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The evolution of Resources Conservation and Recycling over the past 30 years: A bibliometric overview

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ABSTRACT

The aim of this study is to investigate the publication characteristics and development of Resources Conservation and Recycling (RCR) during its past 30 years. Through bibliometric analysis, this paper identified the most prolific authors/institutions/countries and the most cited articles, and tracked the dynamic evolution of hot topics. Besides, VOS viewer software was applied to visualize the collaboration network, journal co-citation network, and keywords co-occurrence network. The study revealed a positive trend in literature production of RCR. The most productive institution, is University of Utrecht in Netherlands, in terms of both total publication and total citations. Keywords frequency and keywords co-occurrence network analysis showed that the most prolific themes are corresponded to the basic aims and scope of the journal. The mainstream research in RCR focuses on recycling, waste management, sustainability, and environmental impact. Life cycle assessment, material flow analysis, and substance flow analysis are popular methods in recent years. Moreover, the emerging hot topics may attract great interest in future, including “food waste”, “carbon footprint”, “resource efficiency”, “circular economy”, “waste of electric and electronic”, “packaging waste”, and “China”. Knowing the objective bibliometric characteristics and the research topic evolution can serve as a useful reference for future studies, which may be of interest to the general audience.

1. Introduction

The Resources, Conservation and Recycling is a monthly, leading international peer-reviewed scientific journal in the field of environmental sciences and engineering environmental. As the result of the merger of two journals, Resources and Conservation (founded in 1975) and Conservation & Recycling (found in 1976), RCR was born as a brand-new international publication in 1988, and is published by Elsevier and included in the Journal Citation Reports of the Web of Science Core Collection, which only indexes those journals that are recognized with the highest quality. The current Editor-in-Chief is Associate Professor Ming Xu from the University of Michigan. Seven professors and scholars from the USA, Denmark, Brazil, France, and China are serving as associate editors. Consistent with its mission, RCR has published a great number of researches on sustainable management and conservation of resources. To celebrate its 30th anniversary, it is desired to evaluate the performance of RCR, explore the evolution trend of its hot topics, and provide guidance references for relative researchers through a scientific and visual way.

Bibliometric is widely recognized as a well-established research method in the information science particularly for evaluating the research performance of academics and universities. It adopts quantitative analysis and statistical methods to analyze the bibliometric characteristics of a given field, evaluate the performance of authors/institutions/countries, discover the hot topics, and reveal the research tendency in future. Many studies have considered specific topics under a bibliometric framework, such as low carbon development (Wang et al., 2017), waste management (Chen et al., 2015), transportation (Najmi et al., 2017), and ecological environment (Zhi and Ji, 2012). There are also several bibliometric studies analyzing only one journal to provide a broad picture of the leading trends in that journal. For example, Chan et al. (2009) provided the retrospective evaluation of European Financial Management from 1995 to 2008. Cobo et al. (2015) analyzed the first 25 years of the Journal of Knowledge-Based Systems. Zeleznik et al. (2017) studied the evolution of the Journal of Advanced Nursing over 40 years. Laengle et al. (2017) analyzed the first 40 years of the European Journal of Operational Research. Calma and Davies (2017) studied the Journal of Higher Education from 1972 to 2014. Through such bibliometric perspective, readers can gain a quick overview on the types and themes of publications, the most productive

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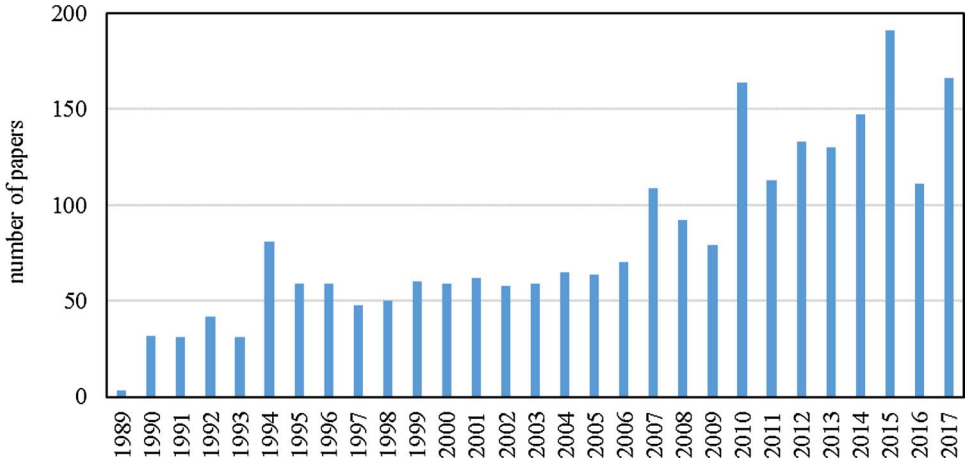

Fig. 1. Annual number of articles published in RCR.

