Agri-food sustainable marketing research: a bibliometric analysis of the evolution of the field since 1990

Betzabé Ruiz-Morales,
Irma C. Espitia-Moreno,
Evaristo Galeana-Figueroa
and Víctor G. Alfaro-García*

Facultad de Contaduría y CienciasAdministrativas,
Universidad Michoacana de San Nicolás de Hidalgo,
Gral. Francisco J. Múgica S/N, C.U., 58030 Morelia, México
Email: betzabe.ruiz@umich.mx
Email: irmacris@umich.mx
Email: evaristo.galeana@umich.mx
Email: victor.alfaro@umich.mx
*Corresponding author

Abstract: The present paper provides a bibliometric analysis of the evolution of the study of agri-foods with sustainability and marketing. The data were obtained from an exhaustive analysis. Using Web of Science (WoS), 1134 papers from 1900 to 2019 were retrieved and analysed. Recent years have witnessed growth in the number of publications referring to sustainability, marketing and agri-foods, and the scientific community is becoming increasingly interested in the relationship between agri-foods and sustainability. Important results and information are presented about the most cited, more productive and influential authors, organisations, journals, countries and papers in this field.

Keywords: agri-food; sustainability; marketing; bibliometrics.

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Biographical notes: Betzabé Ruiz-Morales is currently enrolled in the Business Management Doctoral program at Universidad Michoacana de San Nicolás de Hidalgo. She has a Master's degree in Science and International Business from the Instituto de Investigaciones Económico Empresariales (ININEE – 2016). Her research focuses on innovation and sustainability. She participates actively at international conferences and has published research papers in peer-reviewed journals and book chapters.

Irma C. Espitia-Moreno is Professor and Researcher at the Universidad Michoacana de San Nicolás de Hidalgo (UMSNH). She is member of the Mexican System of National Researchers (SNI I – CONACyT), member of the research network Áreas Naturales Protegidas – CONACyT, member of the Academic Committee of the Master's and Doctoral programs of Business

Administration at Facultad de Contaduría y Ciencias Administrativas (FCCA) and International Business at the Instituto de InvestigacionesEconómico – Empresariales (ININEE). She has also been head of the research department, head of the postgraduate department and coordinator of the PhD program of business administration at FCCA of the UMSNH. She has published various research papers focused on consumer behavior and sustainable packaging management.

Evaristo Galeana-Figueroa is Professor and Researcher at the Universidad Michoacana de San Nicolás de Hidalgo (UMSNH). He is member of the Mexican System of National Researchers (SNI II – CONACyT). He has a degree in Business Administration with specialization in Finance, a Master's degree in Administration, both from the UMSNH and a PhD in Business Organization and Management from the RoviraiVirgili University in Tarragona, Spain. His lines of research are promotion and evaluation of competitiveness, total quality, and its implications in the productive sector. He participates in a scientific collaboration thematic network with the project: Key Factors for the Competitiveness of Manufacturing SMEs in the Central West Region of Mexico. He has been Administrative Secretary, Research Coordinator and Head of the Postgraduate Studies Division of the Facultad de Contaduría y Ciencias Administrativas (FCCA) at the UMSNH. He is also currently the coordinator of the consolidated academic scientific network "Business Competitiveness".

Víctor G. Alfaro-García is Professor and Researcher at the Universidad Michoacana de San Nicolás de Hidalgo (UMSNH). He is member of the Mexican System of National Researchers (SNI I – CONACyT). He has a PhD in Business from the Universitat de Barcelona, Spain. His research interests are fuzzy, intelligent, and expert systems applied to business, innovation management and regional development. He has regular participation as organiser of international congresses, and he is currently the coordinator for Mexico for Red Sistemas Inteligentes y Expertos Modelos Computacionales Iberoamericanos (SIEMCI).

1 Introduction

Almost 6 years have passed since the General Assembly of the United Nations adopted the 2030 Agenda for Sustainable Development. This holistic approach, designed to confront some of the most concerning problems of humanity, includes 17 goals, with the key issues being food security, nutrition and zero hunger. Several indicators show that the objective of eradicating all forms of malnutrition by 2030 is not being accomplished. World conflicts and climate change are some of the factors that compromise the achievement of zero global hunger. Additionally, the impact of the world economic slowdown in 2020 has yet to be evaluated and assessed. This last topic is of major relevance, as hunger is highly related to the cost of acquiring and maintaining a healthy diet, leaving a high percentage of the global population vulnerable. The impact of food insecurity involves a wide-ranging scope of topics ranging from health and environmental issues – e.g., greenhouse gas emissions, energy and land use, water availability, and transgenic food – to economic and social costs.

In recent decades, significant efforts have been made in agricultural food production to tackle the systemic problems previously identified. Agri-food approaches apply

agroecological principles, that is, the generation of food through environmentally friendly practices, to ensure product sustainability. In this commercial sector, producers want to integrate ecological processes and biological controls into the production process and use available resources at a low cost and with less environmental degradation (Dafermos, 2015). Within the agri-food sector, sustainable marketing aims to reduce food waste. Organic waste must be specially treated because it is easily degraded, allowing the use of nutrients and energy. If it is not treated properly, it can produce undesirable results in terms of degradation (Vorhies and Morgan, 2005; Hardoy and Satterthwaite, 2014).

Bibliometric techniques refer to the mathematical and statistical analyses of all the data that appear in scientific publications (Underwood, 1996). These techniques are of particular interest in rapidly growing research areas such as agri-food research, as they provide valuable insights into the behaviour and evolution of developing scientific proposals, specifically, the authors, sources, and trends that currently shape the scope of the advances (Merigó et al., 2015). Some interesting bibliometric studies and systematic reviews in the agri-food research are, e.g., in the health research (Sargeant et al., 2006; Mittal et al., 2018), where the authors revise the scientific approaches towards agri-food-related health issues, foodborne illnesses and pathogens. Bibliometric studies in agri-food supply chain management have also received much attention from scholars, e.g., a bibliometric approach to agri-food supply chain management (Luo et al., 2018), and the integration of sustainability and innovation in diverse sectors, including agriculture (Tebaldi et al., 2018) and logistics best practices of the regional food supply chain (Mittal et al., 2018). Other bibliometric studies include coordination in agri-food systems (Guimaraes et al., 2020), integration of nanotechnology into agri-food systems (Sastry et al., 2010) and agri-food approaches under complex system thinking (Monasterolo et al., 2016).

