



Mapping the knowledge of green consumption: a meta-analysis

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Abstract

Green consumption can facilitate sustainable industrial development and improve the overall efficiency of resource utilization. In response to rapid economic development and increasing environmental emissions, it is critical to promote green consumption so that the whole society can move toward sustainable development. This study aims to systematically review studies on green consumption by means of meta-analysis, bibliometric analysis, and social network analysis. The results show that green consumption is an interdisciplinary research field, involving environmental science, social science, medical science, economics, and other disciplines. Most productive countries, institutions, authors are identified so that the new researchers in this field can find their research partners. Keywords analysis results help identify the research hotspots in this field. It is suggested that future green consumption research should focus on behavior mechanism, stakeholder coordination, and policy evaluation. In general, the results obtained from this study provide valuable information for researchers and practitioners to promote green consumption research.

Keywords Sustainable development · Green consumption · Meta-analysis · Knowledge mapping · Environmental economics

Introduction

In 1992, the Rio Declaration and Agenda 21st adopted by the United Nations Conference on Environment and Development formally put forward the concept of

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“Sustainable Development.” Green consumption is an important approach to achieve the global sustainable development goals. Promoting green consumption not only stimulates sustainable industrial development but also improves the efficiency of resource utilization. Green consumption, also known as sustainable consumption, is a new type of consumption behavior that avoids or reduces damages to the environment by moderate consumption control, and advocates ecological protection (Elkington and Hailes 1989). Green consumption advocates consumers to choose green products that contribute to public health when they consume, pay attention to the disposal and recycling of wastes in the process of consumption, and guide consumers to change their consumption behaviors, focus on environmental protection, conserve resources and energy, so that sustainable consumption can be achieved (Gilg et al. 2005; Geng et al. 2019).

The unsustainable crisis in the process of economic development is closely related to the consumption mode of human beings. Studies on green consumption have increased since the 1960s. Carson (1962), an American marine biologist, published a book titled as “Silent Spring,” which describes the harm of chemical insecticides to the ecosystem on which human beings depend (Dunn 2012; Heckel 2012). Godard (1968) put forward the concept of “Green Revolution” (William 1968). The Roman Club (1972) published a book

entitled “The Limits of Growth,” which proposed to attach importance to the limitation of resources and eliminate the destruction of the earth’s environment (Meadows et al. 1972). Fisk (1973) put forward the theory of responsible consumption, aiming to solve the growing problem of environmental management constraints. Schipper (1989) pointed out that consumer behaviors may affect 45–55% of all energy consumption. Alfredsson (2004) discussed the quantitative impact on energy use and carbon dioxide emissions if households adopt a green consumption model. Koengkan (2018) found that economic growth and trade liberalization increased energy consumption. In general, green consumption promotes the virtuous circle of production and consumption. This requires that all the enterprises should reduce their emissions in production process and maintain ecological balance.

The innovative solutions to the pandemic Covid-19 will contribute to build resilience for a post-pandemic world. Green development is expected to become a new driving force to promote sustainable economic growth. Tracing the literature sources of green consumption is therefore helpful to find innovative environmental policies. Academically, many studies on green consumption have been conducted. However, holistic reviews on these literatures are still lacking. Under such a circumstance, this study aims to systematically review studies on green consumption by means of meta-analysis, bibliometric analysis, and social network analysis and put forward innovative environmental policies. We expect that the cooperation networks of countries, institutions, and authors can be presented and the key features of green consumption studies can be identified, including the most cited articles, the evolution process of research themes and the frontier hotspots. Based upon these findings, we also discuss how to integrate various methods for different disciplines so that valuable insights on promoting green consumption can be identified. This paper is helpful to reflect the knowledge progress in the field of green consumption, a key area of sustainable development, and will provide relevant theoretical supports for SDG12 of the 17 goals set for 2030. The whole paper is organized as below. After this introduction section, the research methods and data sources are described in the “Methods and data” section. Then, empirical results and discussions are presented in the “Results and discussions” section. Finally, conclusions are drawn in the “Conclusions” section.

Methods and data

Methods

In this section, we briefly describe the methods for this study, including meta-analysis, bibliometric analysis, social network analysis, and scientific knowledge mapping.

Meta-analysis method

Systematic review is a literature research method that analyzes the research progress of a specific subject by using different databases, various retrieval tools, and analytical techniques (Bowler et al. 2010; Clark et al. 2016). Meta-analysis is a representative method of systematic review, which uses statistical methods to carry out a systematic qualitative and quantitative analysis on previous research results to draw comprehensive conclusions (Glass 1976). Meta-analysis has been widely used in the medicine, sociology, psychology, economics, and other fields (Pettigrew and Tropp 2006; Nesbit and Adesope 2006; Haidich 2010; Stanley et al. 2013).

Meta-analysis is an in-depth analysis and interpretation of the selected research results and has become an effective method for systematic literature review. Consequently, this meta-analysis method has been developed and enriched with various research demands. Dating back to 1904, Pearson applied the meta-analysis method in the field of medical research, which has become the decision-making basis of evidence-based medicine (Shannon 2016). Glaser et al. (1968) used the synthesis method of qualitative research to carry out the research on the grounded theory of sociology. Smith (1996) introduced meta-analysis into library and information science to analyze the relationship between information retrievals and user needs. Cavlovic et al. (2000) integrated environment and natural resource economics to conduct meta-analysis. Scheufele (2014) used this meta-analysis method to analyze the mode of scientific communication.

Bibliometric analysis method

Bibliometric analysis is an interdisciplinary method that uses mathematical and statistical methods to quantitatively analyze all the knowledge carriers (Pritchard 1969; Keuzenkamp and Mcaleer 1995; Geng et al. 2017). Based on quantitative research methods such as computational technology and mathematical statistics, bibliometric analysis makes quantitative analysis on key words, authors, journals, publication years, institutions, literature contents, and citation information of relevant research articles to reveal the research foci and project future research directions in a certain academic field. Bibliometrics shows Lotka’s Law (1926) for the distribution of authors in scientific and technological documents (Lotka 1926; Greene 2007), Zipf’s Law (1949) for the distribution of word frequency in documents (Piantadosi 2014), and Bradford’s Law (1934) for the distribution of papers in a discipline in journals (Brookes 1969).

