INDIAN CONTRIBUTIONS IN BIBLIOMETRICS
1958-1984: A REVIEW

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Reviews 191 contributions showing the growth pattern, subjectwise activity, most productive journals and authors in the field.

INTRODUCTION

From the evidence available to us, it appears that the bibliometric studies in India started with the publication of an article by S Dutta and T S Rajagopalan in 1958 [31]. However, it may be noted here that the term librametry was coined by Ranganathan in 1948 during a discussion in Aslib Conference held in Lamington Spa (Aslib Proc. 1949, 1, 102), and the term was used more or less in the same sense of bibliometrics in India for quite sometime.

Bibliometric studies in India took a firm root in 1963 when a seminar was organised by DRTC on Documentation Periodicals and quite a few papers were presented in the conference including foreign ones. Eversince, the studies have been continuing. During the period of the last 27 years, about 200 papers have been published on the coverage and overlapping of literature, ranking of periodicals, use of literature by scientists and others, testing of various bibliometric laws and so on. A survey of the studies conducted is long overdue to find out what has already been done, how they have done, what remains to be done, whether there is some gap in our studies etc. Hence, this study.

SCOPE

The study covers all published contributions on the subject made by Indians residing in India and abroad. Articles by foreign authors published in Indian journals have been excluded. Such contributions that are not purely bibliometric in nature, but have relevance to bibliometrics have also been included.

GROWTH

Table 1 shows the yearwise output of literature in India starting from 1958 in which year only one article was published. Afterwards, Ranganathan's bibliometric analysis of the books published by South Indian Saiva Siddhanta Works Publishing Society appeared in 1961 and in 1963 DRTC conducted seminar on Documentation Periodicals in which nine papers by Indian authors were presented. One more paper was published in the Annals of Library Science, and a book appeared on the growth of Indian medical periodicals. The Seminar practically laid down the foundation of the bibliometric studies in India. As a result, bibliometric studies continued uninterrupted in India and are still continuing, even though the number of articles per year did not go beyond five till 1969. The number of articles went to 14 in 1978 because of another DRTC seminar on the subject. From which year, however on an average 13 articles are being published per year. About 200 articles are published per year on the subject in the world. As such India's annual contribution to the subject is of the order of 6% to 8%.

BIBLIOMETRICS - STUDIES ON VARIOUS FACETS


Dutta and Rajagopalan [31] surveyed citation practices followed by 200 Indian and
Table - 1: Yearwise Distribution of Articles

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Using citation analysis technique Gupta [52] investigated the networking of papers basing a sample of papers published in Geliotekhnika and found that co-citation is the most suitable technique for networking. Sen & Gan [146] in their paper provided a mathematical extension to the idea of bibliographic coupling. It is also a known fact that many papers for some reason or the other are not cited. Ghosh [40,41] in his two papers studied this very phenomenon of uncitedness of papers basing papers published in Nature and Journal of the American Chemical Society.

Use Pattern of Documents

Specialists use various types of documents in their pursuit of knowledge. Rao [129] tried to find out the use pattern of documents by specialists employing the method of citation analysis, questionnaire and interview. Mitra [88] studied the use pattern of literature in 14 different disciplines analysing 26 Indian journal citations. Maheshwarappa & Prakash [81] and Guha [45] studied the use pattern of

Kartikeyan & Guha [73] studied the impact of Referativnyi Zhurnal on the use of English literature by Soviet scientists and found the impact to be positive. Ghosh [35], Malwad [83] and Sharma [166] all studied various facets of citation indexes, and Gera [34] discussed the efficacy of Social Science Citation Index in the retrieval of information.