Despite the great attention paid to certain areas of agri-food, little focus has been given to approaches to sustainable agri-food marketing research. The objective of the present paper is to present a bibliometric analysis of the developments in the area to find connections, trends and insights into the evolution and orientation of the advancements. The selected database for the development of this study is Web of Science (WoS). The results present, in convenient tables and figures, the number of papers produced in the field, the most influential and productive authors, the more productive institutions, the most productive journals and countries, the more productive scientific areas and the most cited papers in the agri-food research.

The structure of the paper is as follows. Section 2 presents the methodological approach of this study, detailing the search process and its foundations. Section 3 shows the results of the methodological search. Section 4 presents the discussion, and finally, Section 5 includes the concluding comments of this paper.

2 Methodology

Bibliometric studies present the collection of large amounts of data in an orderly and structured manner. The correct representation of data requires a systematic and traceable search for optimal result quality (Alfaro-García et al., 2020). For the data collection, WoS was used as a base tool. This tool belongs to Clarivate Analytics and compiles diverse databases, citations, references, and bibliographies of a wide variety of publications from 1900 to the present (Clarivate, 2020). Other databases – such as Google Scholar, which

was created in 2004 – are search engines that contain papers from indexed journals, books, theses, patents and documents related to conferences and have scientific and academic validity. The Scopus database was also created in 2004; it allows for different specialised and advanced search options by author, affiliation, or document. It performs citation calculations, provides author profiles, evaluates the performance of scientific journals and includes within its impact metrics the SCimago Journal Rank (SJR), Source Normalised Impact per factor (SNIP), Cite Score and h-index. In Zhu, (Zhu and Liu, 2020), a study was carried out on the search for a specific topic in the Scopus and WoS databases for the same range of years. Based on the results, WoS was demonstrated to have a greater number of publications in papers and reviews than Scopus.

In WoS, the user can access several indexes. We used the following indexes for our methodological approach: Science Citation Index Expanded 1900 (SCI-EXPANDED)-present, Social Sciences Citation Index (SSCI) 1900-present, Arts & Humanities Citation Index (A&HCI) 1975-present, Conference Proceedings Citation Index-Science (CPCI-S) 1990-present, Conference Proceedings Citation Index -Social Science & Humanities (CPCI-SSH)1990-present, Book Citation Index-Science (BKCI-S)2005-present, Book Citation Index-Social Sciences & Humanities (BKCI-SSH) 2005-present and Emerging Sources Citation Index (ESCI) 2015-present. Specifying the consulted indexes allows us to maximise the traceability of the study (Liu, 2019).

To develop the research within WoS, first, the keywords were identified. The following elements related to the agri-food search were identified based on a review of the literature from Luo et al. (2018). Regarding supply chain management in agri-food, they adopted the keywords of agricultural commodities defined by FAO: agri* OR agro* OR farm* OR food*. The second search was based on sustainability. The literature review revealed that some authors use the word sustainability, while others use the word sustainable e.g., "Global food demand and the sustainable intensification of agriculture by Tilman et al. (2011), "Nitrogen uptake, assimilation and remobilisation in plants: challenges for sustainable and productive agriculture" by Masclaux-Daubresse et al. (2010); and "Sustainable intensification in agriculture: premises and policies" by Garnett et al. (2013). These authors use the word sustainability in their research in the field of agriculture, which is also used in "Sustainable supply chain and innovation: a review of the recent literature" (Tebaldi et al., 2018). On the other hand, the following authors use the word sustainability in their scientific research: "Agricultural sustainability: concepts, principles and evidence (Pretty, 2008);""Soil erosion and agricultural sustainability (Montgomery, 2007);""The spread of conservation agriculture: justification, sustainability and uptake (Kassam et al., 2009);" and "The structure of sustainability research in marketing, 1958–2008: a basis for future research opportunities (Chabowski et al., 2011)". Based on the words used by the experts, sustainab* was used to include all the terms used in the literature. Finally, in the last search block, the keywords 'marketing' OR 'green marketing' OR 'sustainable marketing' OR 'ecology marketing' were included, and these words were obtained from the literature review of ecological marketing (Borodin et al., 2016; Masoumi et al., 2019; Tebaldi et al., 2018; Dimitrios, 2000; Winfield et al., 2010).

To better delimit the scope of the search within WoS, the parameters of the document types were refined to retrieve only papers, reviews, letters and notes. The year range was defined as 1900 to 2019, which yielded a result of 1134 papers. Both the main authors and the organisations were searched by country of origin. The h-index was obtained from WoS.

3 Results

In this section, we present the results obtained from the methodology and applied to the data search in WoS. This section shows the annual number of publications in the agri-food sustainable marketing (AFSM)research; the number of citations; the most productive and influential authors in the area; the most productive institutions, journals, and countries; and the most cited papers.

Figure 1 shows the number of publications in the field of AFMS research regarding sustainability and marketing from 1900 to 2019. The blue bars indicate the number of agri-food papers published each year in WoS. In general, the topic has been of research interest; however, from 2015, the number of publications has grown significantly, and in 2019, the percentage change was greater than it was in previous years.

