International Journal of Advanced Research and Development
ISSN: 2455-4030
Impact Factor: RJIF 5.24
www.advancedjournal.com
Volume 3; Issue 2; March 2018; Page No. 1141-1146

Research performance on soil pollution: A bibliometric analysis

K Sivasami
Assistant Professor, Department of Library and Information Science, Annamalai University, Annamalai Nagar, Tamil Nadu, India

Abstract
This paper discuss research performance on soil pollution a bibliometric analysis during from 2002 to 2016, during the study period 1528 records were retrieved and downloaded to analysis the present study. The study reveals that, year wise research publications in Soil pollution indicates during the study period, in the year 2014 has occupies first position with 11.26 percent of papers, 2013 has second position with 10.01 percent of papers, in 2016 has third place with 9.82 percent of records, the Growth Rate of publications is raise from 31 to 150 publications in soil research during the study period. The soil pollution research papers were published in the form of article is more than 75 percent, the remaining document types are least percent, in source types journal has predominate place in soil pollution publications among other sources. The language wise soil pollution research reveals that, nearly 80 percent of papers were published in English language. Among the fifteen countries in Soil pollution research China has occupies first place with 640 publications, Spain has second position with 67 papers, Russian Federation and United States has third and fourth place with 65 papers respectively.

Keywords: soil pollution, soild waste, contamination of soil, waste products, bibliometric

1. Introduction
Soil pollution has increased over the last decades and may pose a risk for human and ecological health. In modern intensive agriculture, large quantities of pesticides (chemicals) are used to kill insects, fungi, nematodes and weeds. The amount of pesticides applied to plants / soils are not directly toxic to human beings and animals, but are fatal to insects, fungi, nematodes and weeds. The soil is a primary recipient of these chemicals and waste products. Furthermore, once these chemical enter the soil they become part of a cycle which affects all forms of life, including men [1, 2].

Soil pollutions in general five kinds those are; contamination of soil with pesticides, contamination with toxic Inorganic compounds, contamination of soil due to Acid rain, contamination of soil due to organic waste disposal, contamination of soil with salts, contamination of soil with chemical Fertilizers. Soil pollution is a result of many activities and experiments done by mankind which end up contaminating the soil, some of the soil pollution types are; Agriculture soil pollution, Soil Pollution by industry and pollution due to urban activities. In India, Soil pollution is mainly due to Pollution concentration in urban areas and unplanned development of Industries. It has been estimated that the urban Pollution of India produces about 15 million tonnes of soild waste per annum causing pollution [3.4].

Soil pollution can reduce microbial biomass, affect the taxonomic diversity of soil communities [5, 6]. And it may act on a variety of microbial processes in the soil, thereby disturbing the nutrient cycling and the capacity to perform key ecological functions, such as mineralization of organic compounds and synthesis of organic substances [7, 8]. The purpose of the present study was to bibliometrically analyze the Soil Pollution research publications from 2002 to 2016, in order to provide insights into the soil pollution literature and identify patterns, tendencies, or irregularities that may exist in the publications. Moreover, this study will provide a comprehensive evaluation of Soil Pollution research at global level.

2. Methodology
The data were collected and analyses are based on publication of the Scopus database, study period from 2002 to 2016. The search string 'Soil pollution' in the title field was used to extract publications related to Soil Pollution. 1528 records were retrieved from Scopus database; the data were downloaded and analyzed by using the Microsoft office Excel spreadsheet application as per objectives of the present study.

2.1 Objectives
- To find out year wise publications in Soil pollution
- To identify document types contributed in Soil pollution
- To analysis language wise publications in Soil Pollution
- To examine top fifteen institution contributed in this research
- To find top fifteen Sources contributions

2.2 Relative Growth Rate (RGT)
The relative growth rate is the increase in the number of publications/pages per unit of time. Here, one year is taken as the unit of time. The mean relative growth rate R (1-2) over a

specified period of interval can be calculated from the following equation suggested by Mahapatra (1985) [9].

$$R(1-2) = \frac{W2 - W1}{T2 - T1}$$

Where,

R = Mean relative growth rate over the specific period of interval;

W1 = log w1 (Natural log of initial number of publications/ pages);

W2 = log w2 (Natural log of initial number of publications/pages);

T2-T1 = Unit difference between the initial time and final time.

