

Scientometric Analysis Of Biodiversity Research Productivity In India: A Study

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Abstract

The present study of Indian contributions of Biodiversity research articles was undertaken by web of science database has been used to retrieve the data for 27 years (1991-2017). Most of the researchers preferred to publish their research result in journal articles. This study identified to analyses coverage year wise distribution, source wise distribution, Institution wise distribution, country wise distribution of the literature also noted. It is observed that Bradford's law of scattering is not fit. This study also verified Zipf's law of word occurrence.

Keywords: Scientometrics, Research Productivity, Biodiversity, Bradford's Law, Zipf's Law.

1. Introduction

The Biodiversity defined as “the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic eco-systems and the ecological complexes of which the area part- this include diversity within species, between species and of ecosystem.

Scientometrics is worried about the quantitative highlights and attributes of science and logical exploration. Accentuation is set on examinations in which the turn of events and instrument of science are concentrated by measurable numerical strategies. The term scientometrics is the field which applies quantitative techniques to investigation of science as a data cycle. Scientometrics manages investigation assessment and realistic portrayal of science and innovation information.

The significant focal point of the investigation is to apply the scientometric study so as to dissect the assessment and profitability of development and improvement of exploration yield in Biodiversity in India. This study related to the pattern of distribution of Biodiversity, collaborative patterns and other aspects is important and useful to understand the mechanism

underlying the growth of knowledge of a discipline. This study also to analyses the evaluation growth and development and of Biodiversity research output interns of its content and coverage growth rates, source wise and geographical distributions. Broadford's law and Zipf's law also noted.

2. Review of Literature

Gupta, Dhawan and Ritu Gupta (2017)¹ analyzed global publications of mobile cloud computing during 2007-2016. The paper examines 3779 global publications on mobile cloud computing research, as covered in Scopus database during 2007-16, experiencing an annual average growth rate of 139.6% and qualitative impact averaged to 4.22 citations per paper. The top 10 most productive countries individually contributed global share from 2.91% to 22.41%, with largest global publication share coming from China (22.41%), followed by USA (19.32%), etc. Together, the 10 most productive countries accounted for 85.74% share of global publication output during 2007-16. Five out of 10 countries have scored relative citation index above the world average of 1: Malaysia (2.41), USA (1.87), U.K. (1.79), Canada (1.43) and Italy (1.16) during 2007-16. The international collaborative publications share of top 10 most productive countries varied from 9.74% to 67.19% in mobile cloud computing research during 2007-16.

Ranganathan and Balasubramani (2013)² studied with the Scientometric study on the publication of "Green Chemistry" research in India. The records are collected from Scopus Database for the period of 1999-2013. A total of 1448 papers were identified in scopus database. The study reveals that, most researchers preferred to publish their research results in journals; as such 88.47% of articles were published in journals. More numbers (328, 25.60%) of articles were published in 2012. The degree of collaboration in Green Chemistry was 0.95. The authorship trend shows that, out of total 1448 literature published, 96% of them or published under the joint author of publications in Green Chemistry research output. It is observed that author productivity is not in agreement with Lotka's law, but productivity distribution data partially fits the law when the value of Chi-square to 218.72.

Sudhier and Dileepkumar (2020)³ reported 25,132 biochemistry research contributions of Indian scientists covered in the Web of Science for a period of 10 years (2004-2013). The paper examines 25,132 biochemistry research contributions of Indian scientists covered in the Web of Science for a period of 10 years (2004-2013). It was found that the biochemistry research is gradually growing and average annual growth rate was 36.84 per cent. The solo research was not prevalent and team research is more in the Indian biochemistry research and 97.46 per cent publications were contributed by multi- authors. It was observed that the value of co- authorship index was generally increasing and it varied from 93 to 105 during the period of study.

3. Objectives of the Study

1. To identify and analysis the pattern of distribution of Biodiversity research output in India
2. To distinguish the year astute dissemination of publications
3. To identify the source wise distribution of publications
4. To consider the Journal wise distribution of publications
5. To verify the Bradford's law of scattering to litrature
6. To study the Institution wise distribution of publications
7. To recognize the country shrewd appropriation of publications
8. To find out the keyword wise Publications
9. To verify the Zipf's Law

3.1 Methodology

The present study targets investigating the exploration yield of researchers in the field of Biodiversity. The growth rates of output in terms of research productivity are analyzed from 1991 to 2017. The data has analyzed and classified into HistCite software it is also systematic in nature in fortifying the experimental legitimacy because of utilization of reasonable factual instruments.

