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A Bibliometric Sketch on Environmental Science Literature with special reference to India's Scenario

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Abstract:

The present paper is prepared with the purpose to assess the publication trends of scholarly articles in the field of Environmental Sciences that are published in 75 Journals indexed under Science Direct Database during the period 2004 to 2010. It examines and presents an analysis of 645 research papers with a focus on Indian scenario. The study takes note scientifically from various angles such as: growth of literature, authorship pattern, degree of collaboration, geographical distribution of publications, distribution by journal, citation pattern, and ranking pattern etc. The study reveals that 'USA' as the most productive country among 67 participative nations and recognized 'Trends in Ecology & Evolution' (TEE) as highly productive journal amongst 75 journals undertaken for this study. The authors sincerely hope that the study may contribute to the domain of Library and Information Science as well as Environmental Science research in many ways.

1. Introduction

Environmental science is the study of the interaction of the living and non-living components of the environment with special emphasis on the impact of humans on these components. It provides an integrated, quantitative, and interdisciplinary approach to the study of environmental systems which has become a global motion and mission nowadays. The present study denotes the publication trends of scholarly articles in the literature "Environmental

Sciences" that are published in 75 Journals, indexed under Science Direct Database during the period 2004 to 2010**.** It further examines and presents an analysis of 645 research papers with special reference to Indian scenario. Apart from this various bibliometric attributes such as growth of literature, authorship pattern, geographical distribution of publications, distribution by journal, citation pattern, ranking pattern, and the degree of collaboration are also presented using the formula given by Subramanyam, and Lotka's law.

2. Review of Literature

Karki (1990) through a study entitled "Environmental Science Research in India: An Analysis of Publications" unmasked that, Indian work in environmental science is highly scattered among various organizations. However, a good proportion of the output comes from a few organizations. Contribution of educational institutions is more than the research institutions. Maximum papers are produced by single-authors closely followed by two-author papers. Based on the publications output it can be inferred that Indian environmentalists are mainly engaged on the problems related to health and toxicology, ecology, wastes, and forestry and environment. Though growth of the literature has not been studied, the sudden spurt in literature and interest of investigators in *environmental science* research are clearly visible. The unusual feature of the Indian environmental science is its coverage mainly in Indian periodicals and largely this is concentrated in few periodicals. Another finding is that, a sizable portion of this literature is spread over non-environmental science journals.

Parent et. al. (2004) in their report "Scientometric Study on Collaboration between India and Canada, 1990-2001 Phase 1 of the 2004 Canada-India Science and Technology (S&T) Mapping Study" pointed out that though India is thought to be a part of the developing world, its scientific output broadly visible in the fields of Biology, Biomedical research, Chemistry, Clinical Medicine, Earth & Space, Engineering & technology, Mathematics and Physics. India managed to implement a strong scientific community, making it the only developing nation present among the top fifteen most important scientific producers. Indian science specializes principally in physics, chemistry and engineering, but does not publish in mainstream international journals that are highly cited. Since India is the second

most populated country in the world, millions of Indian students embark on higher education studies, producing more PhD per capita than any other country in the world.

Gupta (2011) in a study entitled "Mapping of Indian Science and Technology Output in a National and Global Context, 1997-2007" pointed out that, India ranked at 12th position among the top 20 productive countries in the world in science and technology. India has shown close similarity in S&T research with countries like Russia, China, South Korea and Taiwan, which have shown, like India, strong emphasis in physical and engineering sciences but are weak in health sciences. Physical Science is the top priority area of S&T research in India, followed by life sciences, engineering sciences and health sciences. Compared to world average output figures by subject, India's national publications share in physical sciences, life sciences and engineering sciences each has been above the global average in the discipline. The policy makers in science and technology needs to ponder over and decide for the future the Research and Development (R&D) priorities that India needs to pursue to lead India as a knowledge economy by 2020.