BIOLICOMETRIC STUDIES AND PERIODICALS

Several bibliometric studies have been conducted with periodicals. Gupta [64] and Rao [133] both studied the obsolescence and utility factors of periodicals. Rao [132] also studied the growth and obsolescence factors of periodicals relating to sociology. Malwad [84] discussed the pros and cons of the ranking of journals through citation analysis. Rahman et al [112] and Arunachalam [6] studied the various facets of Indian scientific journals. Arunachalam & Markanday [8] conducted a bibliometric analysis of 95 English language scientific journals of Australia, Canada, India and Israel and found that most of the journals are local level journals; their cognitive contribution to mainstream of international research activity is low and they cite more than they are cited. Moreover these journals cite much greater proportion of older references than international journals, indicating their preoccupation with problems of low current relevance. Guha et al [44] in their incomplete study published in five instalments enumerated the reasons that lead to the change of titles in periodicals. Dutta [30] discussed various points relating to evaluation of scientific periodicals, and Subramanyam in his three papers dwelt on environmental research journals [180], reviewed the current trends and future prospects of scientific journals [179] and considered various criteria for journal selection [177]. Dhawan et al [28] also presented a model for journal selection. Kaula [74] dealt with the periodicals in library science. Gupta & Nathan [54] isolated factors that adversely affect the quality of periodicals in developing countries. Sengupta et al [161] discussed the role of bibliometry in journal selection.

BIOLICOMETRIC STUDIES RELATING TO VARIOUS SUBJECTS


to Library and Information Science

Though most of the bibliometric studies in India have been conducted by librarians and information scientists, yet the bibliometric studies on library and information science are few. Neelameghan [99] has discussed at length the expressions of time in information science and their implications. Chakraborty et al [23] found out the giants of library science by analysing the citations in the different editions of the Handbook of Special Librarianship & Information Work (Aslib) on the basis of citation score, S R Ranganathan topped the list of authors. Das Gupta [25] conducted a bibliometric study of writing by and on Ranganathan and published until 1961. Kundu [77, 78] analysed the citations in the Annals of Library Science (afterwards Annals of Library Science and Documentation) vols. 1-22 and found out the 14.9% of the citations are self citations, Annals of Library Science (afterwards Annals of Library Science & Documentation) has been cited most, and American Documentation is the most cited foreign journal. Singh [168] analysed the contribution in library and information science in India during 1971-82. Arunachalam [5] emphasised the need for introducing information technology, user education, research in STI system in India. Bhattacharyya [17] highlighted the trends in librarianship in India.

User study is drawing serious attention of librarians and information scientists for quite sometime. Srinivasan [170] in his paper dwelt on the influence of user studies on the improvement of documentation services in developing countries.

The citation as a mean of literature search has been studied by Ghosh [39] as well as Reddy [136]. Ghosh conducted an experimental study of searching literature using the method of citation mapping. The author opines that the technique will be useful in the compilation of bibliographies on microsubjects.

Social Sciences

Kaula presented some of the characteristics of social science information from Indian user’s point of view including bibliographical form,
core periodicals, publication age of information material, dispersion of periodical literature, and their seepage. The use of literature (a) by European sociologists has been studied by Guha [45], and (b) by research scholars in political science and economics has been studied by Verma & Murthy [184]. The quantitative and collaborative trends in American sociology research have been examined by Patel [103,104]. Parbha [107] conducted a pilot study to probe into the citation behaviour in business administration literature.

Survey Analysis

There are three papers on the subject, in which the documents on survey analysis, and its development and structure have been dealt with by Seetharama [141,142]. Rao [130] studied the dispersion of documents on survey analysis.

Economics

Goil [187] studied the coverage of Indian documents on economics by International Bibliography of Economics, Index of Economic Journals, World Agricultural Economics & Rural Sociology Abstracts, and Journal of Economic Abstracts during 1952-1960. Rajan [188] examined the scattering of Indian documents on economics in 25 Indian and 53 foreign journals of 1959 & 1960 and found that 97.5% of the documents were published in Indian journals.

Physical Education

Basing the citations in Research Quarterly, Rao [127] prepared a ranked list of periodicals on physical education.

Science & Technology

Indians have been publishing research contributions in foreign journals ever since Indian scientists started working on modern science. To what extent Indian scientists publish their contribution abroad was studied for the first time by Guha et al. [43] basing 750 periodicals covered by Insdoc List in 1964. Of the 1406 articles published in foreign journals, 364 articles belonged to chemistry, 323 articles to physics, 175 articles to medicine, and the rest to other fields. The largest number of articles were published in Physical Review (75), Nuovo Cimento (50) and Nuclear Physics (45). Mehrotra and Lancaster (86) also carried out a similar study basing the publications listed under India in the Geographic Section of Corporate Index of the Science Citation Index of the year 1979-81.

