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Bibliometrics and scientometrics in India: An overview of studies during 1995-2014

Part I: Indian publication output and its citation impact

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An analysis of 801 papers published in the area of bibliometrics and scientometrics during 1995-2014 indicates a steep increase in the number of papers published by Indian researchers as compared to the number of papers published during 1970-1994. This indicates a growing interest of Indian scholars in scientometrics and bibliometrics. The paper provides several reasons for this steep increase. The main focus of research is on bibliometric assessment of India and other countries followed by cross national assessment and bibliometric analysis of individual journals. CSIR-NISTADS is the top producing institute contributing about one-third (31.4%) of the total output followed by the output of Bhabha Atomic Research Centre and CSIR-NISCAIR. The distribution of citation data indicates that about one-fifth (21.7%) papers remained uncited. The paper identifies journals in which these uncited papers were published. Only 15% papers were cited more than 20 times. Most of the prolific authors as well as highly cited authors were from the institutions belonging to the Council of Scientific and Industrial Research. Among all authors B.M. Gupta (CSIR-NISTADS) produced the highest number of papers, but the impact as seen in terms of citation per paper and relative citation impact, S. Arunachalam (MSSRF) topped the list.

Keywords: Scientometrics; Bibliometrics; Productivity assessment; Impact assessment; India

Introduction

The term bibliometrics was coined by Pritchard[1]. In early period bibliometric studies were sporadic and often conducted by individuals belonging to the profession of library and information science. The results of these studies were published either in journals belonging to the discipline in question or in journals devoted to the discipline of Library and Information Science (LIS). However, a cohesive group of professionals emerged after the establishment of the international journal *Scientometrics* by Hungarian Academy of Sciences in 1978 and a regular biennial international conference on *Scientometrics and Informetrics* since 1987. As the field evolved, new journals also started evolving. For instance, *Research Evaluation* now published by Oxford Journals started publishing in 1991 and *Journal of Informetrics* being published by Elsevier started publishing in the year 2007. Like *Scientometrics*, both these journals are indexed by Web of Science and Scopus, the two multidisciplinary databases.

India had a long tradition in quantitative thinking in library and information science. The credit for this goes to Late Dr. S.R. Ranganathan who coined the term librametry[2] in a discussion during a conference conducted by ASLIB in 1948. During the last five decades there has been a growing importance of bibliometrics and scientometrics in India as witnessed by growing number of publications in national and international journals by Indian practitioners and their presence at the international conferences on the subject being held at different venues from time to time. With the growing interest of Indian researchers in bibliometrics and scientometrics, India also started publishing its own journals. The first journal from India in the discipline was *JISSI: Journal of International Society for Scientometrics and*

Informetrics, which ceased publication after 1996. Two journals currently being published from India are *COLLNET Journal of Scientometrics and Information Measurement* published by Taylor and Francis group (UK) in collaboration with TARU Publications India and *Journal of Scientometric Research*, an internationally targeted publication of Phcog.Net. However, none of these is being indexed by *Web of Science or Scopus*.

Basu and Garg[3] made a quantitative assessment of bibliometrics/scientometrics in India during 1970-1994. Recently, Rao[4] made a review of the bibliometrics/scientometrics research in India performed during 2001-2013. The study is based on papers indexed by *Library and Information Science Abstracts* (LISA). It explored the various disciplines in which bibliometric studies were undertaken. However, the study did not include several papers that were published in journals not indexed by (LISA) like *Current Science*, *Information Studies, Library Progress, Library Herald and IASLIC Bulletin* etc. The study also did not cover the papers published by Indian researchers published during 1995-2000 (6 years). Thus, a significant number of studies published in these journals were excluded in the study. This has prompted authors to take a stock of the status of bibliometrics/scientometrics research performed in India during the period 1995-2014 (20 years). The aim of the present exercise is to examine how the quantum of output and focus of research in bibliometrics/scientometrics has changed during 1995-2014 as compared to earlier study undertaken by Basu and Garg for the period 1970-1994 and also to examine the impact of the output as seen by their citations in the literature, which remained unexamined in the studies undertaken by Basu and Garg as well as by Rao.

