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Evolution of the Global Scientific Research on the Environmental Impact of Food Production from 1970 to 2020

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Abstract: Food production and consumption account for a significant share of the impact of various pressing and important environmental concerns such as climate change, eutrophication, and loss of biodiversity. In this work, a bibliometric analysis of the last 50 years of research papers, written in English and indexed on Scopus database, was carried out to highlight the evolution of the global scientific research in the environmental assessment of food production (EAFP). The research papers in EAFP started to significantly increase from 2005, being most frequently published by the *Journal of Cleaner Production* and *International Journal of Life Cycle Assessment*. The United States of America was the first publishing country, followed by China, the United Kingdom, and Italy. Wheat, rice, fish, maize, and milk were the food items mainly studied, with different importance depending on the authors' publishing country. *Life Cycle Analysis*, *Carbon Footprint*, and *Water Footprint* were the first three standard methods used to assess *climate change*, *energy consumption*, and *environmental impact*. The *Wageningen University*, *Chinese Academy of Sciences* and *Research Centre*, and *China Agricultural University* were the main publishing research centers. All the papers published worldwide received 18.1 citations per paper, the UK and Chinese papers being those mostly and minimally cited, respectively. Over the last five years, this research field largely aimed to managing the agricultural practices, mitigating global warming and water use, assuring food security and sustainable food consumption, while minimizing food waste formation. Such an objective evaluation of this research topic might help guide researchers on where to address their future research work.

Keywords: environmental analysis; food production; bibliometric study; citation number; authors; affiliations; Scopus

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1. Introduction

Earth's environment is affected by human activities. Since the late 20th century, numerous studies and published papers have highlighted how pollution, burning fossil fuels, deforestation and land exploitation may directly or indirectly cause damage to the environment [1,2]. Today, the increasing human overpopulation and its resulting adverse impacts affect the Earth's environment through ocean acidification, global warming, biodiversity loss, soil erosion, air pollution and undrinkable water. Every choice made can exert multifaceted environmental effects, either negative or positive, on four subsystems [3] like renewable and non-renewable materials; water consumed; land used for agricultural, forest, and grazing areas; raw material extraction or private housing [4]; and emissions such as greenhouse gases (GHG) and several other pollutants, namely SO_X, NO_X, and O_3.

Food production accounts for a significant share of the total impact of several important environmental categories, such as climate change, eutrophication and loss of biodiversity. Between 22% and 37% of global anthropogenic emissions may be attributed to the overall food system [5]. Agricultural production involves the manufacture of fertilizers, pesticides, equipment and energy, as well as land-use change, and is responsible for the great majority (72–82%) of the above GHG emissions. The post-production (2.4 Tg

CO_{2e}) and post-sale (1.0 Tg CO_{2e}) steps produce results of only a minor magnitude, while emissions embedded in food wasted at the consumption phase (~1.6 Tg CO_{2e}) are no way insignificant. About 63% of food-related GHG emissions derived from the production and consumption of animal-based products, except fish and fisheries, 8.5 ± 2.4 Tg CO_{2e} in 2010 [5].

Food production systems are often complex and involve biological systems, which are difficult to control and measure. Some examples are the evaluation of *land occupation* generally resulting in different crop outputs; *soil quality*, this depending on the water content, presence of organic matter, nutrients, heavy metals, living organisms and soil texture and structure [6]; *carbon storage in soils* and *standing biomass*; *yield variability*, between years owing to weather conditions and other factors; and *consumer behavior* towards food consumption, portion sizes, packaging, as well as wastage,. Given the many factors involved, it is quite a difficult task to assess the environmental impact of food products and production systems.

Life Cycle Assessment (LCA) dates to the 1960s, when the energy analyses of industrial systems started to be carried out to account for the oil crises of the early 1970s. The rise of environmental awareness in the late 1980s had the effect of increasing the attention paid to LCA as a potentially valuable environmental management tool. The International Standards Organization (ISO) released four ISO LCA standards (ISO 14040 to 14043) from 1997 to 2000. Following this, the LCA became a decision-support tool for several food companies. The Coca Cola Co. had started to account for the environmental impact of its packaging since 1969. Then, other companies (e.g., Tetrapak, Nestlé, Unilever, Arla Foods) and many beer companies engaged in assessing and improving their environmental sustainability [7,8].

Over the last decade there has been significant advances in terms of the environmental analysis of food products (EAFP). A bibliometric analysis of the research studies performed so far might be used as a basis for the comprehensive understanding of current research on the EAFP and, thus, highlight some potential future research directions.

Several bibliometric studies have been recently published to assess the scientific productivity related to climate change [9–11], food security [12], as well as food security in the context of climate change [13] or food waste [14]. Other scientometric reviews analyzed the effect of climate change on carbon sink [15], water quality [16], and human health [13]. However, no bibliometric study has so far attempted to analyze the scientific literature regarding the environmental assessment of food production and consumption.

Different multidisciplinary citation indices are available online, namely ISI Web of Science, Scopus, Google Scholar, these allowing the extraction of bibliometric indicators, which can be classified as *quantity, quality*, and *structural indicators* [17]. *Primary bibliometric indicators* are elementary measures. They consist of the simple count of publications (*quantity indicators*) and/or citations produced/received (*performance indicator*) by a single author, research group, or journal in a certain time interval and represent the starting point of many bibliometric analyses, even if such measures are usually not very suitable for representing the complexity in the various contexts of application. With regards to the citation count, there is a general agreement about its capacity to represent the impact of an article in the scientific community, but the citation behavior might be influenced by its publication date and language, the author's reputation, membership of an important scientific Institution, as well as the journal characteristics, such as the degree of internationalization, accessibility, and so on. At the same time, the citation data extracted can be used to highlight any connectivity between scientific fields, research groups, as well as authors.

The combinations of the primary indicators with other data (i.e., time interval, average number, etc.) allow the definition of a set of *secondary bibliometric indicators*, such as the *Impact* Factor (IF), and *H-Index* [17].

The construction of the *landscape of science* [18] is now considered an established and prolific field of research and application of bibliometrics. Thanks to natural language processing techniques and a linguistic filter employed by the elaboration software, terms occurring in titles and abstracts of a set of identical elements extracted from publications presents in a database of selected literature are represented as circles in a two-dimensional map [19]. The representation of a research field as a *term map*, or *co-word map*, allows strongly related terms to be located close to each other, while the greater their distance the weaker their relationship will be.

The main aim of this work was to trace global research trends and scientific evolution in the EAFP research from 1970 to 2020, by resorting to a bibliometric, textual, and map analysis to provide a basis for the comprehensive understanding of current research and to highlight the countries, institutions, authors, and journals more productive and influent in this research field.

2. Materials and Methods

2.1. Bibliometric Analysis of Scientific Literature

Elsevier Scopus database (that is, one of the largest abstract and citation database of peer-reviewed literature) was consulted in March 2021 to retrieve bibliographic records related to the environmental impact and sustainability of food production from peer-reviewed articles that were published from 1970 to 2020 (included), this time period having been also subdivided into two time intervals (e.g., 1970–2015, and 2016–2020). This choice implied the exclusion of even important non-peer reviewed articles, some proceedings, communications, and patents, but they were out of the scope of this work. The outcome obtained from a database research analysis can be heavily conditioned by the query string. Indeed, the latter represents the most important tool to extract reliable results for a bibliometric analysis. The words present in the query string were selected as the most important related terms in the field of the environmental assessment of food production. To overcome the numerous limitations related to this kind of exercise, the database queries included two different categories of selected terms related to the topic, as detailed in the electronic supplement (Table S1). Namely, category 1 (C1) was composed of two thematic groups. The first one (A) was related to the *Standard Methods* usable for measuring the environmental impact of food production and consumption, and included 17 words; while the second one (B) included nine generic terms often used in research papers. Category 2 (C2) was composed of words identifying different *food products*. Owing to the numerous foods available, the FAO database (https://www.fao.org/faostat/en/#data, accessed on 18 October 2021) was consulted to identify the foods most relevant worldwide. To this end, all the words contained in the domain *Production* were extracted and included in a few categories, such as *Crop production* (Table S2), and *Crop processed, Live Animals, Livestock Primary,* and *Livestock Processed* (Table S3), by eliminating redundancies and similarity. Moreover, Table S4 shows both several *Generic* terms and other ones characterizing main foods and beverages as derived from the so-called FoodEx2 catalog, that is the *standardized* system recognized by the European Food Safety Agency (EFSA) (https://www.efsa.europa.eu/it/data/data-standardisation, accessed on 18 October 2021) for classifying and describing *foods* and *beverages*. Thus, a total number of 275 words were listed in Tables S2–S4.

