

A Scientometric Analysis of Air Pollution Publications during 2012-2021

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ABSTRACT

In recent years, many researchers have investigated the association between air pollution because it has become a global public health problem. The present study is aimed at analysing the global publication trends on air pollution using Web of Science database for the period 2012-2021. A total of 53791 publications were published on air pollution and the average number of publications per year was 5379. The publications peaked in the year 2021 with 9874. Annual growth rate has decreased from 109.13 in 2013 to 22.48 in 2021. China topped the list with highest share 17084 (31.76%) of publications. USA ranked second with 15493 (28.80%) shares of publications followed by England 3956 (7.35%) share of publications and India should 7th ranks among the countries publishing air pollution publications. Wang, Y is the most productive author with 494 (0.92%) publications followed by Liu, Y with 452 (0.84%) publications, the scientific literature on air pollution is spread over 3339 different web of science source journals.

KEYWORDS: Air pollution, annual growth rate, relative growth rate and doubling time.

1. INTRODUCTION

Air pollution is any physical, chemical, or biological change in the air. A certain percentage of the gas is present in the atmosphere. Increasing or decreasing the composition of these gasses is detrimental to survival. This imbalance in gas composition causes an increase in global temperature which is called global warming. The Earth and its environment are facing a serious threat by the increasing pollution of the air, water, and soil the vital life support systems of the earth. The damage to the environment is caused by improper management of resources and careless of human activity. We need to understand the sources of these pollutants and find ways to control pollution, and this can be done by making people aware of the effects of pollutants.

The global researchers have put restrictions on the amount of fossil fuels that can be used as well as restrictions on how much carbon dioxide and other pollutants can be emitted. Although the global authorities attempting to save our environment from these harmful gasses, it is not sufficient. The rapidly increasing human activities like the burning of fossil fuels, deforestation is the major cause of air pollution. We need to keep the environment clean by controlling

the pollution of air in the coming years. This is clear from the scientometric evidence from 2012 to 2021, that the number of publications in the Web of Science database was increased from 2805 to 9874. Therefore, the present study has been undertaken to know the growth and development of publications in the field of air pollution.

2. OBJECTIVES FOR THE STUDY

The objective of this study is to analyse the global research performance in the field of air pollution as reflected in the publication output during 2012-2021. The study focuses on the following aspects:

- Forms of publications
- Year wise growth of publications
- Most prolific authors
- Highly productive countries
- Highly productive institutes
- Language-wise distribution of publications
- Most preferred source titles for publication and
- High productive subject areas

3. MATERIALS AND METHODS

The Web of Science database was used for retrieving data on air pollution in topic field. A total of 53791 publications were downloaded and analysed by using the Microsoft excels per the objectives of the study. The Web of Science database allows us to refine the results in terms of publication years, countries, institutes, authors, language, subjects and source titles.

