

Biodiversity: A Scientometric Analysis of Publications Output from India During 2003–2012

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Abstract

The study analyzes the biodiversity research output carried out during 2003–12 on different parameters including; share and citation impact, international collaborative papers, contribution of various subject fields, productivity and citation profile of top Indian institutions and authors. The Web of Science Database has been used to retrieve data for 10 years (2003–12). RCI and ACCP were applied to evaluate the scientific impact of publications. India holds 13th rank among the productive countries in biodiversity research consisting of 1,206 papers with a global publication share of 3.01%.

Keywords: Biodiversity research, scientometric analysis, citation, web of science

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INTRODUCTION

Biodiversity, which is short for biological diversity, is a term coined to describe the immense variety and richness of life on the earth. The term is coined by Walter G. Rosen in 1986 and during 1990s; this term has become very widely used in the scientific circles. It is now widely used by the general public, environmental groups, conservationists, industrialists and economists. Biodiversity has gained a very high profile in the national and international political arena. It includes many species that exist and diversity of populations that make up species, the genetic diversity among individual life forms and many different habitats and ecosystems around the globe. India is among the world's top 12th mega-biodiversity national and stands quite high in the total number of living species. Belsare [1], it contains about 20% of the world's biodiversity on 2% of the earth surface. Biodiversity is the variety of all species, the genetic information they contain and the ecosystems they form. The research on biodiversity has been increasing since, last 10 years and something has to be done to counteract the loss of species. Environmentalists and ecologists conduct research to better understand biodiversity, quantify its loss and develop strategies for conserving it. By monitoring biodiversity, environmentalists and ecologists study species

abundance, functions, and their importance to enhance the quality of life.

REVIEW OF LITERATURE

The investigator has carried out an extensive related literature survey from Library and Information Science Abstracts (LISA), Library Information Science & Technology Abstracts (LISTA), EBSCO, Web of Science, Google Scholar during the period 1969, till date.

Following are the selected review of articles from the above sources:

Garg *et al.* [2], conducted a scientometric analysis of the Global Climate Change (GCC) literature to identify the patterns, trends and biases in this research field. Principal component analysis revealed a temporal difference in the keywords associated with each article.

In the first year, they observed that the most frequent keywords indicated worry about the main causes of global climate change, but this shifted in more recent years towards keywords indicating concern with the effects of climate change on biodiversity. Jing *et al.* [3], conducted a study on conservation biology using WOS and Chinese Journals Full-Text Database. The results indicated that core research groups working in the field of conservation biology in China have been

already formed; although the distribution of research groups was scattered over institutions and universities. Konur [4], conducted a bibliometric analysis of all biological invasions-related publications in the Science Citation Index. The indicator, Citation Per Publication (CPP) was used to evaluate the impact of articles, journals and institutions. In the 3323 articles published in 521 journals, 7261 authors from 1905 institutions of 100 countries were participated. As the most productive country of biological invasions research, the US will benefit from more collaboration between institutions, countries, and continents. In addition, analysis of keywords was applied to reveal research trends. Morrone [5], conducted a bibliometric analysis to evaluate global scientific production of Geographic Information System (GIS) papers from 1997–2006 in Science Citation Index. Results indicated that, GIS research steadily increased over the period and the annual paper production in 2006 was about three times higher comparing to 1997's paper productions.

Nabout *et al.* [6], conducted a bibliometric analysis on general trends in world biogeographic literature records using Science Citation Index. Results showed that, USA is the top producing country. According to Pinto [7], there is a growing trend in the number of publications about reserve selection. The objective of their study was to quantify the trends in literature within this sub-area of conservation biology using scientometric analysis. Qiu & Chen [8], the present study explores the characteristics of the literature on the biogas published during the last three decades based on the Science Citation Index Expanded (SCIE) and Social Sciences Citation Index (SSCI) and its implications using the scientometric techniques. The results of this study reveals that the research output on the biogas and the citations received have grown exponentially during this period especially during the last decade with paralleling enormous changes in the research landscape.

OBJECTIVES OF THE STUDY

- To identify the type of documents published by Indian scientists.
- To examine the growth of Biodiversity literature over the period (2003–2012).
- To study the geographical distribution of the research output.
- To examine the pattern of output according to performing sectors and the impact of the output as seen by Relative Citation Impact (RCI) and Average Citation per paper (ACPP).
- To identify prolific institutions involved in biodiversity research and to study their citation impact.
- To study the researches profile of top 10 most productive authors.
- To study research output in context of different subjects.
- To determine the funding agencies of biodiversity.