The database queries consisted of a string obtained from all the possible binary combinations of all the terms included in the two categories C1 and C2, thus the 24 words in C1 were combined with each one of the 275 words in C2 using the 'AND' Scopus operator. In this exercise, only documents containing simultaneously the two terms in the *Title* were extracted. For an accurate description of the Scopus logical operators refer to the Scopus Search Guide (https://dev.elsevier.com/tips/ScopusSearchTips.htm, accessed on 18 October 2021). Obviously, it is almost impossible to produce a *perfect query string*, and background noise will be always produced. To improve the performance of this study, the Scopus search was performed by choosing the only *Title* (T) as research field (excluding Abstract and keywords) on the assumption that this was the most accurate strategy in relation to terms and research selection efficiency [20]. Bibliometric analysis is usually applied at three levels, the so-called macro level referring to national systems, the meso level to institutions, including individual Universities, and finally the micro one to research groups or individual researchers [21].

The resulting database including the title, citation count, year, author, affiliation, country, and abstract was saved in CSV format and elaborated in the following different ways:

1. *A simple data collection* to show quantitative and qualitative bibliometric analysis in tables and graphs reporting the most publishing countries, affiliations, authors, journals, and founding sponsors, as well as the citation number-per-paper index (CPPI).
2. *Abstract textual analysis* to highlight the most studied food and beverage items and used standard methods by resorting to a custom-made Python 3 script. This operation analyzed all the words present in the Abstracts extracted from the database, and gave rise to a txt file to obtain the frequency (occurrence) of the words listed in both categories C2 and C1, as well as other terms related to the main environmental *impact categories*, *production phases*, and *packaging materials* used (Table S5) to give a broader overview of the subject studied.
3. *Map analysis* by using the bibliometric mapping and clustering approach. Thus, world publication maps were plotted using color intensities proportional to the number of publications by means of the VOSviewer v. 1.6.5.0 software (freely available at www.vosviewer.com, accessed on 18 October 2021). This software was specifically developed for creating, visualizing, and exploring scientific bibliometric maps [22,23]. In such a visual map, strongly or weakly related terms are contiguous or distant from each other, respectively. Only terms occurring at least 50 times were extracted from the publications retrieved. The next step was to identify clusters of related terms by means of a software applying the clustering technique [19]. The assignment of terms to the same cluster depended on their co-occurrences in the title and abstract of the publications retrieved, terms often co-occurring were strongly related to each other, and were automatically assigned to the same cluster. On the contrary, terms with a low co-occurrence, or no-occurrences at all, were assigned to different clusters. A cluster made up of terms characterized by the same color represented a research theme in which one or more research topics were identified. A thesaurus file was also used to ensure consistency for different term spelling, or synonyms. For instance, the expression *wheat productivity* or *wheat production* was termed *wheat yield*, while terms considered not relevant to the search (i.e., names of cities or countries) were omitted.

The search was restricted to publications written in English because it was almost impossible to translate all the scientific terms and keywords in English for the elaboration and analysis. Thus, many authors that wrote papers in their native language were excluded. Even if the database obtained did not include all the papers published in the EAFP field, the data collected allowed a general picture of the world scientific research in EAFP topic, and were not intended to draw up a ranking among countries, affiliations, or authors. In general, it was possible to assume a 10–15% underestimation of the data retrieved, as approximately evaluated by counting manually the number of articles published by several authors and automatically those extracted from the database using the search keys. Figure 1 shows a schematic diagram to highlight the bibliometric procedure used in this work.

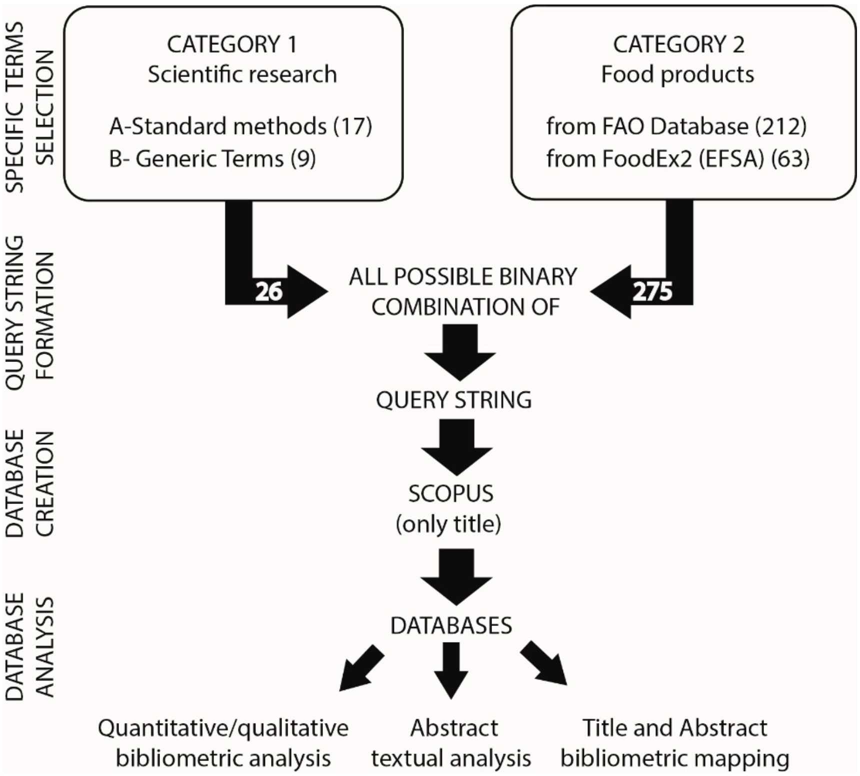

Figure 1. A schematic diagram to highlight the bibliometric procedure used in this work.

2.2. Time Horizon

Since the Scopus search had been conducted in March 2021, publications relative to the year 2020 were included in the analysis. Thus, the publications relative to the year 2021 were underestimated, their overall number being not yet completely indexed by the Scopus database. For the same reason, the citation count regarding the papers published in the year 2021 was excluded.

The selected bibliography was used to extract information regarding the number of publications, countries, main affiliations, authors, citations, and journals. The resulting information was also segmented for the five countries with greater publishing rate in this research topic. The Scimago database (https://www.scimagojr.com/, accessed on 18 October 2021) was used to extract journal info.

3. Results and Discussion

3.1. Bibliometric Analysis

3.1.1. Publication Trends from 1970 to 2020

An overall number of 4186 scientific research works resulted from the research performed here, their annual distribution being shown in Figure 2.