Bibliometric analysis provides theoretical support and information management guarantee for scientific evaluation. At the micro-level, studies on bibliometric analysis include the identification of core documents, the evaluation of

publications, and the evaluation of citations on related papers. At the macro-level, studies on bibliometric analysis include the design of economic information systems and networks, the prediction of research directions, and the development and improvement of basic information theory. Bibliometric analysis has been applied to the description of interdisciplinary research status and progress, such as the ranking of academic journals (Talukdar 2011; Rosenzweig et al. 2016), metrological analysis of the main research management methods (Ferreira et al. 2016; Merigo and Yang 2017), and economics research evolutionary pathways (Schatz and Bashroush 2017; Hodgson and Lamberg 2016).

Social network analysis method

Sociological theory holds that society is not made up of individuals but of networks, which contain the relationships between nodes. The social network analysis method explores the characteristics of the network through the analysis of the relationships in the network (Wolfe 2010; Zheng et al. 2016). According to social network analysis, the literature of one theme is regarded as a whole network, and the keyword co-occurrence network is directly displayed through co-words analysis. At the same time, the concepts of centrality and frequency of social network are used to analyze and dig the keywords in depth so that research hotspots and development trends can be recognized.

The co-words analysis method mainly counts the number of co-occurrences of a group of words in the same document. It analyzes the co-occurrence intensity and co-occurrence relationship of the group of words, reflects the relationships between these words, and reveals the structural changes in a research field they represent. This method uses keywords to represent the main contents of one literature, and reveals the hotspots, frontiers, and trends of the research field by analyzing the co-words relationship and intensity. Clustering analysis refers to the clustering of some keywords with strong co-occurrence intensity. Co-words analysis is mainly used in the fields of artificial intelligence (Courtial and Law 1989; Bullinaria and Levy 2007), scientific metrology (Lamnabhilagarrigue et al. 2017; Olmedagomez et al. 2017), materials science (Linnenluecke et al. 2017), medical science (Buchwald et al. 2004; Chowdhury et al. 2014), and economics (Topalli and Ivanaj 2016; Bracco et al. 2018).

Scientific knowledge mapping

Scientific knowledge mapping is one method for scientific quantitative analysis (Gazni et al. 2012; Jeong et al. 2014). This method takes scientific knowledge as the research object and visually displays the development process, structural relationships, and evolution pathways of scientific knowledge by using data mining, information processing,

knowledge measurement, and graphics drawing. Price (1976) revealed the laws of scientific development based on data equations, created scientific metrology, and formed the original scientific knowledge map. Van Eck and Waltman (2010) designed a computer program for bibliometric mapping. Shiffrin and Cook (1978), Borner et al. (2005), and Chen (2006) published relevant research results, which help to lay the research foundation of mapping science. Due to the co-citation analysis function of knowledge map, scientific knowledge mapping is widely used in economic geography (Cobo et al. 2011; Wei et al. 2015), ecological security analysis (Aretano et al. 2015; Chen et al. 2017), and other related disciplines.

Visual analysis is to analyze the internal relations among different research fields, especially the key words, core author groups, and various cooperative symbiotic networks (Wolfe 1994). By drawing a variety of knowledge maps, such as literature co-occurrence map and keyword map, we can reveal the structure and characteristics of scientific knowledge. Based on the literature citation analysis, keyword co-occurrence analysis and citation surge analysis, the evolution process and the research hotspots in the research field can be uncovered. The core ideas, trends, and sources of the research field are further identified by the co-citation analysis on various journals. By drawing a visual knowledge map, we can effectively predict the development trend and evolution process of one specific scientific field.

Data sources

The literature data for this study are collected from the Web of Science database of Thomson Reuters. Web of Science is an important database platform for obtaining global academic information, which contains more than 12,400 authoritative and influential international academic journals. Web of Science has a strict screening mechanism. According to Bradford's law in bibliometrics (Bradford 1934), it only includes important academic journals in various disciplines. Web of Science database is equipped with intelligent retrieval function, analysis function, and personalized service function, which can be used for basic visualization and statistical analysis of literature measurement. Under such a circumstance, this study selects the core collections from Web of Science, which covers the fields of natural science, engineering technology, social science, arts, and humanities.

In order to obtain publications with high relevance, this study selects the query option of "title, abstract and key words" to search for literatures related with green consumption in the Web of Science core collection database. The retrieval time range is set from 2001 to 2018. In the preliminary search stage, 2180 related literatures are found, including journal papers (68.49%), conference papers (26.36%), book chapters (1.62%), and other publications. In order to provide an

international perspective, this study only analyzes the research papers, conference papers, and review papers published in English language. In total, 2031 papers are selected with this filtering process, which are exported into RIS format for bibliometric analysis.

Results and discussions

Descriptive analysis of related publications

The number of articles is one important indicator to measure the development of a certain research field (Canti and Huisman 2015; Chen et al. 2015). The time distribution of the research literature on green consumption can be intuitively understood by multivariate statistical analysis, which is illustrated in Fig. 1. It is clear that the total publications on green consumption increased from 2001 to 2018. The evolution trend of such publications can be divided into three stages. The first stage is from 2001 to 2007, in which few papers were published. The second stage is from 2008 to 2011, with a clear growth trend. The third stage is from 2012 to 2018, with many papers emerged. Such a trend indicates that green consumption has received more attentions and been widely studied by academia.

