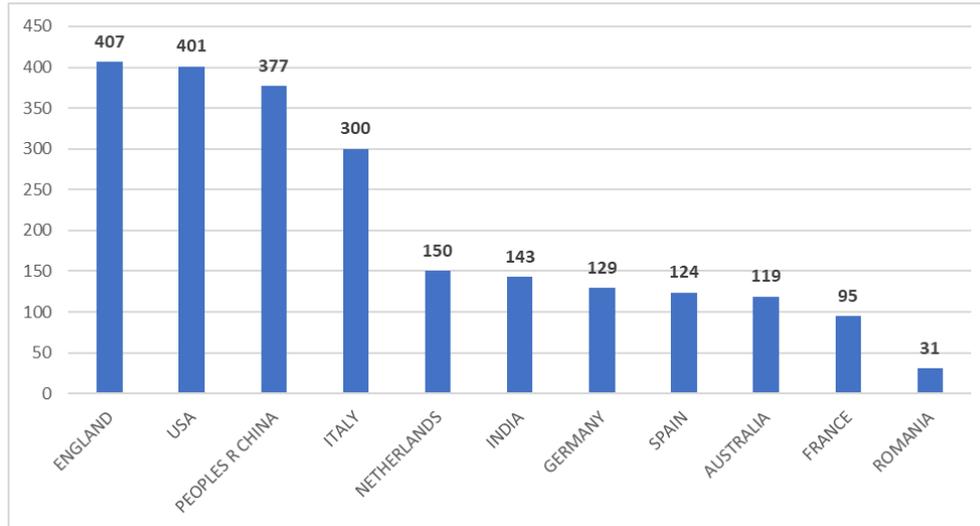
Source: Web of Science (accessed on September 15, 2021)

Figure 3. Number of articles per year on the Web of Sciences search - "short supply chain" (Total 100 articles)



Source: Web of sciences, after data processing, short supply chain search

Figure 4. Top 10 countries that addressed in the scientific research "food supply chain" and the situation in Romania



The quantitative bibliometric analysis using VOSviewer responded to the way of collaboration between authors from various states, concerned with the topic "food supply chain". For the interpretation of the data, the map generated by VOSviewer will be used, based on the following criteria:

- choose the type of analysis and the method of counting
- co-occurrence
- author keywords
- fully connected
- the minimum number of occurrences of a keyword
- of the 6499 keywords, 441 meet the required threshold

From the 466 articles that contain the term "food supply chain", the strongest link is with the topics of sustainability (151), food safety (189) and food waste (159).

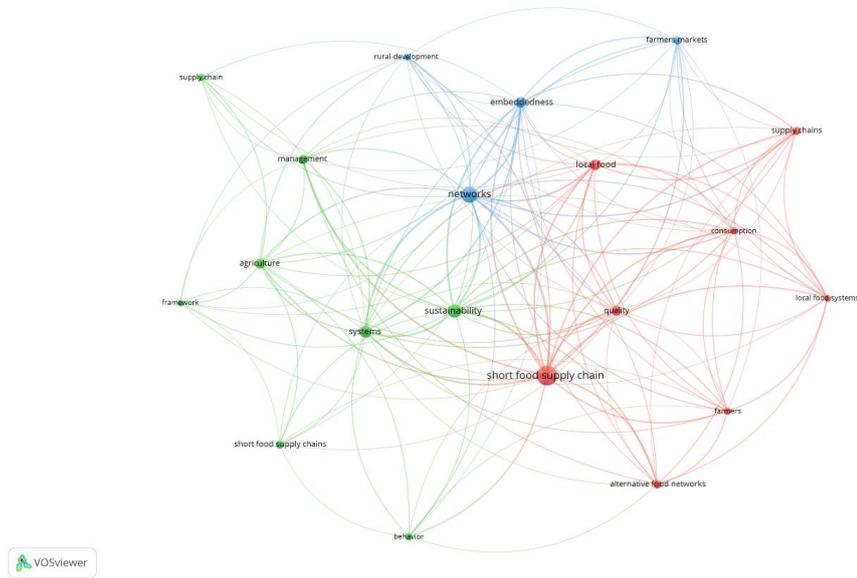
It can be seen that the items selected by the food supply chain have links to the supply chain (19) and to the short food supply chain (40).

It can be seen that articles using the term 'food chain' (18) are related to articles using corporate social responsibility (16), sustainable supply chain (15), food policy (15), food processing (14), haccp (14) as well as environmental impact (14), etc.

