

## Dimensions of Scientometric Research in India (2000-2012): A Bibliometric Study

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### Abstract

The paper analyses the various dimensions of scientometric research in India during 2000-2012. The research data was collected from Google Scholar and Scopus data bases. Bibliometric analysis of the growth in literature, authorship pattern, themes of research, ranking of authors, source of publication, international collaboration, accessibility, etc. were made based on the citations of published literature over a period of 12 years. The study found the year 2012 as the highest productive year in scientometric research with 115 (16.66%) research papers on published in India. Highest number of papers i.e. 201 (29.13%) were authored by Two authors jointly. The highest number of publications 495 (71.73%) are subject/topic based on scientometric studies. B.M. Gupta is the most productive author 40 (5.79%). The highest affiliations of authors are National Institute of Science, Technology and Development Studies (NISTAD), New Delhi with 65 (9.42%) scientometric research publications. The international collaboration of publication has very low in India.

**Key words:** Scientometrics; Scientometric Research; Bibliometric Study.

### Introduction

Scientific research has always been playing an important role in social, economic and physical development of a country. The outcome of scientific research produces social wellbeing directly or indirectly. Thus, promotion of scientific research has become a worldwide phenomenon at each level. The usage and impact of any research particularly scientific research is being measured through bibliometric analysis of citations of research publications. Scientific publications seems to have provided the best available basis for measuring the outputs of individual scientists as there is a good correlation between the eminence of scientists and their sustained research publications (Price, 1986). Nowadays the scientometrics is used for studying mainly the quantitative aspects of science and therefore it is otherwise termed as '*science of science*'. It is considered as a complete disciplinary field with clearly outlined subjects of research, specific set of good

elaborated research methods and techniques. A well developed research community across the world are engaged with scientometric research. The international journal *Scientometrics* published since 1979 by Springer has been devoted to original studies, short communications, preliminary reports, review papers, letters to the editor and book reviews on scientometrics.

Scientometric techniques are being used for several of purposes in science like evaluation of scientific output by analyzing author collaboration, output of publication, authorship pattern, citation impact etc., can be measured by this technique. Scientometrics is a discipline which analyses scientific publications and citations appended to the papers to gain an understanding of the structure of science, growth of science at global level, performance of a country in a particular domain, performance of institutions, departments/divisions, and scientific eminence of an individual scientist. Research publications are clearly one of the quantitative measures for the basic research activity in a country. It must be added, however, that what excites the common man, as well as the scientific community, are the peaks of scientific and technological achievement, not just the statistics on publications.

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### Objectives and Scope of Research

The present study limits its scope to two citation databases Scopus and Google Scholar as source

databases. The study also has the following objectives:

- To quantify research publications in the areas of scientometric research in India.
- To study the year wise growth of scientometric research publications in India.
- To identify the most productive author and most productive institution with regard to scientometric research.
- To analyze types of scientometric research undertaken by Indian researchers.
- To find out the core journals where majority of Indian papers are published.
- To determine the authorship pattern and degree of collaboration in scientometric research in India.

#### *Methodology*

The study employs scientometric method of research. The basic data (citations of research publications on scientometric research in India) was gathered from Scopus database covering a period of 12 years, i.e. 2000 to 2012. As only a few standard papers on scientometric research from India are published in journals indexed in Scopus database, Google Scholar was also used as a data source to cover those publications which are not included in Scopus. Google Scholar is an open citation system and therefore, indexes lot many papers published/archived in varieties of sources other than the journals. The advance search option of Google Scholar was used to retrieve citations pertaining to the topic of the present research. After a careful scrutiny of the retrieved citations, a comprehensive list of 690 citations was prepared and it was further extracted, tabulated and analysed for necessary scientometric interpretations. From the master record of citations, total number of papers, type of scientometric research, degree of collaboration, and such other scientometric scores were determined and interpreted in the lines of scientometric principles.