4. DATA ANALYSIS AND INTERPRETATIONS

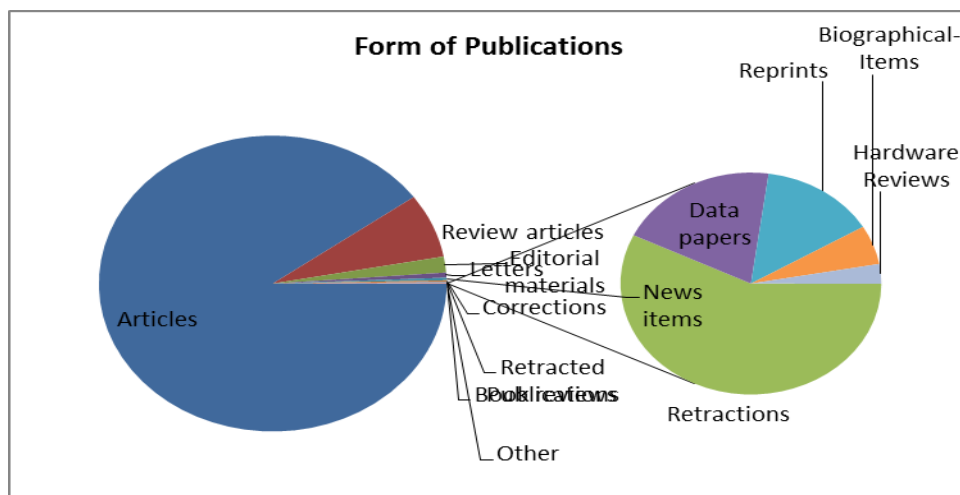
4.1 Form of publications

Table 1 - Form of Publications

| S. No. | Title | Articles | Percentage |
|---------------|------------------------|-----------------|-------------------|
| 1 | Articles | 48424 | 90.02 |
| 2 | Review articles | 3775 | 7.02 |
| 3 | Editorial materials | 935 | 1.74 |
| 4 | Letters | 301 | 0.56 |
| 5 | News items | 151 | 0.28 |
| 6 | Corrections | 97 | 0.18 |
| 7 | Retracted Publications | 42 | 0.08 |
| 8 | Book reviews | 31 | 0.06 |
| 9 | Retractions | 20 | 0.04 |
| 10 | Data papers | 7 | 0.01 |
| 11 | Reprints | 5 | 0.01 |
| 12 | Biographical-Items | 2 | 0.00 |
| 13 | Hardware Reviews | 1 | 0.00 |
| Total | | 53791 | 100.00 |

Air pollution literature has been published in different forms of publications in the world. Out of the 53791 published papers, 48424 (90.02%) were Journal articles followed by Review articles with 3775 (7.02%), Editorial materials with 935 (1.74%), and the remaining forms are less than 1% of the publications. It could be noted from the study that air pollution literature researchers have contributed more to the form of journal articles.

Figure 1 Form of Publications



4.2 Growth of publications

Table 2 provides the AGR of publications for the period 2012 to 2021.

$$\text{AGR} = \frac{\text{End Value} - \text{First Value}}{\text{First Value}} \times 100$$

Table 2 AGR of Publications

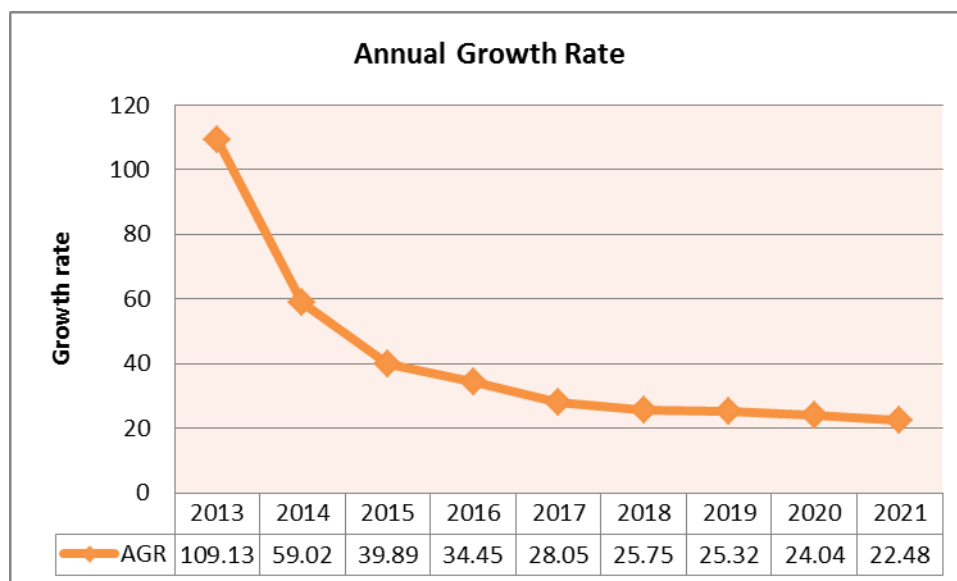
| Year | No. of publications | Cumulative total | Percentage | Annual growth rate (AGR) |
|------|---------------------|------------------|------------|--------------------------|
| 2012 | 2805 | 2805 | 5.22 | - |
| 2013 | 3061 | 5866 | 5.69 | 109.13 |
| 2014 | 3462 | 9328 | 6.44 | 59.02 |
| 2015 | 3721 | 13049 | 6.92 | 39.89 |
| 2016 | 4496 | 17545 | 8.36 | 34.45 |
| 2017 | 4921 | 22466 | 9.15 | 28.05 |
| 2018 | 5785 | 28251 | 10.76 | 25.75 |
| 2019 | 7154 | 35405 | 13.30 | 25.32 |
| 2020 | 8512 | 43917 | 15.82 | 24.04 |
| 2021 | 9874 | 53791 | 18.36 | 22.48 |

A total of 53791 publications were published during 2012-2021. The average number of publications per year was 5379. There were only 2805 publications in 2012 and a continuous growth of publications was observed during the

study period. The highest publications (9874) were in 2021. It was observed that there was a steady growth of publications during 2012-2021.