Therefore,

R (a) = Relative growth rate per unit of publications per unit of time (year)

R (p) = Relative growth rate per unit of pages per unit of time (year)

2.3 Doubling Time (DT)

A direct equivalence exists between the relative growth rate and doubling time. If the number of publications/pages of a subject doubles during a given period, then the difference between the logarithms of the numbers at the beginning and at the end of the period must be the logarithms of the number 2. This difference has a value of 0.693. Thus, the corresponding doubling time for publication and pages can be calculated by the following formula:

$$\text{Doubling time (Dt)} \frac{0.693}{R}$$

Therefore,

$$\text{Doubling time for publications Dt (a)} \frac{0.693}{R(a)}$$

3. Analysis and Interpretation

Table 1: year wise publication on Soil pollution

Sl. No	Year	No. of Records	Percentages
1	2002	31	2.03
2	2003	59	3.86
3	2004	60	3.93
4	2005	71	4.65
5	2006	53	3.47
6	2007	87	5.69
7	2008	91	5.96
8	2009	90	5.89
9	2010	111	7.26
10	2011	127	8.31
11	2012	132	8.64
12	2013	153	10.01
13	2014	172	11.26
14	2015	141	9.23
15	2016	150	9.82
	Total	1528	100.00

Table 1 shows that year wise research publications in Soil pollution from 2002 – 2016 during the study period, 1528 records ware published, among the fifteen years in the year 2014 has occupies first position with 11.26 percent of papers, 2013 has second position with 10.01 percent of papers, in 2016 has third place with 9.82 percent of records, followed by 2015 has 9.23 percent of papers, 2012 has 8.64 percent of papers, 2011 has 8.31 percent of papers, 2010 has 7.26 percent of papers, 2008 has 5.96 percent of papers, 2009 has 5.89 percent of papers, 2007 has 5.69 percent of papers, 2005 has 4.65 percent of papers, 2004 has 3.93 percent of papers, 2003 has 3.86 percent of papers, 2002 has 2.03 percent of papers, it could be noted that during the study period in soil pollution research performance is showing an increasing from 31 to 172 papers in this research.

Table 2: Doubling Time and Relative Growth Rate in soil pollution research publications

Sl. No	Year	No. of Records	Cumulative	W1	W2	W2-W1 R(a)	Mean (a) 1-2	Doubling Time	Mean Dt (a) 1-2
1	2002	31	31		3.43				
2	2003	59	90	0.64	4.07	3.43		0.20	
3	2004	60	150	0.02	4.09	4.07		0.17	
4	2005	71	221	0.17	4.26	4.09	4.11	0.17	0.17
5	2006	53	274	-0.29	3.97	4.26		0.16	
6	2007	87	361	0.49	4.46	3.97		0.17	
7	2008	91	452	0.05	4.51	4.46		0.16	
8	2009	90	542	-0.02	4.49	4.51		0.15	
9	2010	111	653	0.21	4.7	4.49		0.15	
10	2011	127	780	0.14	4.84	4.70		0.15	
11	2012	132	912	0.04	4.88	4.84		0.14	
12	2013	153	1065	0.15	5.03	4.88	4.86	0.14	0.14
13	2014	172	1237	0.11	5.14	5.03		0.14	
14	2015	141	1378	-0.20	4.94	5.14		0.13	
15	2016	150	1528	0.07	5.01	4.94		0.14	
	Total	1528					4.48		0.155

Table 2 indicates that Doubling Time and Relative Growth Rate in Soil pollution research publications during the study period publications of Doubling Time mean value are 0.155. In 2002, the soil research publication was 31; gradually the

research publications were rise to 150 in the year 2016, the relative growth rate mean is 4.48. Conclude for this table its evidence that Growth Rate of publications is raise from 31 to 150 publications in soil research during the study period.

