

SUSTAINABILITY, GREEN MARKETING & SOLID WASTE MANAGEMENT: A BIBLIOMETRIC ANALYSIS

Surjit Kumar Kar, ICFAI Business School, Hyderabad
Saroj Kanta Biswal, Siksha O Anusandhan University, Bhubaneswar
Konda Jayasimha Reddy, ICFAI Business School, Hyderabad
Manish Verma, ICFAI Business School, Hyderabad

ABSTRACT

This report analyses a mapping of research output on green marketing, sustainable marketing, and solid waste management using bibliometric data (SWM). The PubMed database has been used to find every publication pertinent to SWM research. Numerous significant bibliometric tools, including Biblioshiny, ScientoPy, and VOSviewer, were utilised to visualise bibliometric networks and perform bibliometric analysis for co-citation, linking, scientific collaboration analysis, co-word analysis, and other purposes. The study's main findings were that 87 sources contributed to 461 research publications that were published between 2017 and 2021. The findings indicate that although the average number of citations for articles on solid waste management has not increased, they have gradually grown. A maximum of 93 publications are produced by the extremely influential journal "Waste management," which has a significant impact. The second-ranked category, "Waste management & research," has 76 publications. There are 1799 writers, and Ferronato N. and Torretta V. are rated first and second, respectively, with 11 publications apiece. Kumar S. is third with 9 publications. Sustainability, green marketing, Solid waste management, municipal solid waste, waste management, garbage disposal, people, and recycling are the most used keywords.

Keywords: Sustainability, Green Marketing, Solid waste, Bibliometric analysis, PubMed.

INTRODUCTION

Solid waste is nothing more than undesired products/produced or unwanted solid materials that are not in a liquid or gaseous condition and were created by human activity in our environment, whether it be residential, commercial, or industrial. It can be broadly divided into two categories: based on their physical characteristics and place of origin (household, commercial, industrial, institutional, municipal, agricultural, etc); (garbage, ashes, combustible and non-combustible, demolition and construction and hazardous etc). Positive effects on the environment and human health are eliminated by solid waste management. To manage the manufactured items for both public health and the environment, solid wastes are required. Additionally, *"solid waste management is a crucial component of environmental sustainability. One of the most significant challenges confronted in projects, whether recently completed or anticipated in the near future, is social acceptance. Other essential issues include economic efficiency, organisational issues, and air, soil, and water contamination (Tolis et al. 2010).*

Organizational matters, water, soil and air pollution are among the most important issues confronted in projects, either already realized or planned in the near future" (Tolis et

al. 2010).

The term "*bibliometrics*" refers to a group of methodologies used to quantitatively and qualitatively evaluate the scholarly value of works published by particular researchers, institutions, journals, or nations using statistical techniques. Information managers can analyse the rate of publication growth, productive authors, impact factor, citations, H-index, and future needs in a specific discipline with the help of these bibliometric tools. This study aids in developing a clear goal for carrying out thorough research to identify the most recent global trends and hotspots in solid waste research. It also gives a general notion of the publications, organisations, and nations that have a significant influence on a given field of study.

Every year, the world produces 2.01 billion tonnes of solid garbage, with at least 33%—a very conservative estimate—not being handled in a way that protects the environment. The amount of garbage produced every day per person in the world varies greatly, from 0.11 to 4.54 kilos, but averages out at 0.74 kilogrammes. High-income nations produce around 34%, or 683 million tonnes, of the world's waste, although having just 16% of the world's population.