4. ANALYSIS AND DISCUSSION

4.1 Growth of Publications

Table 1: Year wise Publications of Biodiversity

S.No	Publication Year	Recs	TLCS	TGCS
1	1991	2	11	24
2	1992	2	23	66
3	1993	7	32	501
4	1994	7	11	27
5	1995	8	36	317
6	1996	18	70	554
7	1997	21	195	579
8	1998	22	83	376
9	1999	25	126	455
10	2000	34	103	738
11	2001	44	157	2049
12	2002	45	60	999
13	2003	57	156	1194
14	2004	51	173	1144
15	2005	78	226	1620
16	2006	63	154	2173

17	2007	106	202	1779
18	2008	131	206	2472
19	2009	156	207	1796
20	2010	197	274	5274
21	2011	186	157	2306
22	2012	230	210	2689
23	2013	226	160	2685
24	2014	222	131	1528
25	2015	271	74	2298
26	2016	279	46	456
27	2017	298	8	127

To analysis the year wise publication of research on Biodiversity, the data has been presented from the below table-1, we could clearly see that during the period 1991 – 2017 a total of 2786 publications were published. The highest publication is 298 in 2017 with 127 Global citation scores followed by 279 papers in 2016 with 456 Global Citation Score and 271 papers in 2015 with 2298 Global Citation Scores. The lowest publication is 2 in 1991 and 1992 with 24 and 66 Global Citation Scores. It shows that even minimum numbers of records were scored higher global citations. The study also reveals all these 2787 publications have 102525 cited references it shows that there is a healthy trend in citing reference is found among the global Scientists belongs to “Biodiversity”

4.2 Source Wise Distribution of Publications

A study of data in table-2 indicates the source wise distribution of research output in Biodiversity during the period of twenty two years from 1991 to 2018. Out of various sources of publications in Biodiversity, journal articles that appeared in the journals have shown a predominant contribution (84.1%) with Global citation score is 28597 and this source occupies the first position. The source of review comes second in order (7.8 %) of sharing total research output in Bio Diversity” during the period of analysis. The source of Editorial Material comes in the third position (2.8%) with respect to total output in “Biodiversity” research during the study period.

Table 2: Shows source wise distribution of publications

S. No	Document Type	Publications	TLCS	TGCS
1	Article	2345	2858	28597
2	Review	217	217	5988
3	Editorial Material	77	79	599
4	Letter	59	43	103
5	Article; Proceedings Paper	54	77	857
6	Meeting Abstract	10	0	0
7	News Item	9	2	7

8	Review; Book Chapter	5	1	30
9	Book Review	4	0	0
10	Note	3	14	39
11	Article; Book Chapter	2	0	4
12	Article; Retracted Publication	1	0	2
13	Editorial Material; Book Chapter	1	0	0

4.3 Most Preferred Journals

Table 3 lists most preferred journals of Biodiversity research. Out of 774 journals, Current Science has published maximum 319 articles with 2582 global citation score followed by Biodiversity and conservation has published 78 articles with 1280 global citation score and Indian Journal of Traditional Knowledge has published 75 articles with 300 global citation score. It is also identified the highest TLCR values are evident in the journal of “Current Science with 414” TLCR scale measured followed by the “Biodiversity and Conservation” with 176 cited references and so on.

Table 3: Journal wise Distribution of Publications

S. No	Journal	Publications	%	TLCS	TGCS	TLCR
1	Current Science	319	11.4	662	2582	414
2	Biodiversity and Conservation	78	2.8	381	1280	176
3	Indian Journal of Traditional Knowledge	75	2.7	49	300	45
4	Plos One	55	2.0	0	934	94
5	Tropical Ecology	49	1.8	52	215	108
6	Zootaxa	45	1.6	47	219	50
7	Biological Conservation	40	1.4	156	1396	115
8	Journal of Environmental Biology	37	1.3	21	113	26
9	Environmental Monitoring And Assessment	36	1.3	68	282	84
10	Indian Journal of Geo-Marine Sciences	35	1.3	7	33	19
11	Conservation Biology	27	1.0	129	668	49
12	Journal of The Indian Society of Remote Sensing	23	0.8	22	67	62
13	National Academy Science Letters-India	23	0.8	7	35	6