Table 1
The most productive countries/areas in RCR (Top 20).

Rank	Country/Area	TP	TC	TC/TP	h-index	≥100	≥50
1	USA	401	6059	15.11	34	5	18
2	China	274	4017	14.66	34	3	18
3	UK	261	6239	23.90	42	7	30
4	Sweden	129	2952	22.88	32	2	17
5	Netherlands	119	2009	16.88	27	2	6
6	Spain	116	2346	20.22	29	1	9
7	Italy	101	1652	16.36	24	0	5
8	Japan	93	1357	14.59	20	1	5
9	India	90	2147	23.86	25	3	11
10	Australia	80	1821	22.76	24	2	9
11	Canada	73	1368	18.74	18	3	7
12	Brazil	72	936	13	17	0	0
13	Germany	71	1197	16.86	21	0	5
14	France	70	1219	17.41	18	0	7
15	Taiwan	69	1508	21.86	21	2	5
16	Denmark	53	1158	21.85	18	2	6
17	Turkey	51	933	18.29	19	0	4
18	Belgium	51	817	16.02	17	1	3
19	Austria	46	971	21.11	15	1	2
20	Greece	44	777	17.66	17	0	2

TP: total publications; TC: total citations; TC/TP: the citations per publication; ≥: the number of publications whose citations larger than the threshold (50 or 100). Articles originating from Taiwan region were not included under China heading for analysis; Articles originating from England, Scotland, Ireland, and Wales were grouped under the UK heading.

authors/affiliations/areas, and even the trend of hot topics. Such analysis and information present an added value for the journal. To the best of our knowledge, bibliometric analysis has not yet been applied to analyze the development and evolution of RCR.

Therefore, an expansion of the previous studies, the main purpose of this study is to provide a general overview of RCR journal over the past 30 years through bibliometric analysis in honor of its 30th anniversary. Based on various statistic indicators and bibliometric mapping, this study tries to 1) identify the key contributing countries/institutions/authors; 2) discover the collaboration relationship in RCR; 3) reveal how RCR links to other journals; 4) identify the research focuses and hotspot evolution in RCR.

This paper is structured as follows: Section 2 briefly describes the bibliometric methods and data sources used in the analysis. Section 3 presents the major bibliometric characteristics of RCR journal. Section 4 maps collaboration relationship, journal co-citation analysis, and keywords co-occurrence by using the VOS viewer software. Section 5 summarizes the main findings and conclusions of the paper.

2. Data and methodology

Bibliometric analysis is a popular tool to quantitatively analyze literatures published in a specific area (Zhi and Ji, 2012). Using a wide range of indicators and methods, it can discover the distributed architecture characteristics and patterns of the underlying science and technology, but also can assess the development trends or future research (Li et al., 2009; Zhang et al., 2017). For example, the number of publications indicates the productivity of an author, and the number of citations correlates with authors' influence in the scientific field. The h-index proposed by Hirsch (2010) also can be used to assess the total effective output of a researcher with strengths of simplicity and immediate intuitive meaning. The number of authors above a citation threshold permits to identify the authors with a certain level of influence. Keywords analysis can be used to monitor and identify the development of science (Garfield, 1990). Through these bibliometric indicators, a general informative overview of the bibliographic material can be presented.

Network analysis based on graph theory can be adopted to map the relationships between various nodes and detective the network structure. In bibliometric mapping, the nodes in the network can be authors, institutions, countries, literatures, references, journals, and even keywords related to a specific research field. The links can represent the collaboration, co-occurrence, citation, and co-citation relationships between them. Characteristic analysis and cluster analysis of network can help to discover the underlying structure of complex network, which is crucial to reveal the research hotpots and identify the communities/groups/modules (Du et al., 2013; Wang et al., 2016). Besides, in order to show the complex network more intuitively and directly, VOS Viewer (Van Eck and Waltman, 2010), a popular and free software, is used to present a graphical visualization of the bibliometric material published in RCR.

In spite of other internationally known databases (e.g., Scopus, Google Scholar, and Econ Lit), the Web of Science (WoS) database, currently owned by Thomson & Reuters, is usually recognized with the highest quality and extensively used for scientific research retrieval (Merigó et al., 2016). This study focuses on RCR publications from 1988 to 2017 using the WoS database. "Resources Conservation and Recycling" were used as the publication name to search for all years. The research resulted in a total of 2594 documents published in RCR until August 2017, consisted of 8 document types, i.e. articles (2368), reviews (161), proceedings papers (158), editorial materials (37), notes (14), corrections (11), reprints (2) and item about an individual (1). Only articles, 91.29% of the total documents, were analyzed in the following study. Downloaded document information for analysis included author(s), title, source (journal title), language, document type, author keywords, addresses, cited reference count, times cited,