Performance of countries, institutions, and authors

Cooperative network of countries

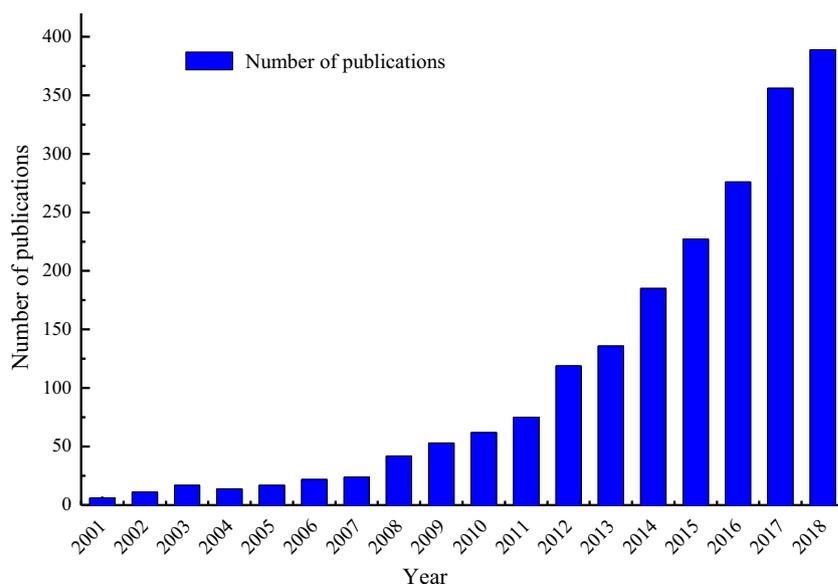
The analysis of cooperative network can help understand the strength of academic research in the field of green consumption in different countries (Gooch et al. 2017; Kyvik and Reymert 2017). This study analyzes the spatial distribution

characteristics of countries carrying out green consumption research. Figure 2 illustrates the visualization map of international network on green consumption research, which includes 56 nodes and 197 links. This means that the research literatures on green consumption were completed in 56 countries, but few knowledge communication and cooperation exist among different countries. Five types of agglomeration are recognized, including governing sustainable tourism consumption, public administration tools, economic growth, replicating best driving practices and buying behaviors.

According to the ranking of cooperation frequency of each country, the node of the USA is obviously larger than any other countries, and its radiation field is also the largest. Scholars from the USA published 495 cooperation articles, ranking the first in the world. This demonstrates that the USA has strong research strength and influence in the field of green consumption. China ranks the second with 337 cooperation articles, indicating that China is an important country in green consumption research. The UK ranks the third with 225 cooperation articles, while Germany ranks the fourth with 122 cooperation articles and Australia ranks the fifth with 116 cooperation articles. Other productive countries in this field include the Netherlands, Italy, and Spain. Table 1 lists these top 20 most productive countries in the research field of green consumption.

From the view of node centrality, the USA has the highest degree of centrality with a value of 0.49, far higher than any other countries. Spain, Malaysia, England, and the Netherlands are also highly centralized, as listed in Table 2. This shows that these countries have great contribution to the academic development of green consumption. Although China has extensive cooperation in the field of green consumption research, it does not play a leading role to promote green consumption research.

Fig. 1 Trend on green consumption publications during the period of 2001–2018



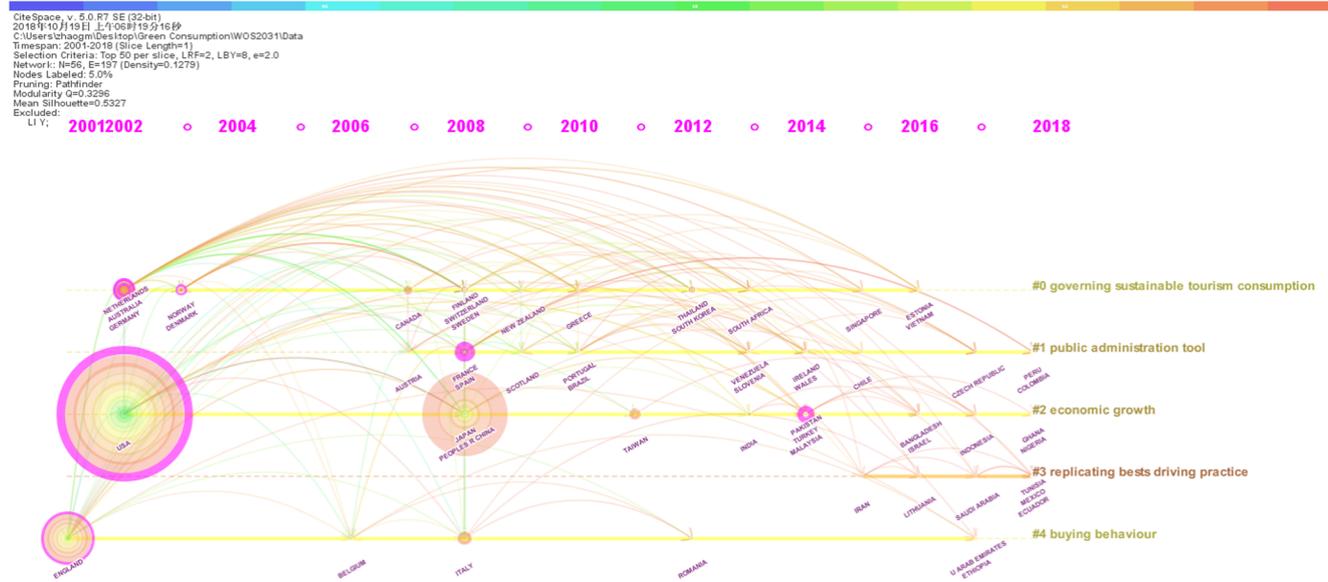


Fig. 2 The cooperative network mapping of countries

Cooperative network of institutions

Statistical analysis of cooperation among research institutions presents the distribution of major research organizations in the field of green consumption. Figure 3 illustrates the cooperation map among relevant research institutions. There are 324 nodes and 295 links in this cooperative network, but few links exist between these nodes. This reflects that the international cooperation teams in the green consumption research are scattered, with less cooperation and communications between different institutions. The cohesive research group has not yet formed. It is therefore critical to promote institutional cooperation among different involved research institutions so that scholars in such a field can create more cross-institutional and cross-disciplinary cooperation teams.