DATABASE AND METHODOLOGY USED

The academic publications were gathered related to biodiversity research based on the Science Citation Index-Expanded (SCI-EXPANDED), Social Sciences Citation Index (SSCI) and Arts & Humanities Citation Index (A & HCI) using the Web of Science Database. WOS is the most frequently used index for scientific output analysis and also identified as the most appropriate. A search was carried out in WOS Database to get an overall picture of the size of the Biodiversity Literature. The data was searched by topic (TS) "Biodiversity". Further, the data was restricted to Indian contributions on biodiversity by limiting it to the period between 2003 and 2012. On the basis of using this searching strategy, a total of 1206 publications were identified in WOS Database as being biodiversity research. Finally, the evaluation was based on parameters including authors, citation, countries, institutions, growth rate, document types and subject areas.

RESULTS

Type of Documents Published

Table 1 indicates that the Indian scientists contributed 1206 items under the eight different document categories. Out of the 1206 items, 1037 (85.70%) were Articles, followed by 84 (6.94%) Reviews, 43 (3.55%) Editorial materials, 35 (2.89%) Letters, 32 (2.65%) Proceeding papers, 4 (0.33%) each were Meeting abstracts & News items and 3 (0.25%) Book reviews.

Table 1: Type of Documents Published.

Sl. No	Document Types	TP	% of TP
1	Articles	1037	85.70%
2	Reviews	84	6.94%
3	Editorial materials	43	3.55%
4	Letters	35	2.89%
5	Proceedings papers	32	2.65%
6	Meeting abstracts	4	0.33%
7	News items	4	0.33%
8	Book reviews	3	0.25%

Note: TP= Total Publication

Publishing Countries

All publishing countries and their share of biodiversity research publications were also identified and calculated. An exercise was carried out to determine the top 20 publishing countries. Table 2 show, the top publishing country on biodiversity research was the USA with 11,146 (27.86%) publications followed by England (11.64%), Australia (8.72%), and others. The number of Indian productivity in biodiversity research is 1,206 publications (3.01%) placed it on 13th world ranking.

India's Research Output, International Collaboration, Share in Biodiversity

The Indian cumulative publications output in biodiversity research consists of 1206 papers, during the period 2003–2012, with the average number of papers per year as 120.6. Considering the international collaboration, India contributed 30.18% share of 364 international collaborative papers. The analysis of year of publication shows that there is constant increase in the number of papers

from 2003–2010. The Indian publications on biodiversity research received 6531 citations, registering an impact of 5.42 citations per paper. The disciplinary research trends in biodiversity research shows that major publications are made in disciplines of Environmental Science and Ecology in each year ranging from 2003–2012 as shown in the below Table 3.

Table 2: World's Output and Ranking of Productive Countries in Biodiversity Research.

Rank	Countries	TP	% of TP
1	USA	11146	27.86%
2	England	4657	11.64%
3	Australia	3491	8.72%
4	Germany	3367	8.42%
5	France	2893	7.23%
6	Canada	2631	6.58%
7	Spain	2321	5.80%
8	Italy	2100	5.25%
9	Brazil	2094	5.23%
10	China	1624	4.06%
11	Netherlands	1537	3.84%
12	Switzerland	1330	3.32%
13	India	1206	3.01%
14	Sweden	1203	3.01%
15	South Africa	1188	2.97%
16	Scotland	952	2.38%
17	Mexico	930	2.32%
18	New Zealand	881	2.20%
19	Belgium	859	2.15%
20	Finland	787	1.97%
	Total	40,014	

Table 3: Indian Research Output, International Publication Share and Its Citation.