3. Objectives of the study:

The present study delimits the area with measuring the Environmental Science research productivity from the period 2004-2010 cited at *Science Direct Database Top 25 Hottest Articles*. The study includes a total of 645 papers from 75 journals and 67 productive countries. The specific objectives of the present study are to determine the:

i. Nature of Authorship pattern in Environmental science literature;
ii. Single Vs Multiple authored papers;
iii. Geographical Distribution of publications;
iv. Publication productivity of India including its states and institutional affiliation;
v. Documentary pattern of publication;
vi. Growth pattern of literature;
vii. Degree of collaboration of authors;
viii. Degree of citation of articles;
ix. Ranking pattern of papers;
x. Segregation of top ranked journals; and
xi. Author productivity pattern.

4. Methodology

Science Direct Database quarterly indexes top 25 hottest published papers in different subject fields. For the present study, thus the top 25 hottest papers in the area of Environmental Science are taken into consideration. All the cited papers from the year 2004 - 2010 are included in this study, comprising of 645 articles. For each article the details of bibliographic information viz. journal title, article title, 1st author, number of authors, affiliation with institutions, country of origin (considering 1st author), year of publication, number of citations, and ranking pattern have been considered and calculated using the MS-Excel spread sheet. As references counts are not freely available, the authors did not able to analyze reference pattern of the papers. Finally, all relevant data were sorted, tabulated, assimilated, synthesized, analyzed and interpreted in a logical order with an aim to draw inferences for the present work keeping in view the objectives of the study.

5. Limitation of the Study:

The study is limited for the period of 7 years starting from the year 2004 up to the year 2010 of selected top 25 hottest papers in the area of Environmental Science from Science Direct Database quarterly indexes. Altogether the sample having 645 papers out of which only 25 are from Indian contributions. Hence some of the observations made in this study based on the sample data especially for Indian scenario may differ from real scenario due to the small sample size.

6. Results and Discussion:

6.1. Chronological distribution of contributions:

Table 1 presents the chronological distribution of research papers and ensures that, Science Direct Database has enlisted 100 hottest papers each year (except 2004) consisting 4 quarters with 25 papers at each quarter. Since, the enlistment of papers has been initiated by Science Direct from July 2004; it is obvious that there are 2 quarters having 20 and 25 papers for the year 2004 under this subject field and there are altogether 645 papers from the year 2004-2010. As regards to the contribution of Indian researchers' to this domain it is found that, there is slow growth in Indian research contribution except the year 2005. Out of total Indian output, highest numbers of papers i.e. 28% are

contributed in year 2010, followed by 24% in 2009, 16% both in 2006 and 2008, and 12% in 2007 respectively by the Indian scholars to the subject Environmental Science.

Table 1: Year-wise scattering of contributions

Year	Distribution of Total No. of Papers [N=645]	Distribution of Indian contribution [N=25]
2004	45(6.97%)	1(4%)
2005	100(15.50%)	0
2006	100(15.50%)	4(16%)
2007	100(15.50%)	3(12%)
2008	100(15.50%)	4(16%)
2009	100(15.50%)	6(24%)
2010	100(15.50%)	7(28%)

6.2. Document type of contributions:

Accounting the sample, it is promulgated that more than 50% of the research papers are 'Article', while next to it, is 'Review Articles' that shares about 36% papers. Although, there are papers from other 5 types of document categories such as: 'Short Survey', 'Mini-Review', 'Opinion', 'Short Communication' and 'Update' etc., they are exiguous as table 2 asserts. Moreover, the table ascertains that, the Indian citations are less scattered among varied document categories rather than the whole citations and clearly states that, Indian papers are confined in two types document categories i.e. 'Article' (56%) and 'Review Article' (44%) as it is reflected from the table.