Objectives of the study

- To examine the pattern of growth of Indian output in the area of bibliometrics and scientometrics during 1995-2014;
- To examine the contents of the published studies in terms of disciplines and sub-disciplines with which these studies dealt and different aspects of scientometrics and bibliometrics research reported in these studies;
- To identify most prolific institutions and the impact of their output as seen by the citations per paper and relative citation impact;
- To identify prolific authors along with their institutional affiliation and the impact of their output in terms of citation per paper and relative citation impact; and
- To examine the pattern of citation of the output and highly cited authors.

Limitations of the study

The study has the following limitations:

- It does not include 14 papers published by Indian scholars written in international collaboration where they were not first authors;
- It does not include papers published in journals not included in the list of journals mentioned in Table 1; and
- It does not include papers of those Indian scholars affiliated to institutions situated abroad.

However, these limitations will not make any significant impact on the findings of the study.

Methodology

The data for the present study were extracted from the websites and hard copies (where the soft version was not available) of the following journals for the period mentioned against each along with the number of articles published in the journal (Table 1).

The publication data for Indian output was further enriched by using name of the prolific authors in Google Scholar for the period 1995-2014 to identify papers those were published in journals related to evaluative bibliometrics and not mentioned above. However, the data does not include papers that were published in subject related journals as well correspondence published in *Current Science*. Bibliographic details of each paper consisted name of the first author with his/her affiliations, subject of the study identified by the title of the paper or abstract and name of the journal where these results were published with its year of publication. A database of all records was created into MS-Excel for analysis. Data was enriched with citation data using Google Scholar, which these papers received from its year of

Table 1—Name of journals and their websites used for study

Sl. no.	Name of the journal and its web site	Period	TNP	PNC (%TNP)
1	Annals of Library and Information Studies http://nopr.niscair.res.in/handle/123456789/66	1995-2014	165	16 (9.7)
2	Scientometrics http://link.springer.com/journal/volumesAndIssues/11192	1995-2014	141	2 (1.4)
3	SRELS Journal of Information Management http://www.i-scholar.in/index.php/sjim/index	1995-2014	129	34 (26.4)
4	DESIDOC Journal of Library & Information Technology http://publications.drdo.gov.in/ojs/index.php/djlit/issue/archive	1995-2014	83	8 (9.6)
5	*IASLIC Bulletin available at isa.niscair.res.in	2000-2014	45	18 (40.0)
6	COLLNET Journal Scientometrics and Information Measurement http://www.tandfonline.com/loi/tsim20#.Uz_ShqiSzp8	2007-2014	41	11 (26.8)
7	Current Science http://www.currentscience.ac.in/php/volumes.php	1995-2014	28	0 (0)
8	Library Herald www.indianjournals.com	1995-2014	27	21 (77.8)
9	Journal of Indian Library Association http://www.ilaindia.net/	1995-2014	32	21 (65.6)
10	Malaysian journal of Library Science (using GOOGLE Scholar)	1995-2014	25	1 (4.0)
11	Information Studies www.indianjournals.com	2000-2014	24	11 (45.8)
12	Journal of Scientometric Research www.jscires.org	2012-2014	17	6 (20.4)
13	Library Progress www.indianjournals.com	2010-2014	14	12 (85.7)
14	**JISSI www.issi-society.org/jissi/	1995-1996	12	11 (91.7)
	Sub total		783	172 (21.9)
	Other journals		18	2 (11.2)
	Grand total		801	174 (21.7)

*Data for IASLIC Bulletin was extracted using Indian Science Abstract for 2000-2014, ***JISSI: Journal of the International Society for Scientometrics and Informetrics* ceased publication in 1996.

publication till 10 July 2016. It was observed that certain papers were not listed in Google Scholar. For those papers, Google was used to find out their citations. The present assessment of bibliometrics and scientometrics in India during 1995-2014 is based on the first author and his affiliation.