Table 3: document types in soil pollution research

Sl. No	Document types	No. of Records	Percentages
1	Article	1171	76.64
2	Conference Paper	218	14.27
3	Erratum	44	2.88
4	Review	39	2.55
5	Book Chapter	21	1.37
6	Editorial	19	1.24
7	Letter	8	0.52
8	Note	4	0.26
9	Book	2	0.13
10	Abstract Report	1	0.07
11	Short Survey	1	0.07
	Total	1528	100.00

Table 3 shows that document types in soil pollution research, 1528 papers were contributed by eleven document types among those, articles has occupies first place with 76.64 percent publications, conference papers has second place with 14.27 percent of papers, Erratum has third place with 2.88 percent of papers, and followed by Review has 2.55 percent, Book Chapter has 1.37 percent of papers, Editorial has 1.24 percent of papers, Letter has 0.52 percent of papers, note has 0.26 percent of papers, book has 0.13 percent of papers, moreover abstract report and Short Survey has 0.07 percent respectively in this research during the study period.

Table 4: sources types in soil pollution

Sl. No	Source types	No. of Records	Percentages
1	Journals	1305	85.41
2	Conference Proceedings	114	7.46
3	Book Series	85	5.56
4	Books	23	1.51
5	Trade Publications	1	0.07
	Total	1528	100.00

Table 4 shows that soil pollution publications were published in sources types, among the 1528 papers were published only five sources. Among the five sources 1305 papers were in journals, Conference Proceedings second place with 114 papers, Book series has third place with 85 papers, Books has 23 papers with fourth place and trade publications are single record with last position.

Table 5: language wise research publications in Soil Pollution

Sl. No	Language	No. of Records	Percentages
1	English	1213	79.38
2	Chinese	246	16.10
3	Russian	32	2.09
4	French	12	0.79
5	Polish	10	0.65
6	Spanish	7	0.46
7	German	6	0.39
8	Persian	5	0.33
9	Turkish	3	0.20
10	Czech	2	0.13
11	Hungarian	2	0.13
12	Dutch	1	0.07
13	Italian	1	0.07
14	Malay	1	0.07
15	Portuguese	1	0.07
16	Romanian	1	0.07
17	Ukrainian	1	0.07
	Total	1528	100.00

Table 5 sows that language wise research publication in Soil pollution, 1528 soil pollution research papers were contributed in seventeen languages, among those languages English langue has occupies first position with 1213 papers, Chinese occupies second place with 246 papers, Russian language has third place with 32 papers, followed by in French language 12 papers were published, in Polish language 10 papers, in Spanish language 7 papers, in German language 6 papers were published, in Persian language 5 papers, in Turkish language 3 papers, in Czech and Hungarian language 2 papers respectively, moreover in Dutch, Italian, Malay, Portuguese, Romanian and Ukrainian languages one papers were contributed in soil pollution research performance.

Table 6: top fifteen countries contributed in soil pollution research

Sl. No	Country	No. of Records	% of 1528
1	China	640	41.88
2	Spain	67	4.38
3	Russian Federation	65	4.25
4	United States	65	4.25
5	Poland	54	3.53
6	United Kingdom	54	3.53
7	India	50	3.27
8	Germany	47	3.08
9	France	44	2.88
10	Iran	39	2.55
11	Italy	38	2.49
12	Canada	35	2.29
13	Turkey	32	2.09
14	Romania	31	2.03
15	Nigeria	26	1.70

Table 6 shows that top fifteen countries contributed in soil pollution research, among the fifteen countries China has occupies first place with 640 publications, Spain has second position with 67 papers, Russian Federation and United States has third and fourth place with 65 papers respectively, Poland and United Kingdom has fifth and sixth place with 54 papers respectively, India has seventh place with 50 papers, Germany has eight place with 47 papers, France has ninth place with 44 papers, Iran has tenth place with 39 papers, Italy has eleventh place with 38 papers, Canada has twelfth place with 35 papers, Turkey has 32 papers with thirteenth place, Romania has fourteenth place with 31 papers, and Nigeria has fifteenth place with 26 papers, and moreover the remaining countries are contributed 25 and below 25 papers contributed in this research during the study period.