Creating maps based on web data from the Web of Science. With the help of VOSviewer, networks of scientific publications, links between researchers, countries, keywords, etc. have been built. Articles in these networks can be linked by co-authoring, citing from the bibliography, or with citation links from the Web of Science database.

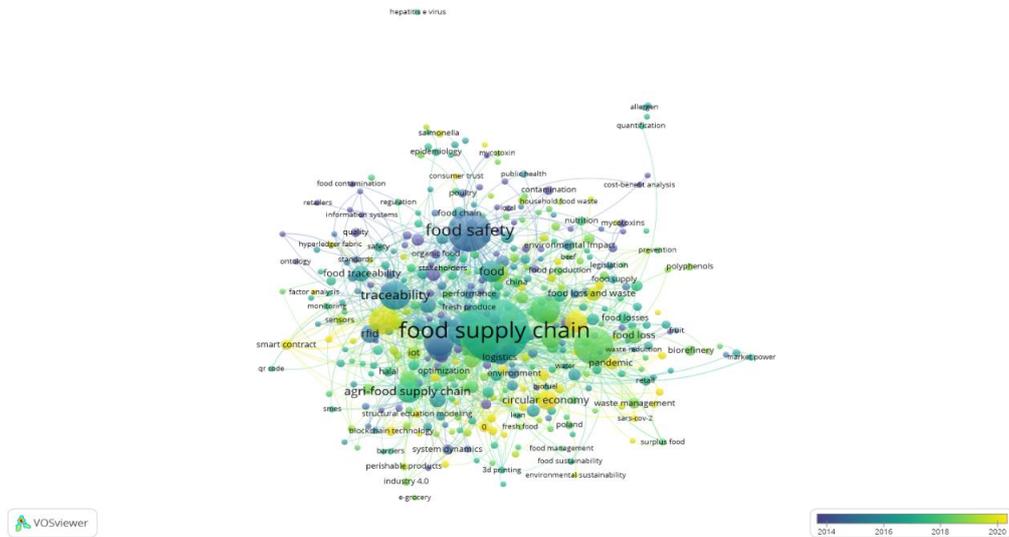
The “food supply chain” node is related to the topics in the scientific articles related to food safety, traceability, agrofood supply chain. Their highlighting is determined by the size of the node, and the color determines the density within the approached subject of the links on the articles.

Graphic 2. The network of nodes starting from the search for the "short food supply chain" in the scientific articles of the Web of Science (analysis on October 15, 2021)

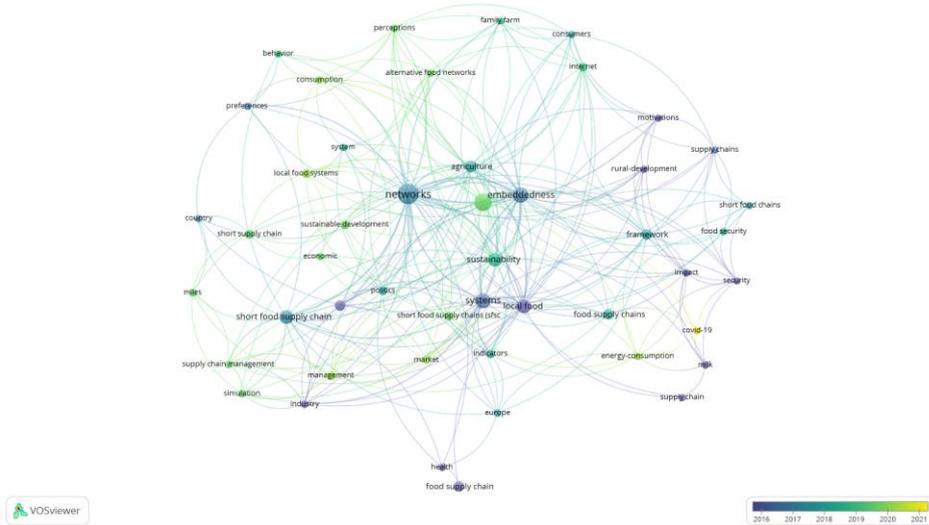


The “short food supply chain” node (red-marked network) determines the interaction with the selected articles in the Web of Science that determine the other 2 clusters that have as main node Networks (network marked in blue, respectively Sustainability (network marked in green). It is found for the cluster that has the main node "short food supply chain" that the articles that have title, summary or keyword address topics of local food, supply chains, quality, consumption, farmers, local food systems, alternative food networks. Below the same representation but on the intensity of the colors on the nodes mentioned above.