Table 1 presents general information regarding the structure of agri-food quotations in WoS. As this topic is new and growing, the number of quotations ranges from less than 15 to 300 or more. Only one publication has quotations of more than 300; 879 publications have under 15 quotations; 106 publications have equal to or more than 15 quotations; 99 publications have 25 or more quotations; 37 publications have 50 or more quotations; and 9 and 3 publications have for 100 and 150 quotations, respectively.

Figure 1 Number of annual publications in the AFSM research since 1990

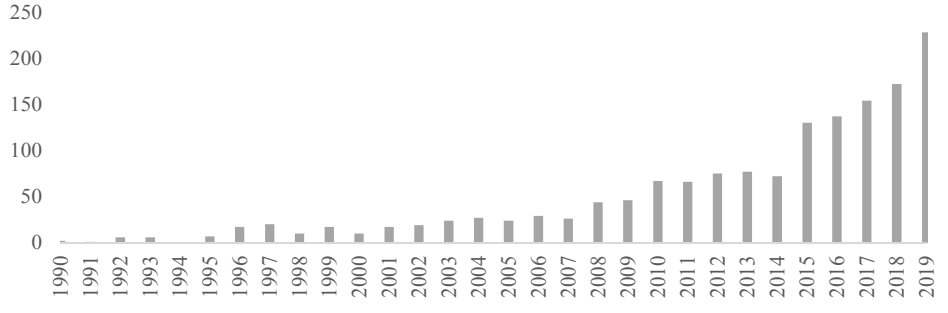

Table 1 General citation structure in the AFSM research in WoS

Number of citations	*Number of papers*	*% Papers*
≥ 300 citations	1 paper	0.088
≥ 200 citations	3 papers	0.264
≥ 100 citations	9 papers	0.793
≥ 50 citations	37 papers	3.262
≥ 25 citations	99 papers	8.730
≥ 15 citations	106 papers	9.347
< 15 citations	879 papers	77.513
Total	*1134 papers*	

Table 2 shows the 30 most productive and influential authors in the AFSM research according to the information retrieved from WoS. The first 4 authors have the same number of publications in agri-food (5); however, Moustier leads the ranking because of

the number of citations received, being the most influential of the authors. Second is Sher, from Pakistan, with 49 citations. Third is Spiller, from Germany, with 42 citations. Finally, Gul, from Turkey, has 5 publications on agri-food.

Table 2 The most productive and influential authors in the AFSM research

R	*Name*	*C*	*TP-AF*	*TC-AF*	*H-AF*	*H*	*TP*	*TC*	*TC/TP*	*TCAF/TPAF*
1	P Moustier	FRA	5	121	2	8	29	344	11.86	24.2
2	H Sher	PAK	5	49	2	14	70	587	8.39	9.80
3	A Spiller	DEU	5	42	4	15	147	1042	7.09	8.40
4	M Gul	TUR	5	5	1	6	61	106	1.74	1.00
5	P Windsor	AUS	4	47	3	25	153	2007	13.12	11.75
6	C Mapiye	ZAF	4	41	2	19	89	999	11.22	10.25
7	C Devendra	MYS	4	31	3	16	83	982	11.83	7.75
8	P Batt	AUS	4	15	2	9	78	417	5.35	3.75
9	R Leakey	ENG	4	12	1	32	135	2540	18.81	3.00
10	S Padulosi	ITL	4	4	1	10	36	314	8.72	1.00
11	AVan Tilburg	NLD	4	5	2	7	24	249	10.37	1.25
12	G Kovacs	HUN	3	304	3	42	154	6109	39.66	101.33
13	J Baresel	DEU	3	302	3	3	3	302	100.66	100.67
14	U Hamm	DEU	3	162	2	20	76	1502	19.76	54.00
15	P Bebeli	DEU	3	131	2	5	10	242	24.20	43.67
16	H De Bon	FRA	3	120	2	5	22	210	9.55	40.00
17	C Herbers	DEU	3	67	2	8	16	205	12.81	22.33
18	M Chimonyo	ZAF	3	65	2	23	156	1891	12.17	21.67
19	A Kahi	USA	3	56	3	10	24	290	12.08	18.66
20	K Dzama	ZAF	3	43	2	23	151	1897	12.56	14.33
21	K Giller	NLD	3	36	3	63	389	1629	41.88	12.00
22	P Ebanyat	UGA	3	33	3	7	17	193	11.35	11.00
23	P Bryla	POL	3	27	2	9	19	281	14.78	9.00
24	M Escribano	ESP	3	21	3	10	24	294	12.25	7.00
25	T Huang	USA	3	18	2	25	108	2,938	27.27	6.00
26	A Agwu	NIG	3	13	2	7	41	136	3.32	4.33
27	R Bush	AUS	3	11	2	13	47	565	12.02	3.67
28	R Black	USA	3	11	2	5	7	107	15.29	3.67
29	A Giuliani	BRA	3	5	1	3	30	12	0.40	1.67
30	F Boccia	ITL	3	2	1	9	19	190	10.00	0.67

Abbreviations: R, rank; C, TP-AF and TC-AF, total papers and citations only with agri-food. H-AF, H index only with agri-food; H index.TP and TC, total papers and citations; TC/TP, result of total citations among total papers; TCAF/TPAF; result of total citation with agri-food among total papers agri-food. Country code ISO: FRA, France; PAK, Pakistan; DEU, Deutschland; TUR, Turkey; AUS, Australia; ZAF, South Africa; MYS, Malaysia; ENG, England; ITL, Italy; NLD, Nederland, HUN, Hungary; USA, United States of America; UGA, Uganda; POL, Poland; ESP, Spain; NIG, Nigeria; BRA, Brasil.

In the area of AFSM research, 7 authors have 4 publications. The most influential of these is Windsor, from Australia, with 47 citations, followed by Mapiye with 41 citations; Deyendra with 31 citations; Batt with 15 citations; Leakey with 12 citations; and Padulosi and Van Tilburg with 5 and 4 citations, respectively.

