RDBCI | Revista Digital de Biblioteconomia e Ciência da Informação
Digital Journal of Library and Information Science

ISSN 1678-765X doi 10.20396/rdbci.v19i00.8666154/27158

ARTICLE

Scientific publications about green marketing
a bibliometric perspective

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ABSTRACT

Introduction/Objective: This is a quantitative-qualitative study, exploratory and descriptive, which aimed to identify and analyze the characteristics of scientific publications in green marketing, from 1991 to 2020. Methodology: The corpus of analysis consisted of articles indexed in the bibliographic platform Scopus and analyzed using bibliometric indicators. Results: The results show that in the period investigated, 1,149 articles on the subject were published. The year 2020 had the highest number of articles published (161). The predominant language of publications is English. The United States of America was identified as the most productive country, and with the largest network of international research collaboration. The knowledge area "Business, Management and Accounting" concentrates almost a third of all publications. As for the trend towards collaborative research, 79% of the articles originated were obtained by more than one author. The most productive authors are Polonsky M.J., with fourteen authorships and Chen Y.S., with ten authorships. 498 journals published on green marketing, and "Sustainability" was the journal with the highest number of publications (49). The investigated corpus erected 36,559 citations, with an average of 31.81 citations per article. 53,877 references were used in the set of articles, these, only 18 sources 20 occurrences or more. A keyword analysis indicated that the term "competitive advantage" separates the zone of trivial information from the zone of research noise. Conclusion: Green marketing research has a temporal thematic progression characterized by five stages: consumer behavior, green marketing, sustainable development, and green products.

KEYWORDS

Information metric studies. Sustainable development. Scientific production.

Publicações científicas em marketing verde
uma perspectiva bibliométrica

RESUMO

Introdução/Objetivo: Estudo quantitativo-qualitativo, de natureza exploratória e descritiva, que objetivou identificar e analisar as características das publicações científicas em marketing verde, no período de 1991 a 2020. Metodologia: O *corpus* de análise foi constituído por artigos indexados na base de dados Scopus, e analisado por meio de indicadores bibliométricos. Resultados: Os resultados mostram que no período investigado foram publicados 1.149 artigos sobre o tema. O ano de 2020 apresentou a maior quantidade de artigos publicados (161). O idioma predominante das publicações é o inglês. Os Estados Unidos da América foram identificados como país mais produtivo, e com maior rede de colaboração internacional de pesquisa. A área de conhecimento "Negócios, Gestão e Contabilidade" concentrou quase um terço das publicações. Quanto aos autores, há tendência à pesquisa colaborativa, 78,94% dos artigos analisados foram produzidos por mais de um autor. Os autores mais produtivos são Polonsky M. J., com quatorze autorias, e Chen Y.S., com dez autorias. 498 periódicos publicaram sobre marketing verde, e o "*Sustainability*" foi o periódico com maior número de publicações (49). O *corpus* investigado recebeu

36.559 citações, com média de 31,81 citações por artigo. 53.877 referências foram utilizadas no conjunto dos artigos. Destas, apenas 18 apresentaram 20 ocorrências ou mais. A análise das palavras-chave indicou que o termo "vantagem competitiva" separa a zona de informações triviais da zona de ruídos de pesquisa. Conclusão: As pesquisas sobre marketing verde tiveram uma progressão temática temporal caracterizada por cinco estágios: comportamento do consumidor, marketing verde, desenvolvimento sustentável, sustentabilidade e produtos verdes.

PALAVRAS-CHAVE
Estudos métricos da informação. Desenvolvimento sustentável. Produtividade científica.

JITA: BB. Bibliometric methods

1 INTRODUCTION

The academic debate on the effects of anthropic activities, such as global warming, has alerted to the risks associated with the contemporary production model, and stimulated a process of social reflection about the importance of preserving the environment through the adoption of more conscious consumption practices, thus raising the demand for more sustainable products and services (CORREA; BRAGA JR.; SILVA, 2017; PAPADAS; AVLONITIS; CARRIGAN, 2017; OTTMAN, 2011).

Sustainability, in its dimensions: environmental, social and economic, had already entered the agenda of researchers in the 1960s (DANGELICO, 2015), however, it was only in the late 1980s, with the advent of the concept of sustainable development, focused on the need for convergence between human development and environmental protection, that sustainability, as a business practice, begins to gain prominence in the literature (ALENCASTRO, 2015).

In this context, the first studies on green marketing, an area of marketing oriented towards social welfare and sustainable development, appear (BRECTU, 2019). Green marketing is conceptualized by Polonsky (2011), as a set of activities that aims to produce and facilitate the marketing of products or services, satisfying market needs and desires, with minimal impact on the environment. Green marketing actions encompass the entire production process, from product conception to consumption, and influence the portfolio of products and services offered, as well as the organization's communication efforts (CAIADO; DIAS; MATTOS; QUELHAS; LEAL FILHO, 2017; HERRMANN; BLUME; KURLE; SCHMIDT; THIEDE, 2015). What gives the green marketing a relevant role in the search for environmental preservation (GARG, 2015).

Researches on green marketing, given the importance and timeliness of the theme, continuously produce a fruitful literature, which addresses it from various perspectives: market size, consumer segmentation, communication strategies, business performance, innovation, conscious consumption, among others (SALEEM; KHATTAK; REHMAN; ASHIQ, 2021). However, despite the growing interest in the study of green marketing (MILOVANOV, 2015), there is little bibliometric research on the subject. In a search conducted in the Scopus database, one of the largest bibliographic platforms in the world (GRANDA-ORIVE et al., 2013), only one publication of this nature was found.

Thus, this study aims to contribute to the understanding of the evolution of research on green marketing, proposing the following research objective: to identify and analyze, through bibliometric indicators, the characteristics of scientific publications on green marketing, indexed in the Scopus database, in the period from 1991 to 2020.

Bibliometric analysis was chosen for the purpose of this study, given that its techniques allow the measurement of the growth of scientific production over time and the identification of the authors who produce the most, as well as their co-authorship and co-citation relationships. In addition, bibliometrics also makes it possible to verify the most important journals in the dissemination of the themes studied, the collaboration networks and co-occurrence of subjects, and the analysis of the dispersion of knowledge produced within the theme investigated (TODESCHINI; BACCINI, 2016).

The structure of the article includes a theoretical framework, based on aspects concerning green marketing and bibliometry; followed by the methodological procedures, which describe the corpus of analysis, the variables investigated and the analytical procedures used; then the results obtained are presented and discussed; finally, the final considerations present the conclusions of the study, its limitations and suggestions for future research.

2 THEORETICAL REFERENCE

This section presents the theoretical framework consulted on the themes of green marketing and bibliometrics, not for the purpose of exhausting these subjects, but to provide a better understanding of these themes, as well as a basis for the analyses performed.

2.1 Green Marketing

Marketing emerged in the early nineteenth century aiming to be the interface between consumption and production (REX; BAUMANN, 2007). Marketing can be defined as a social process "by which people and groups of people obtain what they need and want through the creation, offer and free negotiation of products and services of value with others" (KOTLER, 2000, p.30), covering a wide range of activities such as design, manufacturing, packaging, promotion and distribution of products (KOTLER; KELLER, 2012).

In this sense, the increase in demand for sustainable products, which occurred in the late 1980s, as a result of society's growing concern with the planet's environmental degradation, has stimulated the use of new marketing strategies, influencing the portfolio of products and services offered to consumers, as well as the organization's communication efforts (CAIADO; DIAS; MATTOS; QUELHAS; LEAL FILHO, 2017; HERRMANN; BLUME; KURLE; SCHMIDT; THIEDE, 2015). This framework collaborated to the emergence of green marketing, an area of marketing that is guided by social welfare and sustainable development and considers the ecological perspective as an essential argument of business behavior (BRECTU, 2019).

It is important to mention, that the concept of marketing associated with sustainability has been addressed in the literature by other denominations, besides green marketing, the most recurrent term (DANGELICO; VOCALELLI, 2017). Thus, environmental marketing, sustainable marketing, ecological marketing, or even Eco marketing (ANDREOLI; CRESPO; MINCIOTTI, 2017; CORREA; BRAGA JR.; SILVA, 2017), are nomenclatures that, although distinct, express the same meaning (PEATTIE; CRANE, 2005), converging to the inclusion of environmental issues in marketing processes (REX; BAUMANN, 2007).

Green marketing is conceptualized by Polonsky (2011) as a set of organizational activities, developed to generate and facilitate any exchange, aimed at satisfying the needs and desires of consumers, with the least possible negative impact on the environment. Mathur and Tandon (2019), argue that green marketing is one of the marketing resources that, in principle, allows organizations to be profitable and at the same time ethical and responsible by offering quality, convenience and appropriate price to consumers.