Bibliometric indicators used

We have used the Total Number of Publications (TNP); Total Number of Citations (TNC); Citations per Paper (CPP); Relative Citation Impact (RCI) and Papers Not Cited (PNC) as measures of output and impact. CPP is a relative indicator computed as the average number of citations per paper. It has been widely used in bibliometric studies to normalize a large disparity in volumes of published output among disciplines, countries and institutions for a meaning full comparison of research impact. RCI is a measure of both the influence and visibility of a nation's research in global perspective. It is defined as "a country's share of world citations in the sub-specialty/country's share of world publications in the sub-specialty". RCI = 1 denotes a country's citation rate equal to world citation rate; RCI < 1 indicates a country's citation rate less than world citation rate and also implies that the research efforts are higher than its impact; and RCI > 1 indicates a country's higher citation rate than world's citation rate and also imply high impact research in that country. Here CPP and RCI have been used for a meaningful comparison of

the impact of the research output for different prolific institutions and authors. PNC has been used only for performing sectors to have an idea of the papers these sectors published but were not cited during the period of study.

Results

Pattern of output

During 1970-1994, India had published 423 paper out of which 296 were published in journals. However, during 1995-2014 India published 801 papers in journals. Thus, the output in 1995-2014 has increased more than two and a half times to the number of papers published during 1970-1994 indicating a sharp increase in the number of papers published by Indian researchers in the last two decades. This indicates an increasing interest of Indian research community in the sub-discipline of scientometrics/bibliometrics. Figure 1 depicts the publication data in 10 blocks of two years each along with their growth rate. It indicates that the publication output has steadily increased during the period of study except a marginal dip in 2003-2004. In the first block of 1995-96 the output was just 5% of the total output, which have increased to 21% in the last block of 2013-2014, which is four times more than the initial output in 1995-1996. Compound Annual Growth Rate (CAGR) over the period of 20 years is about 14.9%.

Five possible reasons for a steady increase in the number of papers are:

- Large number of theses submitted to different universities by the students of Library and Information Science (LIS) in the area of scientometrics/bibliometrics. A study by Singh and Babbar[5] indicates that among all sub-disciplines of LIS, highest number of theses was submitted in the sub-discipline of scientometrics/bibliometrics.
- Easy availability of online databases like Web of Science (WoS) and Scopus have helped research scholars to undertake studies in this area which have resulted in proliferation of studies.
- Significant increase in the number of papers in last three blocks are the result of publication of special issues by Annals of Library and Information Studies in 2010 and 2014, DESIDOC Journal of Library and Information Technology in 2011 and 2014 and SRELS Journal of Information Management in 2013.
- International Society for Scientometrics and Informetrics (ISSI) and COLLNET are organizing conferences at regular intervals. Several papers are presented by Indian delegates at these conferences, of which some are published in journals.