Such a trend was in line with that resulting from a research article that analyzed food security in the context of climate change from 1980 to 2019 [13] and retrieved as many as 5960 documents. The first paper appeared in the years 1968–1970 and until 1990 the overall number of papers published remained almost insignificant; then, two increasing trends were clearly identified. The first one covered the latest decade of the 20th century. Such a period represented a turning point of awareness of the scientific community and public opinion. First, the Antarctic ozone hole was discovered in the 1985. Within two years the United States and more than 100 other countries pledged to phase out the use of ozone-depleting compounds. In 1988, the Intergovernmental Panel on Climate Change (IPCC) was established by the World Meteorological Organization (WMO) and the United Nations Environment Program (UNEP) in order to provide the world with a clear and scientifically based view about the current state of knowledge on climate change and its potential environmental and socio-economic impacts. According to [24], the first Life Cycle Assessment (LCA) study on food products was performed at the beginning of the 1990s and in 1996 was hold the first *LCA food* conference dealing with the environmental impacts analysis of the agri-food sector [25]. A second trend extending from 2000 to 2020 exhibited a definitively steeper growth rate of about 800 papers per year consequently not only to the recent attention to the environmental consequences of food production and consumption, but also to the increasing number of affiliations/authors publishing in this research field.

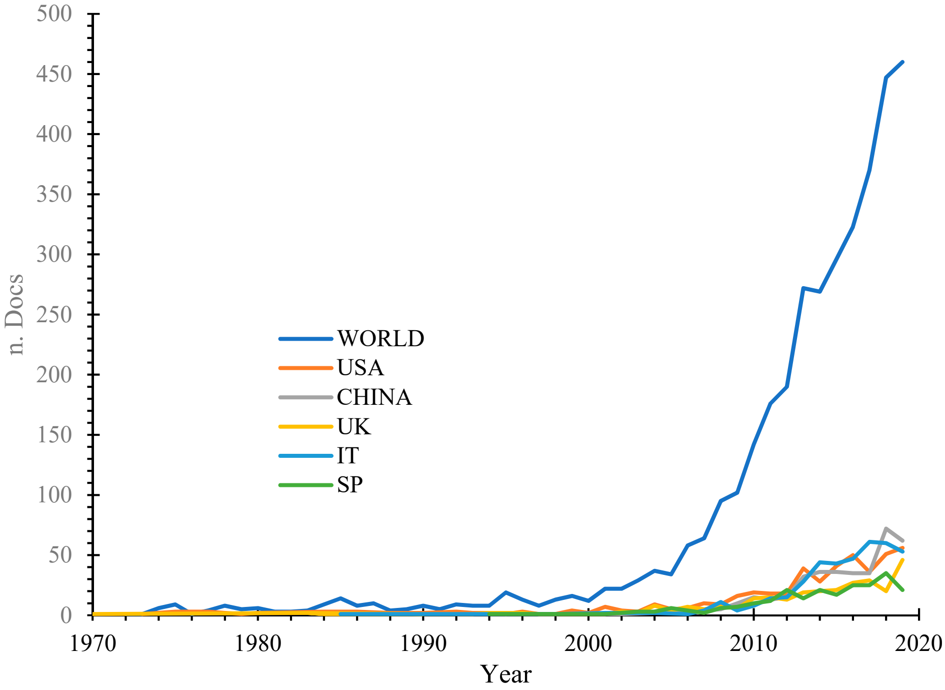

Figure 2. Annual distribution of the overall number of scientific research papers retrieved from the Scopus database from 1970 to 2020.

Table 1 lists the first 20 countries most publishing in this topic, as well as the total number of papers published together with their relative and cumulative percentages. Even if any document might be attributed to multiple countries, the total number of papers retrieved was higher than 4186 (Table 2)

The first 10 nations covered about 53% of the total documents produced, seven of these being European countries. The USA, China, and Italy were the three most productive countries with 548, 465, and 464 documents, respectively, even if the Climate Change Performance Index (CCPI) ranked their efforts to combat climate change at the 61st, 33rd, and 27th position, respectively [26]. In Europe, Italy (464), the UK (328), and Spain (283) were the first three publishing nations with their CCPI at the 27th, 5th, and 4ht position, respectively [26]. Surprisingly, they produced more scientific publications than The Netherlands (170), Denmark (141), and Sweden (161), but, in all, it is likely this achievement is linked to the overall number of inhabitants. Even in this case, in 2021 the CCPI of such countries inversely ranked at the 29th, 6th, and 4th position, respectively [27]. In 2019, the world's largest CO_2 emitters were in descending order China (30.4% of total CO_2 emissions), the United States (13.43%), India (6.83%), the EU27 + UK (8.69%), Russia (4.71%), and Japan (3.03%), these together accounting for 67% of total global fossil CO_2 emitted [27]. As shown in Table 1, China, the USA, and EU28 carried out an intense research activity in this sector (as related to food), showing a certain attention to the problem, differently from Japan and Russia, that ranked at the 17th place and by far lower than the 20th place, respectively. Over the last five years, China, Italy, and USA were the main publishing countries. From 2016 to 2020 the number of publications was higher than that produced from 1970 to 2015 for most of the countries listed in Table 1. A different behavior was noted for Denmark, Sweden, the Netherlands, Australia, and Canada, probably because their research interest switched to other topics.

Table 1. Overall number of publications by country, as well as their relative and cumulative frequencies, as indexed by the Scopus database in different time periods (i.e., 2020–1970; 2020–2016; 2015–1970).

	2020–1970				2020–2016				2015–1970			
No.	**Country**	**No. Docs**	**Relative [%]**	**Cumulative [%]**	**Country**	**No. Docs**	**Relative [%]**	**Cumulative [%]**	**Country**	**No. Docs**	**Relative [%]**	**Cumulative [%]**
1	USA	547	9.7	9.7	China	287	9.3	9.3	USA	273	10.7	10.7
2	China	465	8.2	17.9	Italy	283	9.1	18.4	Italy	181	7.1	17.8
3	Italy	464	8.2	26.1	USA	274	8.8	27.2	China	178	7.0	24.8
4	UK	328	5.8	31.9	UK	169	5.5	32.7	UK	159	6.2	31.0
5	Spain	283	5.0	36.9	Spain	154	5.0	37.7	Spain	129	5.1	36.1
6	Germany	194	3.4	40.4	Germany	106	3.4	41.1	France	97	3.8	39.9
7	France	189	3.3	43.7	Brazil	97	3.1	44.2	Sweden	96	3.8	43.6
8	Australia	173	3.1	46.8	India	97	3.1	47.4	Netherlands	95	3.7	47.3
9	Netherlands	170	3.0	49.8	France	92	3.0	50.3	Australia	94	3.7	51.0
10	Sweden	161	2.9	52.6	Iran	80	2.6	52.9	Germany	88	3.4	54.5
11	India	160	2.8	55.5	Australia	79	2.6	55.5	Canada	79	3.1	57.6
12	Brazil	157	2.8	58.3	Netherlands	75	2.4	57.9	Denmark	74	2.9	60.5
13	Denmark	141	2.5	60.8	Malaysia	71	2.3	60.2	India	63	2.5	62.9
14	Iran	140	2.5	63.2	Thailand	68	2.2	62.4	Brazil	60	2.4	65.3
15	Canada	138	2.4	65.7	Denmark	67	2.2	64.5	Iran	60	2.4	67.6
16	Malaysia	114	2.0	67.7	Sweden	65	2.1	66.6	Belgium	47	1.8	69.5
17	Thailand	107	1.9	69.6	Indonesia	63	2.0	68.7	Japan	47	1.8	71.3
18	Belgium	86	1.5	71.1	Canada	59	1.9	70.6	Malaysia	43	1.7	73.0
19	Switzerland	86	1.5	72.6	Switzerland	49	1.6	72.1	Thailand	39	1.5	74.5
20	Japan	85	1.5	74.1	Turkey	45	1.5	73.6	Switzerland	37	1.4	76.0

Table 2. Top 5 nations ranked by the number of documents published over the 1970–2020 period together with the overall number of citations and average citations per paper index (CPPI).