14	Mycotaxon	22	0.8	8	123	7
15	Proceedings of the National Academy of Sciences India Section B-Biological Sciences	22	0.8	3	42	11
16	Mycosphere	21	0.8	6	40	11
17	Journal of Forestry Research	20	0.7	3	40	80
18	Environmental Conservation	18	0.6	52	373	18
19	Forest Ecology And Management	17	0.6	60	357	36
20	Journal Of Mountain Science	17	0.6	14	48	56
21	Aquatic Ecosystem Health & Management	16	0.6	6	28	14
22	Environmental Management	16	0.6	15	118	69
23	Agriculture Ecosystems & Environment	15	0.5	33	255	35
24	Ambio	15	0.5	88	803	17
25	Ecological Modelling	15	0.5	12	127	10
26	Genetic Resources And Crop Evolution	15	0.5	16	228	11
27	Indian Journal of Animal Sciences	15	0.5	0	10	1
28	International Journal of Sustainable Development and World Ecology	15	0.5	19	106	13
29	Ecological Engineering	14	0.5	22	145	38
30	Mountain Research and Development	14	0.5	26	160	20

4.4 Bradford's law distribution

The Bradford's law was formulated in the year 1934⁽⁵⁾. According to Bradford's distribution the relationship between the zone is 1: a: a², while the relationship in each zone of the present study is 18:33:407 which does not fit into Bradford's distribution. As per Bradford's formulation, it should be 3:9:27, whereas the observed number of journals in the three zones stands as 18:33:407.

Table 4: Bradford's Law of scattering (774 Journals) of Biodiversity Research Publications

S.No	No. of Journals	No. of Articles	Total no. of Articles	Cumulative No. of Articles
1	1	319	319	319

2	1	78	78	397
3	1	75	75	472
4	1	55	55	527
5	1	49	49	576
6	1	45	45	621
7	1	40	40	661
8	1	37	37	698
9	1	36	36	734
10	1	35	35	769
11	1	27	27	796
12	2	23	46	842
13	2	22	44	886
14	1	21	21	907
15	1	20	20	927
16	1(18)	18	18	945(929)
17	2	17	34	979
18	2	16	32	1011
19	6	15	90	1101
20	4	14	56	1157
21	4	13	52	1209
22	3	12	36	1245
23	7	10	70	1315
24	6	9	54	1369
25	7	8	56	1425
26	18	7	126	1551
27	12	6	72	1623
28	23	5	115	1738
29	33(127)	4	132	1870(925)
30	66	3	198	2068
31	156	2	312	2380
32	407(629)	1	407	2787(917)
Total	774		2787	

It is a clear indication that core zone is much concentrated and the other zone is much extended and that shows the scattering of information in Biodiversity is more. When this analysis is done for a wider range of periods, the extent of scattering can get increased. Hence the analysis of data clearly discounts Bradford's law of scattering

4.5 Institution Wise Growth Rate:

The study of institution wise growth rate in Biodiversity research output is considered to be an important attribute of scientometric analysis. Contingent upon the nature and inert elements of the establishment, the exploration success is by all accounts more prominent or lesser. In general, institutions which are explicitly implied for research exercises would contribute a more noteworthy degree of exploration distributions and it isn't sufficient of wanted degree of desires in different institutions.

The analysis of the table 5 given below indicates Institution wise research output. It is noted that out of the 2786 records of the publication, Indian Institute of science had contributed the highest number of research publications 114 (4.1%) and Ashoka Trust for Research in Ecology and the Environment has contributed the second highest number of research publications 105 (3.8%) and Wildlife Institute of India has contributed the third highest number of research publications with records 95 (3.4%) stands third and others.

Table 5 Institution Wise Research output

S.No	Institution	Publications	Percent	TLCS	TGCS
1	Indian Inst Sci	114	4.1	313	3178
2	Ashoka Trust Res Ecol & Environm	105	3.8	303	2032
3	Wildlife Inst India	95	3.4	214	2524
4	Pondicherry Univ	71	2.5	253	1887
5	Banaras Hindu Univ	67	2.4	118	971
6	Univ Delhi	67	2.4	136	1301
7	Nat Conservat Fdn	64	2.3	160	1269
8	CSIR	57	2.0	27	1548
9	GB Pant Inst Himalayan Environm & Dev	56	2.0	104	592
10	Chinese Acad Sci	45	1.6	66	3268
11	Nat Hist Museum	36	1.3	115	1539
12	Assam Univ	35	1.3	23	160
13	Goa Univ	35	1.3	8	266
14	Natl Ctr Biol Sci	35	1.3	71	1819
15	Annamalai Univ	34	1.2	23	358
16	Indian Inst Technol	34	1.2	30	794
17	Natl Inst Oceanog	34	1.2	28	832
18	Univ Massachusetts	32	1.1	189	1003
19	Indian Space Res Org	31	1.1	46	168
20	Indiana Univ	31	1.1	115	2562
21	Jawaharlal Nehru Univ	31	1.1	72	1826
22	French Inst Pondicherry	30	1.1	46	316
23	Tata Inst Fundamental Res	29	1.0	35	746
24	Univ Kashmir	29	1.0	48	255