Year	TP	Discipline Share	ICP	ICP share (%)	TC	ACPP
2003	57	Environmental Sciences (20; 46.93%)	10	17.54%	625	11.02
2004	51	Ecology (15; 29.4%)	10	19.61%	628	12.35
2005	78	Environmental Sciences (21; 26.9%)	14	17.95%	845	10.83
2006	61	Environmental Sciences (18; 29.5%)	18	29.51%	909	14.90
2007	106	Ecology (23; 21.7%)	40	37.74%	821	7.75
2008	130	Environmental Sciences (27; 20.76)	33	25.38%	887	6.82
2009	155	Ecology (40; 25.8)	54	34.84%	541	3.49
2010	194	Environmental Sciences (54; 27.8%)	57	29.38%	957	4.93
2011	182	Environmental Sciences (34; 18.7%)	57	31.32%	256	1.41
2012	192	Environmental Sciences (51; 26.56%)	71	36.98%	62	0.32
Total	1206		364	30.18%	6531	5.42

Note: ICP= International Collaborative Papers, TC= Total Citation, ACCP Average Citation Per Paper

Table 4: The Most Top 10 Publishing Authors.

Sl. No.	Authors	TP	% of TP	TC	ACPP	h-Index
1	Singh, R K	23	1.89%	35	1.52	3
2	Nagendra, H	22	1.81%	285	12.95	9
3	Roy, P S	19	1.56%	89	4.68	7
4	Bhat, D J	14	1.15%	20	1.43	3
5	Davidar, P	14	1.15%	74	5.29	4
6	Kumar, A	14	1.15%	67	4.79	5
7	Bawa, K S	13	1.07%	151	11.62	7
8	Murthy, M S R	13	1.07%	52	4	4
9	Parthasarathy, N	13	1.07%	110	8.46	6
10	Kumar, S	12	0.98%	11	0.92	2
	Total	157	7.68%	894	5.69	

Research Profile of Productive Indian Authors in Biodiversity

Based on the sample of 1206 papers, an exercise was carried out to determine the top most publishing 10 authors in the Biodiversity. As shown in Table 4, top 10 authors published between the range of 11 and 23 papers. The most publishing author was Singh R. K. (23) followed by Nagendra H. (22), Roy P. S. (19), Bhat D. J. (14), and Kumar A. (14) on ‘Biodiversity Research’. Table 4 also contains information on the number of papers, average citation value and H-index as found from the citation tool of the Web of Knowledge Database, concerning all the papers published in the area of ‘Biodiversity Research’. Nagendra H. had 22 papers published with 12 Citation Per Paper on average with H-index of 9, suggesting that he is a senior most researcher working in the field of biodiversity.

Relative Citation Impact (RCI)

This indicator was developed by ISI to measure both the influence and visibility of a nation’s research in global perspective. Tian [9], demonstrates $RCI = \frac{\text{A Country’s share of World Citation}}{\text{Country’s share of world publication}}$.

$RCI=1$ indicates that country’s citation rate is equal to world citation rate; $RCI>1$ indicates that country’s citation rate is higher than world’s citation and $RCI<1$ indicates that country’s citation rate is less than the world’s citation rate.

In the present case, the indicator has been used for examining the impact of performing sectors and most prolific institutions and the country has been replaced with performing sector or institution.

Table 5: Distribution of Output According to Performing Sectors.

Sl. No.	Name of Funding Agency	TP	Share	TC	RCI	ACPP	H-Index
1	Department of Biotechnology Govt. of India	40	3.32%	95	0.44	2.38	4
2	CSIR	39	3.23%	49	0.23	1.26	4
3	Department of Science and Technology Govt. of India	30	2.49%	100	0.62	3.33	4
4	University Grants Commission New Delhi	26	2.16%	22	0.16	0.85	3
5	Ministry of Environment and Forests Govt. of India	22	1.82%	49	0.41	2.23	3
6	National Science Foundation	18	1.49%	64	0.66	3.56	4
7	ICAR, New Delhi	10	0.83%	27	0.50	2.70	4
8	Wildlife Conservation Society	8	0.66%	34	0.78	4.25	4
9	Smithsonian Institution	6	0.50%	3	0.09	0.50	1
10	University of Delhi	5	0.41%	10	0.37	2.00	2

Note: RCI= Relative Citation Impact

Performing Sectors

Table 5 lists, different performing sectors with their total number of publications, total citations, RCI and ACPP. The highest number of papers (40 papers) were published by Department of Biotechnology, Govt. of India, followed by CSIR (39 papers), Department of Science and Technology Govt. of India (30) and UGC (30). The remaining output came from other sectors as listed in Table 5. The standing of different performing sectors judged from the values of RCI indicates that all the performing sectors had $RCI < 1$. The average value of ACPP is 2.3%. There are four performing sectors which had more the 2.3% which is DOB, DST, NCF and WCS and remaining sectors have less than average value of ACPP.

