BIBLIOMETRIC ANALYSIS OF THE GREEN DEAL POLICIES IN THE FOOD CHAIN

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Abstract

Nutrition concerns and food waste are a priority for the European Union, and the implementation of Green Pact policies is of major interest to all those involved in the food chain sector. The main purpose of this paper is to conduct an in-depth analysis of scientific production using bibliometrics, to understand the current structure of studies and future research directions on Green Deal policies in the food chain. 672 documents published between 2000 and 2021 were identified in the Web of Science database. Their scientific content was analysed using VOSviewer software on several levels: descriptive analysis, performance analysis, and scientific mapping from a conceptual, intellectual, and social perspective. In addition, to determine research gaps, the 10 most relevant and influential papers are analysed and synthesized. The most productive countries in terms of scientific output are Italy, India, and the USA, the peak being reached in 2021, and the main field approached is environmental sciences. Most of the articles analysed are reviews, highlighting gaps in primary research on Green Deal policies in the food industry. In this regard, several future research directions in the field are proposed.

Keywords: bibliometric analysis, circular economy, farm to fork, food chain, food waste, Green Deal, sustainable development.

JEL Classification: Q18.

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Introduction

Environmental degradation, the depletion of natural resources, climate change, and the social problems generated by all of these led to the adoption of the 2030 Agenda by the UN General Assembly, on the 25th of September 2015, which established 17 sustainable development goals (SDGs). The sustainability paradigm has changed, from the linear system, known as the 3Rs: "reduce, reuse and recycle" (CCICED, 2008), to the circular system, transformation and re-entry of waste (UN, 2015), encountered by the phrase "take – transform – reuse" (Ormazabal et al., 2018). Through its Communication "Next Steps towards a Sustainable European Future", published on the 22nd of November 2016, the European Commission presented the European Union's response to the objectives of the 2030 Agenda, and, in December 2019, "The European Green Deal" was published (EC, 2019).

In order to stimulate the development of the circular economy and to financially support the process of achieving the sustainability objectives, the Commission published in June 2020 the Regulation on sustainable investments (EC, 2020). Starting from the concept of sustainability, formulated by the Brundtland Commission (UN, 1987): "development that meets the needs of the present without compromising the ability of future generations to satisfy their needs", the circular economy (CE) seeks to find a balance between social needs and nature, for the environment to be protected (Suárez-Eiroa et al., 2021). Sustainable development became a prevalent topic in economic and environmental policies (Cuc et al., 2015).

The Food and Agriculture Organization (FAO, 2019) has globally established five priority categories to implement the 2030 Agenda, prepared to support countries in reducing food loss and waste by 50% by 2030. FAO shows that, along the food chain, the greatest product waste occurs in the consumption phase, but also in the manufacturing process, in infrastructure, due to insufficient recovery and management practices.

The implementation of sustainable policies is influenced by several internal and external factors, both at the organizational level (Trifu et al., 2014) and at the national level. The application of sustainability rules in the food circuit must be done systematically with safe steps, because, worldwide, their impact can create undeniable benefits for the environment, but with social disadvantages that could jeopardize the very desire for environmental protection. The development of the economy in accordance with the directions set out in the Green Deal creates a major pressure on the whole society, on all the parties involved. The Green Deal indicates the Farm to Fork Strategy as being the main path to follow in the food chain sustainability.

The motivation of the present paper is to investigate the evolution of scientific research based on Green Deal policies in the food chain through review and analysis. Consequently, this research aims to provide a critical overview of previous studies and to identify the main challenges and opportunities of implementing Green Deal policies in the food chain. To achieve such a complex objective, three research questions (RQ) are proposed:

- RQ1: What are the main research clusters on Green Deal policies implementation in the food chain?

- RQ2: What is the distribution of scientific production in this field of knowledge in the last two decades?

- RQ3: What are the main research gaps and prospective research paths?

To address the above-mentioned research questions, we applied a quantitative research method, specifically a bibliometric analysis. By investigating what network is created around the most representative keywords and how citations, authors, associations, regions, and publications can be indicative of significance in the research field, the bibliometric analysis explores the formal attributes of fields of knowledge employing mathematical and statistical techniques (De las Heras et al., 2020).

To the authors' knowledge, this paper is the first bibliometric analysis on the application of Green Deal policies in the food chain. This bibliometric analysis is significant for researchers because it includes discussions and suggestions on the role of multidisciplinary approaches to improving science. It is significant for decision-makers in corporate and governmental organizations due to the fact that the research can guide their policies, strategies, and actions towards a sustainable food industry. The article continues with the section of literature review in the field of food chain sustainability, followed by the presentation of the research methodology. The analysis of the results approaches the scientific mapping of the evolution of scientific production by objectively analysing the evolution of the knowledge disseminated in previous studies. The paper ends with the presentation of the conclusions based on the study.