Sustainability, Green Marketing & Solid Waste

In recent times, there has been an upsurge in debates and deliberations over the changing and emerging facets of a 'Post-pandemic world' in academic research and in managerial practices. New terms are being conceptualized, popularized and are getting established in public discussions and domains, e.g. new normal. No one can answer with certainty as to whether the new normal would be free from all possibilities of another pandemic. However, in the parlance of industry practice and academic research we have been accustomed to many concepts and practices e.g. e-Waste Management, Green Marketing, Sustainability, Sustainable Marketing, Design Thinking, Sustainable Design Thinking, The UN's 17 Sustainable Development Goals (SDGs), Corporate Citizenship, CSR, Triple Bottom-line, E-O-L Management, Circular Economy, Ethical Marketing, Environmentalism, E-S-G Reporting, Global Reporting Initiatives and many more. The Covid-19 pandemic was indiscriminate in its clamor irrespective of species, region, gender, age or any other demographic attribute. Can the human race consciously raise a consensus towards a self-regulated code of conduct? This article although does not address this question, it tries to find academic rigor in researches in this domain. Similarly, the growing problem of Waste Management (WM) and especially Solid Waste Management (SWM) in almost every area in India and the rest of the world whether urban, semi-urban or rural has become a major challenge for the administration and governance systems. The Swachh Bharat Abhiyan (Clean India Mission) (See: <https://swachhbharat.mygov.in/>) started by The Government of India in 2014 is very promising and active in raising public awareness and acceptance of clean and hygiene practices and its version 2.0 is underway now. Citizens are aware about the importance of keeping their place of habitation and nearby areas clean and healthy. However, daily waste being created in every household is also a reality. This has given rise to mounting of unsorted wastes in the land filling areas of the cities/ towns. Such practices which are currently being followed are sub-optimal and less sustainable by nature. Reduction, removal, reuse, and recycling of the wastes can be made more sustainable and green. The study is all about the review of literature available on emergence and growth of Solid/ Waste Management (SWM) systems under the purview of green and sustainable practices in different parts of the world and in India.

Objectives

The main objectives of the study are to analyse the following bibliometric characteristics of the solid waste research in the world (2017-2021)

- To examine year-wise literature growth on solid waste research in the world
- To identify the most prolific authors
- To examine the authorship pattern of the contributions
- To identify the most productive organisation
- To find out the high-frequency author keywords
- To find out most relevant resources
- To examine the collaboration between countries

LITERATURE REVIEW

Adesina & Opesade (2018) examined research papers in Nigeria on sickle cell anaemia that were indexed in PubMed from 2006 to 2016. Between the years of 2006 and 2010, 326 publications in total were selected for examination, and the rate of literature growth has grown. But between 2011 and 2015, the number of scientific articles on sickle cell disease fell. It suggests that in recent years, research in this particular area has gradually decreased in Nigeria. The University of Nigeria Teaching Hospital had made the most publications overall. The majority of the authors were from Nigeria, and the level of collaboration ranges from 0.85 to 1.00.

Mesdaghinia, et al. (2015) assessed the solid waste-related papers published in Iran between 1982 and 2013 that were Scopus-indexed. Between 1982 and 2011, the growth rate increased by 45.3 % year by the exponential trend ($R^2 = 0.98$). Most publications have been published in the Journal of Environmental Studies. The main Iranian universities have been found to collaborate the most, and other institutions have contributed fewer publications that are relevant to solid waste.

Science Citation Index (SCI) literature from the years 1992 to 2016 was analysed by Li, Han, and Lu (2018) to track research trends on solid waste recycling and reuse. The findings show that research outputs are expanding quickly and with significant international collaboration. Additionally, from 2002 to 2007, two new, pressing challenges included the manufacturing of biodiesel from used cooking oil and the recycling of electronic waste.

In a study published in 2011 by Ma, Ho, & Fu, researchers looked at solid waste-related publications in the Science Citation Index Expanded (SCIE) database during the years 1991 to 2010. The G7 nations were extremely important to the publication. The authors discover through the keyword analysis that landfill, waste-to-energy, recycling, and composting have been the most popular waste management solutions. Hot zones include sewage adsorption, heavy metals, and anaerobic digestion.

Fu et al. (2010) performed a bibliometric analysis on 6680 papers with a solid waste theme that were listed in the Science Citation Index of the Web of Science database between 1993 and 2008. To give research emphasis, this analysis primarily focused on the frequency of title terms, "Keywords Plus," and author keywords.