Table 1 The top 20 most productive countries in the green consumption field

Rank	Country	Co-paper	Rank	Country	Co-papers
1	USA	495	11	Sweden	68
2	China	337	12	South Korea	54
3	England	225	13	Denmark	49
4	Germany	122	14	France	48
5	Australia	116	15	Brazil	41
6	Netherlands	97	16	India	40
7	Italy	95	17	Norway	40
8	Spain	89	18	Malaysia	38
9	Taiwan of China	72	19	Japan	32
10	Canada	69	20	Switzerland	27

The Chinese Academy of Sciences is the most productive institute in this field, with 31 articles published in the field of green consumption. Other productive institutions include Aarhus University in Denmark, Leeds University in the UK, Lund University in Sweden, Shanghai Jiao Tong University in China, Wageningen University in the Netherlands, Ohio State University in the USA, Tsinghua University in China, Sheffield University in the UK, and Beijing Forestry University in China. Table 3 lists the top 20 productive institutions. It is found that the top 20 research institutions include seven European universities, eight Chinese research

Table 2 The cooperative centrality of the top 30 most productive countries

Rank	Country	Centrality	Rank	Country	Centrality
1	USA	0.49	16	Switzerland	0.05
2	Spain	0.23	17	Belgium	0.05
3	Malaysia	0.21	18	India	0.04
4	England	0.20	19	Finland	0.04
5	Netherlands	0.18	20	Austria	0.04
6	Denmark	0.16	21	New Zealand	0.04
7	Germany	0.15	22	Saudi Arabia	0.04
8	Australia	0.15	23	China	0.03
9	France	0.10	24	Canada	0.03
10	Italy	0.08	25	Scotland	0.03
11	Greece	0.08	26	Sweden	0.02
12	Iran	0.08	27	Brazil	0.02
13	Nigeria	0.07	28	South Africa	0.02
14	Japan	0.06	29	Turkey	0.02
15	Portugal	0.06	30	Pakistan	0.02

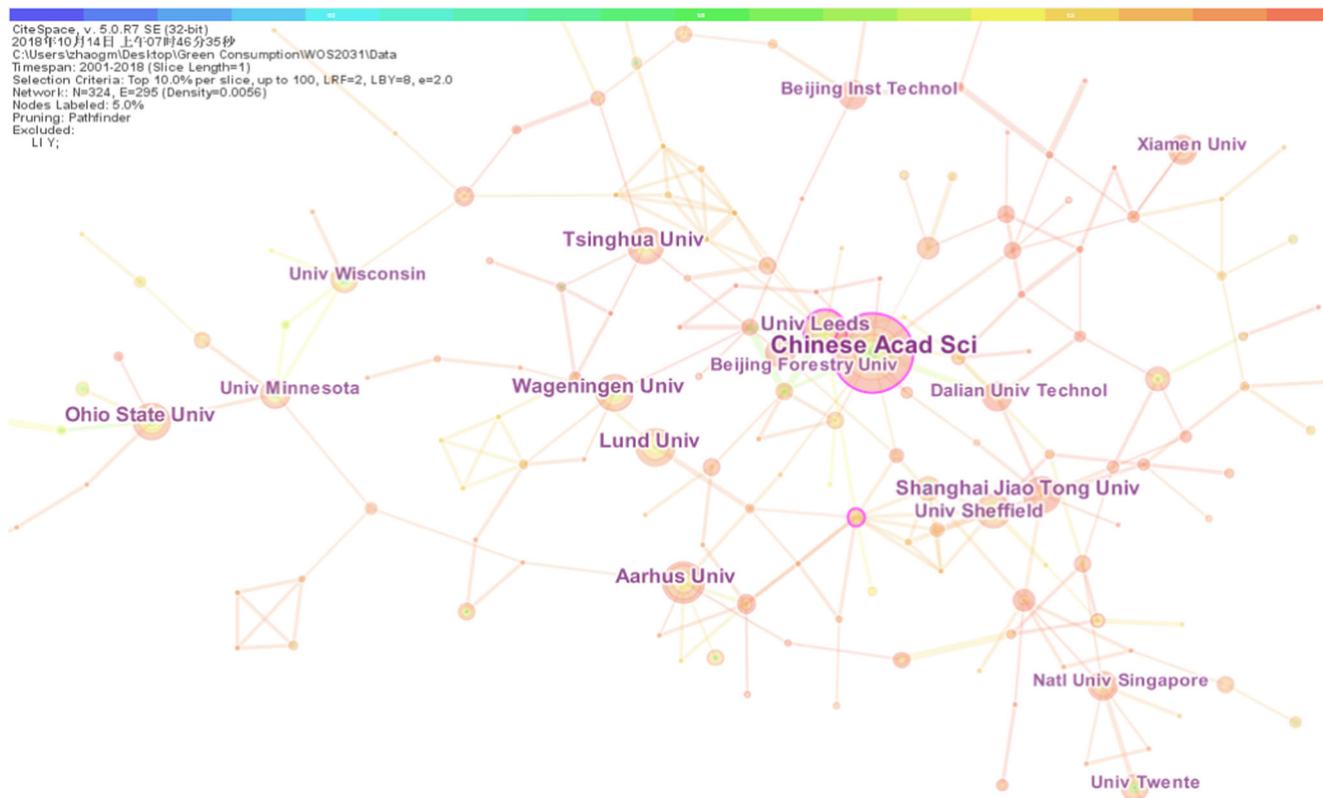


Fig. 3 The cooperative network of academic institutions engaging in green consumption research

institutions, and three American universities, indicating that EU, China, and the USA are very active in this research field.