1. Literature Review

Sustainability is a critical aspect in the growth and improvement of businesses in the food sector. Sustainable development in this sector requires effective management of climate change and environmental degradation, as well as awareness of how to approach food security and marketing. It also requires significant changes in agriculture (Seebode et al., 2012).

Industrial agriculture has had a significant and unprecedented impact on many rural regions in the last 60 years (Maxwell et al., 2016). At both macroeconomic and microeconomic levels, the EU's agricultural, implicit, and food systems have become much more reliant on imports, unequal, and less resilient, generating less added value while exploiting and consuming more (Peeters et al., 2020). All this can be remedied by implementing the Common Agricultural Policy (CAP) objectives outlined in Art. 39 of the Treaty on the Functioning of the European Union (TFEU, 2012), including "increasing the productivity of agriculture" and "promoting technical progress" and "ensuring a fair standard of living".

CAP has a significant impact on agriculture in the EU, particularly through subsidies, which provide critical funding for agricultural enterprises. The European Commission's reform proposal to transform the current CAP has drawn widespread criticism, particularly from Central European countries. Opponents of the reform argue that no priority should be placed on equitable funding distribution, increasing the agricultural sector's competitiveness, or promoting organic farming techniques (Rasovska, 2015).

To address the "urgency" of climate change, initiatives have been proposed to create a new Green Deal (Selwyn, 2021), as well as new strategies to address sustainable development. These strategies are centred on the use of extraordinary financial policy instruments to promote macroeconomic innovation. The changes brought about by the Green Deal's policies and the climate crises have created numerous niche areas that remain unaddressed in terms of the dynamics of financing sustainable innovation. The investment costs associated with sustainable development can reduce the Green Pact's effectiveness (Long and Blok, 2021).

The European Green Deal is the new growth strategy adopted by the European Commission in 2019 to mobilize industry towards a clean and circular economy. The transition aims to eliminate significant amounts of material from value chains and manufacturing processes. These issues are related to agriculture's obligation to protect the environment and climate (Prandecki et al., 2021). Food-importing countries' demand for food can result in unsustainable production patterns in food-exporting countries. Finding solutions that increase the sustainability of EU trade and its implications for global value chains is critical to implementing CAP policies (Kettunen et al., 2020).

León-Bravo et al. (2021) identified several elements that influence the adoption of sustainable practices by Italian companies in the food chain, including: compliance with sustainability rules, the need for a good reputation with customers, conservation of natural resources, technology transfer, the promotion of funding opportunities, information and expert exchange between the actors involved in the food process. Bhattacharya and Fayezi (2021) pointed out that between the parties involved in the food chain there must be a vertical and horizontal collaboration designed to reduce dissipation, food waste, losses in this industrial field. Horizontal relations concern the links between the public sector (state institutions, non-governmental organizations) and the private sector (producers, distributors). The vertical links are those established between traders (farmers – processors – suppliers – sellers/restaurants, etc.).

The Green Deal and Farm to Fork policies establish a new and critical role for agriculture and agri-food, putting farmers under pressure to pique consumer interest. According to the "Farm to Fork" strategy, research and innovation are critical to accelerating the transition from primary production to the consumption of sustainable, healthy, and inclusive food systems.

Preventing food loss and waste is a viable technique for balancing supply and demand, which is essential to improve food security while minimizing the impact on the environment and providing economic benefits to many participants in the food supply chain (Nicastro and Carillo, 2021).

The intensive use of agricultural land has already begun to be reduced, with an emphasis shifting to organic production with the elimination, as much as possible, the use of hazardous substances, herbicides, and pesticides (Silvestri et al., 2021; Chen et al., 2020). Implicitly, the "clean" food trade has begun to develop, including substances and raw materials that protect the environment. Food processing and packaging must be done in an environmentally friendly manner. Product transport is intended to be made with non-polluting, low fuel consumption, mainly made with electric cars. All of these must be followed by investments and re-inventing of the industry (for the carbon footprint to be reduced), but traders will not be inclined to redefine their business and substantially adjust their profit. Therefore, the legislation must be amended, following the course of the sustainable development goal, moving from the linear system of environmental protection, „*take – transform – throw*", to the circular system, "*take – transform – re-use*" (Ormazabal et al., 2018).

As a novelty issue, Selwyn (2021) states that the COVID-19 virus has demonstrated the negative impact of the current agro-industry on ecology and humanity. More and more companies consider it necessary to develop a new environmental agreement (The Green New Deal – GND) to deal with these threats. This GND must fight environmental

degradation, social inequality, and labour exploitation, rather than seek to restart capitalist economies (Selwyn, 2021).

We can state that the implementation of Green Deal policies in the food chain will generate a reform with a focus on the circular economy: from obtaining raw materials to processing, marketing, packaging, and reuse of waste from their consumption. We can expect against the background of the implementation of the Green Deal policies in the food chain, research and development activities will foster leading to technological, managerial, and entrepreneurial solutions to make the whole agri-food chain more environmentally friendly. In our opinion, these research and development activities would lead to the creation of new means without which the transition to a circular economy is difficult, if not impossible.