Green marketing does not necessarily seek consumption reduction but associates it with positive environmental features such as: innovation, energy efficiency, durability, sharing, and reuse (GROENING; SARKIS; ZHU, 2018). Considering this, Dean and Pacheco (2014) argue that adding environmental value to the product, combined with functional and emotional appeal can lead it to transcend the green consumer-oriented market segment, providing the company with a competitive advantage.

Among the potential benefits that organizations obtain when implementing green marketing strategies are better relationship with the various groups of stakeholders; cost reduction by eliminating waste; increased attractiveness in the market and access to bank resources and credit lines under special conditions (RODRIGUES; MOREIRA; OLIVEIRA; AGUIAR; BARBOSA, 2014).

The debate generated around green marketing, given the interdependence between the various actors involved: customers, suppliers, shareholders, government, media and community, has contributed to the consolidation of socio-environmental responsibility practices and ethical values in organizations on increasingly multidimensional and systemic scales, opening great opportunities to meet this consumer market. (CARDOSO; VAN SCHOOR, 2017), and creating a relevant field of research.

2.2 Bibliometrics

Bibliometrics is a metric study of information that applies "statistical analyses to quantify and monitor the production, storage, circulation and use of recorded information and bibliographies, having as its main object of study the bibliographic productions" (CURTY; DELBIANCO, 2020, p.9). For Pritchard (1969), bibliometrics consists of using mathematical terms and statistical methods to study the scientific development of a given area of knowledge.

One of the focuses of bibliometry, according to Araújo (2006) and Alvarado (2002) is to explore the scientific production in each area of knowledge, to obtain a systematized overview of the evolution of research in the area, which facilitates the understanding of the theme and points to future research directions.

From this perspective, Vanti (2002), indicates that bibliometrics enables, among others, the following applications: to identify trends and the growth of knowledge in an area; to verify the core journals of a discipline, as well as the coverage of secondary journals; to study the dispersion and obsolescence of scientific literature; to predict the productivity of authors and the degree of collaboration among them; to evaluate the statistical aspects of words and phrases and to measure the growth of certain areas and the emergence of new research topics.

According to Oliveira (2018) and Santos (2015), there are three classic laws in bibliometrics: Lotka's Law (1926) that addresses the scientific productivity of authors; Bradford's Law (1934) that works with the dispersion of scientific knowledge; and Zipf's Law (1949) that analyzes the frequency of occurrences of words in a text.

Lotka's Law analyzes the scientific productivity of authors, verifying the contribution of each author to scientific development in a certain area of knowledge. Lotka formulated the principles of the inverse square law, establishing that the number of authors who produce "n" contributions in each scientific field is approximately 1/n2 of those who generate only one contribution, and the proportion of those who generate a single contribution would be around 60%. This law was modified by Price, who in his studies concluded that 1/3 of the literature is produced by less than 1/10 of the most productive authors (average of 3.5 documents/author), and that 60% of the authors produce a single document on a given topic (PINTO; GONZALES-AGUILAR, 2014; ARAÚJO, 2006; ALVARADO, 2002).

Bradford's Law calculates the degree of relevance of journals in a given area of knowledge. Bradford observed that few journals produce many articles, of higher quality or importance, while many journals publish few. The statement of Bradford's Law points out that if a collection of journals is arranged in descending order of productivity of articles on a given subject, one can identify a cluster or core of journals that deal essentially with the subject and other clusters or secondary zones that include the same number of articles as the main cluster, "whenever the number of journals existing in the core and successive zones is of order 1: n: n2: n3 ..." (ARAÚJO, 2006, p. 15).

Thus, to determine the most productive cluster, the sum of articles should be divided by three, thus, in a descending list of journal productivity, three clusters are formed, each containing 1/3 of the total number of articles. The first cluster (core) contains a small number

of highly productive journals; the second contains a larger number of less productive journals; and the third, a larger number of journals with lower productivity (PINTO; GONZALES-AGUILAR, 2014; NORONHA; MARICATO, 2008). Other authors, such as Vickery (1948), argue that the number of clusters can be extended to any number.

Zipf's Law, "describes the relationship between words in a given sufficiently large text and the serial order of these words (word count in large samples)" (ARAÚJO, 2006, p.16). Booth (1967) argues that this law was determined by Estoup in 1916 but spread by Zipf (2012) in 1949. Such a law follows the same premise as the previous ones, a small number of words are used with great frequency and a large number of words are used infrequently. In this perspective, Zipf (2012) formulated the principle of least effort, that is, there would be an economy in the use of words, so that the same words would be used several times, which would indicate the subject of the document (GUEDES, 2012; SANTOS; KOBASHI, 2009). Its proposal consists of listing the words that occur in a text in descending order of frequency, the position of a word in this list multiplied by its frequency equals a constant. The equation for this relationship is: r x f = k, where "r" is the position of the word, "f" is its frequency and "k" is the constant (NORONHA; MARICATO, 2008; PINTO; GONZALES-AGUILAR, 2014).

Complementing Zipf's Law, Goffman verified the existence of a transition point, which separates words with high and low frequency. The words present in this region would present great semantic relevance, thus giving meaning to the text (MELLO, 2017). Goffman's Transition Point was disseminated by Pao (1978), and its formula consists of the following equation: $n= (-1+\sqrt{1+8l1})/2$, where "n" represents Goffman's Transition Point, and "l1" the number of words with frequency equal to 1. Goffman's Transition Point, when used in conjunction with Zipf's Law, makes it possible to identify, numerically and graphically, the set of words that represent trivial information (appearing many times), interesting information (contained in the region of the transition point), and noise of no greater importance.

Bibliometrics is not limited to the laws described above (GINGRAS, 2016). On the contrary, Araújo (2006) points out that citation analysis is the most critical area of bibliometry. For Moraes, Furtado and Tomaél (2015, p. 186) the "Citation Analysis is based on the premise that researchers conceive their work from previous works and demonstrate this by citing the preceding works in their texts and in an ordered and standardized list of references." For Moraes and Kafure (2020) the cocitation analysis, based on the occurrence of joint citations between authors or documents, reveals how the organization of knowledge in each area is structured among researchers. Thus, a higher occurrence of cocitations results in greater proximity between the concepts addressed by the cited authors.

3 METHOD

To understand the characteristics of scientific publications in green marketing, a descriptive and exploratory research was conducted, with a quantitative and qualitative approach, a longitudinal temporal cut (VERGARA, 2016), and the use of bibliometric techniques to analyze the data.

Considering that bibliographic platforms are considered relevant sources for bibliometric studies (GRANDA-ORIVE et al., 2013), one of them, Scopus (Elsevier), was defined as the source for the composition of the corpus of analysis. This choice is justified since it is considered one of the largest databases of abstracts and citations of peer-reviewed literature in the world. In addition, it has intelligent tools to track, analyze, and visualize research, which enables a comprehensive overview of scientific production in various areas of knowledge (ELSEVIER, 2021).

The search strategy aimed to cover all the scientific production related to the theme, from 1991 to 2020 (30 complete years), being structured from all the terms mentioned in the literature as synonyms for "green marketing" (PEATTIE; CRANE, 2005). Thus, on 05/24/2021, the following terms were entered into the search text box: "green marketing" OR "environmental marketing" OR "ecological marketing" OR "sustainable marketing" OR "green marketing" OR "environmental marketing" OR "ecological marketing" OR "Eco marketing", using as research parameters: title, abstract and keywords.

The database retrieved 1,154 articles. The data collected for analysis were: document title, authors, author's keywords, source title, year of publication, language of the original document, field of knowledge, citation count, and references. These data were transported in "CSV" format to the Microsoft Excel spreadsheet editor in order to create tables and graphs, and to the VosViewer bibliometric network construction and visualization software in order to create network diagrams.

The data analysis generated information regarding: temporal production, percentage of thematic growth, percentage of knowledge areas, languages and most productive countries, collaboration between countries, predominance of the number of authors per item, dispersion of journals through the application of Bradford's Law, evolution of the number of citations and ranking of the most cited articles, co-citation network, dispersion of keywords through Zipf's Law and analysis of the co-occurrence network of keywords.

