



RESEARCH ARTICLE

Mapping of research productivity on forestry research in India: A scientometric study

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Abstract

The term "Forestry" is combined and used as a search term in the international indexing database "Web of Science," which was first published by the Institute for Scientific Information, which international information scientist Eugene Garfield established. It is discovered that 372 scholarly publications are the result of the research conducted in international and national journals. Over 60% of the forestry research that has come out of India has been contributed by just the top 50 Organisations. According to the source database, Indian publishers have worked with 76 different nations to produce their output, which spans 87 different subject categories in the field of study. A total of 780 authors contributed to the publications. The researcher published work in a variety of open-access journals, with forestry research making up close to 50% of the total. Only a small number of papers in the gold and gold hybrid categories make up 15% of all open-access publications. Every OS green publication is a leading intern of different OA models. The results of the Indian research were also examined in terms of the top worldwide scientific publishers, who have their own reputations and a variety of publications from organizations, publishing houses, and societies. The top three publishers, Springer, Nature, Elsevier, and Taylor and Francis, account for roughly 50% of all publications.

Keywords: Research productivity, Research assessment, Scientometrics, Scholarly publications, Open access, Forestry- India

Introduction:

Measuring scientific research outcomes has become unavoidable in today's world, as the scientific literature doubles every year. Assessing the quality of research outcomes, particularly those reported in reputable indexing systems, enables young researchers and policymakers to use relevant and helpful discoveries at the proper moment. Forestry research is one of the most visible and important in the fight against global warming and deforestation. World organizations have also placed a strong emphasis, particularly in the last two decades, on protecting forest cover and biodiversity, which is gaining attraction. As

smugglers and poachers begin to employ technology and networks that inflict significant damage to forestation initiatives and the habitats of animals, the study literature on forestry and allied science finds a necessity, Ajitha, A., & Vasudevan, T. M. (2018), Prakash, M., & Jayaprakash, M. (2019).

Managing ecosystems involves the use of forests significantly. Living in this world is highly challenging because to how important forests are to maintaining the healthy lifestyles of both humans and other species. Without a healthy forest, humans and other creatures must deal with many challenges. The challenges that forests face are caused by a variety of factors, including new tree diseases, changing climate conditions, and other stressors related to climate. The researcher was interested in learning about the trends in forestry study because of the significance of forestry. Research is vital to improving the researcher's knowledge, which in turn helps the country's development. Research developments are more heavily influenced by the institutions' associated research and development divisions. The foundation for the research and its advancement are research articles that have been published in reputable publications. To determine the worth of the research and its trend, it must be reviewed by some mechanism. The main objective of a scientometric study is to assess the research

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productivity and its impact on various authors, journals, countries, and topic areas change Pautasso, 2016; Rajeswari, S., Nagarajan, M., & Rakhi, V. S. (2012), Ram, S. (2013), Salinas, L. F. C., Ochoa, G. V., & Escorcia, Y. C. (2018).

Objectives

- Measuring the Contributions to of India on forestry research during the study period (2012-2021).
- Identifying the prominent authors who have contributed the most cited works on the chosen topic "Forestry."
- To investigate the distribution of research findings in the chosen field by Journals.
- Identifying the quantum of research publications released under Open Access.
- To determine the distribution of publications by institutional grouping.
- To classify the distribution of publications on various research areas

Methodology

In the current study, a bibliometric method was applied. The investigation was limited to the years between 2012 to 2021. The research is based on Web of Science-indexed "Forestry in India" research publications. The research data was obtained from the Web of Science citation database (<https://apps.webofknowledge.com/>) using the search query (TOPIC ("Forestry") AND (LIMIT-TO (PUBYEAR,2012-2022)). The search approach produced 372 records, which were then analyzed. For the analysis, all sorts of publications were chosen. The whole bibliographic data was obtained in Plaintext (*.txt) file format from the Web of Science database. The bibliometrix R package (Version 4.1.2, released on 7.3.2023) was initially installed and loaded using R Studio.