The table also shows 19 authors who have 3 publications in the area of agri-food. Their rankings are due to the publications' influence according to their citation numbers. The most influential author is Kovacs with 304 citations, followed by Baresel, from Germany, with 302 citations; Hamm with 162 citations; and Bebeli with 131 citations. Another influential author is De Bon, H. from France with 131 citations. In addition, Hebers, also from Germany, has 120 citations. The other authors have 3 publications each, and their quotes vary in number between 67 and 2.

Table 3 presents the 30 most productive organisations in the AFSM research. The following describes the first-ranked organisations with the greatest number of publications: Wageningen University Research with 37 publications; the French National Research Institute for Agriculture, Food and Environment with 24 publications; the Indian Council of Agricultural Research with 18 publications; US Department of Agriculture with 17 publications; and Cornell University with 15 publications.

Table 3 The most productive institutions in the AFSM research

R	*Name*	*Country*	*TP- AF*	*TC-AF*	*H-AF*	*TP*	*TC*	*H*
1	Wageningen U Research	NLD	37	811	14	58,412	2,167,016	399
2	INRAE	FRA	24	790	12	111,868	3,357,055	433
3	Indian Council of Agricultural Research ICAR	IND	18	39	3	52,938	420,707	150
4	United States Department of Agriculture USDA	USA	17	212	8	200,322	5,877,665	537
5	Cornell U	USA	15	251	9	181,668	8,343,090	737
6	CIRAD	FRA	13	237	6	18,020	482,828	212
7	U of Gottingen	DEU	13	224	7	75,626	2,289,661	379
8	Aarhus U	DNK	12	281	8	104,759	3,549,188	488
9	U Hohenheim	DEU	11	241	4	15,328	398,434	201
10	U of North Carolina	USA	11	160	5	271,262	45,704	761
11	U of Sydney	AUS	11	105	5	157,619	4,572,929	530
12	Bucharest U of Economic Studies	ROU	10	28	3	3508	17,638	40
13	Colorado State U	USA	10	153	4	62,348	2,331,328	413
14	International Livestock Research Institute	KEN	10	208	5	3485	73,107	104
15	Swedish U of Agricultural Sciences	SWE	10	184	5	34,850	1,006,564	300
16	U of Florida	USA	10	54	4	172,634	4,974,809	542
17	Pennsylvania State U	USA	9	214	6	164,320	5,882,521	608
18	Stellenbosch U	ZAF	9	56	3	30,823	560,366	222

Table 3 The most productive institutions in the AFSM research (continued)

R	*Name*	*Country*	*TP- AF*	*TC-AF*	*H-AF*	*TP*	*TC*	*H*
19	U of Bodenkultur Wien	AUT	9	49	4	12,345	322,414	184
20	Washington State U	USA	9	147	6	54,018	1,757,646	357
21	Aristotle U of Thessaloniki	GRC	8	188	5	48,466	985,678	244
22	CSIC	ESP	8	242	4	220,969	4,590,039	543
22	Michigan State U	USA	8	187	5	111,679	3,774,954	516
23	U Kassel	DEU	8	223	5	8437	147,229	130
24	U of Gothenburg	SWE	8	42	5	75,766	2,476,783	425
25	U of London	ENG	8	66	3	576,867	843,958	964
26	U of Parma	USA	8	100	6	34,285	943,820	285
27	World Agroforestry Centre	KEN	8	129	5	1402	43,460	90
28	Arizona State U	USA	7	115	4	76,621	2,535,298	456
29	Deakin U	AUS	7	137	4	29,052	595,441	222
30	Embrapa	BRA	7	135	4	25,509	342,123	167

Abbreviation: U, University; INRAE, French National Research Institute for Agriculture, Food and Environment; CSIC, Consejo Superior de InvestigacionesCientíficas; Embrapa, EmpresaBrasieira de PesquisaAgropecuaria: Country code ISO: IND, India; DNK, Denmark; ROU, Romania; KEN, Kenya; SWE, Sweden; AUT, Austria; GRC, Greece.

On the other hand, the most influential organisations according to the number of citations are, again, Wageningen University Research with 811 citations, INRAE with 790 citations, the University of Aarhus with 281 citations, the Consejo Superior de InvestigacionesCientíficas with 242 citations and Cornell University with 251 citations.

The organisations with the highest overall h-indexes are the University of London with an h-index of 964, the University of North Carolina with an h-index of 761, Cornell University with an h-index of 737, Pennsylvania State University with an h-index of 608 and the CSIC with an h-index of 543. Regarding the most productive organisations in general, the University of London leads with 576,867 publications, followed by the University of North Carolina with 271,262 publications; the CSIC with 220,969 publications; the USDA with 200,322 publications; and finally, with 181,668 publications, is Cornell University.

Table 4 presents the most productive journals in the area of AFSM research. Sustainability Magazine leads with 65 publications, followed by the *British Food Journal* with 34 publications, the *Journal of Cleaner Production* with 24 publications and the *Journal of Sustainable Agriculture and Renewable Agriculture and Food Systems* with 21 publications each.

The most influential journals in the area of AFSM research are the *Journal of Cleaner Production*with 474 citations, the *Journal of Renewable Agriculture* with 411 citations, Ecological Economics with 408 citations, Agriculture and Human Values with 380 citations and the *British Food Journal* with 313 citations.

Of the top 5 most productive journals Sustainability Magazine has 17,579 publications, Cleaner Production has 17,173 publications the *Indian Journal of Animal Sciences* has 14,227 publications, Appetite has 5361 publications, and Tropical Animal Health and Production has 4497 publications.

The journals with the greatest influence by the number of citations are Ecological Economics with an h-index of 179 and 201,312 citations, the *Journal of Cleaner Production* with an h-index of 162 and 368,257 citations, Appetite with an h-index of 143 and 151,935 citations, Food Quality and Preference with an h-index of 108 and 73,597 citations, and Land Use Policy with an h-index of 100 and 73,336 citations.