During 1963-65, a few studies were conducted to find out the extent of coverage of Indian contributions in the well-known foreign abstracting & indexing services. Sen [144] presented a summary of some of these findings in his review paper. In another paper, Sen [143] studied the citation of Indian contributions in Nobel Lectures (Physics 1901-62; Chemistry 1901-62, and Medicine 1922-62), and found that 21 Indian scientists were cited in Nobel lectures - 12 of them by C V Raman; M N Saha was the first scientist to the cited (cited by W H Nernst 1920) and S N Bose & H J Bhahba were the last to be cited (both were cited by H Yukawa in 1949). Ranganathan [189] discussed the problem of language barrier in the coverage of documents by abstracting periodicals and suggested remedial measures.

Ranga Rao [125] studied research activities in India basing the publications noticed in the Indian Science Abstracts (Vol.1, 1965) and presented the distribution of papers according to institution, subject and author. Pruthi & Nagpaul [108] studied the pattern and role of communication in R&D. Arunachalam [5] dealt with information aspects of S&T and advocated for the introduction of information technology, user education and research in S&T information.

Naranan [96, 97] studied Bradford's Law and power law relation in science bibliography. How Referativnyi Zhurnal (RZ) has influenced the Russian scientists in the use of non-Russian literature has been studied by Kartikeyan and Guha [73], and it is found that there is an increase in the number of English references per paper as well as an increase in the number of English periodicals cited by Russian scientists after the advent of RZ. Rao [131] studied the distribution of scientific productivity vis-a-vis social change and found that a negative binominal distribution fits scientific data better than many other distributions such as geometric, logarithmic, zeta, etc. It is shown analytically that the negative binominal distribution describes a pattern of scientific productivity under the "success breeds success" condition in a wide variety of social circumstances.
Subramanyam [174] reviewed eight research collaborations and emphasised the need for refining the method of defining and assessing collaboration and its impact on the organisation of research and communication in science.

**History of Science**

There is only one contribution in the field, wherein Mitra [89] discussed the problem related to evaluation and assessment of continuity of scientific ideas in history of science.

**Mathematics**

Three bibliometric studies on mathematics have been carried out in India. Rajagopalan et al [117] studied the extent of coverage and speed of reporting of Indian mathematics literature in *Mathematical Reviews* and *Bulletin Signaletique* taking the articles covered in the *Bibliography of Scientific Publications of South and South East Asia* as the base. *Mathematical Reviews* has covered 55.2% and 50.6% and *Bulletin Signaletique* 50.5% and 36% of the Indian mathematics literature of the years 1961 & 1962. The *Mathematical Reviews* has covered the literature of 1961 & 1962 in 48 and 28 months, and *Bulletin Signaletique* has covered in 16 & 12 months respectively. Peter & Rajagopalan [105] as well as Basak & Das [13] studied the scatter of Indian contributions on mathematics in Indian and foreign journals. The former authors took *Mathematical Reviews* 1965 as the base, and the latter took *Mathematical Reviews* 1977 as the base. Basak & Das also compared the results of 1965 studies with their study to find out the change in trend.

**Physics**

A dozen bibliometric studies have been published in this area showing the interest bibliometricians are taking in physics. The first paper by Rajagopalan & Sen [116] studied the extent as well as the speed of reporting of Indian literature in *Physics Abstracts*. The *Physics Abstracts* has covered 65.5% & 57.4% of Indian literature of 1960 & 1961 in about 2 years time. Kapoor [70] as well as Rangarajan & Gupta [123] studied the scatter of Indian physics literature in the periodicals of different countries. Gupta [48] as well as Dhawan & Yadav [29] examined the type of documents cited by Indian physicists. Gupta [55] based his citation study on a single physicist, i.e. S. Chandrasekhar, the 1983 Nobel Prize winner for physics, and found that 401 works of Chandrasekhar have been cited 10,359 times during 1965-80 and out of 401 contributions only six have accounted for 53% of the citations. Rangarajan et al [124] provided a bird's eye view of the researches going on in the field of physics in India. Arunachalam et al [7] conducted a bibliometric analysis of Israeli contributions in physics covered in 10 major sections of *Physics Abstracts* (Jan-June 1977) and found that the contributions in this area are usually published in the high ranking journals of USA, UK & the Netherlands. The contributions are productive in condensed matter physics, nuclear, atomic and molecular physics. In chemical physics, they seem to be specially strong. A few contributions in the areas of special theories, interaction models, particle systematics and biophysics were found to have high impact factor. The contributions in nuclear physics are not well-cited.