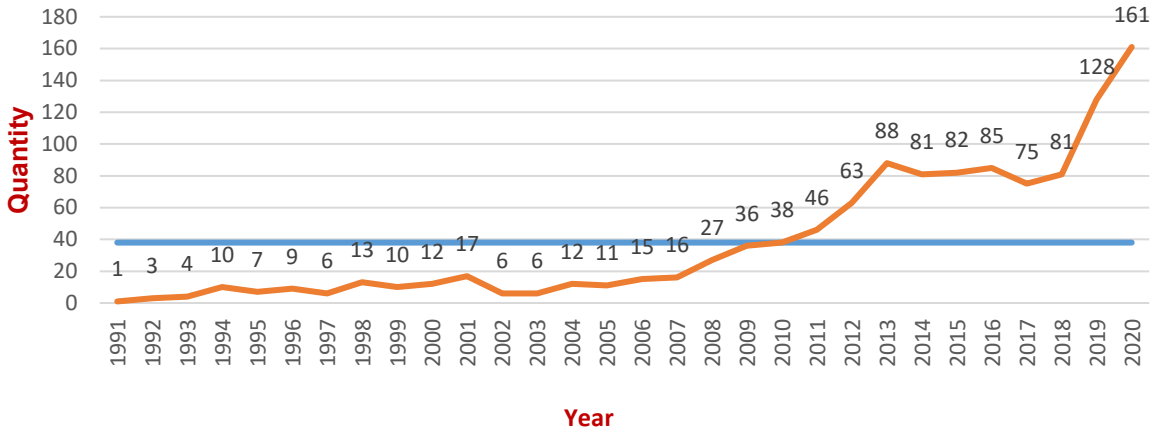
4 RESULTS

This section presents and discusses the results of the research in seven subsections. The first addresses the quantitative evolution of scientific production; the second deals with the areas of knowledge and languages of publications; the third analyzes the productivity of countries and their collaboration networks; the fourth explores issues related to the productivity of authors; the fifth works the dispersion of scientific production in journals; Finally, the seventh subsection highlights the application of Zipf's first Law in conjunction with Goffman's Transition Point on the keywords and an evolutionary temporal analysis of the themes researched in the area of green marketing.

4.1 Quantitative Evolution of Scientific Production

Of the 1,154 items collected (articles only), 1,149 were the object of study, with two items excluded due to duplicity and three because the works did not present authors (these were searched for in the original articles of the periodicals but were not found). In the data, the sum of the annual publications divided by their total, resulted in an average of 38 items (represented in graph 1, by the blue line), making up 30 years of studies on the theme.

Graph 1. Timing of scientific production on green marketing



Source: The authors (2021)

The number of publications increased significantly over the analyzed period, being verified from 2008, constant growth of interest in the academic community by the theme, except for the years 2014 and 2017 that showed a decrease. The year 2020 recorded the highest number of publications, 161 items. On the other hand, the year 1991, the year in which the theme began in the investigated database, listed the lowest number, with only 1 publication, as shown in Table 1.

Table 1. Percentage growth of scientific production on green marketing

Year	Year 2	nº items	Growth/ Reduc.	Year	Year 2	nº items	Growth/ Reduc.
1991	1	1		2008	18	27	169%
1992	2	3	300%	2009	19	36	133%
1993	3	4	133%	2010	20	38	106%
1994	4	10	250%	2011	21	46	121%
1995	5	7	70%	2012	22	63	137%
1996	6	9	129%	2013	23	88	140%
1997	7	6	67%	2014	24	81	92%
1998	8	13	217%	2015	25	82	101%
1999	9	10	77%	2016	26	85	104%
2000	10	12	120%	2017	27	75	88%
2001	11	17	142%	2018	28	81	108%
2002	12	6	35%	2019	29	128	158%
2003	13	6	100%	2020	30	161	126%
2004	14	12	200%				
2005	15	11	92%				
2006	16	15	136%	Total		1149	
2007	17	16	107%	Media		38,30	

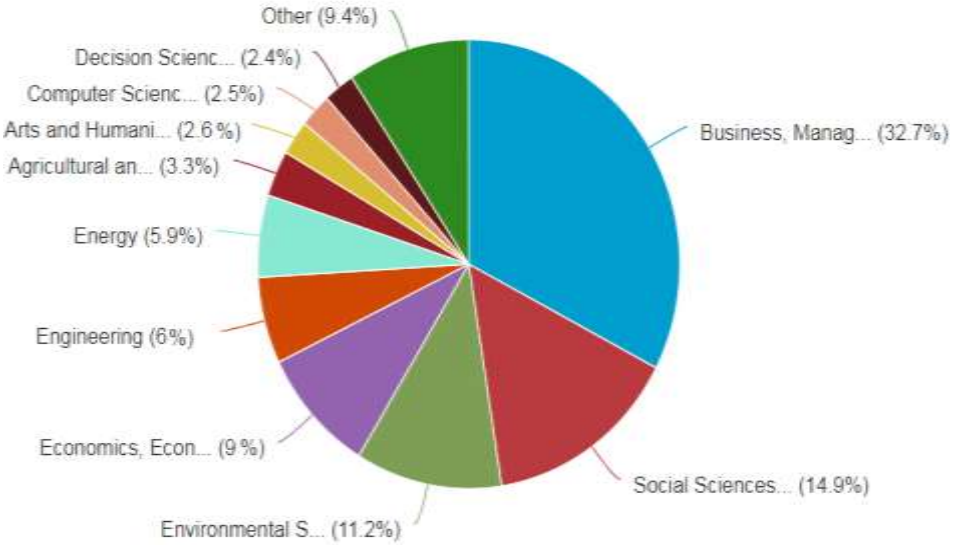
Source: The authors (2021)

In numerical terms, the year 2019 showed the largest growth over the previous year (47 items). In proportional terms, the year 1992 tripled the volume published in the year 1991. It is noteworthy that from 2011 on, the published items exceed the average number of publications.

4.2 Knowledge Areas and Languages

Graph 2 shows the areas of knowledge that most published articles on green marketing. It can be seen that, four areas concentrate 67.8% of all the investigated production, being them: Business, Management and Accounting (32.7%), Social Sciences (14.9%), Environmental Sciences (11.2%) and Economics, Econometrics and Finance (9%). Next, Engineering and Energy produced 6% and 5.9%, respectively. Another 15 areas do not appear in the graph, and together account for 9.4% of all publications

Graph 2. Areas of knowledge of the scientific production on green marketing



Source: The authors (2021)

Regarding the language of the original documents, English predominated, with 1,108 items (96.9%), followed by Portuguese (17 items - 1.48%) and Spanish (8 items - 0.7%). The other languages found were: Chinese, Italian and Polish (each with three items - 0.3%), German (2 items - 0.17%), and with only one item, respectively, the Croatian, Lithuanian, Malayan, Romanian and Russian languages (0.09%).

4.3 Countries: Productivity and Research Collaboration Networks

The most productive countries are shown in chart 2. It can be observed that the United States of America is the country with the largest production volume, contributing with 248 publications on the subject, surpassing the sum of the second and third places, India (132) and China (78). The United Kingdom (72) and Australia (62) complete the ranking of the five countries that most published on green marketing. Brazil, with 32 publications, appears in ninth place in this list, tied with Canada and Spain, which present an average slightly higher than one article per year. Another 75 countries do not make up the table, and together represent 14% of all the production investigated.

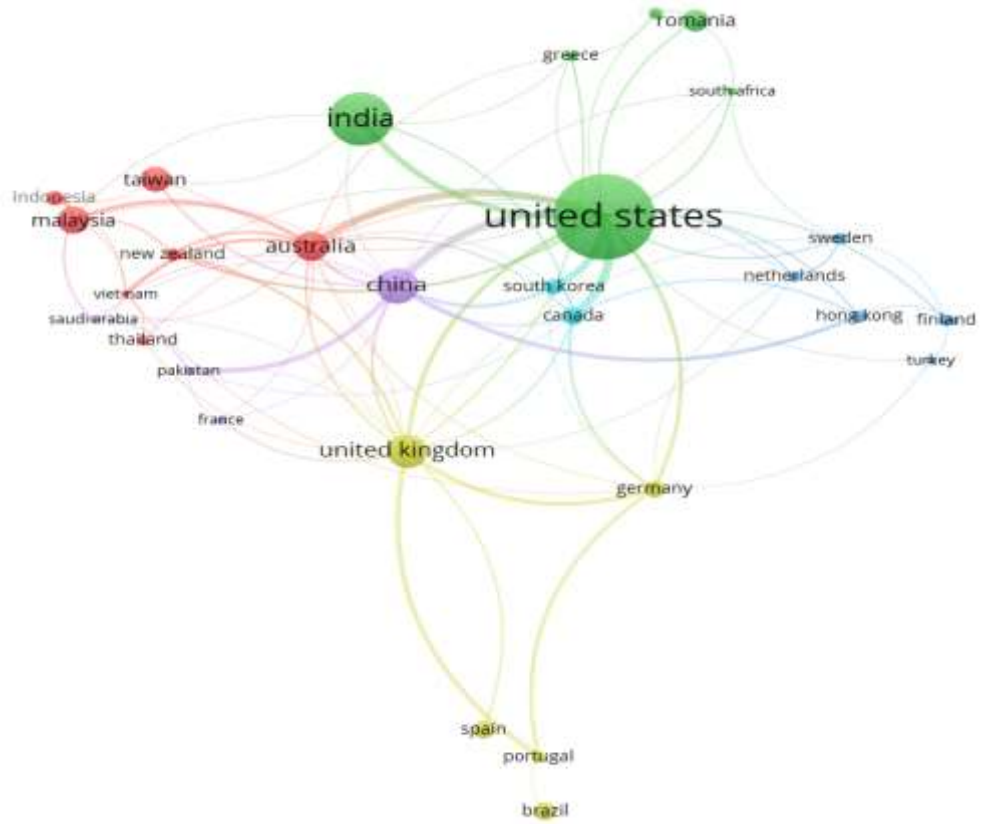
Table 2. Countries with highest scientific production on green marketing