Table 2: Document-wise identification of contribution

Document type	Total No. of Papers [N=645]	Indian Contributions [N=25]
Article	369(57.20%)	14(56%)
Review Article	231(35.81%)	11(44%)
Short Survey	29(4.49%)	-
Mini-Review	7(1.08%)	-
Opinion	5(0.77%)	-
Short communication	3(0.46%)	-
Update	1(0.15%)	-

6.3. Ranking pattern of citations:

Science Direct has enlisted and ranked 25 hottest papers quarterly which are undertaken and examined for the present study. As far as ranking pattern of Indian papers are concerned the highest 28% are ranked in between 21-25, where as 24% papers are in 11-15 and 16-20 ranking categories each, 16% papers are in the rank of 6-10 and lastly a meager 8% papers are at the top rank 1-5 respectively. Table 3 apparently advocates that, less number of papers is at the top rank and more numbers are at the lower rank with respect to Indian contribution. It may be worthwhile to say here that, Indian research productivity would have been an exemplary, if number of contributions could have been decreasing (but in this sample it increases), as compared to the ranking pattern (descending order).

Table 3: Rank-wise presentation of citation

Ranking pattern	Total No. of Papers [N=645]	Indian Contributions
Top 1-5	130(20.15%)	2(8%)
Top 6-10	130(20.15%)	4(16%)
Top 11-15	130(20.15%)	6(24%)
Top 16-20	130(20.15%)	6(24%)
Top 21-25	125(19.37%)	7(28%)

6.4. Lotka's inverse Square Law of Scientific Productivity:

Table 4: Number of expected Authors derived (Lotka's inverse Square Law of Scientific Productivity)

No. of Papers	Considering 1st Author				Considering all Authors			
	No. of Authors Observed	Proportion of Observed Authors with respect to their number of contribution	No. of Authors Expected	Proportion of Expected Authors with respect to their number of contribution	No. of Authors Observed	Proportion of Observed Authors with respect to their number of contribution	No. of Authors Expected	Proportion of Expected Authors with respect to number of contribution
1	548	0.93	548	0.67	2071	0.82	2071	0.67
2	22	0.037	137	0.16	192	0.076	518	0.16
3	08	0.013	61	0.07	84	0.033	230	0.07
4	04	0.006	34	0.04	100	0.039	129	0.04
5	02	0.003	22	0.02	30	0.011	83	0.02
6	01	0.001	15	0.01	30	0.011	58	0.01
Total	585		817		2507		3089	

Assessment of author productivity is a vital part of the metric study which is also considered for the present article as shown in table 4 and it is observed that the maximum number of authors i.e. 548 out of 585 have contributed single papers each and its proportion is 0.93 which is considered to be quite dominant. Besides, from the observation it is clear that, the number of authors contributed 2, 3 4, 5, and 6 number of papers each, do not fit to the Lotka's inverse Square Law of Scientific Productivity, because there is huge gap between number of authors observed and number of authors expected in relation to their productivity pattern. Supplementing to the study the researchers have also accounted all the contributing authors and their productivity pattern which procreate a value adding domain to the present research and demonstrates that, a majority 2071 number of authors produce single paper each whose proportion 0.82 is dominating overall productivity pattern. As regards to Lotka's inverse law it is clear that, the productivity pattern of contributors mismatches marking a wide gap between observed author productivity and expected author productivity pattern respectively.

6.5. Citation pattern of contributions:

The table 5 evidently advocates the citation pattern of whole research papers as well as Indian contributions. The study proclaims that, highest percentage of 47.90% (i.e. 309 out of N=645) papers have had less than 25 citations (>=1<25), followed by 19.84% (i.e. 128 out of N=645) with 25-49 (>=25<50) citations, 10.69% (i.e. 69 out of N=645) having more than 100 (>=100) citations and about 10% papers gets citations 50-99 (>=50<75 & >=75<100) respectively. Besides, it has been noticed that, 12% papers have no citations at all.