From the centrality index point of view, the centrality of the Chinese Academy of Sciences has the highest value of 0.18, while the University of Leeds has the second highest value of 0.14. Newcastle University in Australia ranks the third with a value of 0.11. In addition, other more cooperative universities include Aarhus University, Minnesota University, Oxford University, Manchester University, Arizona State

University, Tsinghua University, Beijing Forestry University, Beijing Normal University, University of Michigan, and Chongqing University. Table 4 lists the most cooperative institutions in the field of green consumption.

Cooperative network of authors

Many scholars have made great contributions to the study of green consumption. Table 5 lists the most productive authors

Table 3 The cooperative frequency of the top 20 most productive institutions

Rank	Institution	Frequency	Rank	Institution	Frequency
1	Chinese Academy of Sciences	31	11	National University of Singapore	12
2	Aarhus University	17	12	Dalian University of Technology	12
3	University of Leeds	16	13	University of Minnesota	12
4	Lund University	16	14	Xiamen University	12
5	Shanghai Jiao Tong University	15	15	Beijing Institute of Technology	12
6	Wageningen University	15	16	University of Twente	11
7	Ohio State University	15	17	University of Wisconsin	11
8	Tsinghua University	15	18	University of Exeter	10
9	University of Sheffield	14	19	Hong Kong Polytech University	10
10	Beijing Forestry University	12	20	Chongqing University	9

Table 4 The cooperative centralities in the top 20 most productive institutions

Rank	Institution	Centrality	Rank	Institution	Centrality
1	Chinese Academy of Sciences	0.18	11	Beijing Normal University	0.07
2	University of Leeds	0.14	12	University of Michigan	0.07
3	Newcastle University	0.11	13	Chongqing University	0.07
4	Aarhus University	0.09	14	University of Chinese Academy Sciences	0.06
5	University of Minnesota	0.08	15	University of Wisconsin	0.05
6	University of Oxford	0.08	16	University of Copenhagen	0.05
7	University of Manchester	0.08	17	International Food Policy Research Institute	0.05
8	Arizona State University	0.08	18	Wageningen University	0.04
9	Tsinghua University	0.07	19	Ohio State University	0.04
10	Beijing Forestry University	0.07	20	University of Sheffield	0.04

in this field. Lin Boqiang, a professor from China Energy Economy Research Center at Xiamen University, published 10 articles on green consumption. According to the following formula in bibliometric analysis (Price 1976; Durieux and Gevenois 2010):

$$M = 0.749 \times (N_{\max})^{(1/2)} \tag{1}$$

where N_{\max} refers to the number of articles published by the most productive author. The threshold of productive authors in green consumption research is further calculated to be 2.37. By choosing authors who have published at least 3 articles as productive authors, 30 authors are identified, with a total of 129 articles, accounting for 6.35% of the total articles.

By analyzing the knowledge map of the cooperative network of the co-authors, 183 nodes and 133 cooperative links have been found, as shown in Fig. 4. It is clear that there are more individual nodes, but less cooperation between these

authors, indicating that academic cooperation in the field of green consumption research is not sufficient. Most cooperation papers were published between professors and their students, but less cooperation papers were jointly published between scholars from different institutions. Therefore, it is crucial to encourage more academic cooperation between scholars from different regions so that they can share the related knowledge and experiences to further promote the green consumption research.

Performance of journals, citations, and keywords

Co-citation analysis on relevant journals

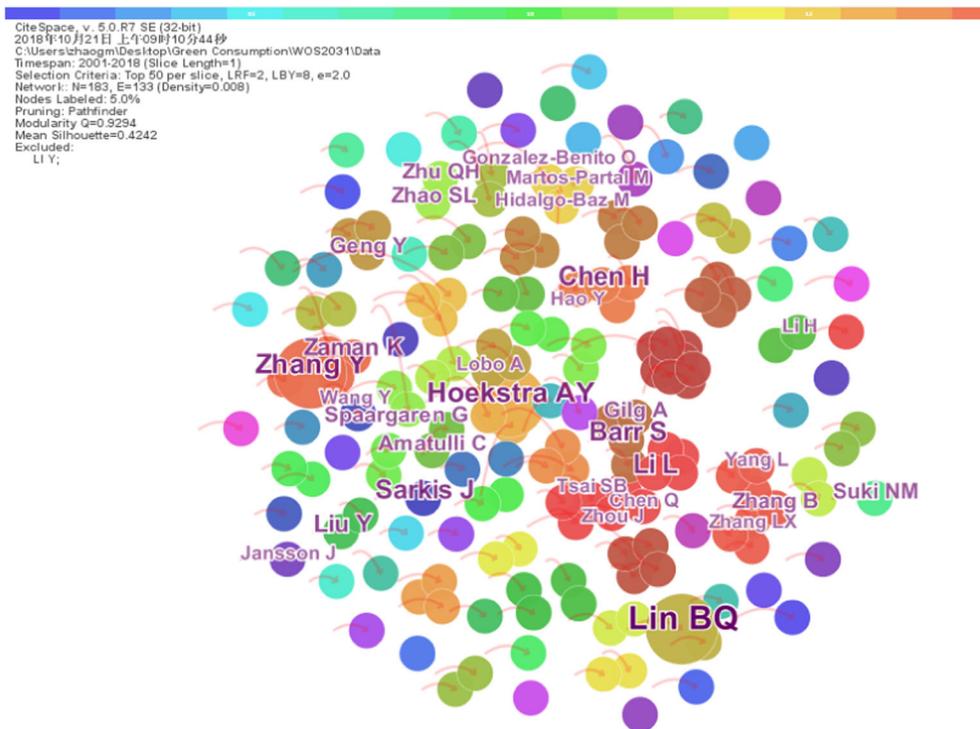
Those papers co-cited in the relevant journals often reflect the core ideas and development trend of a certain research field and present the key research directions in this field (Reeves and Borgman 1983; Sun et al. 2018). By drawing the co-citation visual network, the most relevant journals in the field of green consumption can be identified so that scholars in this field can find the most suitable journals for their submissions. In this study, the critical path algorithm is employed to draw a network map of co-cited journals. During this process, the network node is set as “cited journals” and the top 10 journals in each time zone are selected as the key analysis objects. Figure 5 illustrates that 460 academic journals published articles related with green consumption with 762 cooperative links. By analyzing the themes and contents of these journals, we can find that green consumption is a multi-disciplinary research field involving economics, management, geography, environmental science, etc.