Rangarajan & Bhatnagar [122] also took a very narrow area, i.e. Mossbauer effect, as the subject of study. Literature published on the subject for about two decades from its discovery has been studied. In respect of literature output USA came first, followed by USSR, India ranked 7th. Arunachalam & Singh [10] analysed the citations received during 1970-81 by 255 randomly chosen documents on superconductivity published in 1969-70, and found that 85% of the contributions were in English, USA led the field followed by USSR & Japan. However, Soviet & Japanese contributions were cited less. 22 US contributions received more than 25 citations during the period. Of the papers included in the sample, three papers received more than 100 citations each, 20 papers received between 30 & 100 citations and 63 papers received no citation. The distribution of the citation to the 23 highly cited (at least 30 times) papers as a time series shows a distinct pattern of an initial stage of rapid rise in citations per year followed by a plateau & a subsequent decline. Verma [118] studied the trends in nuclear research in India basing the literature covered in ISA in five years, and found that over 50% of literature is published in four journals and BARC is the topmost contributor. Nagarathna [94] studied the use of documents by nuclear physicists.
There are eleven bibliometric studies devoted to chemistry, which is slightly less in number compared to physics. The first paper by Krishnan & Surendar Mohan [76] studied the coverage of Indian documents in chemistry and chemical technology. This study revealed that Chemical Abstracts covers about 90% of Indian documents within twenty four months. Rangra et al [126] studied the coverage of Indian literature on chemistry & chemical technology excluding metallurgy in Referativnyi Zhurnal (RZ) - Khimiya basing the literature reported in Indian Science Abstracts (V. 1, 1965), and found that only 31% of literature has been covered by RZ.

Ranking of chemistry periodicals has been studied by Singh [167] from the Indian scientists' point of view basing the citations in six issues of Indian Journal of Chemistry Vol.8 (1970). Mohinder Singh [91] has shown how the ranking of chemistry periodicals has undergone change during 1967 & 1976.


Two studies have been made on electrochemistry. George & Parthasarathy [33] studied the scatter of documents on electrochemistry among 592 periodicals. 127 periodicals carried 90% of the documents on the subject. Indian contributions to world literature of electrochemistry have been studied by Arunachalam et al [9] basing the Chemical Abstracts - Section 77(1974). Journal preference of Indian authors, major individual and corporate contributors and the impact of the above papers have also been studied.

Sharma & Saxena [163] examined the refereeing patterns of Indian Journal of Chemistry & the Journal of the Indian Chemical Society to understand their interactions with chemistry journals. Anand[3] analysed the communication of the Journal of the Indian Chemical Society 1979 and found out among others the trend of publications by Indian chemists and the use of journals by them.

Ghosh & Neufeld[41] studied the uncitedness of articles in the Journal of the American Chemical Society. Luthra [79] studied the coverage, bibliographical data, indexes, time lag, cost & use of Chemical Abstracts in comparison with Index Medicus.

Earth Sciences

Earth sciences have accounted for as many as 16 bibliometric studies. Majority of the contributions have come out from two authors i.e. D K Gupta, who has contributed as many as eight papers, followed by A R Chakraborty, whose tally is four.

Gupta, in four of his papers [58,59,60,62] presented the results of the analysis of 642 citations received during 1968-79 by a single paper of Le Pichon on sea flow spreading published in 1968 in the Journal of Geophysical Research. On the basis of the analysis, the author has found out the periodicals citing articles, identified the peers and specialists on plate tectonics and sea-floor spreading, showed how the transmission of the idea contained in Le Pichon's paper followed the epidemic pattern, prepared a ranked list of journals, and applied Bradford's law of scatter. In another paper Gupta [56] analysed the citations on various papers of Le Pichon published during 1965-79 and found out the heavily cited papers of Le Pichon. Gupta [57, 63] also analysed the citations of Geophysics 1980 volume as well as American Association of Petroleum Geologists Bulletin 1970 volume. In the case of geophysics and petroleum geology the average half life of the literature was found to be 9.4 years, and 5.7 years respectively. A bibliography on computer-based storage and retrieval of geoscience information comprising 336 items were also analysed by Gupta and rate of growth etc. was studied [61].

