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# Bibliometric Science Indicators Applied to Environmental Impacts Research

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**Abstract**

The growth and development of research on environmental impacts in terms of publications such as the Web of Science sample are analyzed during the period 2007-2018 using HistCite to learn about a global ranking, citations, article impact, keywords and research trends in this area. The research trend increased during the years 2014 and 2017. The United States is the country with the highest number of publications. The Journal of Cleaner Production is the journal with the highest number of publications, along with Science of Total Environment and the Environmental impact assemble review.

**Keywords**: bibliometric, research results, environmental, impacts

## 1. Introduction

In recent years, the earth has become warmer in his surface due to increase in greenhouse gases (GHG) in his atmosphere [1]. One of the major aspects is that electric power system still relies heavily on fossil fuel that contributes a large proportion in greenhouse gas and air pollutant emissions and brings about a number

of adverse environmental problems [2]. Electric power sector is driven by thermal technology throughout the world, generating over one-third of the global energy related CO2 emissions [3], [4], [5]. Fossil fuels was the most important primary energy supply with 81% of the world; while combustion of fuels is the primary sources of GHG emissions [6]. The amount of carbon dioxide emission was increased from 19 billion tons in decade of 1980's to 35 billion tons in 2014, which would be expected to increase up to 64.2 billion in 2030 [7]. China as country with rapid growths in economy, population and urbanization has increases his demand in energy and electricity with annual growth rates between 9 and 11% in the early 2000's [8], [9]. Air pollution cause by energy-related activities becomes significant dangerous for people health [10], [11].

Material and energy recovery from waste is significantly growing its importance in the last decades aiming to reduce the primary resources exploitation and the excessive recourse to incineration and landfilling [12]. In the last decades there has been growing social awareness in respect of environmental issue correlated to the planet waste by inducing the proliferation of several proposal to the threat the waste in a sustainable way [13], [14]. Earlier research has yielded contradictory results as to the main drivers of environmentally significant behavior, because intent-oriented research has stressed the importance of motivational aspects, while impact-oriented research has drawn attention to people's socioeconomic status [15].

Soil systems have different functions including biomass production, building the physical environment for humans and harboring biodiversity. Moreover, soils are sources of raw material and they are store, filter and transform a broad range of substances, such as nutrients including carbon and water [16]. Soil quality is characterized by biological, chemical and physical properties, allowing an evaluation of soil quality with more frequency because governing parameters differ from site to site and depend on the management goal [17]. All of these aspects not allow to evaluate, quantify and compare the impacts of human actions on soil quality worldwide, and verify the stagnation or a decrease in productivity due to soil degradation, causing economic loss and affects food security [18], [19].

The main contribution of this article is to analyze the growth in research on the environmental impact that is occurring on the planet and the main factors that contribute to this process. This paper shows the qualitative results that can be extracted using bibliometric techniques [20] in the period 2007-2018, examining the characteristics of the publications in this area of investigation and the analysis of the contents of the total production.

## 2. Methodology

Documents related to the topic of environmental impacts have been collected using Web of Science (WoS). The search was conducted using keywords such as "environmental impacts", "environmental", "impacts, "environmental impact production". 6561 documents were collected including articles, lectures, reviews,

letters, and other publication formats. The data was exported to HistCite and then analyzed. Information such as countries, institutions, journals, citations per year were taken into account and subsequently analyzed.

## 3. Results and Discussion

### 3.1 Year-wise distribution of research output

Through this study, it was observed the progress of research on the subject as the years passed. Figure 1 shows a periodic increase in the number of publications.