Table 6 lists the co-citations of the top 20 productive journals. Among them, Energy Policy was cited for 700 times, ranking the first. Ecological Economics was cited for 661

Table 5 The cooperative frequency of the top 20 most productive authors

Rank	Author	Co-papers	Rank	Author	Co-papers
1	Lin B.Q.	10	11	Zhang B.	4
2	Hoekstra AY	7	12	Suki N.M.	4
3	Zhang Y.	7	13	Geng Y.	4
4	Barr S.	6	14	Spaargaren G.	4
5	Sarkis J.	6	15	Zhu Q.H.	4
6	Chen H.	6	16	Amatulli C.	4
7	Li L.	6	17	Gilg A.	4
8	Zaman K.	5	18	Hao Y.	3
9	Liu Y.	5	19	Zhang L.X.	3
10	Zhao S.L.	4	20	Tsai S.B.	3

Fig. 4 The cooperative network of authors



times, ranking the second. Journal of Cleaner Production was cited for 625 times, ranking the third. Journal of Business Research was cited for 425 times, ranking the fourth. Journal of Consumer Research was cited for 376 times, ranking the fifth. These journals cover various fields of energy,

economics, management, and environmental study, further reflecting that green consumption is very interdisciplinary.

From the point of view of the centrality of relevant journals, Environment and Behavior, Annals of the Association of American Geographers, Environment and Planning A, and

Fig. 5 Co-citation analysis on related journals

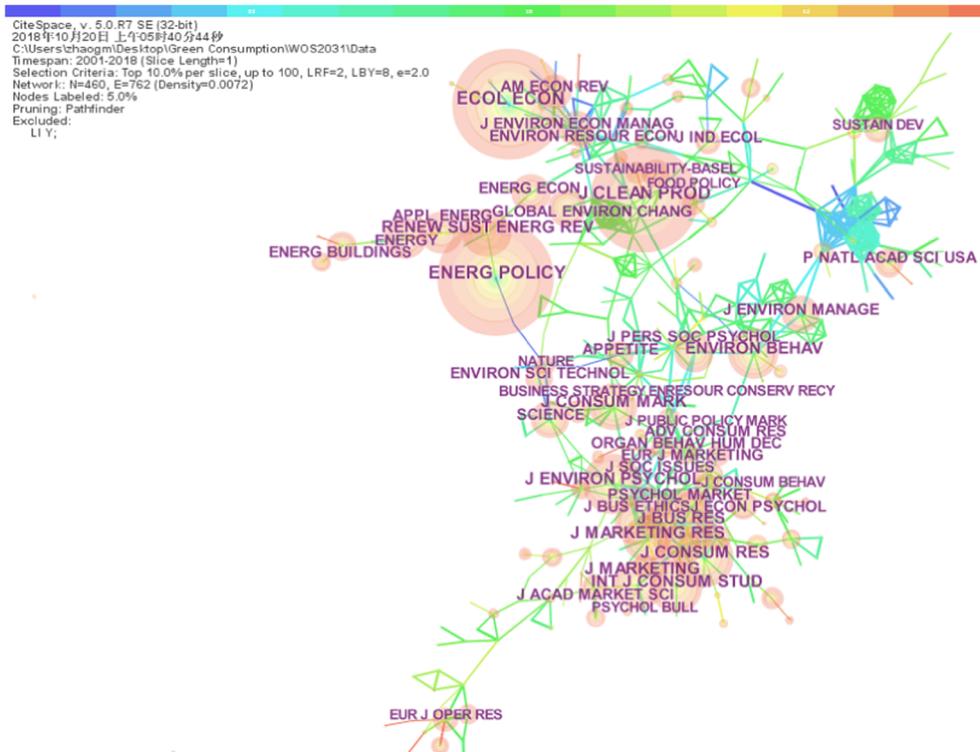


Table 6 The total citations of the top 20 academic journals

Rank	Source of journal	Frequency	Rank	Source of journal	Frequency
1	Energy Policy	700	11	Journal of Marketing Research	297
2	Ecological Economics	661	12	Renewable and Sustainable Energy Reviews	297
3	Journal of Cleaner Production	625	13	Journal of Business Ethics	285
4	Journal of Business Research	425	14	Psychology and Marketing	283
5	Journal of Consumer Research	376	15	Applied Energy	262
6	Journal of Environmental Psychology	371	16	Energy	257
7	Environment and Behavior	321	17	Journal of Personality and Social Psychology	256
8	Journal of Marketing	320	18	Energy Economics	252
9	International Journal of Consumer Studies	320	19	Science	250
10	Journal of Consumer Marketing	305	20	Global Environmental Change	246

American Economic Review are highly centered, indicating that these journals are in the research frontier of green consumption. In particular, Journal of Environment and Behavior ranks the first with the highest centrality of 0.24. The centrality of Annals of the Association of American Geographers is 0.17, ranking the second. The centrality of Environment and Planning A is 0.16, ranking the third. From the total citations point of view, Energy Policy received the most citations, much higher than other journals. Table 7 lists the cooperative centralities of the top 20 academic journals in this research field.

The analysis on co-cited articles

The highly cited articles normally reflect the key research progress of one research field. Figure 6 illustrates a

distribution map for the highly cited articles and authors in the field of green consumption research. There are 565 nodes and 1564 connections. Articles written by Griskevicius et al. (2010), Young et al. (2009), and Lin P.C. (2012) were highly cited in different periods, indicating that these authors made great contribution to this emerging research field.