Table 4 The most productive journals in the AFSM research

R	*Journals titles*	*TP-AF*	*TC-AF*	*H-AF*	*TC/TP (AF)*	*TP*	*TPAF/TP*	*TC*	*TC/TP*	*H*	*IF*	*IF 5*	*AIS*
1	*Sustainability*	65	299	10	4.569	17,579	0.004	36,485	2.075	62	2.592	2.801	0.335
2	*British Food Journal*	34	313	9	9.206	1910	0.018	20,715	10.846	53	1.717	1.952	0.277
3	*Journal of Cleaner Production*	24	474	13	19.750	17,173	0.001	368,257	21.444	162	6.395	7.051	0.864
4	*Journal of Sustainable Agriculture*	21	283	10	13.476	1002	0.021	9052	9.034	36	1.372	0.893	0.228
5	*Renewable Agriculture and Food Systems*	21	411	11	19.571	579	0.036	8673	14.979	43	1.771	2.251	0.494
6	*Agriculture and Human Values*	15	380	10	25.333	750	0.020	15,378	20.504	58	3.128	3.935	0.976
7	*Journal of Rural Studies*	13	311	8	23.923	1905	0.007	49,589	26.031	98	3.301	3.883	0.852
8	*Agroforestry Systems*	11	245	8	20.500	2657	0.004	41,186	15.501	71	1.792	1.890	0.393
9	*Outlook on Agriculture*	10	46	4	4.600	1322	0.008	7,829	5.922	32	1.043	0.943	0.208
10	*Food Quality and Preference*	9	59	4	6.556	2496	0.004	73,597	29.486	108	3.684	4.257	0.827
11	*International Journal of Sustainable Development and World Ecology*	9	140	5	15.556	1160	0.008	11,132	9.597	39	2.811	2.396	0.319
12	*International Journal of Agricultural Sustainability*	8	93	5	11.625	345	0.023	5300	15.362	31	2.243	2.612	0.624
13	*Food Policy*	7	250	5	35.714	2255	0.003	45,433	20.148	88	3.788	4.631	1.258
14	*Food Security*	7	103	5	14.714	712	0.010	10,235	14.375	45	2.153	3.257	0.773
15	*Indian Journal of Animal Sciences*	7	8	1	1.143	14,227	0.000	22,253	1.564	22	0.227	0.263	0.040

Table 4 The most productive journals in the AFSM research (continued)

R	Journals titles	TP-AF	TC-AF	H-AF	TC/TP (AF)	TP	TPAF/TP	TC	TC/TP	H	IF	IF 5	AIS
16	*International Journal of Consumer Studies*	7	58	4	8.286	959	0.007	12,714	13.258	49	1.506	2.253	0.389
17	*Journal of Sustainable Tourism*	7	230	6	32.857	893	0.008	21,608	24.197	69	3.400	4.265	0.581
18	*Land Use Policy*	7	42	3	6.000	3973	0.002	73,336	18.459	100	3.573	4.236	0.782
19	*Quality Access to Success*	7	20	2	2.857	1079	0.006	1132	1.049	11	0.282	0.150	0.038
20	*Tropical Animal Health and Production*	7	92	5	13.143	4497	0.002	33,808	7.518	45	1.089	1.196	0.276
21	*Agroecology and Sustainable Food Systems*	6	42	3	7.000	395	0.015	2276	5.762	21	1.381	1.977	0.388
22	*Appetite*	6	161	3	26.833	5361	0.001	151,935	28.341	143	3.501	4.077	1.003
23	*Ecological Economics*	6	408	5	68.000	4957	0.001	201,312	40.612	179	4.281	5.207	1.114
24	*Journal of Food Agriculture Enviroment*	6	11	2	1.833	3616	0.002	16,333	4.517	33	0.435	0.484	0.199
25	*Journal of Food Products Marketing*	6	17	2	2.833	205	0.029	615	3.000	11	1.448	1.441	0.249
26	*Marine Policy*	6	75	5	12.500	4164	0.001	61,885	14.862	87	2.865	3.149	0.718
27	*African Journal of Agricultural Research*	5	35	2	7.000	1848	0.003	10,541	5.704	31	0.263	0.203	0.055
28	*Agriculture Bassel*	5	8	2	1.600	683	0.007	2400	3.514	20	0.802	0.920	0.159
29	*American Journal of Alternative Agriculture*	5	20	4	4.000	38	0.132	735	19.342	13	0.455	NA	NA
30	*Amfiteatru Economic*	5	21	4	4.200	794	0.006	3322	4.184	20	1.238	0.890	0.060

Abbreviations: IF, Journal Impact Factor; IF5, *Journal Impact Factor* for 5 years; AIS, Article Influence Score.

The *Journal of Sustainable Agriculture* ceased publication in 2014, the *Journal of Food Agriculture Environment* ceased publication in 2012, Marine Policy has data only from 2009 and 2010, and the *American Journal of Alternative Agriculture* has records only from 2003 to 2005.

Table 5 presents the most productive countries according to the number of publications in the field of AFSM research. Figure 2 shows the graphic representation of Table 5. The first place is occupied by US with 284 publications, the second place is occupied by England with 89 publications, the third place is occupied by Germany with 89 publications, Italy is in fourth place with 85 publications and the fifth place is occupied by Australia with 77 publications.