Table 5: Citation pattern of contributions

Citation pattern	**Total contribution [N=645]**	**Have Citation**	**Indian contribution**	**Have Citation**
>=100	69(10.69%)	Approximately 88%	5(20%)	92%
>=75<100	21(3.25%)		5(20%)	
>=50<75	40(6.20%)		-	
>=25<50	128(19.84%)		2(8%)	
Less than 25	309(47.90%)		11(44%)	
No citation	78(12.09%)	Approximately 12%	2(8%)	8%

So far as the citation pattern of Indian contributions (N=25) is concerned highest 44% papers have had citations less than 25 citations (>=1<25), 20% papers have citations between 75-99 (>=75<100) where as another 20% have more than 100 (>=100) citations, 8% papers have 25-49 (>=25<50) citations respectively. Moreover, 8% of Indian papers are found having no citations. In conclusion, it may be justifiable to say that, Indian papers are most noteworthy, because 92% Indian papers are cited as compared to the total contributions of which approximately 88% papers are cited.

6.6. Authorship pattern of citations:

Authorship pattern is important in order to determine the degree of collaboration of research in an area of study. That is why the researchers have made an effort to devise the degree of collaboration of research in the field of environmental science. The table 6 unfolds that, 2, 3 and 4 authored papers are highly dominating over other forms of authorship pattern contributing 30.54%, 18.29% and 15.81% papers to whole citations respectively, while only 13.02% papers are detected to be single authored. Addressing the Indian contributions regarding authorship pattern the table shows that 2 and 3 authored papers are dominating that accounts for 40% and 24% papers respectively.

Table 6: Authorship pattern of citation

Authorship pattern	Total contribution [N=645]	Degree of Collaboration	Indian contribution	Degree of Collaboration
Single Author	84(13.02%)	0.86	02(8%)	0.92
Two Authors	197(30.54%)		10(40%)	
Three Authors	118(18.29%)		06(24%)	
Four Authors	102(15.81%)		03(12%)	
Five Authors	46(7.13%)		01(4%)	
Six Authors	35(5.42%)		02(8%)	
Seven Authors	23(3.56%)		-	
Eight Authors	10(1.55%)		-	
Nine Authors	08(1.24%)		01(4%)	
Ten Authors	02(0.31%)		-	
More than Ten Authors	20(3.10%)		-	

It is noticed from the degree of collaboration that, multi authorship papers are dominating over single authored papers with regard to whole contribution which is also identical with that of Indian authorship pattern. It is also

observed that the proportion of Indian multi authorship (0.92) is higher than the whole paper multi authorship (0.86). As a whole, both the results of degree of collaboration signify that, research is admittedly a collective and collaborative practice rather than an individual effort.

6.7. Contribution of Indian Publications:

Table 7: Institution and State wise contribution of Indian Publications

Sl. No.	Name of the Institution	Number of Contributions	Name of State	Number of Contribution
1	Guru Jambheshwar University of Science & Technology	04(16%)	Haryana	04(16%)
2	IIT Roorkee	03(12%)	UP	04(16%)
	IIT Kanpur	01(4%)		
3	National Institute for Interdisciplinary Science and Technology (NIIST)	02(8%)	Kerala	03(12%)
	Amala Institute of Medical Sciences	01(4%)		
4	National Environmental Engineering	01(4%)	Maharashtra	03(12%)
	Bhabha Atomic Research Centre	01(4%)		
	Pune University	01(4%)		
5	IIT Kharagpur	02(8%)	West Bengal	03(12%)
	University of Calcutta	01(4%)		
6	IIT Delhi	02(8%)	Delhi	02(8%)
7	National Institute for Plant Biodiversity Conservation and Research	02(8%)	Odisha	02(8%)
8	Indian Institute of Chemical Technology	01(4%)	Andhra Pradesh	01(4%)
9	Tezpur University	01(4%)	Assam	01(4%)
10	Bhilai Steel Plant	01(4%)	Bihar	01(4%)
11	Anna University	01(4%)	Tamilnadu	01(4%)

Addressing the geographical distribution of Indian papers among the Indian states and the papers affiliation to varied institutions the table 7 denotes that, there are 11 productive states of India among which Haryana and U. P. are most prolific states having highest number of contributions i. e., 16% each, followed by Kerala, Maharashtra and West Bengal each with 12% papers, while Delhi (8%), Odisha (8%) and remaining 4 states such as: Andhra Pradesh, Assam,