Country	Published Articles	%	Country	Published Articles	%
United States	248	21,6%	Canada	32	2,8%
India	132	11,5%	Spain	32	2,8%
China	78	6,8%	Germany	29	2,5%
United Kingdom	72	6,3%	South Korea	28	2,4%
Australia	62	5,4%	Iran	27	2,3%
Malaysia	55	4,8%	Indonesia	26	2,3%
Taiwan	51	4,4%	Hong Kong	21	1,8%
Romania	42	3,7%	New Zealand	21	1,8%
Brazil	32	2,8%	Other Countries	161	14,0%

Source: The authors (2021)

To complement the view on the scientific production of the countries in green marketing, we sought to identify the research collaboration networks that were established among them. Thus, Figure 1 presents a collaborative network among the 32 countries that published ten times or more on the subject. In the network, the nodes and the larger names reflect their higher occurrence, the colors indicate the groupings in clusters, and the lines present the connections between the countries.

Figure 1. Network of research collaboration among countries that have published on green marketing



Source: The authors (2021)

The United States is the country that presents the largest collaboration network in green marketing research, seventy-two connections, with India, China, the United Kingdom and Australia as main partners. The second largest collaboration network was developed by China, 40 connections, which researched in partnership mainly with Hong Kong, Pakistan and Taiwan, besides the United States. Other networks that stand out are the United Kingdom, 37 connections, with the United States, Spain, Portugal, and Germany as the main collaborators. And Australia, 35 connections, with the United States, Malaysia and New Zealand its most productive partners. India, the second country that has published the most on green marketing, boasts a network with thirteen connections, with the United States, China, and Canada as its main partners. Brazil has only one connection, which was established with Portugal, a European country that shares the same language.

4.4 Author Productivity

Regarding the number of authors per item, the empirical data show a variation between one and nine. For the study, "main authors" are those indicated as first author and "co-authors" those who appear from the second authorship position onwards. According to Hilário, Grácio, and Wolfran (2017) and Youtie and Borzeman (2014), the first author is considered to be the one with the greatest scientific contribution to the research. Table 3 presents the number of authors per item of scientific production on the theme studied.

Table 3. Number of authors per item of the scientific production on green marketing

Year	Authors									Total	%
	One	Two	Three	Four	Five	Six	Seven	Eight	Nine		
1991	1									1	0,09
1992	3									3	0,26
1993	3	1								4	0,35
1994	6	3	1							10	0,87
1995	2	4	1							7	0,61
1996	3	6								9	0,78
1997	3	1		2						6	0,52
1998	5	4	3			1				13	1,13
1999	4	3	2	1						10	0,87
2000	8	2	1					1		12	1,04
2001	5	3	7	2						17	1,48
2002	3	1	2							6	0,52
2003	3	1	2							6	0,52
2004	4	5	3							12	1,04
2005	1	7	3							11	0,96
2006	3	6	4	1		1				15	1,31
2007	10	4		1		1				16	1,39
2008	13	7	4	1	1		1			27	2,35
2009	15	10	7	2	1	1				36	3,13
2010	9	18	7	4						38	3,31
2011	9	18	10	7	1	1				46	4,00
2012	11	25	17	9	1					63	5,48
2013	12	35	23	12	5			1		88	7,66
2014	17	23	21	11	8	1				81	7,05
2015	18	21	27	10	4	2				82	7,14
2016	17	31	18	11	6	1	1			85	7,40

2017	13	26	19	12	4		1			75	6,53
2018	10	30	24	7	9	1				81	7,05
2019	13	47	38	18	7	4	1			128	11,14
2020	18	52	37	24	19	6	2	2	1	161	14,01
Total	242	394	281	135	66	20	6	4	1	1149	100,00
%	21,06	34,29	24,46	11,75	5,74	1,74	0,52	0,35	0,09	100,00	
% accum.	21,06	55,35	79,81	91,56	97,30	99,04	99,56	99,91	100,00		

Source: The authors (2021)

There is a predominance of publications with two authors (34.2%), and 78.94% of the analyzed items were produced by more than one author, demonstrating that collaborative research is a more common pattern than single authorship in the green marketing literature. To identify the most productive authors, researchers were ranked based on the number of published papers with single and multiple authorship. We identified 2,569 authorships, generating a collaboration index of 2.23, which means that there are on average 2.23 authors collaborating on each paper.

2,223 authors have only published once, while 182 have published twice. 34 authors have three publications, while 16 have published 4 times. Table 4 presents the 13 authors who produced more than 5 articles, informing the total number of articles published, authorship position, year of publication, and the year in which they published the most.

Table 4. Authors who have published the most on green marketing

Author	Total of Articles	Author's Data		Publication Year	Highest Publication Year
		Authoring Position	Qty of Articles		
Polonsky M.J.	14	1°	9	1994/ 1995/ 1997/ 1998 (3)/ 2001/ 2011 (2)	1998 (3 items)
		2°	5	1995 (2)/ 2015/ 2016/ 2019	
Chen Y.-S.	10	1°	9	2010/ 2012/ 2013 (3)/ 2014/ 2015/ 2020 (2)	2013 (3 items)
		2°	1	2014	
do Paço A.	9	1°	9	2009 (2)/ 2010 (3)/ 2012/ 2013 (2)/ 2014	2010 (3 items)
Sun Y.	7	1°	6	2014/ 2016/ 2019/ 2020 (3)	2020 (3 items)
		2°	1	2019	
D'Souza C.	6	1°	6	2006/ 2007/ 2013/ 2015/ 2018/ 2019	(1 item year)
Leonidou L.C.	6	1°	5	2010/ 2011/ 2013 (2)/ 2014	2011/ 2013 (2 items)
		2°	1	2011	
Leonidou N.C.	6	1°	2	2011/ 2013	2011/ 2013 (2 items)
		2°	4	2010/ 2011/ 2013/ 2014	
Guo R.	5	1°	5	2014 (3)/ 2017/ 2018	2014 (3 items)
Hartmann P.	5	1°	5	2004/ 2005/ 2006/ 2007/ 2008	(1 item year)
Ozanne L.K.	5	1°	4	1996 (2)/ 1998/ 2011	1996 (2 items)
		2°	1	1999	
Peattie K.	5	1°	4	1999/ 2001/ 2005/ 2010	(1 item year)
		3°	1	2003	
Taghian M.	5	2°	5	2006/ 2007/ 2013/ 2015/ 2018/ 2019	(1 item year)

Tao L.	5	2°	4	2014 (3)/ 2017	2014 (3 items)
		5°	1	2018	

Source: The authors (2021)

The authors with the highest production, according to table 4, are: Polonsky M. J., with fourteen authorships (nine as main author and five as second author), with 1998 being the year in which he published the most, and Chen Y. S., with ten authorships (nine as main author, and one as second author), having in 2013 his highest volume of publications.

4.5 Journals' Productivity

The research identified 498 journals that, over the 30 years investigated, published articles on green marketing. Sustainability" is the publication vehicle with the largest number of items on the subject (49 items, representing 4.26% of these), followed by the "Journal of Cleaner Production" with 28 items and the "Journal of Business Research" with 20 items. In Table 5 it is possible to verify that 303 different vehicles of publication have only 1 published item on the subject, which represents 26.37% of the analyzed items.