#### *Review of Literature*

A literature review goes beyond the search for information and includes the identification and articulation of relationships between the literature and their field of research. Taking the entities of study into account, scientometric research could base on Subject/Topics, Publication Sources, countries/

institutions, individuals, etc. A few of important published literature sources have been reviewed for the present study. Gunasekaran and Balasubramani (2012), in their study "*Scientometric Analysis of Artificial Intelligence Research Output: An Indian Perspective*" analysed the artificial intelligence (AI) research output of India carried out during the year 1973 – 2011. The different parameters including authorship pattern, growth, rank with global publication, institutions contribution, most productivity journals were analysed. Scopus citation database has been used to retrieve the data for 39 years (1973-2011) by using the keywords (Artificial, Intelligence, Neural networks). The profile of India research output was compared with other countries help of scientometrics technique. Raja and Ba,asubramani (2011), in their study "*Plasmodium Falciparum Research Publication in India: A Scientometric Analysis*" studied the plasmodium falciparum research publications in India measured from *Hiscite* software and other tools. The results revealed the growth of Indian literature in plasmodium falciparum deposition and made a quantitative assessment of the research in terms of year-wise research output, geographical distribution, and nature of collaboration, characteristics of highly productive institutions and the channel of communication used by the scientists. Srinivasa, Surulinath and Neelakandan (2012) in their study "*Indian Perspective of Medicinal Plant Research: A Scientometric Study*" analysed the scientometric parameters for medicinal plant research publications. Investigators have compared the author productivity and citations by various institutions at national level.

#### *Scientometrics as a research method*

Kalyane and others (2001) in their paper "*Scientometric portrait of Ranjit Kumar Mitra*" published in *ILA Bulletin* have stated,

"Scientometrics has carved a niche between Science/Scientists and Texts. Scientometrics, Journal of the American Society for Information Science (JASIS), Information Processing and Management, Research Policy, and Science and Public Policy are the most important journals publishing articles related to scientometrics (Kalyane & Others; 2001). The majority of scientometric papers deal with empirical investigation of publications in specific scientific fields and subfields. Such research is often carried out by information science specialists and is published in information science journals. Research publications useful to scientists, experts in specific scientific fields, are scattered in many specialised journals. From the scientometric point of view

empirical investigations of this kind are of applied character. Their role is pivoted to creation of an empirical basis for scientometrics”.

#### Classification of Scientometric Methods

There are some classifications of the scientometric methods and models, submitted mainly by representatives of the Russian school of scientometrics. Haitun (1983) divides the scientometric methods into several classes: statistical method with measures – number of discoveries, number of journals, number of institutions, number of scientists, frequency of co-authorships, and some others; a method of publication counting with a measure – number of research products (articles, monographs, patent descriptions, reports, etc.); citation index with a measure – number of citations; text analyses (content analysis, thesaurus and slang method) with measures – different text entities.

W. Glänzel (2003) divides the scientometrics and its methods into the following structural entities:

- *Dynamical Scientometrics*, handling with the construction of comprehensive models of growing of the scientific knowledge, the aging of the scientific information, the development of the citation processes, etc.;
- *Structural Scientometrics*, corresponding mainly with the problem “mapping of the cognitive structure of scientific knowledge”, based on methods as co-citation, bibliographic coupling or co-word analysis;
- *Evaluative Scientometrics*, with a subject – the assessment in the sphere of scientific research, and for the purposes of the science policy;
- *Prognostic Scientometrics*, drawing visions about the development of the science processes in the future.

### Data Analysis and Discussion

#### Growth of research publications

The growth of research publication presented in the Table.1 presents the data relating to growth of scientometrics research in India over a period of 12 years i.e. during 2000-2012. It is evident from the data as reflected in the table above that, the research publications in scientometrics is persistently increasing from only 27 publications in 2000 to 115 publications in 2012. The year 2012 stood as the

highest productive year in which 115 (16.66%) research papers on scientometrics were published in India.