Bihar and Tamilnadu distinctively provided each 4% research papers each. Nevertheless, among the Indian affiliated institutions Guru Jambheshwar University of Science & Technology (Haryana), IIT Roorkee (U. P.) are found top ranking productive institutions with identical share 16% and 12%. Besides, there are 4 more prominent institutions such as: National Institute for Interdisciplinary Science and Technology (NIIST) of Kerala, IIT Kharagpur (West Bengal), IIT Delhi (Delhi), and National Institute for Plant Biodiversity Conservation and Research (Odisha) contributed 8% papers each and rest 10 institutions participated adding each 4% papers to the domain of environmental Science.

6.8. Country-wise participation to whole citation:

Table 8: Country-wise participation to whole citation

Sl. No.	Name of Country	No. of contribution	Percentage	C. F.
1	USA	179	27.75	27.75
2	UK	75	11.62	39.37
3	Australia	37	5.73	45.1
4	France	32	4.96	50.06
5	Canada	27	4.18	54.24
6	Spain	26	4.03	58.27
7th	India	25	3.87	62.14
8	Germany	22	3.41	65.55
9	China	20	3.10	68.65
10	The Netherlands	19	2.94	71.59
11	Italy	14	2.17	73.76
12	Switzerland	14	2.17	75.93
13	Sweden	10	1.55	77.48
14	Turkey	9	1.39	78.87
15	Belgium	8	1.24	80.11
16	Japan	8	1.24	81.35
17	Denmark	7	1.08	82.43
18	Finland	7	1.08	83.51
19	Ireland	7	1.08	84.59
20	Norway	6	0.93	85.52
21	Slovakia	6	0.93	86.45
22	Colombia	5	0.77	87.22
23	Greece	5	0.77	87.99
24	Korea	5	0.77	88.76
25	Others (43)	72	11.16	99.99
Total (67)		645	*	*

Study of the geographical scattering of publications proactively determines the strength and weakness of the productive countries which is intensively portrayed in the table 8. The study discovers that, USA is the most prolific country with a commanding research production of 27.75% among other productive nations. Besides, UK, Australia, France, Canada and Spain posed 2nd, 3rd, 4th, 5th and 6th position contributing 11.62%, 5.73%, 4.96%, 4.18% and 4.03% papers to their credit. Moreover, India is found to have 7th rank having its share **3.87%** to the whole contribution, while other ***60*** participative regions collectively added 36.87% research productions as a whole.

6.9. Journal-wise mapping of whole contribution:

Table 9: Journal-wise mapping of whole contribution

SL. No.	Name of Journal	No. of Contributions	%	C. F.
1	Trends in Ecology & Evolution (TEE)	167	25.89	25.89
2	Bio-resource Technology (BT)	75	11.62	37.51
3	Water Research (WR)	37	5.73	43.24
4	Analytica Chimica Acta (ACA)	30	4.65	47.89
5	Energy Policy (EP)	20	3.1	50.99
6	Biological Conservation (BC)	19	2.94	53.93
7	Atmospheric Environment (AE)	18	2.79	56.72
8	Mutation Research/Fundamental and Molecular Mechanisms of Mutagenesis (MRFMMM)	18	2.79	59.51
9	Ecological Modelling (EM)	17	2.63	62.14
10	Food and Chemical Toxicology (FCT)	15	2.32	64.46
11	Journal of Hazardous Materials (JHM)	15	2.32	66.78
12	Ecological Economics (EE)	14	2.17	68.95
13	Ecological Indicators (EI)	14	2.17	71.12
14	Forest Ecology and Management (FEM)	14	2.17	73.29
15	Environmental Pollution (EP)	11	1.7	74.99
16	Annals of Nuclear Energy (ANE)	10	1.55	76.54
17	Journal of Cleaner Production (JCP)	10	1.55	78.09
18	Journal of Env. Management (JEM)	10	1.55	79.64
19	Agriculture, Ecosystems & Environment (AEE)	9	1.39	81.03
20	Chemico-Biological Interactions (CBI)	9	1.39	82.42
21	Remote Sensing of Environment (RSE)	9	1.39	83.81
22	Soil Biology and Biochemistry (SBB)	9	1.39	85.2
23	Others (*53 Journals*)	95	14.72	99.92