Table 5 The most productive countries in the AFSM research

R	*Country*	*TP*	*CA*	*TC*	*TC/TP*	*H*
1	USA	284	5661	6080	21.41	43
2	ENG	89	2017	2052	23.06	26
3	DEU	89	1803	1895	21.29	23
4	ITL	85	1882	1940	22.82	24
5	AUS	77	1064	1078	14.00	20
6	IND	75	664	686	9.15	16
7	ESP	58	677	686	11.83	12
8	FRA	55	1308	1316	23.93	15
9	NLD	51	1284	1306	25.61	20
10	CAN	49	808	816	16.65	15
11	BRA	42	378	379	9.02	11
12	ZAF	36	242	247	6.86	10
13	TUR	35	274	275	7.86	5
14	CHN	34	557	558	16.41	13
15	SWE	32	488	491	15.34	13
16	KEN	26	596	602	23.15	13
17	CHE	24	380	383	15.96	11
18	BEL	22	671	676	30.73	9
19	DNK	21	672	674	32.10	13
20	GRC	20	418	427	21.35	10
21	NZL	20	324	325	16.25	10
22	NIG	20	88	91	4.55	5
23	AUT	19	405	405	21.31	19
24	ETH	18	227	230	12.77	8
25	TWN	18	154	155	8.61	18
26	MYS	17	149	151	8.88	7
27	ROU	17	84	86	5.05	5
28	PAK	16	100	100	6.25	5
29	SCT	16	571	580	36.25	8

Table 5 The most productive countries in the AFSM research (continued)

R	*Country*	*TP*	*CA*	*TC*	*TC/TP*	*H*
30	MEX	15	600	601	40.06	6
31	VNM	15	307	324	21.60	11
32	IDN	14	78	78	5.57	5
33	PRT	14	490	492	35.14	8
34	THA	14	286	286	20.42	5
35	JPN	13	92	92	7.07	2
36	POL	13	228	233	17.92	6
37	UGA	13	269	276	21.23	7
38	NOR	12	221	221	18.41	8
39	IRL	11	869	869	79.00	6
40	KOR	11	198	198	18.00	6

Abbreviations: IND, India; CAN, Canada; CHN, China; CHE, Switzerland; BEL, Belgium; NZL, New Zealand; AUT, Austria; ETH, Ethiopia; TWN, Taiwan, ROU, Romania; SCT, Scotland; VNM, Vietnam; IDN, Indonesia; PRT, Portugal; THA, Thailand; JPN, Japan; UGA, Uganda; NOR, Norway;IRL, Ireland; KOR, South Korea.

Figure 2 The most productive countries in the AFSM research (see online version for colours)

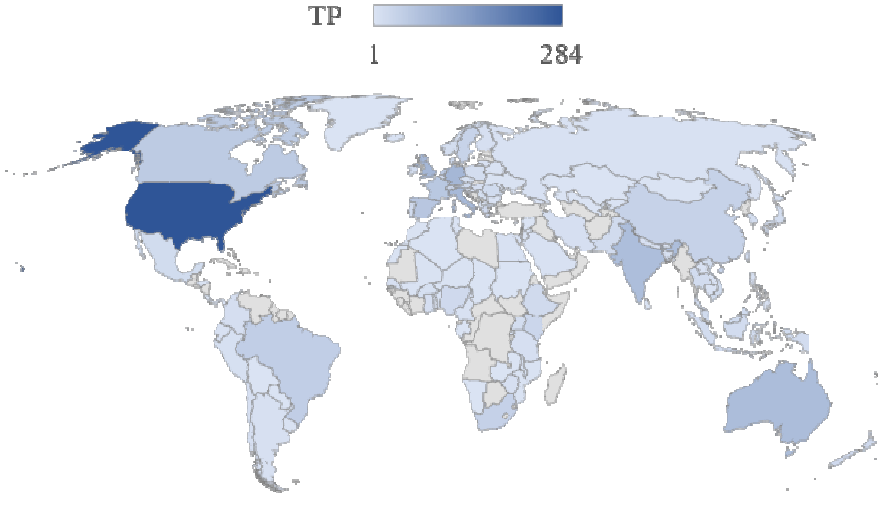

Table 6 shows the top 20 most productive areas of AFSM research. First, agriculture had 401 publications, followed by environmental sciences ecology with 278 publications; business economics with 224 publications; and science technology – other topics and food science technology had 160 and 105 publications, respectively.

Table 6 The most productive research areas in the AFSM research

R	*Research areas*	*TP*	*CA*	*TC*	*TC/TP*	*H*
1	Agriculture	401	4959	5379	13.41	35
2	Environmental Sciences Ecology	278	4421	4716	16.96	33
3	Business Economics	224	3155	3361	15.00	32
4	Science Technology Other Topics	160	2210	2354	14.71	27
5	Food Science Technology	105	1682	1746	16.63	20
6	Social Sciences Other Topics	55	894	947	17.22	18
7	Nutrition Dietetics	52	1048	1078	20.73	17
8	Engineering	47	1108	1165	24.79	22
9	Forestry	41	416	429	10.46	12
10	Public Administration	41	666	682	16.63	12
11	Geography	36	948	996	27.67	17
12	Veterinary Sciences	36	499	503	13.97	11
13	Plant Sciences	35	1086	1108	31.66	16
14	Public Environmental Occupational Health	32	287	289	9.03	10
15	Sociology	28	742	800	28.57	15
16	Development Studies	25	401	404	16.16	10
17	Fisheries	21	374	377	17.95	10
18	History Philosophy of Science	21	460	504	24.00	13
19	Biodiversity Conservation	17	500	511	30.06	10
20	Biotechnology Applied Microbiology	16	711	711	44.44	10

Table 7 shows the top 20 most frequently cited papers in the AFSM research, the title of the paper and the number of citations. The most frequently cited paper is Vermeir-Verbeke; the authors analysed the determinants of sustainable food consumer behaviour in Belgium by empirically analysing the responses of 456 young adults using a questionnaire and showing an advertisement for hypothetical sustainable dairy products. The results of the stepwise multiple regression models showed that 50% of the variance in the intention to consume sustainable dairy was explained by the combination of personal attitudes, perceived social influences, perceived consumer effectiveness and perceived availability.