25	ATREE	28	1.0	60	469
26	Indian Agr Res Inst	28	1.0	11	331
27	Salim Ali Ctr Ornithol & Nat Hist	28	1.0	45	186
28	Univ Agr Sci	28	1.0	46	236
29	Zool Survey India	28	1.0	51	400
30	Cent Agr Univ	27	1.0	32	115

4.6 Country Wise Research Output of Biodiversity

Table 6 indicates Country wise research output of Biodiversity literature covered by the study period. Totally 131 countries have contributed 2786 records with 6941 TLCS and 190785 global citation scores earned and shared publications of total research output. It is observed that the country wise analysis of the research output related to biodiversity indicates the following results. The India has the highest productivity and highest local and global citation scores measured and it stands first rank among 131 countries. India has 2735 (98.1%) of output with 3112 Local citation and 34786 global citation scores measured. Next productivity country of USA has the highest publications 337 (12.1%) of articles and it stands second position with 682 Local citation scores and 13432 global citation scores measured; followed by UK has produced 181 (6.5%) of publications with 325 local citation and 9557 global citation values measured and it stands third rank position.

Table: 6 Country wise Research output of Biodiversity

S.No	Country	Recs	Percent	TLCS	TGCS
1	India	2735	98.1	3112	34786
2	USA	337	12.1	682	13432
3	UK	181	6.5	325	9557
4	Germany	106	3.8	90	4692
5	Peoples R China	98	3.5	110	4796
6	Australia	96	3.4	150	6231
7	Canada	91	3.3	144	7225
8	France	91	3.3	135	4685
9	Netherlands	64	2.3	104	6055
10	Italy	63	2.3	141	5176
11	South Africa	56	2.0	77	5528
12	Switzerland	56	2.0	91	4239
13	Brazil	46	1.7	56	3083
14	Sweden	40	1.4	72	3650
15	Belgium	39	1.4	135	3924
16	Japan	38	1.4	51	2946
17	Spain	36	1.3	32	1465

18	Kenya	34	1.2	53	3586
19	Mexico	34	1.2	60	4106
20	Nepal	33	1.2	51	901
21	Unknown	31	1.1	50	315
22	Denmark	27	1.0	22	1991
23	South Korea	25	0.9	15	968
24	Thailand	25	0.9	31	1116
25	Norway	24	0.9	43	3249
26	Sri Lanka	24	42	849	26
27	Malaysia	23	33	1652	27
28	Philippines	23	42	2682	28
29	Singapore	22	127	1967	29
30	New Zealand	21	34	2215	30

4.7 Documentation of Keywords Appeared in the Publications

Publications pass on exactly the idea substance of the papers. The strength of data focused on the content of the papers is more than the remainder of the segment of the papers. Subsequently, if a word happens more often than anticipated it to happen, at that point it mirrors the accentuation given by the authors about the exploration field of their advantage.

The significant words are called “Keyword” are perhaps the best pointer to comprehend and get a handle on momentarily the idea substance of the papers, methodologies used and areas of research addressed to the high frequency keywords were “INDIA” is topped with 1120 records with first rank of the frequency and the Global Citation Score of 8684. The next word follows as “Biodiversity” with 543 records with second rank of the frequency and global citation score of 8049 as well as follows the publications. It is identified from these analyses of TLCS, TGCS the “India” has scored the highest Global Citation Score of 8684 followed by the “Biodiversity” that has scored the second highest Global Citation Score of 8049 respectively.

Table 7: Word Wise Distribution of Research Output

S.No	Word	Recs	%	TLCS	TGCS
1	India	1120	40.2	1635	8684
2	Biodiversity	543	19.5	1184	8049
3	Diversity	376	13.5	503	4430
4	Species	310	11.1	397	3219
5	Western	305	10.9	943	3120
6	Conservation	297	10.7	668	4195
7	Ghats	277	9.9	945	2978
8	Forest	267	9.6	583	3119
9	Tropical	181	6.5	486	3002
10	Plant	154	5.5	273	2078