2. Research Methodology

Many important decisions in economic growth priorities, funding allocation, national and international policies, partnership prospects, and so forth are based on scientific production evaluation. The quality of research measured by the impact of a publication becomes a key factor (Pranckutė, 2021). Bibliometrics represents a branch of scientometrics that examines the activity of scientific publications using mathematical and statistical approaches. In recent years, the interest in bibliometric analysis as major scientific activity has increased considerably. Bibliometrics has been thrivingly applied in various fields of research, for example: business (Srivastava, 2021), economics (Dima, 2021), environmental sciences (Herrera-Franco et al., 2021), finance (Nath and Chowdhury, 2021), mathematics (Hwang and Tu, 2021), medicine (Vuillemin, 2021).

The quantitative structure of the bibliometric analysis makes it ideal for this study because it maintains the authors' bias under control. Its ability to handle massive databases allows it to extract information from a large corpus. In the current study, a bibliometric analysis was performed to identify, organize, and analyse trends in the proposed research area. Selecting the right database is decisive for a well-performed evaluation. The Web of Science Main Collection is a very comprehensive bibliographic data source, and provides the best coverage depth, especially regarding citations (Pranckutė, 2021). It became the most prominent bibliographic data source for journal selection, research assessment, bibliometric analysis, and other tasks over time (Li et al., 2018).

The methodology was applied to generate a complete search of the WOS database using the syntax: "food" AND "Green Deal" in the title, abstract and keywords of the papers. To refine the search, two filters were applied to the dataset: "language" (English) and "year of publication" (2000 - present, including 16 "Early access" articles with publication date: 2022). The application of these filters resulted in 672 documents that constitute the data set to be analysed.

The data analysis program VOSviewer (van Eck and Waltman, 2020), version 1.6.15, specialized in the analysis of bibliometric and sociometric networks, was used to analyse the performance of documents, sources, authors, organizations or countries and scientific mapping based on conceptual structure, the intellectual structure, and the social structure of the data.

The representation of bibliometric and sociometric networks is typically performed in one of three ways: distance-based, visual, or time-based. The distance and force of association

approach are used by the VOSviewer program to identify certain networks that are situated close one to another (van Eck and Waltman, 2010). The shorter the distance of two nodes, the closer they are associated, or similar. The research undertaken is based on the research frame described in Figure no. 1.
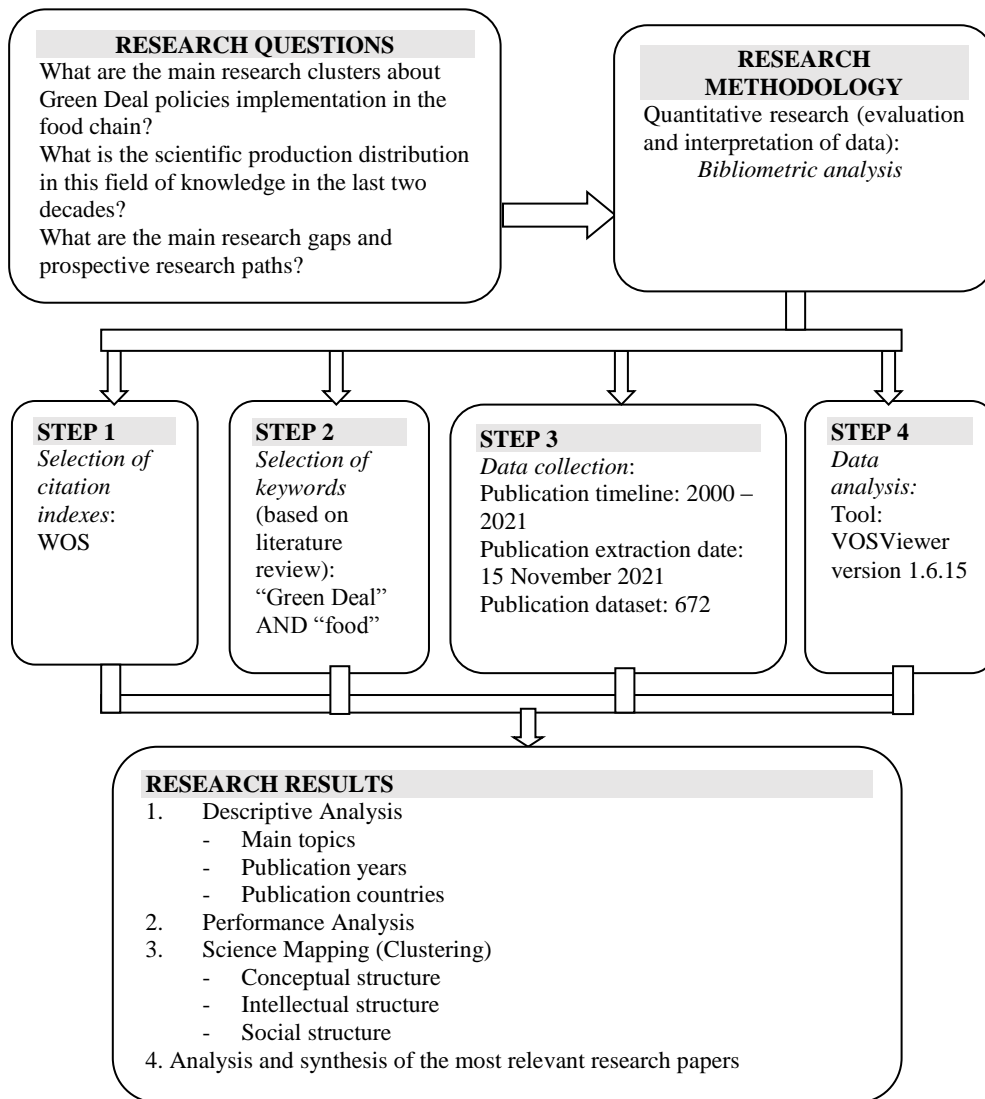
RESEARCH QUESTIONS
What are the main research clusters about Green Deal policies implementation in the food chain?
What is the scientific production distribution in this field of knowledge in the last two decades?
What are the main research gaps and prospective research paths?