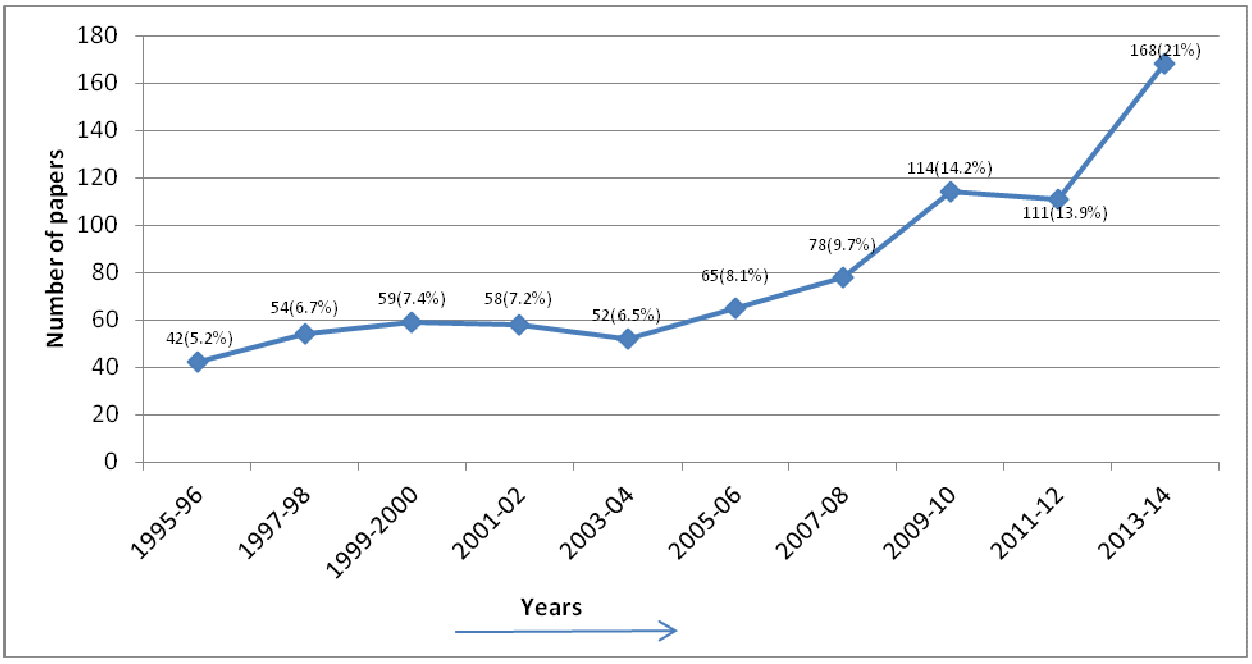

Fig. 1—Indian output in bibliometrics/scientometrics during 1995-2014

- The number of bibliometric studies on individual journals increased significantly because these journals are now accessible in open access.

Distribution of output by performing sectors

Like scientific research, bibliometrics/scientometrics in India are performed by several sectors. These include schools of library science and library professionals of different universities, engineering colleges including Indian Institutes of Technology (IITs), medical colleges/hospitals and scientists/librarians of scientific agencies such as Council of Scientific and Industrial Research (CSIR), Department of Atomic Energy (DAE), Indian Council of Medical Research (ICMR), Indian Council of Agriculture Research (ICAR) including State Agricultural Universities (SAUs) etc. Table 2 provides the distribution of output by different performing sectors along with papers not cited. It indicates that like scientific research the share of output of academic institutions is highest followed by the output of CSIR. These two sectors together contributed more than two-third (68.3%) of the total output. Remaining 31.7% of the output came from other performing sectors like DAE, ICAR, SAUs, engineering and medical colleges and other scientific agencies etc. Among others, M.S. Swaminathan Research Foundation (Chennai) contributed the highest number (13) papers. An examination of papers that were not cited indicates that approximately 22% papers did not get any citation during 1995-10 July 2016. The share of papers not cited was highest (35.3%) for the medical colleges closely followed by academic sector (33.6%). The share of papers that did not receive any citation was also slightly more than the national average for papers published by LIS professional of engineering colleges. DAE and CSIR had less than 10% papers that remained uncited.

Prolific institutions and impact of their output

Total output came from 201 academic and research institutions scattered in different parts of India. Table 3 presents the distribution of output by prolific institutions along with the citations these papers received and the values of Citation per Paper (CPP) and Relative Citation Impact (RCI). Only those institutes have been considered as prolific which published eight or more papers during the period of study. It indicates that highest number (173) research papers were contributed by CSIR-National Institute of Science, Technology and Development Studies (CSIR-NISTADS), New Delhi followed by Bhabha Atomic Research Centre (BARC), Mumbai and CSIR-National Institute of Science Communication (CSIR-NISCAIR), New Delhi. The output of BARC and CSIR-NISCAIR is very close to each other. These three institutes together contributed more than one-third (34.1%) of the total Indian output in bibliometrics/scientometrics during 1995-2014. The share of 15 institutions listed in Table 3 was more than half (52.9%) of the Indian research output and the remaining papers were published by 186 institutions located in different parts of India. This indicates that the output in the field of scientometrics is highly concentrated among only a few institutions. Further analysis of data indicates that of the 15 institutions listed in Table 3 most are academic institutions, except four which are from CSIR, DAE and a NGO.