The research data was collected, and various scientometric indicators such as Histcite, VOSviewer, and Biblioshiny were used, there are other important scientometric indicators were also applied in this study. These scientometric indicators were used in this study to

Table 1: Affiliation wise on Publications

S. No	Affiliations	Records	% of 372
1	Indian Council of Agricultural Research ICAR	63	16.89
2	Indian Council of Forestry Research Education ICFRE	31	8.311
3	Indian Institute of Technology System IIT System	28	7.507
4	Department of Space DOS Government of India	20	5.362
5	Dr Yashwant Singh Parmar University of Horticulture Forestry	19	5.094
6	Indian Space Research Organisation ISRO	18	4.826
7	Forest Research Institute FRI	17	4.558
8	Council of Scientific Industrial Research CSIR India	14	3.753
9	Banaras Hindu University BHU	13	3.485
10	CGIAR	11	2.949
11	League of European Research Universities LERU	10	2.681
12	Punjab Agricultural University	10	2.681
13	National Institute of Technology NIT System	9	2.413
14	Space Applications Centre SAC	9	2.413
15	ICAR Indian Agricultural Research Institute	8	2.145
16	National Remote Sensing Centre NRSC	8	2.145
17	Teri University	8	2.145
18	Indian Institute of Technology IIT Kharagpur	7	1.877
19	SHER E Kashmir University of Agricultural Sciences Technology of Kashmir Skuast Kashmir	7	1.877
20	Birla Institute of Technology Mesra	6	1.609
21	Hemwati Nandan Bahuguna Garhwal University	6	1.609
22	ICAR Central Soil Salinity Research Institute	6	1.609
23	ICAR National Bureau of Soil Survey Land Use Planning	6	1.609
24	Indian Institute of Remote Sensing IIRS	6	1.609
25	Indian Institute of Science IISc Bangalore	6	1.609

explore the scholarly communication growth and trends such as publication trend for the period of study, authors' affiliation and their productivity, source of journals, research areas, and exploration of citation patterns and so on, Senthilkumar, R. (2012).

Analysis and Interpretation

Indian Contributions on Forestry Publications

Indian contribution on forestry research has been culled out from the total research outcome published in various journals and other sources which are indexed in the Web of Science database have been analyzed. It reveals 372 total contributions to forestry from India, which forms 2.27% percentage of the total outcome. These publications are contributed by 87 numbers of authors, 780 numbers of research universities and contributions in India spread across the states of India, which has a score of 5060 global citations with h-Index 33. In the source database, the research also sponsored by 280 funding agencies from both India and the International level. The publications output spread out 87 subject categories in research areas as to the source database, Indian publications have collaborated with 76 countries across the globe. 780 numbers of authors contribute the total publications.

Affiliation wise Publications

The researcher has analyzed the publications from Indian nation as to the contributions of Institutions, which consist of Universities and Research Organizations, government departments and Non-Government Organizations. Of 372 total publications, Indian council of Agriculture Research (ICAR) formed 16.89% with 63 publications which is followed by Indian Council of Forest Research Education (ICFRE) with 31 publications that forms 8.3% of total Indian contributions. The third position goes to Indian Institute of Technology (IIT). All IITs with a contribution of 28 publications that forms 7.50% of total contribution from India. Department of Space and Dr. Yashwant Singh Parmar University of Horticulture positioned in fourth and fifth ranks in terms of research organizations with 20 publications and 19 publications respectively that altogether contribute 10% of the total outcomes of Indian contribution of forest research, Sivasami, K. (2021), Sivasekaran, K., & Srinivasaragavan, S. (2013).

Funding Support

Given in that the top 50 Organizations alone contributed more than 60% of the research out come in forestry from India. The researcher also distributed the records according to funding organizations as it is reflected in the source database. It is found that University Grants Commission (UGC) is the top funder contributed 5.09% of the total research records with 19 records followed by Department of Science and Technology, it is also interesting to know that

European Commission, National Natural Science Foundation of China, Dutch Academy are the funding agencies that contributed the Indian research along with German National Research Agency and French National Research Agency as International research organizations. Nearly around one third of the publications are sponsored research outcome as the evident from the data.