Table 5. Productivity of journals that published on green marketing

Publication Media	Quant.	%	Bradford Distribution
Sustainability (Switzerland)	49	4,26%	*Cluster* Central 15 journals 267 publications (23.24%)
Journal of Cleaner Production	28	2,44%	
Journal of Business Research	20	1,74%	
Quality - Access to Success	19	1,65%	
Business Strategy and the Environment	18	1,57%	
Journal of Consumer Marketing	17	1,48%	
Journal of Business Ethics	16	1,39%	
Marketing Intelligence and Planning	16	1,39%	
Journal of Strategic Marketing	15	1,31%	
Industrial Marketing Management	13	1,13%	
International Journal of Consumer Studies	13	1,13%	
International Journal of Contemporary Hospitality Management	12	1,04%	
Journal of Marketing Management	12	1,04%	
Espacios	10	0,87%	
Amfiteatru Economic	9	0,78%	
6	8	4,2%	*Cluster* 1 56 journals 293 publications (25.5%)
2	7	1,2%	
12	6	6,3%	
15	5	6,5%	
21	4	7,3%	
38	3	9,9%	*Cluster* 2 124 journals 286 publications (24.89%)
86	2	15,0%	

303	1	26,37%	*Cluster* 3 303 journals 303 publications (26.37%)
Total		100%	

Source: The authors (2021)

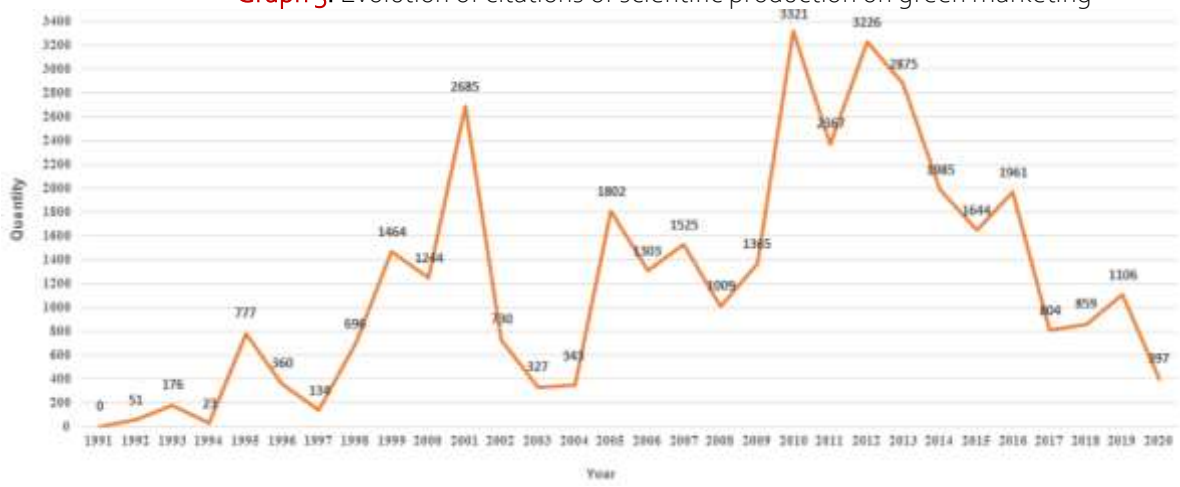
To find the core of the journals most devoted to publishing on green marketing, we followed Bradford's Law, arranging the journals in descending order of productivity. Subsequently, the 1,149 articles were divided by 3, resulting in 383 items. This quantity proved to be inconsistent for the formation of zones or clusters of journals with the same total number of articles. Thus, we proceeded with another division of the articles, this time by four (VICKERY, 1948), resulting in 287.25, a number that proved feasible for the identification of the most productive core, and the other clusters.

Thus, in table 5 are named in descending order of publications the 15 publication vehicles that make up the core cluster of highly productive journals on green marketing, and in the sequence, are quantified and identified by color the other three less productive clusters.

4.6 Quotations and Co-citations

The evolution of the number of citations that the articles received over the analyzed period is shown in Graph 3. The 1,149 articles that make up the corpus of the research received 36,559 citations, with an average of 31.81 citations per article. In absolute numbers, the articles published in 2010, 2012 and 2001 concentrated the highest number of citations (3,321), (3,226) and (2,685), respectively. On the other hand, when considering the average number of citations per published article, we have the years 2005, 2001 and 1999 with the highest scores of 163.8, 157.9, 146.4.

Graph 3. Evolution of citations of scientific production on green marketing



Source: The authors (2021)

Table 6 describes the 10 articles that received the highest number of citations, also showing the average number of citations these articles received per year, and their authors. Thus, the article "Targeting consumers who are willing to pay more for environmentally friendly products" by Laroche, Bergeron and Barbaro-Forleo (2001), which addresses the

willingness of consumers to pay more for green products, received 1. 321 citations. 321 citations, being the most cited article in the analyzed corpus, while "Predicting green product consumption using theory of planned behavior and reasoned action", by Paul, Modi and Patel (2016), research that seeks to predict the consumption of green products by applying the Theory of Planned Behavior, concentrates the highest average number of citations per year (110.5).

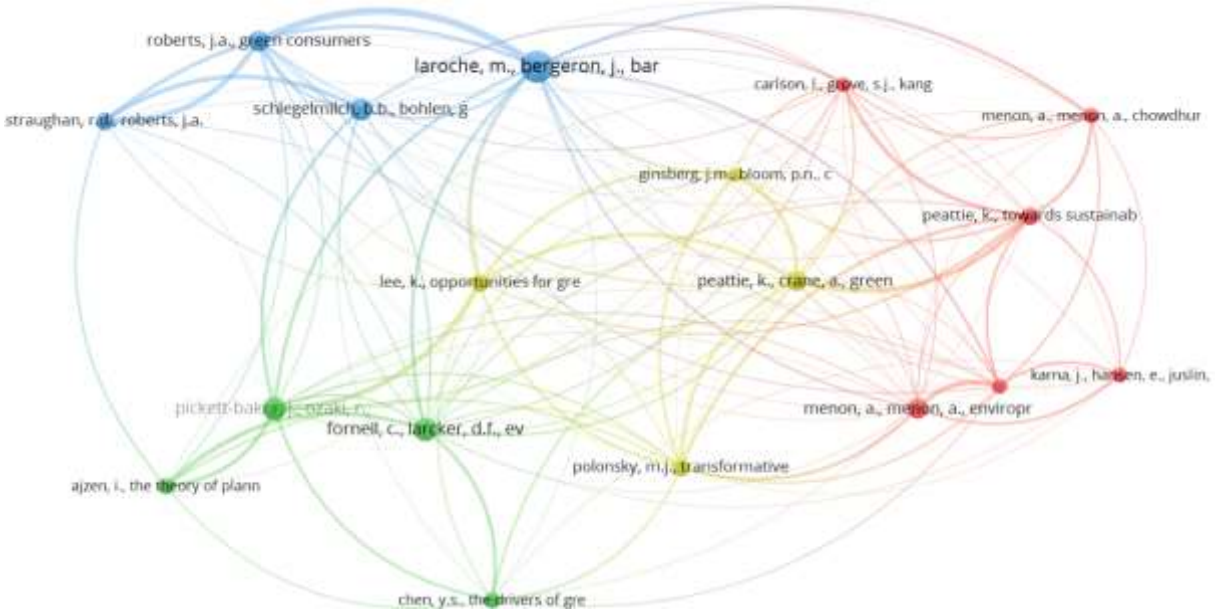
Table 6. Articles on green marketing with highest number of citations

Authors	Title	Citations	Citations/ Year
Laroche, Bergerone Barbaro-Forleo (2001)	*Targeting consumers who are willing to pay more for environmentally friendly products*	1321	69,53
Zhu, Sarkis e Geng (2005)	*Green supply chain management in China: Pressures, practices and performance*	846	56,40
Straughan, e Roberts (1999)	*Environmental segmentation alternatives: A look at green consumer behavior in the new millennium*	683	32,52
Manaktola e Jauhari (2007)	*Exploring consumer attitude and behavior towards green practices in the lodging industry in India*	490	37,69
Kalafatis, Pollard, East e Tsogas (1999)	*Green marketing and Ajzen's theory of planned behavior: A cross-market examination*	474	22,57
Miles e Covin (2000)	*Environmental marketing: A source of reputational, competitive, and financial advantage*	460	23,00
Luchs , Naylor , Irwin e Raghunathan (2010)	*The sustainability liability: Potential negative effects of ethicality on product preference*	449	44,90
Chen (2010)	*The drivers of green brand equity: green brand image, green satisfaction, and green trust*	447	44,7
Paul , Modi e Patel (2016)	*Predicting green product consumption using theory of planned behavior and reasoned action*	442	110,5
Baumann , Boons e Bragd (2002)	*Mapping the green product development field: Engineering, policy and business perspectives*	381	21,17

Source: The authors (2021)

According to Grácio (2016, p. 88), "cocitation identifies the connection/similarity of two cited documents via their joint occurrence frequencies in a list of citing authors' references." Thus, a reference cocitation network was devised to identify the works most shared by authors who have published on green marketing. From this perspective, in the network below, the nodes and name of the largest references reflect their highest occurrence, the colors indicate the clustered groupings, and the lines present the interrelatedness of the references. Of the 53,877 references cited in the investigated corpus, 18 stand out with 20 occurrences or more, as presented in figure 2.

Figure 2. Co-citation network of publications on green marketing



Source: The authors (2021)

The 18 documents that make up the network were grouped into 4 clusters. The green cluster is composed of 4 items that study "Green Products", while the blue cluster gathers 4 items that deal with "Consumer Behavior". The red cluster, on the other hand, is made up of 6 items that deal with "Marketing strategies", while the yellow cluster gathers 4 items, which work with "Green marketing theories and concepts".

