

Latin american production on solid waste management in Scopus, 2010 - 2020

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ABSTRACT

Solid waste management has become a critical problem in developing countries, therefore, with the aim of analyzing the Latin American scientific production on solid waste management in Scopus, a retrospective descriptive study was conducted considering as the unit of analysis the publications on solid waste management in journals indexed in Scopus, during the period 2010 to 2020. The search included all published and indexed articles, using the fields Article Title, Abstracts, Keywords, having as search term the word "Solid waste management". As result, 494 articles were found, of which 420 are original, 58 are reviews, and the rest are letters, editorials, conference papers, and notes. Brazil stands out as the largest producer of solid waste management knowledge (62.5% of Latin American production), followed by Mexico, Colombia, Chile, and Argentina. On the other hand, 158 international institutions have participated in the Latin American production and only 10 have produced more than 10 articles, with universities in Brazil and Mexico standing out. Among the most productive journals, Waste Management and Waste Management And Research stand out; and the researchers with the most publications are Liséte Lange and Sandro Donnini Mancini. It is concluded that research on solid waste management in Latin America in the period 2010 - 2020 is still deficient compared to other areas of the environmental field. The Latin American countries with the highest production in this area are Brazil, with more than 50%, followed by Mexico, Colombia, Chile, and Argentina.

Keywords: Solid Waste, Solid Waste, Scientific Production, Latin America, Latin America, Scopus

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1. Introduction

Throughout history, human activity has been generating waste, precisely, the denomination that refers to what no longer serves and ceased to have utility. Therefore, solid waste is those materials resulting from daily activities that are discarded because they are no longer useful [1]. Solid waste management is a problem for large cities, especially in developing countries, where factors such as population growth, population concentration in urban areas, inefficient development of the industrial and/or business sector, changes in consumption patterns and improvements in living standards, among others, have increased the generation of solid waste [2]. Currently, all issues related to environmental impact are of social concern [3], therefore, solid waste management is considered a public problem [1], on which a large number of investigations seek to determine the factors that influence its management in developing countries [4]. As revealed by research in Mexico, where, regarding environmental pollution caused by solid waste, it is reported that in databases such as Redalyc, Scielo, Dialnet, EBSCO, and CONRICYT it is evident that this has been a problem that has been

increasing globally [2]. This reality differs in developed countries, where public health is no longer an objective of integrated waste management, but rather the concern is focused on the optimization of waste management practices with a view to resource conservation. Whereas in developing countries solid waste management is considered one of the three most recurrent problems for any municipal management [4]. Scientific literature reports research on the topic, especially initiatives reporting how municipal solid waste should be managed [5], frequent problems related to recycling and recovery [6], sustainability of smart waste management plans [7], the direction of research on waste recycling modeling [8], technologies for solid waste management [9], especially those applied in developing countries [10] and the odd case study with some encouraging results such as the one reported in Egypt [11]. It is also important a general and systematic description of the scientific literature related to solid waste; in this regard, the literature reports studies such as the one conducted by C. Rodrigues-Vaz, D. Oliveira-Inomata, and J. Cesar-Stiirmer who after doing bibliometric research in Higher Education institutions, resorted to databases such as Web of Science, Scopus and Science direct, finding that out of a total of 118 articles only 14 were related to the topic [12]. Another bibliometric study on the evolution and state of research in environmental accounting found that the terms most related to this topic are sustainability, sustainable development, environmental impact, and climate change [3]. Similarly, a study that aimed to identify global trends related to solid waste between 1997 to 2014, resorted to databases such as *Science Citation Index Expanded*, *Social Science Citation Index*, and *Conference Proceedings Citation Index*, realizing that research was increasing in topics such as energy fuels, chemical engineering and biotechnology applied to microbiology, noting also the predominance of Chinese institutions and industrialized countries that generate scientific knowledge do the subject [13]. Scientific activity in the world is linked to the search for solutions to improve municipal solid waste management [14]. This reality contrasts with what is happening in Latin America, where a few initiatives have attempted to systematize the available information that conducted a bibliometric study on scientific production in environmental education; however, it is still pending to analyze the scientific activity on solid waste management [15]. Since in this continent, there is evidence of a large percentage of generation and very few initiatives for proper management [16], this despite having regulations for the comprehensive management of solid waste [17-27]. Therefore, the objective of this research was to analyze the Latin American scientific production on solid waste management in Scopus, period 2010 - 2020.

2. Materials and methods

2.1. Design

A retrospective descriptive study.

2.2. Unit of analysis

The unit of analysis was considered to be the publications on solid waste management, in journals indexed in Scopus, during the period 2010 to 2020 and whose authorship mentions affiliations of Latin American institutions. Scopus includes more than 40804 journals of science, technology, social sciences, arts, humanities, and medicine, so it was decided to use this database due to a large number of journals included, and its rigorous selection process of journals, which allows collecting the most relevant studies on the subject.