Author Productivity:

Top fifty authors contributed more than 50% of the research out come in forestry from India. There is no significant authors as it is given from the analysis given the top three authors contributed 2% of the total research outcome each which altogether found 7.2% of the total research outcome. The analysis shows that Kumar A, Kumar M and Kumar S being the top three authors contributed with 12 and 10 records each in forest research outcome.

Prolific Journals in India

There are number of journal publications are published from national and international journals of forest research

Table 2: Funding Support

S.No	Funding Agencies	Records	% of 372
1	University Grants Commission India	19	5.094
2	Department of Science Technology India	16	4.29
3	Council of Scientific Industrial Research CSIR India	10	2.681
4	Department of Biotechnology DBT India	8	2.145
5	European Commission	8	2.145
6	National Natural Science Foundation of China NSFC	5	1.34
7	CGIAR	4	1.072
8	Deutscher Akademischer Austausch Dienst DAAD	3	0.804
9	Indian Council of Agricultural Research ICAR	3	0.804
10	Indian Council of Medical Research ICMR	3	0.804
11	National Science Foundation NSF	3	0.804
12	Natural Sciences and Engineering Research Council of Canada NSERC	3	0.804
13	NBHM DAE Government of India	3	0.804
14	Space Application Centre Sac ISRO Ahmedabad	3	0.804
15	DFO of Saranda Forest Sail	2	0.536
16	Directorate of Research Head Department of Soil Science Punjab Agricultural University Ludhiana	2	0.536
17	Forest Department of Jharkhand	2	0.536
18	French National Research Agency ANR	2	0.536
19	German Research Foundation DFG	2	0.536

Table 3: Prolific Authors in India

S.No	Authors	Institution & Country	Records	% of 372
1	Kumar, Ashok	Forest Res Inst, Div Genet & Tree Improvement, Dehradun, Uttarakhand, India	12	3.217
2	Kumar, Manoj	FRI, GIS Centre, PO New Forest, Dehradun, Uttarakhand, India	10	2.681
3	Kumar, Subodh	Indian Inst Technology, Department Mineral Engineering, Kharagpur, West Bengal, India	10	2.681
4	Singh, Akath	Cent Arid Zone Research Institute, ICAR, Rajasthan, India	9	2.413
5	Misra, Arvind Kumar	Banaras Hindu University, Dept Math, Inst Science, Uttar Pradesh, India	8	2.145
6	Das, Ashesh Kumar	Assam University, Department Ecology & Environmental Science, India	7	1.877
7	Gupta YC	Dr Yashwant Singh Parmar University, Horticulture & Forestry, Himachal Pradesh, India	7	1.877
8	Kumar, Praveen	Centre Arid Zone Research Institute, ICAR, Rajasthan, India	7	1.877
9	Singh, Satbir	University of Jammu, School Biotechnology, Jammu, India	7	1.877
10	Kumar, Rahul	Forest Research Institute, Div Genet & Tree Improvement, Dehradun Uttarakhand, India	6	1.609
11	Sharma, Vivek	Punjab Agriculture University, Department of Soil Science, Punjab, India	6	1.609
12	Singh, Ram Kumar	TERI School Advance Studies, Department National Resources, New Delhi, India	6	1.609
13	Lata, Kusum	Banaras Hindu University, Department of Maths, Institute Science, Uttar Pradesh, India	5	1.34
14	Pandey, Shailesh	Forest Research Institute, Forest Pathol Discipline, Divisional Forest Protect, Dehradun, Uttarakhand, India	5	1.34
15	Ravindranath NH	Indian Institute of Science, Centre Sustainable Technology, Bangalore, Karnataka, India	5	1.34
16	Sharma, Anu	Indian Agriculture Research Institute, New Delhi, India	5	1.34
17	Sharma, Sandeep	Punjab Agriculture University, Dept Soil Science, Punjab, India	5	1.34
18	Singh, Rajveer	Auburn University, Department of Crop Soil & Environment Science, Soil & Environment Science, USA	5	1.34
19	Yadav RK	ICAR Cent Soil Salin Research Institute, Haryana, India	5	1.34
20	Chakrabarty, Abhisek	Vidyasagar University, Department of Remote Sensing & GIS, Midnapore, India	4	1.072
21	Chaturvedi, Rajiv Kumar	Indian Inst Science, Divisional Centre Climate Change, Bangalore, Karnataka, India	4	1.072
22	Das, Supriya	Government Degree College, Dharmanagar, Tripura, India	4	1.072
23	Dhiman SR	Dr Yashwant Singh Parmar University Horticulture & Forestry, Himachal Pradesh, India	4	1.072
24	Joshi, Pawan Kumar	Jawaharlal Nehru University, Special Centre Disaster Res, New Delhi, India	4	1.072
25	Kayet, Narayan	Indian Institute of Technology, Department of Mineral Engineering, Kharagpur, West Bengal, India	4	1.072