Prolific Institutions

Table 6 lists, top 20 most prolific institutions on 'Biodiversity Research'. Out of top 18 institutions which have contributed papers between the range of 15–65 papers, 9 belongs to academic sector and 8 are university's and rest belongs to other sectors like ICAR, DOB,

ATREE and DST. Among these, 'ATREE' topped the list with 65 papers followed by 'Wildlife Institute of India' with 48 papers and 'Indian Institute of Science' with 43 papers closely followed by 'Pondicherry University' with 40 papers. Impact of research output of these institutions has been examined by using the same impact indicators has been used for performing sectors. Among the 18 institutions listed in Table 6. 14 had $RCI > 1$ and was highest for National Centre for Biological Sciences (3.72) closely followed by Natural History Museum (3.22), Indian University (2.60), Wildlife Institute of India (WII) (2.24).

This implies that papers published by these institutions were cited almost twice than the average Indian papers. Goa University had the lowest value for RCI. The value of CPPY was highest than the average value for 12 institutions and it was highest (7.99) for 'National Centre for Biological Sciences'. According to the World Resources Institute, 'Biodiversity' is the variety of the world's organisms including their genetic diversity and the assemblage they form [10].

Table 6: Most Prolific Institutions and the Impact of Their Output.

Rank	Institutional Name	TP	% of TP	TC	RCI	ACPP	h-Index
1	ATREE	65	5.39%	574	1.63	8.83	13
2	Wildlife Institute of India	48	3.98%	582	2.24	12.13	11
3	Indian Institute of Science	43	3.57%	310	1.33	7.21	10
4	Pondicherry University	40	3.32%	322	1.49	8.05	11
5	University of Delhi	35	2.90%	296	1.56	8.46	9
6	Banaras Hindu University	30	2.49%	248	1.53	8.27	7
7	G B Pant Institute of Himalayan Environment & Development	28	2.32%	118	0.78	4.21	6
8	National Institute of Oceanography	22	1.82%	171	1.44	7.77	9
9	Indiana University	20	1.66%	282	2.60	14.1	9
10	Natural History Museum	20	1.66%	349	3.22	17.45	9
11	Central Agricultural University	19	1.58%	34	0.33	1.79	3
12	Annamalai University	18	1.49%	40	0.41	2.22	3
13	CSIR	18	1.49%	46	0.47	2.56	3
14	National Centre for Biological Sc.	18	1.49%	362	3.72	20.11	5
15	University of Kerala	17	1.41%	161	1.75	9.47	6
16	Goa University	15	1.24%	14	0.17	0.93	2
17	Indian Institute of Technology	15	1.24%	146	1.80	9.73	3
18	National Bureau of Plant Genetic Resources	15	1.24%	37	0.46	2.47	4

Table 7: Subject-wise Break-up of Publications on Biodiversity, 2002–2012.

Sl. No.	Research Areas	TP	%TP
1	Environmental Sciences	237	19.65%
2	Science and Technology	209	17.15%
3	Ecology	194	16.08%
4	Biodiversity Conservation	145	11.90%
5	Plant Sciences	143	11.73%
6	Agriculture	85	6.97%
7	Zoology	72	5.91%
8	Biotechnology Applied Microbiology	53	4.35%
9	Life Sciences Biomedicine	42	3.45%
10	Microbiology	41	3.36%
11	Forestry	38	3.12%
12	Marine Freshwater Biology	38	3.12%
13	Mycology	29	2.38%
14	Remote Sensing	29	2.38%
15	Oceanography	28	2.30%
16	Biochemistry Molecular Biology	27	2.22%
17	Physical Geography	24	1.97%
18	Pharmacology Pharmacy	23	1.89%
19	Genetics Heredity	20	1.64%
20	Evolutionary Biology	19	1.56%

Biodiversity Research Output in the Context of Different Subjects

Table 7 lists, the Indian research output in biodiversity research during 2003–2012 has been published in context of 20 broad subjects (as reflected in Database classifications based on Web of Science) with the highest publications output coming from Environmental Sciences (237 papers and 19.65% share), followed by Science Technology (206 papers, 17.15% share), Ecology (194 papers, 16.08% share), Biodiversity Conservation (145 papers, 11.90% share), Plant Science (143 papers, 11.73% share) etc, as shown in Table 7.

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