The average value of CPP for India is 9.9. Of all the institutes listed in Table 3 only four institutes namely CSIR-NISTADS, CSIR-NISCAIR, BARC

Table 2—Distribution of output by performing sectors

Sl. no.	Performing sector	TNP	TNP %	PNC (% TNP)
1	Academic institutions	289	36.1	97 (33.6)
2	CSIR	258	32.2	24 (9.3)
3	DAE	58	7.2	5 (8.6)
4	ICAR+ SAUs	41	5.1	6 (14.6)
5	ENGC including IITs	40	5.0	9 (22.5)
6	Medical colleges	17	2.1	6 (35.3)
7	Other institutions under different ministries of the Government of India*	52	6.5	11 (21.2)
8	Others	46	5.7	16 (34.8)
	Total	801	100	174 (21.7)

Table 3—Most prolific institutions and impact of their output

Sl. no.	Institutions	P (%)	C (%)	CPP	RCI
1	CSIR-NISTADS, New Delhi	173(21.6)	2483(31.4)	14.4	1.5
2	BARC, Mumbai	51 (6.4)	1007 (12.7)	19.7	2.0
3	CSIR-NISCAIR, New Delhi	49 (6.1)	523 (6.7)	10.7	1.1
4	Karnataka University, Dharwad	22 (2.7)	111(1.4)	5.0	0.5
5	University of Kerala, Trivandrum	16 (2.0)	60 (0.8)	3.8	0.4
6	KUVEMPU University, Shimoga	13(1.6)	60 (0.8)	4.6	0.5
7	M S Swaminathan Foundation, Chennai	13(1.6)	407 (5.1)	31.3	3.2
8	Mysore University, Mysore	12 (1.5)	61 (0.8)	5.0	0.5
9	Annamalai University, Chidambaram	12 (1.5)	59 (0.7)	4.9	0.5
10	University of Burdwan, Burdwan	10 (1.2)	77 (0.9)	7.7	0.7
11	DRTC, Bangalore	10 (1.2)	94 (1.2)	9.4	1.0
12	Gov. medical college and hospital, Chandigarh	9 (1.1)	49 (0.6)	5.5	0.5
13	Manonmaniam Sundaranar University, Tirunelveli	9 (1.1)	15 (0.2)	1.7	0.2
14	Shrivenkateshwara univ. Meerut	9 (1.1)	16 (0.2)	1.8	0.2
15	Banaras Hindu university, Banaras	8 (1.1)	62 (0.8)	7.7	0.7
16	IGNOU, New Delhi	8 (1.1)	64 (0.8)	8.0	0.7
	Sub total	424 (52.9)	5148 (65.0)	12.1	1.2
	Other 185 institutions	381 (47.1)	2763 (35.0)	7.3	0.7
	Grand total	801	7911	9.9	1.0

and MSSF had higher than average value of CPP than Indian average. CPP for DRTC was close to the national average. The value of CPP for all remaining institutes including others was less than the value of Indian average. Among all the institutes listed in Table 3 highest value of CPP was for M S Swaminathan Research Foundation (MSSF), Chennai followed by Bhabha Atomic Research Centre. MSSRF had higher CPP, because all its papers were published in *Current Science and Scientometrics*, both indexed by *Science Citation Index (SCI).* Trends regarding the values of RCI were similar to CPP. The low value of RCI for different academic institutions listed in Table 3 indicates that the impact of the research performed at these institutes does not commensurate with their output. One possible reason for low impact of the output of academic institutions might be that these institutions have published their research findings in Indian journals, of which several are not even indexed by abstracting services in the discipline of library and information science.