Time Period	Country	No. Doc.s	No. Citations	CPPI
1972–2020	WORLD	4186	84917	20.3
1973–2020	USA	548	13604	24.8
2002–2020	China	465	6782	14.6
1970–2020	Italy	464	9749	21.0
1985–2020	UK	328	9699	29.6
1994–2020	Spain	283	6673	23.6

From the bibliometric analysis carried out here, it was possible to extract an overview of the number of citations per each article. This assessment was just restricted to the year 2020, because many of the articles published in the 2021 have not been cited yet. Table 2 show the first five countries ranked by the number of documents published during the time periods accounted for, together with total citation count and citation per paper index (CPPI). All the scientific papers retrieved from Scopus database received an average number of 20.3 citations per paper. Interestingly, Table 2 displays that CPPI ranged from 16.6 to 29.6 for Chinese and UK papers, respectively. For some countries (i.e., the UK, USA, Spain, and Italy) CPPI was greater than the world average value, whereas for the second publishing country (i.e., China), such an index was smaller than 20.3. Thus, the CPPI might be regarded as an index measuring the scientific relevance of a paper that should no way be confused with its scientific quality.

3.1.2. Affiliations

The affiliation search returned a list of the institutions involved in the environmental analysis of food production. Table 3 shows the number of papers published by these affiliations from 1970 to 2020.

The *Wageningen University* & *Research* (NL) resulted to be the first affiliation in terms of number of publications, followed by the *Chinese Academy of Sciences*, which includes other affiliations separately named in Scopus, such as the *Institute of Geographical Sciences* and *Natural Resources Research Chinese Academy of Sciences*, *University of Chinese*

Academy of Sciences. Moreover, other Chinese Institutions ranked at the 3rd, 12th, and 16th places, whereas the *Aarhus Universitet* (DK) together with other five European affiliations is in the Top 10 world ones. The first 20 affiliations altogether represented about 20% of the world publications over the years 1970–2020. Thus, there is a widely distributed interest on this scientific research field. Generally, in some countries, and particularly in the USA, the papers retrieved were produced by numerous institutions. Inversely, in other countries, like Sweden, Denmark, and Iran, such papers were performed by specialized research centers.

3.1.3. Authors

A search dedicated to the papers' authors returned the list of the most publishing authors, shown in Table 4, together with the overall number of papers released by such authors in their own country over the time intervals examined. Prof. Adisa Azapagic at the University of Manchester (UK) resulted to be the most publishing author with 31 papers, followed by Prof. María Teresa Moreira (27) at the Universidad de Santiago de Compostela (Spain), and Ian Vázquez-Rowe (25) at the Pontificia Universidad Catolica del Peru (Peru), and Feijoo Gumersindo (24) at the Universidad de Santiago de Compostela (Spain). It can be also noted that one author from Iran and another one from Thailand are included in the first Top 10, indicating a high specialization activity in both countries. The research string used did not allow to number all the papers published by the authors listed in Table 4, being the underestimation of the order of 10–15%, as reported above.

3.1.4. Journals

A journal-based search returned the list of the peer-reviewed journals publishing more frequently papers related to the topic of concern. Table 5 shows the number of publications hosted by such journals, their ranking in quartiles (Q), Scimago Scientific Journal Ranking (SJR), and H-index, as extracted from https://www.scimagojr.com/, accessed on 18 October 2021. In particular, the quartile ranking classifies scientific journals on the basis of their impact factor or impact index.

Table 3. Number of publications for affiliation, as referred to different time periods (2020–1970; 2020–2016; 2015–1970).

	2020–1970		**2020–2016**		**2015–1970**	
No.	**Affiliation**	**No. Docs**	**Affiliation**	**No. Docs**	**Affiliation**	**No. Docs**
1	Wageningen Univ. & Res.	79	Chinese Academy of Sciences	50	Wageningen Univ. & Res.	51
2	Chinese Academy of Sciences	78	China Agricultural Univ.	41	Swedish Ins.e for Food and Biotech.	41
3	China Agricultural Univ.	70	Univ. degli Studi di Milano	32	Aarhus Universitet	35
4	Aarhus Universitet	55	M. of Agric. of the People's Rep. China	32	China Agricultural Univ.	29
5	Univer. de Santiago de Compostela	47	The Univ. of Manchester	31	Chinese Academy of Sciences	28
6	Univ. of Tehran	45	Danmarks Tekniske Universitet	29	Agriculture et Agroalimentaire Canada	25
7	Univ. degli Studi di Milano	45	Wageningen Univ. & Res.	28	Univ. de Santiago de Compostela	25
8	Centre INRAE Bretagne-Normandie	44	Ministry of Education China	26	Centre INRAE Bretagne-Normandie	24
9	Swedish Ins.e for Food and Biotecg.	41	Univer. of Chinese Acad. of Sciences	25	Sveriges lantbruksuniversitet	24
10	The Univ. of Manchester	41	Northwest A&F Univ.	25	Univ. of Tehran	23
11	Sveriges lantbruksuniversitet	38	Univ. of Tehran	22	Nanjing Agricultural Univ.	19
12	Ministry of Education China	37	Univer. de Santiago de Compostela	22	Agrocampus Ouest	18
13	Agriculture et Agroalimentaire Canada	37	Chinese Acad. of Agricultural Sciences	21	Ins. de Recerca I Technologia Agroal.	18
14	Univ. of Chinese Acad. of Sciences	37	Centre INRAE Bretagne-Normandie	20	Universiteit Gent	18
15	Danmarks Tekniske Universitet	36	Aarhus Universitet	20	Univ. of California. Davis	16
16	M. of Agricul. of the People's Rep. China	36	Univ. degli Studi di Bari	19	CIRAD Centre de Rech. de Montpellier	16
17	Agrocampus Ouest	35	CIRAD Centre de Rech. de Montpellier	19	Chalmers Univ. of Technology	15

Table 3. *Cont.*

	2020–1970		2020–2016		2015–1970	
No.	**Affiliation**	**No. Docs**	**Affiliation**	**No. Docs**	**Affiliation**	**No. Docs**
18	CIRAD Centre de Rech. de Montpellier	35	INRAE	19	Malaysian Palm Oil Board	14
19	Northwest A&F Univ.	33	Univ. degli Studi della Tuscia, Viterbo	18	Teagasc-Irish Agric. and Food Dev. Aut.	14
20	Univ. of California, Davis	32	Pontificia Univ. Catolica del Peru	18	Natural Resources Ins.e Finland Luke	14

Table 4. Number of publications by the first 20 highly publishing authors in the world, as referred to different time periods (i.e., 2020–1970; 2020–2016; 2015–1970).

	2020–1970			2020–2016			2015–1970		
No.	**Name**	**No. Docs**	**Country**	**Name**	**No. Docs**	**Country**	**Name**	**No. Docs**	**Country**
1	Azapagic A.	31	UK	Azapagic A.	25	UK	Sonesson U.	14	Sweden
2	Moreira M.T.	27	Spain	Bacenetti J.	17	Italy	Feijoo G.	13	Spain
3	Vázquez-Rowe I.	25	Peru	Moreira M.T.	15	Spain	Rafiee S.	13	Iran
4	Feijoo G.	24	Spain	Vázquez-Rowe I.	13	Peru	Hermansen J.E.	12	Denmark
5	Bacenetti J.	22	Italy	Gheewala S.H.	12	Thailand	Moreira M.T.	12	Spain
6	Rafiee S.	22	Iran	Holden N.M.	12	Ireland	Vázquez-Rowe I.	12	Peru
7	Gheewala S.H.	21	Thailand	Vignali G.	12	Italy	Antón A.	10	Spain
8	Sonesson U.	21	Sweden	Feijoo G.	11	Spain	Cederberg C.	10	Sweden
9	Knudsen M.T.	19	Denmark	González-García S.	10	Spain	Hospido A.	10	Spain
10	Holden N.M.	18	Ireland	Ingrao C.	10	Italy	Subramaniam V.	10	Malaysia
11	González-García S.	17	Spain	Knudsen M.T.	10	Denmark	Van Der Werf H.M.G.	10	France