References that are frequently cocited imply advanced ideas and 52019) may indicate transitions in paradigms or the authors' influence in each field of research (CHEN, 2006). In this sense, the most frequently cited article in the network is "Targeting consumers who are willing to pay more for environmentally friendly products", present in the group of studies that deal with consumer behavior. This article researched demographic and psychographic characteristics of consumers who are willing to pay more for environmental attributes of products, identifying that woman, married and with at least one child living at home, have a higher propensity to this behavior. Therefore, this study represents an important articulation at the base of the development of the green marketing research field. Table 7, presents the 18 most co-cited articles, divided by clusters, describing their authors, frequency of co-citation, document title, and study findings.

Table 7. Most co-citaded articles on green marketing

Cluster	Author	Cocitation	Title	Findings
Green (Green Products)	Pickett-Baker e Ozaki (2008)	45	*Pro-environmental products: marketing influence on consumer purchase decision*	It suggests that most consumers cannot easily identify green products. And while they prefer products made by greener companies, they do not find the marketing of the product particularly relevant or engaging.
	Fornell e Larcker (1981)	43	*Evaluating structural equation models with unobservable variables and measurement error*	It points out that shared variance measures can overcome statistical errors that have occurred in previous consumer behavior research.
	Ajzen (1991)	25	*The theory of planned behavior*	Points out the effectiveness of the Theory of planned behavior for predicting human behavior.

	Chen (2010)	25	*The drivers of green brand equity: green brand image, green satisfaction, and green trust*	It shows that green brand image, green satisfaction and green trust are positively related to green brand value.
Blue (Consumer Behavior)	Laroche, Bergeron e Barbaro-Forleo (2001)	64	*Targeting consumers who are willing to pay more for environmentally friendly products*	It found that the profile of consumers who are willing to pay more for green products is female, married, with at least one child living at home.
	Roberts (1996)	43	*Green consumers in the 1990s: profile and implications for advertising*	It found that the best indicator to explain consumer behavior is the belief that their individual actions can improve environmental problems.
	Schlegelmilch, Bohlen e Diamantopoulos (1996)	35	*The link between green purchasing decisions and measures of environmental consciousness*	Literature review that identified that measures of environmental awareness are linked to environmentally responsible purchasing behavior.
	Straughan e Roberts (1999)	35	*Environmental segmentation alternatives: a look at green consumer behavior in the new millennium*	It indicated that perceived consumer effectiveness (PCE) provides greater insight into environmentally conscious consumer behavior.
	Peattie e Crane (2005)	51	*Towards sustainability: the third age of green marketing*	It assesses the evolution of green marketing, dividing it into three stages: ecological marketing, environmental marketing, and sustainable marketing.
	Miles e Covin (2000)	39	*Environmental marketing: a source of reputational, competitive, and financial advantage*	Explores the relationship between reputation, environmental performance, and financial performance, and analyzes the contingencies that affect environmental policymaking.
	Menon e Menon (1997)	36	*Enviropreneurial marketing strategy: the emergence of corporate environmentalism as market strategy*	Identifies 3 types of environmental marketing strategies and develops a model of the antecedents and consequences of an environmental marketing strategy.
	Carlson, Grove e Kangun (1993)	34	*A content analysis of environmental advertising claims: a matrix method approach*	It suggests that claims that exalt the environmental benefits of products and those that are designed to enhance an organization's environmental image are more likely to be considered misleading.
	Karna, Hansen e Juslin (2003)	21	*Social responsibility in environmental marketing planning*	They highlight that green values, environmental marketing strategies and their structures and functions are logically connected to each other.
	Menon, Menon, Chowdhury e Jankovich (1999)	27	*Evolving paradigm for environmental sensitivity in marketing programs: a synthesis of theory and practice*	Discusses the concept of marketing programs, based on the environment, in the context of each element of the marketing mix.
Yellow (Green Marketing Theories	Peattie e Crane (2005)	51	*Green marketing: legend, myth, farce or prophesy?*	It points out that many concepts about green marketing addressed in the literature have no support in marketing philosophy or environmentalism.

and Concepts)	Lee (2008)	46	*Opportunities for green marketing: young consumers*	It shows that social influence was the main predictor of Hong Kong adolescents' green buying behavior, followed by environmental concern, self-image concern in environmental protection, and perceived environmental responsibility.
	Polonsky (2011)	44	*Transformative green marketing: impediments and opportunities*	It discusses the inability of consumers, companies, and governments to adopt systemic environmental thinking, and proposes three measures: marketers must look for new ways to calculate and communicate the green value of products; the discourse on the environment needs to be changed; and reorienting marketing toward adding value to products.
	Ginsberg e Bloom (2004)	34	*Choosing the right green marketing strategy*	It addresses the theories of green marketing strategies, passive, or "lean", and more aggressive approaches such as "extreme green".

Source: The authors (2021)

When analyzing the results presented so far, considering the theoretical framework consulted, it appears that, in accordance with the laws of Bradford (1934) and Lotka (1926), there is a concentration, in terms of authors and journals, that work with greater dedication on the subject, as well as more commonly cited studies. In other words, although there has been a significant increase in scientific production on green marketing between 1991 and 2020, it can be seen that the literature is being established, with greater emphasis, on some specific authors, works and journals.

4.7 Keywords (Zipf's Law and Co-occurrence)

Regarding the keywords, Chart 8 presents a quantitative summary of the occurrences found. Of the 2,738 terms, 2,190 (79.98%) occurred only once. Except for the terms used in the search, the keywords "sustainability" stood out with 116 occurrences, followed by "consumer behavior" and "sustainable development" with 58 occurrences each, demonstrating areas of green marketing studies that received greater emphasis.

Table 8. Frequency of keywords in the scientific production on green marketing

Qty of Keywords	Freq.	Total of Keywords	Aggregate*	Keywords
1	510	510	10,00%	*Green Marketing*
1	116	116	2,27%	*Sustainability*
1	62	62	1,22%	*Sustainable marketing*
2	58	116	2,3%	*Consumer behavior; Sustainable development*
1	56	56	1,10%	*Green product*
1	54	54	1,06%	*Environmental marketing*
1	45	45	0,88%	*Environment*
1	32	32	0,63%	*Marketing*

1	29	29	0,57%	*Corporate social responsibility*
1	21	21	0,41%	*Marketing strategy*
1	19	19	0,37%	*Sustainable consumption*
1	18	18	0,35%	*India*
3	17	51	1,00%	*Green advertising; Green trust; Greenwashing*
1	15	15	0,29%	*Environmental management*
1	14	14	0,27%	*Green consumerism*
4	13	52	1,02%	*Green consumption; Green purchase intention; Environmental concern; Market segmentation*
6	12	72	1,41%	*Ecological marketing; Environmental knowledge; Social marketing; Social responsibility; Supply chain management; Purchase intention*
2	11	22	0,43%	*Green marketing strategy; Green supply chain*
3	10	30	0,59%	*Green consumer; Green satisfaction; Willingness to pay*
8	9	72	1,41%	.....
13	8	104	2,04%	.....
11	7	77	1,51%	.....
18	6	108	2,12%	*Competitive advantage; effectiveness; environmental responsibility; green brand image; green consumer behavior; green hotel; green perceived quality; green purchase behavior; life cycle assessment; Malaysia; management; market orientation; new product development; perceived consumer; performance; psychographics; sustainable; tourism; trust*
21	5	105	2,06%	.....
57	4	228	4,47%	.....
107	3	321	6,30%	.....
280	2	560	10,98%	.....
2190	1	2190	42,95%	.....
2738		5099	100%	.....

*Quantity of keywords (per row) divided by total keywords
Source: The authors (2021)

To identify the keywords with the highest semantic content from the analyzed studies, separating them from terms representing trivial information and search noise, Zipf's first Law formula was used in conjunction with Goffman's Transition Point (ZIPF, 2012; PAO, 1978). The 2,738 unique keywords, excluding the term "green marketing" (the main search term), were sorted according to frequency of occurrence "f", and ranked in descending order of frequency of occurrence, enabling a serial order "r" to be obtained. By multiplying the serial order "r" by the frequency of occurrence "f", the constant "k" of Zipf's first law is obtained (ZIPF, 2012).