RESEARCH METHODOLOGY
Quantitative research (evaluation and interpretation of data):
Bibliometric analysis

STEP 1
Selection of citation indexes:
WOS

STEP 2
Selection of keywords (based on literature review):
"Green Deal" AND "food"

STEP 3
Data collection:
Publication timeline: 2000 – 2021
Publication extraction date: 15 November 2021
Publication dataset: 672

STEP 4
Data analysis:
Tool: VOSViewer version 1.6.15

RESEARCH RESULTS
1. Descriptive Analysis
    -   Main topics
    -   Publication years
    -   Publication countries
2. Performance Analysis
3. Science Mapping (Clustering)
    -   Conceptual structure
    -   Intellectual structure
    -   Social structure
4. Analysis and synthesis of the most relevant research papers

Figure no. 1. Research methodology design

3. Findings

The bibliometric review involves addressing three main sections, namely descriptive analysis, performance analysis and scientific mapping.

3.1. Descriptive analysis

In the first stage of the descriptive analysis, the main 10 categories that registered the most publications in the analysed period from the Web of Science were identified (Table no. 1). The increased interest of the authors for the sustainability of the food industry from an environmental perspective and for research aimed at technologies aimed at developing the food industry is noted. The results of studies in these fields can be the basis for developing applications to facilitate the development of food science by increasing the implementation of Green Deal policies at the organizational level, as well as disseminating current information among stakeholders and in academia.

Table no. 1. WOS main categories

No.	Web of Science categories	Frequency	Percentage of total sample
1.	Environmental Sciences	116	17.26%
2.	Food Science Technology	106	15.77%
3.	Green Sustainable Science Technology	87	12.94%
4.	Environmental Studies	54	8.03%
5	Biotechnology Applied Microbiology	41	6.10%
6.	Chemistry Multidisciplinary	40	5.95%
7.	Engineering Environmental	31	4.61%
8.	Agriculture Multidisciplinary	30	4.46%
9.	Agronomy	30	4.46%
10.	Chemistry Applied	30	4.46%

Source: WOS database

According to the data available in the WOS database, regarding the scientific production distribution in the last 10 years, there is an ascending evolution, but with slight fluctuations (Table no. 2). In the period 2017-2021, the number of papers that addressed the analysed topic increased significantly; during this period of time, between 9.38% and 17.56% of the total papers included in the analysed sample were published each year. Also, in the last two years, there has been an increase in the number of publications of more than 500% compared to 2012.

The trend noted is that after each year or at most two years of increase in scientific production, a slight decrease is encountered in the following year, as is the case in 2014, 2016, and 2019. This evolution can be justified by the fact that reports and legislative initiatives aimed at the Green Deal in the food industry appear with a certain periodicity and, after their publication, there is an increased appetite among researchers to address the field. The fluctuation could be influenced by a multitude of factors, including the number of entities involved in research on sustainable issues, the amounts that governments allocate to research, the sanctions imposed on polluting countries, and the measures which these countries should impose, the number of Ph.D. students, the concern of civil society on food chain issues, etc.