The table 2 also shows that the annual growth rate of the total publications calculated year wise. AGR reveals that it has decreased from 109.13 in 2013 to 22.48 in 2021. There is a decreasing trend in the growth rate as seen in the figure 2.

Figure 2 Annual growth rate of publications



4.3 Relative Growth Rate (RGR) and Doubling Time

The Relative Growth Rate (RGR) is the increase in number of articles or pages per unit of time. This definition derived from the definition of relative growth rates in the study of growth analysis in the field of air pollution. The mean relative growth rate (R) over the specific period of interval can be calculated from the following equation.

Relative Growth Rate (RGR)

$$R = \frac{1}{T_2 - T_1} \log \frac{W_2}{W_1}$$

Whereas

1-2 R- mean relative growth rate over the specific period of interval

Log_e W₁ - log of initial number of articles

Log_e W₂ - log of final number of articles after a specific period of interval

T₂-T₁- the unit difference between the initial time and the final time

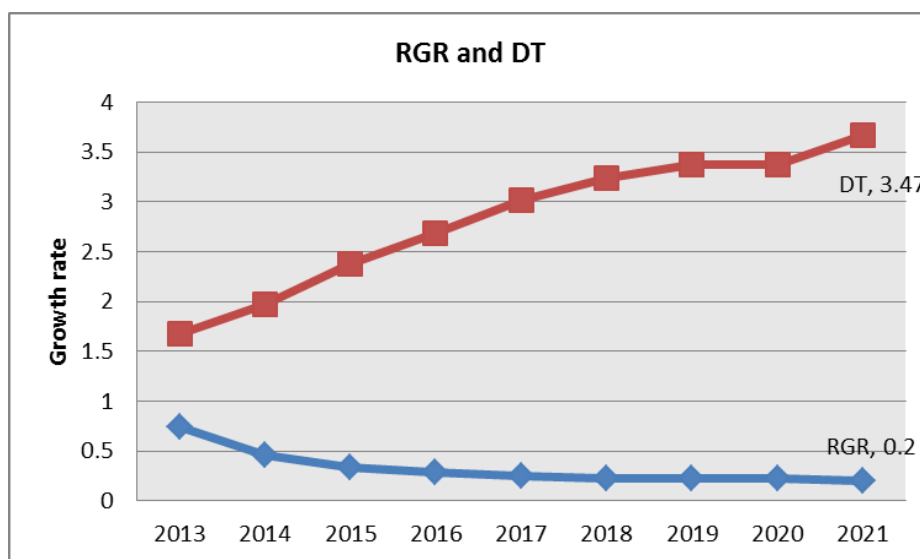
The year can be taken here as the unit of time.

Doubling Time (DT) = 0.693/R

Table 3 Relative growth rate (RGR) and Doubling time (DT) of publications

| Year | No. of Publications | Cumulative Total | W1 | W2 | RGR | DT |
|------|---------------------|------------------|-------|-------|------|------|
| 2012 | 2805 | 2805 | - | 7.94 | - | - |
| 2013 | 3061 | 5866 | 7.94 | 8.68 | 0.74 | 0.94 |
| 2014 | 3462 | 9328 | 8.68 | 9.14 | 0.46 | 1.51 |
| 2015 | 3721 | 13049 | 9.14 | 9.48 | 0.34 | 2.04 |
| 2016 | 4496 | 17545 | 9.48 | 9.77 | 0.29 | 2.39 |
| 2017 | 4921 | 22466 | 9.77 | 10.02 | 0.25 | 2.77 |
| 2018 | 5785 | 28251 | 10.02 | 10.25 | 0.23 | 3.01 |
| 2019 | 7154 | 35405 | 10.25 | 10.47 | 0.22 | 3.15 |
| 2020 | 8512 | 43917 | 10.47 | 10.69 | 0.22 | 3.15 |
| 2021 | 9874 | 53791 | 10.69 | 10.89 | 0.20 | 3.47 |

The year wise RGR is found to be in the range of 0.74 to 0.20. It has been observed from Table 2 and figure 2 that RGR is downward trend from 2013 (0.74) to 2021 (0.20). The doubling time (DT) was upward trend from 2013 (0.94) to 2021 (3.47).