The second most frequently cited paper (170 citations) (Wolfe et al., 2008) aimed to examine the needs for sustainable improvement in the context of three main types of marketing: global, regional, and local. The methodology included the physiological measures of plant parameters that are now becoming more accurate, rapid, and applicable to large populations as well as molecular markers. The results show a high mineral N content in the soil immediately after ploughing when the uptake ability of winter cereals is low and N losses during the winter. In the later growth stages of cereals, the demand from the plants is often much greater than the supply from mineralisation.

Table 7 The most cited papers in the AFSM research

	Papers	*TC*
1	Sustainable food consumption among young adults in Belgium: Theory of planned behaviour and the role of confidence and value	298
2	Developments in breeding cereals of organic agriculture	170
3	Do rewards really create loyalty*	162
4	Issues, impacts, and implications of shrimp aquaculture in Thailand	151
5	Potential synergies and challenges in refining cellulosic biomass to fuels, chemicals, and power	149
6	Sustaining intensification of smallholder livestock system in the tropics	148
7	Measuring and monitoring animal welfare: Transparency in the food product quality chain*	138
8	Regulating meaning, appropriating nature: The codification of California organic agriculture	126
9	Poaching is more than an Enforcement Problem	125
10	The use and usefulness of carbon labelling food: A policy perspective from a survey of UK supermarket shoppers	114
11	Place, taste, or face-to-face? Understanding producer-consumer networks in local food systems in Washington State	111
12	Organic farmers in Ontario: An examination of the conventionalisation argument	103
13	Social dimensions of organic coffee production in Mexico: Lessons for eco-labelling initiatives	100
14	Consumer interactions and influences on farmers market vendors	97
15	Smallholder Cacao (Theobroma cacao Linn.) cultivation in agroforestry systems of West and Central Africa: challenges and opportunities	95
16	Conserving wild fish in a sea of market-based efforts	92
17	Situation, changes and future of goat industry around the world	91
18	Helping People Make Better Choices: Exploring the behaviour change agenda for environmental sustainability	84
19	Moving local food through conventional food system infrastructure: Value chain framework comparisons and insights	81
20	Linking shade coffee certification to biodiversity conservation: Butterflies and birds in Chiapas, Mexico	79

The third most frequently cited paper is by Dowling and Uncles (162 citations). The study concentrated on a company that initiated a customer loyalty program to retain existing customers, maintain sales and profit levels, increase the potential value of existing customers and encourage customers to buy their other products. However, based on a review of the behavioural loyalty research, the authors postulated that the schemes did not fundamentally alter the marketplace structure but increased market expenditures without creating any extra brand loyalty. The research showed that only approximately 10% of the buyers of many types of FMCG are 100% loyal to a particular brand over a one-year period. Consumers do not buy only one brand; for example, surveys of European business airline travellers show that more than 80% are members of more than one frequent flyer program.

The fourth most frequently cited paper was by Dierberg and Kiattisimkul (151 citations) and studied the effects of water quality on intensive shrimp aquaculture in Thailand. The technical components included the deployment of wastewater treatment and minimal water use systems designed to make aquaculture operations more hydraulically closed. As the integrated management of aquaculture becomes more common, the risk of industry failure in farming is likely to be less and discharge loads are reduced from intensively managed shrimp ponds into receiving waters. Projected constraints on future shrimp farming and marketing – such as land and broodstock shortages, continuing disease outbreaks, negative publicity, standards compliance, water treatment and solid disposal costs, and increased competition from farmers in other Asian countries – will also push governments and industries to adopt integrated aquaculture management (Dierberg and Kiattisimkul, 1996).

The fifth most frequently cited paper was by Wyman (149 citations). The study consisted of lignocellulosic biomass such as agricultural and forestry residues and showed that dedicated crops provide a low-cost and uniquely sustainable resource for the production of many organic fuels and chemicals that can reduce greenhouse gas emissions, enhance energy security, improve the economy, dispose of problematic solid wastes, and improve air quality. A techno economic analysis of the biological processing of lignocellulosics to ethanol was adapted to project the cost of making sugar intermediates for producing a range of such products, and sugar costs were predicted to drop with plant size as a result of economies of scale that outweigh the increased biomass transport costs for facilities processing less than approximately 10,000 dry tons per day. Criteria were then reviewed for identifying promising chemicals in addition to fuel ethanol to make from these low-cost cellulosic sugars. The large market for ethanol makes it possible to achieve economies of scale that reduce sugar costs, and co-producing chemicals promises greater profit margins or lower production costs for a given return on investment. Additionally, power can be sold at low prices without a significant impact on the selling price of sugars. However, the manufacture of multiple products introduces additional technical, marketing, risk, scale-up, and other challenges that must be considered in the refinement of lignocellulosics (Wyman, 2003).

4 Discussion

Several international organisations monitor the efforts of nations in relation to agri-foods, three of which are described below. First, since 1995, the World Trade Organisation (WTO) has taken steps to reform the agricultural sector and address the subsidies and significant trade barriers that distort the agricultural trade. The overall goal is to establish a more equitable trading system that increases market access and improves the livelihoods of farmers worldwide. In 2015, they made historic decisions to eliminate agricultural export subsidies and establish rules for other forms of agricultural export support (WTO, 2021). Another international agency linked to agri-foods is the Food and Agriculture Organisation (FAO), founded in 1945 that currently has reliable statistics to assist political and economic decision-making related to food and agriculture, from hunger and malnutrition to rural poverty, food system productivity and the sustainable use of food systems, natural resources and climate change. The FAO collects, analyses, interprets and disseminates agri-food statistics and implements methodologies and standards that help countries generate reliable data and information (FAO, 2021). Finally,

the United Nations (UN) is strongly related to agri-foods, mainly through its sustainable development goals (SDG). In 2015, they approved the 2030 agenda for sustainable development, which is an action plan promoting people, the planet and prosperity and which intends to strengthen universal peace and access to justice. The agenda establishes 17 goals with 169 integrated and indivisible targets covering the economic, social and environmental spheres. The new strategy will guide the world's development programs for many years. By adopting it, states commit to mobilising the necessary means for its implementation through partnerships focused on the needs of the poorest and most vulnerable people. Within the 2030 agenda, the goal that corresponds to agri-food is Goal 2 – Zero Hunger, whose purpose is to end hunger and ensure access for all people to healthy, nutritious and sufficient food yearlong (UN, 2015).