Journal-wise mapping of literature in the field of Environmental Science has also been depicted through the present research shown at table 9. The study reflects that, the journal "Trends in Ecology & Evolution (TEE)" plays a commendable role having a distinguished share i. e., 167 (25.89%) among 75 productive journals, while the journal Bio-resource Technology (BT), Water Research (WR) and Analytica Chimica Acta (ACA) are found to have at the rank of 2nd, 3rd and 4th with respective contribution 11.62%, 5.73% and 4.65%respectively. In addition, the journals categorically produces literature such as: "Energy Policy (EP)" (3.10%), "Biological Conservation (BC)" (2.94%), "Atmospheric Environment (AE)" and "Mutation Research/Fundamental and Molecular Mechanisms of Mutagenesis (MRFMMM)" each (2.79%), "Ecological Modeling (EM)" (2.63%), "Food and Chemical Toxicology (FCT)" (2.32%) "and Journal of Hazardous Materials (JHM)" equally contributed each (2.32%), following "Ecological Economics (EE)", "Ecological Indicators (EI)", and "Forest Ecology and Management (FEM)" added 2.17% research products each identically. Apart from these, other 61 participative journals contributed less than 2% papers each and posed as a share holder in Environmental Science scholarly communication.

6.10. Top Ranked Journals:

The present study is consisting of total 645 papers which were published in 75 journals. Out of 75 journals only two (2.66%) journals namely *'Trends in Ecology & Evolution (TEE)' and 'Bio-resource Technology (BT)'* have published collectively more than 1/3 of contributions (37.51% i.e. 242 out of N-645), however 11 journals (14.66%) produced 33.64% (217 out of N=645) of literature, followed by a large number of 62 journals (82.66%) produced only 28.84% (186 out of N=645) contributions.

Table: 10: Distribution of Papers in Journals

Zones	**No. of Journals Observed**		**Distribution of Papers**	
(Approx. 1/3 of contributions)	No.	%	No.	%
First	02	2.66%	242	37.51%
Second	11	14.66%	217	33.64%
Third	62	82.66%	186	28.84%

6.11. Top 10 Countries v/s top ranked Journals:

Table: 11: Contribution of top 10 Countries to top ranked Journals

Sl. No	Top Ranked Journals (n=10)	Top 10 Countries										Total
		USA	UK	Australia	France	Canada	Spain	India	Germany	China	Netherlands	
1	TEE	46	16	06	09	06	07	05	10	10	06	121
2	BT	20	12	4	1	3	3	2	0	3	3	51
3	WR	10	2	7	2	1	2	0	0	3	2	29
4	ACA	5	5	3	1	3	3	1	1	0	0	22
5	EP	3	3	2	2	2	1	0	1	0	0	14
6	BC	3	3	2	0	2	1	0	0	1	0	12
7	AE	1	7	1	1	0	0	1	0	1	0	12
8	MRFMMM	1	2	2	1	1	0	0	1	0	1	9
9	EM	4	2	1	2	0	0	1	2	0	0	12
10	FCT	4	1	0	5	0	0	0	0	0	0	10
Total		**97**	**53**	**28**	**24**	**18**	**17**	**10**	**15**	**18**	**12**	***292***

It is worthwhile to measure top 10 Countries' contribution to top ranked journals in the present study. As shown in table 11, USA being the most prolific productive country has contributed highest number of papers (46) to the most prolific journal 'TEE', following the papers published by journals such as: 'BT' (20), 'WR' (10), 'ACA' (5) and in journal 'EM', 'FCT' 4 papers each, while in 'EP', 'BC' journals 3 papers each and 1 paper each in the journals 'AE' as well as 'MRFMMM' respectively. As far as other top 9 nations' contributions are concerned, except 'Australia', all 8 countries such as: UK, France, Canada, Spain, India, Germany, China and Netherlands have highest number of papers in most productive journal 'TEE' and contribution to other journals are relatively meager. Overall, it is depicted that, USA, UK, Australia, France, Canada, Spain have contributed 97, 53, 28, 24, 18, 17 number of papers to top 10 journals, whereas India contributed only 10 papers which is less as compared to Germany, China and Netherlands who got 8^{th}, 9^{th} and

10th rank having more contribution to top 10 journals, but their total contribution is less than Indian. That is why India got 7th rank.