Table 4. *Cont.*

	2020–1970			2020–2016			2015–1970		
No.	**Name**	**No. Docs**	**Country**	**Name**	**No. Docs**	**Country**	**Name**	**No. Docs**	**Country**
12	Ingrao C.	16	Italy	Cimini A.	9	Italy	Dewulf J.	9	Belgium
13	Vignali G.	16	Italy	De Marco I.	9	Italy	Flysjö A.	9	Denmark
14	Basset-Mens C.	15	France	Jeswani H.K.	9	UK	Gheewala S.H.	9	Thailand
15	Subramaniam V.	15	Malaysia	Moresi M.	9	Italy	Knudsen M.T.	9	Denmark
16	Thoma G.	15	USA	Rafiee S.	9	Iran	May C.Y.	9	Malaysia
17	Bava L.	14	Italy	Bava L.	8	Italy	Andersson K.	8	Sweden
18	Nemecek T.	14	Switzerland	Birkved M.	8	Denmark	Basset-Mens C.	8	France
19	Zucali M.	14	Italy	Iannone R.	8	Italy	Berlin J.	8	Sweden
20	Hermansen J.E.	13	Denmark	Rosentrater K.A.	8	USA	Corson M.S.	8	France

Table 5. Top 20 world journals ranked by the number of EAFP-related publications for the periods examined (1970–2020).

No.	Journal	No. Docs	Q	SJR	H-Index
1	Journal of Cleaner Production	499	Q1	1.81	173
2	International Journal of Life Cycle Assessment	179	Q1	1.60	98
3	Science of the Total Environment	116	Q1	1.66	224
4	Sustainability Switzerland	106	Q2	0.58	68
5	Acta Horticulturae	67	Q4	0.18	54
6	Resources Conservation and Recycling	50	Q1	2.22	119
7	Journal of Environmental Management	46	Q1	1.31	161
8	Agricultural Systems	42	Q1	1.51	101
9	Agriculture Ecosystems and Environment	34	Q1	1.72	163
10	Energy	34	Q1	2.17	173
11	Iop Conference Series Earth and Environmental Science	33			
12	Journal of Food Engineering	32			
13	Environmental Science and Pollution Res.	30			
14	Ecological Indicators	29			
15	Journal of Dairy Science	28			
16	Water Switzerland	26			
17	Bioresource Technology	25			
18	Environmental Science and Technology	25			
19	Energies	23			
20	Animal	21			

The journals mainly specialized in the EAFP topic were those appearing in the first positions, namely in descending order the *Journal of Cleaner Production* with 499 papers published in the 1970–2020 interval, *International Journal of Life Cycle Assessment* with 179 papers, and *Science of the Total Environment* with 116 papers. Other journals, not exclusively publishing papers dealing with food production, firstly dealt with agricultural and environmental science aspects, and, then, with their climate ones. The great majority of these journals were first-quartile journals with SJR citation index in the top 25% of journals for at least one of its classified subdisciplines.

According to Table 6 that ranks all the above 20 journals with respect to the average citation per paper index (CPPI), the *International Journal of Life Cycle Assessment* yielded the greatest CPPI (35.8), followed by the *Journal of Cleaner Production* (32.4), *Science of the Total Environment* (23.5), and *Sustainability Switzerland* (7.8), the latter being the only open-access journal.

3.1.5. Founding Sponsors

Table 7 reports the data extracted from the Scopus database when accounting for the founding sponsors. Over the 1970–2020 period, the *European Commission* was the first sponsor in terms of publications produced, followed by the *National Natural Science Foundation of China*, and *Ministry of Science and Technology of the People's Republic of China*. Such a wide presence of Chinese papers again shows a certain sensitivity of China towards the environmental sustainability of food production, probably because this nation is currently the first CO_2 emitter in the world [25].

Table 6. Top 5 journals ranked by the overall number of papers published from 1970–2020 together with the overall number of citations, total citations per paper index (CPPI), and citation per paper index (10%-CPPI) and percentage of citations (10%-CG) generated by the first 10% of published articles in order of citation received.

No.	Journal	No. Doc.s	No. Cit.s	CPPI	10%-CPPI	10%-CG
1	Journal of Cleaner Production	499	16158	32.4	123.6	37.5
2	International Journal of Life Cycle Assessment	179	6412	35.8	140.1	37.1
3	Science of the Total Environment	116	2730	23.5	91.4	36.8
4	Sustainability Switzerland	106	824	7.8	29.7	36.0
5	Acta Horticulturae	67	279	4.2	23.8	51.3

Table 7. Founding Sponsors cited in the papers retrieved from the Scopus database over the 1970–2020 period.

No.	Sponsor	No. Docs
1	European Commission	162
2	National Natural Science Foundation of China	138
3	Ministry of Science and Technology of the People's Republic of China	74
4	UK Res. and Innovation	68
5	European Regional Development Fund	50
6	Engineering and Physical Sciences Res. Council	40
7	National Key Res. and Development Program of China	40
8	Seventh Framework Programme	38
9	National Science Foundation	37
10	Ministry of Education of the People's Republic of China	33
11	Conselho Nacional de Desenvolvimento Científico e Tecnológico	30
12	Horizon 2020 Framework Programme	30
13	Coordenação de Aperfeiçoamento de Pessoal de Nível Superior	27
14	National Basic Res. Program of China (973 Program)	26
15	Ministerio de Economía y Competitividad	25
16	Ministério da Ciência, Tecnologia, Inovações	25
17	Fundamental Res. Funds for the Central Universities	24
18	Government of Canada	24
19	U.S. Department of Agriculture	24
20	Ministry of Agriculture of the People's Republic of China	23

3.2. *Textual Analysis*

3.2.1. The Most Cited Food-Related Terms

Table 8 shows the mostly used terms (occurrence) and their relative frequency (%) in the database constructed using the Title of the papers produced worldwide or in the five mostly publishing countries (Table 1). The term *milk* was that most cited worldwide, the same conclusion can be drawn for other terms, such as *rice, maize, fish,* and *wheat.* Such terms were those most used also for the five most publishing countries, but in different order. In China, *rice* resulted to be the first term used, owing of course to the high amount of rice produced and consumed (http://www.fao.org/faostat/en/#data/QC/visualize, accessed on 18 October 2021). Italy and Spain differentiate from the other countries for their characteristic terms were related to their diet and/or production. Both countries had *wine* as the third and fourth term most frequently studied, respectively, followed by *wheat*, and *milk*. The term *olive oil* was at 6th place, while the term *pasta* was present in Italian publications only. It is worth noting that worldwide the term *palm oil* resulted to be more studied than the terms *cattle*, *coffee*, or *cheese*. The term *beer* was only present in Chinese (just less cited than *tea*) and Italian papers at the 13th and 14h place, respectively.

Table 8. Ranking of the occurrence of the most food-related terms in the Abstract/Title of the papers indexed in the Scopus database, as referred to the world and five most publishing countries.