Table no. 2. WOS Publication Years

No.	Publication Year	Frequency	Percentage of Total Sample (%)	Evolution from previous year (%)
1.	2021	118	17.56	20.41
2.	2020	98	14.58	46.27
3.	2019	67	9.97	-4.29
4.	2018	70	10.42	11.11
5.	2017	63	9.38	57.50
6.	2016	40	5.95	-4.76
7.	2015	42	6.25	75.00
8.	2014	24	3.57	-31.43
9.	2013	35	5.21	133.33
10.	2012	15	2.23	~

Source: Developed by authors, based on WOS database

Next, the main research groups on the implementation of Green Pact policies in the food chain (RQ1) were analysed. The works considered in our study were written by 4,480 authors, affiliated to 2,036 entities (universities, research institutes, laboratories, non-governmental organizations, national libraries, companies, associations, state institutions/administration, etc.). Most of the authors are affiliated with Wageningen University Research in the Netherlands (19), INRAE in France (16), Consejo Superior de Investigaciones Cientificas in Spain (13), and the University of California System in the USA (12). Also, most of the research was funded by universities (150 publications), followed by research institutes (25 publications).

It is noted the appetite of researchers with affiliation from all continents of the world for the subject, except Africa and Australia, which are not found in the top 10 countries or regions in terms of the number of publications. The focus on this topic is approached mainly by authors from European research institutions (Table no. 3).

Table no. 3. WOS - Country/region of publication

No.	Country/Region	Frequency	Percentage of Total Sample (%)
1.	Italy	90	13.39
2.	India	87	12.94
3.	USA	86	12.79
4.	Germany	71	10.56
5.	Peoples R China	65	9.67
6.	Spain	65	9.67
7.	France	41	6.10
8.	Netherlands	41	6.10
9.	Canada	36	5.35
10.	Belgium	35	5.20

Source: WOS database

This is justified by the high number of legislative initiatives at the European Union level in the field of the Green Deal and the food industry, as well as by the increased interest given by EU member states to the sustainability of the industry and environmental protection issues. As a result of the measures taken at the European level in this regard, as well as the

financial support provided to the Member States through numerous funding programs, the researchers approached this field to tackle the appropriateness of the measures and quantify the effects generated by the measures in the field. Also, countries that are prolific in various fields of research (such as India or China) and have a large population have been involved in finding sustainable food solutions to meet the goals of the 2030 Agenda.

3.2. Performance analysis

Citation analysis. Based on the sample of 672 papers selected from WOS, an analysis of the distribution of scientific output in the last two decades was carried out (RQ2), respectively, the number of citations compared to the number of publications (Figure no. 2). It stands out the ascending evolution of the number of citations, but this follows the same pattern regarding the number of publications per year, described in the previous section. Therefore, after about two years of increases in the number of citations, there is a slight decrease, a situation that is repeated throughout the analysed period. Also, there is a spectacular increase in the number of citations in 2020 and 2021 (over 3,000 citations each year), compared to 2000, which indicates the development of the analysed field and the growing interest of researchers, but also the fact that, in recent years, WOS publications include a much larger number of references than those published 10 years ago.
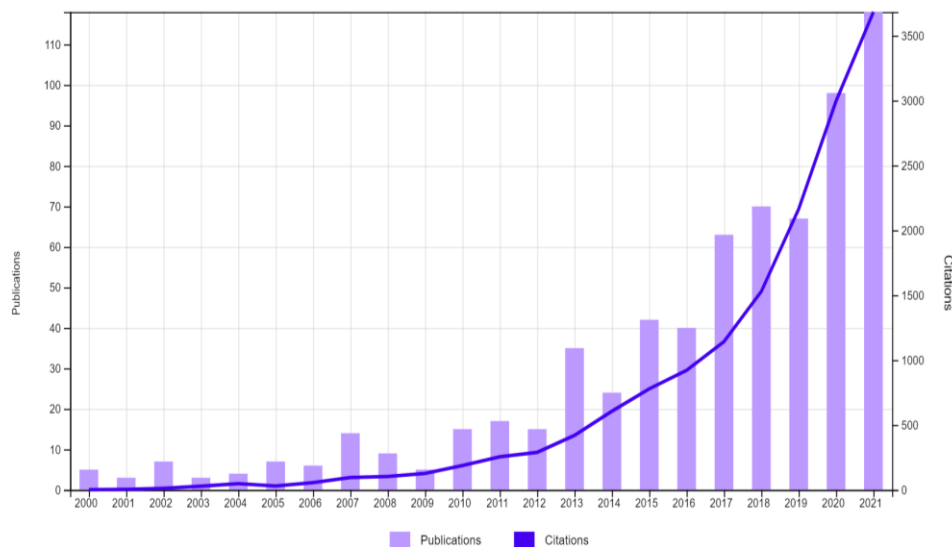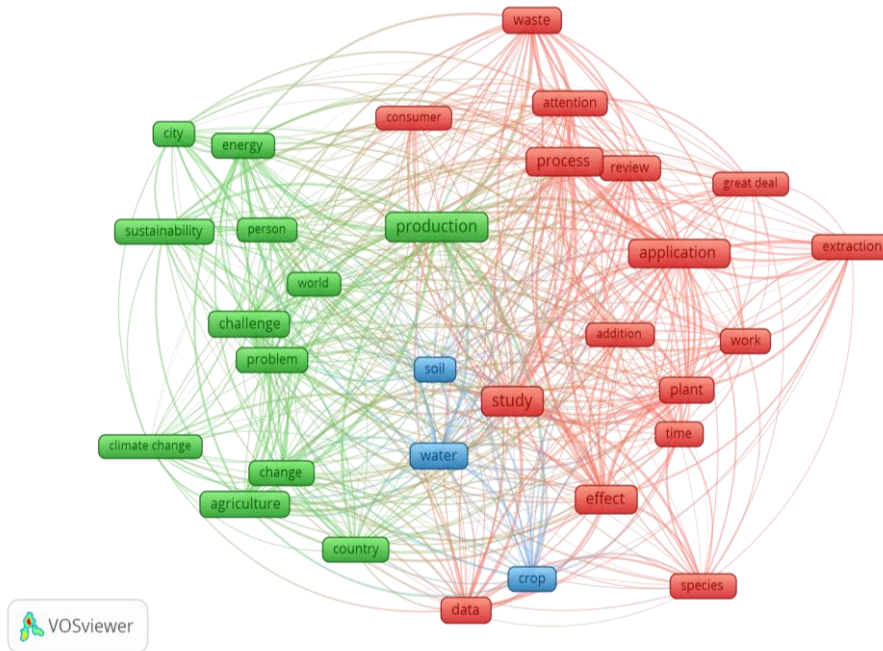