6.12. Chronological scattering of papers by top 10 Countries:

Chronological distribution of research productivity among top 10 countries as reflected in table 12 shows that, 2006 is the most remarkable productive year for 'USA', and Canada, while 2005 is for 'UK', 2010 for 'Australia', 'Spain' and 'India', 2009 for 'France', 2007 and 2008 for 'Germany', 2008 for 'China' and 'Netherlands' respectively having highest number of contributions in the mentioned years rather than other productive years. Further, it is ascertained that, chronological scattering of publication productivity in case of 'USA', 'Australia', 'Germany', and 'Netherlands' are found on an average parallel, while 'UK', 'Canada' and 'China' shows negative trend, but the remaining countries such as: 'France', 'Spain' and 'India' indicates a growing trend as well.

Table: 12: Chronological scattering of papers by top 10 Countries

Sl. No.	Country	Year-wise Contribution of Top 10 Countries							Total
		2004	2005	2006	2007	2008	2009	2010	
1	USA	13	30	33	23	24	29	27	179
2	UK	7	20	15	7	9	8	9	75
3	Australia	4	6	7	4	3	5	8	37
4	France	1	1	5	6	3	9	7	32
5	Canada	2	5	6	4	5	2	3	27
6	Spain	2	2	2	6	2	4	8	26
7	**India**	**1**	*****	**4**	**3**	**4**	**6**	**7**	**25**
8	Germany	*	2	3	5	5	3	4	22
9	China	*	4	2	3	7	3	1	20
10	The Netherlands	3	3	3	2	4	2	2	19
Total		33	73	80	63	66	71	76	462

6.13. Chronological scattering of papers by top 10 Journals:

The chronological distribution of papers produced by top 10 journals as tabulated above envisages that, the journal 'TEE' is the only leading contributor having highest number of papers i. e. 100 during the year 2008 which predominates all other ranked journals in the discipline of Environmental Sciences. By and large, the journals 'BT' and 'BC' contributed equal number of papers in 2005, while 'WR', 'ACC', and 'EP' have considerable contributions categorically in the years 2009, 2004, and 2006 respectively. Adjoining to these journals remaining 4 such as: 'AE', 'MRFMMM', 'EM' and 'FCT' aggregated their major share during the productive years 2005, 2007, 2006 and 2010 respectively. In conclusion it is disclosed that, except the journal 'FCT' all the top 9 journals are denoting an adverse trend in their contribution at each successive chronological productive sessions the above table connotes.

Table 13: Chronological scattering of papers by top 10 Journals

Sl. No.	**Journals**	**Year-wise Contribution of Top 10 Journals**							**Total**
		2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	
1	Trends in Ecology & Evolution (TEE)	*	*	*	24	100	29	14	167
2	Bio-resource Technology (BT)	*	37	*	*	*	8	30	75
3	Water Research (WR)	*	*	*	*	*	27	10	37
4	Analytica Chimica Acta (ACC)	24	*	*	*	*	1	5	30
5	Energy Policy (EP)	*	*	20	*	*	*	*	20
6	Biological Conservation (BC)	*	14	*	*	*	1	4	19
7	Atmospheric Environment (AE)	2	11	*	*	*	4	1	18
8	Mutation Research/Fundamental and Molecular Mechanisms of Mutagenesis (MRFMMM)	*	*	*	17	*	*	1	18
9	Ecological Modelling (EM)	*	*	14	*	*	2	1	17
10	Food and Chemical Toxicology (FCT)	*	*	3	*	*	5	7	15
Total		**26**	**62**	**37**	**41**	**100**	**77**	**73**	**416**