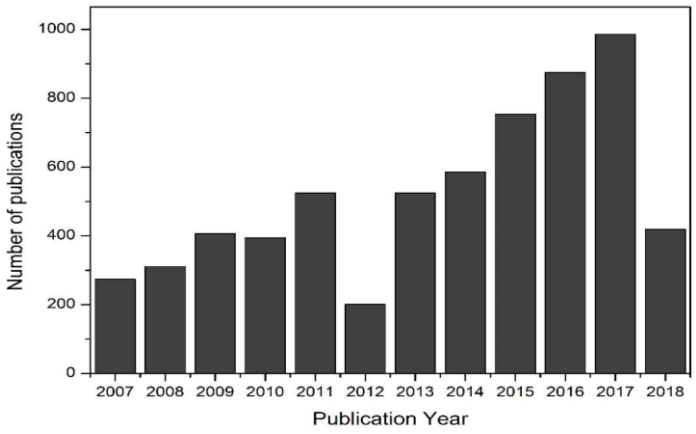


Figure 1. Results, a) annual diesel engine research product from 2007 to 2018, b) total publications by country from 2007 to 2018.

In 2010 and 2012, there was a decrease in research on the subject, and these were the only two years in which the growth trend was not maintained. Likewise, the two years of greatest percentage growth were 2011 and 2013, years following the years of negative percentage growth, showing how they sought to recover the lost ground in these two years. On the other hand, the year with the greatest number of publications was 2017 with 986 researches concerning the topic, expecting a greater number for 2018, whose results are expected until June 2018.

### 3.2 Distribution based on the institution of research results and citations

Similarly, the influence of institutions on environmental impact studies was analyzed throughout the 12 years reviewed. It was found that in the largest number of investigations was not possible to identify due to unknown information in the database as can be read in Figure 2. In additions, this figure also shows that in 2013, 2014, 2015 and 2016 they were the only ones in which the unknown number of institutions was not the highest in publications.

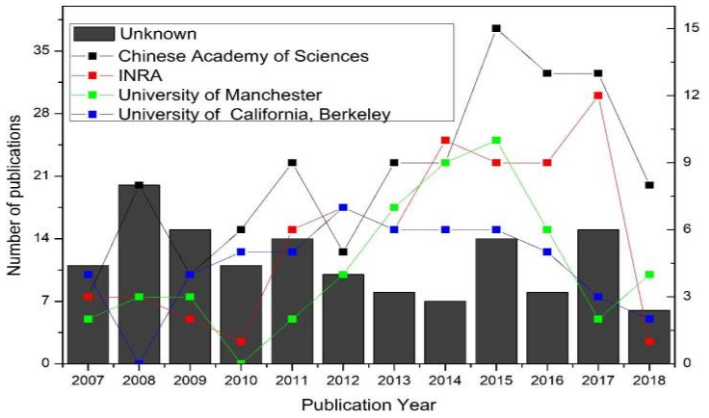


Figure 2. Total publications by institution from 2007 to 2018.

It is also noted that the institution with the greatest contribution is the Chinese Academy of Sciences, with 1.63% of the total published in the 12 years of studies showing its peak with 15 publications in 2015, surpassing in that year the number of investigations published by unknown institutions. Alongside this, only INRA and the University of Manchester achieved or exceeded 10 publications in a calendar year.

### 3.3 Distribution of central journals and quotations

As in the case of journals, the participation of the five most published journals in the years of study was analyzed. Figure 3 shows the trend towards an increase in the first three journals of the list.

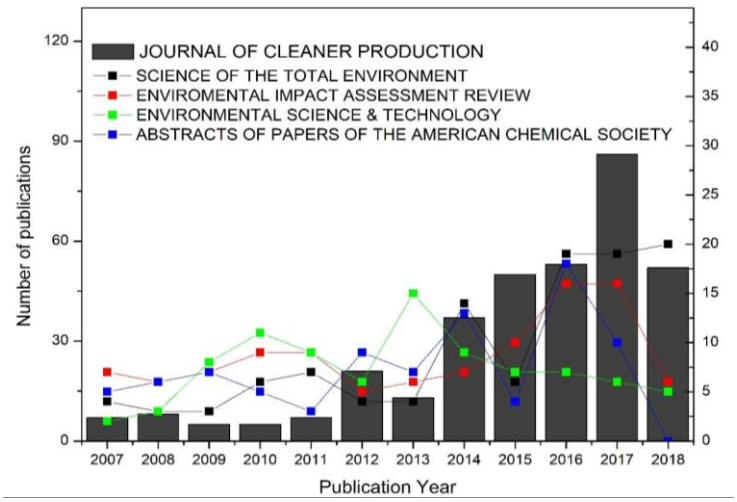


Figure 3. Total publications by journals from 2007 to 2018.