Pattern of authorship and most prolific authors

The papers were contributed by 327 authors from 201 different Indian institutions. The pattern of authorship indicates that of the 801 papers, 361 (45%) were two authored, 221 (27.6%) were single authored and the rest 219 (27.4%) were multi authored where three or more than three authored were involved in producing a paper. Table 4 lists 13 most prolific authors along the values of CPP and RCI for each author. Only those authors have been considered prolific those who have contributed 1 per cent or more of the total output. Of the 13 prolific authors, five belonged to CSIR-NISTADS and the remaining seven to other seven different institutions. These 13 prolific authors contributed about one third (241, 30%) of the papers and obtained 3483 (44%) citations. Among all the authors, B.M. Gupta of CSIR-NISTADS topped the list in productivity, but the value of CPP was highest for S. Arunachalam of MSSRF followed by B.S. Kademani of BARC and S. Bhattacharya from CSIR-NISTADS. Similar trends were followed by the values of RCI. Further analysis of data indicates the value of CPP was less than the average CPP value of India for five authors. It was lowest for Gupta, Ritu, Dutta, B. and Sudhier, K.G. Similar trends were visible for RCI values indicating that the impact of the research of these authors did not commensurate with the research output. The reason for their low impact is the same as mentioned for prolific institutions.

Pattern of citations

Citation rates reflect the impact of published work on international community. Citation counts of authors or a group of authors or an institution is an indication of the influence or visibility of individuals or groups or institutions. High levels of citations to a

Table 4—Most prolific authors and impact of their output

Sl. no.	Authors	TNP (%)	TNC (%)	CPP	RCI
1	Gupta, B.M. (NISTADS)	70 (8.7)	834 (10.5)	11.9	1.2
2	Garg, K.C. (NISTADS)	32 (4.0)	509 (6.4)	15.9	1.6
3	Prathap, G. (NISCAIR)	25 (3.1)	343 (4.4)	13.7	1.4
4	Kademani, B. S. (BARC)	20 (2.5)	544 (6.9)	27.2	2.7
5	Bhattacharya, S. (NISTADS)	17 (2.1)	361 (4.6)	21.2	2.2
6	Sangam, S.L. (Mysore Univ.)	16 (2.0)	82 (1.0)	5.1	0.5
7	Arunachalam, S. (MSSF)	12 (1.5)	371(4.7)	30.9	3.1
8	Basu Aparna (NISTADS)	12 (1.5)	212 (2.7)	17.7	1.8
9	Sudhier, K. G. (Univ. of Kerala)	10 (1.2)	58 (0.7)	5.8	0.6
10	Kumar, S. (NISTADS)	9 (1.1)	53 (0.7)	5.9	0.6
11	Gupta Ritu (SriVenkateshwara University)	9 (1.1)	16 (0.2)	1.8	0.2
12	Rao, I.K.R. (DRTC)	9 (1.1)	82 (1.0)	9.2	0.9
13	Dutta B. (Vidyasagar university)	8 (1.0)	22 (0.3)	2.8	0.3
	Sub total	241 (30.1)	3483 (44.0)	14.5	1.5
	Others	560 (69.9)	4424 (56.0)	7.9	0.8
	Total	801 (100)	7911 (100)	9.8	1.0

Table 5—Pattern of citations

Sl. no.	Citations received	Number of papers (%)	Total citations
1	0	174 (21.7)	0
2	1	75 (9.3)	75
3	2	75 (9.3)	150
4	3	46 (5.7)	138
5	4	41 (5.1)	164
6	5	48 (6.0)	240
7	6-10	126 (15.7)	971
8	11-15	56 (7.0)	717
9	16-20	43 (5.4)	778
10	21-30	46 (5.7)	1140
11	31-50	44 (5.5)	1656
12	More than 50	27 (3.4)	1882
	Total	801(100)	7911

scientific publication have been interpreted as signs of scientific influence, impact, and visibility. An author's visibility can be measured through a determination of how often their publications have been cited in other publications. The impact of research can thus be assessed by making citation counts of the articles received over a period of time. Table 5 presents the distribution of citations received by 801 papers during 1995-2016 (July 10, 2016). Of the total papers published by Indian authors in bibliometrics/scientometrics about 22% of the papers remained uncited and the rest were cited one or more times**.** Of the total cited papers about one third (35.4%) were cited between 1-5 times and about one-forth (28.1%) were cited 6-20 times. Remaining (14.8%) were cited more than 20 times. Of these, the proportion of papers those received more than 50 citations was approximately 3.4%. The share of citations for highly cited papers was approximately 24% of the total citations. Raw analyses of data on the pattern of citations indicate that most of the uncited papers were published in *Library Progress* (86%), *Library Herald* (78%), *Journal of the Indian Library Association* (66%), *Information Studies* (46%), *SRELS Journal of Information Management* and *COLLNET Journal of Scientometrics and Information Measurement* each 26%. However, the percentage of uncited papers in other Indian library science journals was much less as compared to these journals. Based on this one can infer that the papers published in most Indian library science journals except *Annals of Library and Information Studies, DSIDOC Journal of Library and Information Technology and Journal of Scientometric Research* are not well connected to the mainstream bibliometric research literature.