Table 7: top fifteen authors contributed in soil pollution research papers

Sl. No	Author Name	No. of Records	% of 1528
1	Blaha, U.	7	0.46
2	Kolesnikov, S.I.	7	0.46
3	Sun, T.	7	0.46
4	Zhou, Q.	7	0.46
5	Lv, J.	6	0.39
6	Ouyang, W.	6	0.39
7	Trevors, J.T.	6	0.39
8	Vega, F.A.	6	0.39
9	Zhang, W.	6	0.39
10	Andrade, M.L.	5	0.33
11	Arias-EstÃ©vez, M.	5	0.33
12	Gao, Y.	5	0.33
13	Lei, M.	5	0.33
14	Nahmani, J.	5	0.33
15	RÃ¶sler, W.	5	0.33

Table 7 indicates that top fifteen authors contributed in soil pollution research publications during the study period, among the fifteen authors Blaha, U. has first position, Kolesnikov, S.I. has second place, Sun, T. has third place, Zhou, Q. has fourth place, Lv.J, has fifth place, Ouyang, W. has sixth place, Trevors, J.T. has seventh place, Vega, F.A. has ninth place, Andrade, M.L. has tenth place, Arias-EstÃ©vez, M eleventh place, Gao, Y. Has twelfth place, Lei, M. has thirteenth place, Nahmani, J. has fourteenth place, RÃ¶sler, W. has fifteenth place with 5 records among the contributors.

Table 8: authorship pattern in soil pollution research papers

Sl. No.	Authorship pattern	No. of Records	Percentages
1	Single	123	8.05
2	Double	233	15.25
3	Three	280	18.32
4	Four	315	20.62
5	Five and Above	577	37.76
	Total	1528	100.00

Table 8 shows that authorship pattern in soil pollution research papers, among the 1528 papers, 577 papers were contributed five and above authors collaborative, followed by four authors collaborative publication are 315 papers, three authors collaborative publication are 280 papers, double author collaborative publication are 233 papers, and single author contribution are 8.05 per cent of papers.

Table 9: top fifteen affiliations contributed in soil pollution research

Sl. No	Affiliations/ Institutions	No. of Records	% of 1528
1	Chinese Academy of Sciences	144	9.42
2	Ministry of Education China	43	2.81
3	Zhejiang University	40	2.62
4	University of Chinese Academy of Sciences	29	1.90
5	Beijing Normal University	27	1.77
6	Shenyang Institute of Applied Ecology Chinese Academy of Sciences	26	1.70
7	Russian Academy of Sciences	22	1.44
8	Nanjing University	18	1.18
9	Lomonosov Moscow State University	16	1.05
10	Research Center for Eco-Environmental Sciences Chinese Academy of Sciences	16	1.05
11	Ministry of Agriculture of the People's Republic of China	16	1.05
12	Institute of Geographical Sciences and Natural Resources Research Chinese Academy of Sciences	15	0.98
13	Universidad de Vigo	14	0.92
14	Chinese Research Academy of Environmental Sciences	14	0.92
15	University of Tehran	12	0.79

Table 9 shows that top fifteen institutions contributed in soil pollution research publications, among the fifteen institutions 'Chinese Academy of Sciences' has occupies first position with 144 papers, followed by 'Ministry of Education China' has second position with 43 papers, 'Zhejiang University' has third place with 40 papers, 'University of Chinese Academy of Sciences' has fourth place with 29 papers, 'Beijing Normal University' has fifth place, 'Shenyang Institute of Applied Ecology Chinese Academy of Sciences' has sixth place 'Russian Academy of Sciences' has seventh place, 'Nanjing University' has eighth place, 'Lomonosov Moscow State University' has ninth place, 'Research Center for Eco-Environmental Sciences Chinese Academy of Sciences' has tenth place, 'Ministry of Agriculture of the People's Republic of China' has eleventh place 'Institute of Geographical Sciences and Natural Resources Research Chinese Academy of Sciences' has twelfth place 'Universidad de Vigo' has thirteenth place 'Chinese Research Academy of Environmental Sciences' has fourteenth place 'University of Tehran' has fifteenth place with12 papers among the fifteen institutions during the study period.