The CLEANER PRODUCTION journal shows the greatest growth, reaching 184.61% growth in the year 2014, from 13 publications to 37. This journal is also

the one that published the most research on this subject, contributing a total of 344 articles, with its highest peak in 2017 with 86 publications. These numbers triple SCIENCE OF TOTAL ENVIRONMENTAL production, that has reached its peak of production in the year 2018 still unfinished with 20 publications reaffirming its constant growth since 2016.

Table 1. Classification of top 10 journals of published papers, TLCS, TGCS, H index and Impact Factor.

| JOURNAL | RECORD | PERCENT | TLCS | TGCS | H index | IMPACT FACTOR |
|---|---|---|---|---|---|---|
| JOURNAL OF CLEANER PRODUCTION | 344 | 5,24 | 374 | 4462 | 132 | 6,207 |
| SCIENCE OF THE TOTAL ENVIRONMENT | 109 | 1,66 | 68 | 2206 | 190 | 5,102 |
| ENVIRONMENTAL IMPACT ASSESSMENT REVIEW | 105 | 1,60 | 227 | 1650 | 73 | 3,483 |
| ENVIRONMENTAL SCIENCE & TECHNOLOGY | 88 | 1,34 | 155 | 3949 | 319 | 6,198 |
| ABSTRACTS OF PAPERS OF JOURNAL OF THE AMERICAN CHEMICAL SOCIETY | 81 | 1,23 | 0 | 0 | 514 | 13,858 |

As it was observed in the previous figure, the JOURNAL OF CLEANER PRODUCTION leads the production in this subject, contributing 5.24% of all research, and with 4462 it is the one that presents the highest number of global citations and presents the impact factor of 6.207, the highest only surpassed by ABSTRACTS OF PAPERS OF JOURNAL OF THE AMERICAN CHEMICAL SOCIETY, which, by only publishing the abstracts, is highly consulted for this reason, reaches an impact factor of 13.858. For this same reason, it does not have global or local meetings.

### 3.4 High-impact authors

In the same way, the contribution made by the researchers was reviewed, the publications made by each of them were quantified and the results were shown in Figure 4. Here the publications that did not have a clear author were quantified and for data processing these documents were counted in a list in the name of anonymous. The total of these totaled 25 only matched by the author Azapagic A.

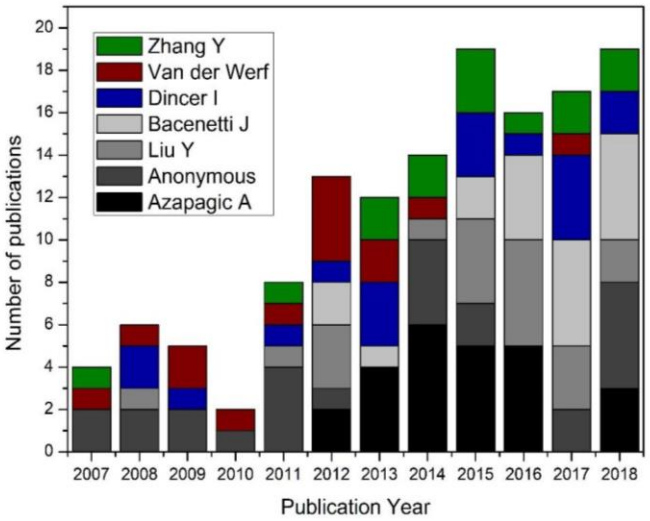


Figure 4. Number of publications by authors from 2007 to 2018.