A bibliometric analysis of all biological invasions was carried out by Qiu & Chen (2009) using information from the SCI Web of Science Database between 1991 and 2007. 7261 authors from 521 publications in the 100 studied nations published a total of 3323 documents. Based on the CPP study, the number of citations per publication (CPP) was used as an indication for assessing the information and cooperation among the biological invasions-related research literature in Japan and China, which was less successful than that of Latin America and South Africa.

Maharana (2014) examined publications on malaria research by Indian researchers from 2003 to 2012 that were included in the Web of Science (WoS) bibliographic database. As the primary source of data, this study uses 2020 research documents with a 48-hour index and the

greatest percentage of researchers' preferred articles (81.43 %). Tropical medicine and parasitology were the two main research fields, while "Malaria Journal" was the most fruitful journal overall with 97 pieces. In India, the CSIR has traditionally been the primary funding source for research grants. During this time, there has been a steady increase in malaria research in India Zyoud, (2015).

Alagu & Thanuskodi (2019) used the Hiscite programme to analyse publications on digital literacy that were listed in the Web of Science (WoS) bibliographic database between 1992 and 2011. Out of a total of 512 publications, 2011 had the highest number (126) of research publications published. According to this analysis, the USA is the most productive nation in terms of research papers, followed by the UK and Australia Sweileh, (2018).

METHODOLOGY

The information utilised in this study was obtained from PubMed on August 23, 2022. After the biblioshiny syntax has been run in R Studios, the R Studios open the Bibliometrix website and link us to Google. Utilizing information from that website, the term "solid waste management" has been used as a keyword and "2018-2022" has been chosen as the study period. 552 documents in total have been downloaded and used by Bibliometrix to conduct data analysis Subramanyam, (1983).

Data Analysis and Interpretation

Sl. No	Year	No.of Publications	Percentage	Cumulative	Percentage
1.	2017	40	8.68	40	8.68
2.	2018	68	14.75	108	23.43
3	2019	106	22.99	214	46.42
4	2020	145	31.45	359	77.87
5.	2021	102	22.13	461	100
	Total	461	100		

Table 1 above displays the global distribution of publications on "solid waste management" research by year Shahriyari, et al. (2018). Over the course of the five-year study period, authors from all over the world produced a total of 461 papers. On this subject, 92 papers are typically published per year. According to the study, 40 articles were published on average with an 8.68% average in 2017 and 102 papers with an average of 22.13% in 2021. This data makes it evident that the rate of publishing growth has steadily increased by more than three times over the past five years. The years with the most and least contributions were respectively 2020 (145 papers, 31.45%) and 2017 (40 papers, 8.68%). Additionally, each year's percentage and the total number of publications have been provided. The amount of literature on "solid waste management" has grown significantly over time Mohanathan & Rajendran (2018).

Year	No. of Publications	Growth Rate	Average Growth Rate Percentage
2017	40	0	0
2018	68	28	70.0
2019	106	38	55.88
2020	145	39	36.79

2021	102	-43	-29.65
Total	461	62	Average = 40.54

Annual growth of Publication

Table 2 displays the total number of papers published between 2017 and 2021 to provide an overview of the expansion of the literature Ji, et al. (2018). There were 461 research publications published in total, with a growth rate (total growth rate/number of years) average of 40.54%. This table also reveals that the growth rate for 2021 will be negative. The year 2019 achieved the highest growth rate for publications, followed by the year 2020 with a growth rate of 36.79%. The following formula is used to determine the year-over-year growth rate Gonçalves, et al. (2018).

$$r = \frac{P1-P0}{P0} \times 100$$

Where, r = Publication growth in Percentage
 P0 = Number of publications in the base/previous year
 P1 = Number of publications in the present year

Sl.No	Authors	No.of Publications	Percentage of Publications
1.	Ferronato N	11	1.1
2.	Torretta V	11	1.1
3.	Kumar S	9	9.0
4.	Wang Y	7	7.0
5.	Gorritty portillo MA	6	6.0
6.	Kumar R	6	6.0
7.	Barlaz MA	4	4.0
8.	Farzadkia M	4	4.0
9.	Fujiwara T	4	4.0
10.	Guisbert lizarazu EG	4	4.0

Out of a total of 1799 writers, Table 3 lists the top ten most productive authors based on the number of research articles they produced throughout the research period of 2017–2021. Ferronato N. and Torretta V., who have published 11 works, are the most productive writers, followed by Kumar (9 papers).