11	Indian	153	5.5	153	1187
12	New	145	5.2	159	1081
13	Himalaya	133	4.8	244	1402
14	Assessment	121	4.3	270	1639
15	Using	120	4.3	191	1288
16	Forests	113	4.1	272	1518
17	Management	107	3.8	108	996
18	Case	105	3.8	148	825
19	Distribution	103	3.7	180	1065
20	Community	102	3.7	97	959
21	Analysis	90	3.2	139	762
22	Change	87	3.1	113	2421
23	Structure	83	3.0	119	675
24	Genetic	82	2.9	31	662
25	Eastern	80	2.9	147	575
26	Pradesh	80	2.9	88	440
27	South	80	2.9	139	747
28	Based	79	2.8	112	780
29	Communities	78	2.8	100	721
30	Southern	78	2.8	134	751

4.8 Zipf's Law of word occurrence

Zipf's law⁽⁸⁾ states that "in a long textual matter if words are arranged in their decreasing order of frequency, then the rank of any given word of the text will be inversely proportional to the frequency of occurrence of the word".

i.e. $rf = c$

where r = rank, f = frequency and c is constant

Taking log on both the sides, $\log(f) + \log(r) = \log c$

Or $\log(f) + \log(r) = c$ (where c is constant)

To apply this law, the words collected from the title of the articles and ranked according to their frequency of occurrence in decreasing order.

Word: India

Frequency: 1120

Rank: 1

Log of frequency + log of rank

Log 1120 + log 1

= 7.02 + 0

= 7.02 word

Thus, it is proved that Zipf's law is valid even today.

Table 8: Ranking of Word Occurrence in Zipf's Law

S.No	Word	Records(f)	Rank(R)	Log (f)	Log (r)	Log (c)
1	India	1120	1	7.02	0	7.02
2	Biodiversity	543	2	6.30	0.69	6.99
3	Diversity	376	3	5.93	1.10	7.03
4	Species	310	4	5.74	1.39	7.12
5	Western	305	5	5.72	1.61	7.33
6	Conservation	297	6	5.69	1.79	7.49
7	Ghats	277	7	5.62	1.95	7.57
8	Forest	267	8	5.59	2.08	7.67
9	Tropical	181	9	5.20	2.20	7.40
10	Plant	154	10	5.04	2.30	7.34
11	Indian	153	11	5.03	2.40	7.43
12	New	145	12	4.98	2.48	7.46
13	Himalaya	133	13	4.89	2.56	7.46
14	Assessment	121	14	4.80	2.64	7.43
15	Using	120	15	4.79	2.71	7.50
16	Forests	113	16	4.73	2.77	7.50
17	Management	107	17	4.67	2.83	7.51
18	Case	105	18	4.65	2.89	7.54
19	Distribution	103	19	4.63	2.94	7.58
20	Community	102	20	4.62	3.00	7.62
21	Analysis	90	21	4.50	3.04	7.54
22	Change	87	22	4.47	3.09	7.56
23	Structure	83	23	4.42	3.14	7.55
24	Genetic	82	24	4.41	3.18	7.58
25	Eastern	80	25	4.38	3.22	7.60
26	Pradesh	80	25	4.38	3.22	7.60
27	South	80	25	4.38	3.22	7.60
28	Based	79	28	4.37	3.33	7.70
29	Communities	78	29	4.36	3.37	7.72
30	Southern	78	29	4.36	3.37	7.72

5. Major Findings:

Based on the analysis undertaken the present study, the following findings are drawn.

- ✚ The findings of Indian research productivity in Biodiversity has the highest publication as 298 in the year 2017 with 127 Global Citation Scores followed by 279 papers in 2016 with 456 Global Citation Score and 271 papers in 2015 with 2298 Global Citation Scores. The lowest publication is 2 in 1991 and 1992 with 24 and 66 Global Citation

- ✚ The study found that the total research output of the Biodiversity for the study period (1991 – 2017) published in 774 journals. As the major portion of the research productivity (40.3%) covered by 30 journals that is coincide with the theory of Bradford’s Law of scattering of journals in research productivity.
- ✚ Top 30 institutions were contributed 1364(48.8%) articles of the total research productivity.
- ✚ The study found that the country wise analysis of the research output related to biodiversity indicates the following results. The India has the highest productivity and highest local and global citation scores measured. USA and UK has the next highest productivity of Biodiversity.
- ✚ The formulated of the applicability of Bradford’s law of scattering in various journals is identified as invalidated.
- ✚ It is identified from keyword analyses of TLCS, TGCS the “India” has scored the highest Global Citation Score of 8684 followed by the “Biodiversity” that has scored the second highest Global Citation Score of 8049 respectively.
- ✚ The formulated of the applicability of Zipf’s law of is identified as validated.

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