Highly cited papers

We identified papers those were cited 50 or more times. Table 6 lists 27 papers those were cited 50 or more times. These papers received 1882 citations in all constituting about one-fourth (24%) of all citations. Of the 27 highly cited papers 15 were

Table 6—Highly Cited papers

Sl. no.	Bibliographic details	TNC	CPY
1	Sharma, S., Thomas, V., Inter-country R&D efficiency analysis: An application of data envelopment analysis, *Scientometrics* 76(3) 2008, 483-501	191	23.8
2	Bhattacharya, S., Basu, P. K., Mapping a research area at the micro level using co-word analysis, *Scientometrics*43(3) 1998, 359-372	113	6.3
3	Arunachalam, S., Doss, M.J., Mapping international collaboration in Asia through Co-authorship analysis, *Current Science* 79(5) 2000, 621-628	97	6.5
4	Garg, K.C., Padhi, P., A study of collaboration in laser science and technology, *Scientometrics* 51(2) 2001, 415-427	90	6.0
5	Dutt, B., Garg, K.C., Bali, A., Scientometrics of the international journal *Scientometrics,Scientometrics*56 (2003) 81-93	85	6.1
6	Ramesh Babu A., Singh Y.P., Determinants of research productivity, *Scientometrics* 43(3) 1998, 309-329	73	4.1
7	Kalyane V.L., Sen B.K., A bibliometric study of the Journal of Oil Seeds Research, *Annals of Library Science and Documentation* 42(4) 1995, 121-141	72	3.4
8	Prathap, G., Is there a place for mock h index, *Scientometrics*(84) 2010, 153- 165	67	6.7
9	Basu, A., Kumar B.S.V., International collaboration in scientific papers, *Scientometrics* 48(3) 2000, 381-402	67	4.2
10	Kademani B.S., Vijai, K., Anil, S., Anil, K., Scientometric dimensions of Nuclear science and technology research in India: a study based on INIS 1970-2002, *Malaysian Journal of Library and Information Science* 11(1) 2006, 23-48	65	6.5
11	Basu, A., Aggarwal Ritu., International collaboration in science in India and its impact on institutional performance, *Scientometrics*52(1) 2003 379-294	65	5.0
12	Kalyane, B.L., Sen B.K., Scientometric portrait of Nobel laureate Pierre-Gilles de Gennes, *Malaysian Journal of Library & Information Science*, 1(1)1996, 13-26	64	3.2
13	Patra S, K., Bhattacharya, P., Verma, Neera, Bibliometric study of literature on bibliometrics, *DESIDOC Journal of Library and Information Technology*, 26(1) 2006, 27-32.	63	6.3
14	Verma, Neera., Tamarakar, R., Sharma, P., Analysis of contributions in 'Annals of Library and Information Studies' *Annals of Library and Information Studies* 54(2) 2007,106-111	62	6.9
15	Gupta, B.M., Kumar, S., Aggarwal, B.S., A comparison of productivity of male and female scientists of CSIR, *Scientometrics* 45(2) 1999, 269-289	58	3.4
16	Kalyane, V. L., Sen, B.K., Research productivity of Tibor Braun: An analytical chemist cum Scientometrician, *Annals of Library and Information Studies* 50(2) 2003, 47-61	57	4.4
17	Kademani B.S., Kalyane, B L., Outstandingly cited and most significant publications of R. Chidambaram, *Malaysian Journal of Library and Information Science* 1(1) 1(1) 1996, 21-36	57	2.8
18	Bhattacharya, S., Kretschmer, H., Meyer, M., Characterizing intellectual space between science and technology, *Scientometrics* 58(2) 2003 369-390	57	4.4
19	Kalyane, V. L., Sen, B. K., Scientometric portrait of C. R. Bhatia, an Indian geneticist and plant breeder. *Malaysian Journal of Library & Information Science*, 3(1)1998, 25-42.	56	3.2
20	Kademani, B.S., Kalyane, V.L., Kademani, A.B., Scientometric Portrait of Nobel Laureate S. Chandrasekhar. *JISSI: The international journal of scientometrics and informetrics*, 2(2-3) 1996, 119-135.	56	2.8
21	Anuradha, K.T., Urs, Shalini, R., Bibliometric indicators of Indian research collaboration: A correspondence analysis, *Scientometrics* 71(2) 2007, 179-189	56	6.3
22	Kalyane, V.L., Munnolli, S.S., Scientometric portrait of T S West, *Scientometrics* 33(2) 1995, 233-256	55	2.6
23	Munnolli, S.S., Kalyane, V. L., Scientometric portrait of Ram Gopal Rastogi. *Annals Lib. Inf. Studies*, 50 (1) 2003,1-17	53	3.8
24	Karpagam, R., Gopalkrishnan, S., Natarajan, M., Ramesh Babu, B., Mapping of nano science and nano technology research in India: a scientometric analysis 1990-2009, *Scientometrics* 89 (2011) 501-522	53	10.6
25	Banerjee, P., Indicators of innovation as a process, *scientometrics* 43(3) 1998, 331-357	50	3.4
26	Gupta, B.M., Dhawan, S.M., Status of India in science and technology as reflected in its publication output in the Scopus international database, 1996-2006, *Scientometrics* 80(2) 2009, 473-480	50	5.6
27	Jena, K.L., A bibliometric analysis of the journal 'Indian Journal of Fibre and Textile Research, *Annals of Library and Information Studies* 53 (1) 2006, 22-30	50	5.0