World			**USA**			**China**			**Italy**			**UK**			**Spain**		
Terms	**Doc.s**	**%**	**Terms**	**Doc.s**	**%**	**Terms**	**Doc.s**	**%**	**Terms**	**Doc.s**	**%**	**Terms**	**Doc.s**	**%**	**Terms**	**Doc.s**	**%**
milk	1383	9.6	dairy	228	13.0	rice	497	28.6	milk	208	13.5	dairy	96	8.2	milk	96	11.5
rice	1320	9.1	milk	205	11.7	wheat	219	12.6	dairy	120	7.8	rice	80	6.8	dairy	75	9.0
dairy	1125	7.8	rice	152	8.7	maize	188	10.8	wine	115	7.5	milk	79	6.8	fish	70	8.4
wheat	867	6.0	fish	105	6.0	vegetable	88	5.1	food waste	69	4.5	meat	78	6.7	wine	48	5.7
fish	599	4.1	cattle	77	4.4	food waste	84	4.8	wheat	67	4.3	food waste	73	6.2	meat	39	4.7
meat	593	4.1	meat	69	3.9	cotton	81	4.7	olive oil	53	3.4	fish	55	4.7	rice	35	4.2
maize	491	3.4	wheat	64	3.7	fish	55	3.2	rice	51	3.3	sugar	46	3.9	maize	29	3.5
food waste	479	3.3	maize	62	3.5	milk	45	2.6	pasta	51	3.3	wheat	43	3.7	cheese	27	3.2
sugar	465	3.2	food waste	52	3.0	dairy	35	2.0	cheese	43	2.8	meal	30	2.6	wheat	23	2.7
palm oil	410	2.8	cotton	42	2.4	rubber	27	1.6	meat	43	2.8	maize	29	2.5	rapeseed	21	2.5
cotton	323	2.2	meal	39	2.2	meat	27	1.6	maize	41	2.7	sheep	26	2.2	legumes	21	2.5
vegetable	277	1.9	wine	38	2.2	tea	26	1.5	fruits	39	2.5	wool	25	2.1	olive oil	18	2.2
wine	273	1.9	rubber	36	2.1	beer	24	1.4	vegetable	37	2.4	legumes	25	2.1	food waste	18	2.2
cattle	270	1.9	vegetable	32	1.8	sugar	23	1.3	beer	32	2.1	wine	24	2.1	vegetable	17	2.0
oil palm	266	1.8	palm oil	31	1.8	cassava	21	1.2	fish	26	1.7	rapeseed	23	2.0	cotton	16	1.9
coffee	257	1.8	sugar	28	1.6	wool	21	1.2	fat	26	1.7	vegetable	19	1.6	seafood	16	1.9
rubber	250	1.7	rye	26	1.5	legumes	20	1.2	cattle	22	1.4	tea	18	1.5	tomatoes	15	1.8
meal	219	1.5	legumes	25	1.4	sorghum	18	1.0	bread	22	1.4	palm oil	18	1.5	cattle	13	1.6
cheese	200	1.4	lettuce	24	1.4	seafood	18	1.0	sorghum	21	1.4	rapeseed oil	18	1.5	wool	11	1.3
seed	180	1.2	tea	24	1.4	barley	16	0.9	barley	20	1.3	bread	18	1.5	sugar	11	1.3
rapeseed	164	1.1	coffee	23	1.3	fruits	16	0.9	whey	19	1.2	chocolate	17	1.5	bread	10	1.2
tea	164	1.1	seafood	22	1.3	tobacco	15	0.9	meal	18	1.2	cotton	15	1.3	barley	9	1.1
bread	149	1.0	cheese	21	1.2	soybeans	13	0.7	tea	16	1.0	butter	15	1.3	yoghurt	9	1.1

3.2.2. The Most Cited Environmental Impact Categories and Standard Methods

Table 9 shows the environmental impact categories and standard methods most frequently used and their relative frequency, as searched in the Title or Abstract of published papers. *Life Cycle Assessment* (LCA), *Carbon Footprint* (CF), and *Water Footprint* (WF) were the first three standard methods mostly used. However, the LCA procedure does not a priori give any clue about the impact categories effectively considered. In any case, the most used methods relied on just a single environmental issue (i.e., CF including the Publicly Available Specification 2050, WF, *Ecological Footprint*, and *Cumulative Energy Demand*), followed by the standard methods that analyze the environmental impact with mid- (i.e., *Environmental Product Declaration*, *TRACI*) or end- (i.e., *IMPACT 2002*$^+$) point impact categories, and more recently by the *Product Environmental Footprint* (PEF) method, where as many as 16 mid-point categories are normalized with respect to the impacts caused by one person living in the world during one year and weighed excluding or including three toxicity related impact categories (i.e., human toxicity cancer, human toxicity non-cancer and freshwater eco-toxicity) to yield a single weighted score. Further details were summarized by Moresi et al. 2021, [28].

Table 9. Occurrence of the environmental impact assessment methods in the abstract of the papers published in the 1970–2020 period.

No.	1970–2020	Occurrence	1970–2015	Occurrence	2016–2020	Occurrence
1	LCA	2128	LCA	1183	LCA	945
2	Life Cycle Assessment	1372	Life Cycle Assessment	660	Life Cycle Assessment	712
3	Carbon Footprint	978	Carbon Footprint	474	Carbon Footprint	504
4	Water Footprint	804	Water Footprint	340	Water Footprint	464
5	Ecological Footprint	148	Ecological Footprint	102	CED	52
6	CED	84	Ecoindicator	37	Ecological Footprint	46
7	Eco-indicator	42	CED	32	EPD	8
8	Impact 2002	17	PAS 2050	13	PEF	8
9	PAS 2050	14	Impact 2002	11	Impact 2002	6
10	EPD	13	EPD	5	TRACI	5
11	PEF	11	TRACI	5	Eco-indicator	5
12	TRACI	10	PEF	3	PAS 2050	1
13	EPS 2000	1	AWCC	0	EPS 2000	1
14	AWCC	0	CML 2002	0	AWCC	0
15	CML 2002	0	EDIP 2003	0	CML 2002	0
16	EDIP 2003	0	EPS 2000	0	EDIP 2003	0
17	Eco Scarcity	0	Eco Scarcity	0	Eco Scarcity	0
	Total	5622		2865		2757

AWCC—Australian Wine Carbon Calculator; CED—Cumulative Energy Demand; EPD—Environmental Product. Declaration; PEF—Product Environmental Footprint.

3.3. *Map Analysis*

Figure 3 shows the term map referred to the 1970–2020 period. The 299 terms displayed on the map were grouped in six clusters, which appeared well separated and were identified by different colors.

Among the 116 terms marked in red, the three main terms were *development, consumer, challenge* and *food production*, these cluster terms were clearly linked to issues related to environmental policies, decision-making about the mitigation measures to be undertaken to address and resolve the environmental impacts of food production, and communication of environmental and sustainability aspects to different stakeholders. The term *diet* was closely related to another cluster (marked in yellow), and in particular to *meat.* Such a cluster represents an important sector of study regarding the *livestock* impact on food production, *milk* production and *land use.*

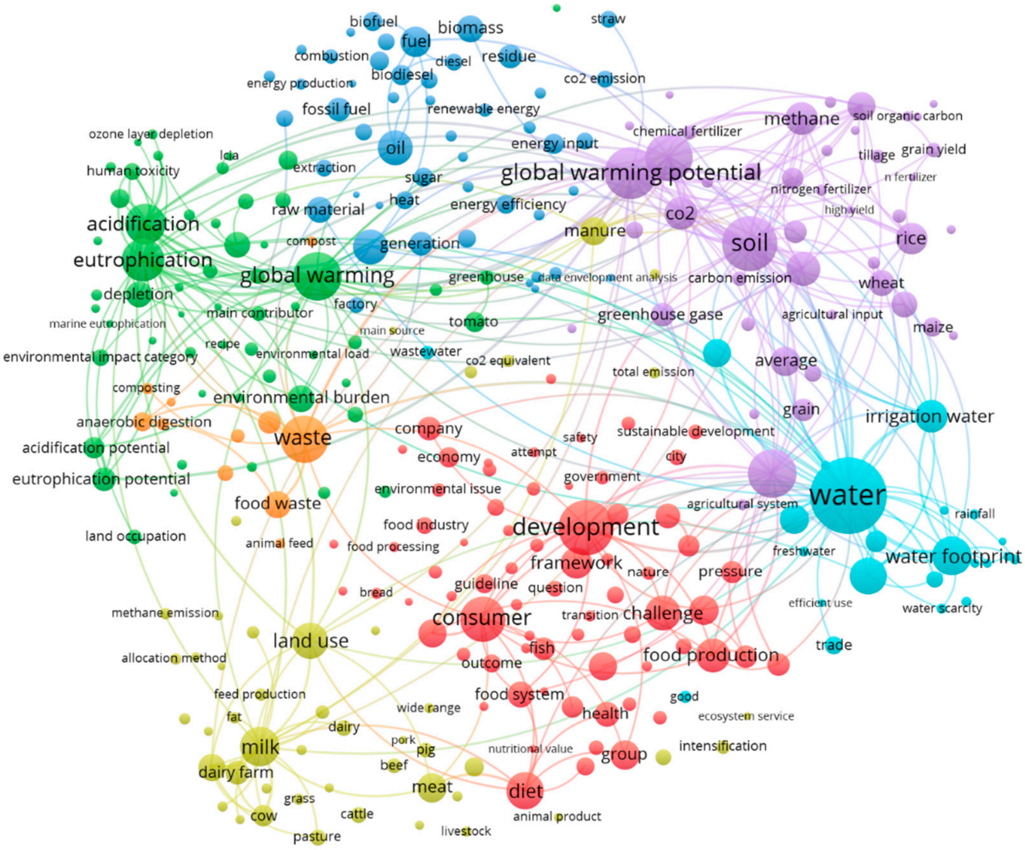

Figure 3. The term map referred to the 1970–2020 period.