Table 8 lists the top 10 most cited articles on green consumption research, including the published journals, citations, and key authors. Most of these highly cited articles present the key concepts, theories, methods, and key practices, as well as comprehensive reviews on green consumption. These articles built up a solid foundation for this research field and should be further studied by researchers in this field.

Table 7 The cooperative centralities of the top 20 academic journals

Rank	Centrality	Source of journal	Rank	Source of journal	Centrality
1	0.24	Environment and Behavior	11	Journal of Cleaner Production	0.09
2	0.17	Annals of the Association of American Geographers	12	Journal of Consumer Marketing	0.09
3	0.16	Environment and Planning A	13	Science	0.09
4	0.14	American Economic Review	14	Journal of Economic Psychology	0.09
5	0.12	Journal of Business Research	15	Environmental Politics	0.09
6	0.12	Appetite	16	Journal of Rural Studies	0.09
7	0.11	Energy Policy	17	Journal of Consumer Research	0.08
8	0.11	Environmental Science and Technology	18	Journal of Environmental Psychology	0.08
9	0.11	Nature	19	Journal of Environmental Economics and Management	0.08
10	0.10	Journal of Environmental Management	20	American Psychologist	0.08

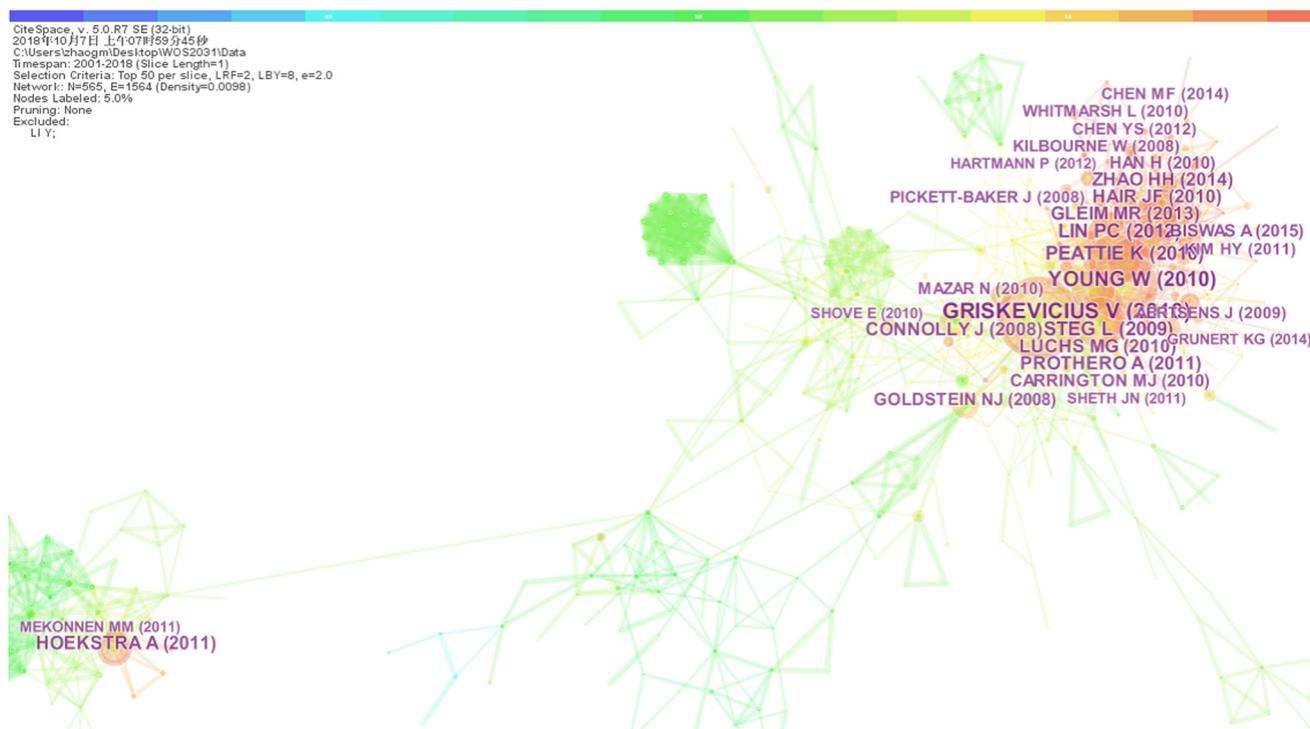


Fig. 6 The distribution map of co-cited articles

The analysis on keywords co-occurrence

The keywords are the refinement of the core ideas of one article. Keywords with more frequent occurrences can reflect the hotspots of one research field (Lin and Huang 2012; Gurtu et al. 2015; Paco et al. 2019). Based on the dual characteristics of the graph and spectrum, this paper uses the methods of keyword co-occurrence analysis, high-frequency word statistics, high-frequency word display, and cluster analysis to reveal the dynamic and complex network relationship of green consumption research. Figure 7 illustrates a knowledge map of keywords, in which 223 nodes and 846 links exist. The research hotspots of green consumption mainly focus on the behaviors of green consumption, the mode of green consumption, the attitude of green consumption, the impact of green consumption, sustainable consumption, consumers, green consumer goods, green consumption policies, and climate change.

Cowords analysis is mainly used to determine research topics and collaboration networks. This method is helpful to judge the semantic relations in scientific documents (He 1999; Bullinaria and Levy 2007; Lee and Su 2010). Based on the centrality and co-occurrence network of keywords, this study reveals the key themes and evolution path of green consumption research. It is found that the most common keywords include sustainability, behavior, and policy. These keywords have high centralities and reflect the hotspots of green consumption research. The results of keyword clustering show that the research topics of green consumption mainly focus

on three aspects: the impact of green consumption on the natural ecosystem, the relationship between green consumption and human beings, and energy management policies. Table 9 lists such clustering categories of co-words.