Table 10: top fifteen soil pollution papers contributed source titles

Sl. No	Source title	No. of Records	% of 1528
1	Water Air and Soil Pollution	65	4.25
2	Advanced Materials Research	50	3.27
3	Huanjing Kexue Environmental Science	44	2.88
4	Environmental Monitoring and Assessment	40	2.62
5	Environmental Pollution	35	2.29
6	Science of the Total Environment	32	2.09
7	Chinese Journal of Applied Ecology	29	1.90
8	Environmental Earth Sciences	27	1.77
9	Applied Mechanics and Materials	22	1.44
10	Chemosphere	21	1.37
11	Environmental Science and Pollution Research	20	1.31
12	Bulletin of Environmental Contamination and Toxicology	19	1.24
13	Eurasian Soil Science	19	1.24
14	Zhongguo Huanjing Kexue China Environmental Science	18	1.18
15	Chinese Journal of Ecology	17	1.11

Table 10 shows that top fifteen soil pollution papers contributed source titles, among the fifteen sources 'Water Air and Soil Pollution' has first place with 65 papers, 'Advanced Materials Research' has second place with 50 papers, 'Huanjing Kexue Environmental Science' has third place with 44 papers, followed by 'Environmental Monitoring and Assessment' has fourth place, 'Environmental Pollution' has fifth place 'Science of the Total Environment' has sixth place, 'Chinese Journal of Applied Ecology' has seventh place 'Environmental Earth Sciences' has eighth place 'Applied Mechanics and Materials' has ninth place 'Chemosphere' has tenth place, 'Environmental Science and Pollution Research' has eleventh place 'Bulletin of Environmental Contamination and Toxicology' has twelfth place 'Eurasian Soil Science' has thirteenth place 'Zhongguo Huanjing Kexue China Environmental Science' has fourteenth place and fifteenth

place is 'Chinese Journal of Ecology' with 17 papers published in this sources.

4. Conclusion

Conclude from the present study, during the study period in soil pollution research performance is showing an increasing from 31 to 172 papers in this research, articles has occupies first place with 76.64 percent publications, conference papers has second place the remaining nine documents are contributing least number of publications, 1528 soil pollution research papers were contributed in seventeen languages the remaining sixteen languages are contributed least number of publications, country wise contribution in soil population research publications China has contributed 640 papers ion this research during the study period, moreover the remaining countries were contributed least number of publications, Blaha, U, Kolesnikov, S.I., Sun, T., and Zhou, Q. They highly contributed in this research, single author contributions are least majority of contributions are collaborative authorship.

5. References

1. Armando Duarte C, Anabela Cachada, Teresa AP. Rocha-Santos. Soil Pollution: From Monitoring to Remediation, Academic press, United Kingdom, 2018.
2. Sahai VN. Fundamentals of Soil, 4th revised ed. Kalyani publishers, New Delhi, 2011.
3. Rathinasamy A, Bakiyathu Saliha B. Fundamentals of Soil Science, Scientific publishers, Jodhpur, 2016.
4. Harold Zeliger I. Human Toxicology of Chemical Mixtures, 2nd ed. William Andrew applied Science publisher, The Boulevard, 2011.
5. Shukurov N, *et al*. Coupling geochemical, mineralogical and microbiological approaches to assess the health of contaminated soil around the Almalyk mining and smelter comlex, Uzbekista. Sci. Total Environ, 2014, 447-459.
6. Stefanowicz AM, Niklinska M, Laskowski R. Metals affect soil bacterial and fungal functional diversity differently. Environ. Toxicol. Chem. 2008; 27:591-598.
7. Giller KE, Witter E, McGrath SP. Toxicity of heavy metals to microorganisms and microbial processes in agricultural soils: a review. Soil Biol. Biochem. 1998; 30:1389-1414.
8. Moreno *et al*., Soil organic carbon buffers heavy metal contamination on semiarid soils: effects of different metal threshold levels on soil microbial activity. Eur. J. Soil Biol. 2009; 45:220-228.
9. Mahapatra M. On the Validity of the Theory of Exponential Growth of Scientific Literature, Proceedings of the 15th IASLIC Conference, Bangalore, 1985, 61-70.