belong to Indian organizations. Current science, a leading publication of Indian Academy of Sciences placed in top positions with 24 publications that form 6.43% which is followed by Indian Journal of Agricultural Sciences and Range Management and Agro Forestry journal with 17 records and 7 publications respectively. There are journals that are multidisciplinary including IEEE technical journals also published forestry research in their publications. The journals also have scope of various subjects such as Biotechnology, Nano science, Bioenergy, Agronomy, Soil Science, in addition to forestry and environmental research, remote sensing, and so on.

Open Access (OA) Research of Publications

The researcher published in different kinds of open access publications, the forestry research contributed nearly around 50% in OA journals. Among different OA categories only a few are gold and gold hybrid publications that

alone considered 15% of the OA publications. All OS green publications are dominant interns of various OA models.

Publishers

The Indian research outcome also analyzed in terms of the leading publishers are international scientific publishing which are having its own reputations with a combination of society publications, publishing houses and organizational publications. Springer, nature, Elsevier, and Tailor and Francis are the top three publishers carried out nearly about 50% publications. Springer-nature has published 82 articles with 21.984% placed in the top followed by Elsevier with 72 publications with 19.3% and Tailor and Francis a leading international scientific commercial publisher with 32 publications forming 8.57% there are the society publications Indian Academies of Sciences, IEEE, Horticulture Society of India, and Institute of Physics publishing and so on. Leading publications are contributed by good number

Table 4: Prolific Journals in India

S.no	Publication Titles	Impact Factor	Records	% of 372
1	Current Science	1.102	24	6.434
2	Indian Journal of Agricultural Sciences	0.39	17	4.558
3	Range Management and Agroforestry	0.85	7	1.877
4	Agroforestry Systems	2.549	6	1.609
5	Indian Journal of Horticulture	0.24	6	1.609
6	Journal of the Indian Society of Remote Sensing	0.869	6	1.609
7	Environment Development and Sustainability	4.35	5	1.34
8	Forest Policy And Economics	3.673	5	1.34
9	IEEE Access	3.367	5	1.34
10	IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing	4.54	5	1.34
11	Environmental Monitoring and Assessment	2.513	4	1.072
12	Geocarto International	4.889	4	1.072
13	Indian Journal of Traditional Knowledge	0.757	4	1.072
14	International Forestry Review	1.90	4	1.072
15	Journal of Sustainable Forestry	1.5	4	1.072
16	Journal of Tropical Forest Science	0.90	4	1.072
17	Land Use Policy	2.292	4	1.072
18	Renewable Sustainable Energy Reviews	14.98	4	1.072
19	Tropical Ecology	1.046	4	1.072
20	Water Air and Soil Pollution	1.9	4	1.072
21	Carbon Management	3.182	3	0.804
22	Chemosphere	7.086	3	0.804
23	Environmental Science and Pollution Research	4.223	3	0.804
24	International Journal of Environmental Research and Public Health	3.39	3	0.804
25	Journal of Cleaner Production	9.297	3	0.804

Table 5: Open Access of Publications

S.No	Open Access	Records	% of 372
1	All Open Access	86	23.056
2	Gold	53	14.209
3	Gold-Hybrid	3	0.804
4	Free to Read	10	2.681
5	Green Published	27	7.239
6	Green Accepted	13	3.485
7	Green Submitted	22	5.898

of national institutions such as universities across the globe.