Figure 3 Relative growth rate for research output

4.4 Identification of most prolific authors

Table 4 Identification of most prolific authors

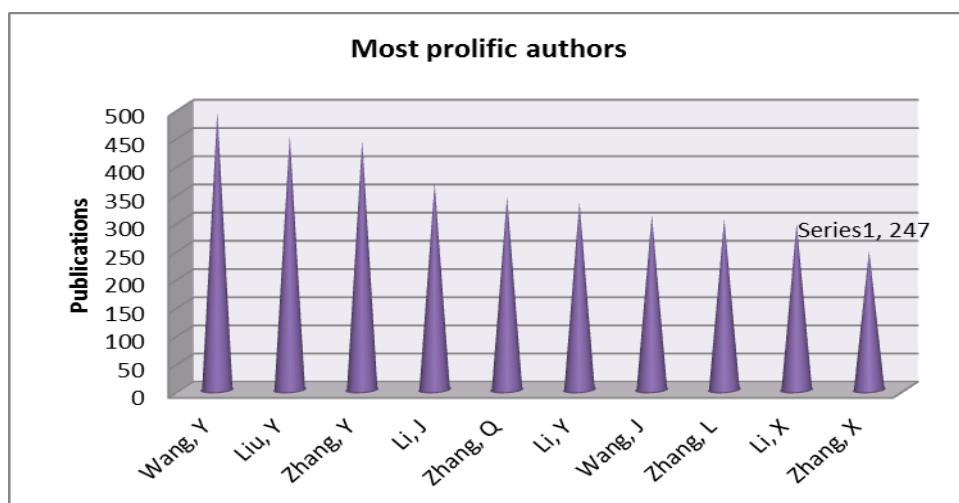
| S. No. | Author | No. of publications | Percentage |
|--------|----------|---------------------|------------|
| 1 | Wang, Y | 494 | 0.92 |
| 2 | Liu, Y | 452 | 0.84 |
| 3 | Zhang, Y | 443 | 0.82 |
| 4 | Li, J | 367 | 0.68 |

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|----|----------|-----|------|
| 5 | Zhang, Q | 343 | 0.64 |
| 6 | Li, Y | 334 | 0.62 |
| 7 | Wang, J | 310 | 0.58 |
| 8 | Zhang, L | 304 | 0.57 |
| 8 | Li, X | 296 | 0.55 |
| 10 | Zhang, X | 247 | 0.46 |

The authors having 200 or more publications during 2012-2021 are given in Table 4. Wang, Y is the most productive author with 494 (0.92%) publications followed by Liu, Y with 452 (0.84%) publications, Zhang, Y with 443 (0.82%) publications, Li, J with 367 (0.68%) publications, Zhang, Q with 343 (0.64%) publications, Li, Y with 334 (0.62%) publications, Wang, J with 310 (0.58%) publications and Zhang, X with 247 (0.46%) publications respectively.

Figure 4 Most prolific authors



4.5 Highly productive institutes

Table 5 Highly productive institutes

| S. No. | Institutions | Country | No. of Publications |
|--------|--|---------|---------------------|
| 1 | Chinese Academy of Science | China | 3107 (5.78%) |
| 2 | Peking University | China | 1458 (2.71%) |
| 3 | Tsinghua University | China | 1194 (2.22%) |
| 4 | University of Chinese Academy of Science | China | 1088 (2.02%) |
| 5 | Nanjing University of Information Science and Technology | China | 901 (1.68%) |
| 6 | United States Environmental Protection Agency | USA | 847 (1.58%) |
| 7 | Fudan University | China | 840 (1.56%) |
| 8 | Harvard University | USA | 837 (1.56%) |
| 9 | University of Washington | USA | 708 (1.32%) |
| 10 | Sun Yat Sen University | China | 646 (1.20%) |

Table 5 presents the top 10 institutes that have contributed 600 or more publications on air pollution during 2012-2021. A total of 27,151 institutions are contributed entire research output of the study. Among these top 10 institutions 7 are from China and three from USA. Chinese Academy of Science, China topped the list with 3107 (5.78%) publications followed by Peking University, China with 1458 (2.71%) publications, Tsinghua University, China with 1194 (2.22%) publications, University of Chinese Academy of Science, China with 1088 (2.02%) publications and Nanjing University of Information Science and Technology, China with 901 (1.68%) publications respectively.