The analysis on burst-citation keywords

This study traces the hotspots of green consumption research, analyzes the evolution pathway of this field, and identifies key issues for future study. Figure 8 illustrates the distribution map of burst-citation keywords, in which 478 nodes and 1741 connected bursting words are presented. This figure shows that the research hotspot of green consumption is the optimization of 3E system, namely environment, economy, and energy. This symbiotic network also presents other keywords on green consumption.

Although many aspects in the field of green consumption have been investigated, other issues, such as the behavior mechanism of green consumption, the stakeholders' coordination on green consumption, and the impact assessment of green consumption policies. These issues can be further studied by using knowledge of big data and behavior observation so that insights on consumers' behaviors can be obtained. More interdisciplinary studies should be initiated so that knowledge from management, economics, pedagogy, psychology, sociology, ethics, and environmental science can be integrated. In addition, academics should work with policy-makers together so that policy recommendations from

Table 8 The cited frequency of the top 10 articles

Rank	Article	Source of journal	Author	Year	Frequency
1	Going green to be seen: status, reputation, and conspicuous conservation	Journal of Personality & Social Psychology	GRISKEVICIUS V.	2010	85
2	Sustainable consumption: green consumer behavior when purchasing products	Sustainable Development	YOUNG W.	2010	67
3	The influence factors on choice behavior regarding green products based on the theory of consumption values	Journal of Cleaner Production	LIN P. C.	2012	55
4	Green consumption: behavior and norms	Annual Review of Environment & Resources	PEATIE K.	2010	51
5	Encouraging pro-environmental behavior: an integrative review and research agenda	Journal of Environmental Psychology	STEG L.	2009	50
6	Against the green: a multi-method examination of the barriers to green consumption	Journal of Retailing	GLEIM M. R.	2013	44
7	Sustainability marketing research: past, present and future	Journal of Marketing Management	PROTHERO A.	2014	42
8	The sustainability liability: potential negative effects of ethicality on product preference	Journal of Marketing	LUCHS M. G.	2010	42
9	Water footprint assessment manual	Water Footprint ASSE	HOEKSTRA A.	2011	37
10	What affects green consumer behavior in China? A case study from Qingdao	Journal of Cleaner Production	ZHAO H. H.	2014	36

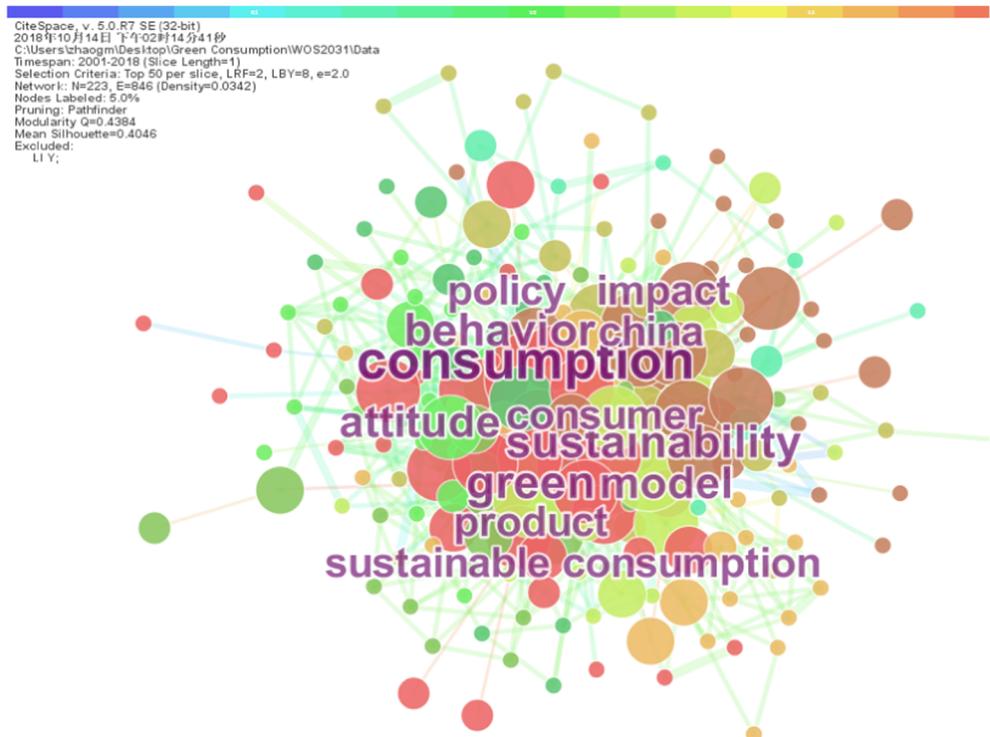
academia can be digested and accepted by those decision makers.

Conclusions

In order to respond increasing resource depletion and environmental crisis, it is critical to promote green consumption so

that sustainable industrial development can be achieved and the overall resource efficiency can be improved. This study conducts a systematic review on green consumption by applying meta-analysis, bibliometric analysis, and social network analysis. The Web of Science database was selected for articles searching. In total, 2031 articles were collected for this bibliometric analysis. It is found that studies on green consumption have increased during the last two decades. The

Fig. 7 The distribution map of co-occurrence keywords



helps them to identify key research hotspots and further research directions. Finally, the results of this study suggest that future green consumption research will focus on behaviors mechanism, stakeholders' coordination, and policy evaluation of green consumption. In particular, interdisciplinary methods are encouraged to further apply in this field so that more innovative findings can be achieved. This study reviews all the relevant literatures on green consumption. However, the study period was set as from 2001 to 2018 due to time limitations. It will be necessary to expand the research period so that more relevant studies can be found. Also, this study focuses on the cooperation networks of countries, institutions and authors, as well as the key features of green consumption studies, the major targets of meta-analysis, bibliometric analysis, and social network analysis. Consequently, the interdisciplinary problems of green consumption are not further investigated, but green consumption has involved in many disciplines, including social science, behavioral science, policy, consumer law and protection, human rights, and natural science. Therefore, it is critical to study such cross-disciplinary issues in the future.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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