Chakraborty in his four papers [19-22] dwelt on various aspects of geological literature. Analysing the representative data of the last four decades, the author observed a growing tendency towards team research [22]. Scattering of Indian geological literature in Indian and foreign periodicals has also been studied and it is found that about 90% of the literature is covered in Indian sources [21]. A citation pattern based on the chronological distribution has been studied in the field of marine geology. The pattern indicates in order to cover literature upto certain period, periodical upto which year should be procured [19]. Chronological development of documentation activity in geological science in India has been traced which shows.
earliest documentation work in India was carried out in Geological Survey of India.

Raina [113] analysed a sample statistical data of the research output of Indian geologists and found out the time lag, citation pattern, geographical distribution of authors and their information needs. Kapoor [71] analysed the citations in the Annual Review of Earth & Planetary Science, Vol. 1-9, 1973-81 and prepared a rank list of 82 journals accounting for 76% of the total citations. Countrywise and subjectwise distribution of journals have also been provided. Nag [92] and Vaidyanathan [181] carried out bibliometric analysis taking the Indian Journal of Earth Science and Journal of the Geological Society of India respectively as the base.

Biological Sciences

Quite a good number of bibliometric studies have been carried on biological sciences in general as well as on its various branches. The credit for this mostly goes to I N Sengupta, who has contributed as many as 15 articles (13 singly & 2 jointly) in this area. Iyer [67] studied the scatter of Indian biological contributions in Indian and foreign journals. The contributions made by Indians residing abroad has also been taken into account. Sengupta [150, 156, 157] prepared a ranked list of biomedical periodicals from the Indian scientists point of view, and studied the factors responsible for changing the ranks of scientific periodicals.

There is only one study on anthropology, in which Rana [119] analysed the citations in 272 articles published in Man in India during 1970-79 and found that mostly books have been cited & most of the citations are more than 10 year old. Shalini & Raghavan [162] studied the scatter of literature in genetics.

On microbiology, there are two contributions, both of which are by Sengupta [147, 153], wherein the growth and development of the subject have been studied and a ranked list of periodicals prepared taking the Annual Review of Microbiology 1968-70 as a source journal.

Of the seven contributions on biochemistry, three are by Sengupta [151,158,159], wherein he studied the growth of biochemical literature, change in the ranking of periodicals, and offered a weightage formula to rerank biochemical periodicals. Rathore & Mishra [135] examined the usefulness of biochemical periodicals in India, and Bhat [14] studied how author abstracts have been treated by various abstracting services and found that most of the author abstracts have been published without any change.

Chandran [24] and Raina [114] both analysed the citations of the Annual Review of Biochemistry 1979 & 1983 volumes respectively from various angles. Raina attempted to establish the stability in the ranks of some important journals in biochemistry by comparing some ranked lists compiled earlier.

Because of environmental pollution, environmental research is continuously gaining ground all over the world. India is also no exception. In this perspective, Bhar et al [16] has studied the channels of publishing of research contributions on the subject. Subramanyam & O Pecko [180] dealt with environmental research journals.

Botany

There are two studies on botany in general. In one, Rahman & Malik [111] examined the trends of botanical research in India in 1960s, and in the other, Maheswarappa and Prakash [81] studied the literature use pattern of botanical research workers analysing the citations of some doctoral theses.


Zoology

As far as bibliometric studies by Indians are concerned, zoology is a fallow area. Only one study on the subject has been noticed by us. The study by Ghosh [37] dwelt on the scatter of zoological contributions among 263 periodicals. 96 periodicals carried 90% of the contributions.
17%, 12%, and 9% of the contributions were published in USA, UK and Germany respectively.

**Discoveries & Patents**

There are two papers on discoveries [100,102] and one paper by Amba [2] on the use of patents, which has already been discussed. Both the papers on discoveries have been authorised by Neelameghan & others. One paper deals with the distribution pattern of discoveries, and the other studies discovery & rediscovery of antibiotics.

**Medicine**

Though in the realm of Indian scientific literature, medicine tops the list in respect of quantity of papers as well as the number of periodicals, yet bibliometric studies on the field are not many. We have encountered about a dozen papers, half of which has been contributed by Sengupta either singly or jointly. Hence, there is enough scope in this area also for bibliometric studies.