published in the international journal "Scientometrics" and the rest 12 were published in *Annals of Library and Information Studies (5), Malaysian Journal of Library and Information Science (4), Current Science, DESIDOC Journal of Library and Information Technology and JISSI* (now ceased) one each. Of the 27 highly cited papers nine were published from CSIR-NISTADS, eight from Bhabha Atomic Research Center, two each from Indian Institute of Technology (Delhi), and one each from CSIR-NISCAIR, Indian Agriculture Research Institute (New Delhi), MLB college of Excellence (Gwalior), Indian Institute of Science (Bangalore), Tata Memorial Research Centre (Mumbai), Anna University (Chennai), College of Engineering and Technology (Bhubaneswar), MSSRF (Chennai). Since the number of citations varies according to the period for which citations are calculated. To normalize that variation we have calculated citation per year (CPY). This is similar to citation per paper per year used earlier by Garg *et al*[6] in their study on genetics and heredity research in India during 1991-2008. This indicates that if the highly cited authors are ranked according to CPY, then the rank of different authors changes. For instance, the paper which ranked 24 in total citations will rank at two in terms of CPY. However, the position of the paper ranked first remains unaltered.

Conclusion

Based on the above analysis it can be concluded that the scenario of bibliometric studies during 1995-2014 has changed considerably as compared to 1970-1994 in terms of output as well as areas of investigation and journals used for communicating research results. A sharp increase has taken place in the number of papers published by Indian scholars and the quantum of studies published during 1995-2014 has increased more than two and a half times to the number of studies published during 1970-1994. Majority of the contributions emanated mainly from CSIR-NISTADS, CSIR-NISCAIR and BARC though several new institutes and new authors have emerged during 1995-2014 which were not present in the earlier period of 1970-1994. The pattern of citation indicates that almost one-fifth (22%) of the papers were not cited. Though the academic sector has played an important role in publication of papers, but their impact as seen through citations per paper as well as relative citation impact appears to be poor. The study also indicates that the field of scientometrics/bibliometrics is still dominated by professionals of library science who are publishing studies in a piecemeal fashion either because some scholars are pursuing for higher degree or because of the introduction of Academic Performance Index (API) for promotion to next higher grade by several universities.

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