Figure no. 2. WOS - Citation analysis
Source: WOS

3.3. Science Mapping

Conceptual structure: Co-word analysis. In the first phase, the co-occurrence term analysis was performed for the analysed sample, respectively, the research published from 2000 until now. In this sense, the following restrictions were applied to the VOSviewer program: the analysis was performed in the "Abstract" field, and the minimum number of occurrences of a term was limited to 50. The result was the network visualization map

based on the text data shown in Figure no. 3. The main findings indicate that 31 items were registered, grouped in 3 clusters, which generated 457 links and a total link strength of 14,912. The terms grouped in the 3 resulting clusters are symbolized in different colours for each cluster, standing out as the main themes: production, sustainability, agriculture, challenge (cluster 1 - green); crop, soil, water (cluster 2 - blue); application, effect, process, study (cluster 3 - red).

Figure no. 3. Network visualization map based on text data – term co-occurrence
Source: VOSviewer, version 1.6.15

Intellectual structure: Co-citation analysis. To generate the network visualization map of the co-citation illustrated in Figure no. 4, the following restrictions were applied to the data sample: the minimum number of citations of a cited reference was set to 5, and the selected method was the association. The generated results indicated the presence of 17 items, grouped into 4 clusters, among which there are 69 links, and the total value of link strength is 108. It is noted that the identified publications are part of the entire timeframe, and do not target a certain period; for example, they are not just recent works or from the beginning of the analysed period.
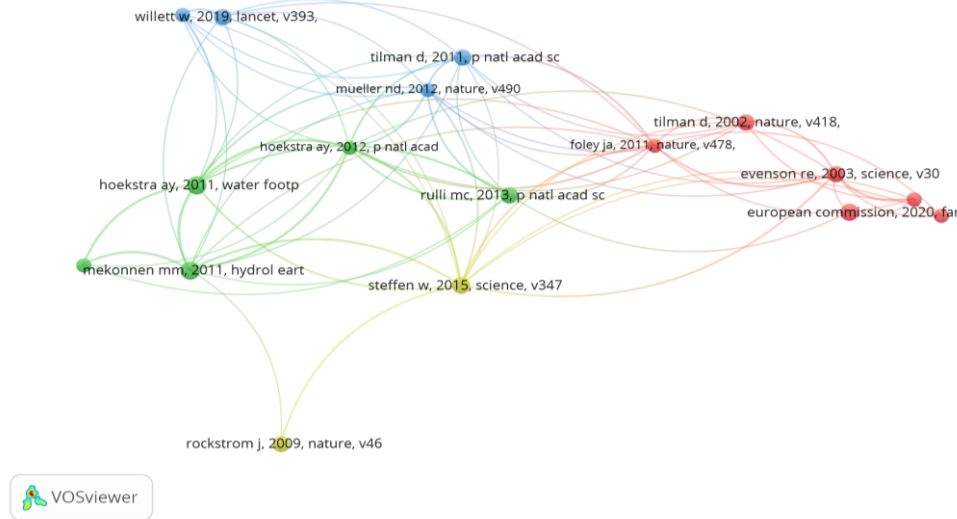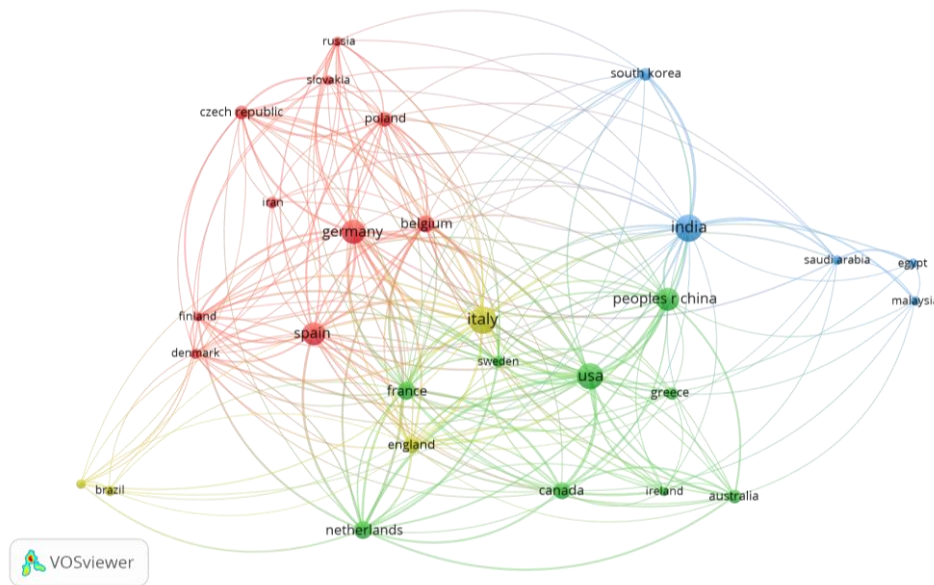
Figure no. 4. Network visualization map of the co-citation (Full counting)
Source: VOSviewer, version 1.6.15