Sl.No	Most Relevant Words	No.of Frequency of the words
1	solid waste management	87
2	municipal solid waste	67
3	waste management	45
4	municipal solid waste managemen	41
5	circular economy	26
6	developing countries	24
7	solid waste	23
8	recycling	22

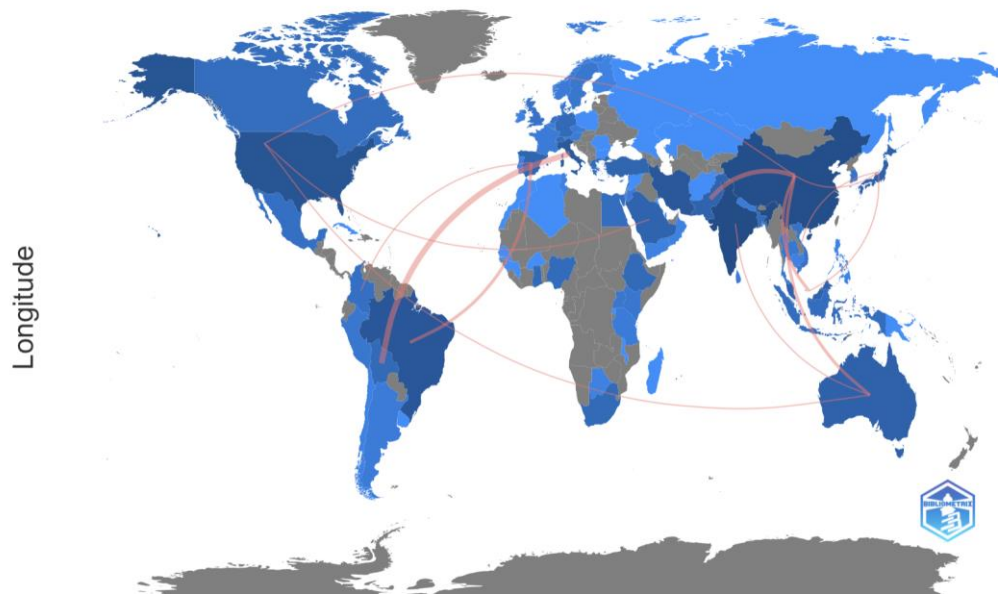


FIGURE 3
COLLABORATION WORLD MAP

As shown in Figure 3, several countries have published articles on Solid Waste Management. However, most of the published articles were concentrated in a few countries. As expected, English-speaking countries (such as the USA, UK and Australia) were the most represented. There was also a substantial presence of Asian countries like India, Pakistan, and China. This may be because the developed countries produce most of the solid waste around the world.

CONCLUSION

This report provides a basic summary of the research on solid waste management that has been published worldwide between 2017 and 2021. During the study period, information on 461 publications was gathered from the PubMed bibliographic database. The study notes that 40 papers were published with an average of 8.6% in 2017 and 102 papers were published with an average of 22.13% in 2021, indicating that the growth rate of publication pattern has gradually increased more than three times in the last five years span of time. It was also noted that an average of 92 papers were published on this topic annually. In the field of solid waste management study, the highest level of collaboration (0.97) demonstrates the authors' shared information and coordinated research efforts. The Waste Management (New York, N.Y.), which has published the most publications, also recognised the keywords "solid waste management," "waste management," "municipal solid waste," and "municipal solid waste management," which frequently appeared in solid waste management study worldwide. The importance of the expanding body of literature on solid waste management studies around the globe reveals human attitudes about recycling and reusing solid waste to save the environment.