The green-marked cluster included 55 items, regarding the impact categories mostly cited, the terms *global warming*, *eutrophication*, and *acidification* being the prevailing ones. This cluster is near the blue-marked one, where the biggest spot was represented by the terms related to *fossil fuels*, *oil* and *combustion* probably for transportation and *heat* generation. Clearly, the *fossil fuel* problems were emphasized by other terms, such as *biofuel*, *biodiesel*, *ethanol*, and *sugar*, these underlining the use of an edible raw material as energy source.

The viola-marked cluster was strictly related to *agriculture* and raw material production (in particular *wheat* and *rice*). *Nitrogen fertilizer*, *methane*, *CO*$_2$ resulted to be linked to the *soil* and *global warming potential* spots. One of the biggest spots included the term *water* with connection to all the other clusters and the smallest cluster regarding *waste*, *food waste*, *composting*, and *anaerobic digestion.*

About 70% of the global water consumed by humans is used in agriculture [29], primarily for irrigation. Thus, in food products coming from irrigated land, irrigation will dominate the water use.

Figures 4 and 5 elucidate the main links (i.e., co-occurrence between terms), as referred to the 1970–2016 and 2017–2020 periods. One of the main topics of the first period concerned several terms, namely *sustainability*, *milk*, *fertilizer*, *global warming*, *eutrophication*, and *land use*. On the contrary, in the following four years the main research topics diverted to *water*, *diet*, *consumer* and *sustainable food consumption*, *food waste*, and *waste disposal*, this including *incineration* and *recycling*, such as *composting* and *anaerobic digestion.*

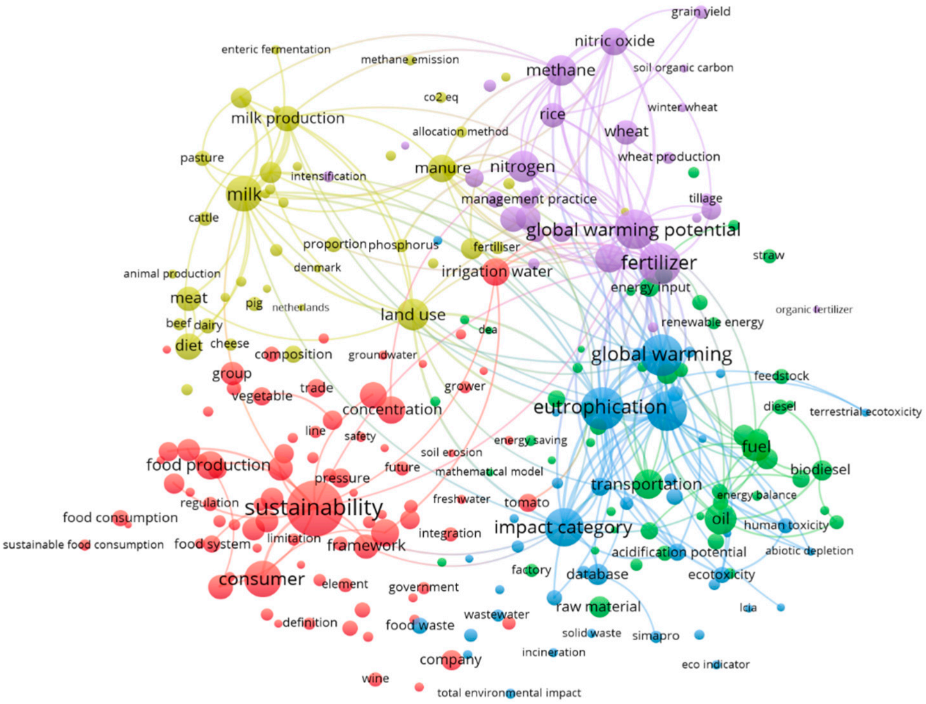

Figure 4. The term map referred to the 1970–2015 period.

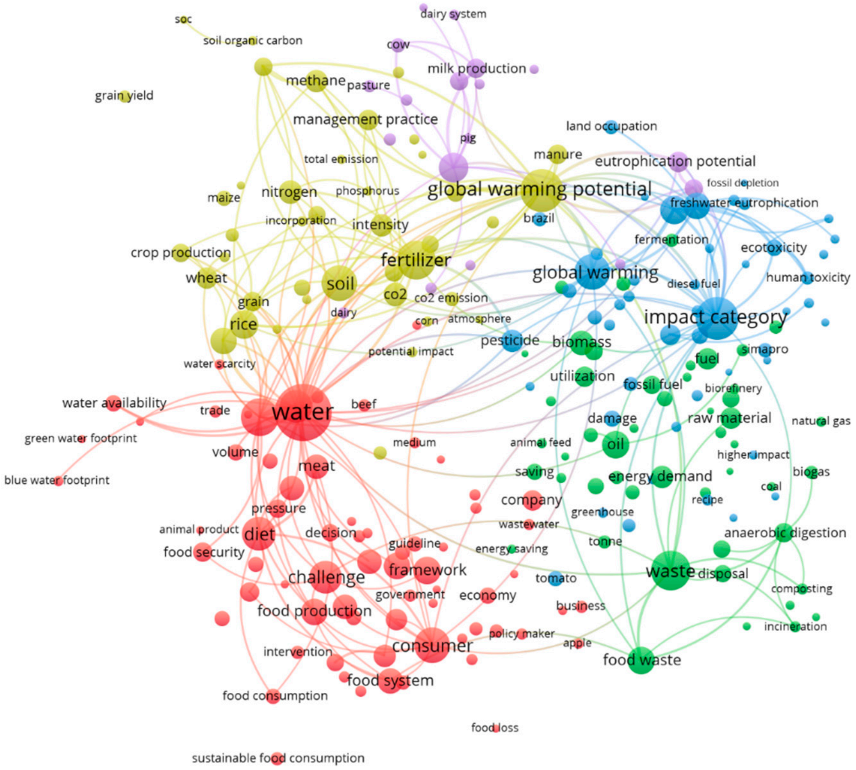

Figure 5. The term map referred to the 2016–2020 period.

3.4. Firstly Indexed and Mostly Cited Papers

Table S6 in the electronic supplement shows the first 10 published papers concerning the EAFP, these having been indexed by the Scopus database since 1968, as well as those mostly cited ones over the latest 50 years.

The term *environmental impact* firstly appeared in 1974 and was related to the disposal of sulfur removal sludges generated by the slaked lime-wet scrubber process, and use of antibacterial drugs in food animals. A paper published in 2006 explored the consumer attitude towards a more sustainable food consumption and resulted to be the most cited paper in this research sector, gathering more than one thousand citations.