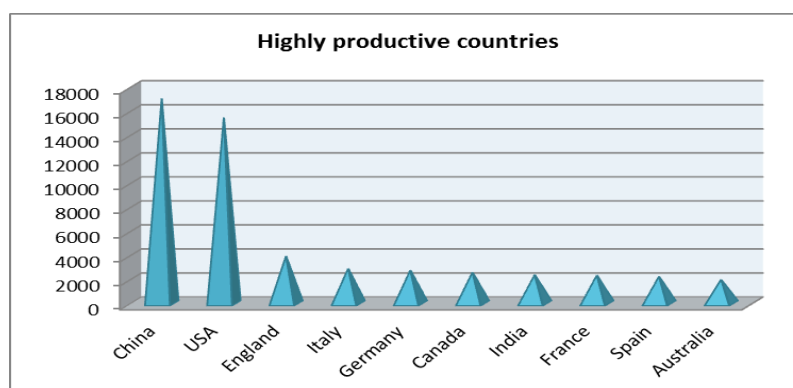
4.6 Highly productive countries

Table 6 Highly productive countries

| Rank | Country | Total Publications | Percentage |
|------|-----------|--------------------|------------|
| 1 | China | 17084 | 31.76 |
| 2 | USA | 15493 | 28.80 |
| 3 | England | 3956 | 7.35 |
| 4 | Italy | 2911 | 5.41 |
| 5 | Germany | 2764 | 5.14 |
| 6 | Canada | 2597 | 4.83 |
| 7 | India | 2394 | 4.45 |
| 8 | France | 2350 | 4.37 |
| 9 | Spain | 2248 | 4.18 |
| 10 | Australia | 1986 | 3.69 |

In all, there were 176 countries involved in the research in air pollution field and which published at least one publication. The publications share of highly productive countries (≥ 1900 publications) in air pollution varies from 3.69% to 31.76% as seen in the table 6 and figure 5. China topped the list with highest share 17084 (31.76%) of publications. USA ranked second with 15493 (28.80%) shares of publications followed by England 3956 (7.35%) share of publications, Italy with 2911 (5.41%) share of publications, Germany with 2764 (5.14%) share of publications, Canada with 2597 (4.83%) share of publications and India with 2394 (4.45%) share of publications respectively. However, China and USA together accounts for 60% of world air pollution research publications. India 7th ranks among the countries publishing air pollution publications.

Figure 5 Highly productive countries



4.7 Language wise distributions

Table 7 Language wise distribution of publications

| Rank | Language | No. of Publications |
|------|------------|---------------------|
| 1 | English | 53455 (99.37%) |
| 2 | German | 107 (0.20%) |
| 3 | French | 72 (0.13%) |
| 4 | Spanish | 47 (0.09%) |
| 5 | Chinese | 40 (0.07%) |
| 6 | Polish | 25 (0.05%) |
| 7 | Japanese | 15 (0.03%) |
| 8 | Czech | 9 (0.02%) |
| 9 | Portuguese | 9 (0.02%) |
| 10 | Russian | 8 (0.01%) |

Publications on air pollution are spread over 14 languages. The study reveals that the maximum number of publications have been published in English language with 53455 (99.37%) publications, followed by German language with 107 (0.20%) publications, French language ranks third position with 72 (0.13%) publications, Spanish language with 47 (0.09%) publications, Chinese language with 40 (0.07%) publications, Polish language with 25 (0.05%) publications and Japanese language with 15 (0.03%) publications. The most predominant language used for communication was English in every year in total productivity on the subject during the study period.

4.8 Most preferred source titles

Table 8 Source Title of Publications

| S. No. | Source Title | No. of Publications | Percentage | Impact Factor |
|--------|---|---------------------|------------|---------------|
| 1 | Science of the total environment | 2744 | 5.10 | 7.96 |
| 2 | Atmospheric environment | 2742 | 5.10 | 4.79 |
| 3 | International journal of environmental research and public health | 1747 | 3.25 | 3.39 |
| 4 | Environmental science and pollution research | 1630 | 3.03 | 4.22 |
| 5 | Atmospheric chemistry and physics | 1628 | 3.03 | 6.13 |
| 6 | Environmental pollution | 1627 | 3.02 | 9.13 |
| 7 | Environmental research | 1315 | 2.44 | 6.49 |
| 8 | Environment international | 1075 | 2.00 | 9.62 |
| 9 | Atmosphere | 1010 | 1.88 | 2.68 |
| 10 | Journal of cleaner production | 926 | 1.72 | 5.84 |