Table 9. Frequency of keywords for the application of Zipf's first law

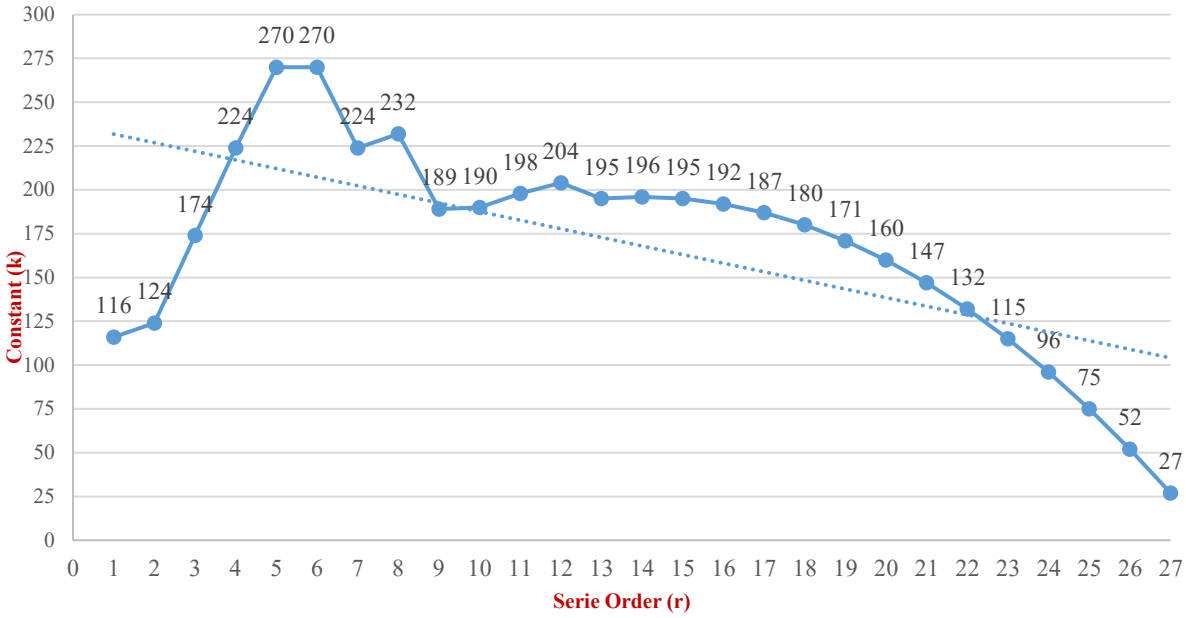
Qty of keywords ranked in the Order of the series	Serial "r" order	Frequency of Occurrence "f"	Constant of Zipf's first law (r.f=k)
1	1	116	116
1	2	62	124
2	3	58	174
1	4	56	224
1	5	54	270
1	6	45	270
1	7	32	224

1	8	29	232
1	9	21	189
1	10	19	190
1	11	18	198
3	12	17	204
1	13	15	195
1	14	14	196
4	15	13	195
6	16	12	192
2	17	11	187
3	18	10	180
8	19	9	171
13	20	8	160
11	21	7	147
18	22	6	132
21	23	5	115
57	24	4	96
107	25	3	75
280	26	2	52
2190	27	1	27

Source: The authors (2021)

In graphic 4 we can observe the maximum point 270, referring to the series orders 5 and 6, and the minimum point 27, which represents the series order 27 of the frequency of occurrence terms. Also in chart 4, it can be seen that the dashed line demonstrates the decreasing trend, resulting from the series multiplied by the frequency of occurrence, between the products of series 3 and 22. Thus, according to Pao (1978), to the left of series 3 are the keywords considered as trivial information (Zone I), and to the right of series 22 are the keywords considered as noise (Zone III).

Graph 4. Zipf's first law (r.f = k) in scientific production on green marketing



Source: The authors

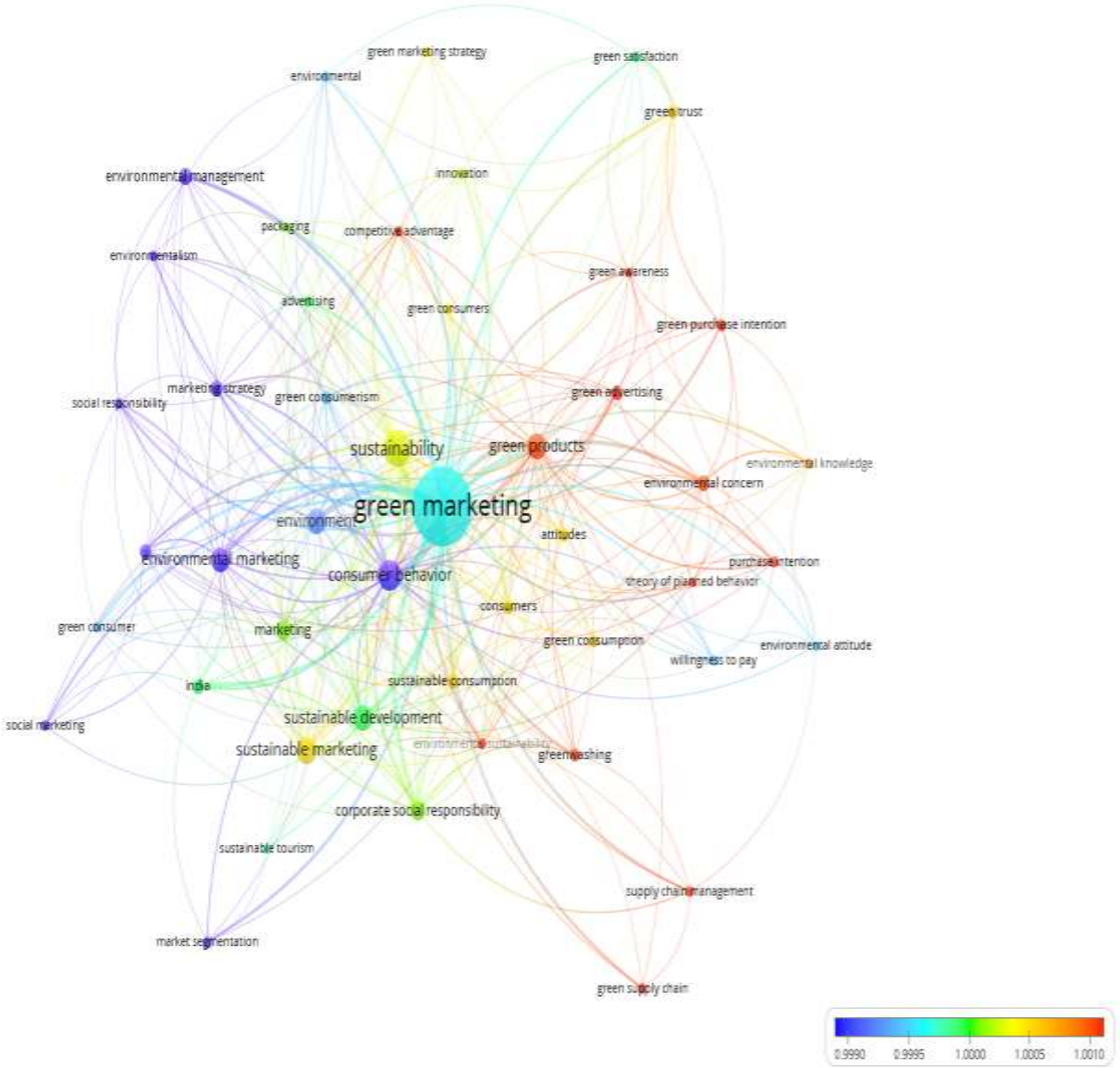
In this context, to identify which is the word that separates the trivial information zone from the noise zone, Goffman's Transition Point (T) was calculated which, by returning a value of T equal to 65.68, indicates that the 65th keyword is the one that exhibits this transition. The 65th keyword is in a group of eighteen terms, with frequency of occurrence equal to 6, and ranked arbitrarily in alphabetical order. Thus, the mapped keyword was competitive advantage. The keywords that have the same frequency of occurrence, six repetitions, and occupy the series of order 22 are, respectively: *competitive advantage; effectiveness; environmental responsibility; green brand image; green consumer behavior; green hotel; green perceived quality; green purchase behavior; life cycle assessment; Malaysia; management; market orientation; new product development; perceived consumer; performance; psychographics; sustainable; tourism* e *trust,* as of table 8.

The region with the same frequency of occurrence (6) presents as attribute "[...]greater semantic content and with indexing characteristics of the theme to which they are linked" (MELLO et al., 2017, p.63). In this sense, the keyword "competitive advantage" refers to the study of the benefits that organizations acquire when adopting green marketing practices, which makes the applicability of the concept referring to Goffman's Transition Point (T) valid.

The last analysis procedure of this study was also performed on the keywords and aimed to analyze the thematic progression of green marketing research in the investigated period. One of the analysis techniques that allows understanding the thematic evolution of the scientific production of a given subject is the keyword co-occurrence analysis (LI, 2018). To this end, a network diagram was prepared with the support of the VosViewer software to create a visualization of the cooccurrences of keywords, in the domain of green marketing research. Cooccurrence is calculated as the number of times two keywords appear together in publications. In a network diagram, keywords most likely to reflect related topics are grouped into clusters, which are visually differentiated by colors (MORAES; KAFURE, 2020). The keyword with the highest frequency in each cluster presents the largest node. In addition, the changes in the colors of the clusters, as they change from one cluster to another, reveal how the study area has progressed (CHEN; CHEN; WU; XIE; LI, 2016).