ACKNOWLEDGEMENT

"Note: This research article is a working paper series from the project funded by The Research Committee, IFHE- A Deemed to be University u/s 3 of The UGC Act, 1956 (NAAC A++), Donthanapally, Shankarpally Road, Hyderabad - 501 203, Telangana, India."

REFERENCES

- Adesina, O.A., & Opesade, A.O. (2018). Bibliometric Analysis of Sickle Cell Anaemia Literature on Nigeria Listed in Pubmed between 2006 and 2016. *Library Philosophy and Practice*, 1.
- Alagu, A., & Thanuskodi, S. (2019). Bibliometric analysis of digital literacy research output: A global perspective. *Library Philosophy and Practice*, 1-19.
- Fu, H.Z., Ho, Y.S., Sui, Y.M., & Li, Z.S. (2010). A bibliometric analysis of solid waste research during the period 1993–2008. *Waste Management*, 30(12), 2410-2417.
- Gonçalves, A.T.T., Moraes, F.T.F., Marques, G.L., Lima, J.P., & Lima, R.D.S. (2018). Urban solid waste challenges in the BRICS countries: a systematic literature review. *Revista Ambiente & Água*, 13.
- Ji, L., Liu, C., Huang, L., & Huang, G. (2018). The evolution of Resources Conservation and Recycling over the past 30 years: A bibliometric overview. *Resources, Conservation and Recycling*, 134, 34-43.
- Maharana, R. (2014). Malaria research in India during 2003-2012: A bibliometric analysis. *Collection Building*, 33(2), 53-59.
- Mesdaghinia, A., Mahvi, A.H., Nasserli, S., Nodehi, R N., & Hadi, M. (2015). A bibliometric analysis on the solid waste-related research from 1982 to 2013 in Iran. *International Journal of Recycling of Organic Waste in Agriculture*, 4, 185-195.
- Mohanathan, P., & Rajendran, N. (2018). Research output of greenhouse effect in India: a scientometric Analysis. *Library Philosophy and Practice*, 1.
- Qiu, H., & Chen, Y.F. (2009). Bibliometric analysis of biological invasions research during the period of 1991 to 2007. *Scientometrics*, 81(3), 601-610.
- Shahriyari, T., Tabatabaei Fard, S.F., Arefinejad, A., Afzale, A., Talebi, F., & Momeni, H. (2018). Quantity analysis of solid waste in the dentistry offices in birjand, 2017. *Journal of Birjand University of Medical Sciences*, 25(3), 255-262.
- Subramanyam, K. (1983). Bibliometric studies of research collaboration: A review. *Journal of information Science*, 6(1), 33-38.
- Sweileh, W.M. (2018). Global research output in the health of international Arab migrants (1988–2017). *BMC public health*, 18, 1-12.
- Tolis, A., Rentizelas, A., Aravossis, K., & Tatsiopoulou, I. (2010). Electricity and combined heat and power from municipal solid waste; theoretically optimal investment decision time and emissions trading implications. *Waste management & research*, 28(11), 985-995.
- Zyoud, S.E.H., Al-Jabi, S.W., Sweileh, W.M., Al-Khalil, S., Zyoud, S.H., Sawalha, A.F., & Awang, R. (2015). The Arab world's contribution to solid waste literature: a bibliometric analysis. *Journal of Occupational Medicine and Toxicology*, 10(1), 1-9.

Received: 04-Apr-2023, Manuscript No. AMSJ-23-13431; **Editor assigned:** 05-Apr-2023, PreQC No. AMSJ-23-13431(PQ); **Reviewed:** 18-Apr-2023, QC No. AMSJ-23-13431; **Revised:** 29-Apr-2023, Manuscript No. AMSJ-23-13431(R); **Published:** 02-May-2023