According to the FAO (2019), sustainability goals can be achieved only when agri-food, livelihoods and natural resource management are contemplated together, with the aim of ending hunger, achieving food security and promoting sustainable agriculture. The importance of agribusiness and sustainability expressed by the FAO is aligned with the increase in scientific papers in the AFSM research. Since 2015, when this area of research doubled in terms of publications compared to 2014, publications have continued to increase.

On the other hand, the WTO (2020), shows that the countries with the highest agri-food exports are Argentina, Australia, Brazil, Canada, Chile, Columbia, Costa Rica, Philippines, Guatemala, Indonesia, Malaysia, New Zealand, Pakistan, Paraguay, Peru, South Africa, Thailand, Uruguay and Vietnam. These countries also have the highest global participation in agro-industrial trade. Therefore, these countries are expected to have the highest scientific production in the AFSM research; however, in contrast to the results obtained in this bibliometric study, Argentina, Chile, Columbia, Costa Rica, the Philippines, Guatemala, Paraguay, Peru and Uruguay do not appear among the top 40 most productive countries in the AFSM research.

The most productive and influential authors in the AFSM research are concentrated among a few countries: Germany (5); Australia (3); the USA (3); South Africa (3); France (2); Italy (2); the Netherlands (2); and Brazil, England, Spain, Hungary, Turkey, Malaysia, Nigeria, Uganda and Poland (1/per). Similarly, the most productive institutions in the AFSM research are in the USA (1); Germany (3); Australia, France, Kenya and Sweden (2/per); and England, Spain, India, Greece, the Netherlands, South Africa, South Africa, South Africa, South Africa and US, India, Greece, the Netherlands, South Africa and Romania (1/per). The most productive and influential countries in the AFSM research do not belong to the countries with the highest global productivity in agri-foods. It is interesting to generate studies that allow the visualisation of the integration and synergy between the countries that are most relevant in international trade statistics and those that carry out systematic scientific research in agribusiness.

The SDGs in 2015 permit us to observe a growth in the productivity of the AFSM research. Since 2015, stimulating the study of agri-food and sustainability to provide relevant information to Goal 2 – Zero Hunger and achieve the sustainable goal, the relevance of the implementation of the SDGs can be observed in various papers such as "A bibliometric review of the knowledge base for innovation in sustainable development".

5 Conclusion

This research allows us to describe the importance of sustainable marketing in agri-foods through scientific advances from 1900 to 2019. To carry out this bibliometric study, we used the methodology elaborated by Luo et al. (2018) and Merigó et al.(2015). We obtained the words to search in WoS, which makes a small contribution to the detailed analysis of the studies conducted in the field of agri-food, sustainability and marketing.

The objective of the present paper is to present a bibliometric analysis of the developments in agri-food, sustainability and marketing to find connections, trends and insights into their evolution and orientation. For the data collection, WoS was used as a base tool. This tool belongs to Clarivate Analytics. For the development of the research within WoS, first the keywords were identified. As an essential element within the search block, the words related to agri-food were used: agri* OR agro* OR farm* OR food* (Luo et al., 2018; Mittal et al., 2018). The second block of keywords was sustainability and sustainable. Additionally, sustainab* (Chabowski et al., 2011; Tebaldi et al., 2018) was added to include all the words related to sustainability. Finally, in the last search block, the keywords 'marketing' OR 'green marketing' OR 'sustainable marketing' OR 'ecology marketing' were included. These words were obtained from the literature review of ecological marketing (Borodin et al., 2016; Masoumi et al., 2019; Tebaldi et al., 2018; Dimitrios, 2000; Winfield et al., 2010).

This paper identifies the most influential published sources and explores the changes to the AFSM research using the bibliographic references cited by a significant group of authors active in the discipline. The findings presented and discussed in the previous section lead to the following conclusions:

A total of 1134 papers were published in this area of research, with a considerable increase in the number of publications from 2015 onwards. The authors with the most publications in this field – Moustier, Sher, Spiller and Gul – have 5 publications. The most productive institution in the AFSM research is Wageningen University Research, with 37 publications. The most productive journal in the area is Sustainability, with 65 papers. UShave the largest number of publications, and the most productive area is agriculture, with 401 papers. These analyses measured the productivity and influence of the authors, organisations and journals involved in the research field by searching the information in the WoS database, which allows us to trace the evolution of sustainable marketing in agri-food; identify the most productive countries and the journals in which they publish to generate future collaborations and synergy among the scientific community; and promote theoretical contributions and the application of sustainable marketing in the various primary, productive and academic branches. Finally, the study was carried out to provide information to experts in the field of sustainability, the exponents of the subject and those involved in the area of agri-food.

The practical implications of bibliometric analyses include the ranking of the performance of authors, journals, organisations, institutions and countries, allowing us to know the scientific activity in the AFSM research. They also allow a comparison between the different actors involved in this area of scientific research, thus aiming to create collaboration and synergies. Moreover, the connection is presented between the efforts that international organisations promote for the inclusion of agri-food research as support for the achievement of sustainability global goals.

As a future line of research, it would be appropriate to apply more indicators to the bibliometric study and add information from other databases such as Scopus and Google

Scholar to strengthen and expand the content of the information on AFSM research. Furthermore, a comparison should be made between the statistical data obtained in this bibliometric analysis based on WoS and the data that can be obtained from other databases. It would also be helpful to review the dissemination practices of the results obtained in this bibliometric study and obtain its scope of support for researchers in AFSM research.

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