Research Areas of Publications

The researcher also analyzed the research outcome of Forestry from India into the different research areas as prescribed by the source database. The dominant areas are Environmental Sciences and Ecology with 125 publications forming 33.51% followed by agriculture with 17 publications forming 18.76%, Forestry with 39 publications forming 10.45%, engineering with 38 publications forming 10.18% respectively. There are other areas of Science and Technology and other topics also has had 57 publications which forms 15.282%. The publications also spread across the subjects' viz. Computer Science, Developmental Studies, Business Economics, Communications, Public Environment, and Occupational Health, Biophysics,

Table 6: Publishers

S.No	Publishers	Publishers	% of 372
1	Springer Nature	82	21.984
2	Elsevier	72	19.303
3	Taylor & Francis	32	8.579
4	Indian Academy Sciences	25	6.702
5	Wiley	20	5.362
6	Indian Council Agricultural Research	17	4.558
7	IEEE	13	3.485
8	MDPI	10	2.681
9	National Institute of Science Communication-NISCAIR	8	2.145
10	Range Management Soc India	7	1.877
11	Horticultural Soc India	6	1.609
12	Commonwealth Forestry Association	4	1.072
13	Forest Research Institute Malaysia	4	1.072
14	Frontiers Media Sa	4	1.072
15	Sage	4	1.072
16	Scientific Publishers	4	1.072
17	Northeast Forestry University	3	0.804
18	Triveni Enterprises	3	0.804
19	Agricultural Research Communication Centre	2	0.536
20	Gaurav Soc Agricultural Research Information Centre-ARIC	2	0.536
21	IGITUR, Utrecht Publishing & Archiving Services	2	0.536
22	Inst Mathematics & Informatics	2	0.536
23	IOP Publishing Ltd	2	0.536
24	PEERJ Inc	2	0.536
25	Resilience Alliance	2	0.536

Table 7: Research Areas of Publications

S. No	Research Areas	Records	%	Research Areas	Records	%
1	Environmental Sciences Ecology	125	33.512	Public Environmental Occupational Health	4	1.072
2	Agriculture	70	18.767	Biophysics	3	0.804
3	Science Technology Other Topics	57	15.282	Geochemistry Geophysics	3	0.804
4	Forestry	39	10.456	Geography	3	0.804
5	Engineering	38	10.188	Mechanics	3	0.804
6	Plant Sciences	29	7.775	Mycology	3	0.804
7	Remote Sensing	20	5.362	Public Administration	3	0.804
8	Water Resources	17	4.558	Urban Studies	3	0.804
9	Geology	16	4.29	Area Studies	2	0.536
10	Energy Fuels	14	3.753	Instruments Instrumentation	2	0.536
11	Mathematics	14	3.753	Life Sciences Biomedicine Other Topics	2	0.536
12	Imaging Science Photographic Technology	13	3.485	Materials Science	2	0.536
13	Meteorology Atmospheric Sciences	13	3.485	Pharmacology Pharmacy	2	0.536
14	Computer Science	11	2.949	Veterinary Sciences	2	0.536
15	Development Studies	11	2.949	Zoology	2	0.536
16	Biotechnology Applied Microbiology	10	2.681	Anthropology	1	0.268
17	Business Economics	10	2.681	Astronomy Astrophysics	1	0.268
18	Biodiversity Conservation	8	2.145	Cell Biology	1	0.268
19	Chemistry	8	2.145	Dermatology	1	0.268
20	Biochemistry Molecular Biology	6	1.609	Developmental Biology	1	0.268
21	Physical Geography	6	1.609	Evolutionary Biology	1	0.268
22	Telecommunications	6	1.609	Food Science Technology	1	0.268
23	Entomology	5	1.34	Genetics Heredity	1	0.268
24	Microbiology	5	1.34	Integrative Complementary Medicine	1	0.268
25	Physics	4	1.072			

Mechanics, Public Administration and Urban Studies, Area Studies, Pharmacology, and Veterinary Sciences. This shows that the interdisciplinary and multidisciplinary research approach is dominant from the Indian contributions.