**Table 1:** Year-wise growth of scientometrics research publications in India

Year	Number of Research Papers Published (N=690)	Percentage (%)
2000	27	3.91
2001	35	5.07
2002	35	5.07
2003	16	2.31
2004	24	3.48
2005	33	4.78
2006	30	4.35
2007	36	5.22
2008	48	6.96
2009	113	16.38
2010	65	9.42
2011	113	16.38
2012	115	16.67
Total=690		100.00

#### Authorship Pattern

Table-2 below indicates that the highest number of papers, i.e, 201 (29.13%) have been authored by two authors jointly followed by 191 (27.68%) by single author. While 149 (21.59%) and 60 (8.69%) publications authored by three and four authors respectively, 89 (12.89%) articles are authored by more than four authors. Data relating to authorship pattern as above is evident that collaboration of two authors in scientometrics research has produced highest number of articles.

**Table 2:** Authorship pattern of publications

Authorship Pattern	Nos. of Publications	Percentage (%)
Single author	191	27.68
Two authors	201	29.13
Three authors	149	21.59
Four authors	60	8.69
More than four authors	89	12.89

#### Types of Scientrometric Research

Any scientometric study/research has a theme which is mainly classified into four broad categories such as Subject/Topic based, Source of publication based, institution based or based on individuals. Out of 690 citations of scientometric publications in India used in this study highest number of publications i.e. 495 (71.73%) are subject/topic based studies. The second highest rank of type of scientometric research is ‘source of publication’ base mostly journals. Next

to this, 'institution' based scientometric studies is the third major types of research in India with 51

(7.1%) publications. A few studies have also been conducted on scholarly contributions of individual scientists, academicians, etc.

**Table 3:** Distribution of papers by theme of research

Type of Scientometric Study	Nos. of publications	Percentage (%)
Subjects/Topics	495	71.73
Publication sources (Journals)	77	11.16
Institutions	51	7.34
Individuals	35	5.07
Others	32	4.64
Total	690	100%

### Ranking of Authors

**Table 4:** Ranking (Top Ten) of authors by their productivity

Name of Authors	Affiliation	Number of Contributions (n=690)	Percentage (%)
Gupta, B. M.	National Institute of Science, Technology and Development Studies (NISTADS) New Delhi	40	5.79
Kademani, B. S.	Bhabha Atomic Research Centre, Mumbai	33	4.78
Garg, K.C.	National Institute of Science, Technology and Development Studies (NISTADS) New Delhi	29	4.20
Kumar, Vijai	Bhabha Atomic Research Centre (BARC) in Trombay, Mumbai	23	3.33
Kalyane, V.L.	Bhabha Atomic Research Centre (BARC) in Trombay, Mumbai	17	2.46
Sagar, Anil	Bhabha Atomic Research Centre (BARC) in Trombay, Mumbai	15	2.17
Bala, Adarsh	Government Medical College & Hospital, Sector 32, Chandigarh.	10	1.44
Kumar, Suresh	Bhabha Atomic Research Centre (BARC) in Trombay, Mumbai	10	1.45
Arunachalam, S.	M S Swaminathan Research Foundation (MSSRF), Chennai	10	1.45
Kumar, Anil	Bhabha Atomic Research Centre (BARC), Trombay, Mumbai	9	1.30
Dhawan, S.M.	Information Consultant, New Delhi	9	1.30

### Ranking of Institutions

Affiliation of authors is another important indicator of research productivity. The present research has also identified such a trend of "vital few" institutions contributing to scientometric research in India. Table-4 reveals that, the highest affiliations of authors are from National Institute of Science, Technology and Development Studies (NISTAD), New Delhi with 65 (9.42%) publications. The institution ranked second in the productivity of scientometrics publications is Scientific Information Resource Division, Bhabha Atomic Research Centre (BARC), Mumbai with 44 (6.37%) publications. The publications of these two institutions alone constitute more than 15% of the research publications in

scientometrics from India. The other institutions who have more than 1% publications are Annamalai University (Tamilnadu), Bharathidasan University (Tirichirapalli) and Indian Institute of Science (Bangalore).