Table 8 provides the leading journals each with number of publications and impact factor. The scientific literature on air pollution is spread over 3339 different web of science source journals. It reveals that Science of the total

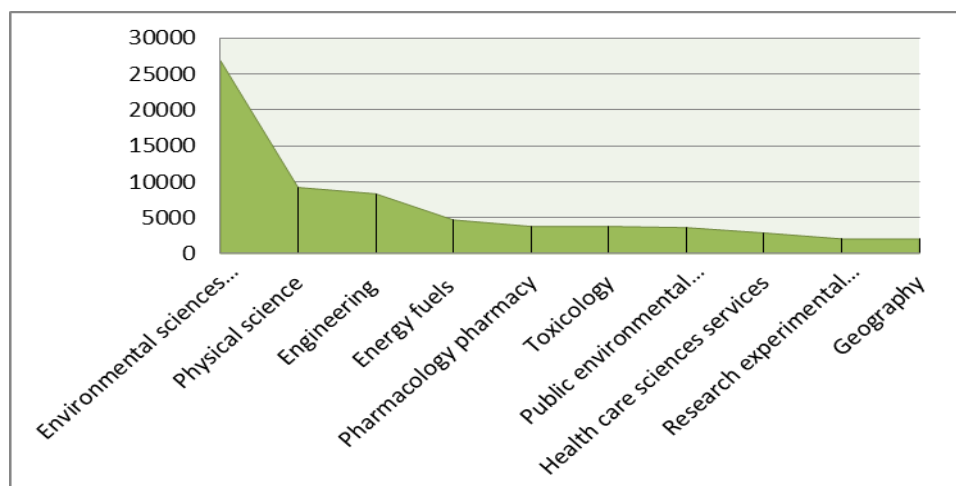
environment the list with the highest number of publications 2744 (5.10%) and the impact factor is 7.96, followed by Atmospheric environment with a share of 2742 (5.10%) publications and the impact factor is 4.79. International journal of environmental research and public health the third position with 1747 (3.25%) publications and the impact factor is 3.39. The fourth highest source title is Environmental science and pollution research with 1630 (3.03%) publications and the impact factor is 4.22, Atmospheric chemistry and physics with 1628 (3.03%) publications and the impact factor is 6.13 and Environmental pollution with 1627 (3.02%) publications and the impact factor is 9.13.

4.9 High productivity subject areas

Table 9 High productivity subject areas

| S. No. | Subject | No. of Articles | Percentage |
|--------|---|-----------------|------------|
| 1 | Environmental sciences ecology | 26873 | 49.96 |
| 2 | Physical science | 9203 | 17.11 |
| 3 | Engineering | 8310 | 15.45 |
| 4 | Energy fuels | 4680 | 8.70 |
| 5 | Pharmacology pharmacy | 3782 | 7.03 |
| 6 | Toxicology | 3782 | 7.03 |
| 7 | Public environmental occupational health | 3609 | 6.71 |
| 8 | Health care sciences services | 2865 | 5.33 |
| 9 | Research experimental medicine | 2047 | 3.81 |
| 10 | Geography | 2009 | 3.73 |

Figure 6 High productivity subject areas



The scientific literature on air pollution is spread over 97 different subjects. Table 9 shows high productivity subjects which are contributing more than 2000 articles. It is found that Environmental sciences ecology has highest number of articles with 26873 (49.96%) followed by Physical Science contributing 9203 (17.11%) articles. Engineering occupies the third position with 8310 (15.45%) articles. The fourth highest articles belonged to the subject Energy fuels with 4680 (8.70%), Pharmacology pharmacy with 3782 (7.03%) and Toxicology with 3782 (7.03%) articles respectively.

CONCLUSIONS

The present study attempted to highlight the growth and development of research publications on air pollution. A total of 53791 publications were published during 2012-2021 and the average number of publications per year was 5379. There was a steady growth of publication during the study period. Chinese Academy of Science, China topped the list with 3107 (5.78%) publications followed by Peking University, China with 1458 (2.71%) publications and Tsinghua University, China with 1194 (2.22%) publications. The scientific literature on air pollution is spread over 97 different subjects. Environmental sciences ecology has highest number of articles with 26873 (49.96%) followed by Physical Science contributing 9203 (17.11%) articles. Publications on air pollution are spread over 14 languages and the maximum number of publications have been published in English language with 53455 (99.37%) publications.

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