Social structure: Co-authors' country analysis. For the elaboration of the visualization map of the network of co-authors' countries presented in Figure no. 5, the following preconditions were set: the set unit of analysis was "Countries", the "Full Count" method was selected, the minimum number of documents in a country was set to 10, and the minimum number of citations by an author was set to 10, in order to evaluate the scientific importance of the elaborated works.

The results indicate the presence of 4 clusters, comprising 28 items, and registering 227 links with a total link strength of 540. The countries that stand out as main scientific producers are mostly those highlighted in the Descriptive analysis. The first cluster includes Italy, England, and Brazil; another cluster includes Germany, Spain, and Belgium; a third cluster has India as its main scientific producer; the fourth cluster includes countries such as the USA and the People's Republic of China. It is noted that there is no sustained interest over time by the same authors in the field of the Green Pact and the food industry, as very few authors have approached the topic in their research more than three times.

Figure no. 5. Network visualization map of the co-authorship countries.
Source: VOSviewer, version 1.6.15

3.4. Analysis and Synthesis of the Most Relevant Research Papers

In order to identify research gaps and prospective research pathways in the field of Green Pact policies in the food chain (RQ3), we have also analysed and synthesized the most relevant and influential research papers on this topic. For this purpose, we used the same database of articles as in the bibliometric analysis, retaining only the Highly Cited Papers from the past five years, from 2017 to 2021. The search and filters generated 14 articles. Further analysis of the keywords and abstracts led us to exclude four articles that belong to the fields of medicine, biology, and chemistry. In the summary of the most relevant and influential research, we have 10 articles. The main findings of the analysis are presented in Table 4. The articles are presented in descending order of the number of citations.

Table no. 4. Summary of research on Green Deal policies in the food chain

Author(s) and year	Web of Science Categories	Key findings, research methodology (RM) and sample (S)
Ramankutty et al., 2018	Plant Sciences	It examines the global food system's accomplishments and failures, and current disputes over environmental health and food security. It indicates a new coordinated research program that combines contemporary breeding with agroecological approaches. RM: Literature review (LR); S: 177 papers/research articles