Bibliographic Coupling between Countries

Bibliographic coupling occurs when two works in their bibliographies refer to the same third work. It indicates that there is a possibility that the two works are about the same subject. If two documents cite one or more documents in common, they are bibliographically coupled. This was done based on the Documents relations between the clusters. In the visualization presented in fig.18, each cluster has a color (i.e., red, green, blue, or yellow) that indicates the group to which the cluster was assigned. In this way, a breakdown of the USA and Germany derived into broad subfields is obtained.

The red clusters in the green area of the visualization seem to cover research in Finland, Norway, Poland. The red clusters in the bottom area seem to cover USA, Germany,

Brazil, Japan and Chile. The clusters in the top-left area, colored blue and violet seem to relate to research in Qatar and Israel. In particular, when the mouse is hovered over a cluster, more detailed information on the cluster is presented follows:

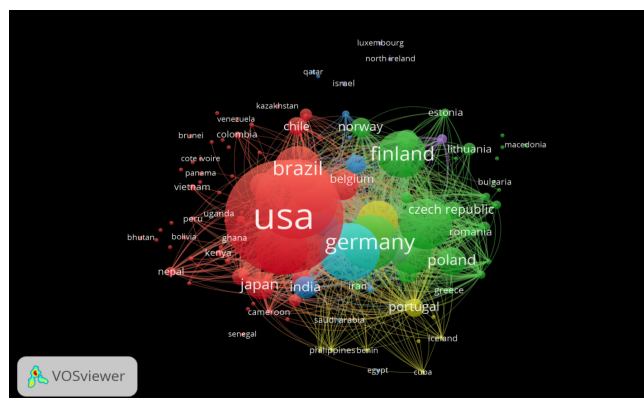


Figure 1: Bibliographic Coupling between Countries

Source: VOSviewer

In USA the visualization describes which is in cluster 1, 118 links, 2862513 total link strength with 3012 documents and 13704 citations followed by Germany in Cluster 2, 118 links, 2312749 total link strength with 1174 documents and 26736 citations next to this Sweden in Cluster 2, 115 links, 1555830 total link strength with 1063 documents and 20456 citations.

Conclusion:

Researcher has analyzed the publications from Indian nation as to the contributions of Institutions, which consists of Universities and Research Organizations, government departments and Non-Government Organizations. Of 372 total publications, Indian council of Agriculture Research (ICAR) formed 16.89% with 63 publications which is followed by Indian Council of Forest Research Education (ICFRE) with 31 publications that forms 8.3% of total Indian contributions. The third position goes to Indian Institute of Technology (IIT). All IITs with a contribution of 28 publications that forms 7.50% of total contribution from India. Department of Space and Dr. Yashwant Singh Parmar University of Horticulture positioned in fourth and fifth ranks in terms of research organizations with 20 publications and 19 publications respectively that altogether contribute 10% of the total outcomes of Indian contribution of forest research.

Top fifty authors contributed more than 50% of the research out come in forestry from India. There is no significant authors as it is given from the analysis given the top three authors contributed only two percent of the total research outcome each which altogether found 7.2% of the total research outcome. The analysis shows that Kumar A, Kumar M and Kumar S being the top three authors contributed with 12 and 10 records each in forest research outcome.

There are number of journal publications are published from national and international journals of forest research belong to Indian organizations. Current science, a leading publication of Indian Academy of Sciences placed in top

positions with 24 publications that form 6.43% which is followed by Indian Journal of Agricultural Sciences and Range Management and Agro Forest journal with 17 records and 7 publications respectively. There are journals that are multidisciplinary including IEEE technical journals also published forestry research in their publications. The journals also have scope of various subjects such as Biotechnology, Nano science, Bioenergy, Agronomy, Soil Science, in addition to forestry and environmental research, remote sensing, and so on. It is also found that India is in 17th position in the world as to the premiere indexing database in terms of research publications which needs to be further accelerate on India is in 10th position on form of world forest cover.

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