Graphic 3. The network of nodes starting from the search for "food supply chain" in scientific articles in the Web of Science (analysis on October 15, 2021), with intensity marked in various colors depending on the year of publication



Graphic 4. The network of nodes starting from the search for "short food supply chain" in scientific articles in the Web of Science (analysis on October 15, 2021), with intensity marked in various colors depending on the year of publication



Source: Web of Science - publications a) topic “food supply chain”,
b) topic “short food supply chain”

4. Conclusions

This bibliometric analysis facilitated the obtaining of the following aspects:

- Presentation of the interest in the field of scientific research on the field "food supply chain", thus after the first article in 1995 of the *European Review of Agricultural Economics* 22 (3), pp. 271-281, entitled *Contemporary Food Policy Issues and the Food-Supply Chain*, authors Henson, Sloader, Rtraill, B in 1996 in *American Journal of Agricultural Economics* 78 (5), pp. 1181-1186, author King, RPPhumpiu, PF at the Annual Meeting of the American-Agricultural-Economics-Association also presents publishes *Reengineering the food supply chain: The ECR initiative in the grocery industry*, by the end of 2020, 20 articles address this topic.

According to the Web of Sciences chart, the period 2015-2021 shows that scientific research has intensified studies in this field of vital importance for the global economy, the maximum being reached in 2021, being published 545 articles in Web of Sciences.

- The topic "short food supply chain" appears in the Web of Science database in 2002, with the publication of the article *Customer value creation in the short food supply chain: Theoretical aspects and exploratory findings*, authors Forsman, S; Paananen, J presented 5th International Conference on Chain and Network Management in Agribusiness and the Food Industry published in *PARADOXES IN FOOD CHAINS AND NETWORKS*, pp. 153-164

The topic is approached timidly in 2005, 2010 and 2014, but since 2015 it has become a topic of interest to the scientific world being addressed in 78 articles in the period 2015-2021, with a potential that can exceed the number of articles in 2021, this being of 19 studies, analyzes on this topic

- The countries with the most scientific papers published in the field of short food supply chain are Italy (29), Hungary (13), France (8), Brazil (7), Belgium (6), Great Britain (5), Poland (5). Romania has 2 articles on this topic published in Web of Sciences.
- The countries with the most published scientific papers in the field of food supply chain are Great Britain (438), USA (437), R. P. China (416), Italy (331), India (190), the Netherlands (157), Germany (143), Spain (140), Australia (), France (101), etc. Romania has published 32 articles on this subject, of which 12 are affiliated to the Academy of Economic Sciences in Bucharest.

Bibliometric analysis allows us to obtain quantitative measurements of concepts such as the results of scientific research, scientific impact and how to collaborate globally. Obtaining indicators that provide the proximity of the studied subject allows us to identify both trends in the world countries that address the same topics, making collaborations with representatives of the scientific environment, analyzing the impact obtained on the Web of Sciences database.

From the data analyzed bibliometric topics are of impact for scientific research in the context of global changes that require the exploitation of raw materials in conditions of sustainability and ensuring food security.

References

1. Report FAO -COVID-19 and the risk to food supply chains: How to respond?, <https://www.fao.org/documents/card/en/c/ca8388en> [Accessed 18 September 2021].
2. Gauthier, É., 1998. *Bibliometric Analysis of Scientific and Technological Research: A User's*
3. *Guide to the Methodology*. [online] Available at: <<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.470.2634&rep=rep1&type=pdf>> [Accessed 15 September 2021].
4. Van Eck, N.J. and Waltman, L., 2011. Text mining and visualization using VOSviewer.
5. [online] Available at: < <https://arxiv.org/ftp/arxiv/papers/1109/1109.2058.pdf>>
6. [Accessed 15 September 2021].
7. Van Eck, N.J. and Waltman, L., 2019. VOSviewer Manual for version 1.6.13. [online] Available at: <https://www.vosviewer.com/documentation/Manual_VOSviewer_1.6.13.pdf>
8. [Accessed 15 September 2021].
9. Waltman, L., and Noyons, E., 2018. *Bibliometrics for Research Management and Research*
10. *Evaluation*. [online] Available at: https://www.cwts.nl/pdf/CWTS_bibliometrics.pdf [Accessed 15 September 2021].
11. <https://www.e-nformation.ro/partners/web-of-science-group> [Accessed 10 August 2021, april 2022].
12. <https://www.agrobridges.eu/the-horizon-agrobridges-project-meets-the-other-horizons/>