Author(s) and year	Web of Science Categories	Key findings, research methodology (RM) and sample (S)
Klerkx and Rose, 2020	Food Science & Technology	It examines how technologies influence different transition paths to sustainable agricultural and food systems, driven by goal-oriented innovation systems, and highlights the importance of the inclusion and exclusion effects of Agriculture 4.0 technologies. RM: LR; S: 118 papers/research articles
Zorpas, 2020	Environmental Sciences	A comprehensive approach to analysing how to create, execute, monitor, and improve a waste management plan at the local and/or national levels. RM: holistic approach; S: 100 papers/research articles
Kavitha et al., 2018	Environmental Sciences	It examines the possible benefits and drawbacks of using biochar in agricultural soils. RM: LR; S: 115 papers/research articles
Kardung et al., 2021	Green & Sustainable Science & Technology; Environmental Sciences; Environmental Studies	For assessing and analysing the evolution of the EU bioeconomy, it offers a conceptual analytical framework. The bioeconomy encompasses a number of related ideas (for example, bio-based economy, green economy, and circular economy), having strong synergies, particularly between the bioeconomy and circular economy concepts. Analysing the driving variables, it gives useful data for monitoring activity. RM: LR; S: 114 papers/research articles
Demena and Afesorgbor, 2020	Economics; Energy & Fuels; Environmental Sciences; Environmental Studies	A meta-analysis of the influence of Foreign Direct Investment (FDI) on environmental emissions based on 65 original studies. It demonstrates that the underlying effect of FDI on environmental emissions is close to zero; after accounting for study heterogeneity, FDI cuts environmental emissions considerably. RM: Meta-Analysis of Economics Research Network (MAER-Net); S: 65 papers/research articles
Vanham et al., 2018	Environmental Sciences	It seeks to determine if the currently proposed Water Stress indicator 6.4.2 (used for SDG monitoring) takes into consideration the many factors that must be included in a Water Stress indicator. RM: Defining indicators; S: n/a.
Sharma et al., 2020	Environmental Sciences	It offers a positive contribution to the research and development of biological approaches to H_2 manufacturing technology. Biohydrogen production's economic feasibility is critical for achieving a circular economy system and long-term development. RM: LR; S: 115 papers/research articles
Enamala et al., 2018	Green & Sustainable Science & Technology; Energy & Fuels	A complete analysis of the numerous methods of biomass harvesting and lipid extraction from microalgae which examines their benefits and drawbacks. It discusses the circumstances that promote lipid accumulation, the yield from diverse species. RM: LR; S: 170 papers/research articles

Author(s) and year	Web of Science Categories	Key findings, research methodology (RM) and sample (S)
Saravanan et al., 2018	Green & Sustainable Science & Technology; Engineering, Environmental; Environmental Sciences	It studies the status of energy consumption, the advancement of biofuel sources, and the obstacles in microalgal biofuel production and commercialization, focusing on the key features of India's national biofuel policy. RM: Doctrinal methods, Policy analysis; S: 11 policy papers

Source: WOS database

Only four of the most relevant and influential research are research articles, while the rest of six are research reviews. This ratio highlights the need for more empirical studies and primary sources, regardless of the research area. More data is needed to support policies, assess their impact, and drive improvements.

Regarding the research methodology, we observed that six out of the 10 papers are based mainly on literature review, while three are based on other secondary research methodologies such as doctrinal methods, policy analysis, MAER, and holistic approach. There is only one research paper that is not based on secondary research and aims to define a new indicator to measure water stress.

On the topic of Green Deal policies in the food chain, implicitly of the "Farm to Fork" strategy, at least in the economic research, there is a gap in primary research. This gap can be filled in with studies related to the evaluation of the impact of these policies on the food chain, to managerial and entrepreneurial solutions that amplify the impact of Green Deal policies on the food chain, to managerial and entrepreneurial solutions for the challenges that Green Deal policies bring for SMEs, etc.

Conclusion

The European Green Deal sets a new standard for building sustainable food chain development policies, with the basic strategy being that of Farm to Fork. This pact established a holistic and balanced approach that takes into account economic development, social needs, and environmental conservation. In our opinion, the implementation of the Green Deal policies throughout the food chain will generate a reform with an emphasis on the circular economy: from obtaining raw materials, to processing, marketing, packaging, and reusing the waste resulting from their consumption.

This bibliometric analysis contributes to the development of research on the implementation of Green Deal policies in the field of the food chain, as longitudinal studies of scientific interest facilitate the clarification of research or expanding research directions. The results obtained through this research facilitate the mapping of the evolution of scientific production in this field by providing a map of the knowledge disseminated in previous studies, carried out on a scientific and objective basis.

Most of the published papers highlight the authors' interest in the sustainability of the food industry, from an environmental perspective and for research into technologies that facilitate the development of the food industry. In the last two years, there has been an increase of over 500% in the number of publications compared to 2012, on all continents.

In addition, there is no sustained interest over time by the same authors in the field of Green Pact policies in the food industry, as very few researchers have addressed the topic more than three times in their research. The analysis applied to the most relevant and influential articles, in terms of citations, revealed that most of these are reviews. This highlights the need to publish more empirical studies and primary sources to help support policy implementation, assess its impact, and generate improvements.

The contributions of this research are many. First of all, the paper makes a major contribution to the scientific field of Green Pact policies in the food chain through the first systematization of existing knowledge, this being, at the time of writing, the first bibliometric analysis of Green Pact policies in the food industry. The second contribution refers to the identification of research gaps, the paper identifying the need for empirical and primary studies in the field. Third, research offers a set of challenges and opportunities to implement Green Pact policies in the food chain, thus expanding scientific knowledge in the field of research interest.

This research has some limitations that could serve as a basis for future studies. These limitations stem from the fact that it is based on quantitative analysis, and thus qualitative aspects are not taken into account. Similarly, the study focused solely on scientific documents from the WOS database, and using other databases, such as Scopus, can generate slightly different results. As future research areas, it would be interesting to investigate (i) business models that implement the Farm to Fork Strategy in the food industry; and (iii) green and sustainable food systems.

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