7. Major Findings

Some of the key findings of the present study that deserve mention are as under:

i. As regards to the contribution of Indian researchers' to the domain of Environmental Science it is found that, there is slow growth in Indian research production. Out of whole Indian share, 2010 is the most productive year with a contribution of 28% papers.

ii. It is promulgated from table 2 that, more than 50% of the research papers are 'Article'.

iii. As far as ranking pattern of Indian papers are concerned the highest 28% Indian contributions are assigned 21-25 rank, while a meager 8% of Indian papers appears at the rank 1-5.

iv. Authors' productivity does not fit to the Lotka's inverse Square Law of Scientific Productivity as reflected in table 4.

v. The table 6 reflects the citation pattern of total research papers as well as Indian contributions. It is to be noted that, the non-cited papers from India are lesser in number than the non-cited papers of total contributions. Hence it signifies that, maximum numbers of Indian papers are cited by others as compared to total publications.

vi. Degree of collaboration of whole papers and Indian papers both apparently address that, research is a collaborative work, rather than an Individual activity.

vii. Addressing the geographical distribution of Indian papers among the Indian states and the papers affiliation to varied institutions the table 7 denotes that, there are 11 productive states of India among which Haryana and U. P. are most prolific states having highest numbers of contributions i. e. 16% each. Nevertheless, among the Indian affiliated institutions Guru Jambheshwar University of Science & Technology (Haryana), IIT Roorkee (U. P.) are found top ranking productive institutions with identical share 16% and 12%.

viii. The study reveals that, USA is the most prolific country with an outstanding research production of 27.75% among other productive nations, while India is found to have the distinction of 7^{th} rank with 3.87% contributions.

ix. The study unfolds that, the journal "Trends in Ecology & Evolution (TEE)" plays a commendable role having a distinguished share i. e. 167 (25.89%) among 75 productive journals.

x. Out of 75 journals only two (2.66%) journals namely *'Trends in Ecology & Evolution (TEE)' and 'Bio-resource Technology (BT)'* collectively published more than 1/3 of papers (37.51% i.e. 242 out of N-645) which vigorously caused to be designated as top ranked journals.

xi. As shown in table 11, USA being the most prolific productive country has contributed highest number of papers (46) to the most prolific journal 'TEE'.

xii. 2006 is the most remarkable productive year for 'USA', while 2010 is best productive year for India.

xiii. The journal 'TEE' is considered the only leading and dominating journal with highest number of papers i. e. 100 during the year 2008 at a comparative perspective with all other journals in the discipline of Environmental Sciences the study addresses.

8. Conclusion:

The journals namely *'Trends in Ecology & Evolution (TEE)' and 'Bio-resource Technology (BT)'* have collectively published more than 1/3 literature i.e. 37.51% papers out of 75 journals which may be considered as the two top ranked journals in the field of Environmental Science. The present study reflects that USA is the most prolific country that contributes about 27.75% scholarly papers in the field of Environmental Science, while India is found to have the distinction of 7th rank with 3.87% contributions among other productive nations. Year-wise data exhibits that 2006 is the most remarkable productive year for 'USA', while 2010 is the most productive year for India. The growth of scientific output of India specifically in the field of Environmental Science is found considerably slow as the study unfolds. Indian Environmental Science papers principally placed in top 10 International journals, which cover 40 percent of the whole share. Though India is the second most populated country in the world, yet it has not been occupied a very appealing place in environmental science research productivity in the global arena, but enviably marked as a leading producer in Asia with contributing 25 (3.87%) papers, which determines 7th rank in globe,

followed by China who placed 9th rank in world, 2nd rank in Asia producing 20 (3.10%) papers respectively. The findings of the present study will be helpful to know India's contribution towards Environmental Science and it will encourage the environmental scientists to put their best effort to the field.

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