2.3. Procedure

The search included all published and indexed articles, using the fields Article Title, Abstracts, Keywords, using in the search terms the words: "Solid waste management". With the extracted documents, a database was organized in Microsoft Excel that included the following data: name of the signing authors, the title of the publication, type of publication, affiliation institutions of the signing authors, journal of publication, and country of publication.

2.4. Data analysis

The data obtained were analyzed through the statistical software SPSS version 26.0, obtaining the frequency tables and with the support of the VOSviewer software, a network was elaborated with the main thematic axes associated with the keywords of the publications.

3. Results

A total of 494 articles published and indexed in Scopus were found, with authorship to affiliations of Latin American institutions. Six types of publishable documents were included in the analysis (**Table 1**).

Table 1. Types of documents in solid waste management publications

Type of document	N
Article	420
Review	58
Editorial	7
Conference paper	5
Letter	2
Note	2

Brazil is the Latin American country that contributes with the highest scientific production on solid waste, representing 62.55% of the Latin American production, followed by Mexico, Colombia, Chile, and Argentina, countries that have 15 or more publications. There are 03 Latin American countries (Paraguay, Jamaica, and Venezuela) that have at least 01 publications on the variables studied (see Table 2).

Table 2. Latin american countries with scientific production in the area of solid waste management

Country	N	%
Brazil	309	62.55
Mexico	67	13.56
Colombia	45	9.11
Chile	20	4.05
Argentina	15	3.04
Bolivia	9	1.82
Ecuador	8	1.62
Peru	7	1.42
Cuba	5	1.01
Honduras	2	0.40
Uruguay	2	0.40
Dominican Republic	2	0.40
Paraguay	1	0.20
Jamaica	1	0.20
Venezuela	1	0.20

In terms of productivity by institution, 158 international institutions have participated in the Latin American production on solid waste management; however, only 10 have produced more than ten articles. **Table 3** presents the results of the institutions with a frequency of publication of ten or more documents, among which the institutions of Brazil and Mexico stand out.

Table 3. Latin american institutions involved in solid waste management research

Institution	Country	Documents
University of Sao Paulo - USP	Brazil	61
Federal University of Rio de Janeiro	Brazil	33
UNESP-Universidade Estadual Paulista	Brazil	26
Federal University of Minas Gerais	Brazil	25
State University of Campinas	Brazil	18

Institution	Country	Documents
The Federal University of Rio Grande do Sul	Brazil	17
Federal Technological University of Parana	Brazil	13
Michoacán University of San Nicolás de Hidalgo	Mexico	13
Rio de Janeiro State University	Brazil	12
Autonomous University of Baja California	Mexico	10

Table 4 presents the list of the most productive journals, among which Waste Management and Waste Management and Research stand out (publications greater than 40 documents). These journals are located in quartile 1 and quartile 2 of the SJR respectively and are classified in the environmental science category. The scientific production is concentrated in journals in quartiles 1 and 2, which demonstrates not only the high visibility of the contributions but also their potential quality.

Table 4. Most productive journals in the field of solid waste management

Magazine	Documents	Country	Quartile	SJR	Categories
Waste Management	65	United Kingdom	Q1	Environmental Science	1.63
Waste Management And Research	44	United Kingdom	Q2	Environmental Science	0.65
Journal Of Cleaner Production	29	Netherlands	Q1	Business, Management, and Accounting; Engineering; Environmental Science	1.89
Resources Conservation And Recycling	26	Netherlands	Q1	Economics, Econometrics, and Finance; Environmental Science	2.22
Sanitary and Environmental Engineering	23	Brazil	Q3	Environmental Science	0.19
International Journal of Environmental Pollution	13	Mexico	Q4	Environmental Science	0.19
Journal Of Environmental Management	12	United States	Q1	Environmental Science	1.32
Spaces	10	Venezuela	Q3	Business, Management and Accounting; Decision Sciences	0.22
Sustainability Switzerland	9	Switzerland	Q2	Energy; Environmental Science	0.58
Journal Of Solid Waste Technology And Management	8	United States	Q4	Environmental Science	0.16

Table 5 shows the authors who to date have contributed the largest number of studies on solid waste management. Of the 138 authors of the 494 documents analysed, those who have contributed more than five documents to date include researchers such as Lange, Liséte and Mancini, Sandro, among others.

Table 5. Latin american authors with the highest production of documents on solid waste management

Authors	Institution	Country	Number of documents	h index
Lange, Liséte C.	Federal University of Minas Gerais	Brazil	7	16
Mancini, Sandro Donnini	UNESP-Universidade Estadual Paulista	Brazil	7	10
Battistelle, Rosane Aparecida Gomes	UNESP-Universidade Estadual Paulista	Brazil	5	12
Colvero, Diogo Appel	Brazilian National Council for Scientific and Technological Development	Brazil	5	3
Fehr, Manfred	Uberlândia Federal University	Brazil	5	9
Feitosa, Anny Kariny	University of Vale do Taquari - Univates	Brazil	5	1
Gorritty Portillo, Marcelo Antonio	Universidad Mayor de San Andres Bolivia	Bolivia	5	4
Guisbert Lizarazu, Edith Gabriela	Universidad Mayor de San Andres Bolivia	Bolivia	5	3
Ponce-Ortega, José María	Michoacán University of San Nicolás de Hidalgo,	Mexico	5	35
Santibañez-Aguilar, Ezequiel	José Tecnológico de Monterrey	Mexico	5	12