### Sources of Publications

In the present research found that highest number of scientometric publications in India was published in *Scientometrics* journal. 136 (19.71%) papers were published in this journal. The second highest source of publications is Handbook of Research on Innovations in Database Technologies and Applications: Current and Future Trends where 63

**Table 5:** Ranking of institutions by author affiliation in scientometrics publications in India

Affiliation of authors	Nos. of Papers (N=690)	Percentage
National Institute of Science, Technology and Development (NISTAD) Studies, New Delhi <a href="http://www.nistads.res.in/">http://www.nistads.res.in/</a>	65	9.4
Scientific Information Resource Division, Bhabha Atomic Research Centre (BARC), Mumbai <a href="http://www.barc.gov.in">http://www.barc.gov.in</a>	44	6.4
Annamalai University, Tamilnadu <a href="http://annamalaiuniversity.ac.in/">http://annamalaiuniversity.ac.in/</a>	9	1.3
Bharthidasan University, Tiruchirappalli <a href="http://www.bdu.ac.in/">http://www.bdu.ac.in/</a>	9	1.3
Indian Institute of Science, Bangalore <a href="http://www.iisc.ernet.in/">http://www.iisc.ernet.in/</a>	8	1.1
Department of Library and Information Science, Sambalpur University, Orissa <a href="http://www.suniv.ac.in/">http://www.suniv.ac.in/</a>	6	0.8
M. S. Swaminathan Research Foundation Chennai, India <a href="http://www.mssrf.org/">http://www.mssrf.org/</a>	6	0.8
Information and Library Network Centre (INFLIBNET), Ahmedabad <a href="http://www.inflibnet.ac.in/">http://www.inflibnet.ac.in/</a>	4	0.6
ManonmaniamSundaranar University, Tirunelveli, Tamil Nadu <a href="http://www.msuniv.ac.in/">http://www.msuniv.ac.in/</a>	3	0.43
Centre Studies Science Policy, Jawaharlal Nehru University, New Delhi <a href="http://www.jnu.ac.in/">http://www.jnu.ac.in/</a>	3	0.43
Indian Institute of Chemical Technology, Hyderabad <a href="http://www.iictindia.org/">http://www.iictindia.org/</a>	3	0.43
Indian Statistical Institute, Kolkata <a href="http://www.isical.ac.in/">http://www.isical.ac.in/</a>	3	0.43

(9.13%) papers were published. The *Handbook of Research on Innovations in Database Technologies and Applications: Current and Future Trends* provides a wide compendium of references to topics in the field

of database systems and applications. *Annals of Library and Information Studies* is the third position in ranking of sources of publications with 39(5.65%) paper is published.

**Table 6:** Distribution of papers by sources of publication

Sources of Publication	Nos. of Papers (N=690)	Percentage
Scientometrics	136	19.71
Handbook of Research on Innovations in Database Technologies and Applications: Current and Future Trends	63	9.13
Annals of Library and Information Studies	39	5.65
Malaysian Journal of Library & Information Science	31	4.49
Current Science	28	4.05
DESIDOC Bulletin of Information Technology	25	3.62
Library Philosophy and Practice	15	2.17
Indian Journal of Information Sources and Services	13	1.88
SRELS Journal of Information Management	8	1.15
International Journal of Nuclear Knowledge Management	8	1.16
Social Sciences Research Network	7	1.01
COLLNET Journal of Scientometrics and Information Management	6	0.87

*International Collaboration in India*

During the recent years, international collaboration in science has increased so as

collaboration in scientometric research. Table-6 evidences that, even though greater international collaboration in scientific research in general,

scientometric research in India has a very low level of collaboration. Out of 860 papers, only 15(2.17%) paper are having international collaboration

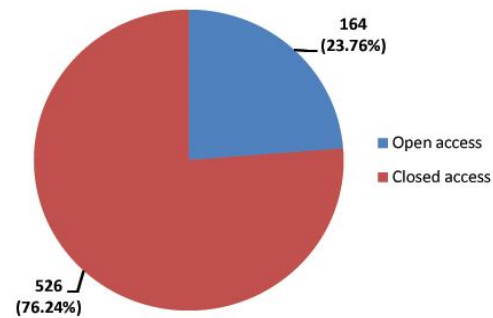
#### Accessibility to Scientometric Publications

The usability of research publications and citations to them are highly reliant on their accessibility. Open accesses to the publications essentially results in more usability and more citations and reverse the case when it is closed access. Open Access (OA) means free online access to all peer-reviewed journal articles. The above table described that 526(76.13%) paper are closed accesses and only 164(23.76%) paper are open accesses.