4. Discussion of Results

The present bibliometric review highlighted the presence of some novel aspects regarding the actual EAFP sector. The first and most evident conclusion of this study pointed out that the production of the scientific community in terms of number of publications is still relatively small despite the social and scientific relevance of the environmental impact of food production and consumption in terms especially of food security, air and soil quality, diet and health. In all probability, the limited number of publications retrieved depended on the evolution of this sector that has just a recent origin. On the other hand, the data analysis at the macro level highlighted that two of the most GHG emitting countries, namely China and the USA (http://www.globalcarbonatlas.org/en/CO2-emissions, accessed on 18 October 2021) were the first ones in terms of the number of publications on this topic. Moreover, such nations displayed a long and consistent record of investment in research and development (R&D) (https://www.rdworldonline.com/2021-global-rd-funding-forecast-released/), accessed on 18 October 2021). Nevertheless, if their prolific scientific production in terms of total world scientific publications was related to their population and governmental investment in R&D (see Table S7 in the Supplementary Material), the number of scientific papers per each billion USD invested o per million citizens was just of the order of unity, while it roughly increased by a factor of 10 in the case of the most publishing European countries, such as Italy, the UK, and Spain.

Not by chance, the scientific research in the EAFP field resulted to be mainly carried out in Europe, since 10 out of the first 20 nations and 12 out of the first 20 Institutions/Research Centers, as well as the most publishing authors, were European.

The publications resulted to be concentrated in few journals (e.g., the *Journal of Cleaner Production*, *International Journal of Life Cycle Assessment*, and *Science of the Total Environment*), even if the EAFP topic has interested other magazines not always directly related to this research area as measured by a higher number of citations per paper with respect to the world average one.

The textual analysis showed that a great number of studies just focused on a single environmental issue, mainly the climate impact measured via the carbon footprint or water footprint methodology. This choice was probably encouraged by a wide-ranging public debate on this issue, a relatively important share of the overall GHG emissions by the food sector, and a good availability of data, even if such impact categories are regarded to be insufficient to describe the full range of environmental impacts deriving from the food systems. Less attention was up to now given to other standard methods, such as EPD® and PEF, likely for their relatively recent introduction. Since the characterization of the whole environmental profile of a single food or drink product is costly [30,31], and the climate change impact category is quite more reliable than all the other ones used in the aforementioned standard methods [32], the assessment of the product carbon footprint might be regarded as not only a cheaper tool to identify the major hotspots of the food supply chain, but also a proper method to start improving the sustainability of the 99% of the food and beverage small- and medium-sized enterprises [33]. Moreover, since the collection of primary data involves time, cost, and resource efforts, especially for SMEs, the use of secondary data might be more than sufficient for a preliminary identification of the major hotspots of a process or product, as shown in the production of bread [34] and lager beer [35].

The bibliometric map also showed a scientific interest towards other environmental impacts not exclusively related to fossil energy use or climate impacts, such as those linked to the agricultural production affecting the biodiversity, soil quality, water release of nutrients (mainly nitrogen and phosphorus), and pesticides. For instance, the GHG emissions associated to such a phase are in descending order due to: (1) crop residue decomposition;

(2) inorganic fertilizers applied; (3) manufacture, storage, and transportation of inorganic N and P fertilizers, and pesticides to the farm gate; (4) main farming operations, such as tillage, seeding, pesticide spraying, and crop harvesting; (5) soil carbon gains or losses from various cropping systems; and (6) emissions of N_2O from fallow areas destined to the growth of the next year crop [36]. Several crop rotation systems, lower N fertilizer rates, and reduced tillage seemed to be effective to mitigate the carbon footprint of several crops, such as durum wheat [37–39]. Even if organic farming is regarded as low-carbon agriculture [40], its lower productivity with respect to conventional one requires more cultivated land, this greatly enhancing the damage to the ecosystem quality, as observed in the case of organic durum wheat [41].

Figure 3 shows an important correlation between nutrition (diet) and meat and food security. Since the world population is expected to grow from about 7 billion to 9.6 billion people in 2050, as well as the global meat and milk consumption, especially in China and India, the promotion of healthy diets can reduce the environmental footprint of food consumption [42,43], as in the case of the Mediterranean diet, which is not only protective against lifestyle diseases, such as cardio-vascular disease, obesity, type 2 diabetes mellitus and certain cancers, but also responsible for a more favorable impact on the environment [44].

As shown in Figure 3, the utmost studied foods coincided with the most impacting ones, such as meat and milk. In this group also rice and wheat were included, even if they are staple food with a relatively low environmental impact but a high worldwide production and consumption.

Over the latest five years (Figure 5), other terms, such as *water*, *energy demand* and *food waste*, underlines the contribution of the consumer and post-consumer steps of the life cycle of different foods and beverages. As concerning the consumer phase, any mitigation action of its environmental impact would ask for the diffusion of more appropriate cooking systems. In the case of dry pasta, its cooking energy consumption might be significantly reduced by using quite smaller water-to-pasta ratios than the conventional one of 10 L per kg of dry pasta [45–47] or adopting novel home eco-sustainable pasta cookers [48,49]. On the contrary, in the case of coffee the use of ground and roasted coffee instead of coffee pods or capsules would drastically cut the GHGs emitted to produce their packaging materials and dispose of post-consumer packaging wastes [50].

Finally, an increasing number of studies focused not only on the analysis of food waste to measure their environmental impacts and suggested some mitigation options, but also on *water* and *land use*, the latter being especially related to *meat* and *milk* production. Food is lost and wasted along the whole supply chain from farms to processing, retailing and consumption at home and restaurants. Food waste not only involves the loss of valuable and often scarce resources, such as water, soil, and energy, but also contributes to climate change. In the European Union, about 88 million metric tons of food are wasted every year, equivalent to 173 kg per person, 53% and 19% of which being wasted by households and processing, respectively [51]. Per capita food waste generation by households was found to be practically independent of the country income, thus any action on food waste would be equally relevant in high, upper-middle and lower-middle income countries [52]. Food waste should be handled to avoid a negative impact on the environment or human health. According to the waste hierarchy set out at Article 4 of the revised Waste Framework [53], food waste formation should be limited as much as possible using for example less material in design and manufacture. Once formed, its entire apparatus or replacement parts should be refurnished to be re-used, recycled, submitted to other recovery options, and finally disposed of via landfilling or incineration with no energy recovery, as the least preferred option.

From such a map analysis, the food and beverage industry is expected in the near future to bear an ever-increasing responsibility towards consumer and environment and to invest more to prevent the development of more serious and costly adverse effects on food security.

5. Conclusions

The bibliometric data analysis, articulated through various indicators and combined to literature mapping clustering tools, allowed a graphical and numerical assessment of the research panorama on the environmental assessment of food production, as well as the geographic origin of this kind of research and growth or erosion of the scientific impact of specific countries. It represented an objective evaluation of this particular research topic, researchers or research Institutions, and could help researchers to address their research work and select the appropriate journals for their papers. The data highlighted the presence of few specialized journals with relevant citations per paper and H-index, as well as many other multidisciplinary journals with H-Indexes like those of the specialized ones. Over the latest five years this research field was mainly aimed at managing the agricultural practices, mitigating global warming and water use, assuring food security and sustainable food consumption, while minimizing food waste formation.

Supplementary Materials: The following are available online at https://www.mdpi.com/article/10.3390/su132111633/s1, Table S1: List of terms used for the query string: Category 1—Selected Terms of two thematic groups, A—Standard methods and B—Generic Terms, Table S2: List of terms used for the query string: Category 2—Food products, Crop production Terms, Table S3: List of terms used for the query string: Category 2—Food products, category Crop processed, Live Animals, Livestock Primary, Livestock Processed, Table S4: List of terms used for the query string: Category 2—Food products, category Generic, Food and beverage, Table S5: List of terms used for textual analysis of abstract, Table S6: Scientific production in EAFP for the top 5 nations ranked by the number of documents published related to their population and governmental investment in R&D.

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Conflicts of Interest: The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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