Figure 1 shows that the most frequent descriptor is solid waste management with 257 occurrences, followed by waste management and solid waste with 254 and 186 occurrences, respectively. In this case, the number of co-occurrences of two words indicates the number of publications in which both words appear in the list of keywords of the selected papers. The colors indicate clusters of keywords relatively related to each other according to the strength of association obtained by the VOSviewer program, in addition to the visual difference of clusters. Using the 89 descriptors out of a total of 5187 recorded in the 494 retrieved documents and the five clusters, the thematic focus of each grouping was analyzed. Cluster 1 (red) includes the words solid waste management and its relation to biodegradation and garbage disposal. The green cluster analyses the themes of municipal solid waste, its economic and environmental impact. The yellow cluster describes recycling logistics and environmental planning. Finally, the purple cluster indicates the relationship between waste pickers as conservation agents and the informality of their sector.

more than 5 papers, which is congruent with the law of scientific productivity where only six percent of the authors in a given field produce more articles [39]. Another important aspect is that researchers publish in Q1 and Q2 journals respectively, which shows their high visibility and quality, taking into account that the COVID-19 pandemic has generated a significant increase in publications from the area of environmental sciences [40]. It is also observed that co-authorship networks of universities or institutions have little collaboration between them [41] and that even for Brazilian universities there are numerous obstacles to incorporate the environmental dimension in the training of human resources [12]. It is therefore important that Latin American researchers from countries with emerging research increase the level of collaboration with academics from countries such as Brazil and Mexico and with universities such as the University of Sao Paulo and the Federal University of Rio de Janeiro that have experience in the field of solid waste management, but without losing opportunities for collaboration with countries such as the United States, the United Kingdom, and Italy, which are also countries with more resources to invest [42]. Both international and regional cooperation can stimulate insightful and innovative ideas while keeping abreast of the latest research published in influential journals that can explore the possibility of using solid waste as a renewable energy source and improve public acceptance in Latin American countries. Therefore, it is important to pinpoint the preferences of researchers which in the case of Brazil are related to recycling, sustainability, and life cycle assessment [43]. Among the most productive journals chosen by Latin American researchers is Waste Management. Likewise, [44] Reported the Waste Management journal as the most productive journal in the environmental area. Similar studies report that Waste Management journal was most frequently cited with an impact factor of 5.431, indicating that its papers are most read, discussed, and referenced [42, 45], similar data in the case of India and Arab countries [46, 47]. In studies in the field of engineering and environmental sciences, Waste Management published the most articles [30]. The clusters found are identified by the research activity by the institutes [38]. Clustering methods have a long tradition in bibliometrics as a tool for grouping bibliometric units based on similarity properties that measure the distance between them [48]. Cluster analysis (1), Red, shows words kind of coexistence namely: waste disposal, landfill, water pollutants, biofuel, leachate treatment, solid waste management, biodegradation, and garbage disposal. It is the largest cluster. Waste management is mainly considered in the context of sustainable development as one of the key services that every city government should provide [7, 49]. As well as waste management evaluation methods [50]. The blue cluster (2), shows the coexistence words: solid waste, sustainable development, environmental policies. This cluster represents problems related to sustainability and which are a line of research that occurs in the governance framework [4]. As well as interventions on issues related to urban solid waste and waste collectors [51]. The green cluster (3) shows the coexistence words: municipal solid waste, environmental impact, circular economy, waste incineration, greenhouse gases, developing countries. This is a group of problems related to the economic and environmental impact of municipal solid waste. These components were presented in different studies) [36, 37]. And in the case of Brazil, which has regulatory policies that can stimulate the circular economy that today is one of the most recurrent themes in the environment [52, 53]. The yellow cluster (4) shows the coexistence words: logistics, recycling, environmental planning, optimization, e-waste. Here we can find some relatively novel terms such as e-waste that have been causing a series of problems in the region and that can support a proposal for continuous monitoring and analysis to better manage this type of waste [54, 55]. This study has some limitations, although Scopus has a wide scope in relation to publications, however, it is limited in terms of inclusion of low impact sources and updating of the latest articles. On the other hand, the study did not include journals indexed by SCI of WoS so it is likely that some documents have been lost.

5. Conclusions

We conclude that, through this study, significant points have been obtained on the Latin American production of solid waste management throughout the period from 2010 to 2020. The number of articles on solid waste was 494 articles, most of these articles were published in 10 scientific journals in the Environmental Science categories of Scopus. The Latin American countries with the highest production are at the same time those with the highest production in science, being Brazil with more than 50% of production followed by Mexico, Colombia, Chile, and Argentina those who published a large number of articles. The journal Waste Management published the largest number of articles. Among the most representative topics are solid waste management and its relationship with biodegradation. Urban solid waste, recycling logistics, environmental planning, and the relationship of waste pickers as agents of conservation.

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