**Table 7:** International collaboration in scientometric research

	Number of paper of papers (n=690)	Percentage %
Yes	15	2.17
No	675	97.82

**Fig. 1:** Accessibility of scientometric research publications



#### Top Cited papers in Scientometrics in India

Citation counts are one of the important measures of ranking of papers in a specific area of research. In the present investigation the following research papers having citation above 50 are listed below. Table.7 reflects that, out of 12 papers highest number of citations (94) is credited to the thematic paper authored by I. N. Sengupta. Out of 12 high cited papers 5 are authored by V. L. Kalyane, a scientist at Bhaba atomic Research Centre, Mumbai followed by B. S. Kadameni, a scientist from the same institution with 4 papers. It is evident that, in India BARC has been excelling in the scientometric research over the years.

**Table 8:** Top cited research papers in scientometrics (as retrieved from *Google Scholar*)

Sl. No.	Papers on Scientometric Research	Nos. of Citations (from Google Scholar)
1.	Sengupta, I. N. Bibliometrics, Informetrics, Scientometrics, and Librametrics: An Overview. <i>Libri</i> , vol. 42, n.2. pp 75-98.	94
2.	Kadameni, B. S. and Kalyane, V. L. and Kadameni, A. B. Scientometric portrait of Nobel laureate Dr. C.V. Raman. <i>Indian Journal of Information, Library and Society</i> , 1994, vol. 7, n. 3-4, pp. 215-249.	68
3.	Kalyane, V. L. and Sen, B. K. Research Productivity of Tibor Braun: An Analytical Chemist - cum - Scientometrician. <i>Annals of Library and Information Studies</i> , 2003, vol. 50, n. 2, pp. 47-61.	58
4.	Kadameni, B. S. and Kalyane, V. L. Outstandingly cited and most significant publications of R. Chidambaram, a nuclear physicist. <i>Malaysian Journal of Library &amp; Information Science</i> , 1996, vol. 1, n. 1, pp. 21-36.	57
5.	Kadameni, B. S. and Kalyane, V. L. and Kadameni, A. B. Scientometric portrait of Sir K. S. Krishnan. <i>Indian Journal of Information, Library and Society</i> , 1996, vol. 9, n. 1-2, pp. 125-150.	57
6.	Kalyane, V. L. and Sen, B. K. Scientometric portrait of C. R. Bhatia, an indian geneticist and plant breeder. <i>Malaysian Journal of Library &amp; Information Science</i> , 1998, vol. 3, n. 1, pp. 25-42.	56
7.	Arunachalam, S and Gunasekaran, S. Diabetes research in India and China today: From literature-based mapping to health-care policy. <i>Current Science</i> , 2002, vol. 82, n. 9, pp.1086-1097	53
8.	Munnolli, S. S. and Kalyane, V. L. Scientometric portrait of Ram GopalRastogi. <i>Annals of Library and Information Studies</i> , 2003, vol. 50, n. 1, pp. 1-17.	52
9.	Kalyane, V. L. and Munnolli, S. S. Scientometric portrait of T. S. West. <i>Scientometrics</i> . 1995. vol. 33, n. 2. Pp. 233-256	51
10.	Kadameni, B. S. and Kalyane, V. L. and Balakrishnan, M. R. Scientometric portrait of P. K. Iyengar. <i>Library Science</i> , 1994, vol. 31, n. 4, pp. 155-176.	50
11.	Kalyane, V. L. and Kalyane, S. V. Scientometric portrait of M. S. Swaminathan. <i>Library Science</i> , 1994, vol. 31, n. 1, pp. 31-46.	50
12.	Kalyane, V. L. and Kadameni, B. S. Scientometric portrait of R. Chidambaram: a publication productivity analysis. <i>Journal of Information Sciences</i> , 1995, vol. 5, n. 3, pp. 101-140.	50