Figure 3 presents a network diagram of keyword cooccurrences, with a minimum frequency of nine occurrences. It can be seen that the network grouped the keywords into five main nodes. Purple nodes correspond to keywords used at the beginning of the investigated period, the progression to blue, green, and yellow nodes indicate intermediate stages, while red nodes correspond to keywords that have become more recently used.

Figure 3. Keyword co-occurrence network of the scientific production on green marketing



Source: The authors (2021)

The purple-colored cluster has its largest node in the term "consumer behavior", indicating that consumer behavior was one of the most addressed topic areas in the initial phase of green marketing research. The average value of the co-occurrence of the term "consumer behavior" is found close to 0.9990, associating the keywords ecological marketing; environment; environmentalism, environmental management, environmental marketing, market segmentation, marketing strategy, social marketing, and social responsibility.

This suggests that at the beginning of the studies on green marketing, researchers from various areas addressed issues related to the environment, social responsibility, and environmental management, corroborating the idea that green marketing emerged in the wake of social concern with environmental degradation (ALENCASTRO, 2015), and the perception that companies should take a proactive role in preserving the environment. Such studies triggered the proposition of the concepts of environmental marketing, ecological marketing and social marketing, culminating with the creation of marketing strategies for the segmentation of the green market (REX; BAUMANN, 2007).

The network also shows that the concepts developed in the initial phase were later applied by market researchers. This is revealed using the terms *green consumerism, green consumer, willingness to pay, environmental attitude,* which address them to pay for environmental attributes of products and services. This cluster is represented by the color blue, and its largest node is the keyword "green marketing". It is worth noting that, as it is the main search term in this research, the keyword "green marketing" maintains a correlation with all the other terms in the network. The average value of the co-occurrence of the node "green marketing" is in the range 0.9990 to 0.9995.

The green cluster shows that the studies have expanded their scope of investigation, reaching new organizational themes, such as: adversity, green satisfaction, innovation, packaging, and sustainable tourism. In addition, the presence of the term "India" demonstrates the contribution of authors from an emerging country in this area and confirms what was presented in chart 2 (productivity of the countries). Completing this cluster, we have "corporate social responsibility" converging to the largest node "Sustainable development". The average value of the co-occurrence of this cluster is in the range of 0.9995 to 1.000. Analyzing this cluster, it is inferred that the authors began to relate sustainable development with the perspective of corporate social responsibility and themes linked to the study of conventional marketing: packaging, advertising, innovation, but tending to an environmental bias, such as green satisfaction and sustainable tourism.

Continuing the thematic evolution of the study in green marketing, we have that the knowledge produced, up to that point, progressed to the themes (i) sustainability, worked together with sustainable marketing and sustainable consumption; (ii) green consumption and its interface with green trust and green marketing strategy and (iii) attitudes and consumers, all belonging to the yellow cluster. Therefore, one can assume that the authors sought to link marketing to sustainability, having consumption as the link, given that the studies in this period focused on terms such as: *consumers, attitudes, green consumption and sustainable consumption,* addressed jointly with research on green marketing strategies and green trust. The largest node in this cluster is evidenced by the keyword "sustainability", and has a mean value close to 1.0005

Finally, the group of keywords belonging to the red cluster indicates the topic areas in which green marketing research is advancing in recent times. As shown in graph 1 (temporality of scientific production), studies in green marketing have been increasing in quantity, which is reflected in the volume of new research fronts. In this way the red cluster, of node "green products", presents greater thematic diversity, thirteen areas.

Thus, based on the co-occurrence network (figure 3), we infer that the progression of research on green marketing is advancing toward the following themes: competitive advantage, environmental concern, environmental knowledge, environmental sustainability, green adversity, green awareness, green purchase intention, green supply chain, greenwashing, purchase intention, supply chain management, and theory planned behavior.

Such terms are in line with the literature consulted, which also recognizes that academic research on green marketing is advancing in the areas of greenwashing (ANDREOLI;

CRESPO; MINCIOTTI, 2017), green products (BHARDWAJ; GARG; RAM; GAJPAL; ZHENG, 2020), green purchase intention (VERMA, 2017), green advertising (LIU; LIU, 2020), green supply chain (NKRUMAH; ASAMOAH; ANNAN; AGYEI-OWUSU, 2020).

Noteworthy is the presence of the keyword "competitive advantage" in the last cluster, a term identified in this study through the application of Zipf's first law and Goffman's Transition Point, as a transition element between trivial information and research noise, which demonstrates the consistency of the formation of this network. In addition, "green awareness" and "environmental knowledge" also appear in this last group of keywords, indicating that researchers are linking green marketing to psychographic aspects of consumers, as confirmed by the studies of Pereira, Viana, and Alves (2019) and Mohiuddin, Mamun, Syed, Masud, and Su (2018).

The co-occurrence analysis of the keywords above, evidences maturation in the field of research on green marketing that, progressed from the first debates on consumer behavior, advancing to aspects concerning green marketing itself, and concepts related to sustainable development and sustainability, until reaching the current studies on green products. It should also be noted that throughout the distinct stages of development of the research topics, some of the terms were adapted (green consumers/consumers, for example) or re-signified (greenwashing, a term that came to identify deceptive corporate behavior in the disclosure of environmental practices) with the intention of marking a new topic of study.

5 FINAL CONSIDERATIONS

The study in question raised bibliometric indicators related to scientific production on green marketing. The description and analysis of such indicators contributes to a greater understanding of the literature on the subject, providing an overview of this field of research, as well as allowing the exploration of specific contexts, according to the need for information.

In this sense, among the results found, it is noteworthy that, between 1991 and 2020, 1,149 scientific articles published in the Scopus database (Elsevier) on the topic of green marketing were surveyed. This shows a constant growth of this literature, which had 1 article published in the first year of the subject in the database (1991), and 161 in the last year analyzed (2020).

The field of knowledge "Business, Management and Accounting" was responsible for almost a third of the published studies. The predominant language of the publications was English, with 1,108 contributions, followed by Portuguese with 17 articles. The most productive countries were the United States with 248 items and India with 132. Brazil appears in ninth place with 32 documents, and an average of just over one item per year.

Co-authorship is a more common pattern in scientific production on green marketing (78.94%) than individual research (21.06%), and the average collaboration index - number of authors per work - was 2.23. A total of 2,569 different authors were identified, of which 2,223 published only once, and only two authors published 10 papers or more. Thus, the most productive authors on green marketing are: Polonsky M.J., with fourteen items, and Chen Y.S., with ten items.

The application of Bradford's Law divided the 498 journals, which published on green marketing, into four clusters. The last cluster, characterized by the greatest dispersion of publications, had 303 journals, each of them with only 1 item published on the subject. In contrast, the central cluster, which contains the core of the journals most dedicated to the theme,

is composed of 15 journals. The journal "Sustainability", with 49 articles, concentrated the largest number of publications.

The articles that comprised the corpus of analysis together received 36,559 citations, an average of 31.81 citations per article. The article "Targeting consumers who are willing to pay more for environmentally friendly products" by Laroche, Bergeron and Barbaro-Forleo (2001), which addresses the willingness of consumers to pay more for green products, received the highest number of citations (1,321). The same article was also the most cited, indicating that this study represents an important articulation at the base of the development of the green marketing research field.

Grouping the 5,099 keywords resulted in a total of 2,738 terms, of which 42.95% were used only once. The most recurrent keyword, apart from the terms used in the search, was "Sustainability". The keyword "Competitive advantage" was found, by means of Zipf's first Law and Goffman's Transition Point, to be the term that displays the transition characteristics between the zones of trivial information and zones of search noise.

The analysis of the thematic evolution of research, based on the co-occurrence of keywords, found five clusters, which represent various stages of scientific production on green marketing. These clusters are characterized by the terms *consumer behavior, green marketing, sustainable development, sustainability and green products*.

As a limitation, this work explored only one database, which has an interdisciplinary character. Thus, future studies that encompass a larger number of databases, and the combination of interdisciplinary databases with more specific thematic databases are suggested. We also glimpse the possibility of complementing the bibliometric indicators by means of altimetric studies - an alternative informational metric - which could provide a broader and more diversified understanding of the researched theme.

CRediT

RECOGNITIONS: Not applicable.

FINANCING: Not applicable.

CONFLICTS OF INTEREST: Authors certify that they have no commercial or associative interest that represents a conflict of interest in relation to the manuscript.

ETHICAL APPROVAL: Not applicable.

AVAILABILITY OF DATA AND MATERIAL: Not applicable.

AUTHORS'CONTRIBUTIONS: SILVA, R.F. da (Conceptualization, Data Curation, Formal Analysis, Research, Methodology, Resources, Visualization, Writing). RAZZOLINI FILHO, E. (Methodology, Supervision, Validation)

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Article submitted to the similarity system
Submitted: 23/06/2020 – Accepted: 16/07/2020 – Published: 22/08/2020