For this author, the first few years he did not present research on the subject, only until 2012 did he publish 2 publications, after this year his activity was constant until 2017, when he did not publish on the subject. Likewise, in 2014 it presented 6 investigations, being this the highest point reached by any researcher and after that in the following two years it remained very close, publishing 5 more in each one. Another author who presented an interesting activity especially in the last 4 years was Bacenetti J in which he added 16 publications surpassing the rest of the authors in that time.

The acceptance and credibility of the publications of the above-mentioned authors can be assessed by the number of local citations (TLCS) and the global total of citations (TGCS). These values show the extent to which the research of these authors has been taken into account. This value can be seen in Table 2 for each of the 6 authors with the greatest number of publications. It can be observed that the author Azapagic A is not only the most published but also the most widely quoted, followed by Van der Werf with 546.

Table 2. Top 7 authors with most publications

| AUTHORS | RECORDS | PRECENT | TLCS | TGCS |
|---|---|---|---|---|
| Azapagic A | 25 | 0,38 | 30 | 582 |
| Anonymous | 25 | 0,38 | 0 | 0 |
| Liu Y | 20 | 0,30 | 9 | 226 |
| Bacenetti J | 19 | 0,28 | 33 | 227 |
| Dincer I | 28 | 0,42 | 13 | 448 |
| Van der Werf | 14 | 0,21 | 44 | 546 |
| Zhang Y | 14 | 0,21 | 4 | 52 |

On the other hand, the contribution of each country was studied by measuring the articles published each year. Figure 5 shows the top 10 nations with the highest number of publications on environmental impact, this can give us a view of the interest of these countries in the issue and that have devoted so much of their resources to tackle this problem.

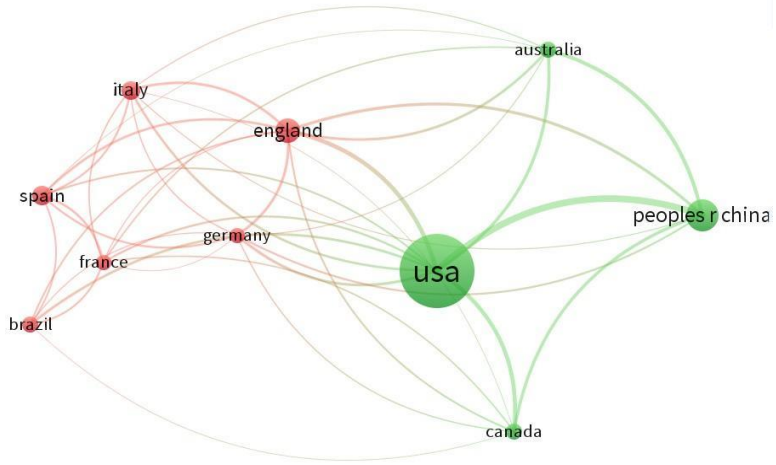


Figure 5. Publications network by country

This figure shows the USA as the country with the highest number of publications made with 1468 doubling to the People's Republic of China which has 602 and England which has 619 showing the dominance of the USA in this important issue. As for TGCS, the USA also dominates with 21128 citations speaking very well of the quality of the work done by this country.

## 4. Conclusions

In general, the trend in environmental impact research has increased during 2007 and 2018, where it increased considerably between 2014 and 2017. These results imply that the problem of climate change, greenhouse effect, among other environmental problems produce a great impact on the research of environmental impacts, hoping that the future academic production will continue to increase. The keyword analysis revealed that the research was separated into three aspects: Identification of the environmental problems that cause impacts on the environment, solution of various environmental problems with the intention of reducing these problems and analysis of how methods of reducing environmental impacts affect the different branches of society. During the years of research, the USA is the country with the highest number of publications, which implies that the subject is a research trend, in addition to the fact that many US policies wish to reduce the amount of environmental problems in their country. Research on environmental impacts has shown a strong understanding of the relationship between

climate change and its impacts on the environment, making it difficult for many academics to reach consensus on certain issues.

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