## Findings of the Study

It was found that scientometrics research in India over a period of period of 12 years during 2000-2012 have published 690 numbers of articles (as indexed in Socopus database and retrieved from Google Scholar). The year 2012 is the most productive year for scientometrics research having published 115 (16.66%) research papers. According to the authorship patterns of scientometrics research in India, the contributions of two authors have the highest number of articles 201 (29.13%) which in the top publications. Hence it is found that research in collaboration of two authors is dominants on individual and other collaborative research. B. M. Gupta ranked first among the contributors of scientometric research publications in India. B.M Gupta was working in National Institute of Science, Technology and Development Studies (NISTADS) New Delhi. He is the most productive author with 40 (5.79%) numbers of publications. In this study highest affiliation of authors is with National Institute of Science, Technology and Development Studies (NISTADS), New Delhi. The authors of 65 (9.4%) scientometric publications are affiliated with this institution. In this analysis the highest number of papers are published in *Scientometric* (ISSN: 0138-9130) Journal. *Scientometrics* is a peer-reviewed academic journal in the field of scientometrics published by Springer. It was found that a majority of research publications i.e. 71.73% included scientometrics of various subjects/topics as their theme. The themes basically included emerging areas of physics, chemistry, biological sciences, medicine, etc. It was found that the degree of international collaboration remains very low (0.02). This is one area which needs immediate attention of the Indian scientometric researchers to undertake research projects in collaboration with researchers abroad for more visibility and impact. It was found that the paper entitled "Bibliometrics, Informetrics, Scientometrics, and Librametrics: An Overview", a theoretical paper authored by I. N. Sengupta ranked first with highest number of citations (94). Most of the publications having 50 or more citations are authored by V. L. Kalyane and B. S. Kadameni of Bhabha Atomic Research Centre, Mumbai.

## Suggestions

- In India there are a lot of research funding to universities, research laboratories, and such

other institutions are made through University Grants Commission (UGC), Indian Council of Social Science Research (ICSSR), Indian Council of Medical research (ICMR), Council Scientific and Industrial Research (CSIR), etc. It is suggested that these funding agencies should undertake scientometric evaluation of their funded research in order to assess their impact, usability, citations, etc.

- Many of the scientometric research publications in India are published in conference proceedings which are neither indexed in Scopus nor found in Google Scholar are missed while quantifying scientometric literature in India. Therefore, it is suggested that the authors should communicate their papers to Journals and if they are already published in other sources, a copy of such papers should be archived in the online repositories.
- *Scintometrics* is called as "*Science of Science*" and hence demands increased collaboration in research. A close collaboration between the scientists and information professionals would result high quality scientometric research in India.
- *Scientometrics* involves mathematical derivations and therefore, the students of library science schools should be taught scientometric principles and its mathematical derivations. This will again lead to better scientometric assessment.
- Many a times it is found that data of institutional publications are difficult to obtain from databases. If collected the data is incomplete and incomprehensive. Therefore, it is suggested that the universities, research institutions and other such establishment engaged in science research should have their own institutional repository of research papers. This will immensely beneficial for scientometric research.

## Conclusion

*Scientometrics* is one of the most important quantitative measures for the assessment of scientific research. Many of the research in scientometrics in India are simple quantifications of published literature in scientific research. This kind of research does not add much value to the science. It requires deeper scientometric analysis, applications of mathematical and statistical tools and formulas for derivation of meaningful information about scientific research in India. The LIS scholars in collaboration with the scholars various scientific disciplines

should work together for better understanding of the behaviour of mathematics and students should be taught bibliometric and scientometric techniques at their graduation level and the government should promote scientometric research endeavours in India to evaluate scientific research.

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