The growth of Indian medical societies and periodicals during 1780-1920 was studied in detail by Neelameghan [97a] which was updated by Sen et al [145] till 1965. In the same paper, the coverage of Indian medical literature in *Index Medicus* (IM) and *Excerpta Medica* was studied and it was found that *Index Medicus* and *Excerpta Medica* covered respectively only 38% and 13.5% of the Indian literature in 10 and 23 months, noticed in the *Bibliography of Scientific Publications of South & South East Asia* 1972. Vetal [185] studied the time lag in the coverage of Indian literature in the above mentioned services and argued for a local documentation list. Luthra [79] studied the coverage, bibliographic data, indexes, time lag, cost and use in *Index Medicus* in comparison with *Chemical Abstracts*. Sengupta [152, 157] and Sengupta et al [161] have prepared ranked list of periodicals of medicine, which would help librarians in the better selection of periodicals. Neelameghan & Ranga Rau [101] studied the seepage of documents in medical electronics. The historiography of Indian medicine has been analysed by Neelameghan [98] for the period 1954-61, during which period Indian contributions have risen by 65% while foreign contribution by 30%.

Sengupta in five different papers [148, 149, 154, 155, 160] - the last one is a joint contribution, studied the growth of physiology, pharmacology and neurosciences literature and prepared ranked list of periodicals on all the areas.

Ghosh [38] studied the information content of contraception literature.

**Engineering**

The number of bibliometric studies in the field of engineering is few, despite the fact that we have quite a large number of engineering librarians. It is interesting to note that about half of the contributions in this field are from non-engineering librarians.

Analysing the papers of the Soviet periodical *Geliotekhnika* (Solar Energy Engineering) as well as citations in those papers, Gupta in his three papers [50-2] studied the internal and external connections of a research branch, networks of scientific papers discussed earlier, and also studied the citations on solar energy research in USSR. Roy [138] commented on the citation study of materials science department.

Nagpal et al [95] studied the trends in electronic engineering research in India in 1960s. The scatter of contributions in radio engineering have been studied by Gundu Rao [46] and Rao [128], and on antennas by Gundu Rao & Talwar [47].

Gupta et al [64] studied the active life of periodicals on structural engineering, and found that periodicals in this field lose their utility value after eight years.

In the three studies devoted to aeronautics and astronautics - a ranked list has been prepared by Bhat and Elisha Raju [15]. Garudadwajan and Murthy [32] applied Bradford law to obtain a fairly reliable estimate of core periodicals on aeronautics and related fields, and Mamadpalli [85] studied the publication channel, number of publications etc of NAL scientists as well as the reasons for their preferring particular journals for publishing their articles.

**Agriculture & Agro-industries**

Considering the output of Indian scientific literature, agriculture ranks second, next only to medicine. However, bibliometric studies on the
field are not many. Hence, there is scope for good number of studies in the field.

Rajagopalan was the earliest to usher in bibliometric studies in this field in India. The extent and speed of coverage of Indian literature on agriculture, botany, zoology and animal husbandry as reported in the *Bibliography of Scientific Publications of South & Southeast Asia 1956-1962* was examined in the *Biological Abstracts, Bibliography of Agriculture*, and six CAB Abstracting services (i.e. *Soils & Fertilisers, Plant Breeding Abstracts, Horticultural Abstracts, Field Crop Abstracts, Animal Breeding Abstracts and Dairy Science*) in his papers [115, 118].

Quite a good amount of time is elapsed between the submission of a paper and its final publication in a periodical. Jain & Goyal [69] studied this very aspect in their paper. This seems to be the only study made in India on this aspect.

Phadnis & Sital [106] have presented a complete picture of agricultural research in India and an account of information facilities available to an agricultural scientist in India. Hadagali [65] and Deshmukh & Ashok Kumar [26] have compiled on the basis of citation analysis, ranked list of periodicals on agricultural economics, and soil science.

The impact of contributions of a single author in terms of citation count has been studied [55,56] in the case of S. Chandrasekhar and Le Pichon. Sinha and Bhatnagar [169] have conducted a similar study taking 68 contributions of Dr R C Sinha, an India-born plant pathologist settled in Canada.

Subbaiah [171-2] carried out two studies analysing the Indian contributions on grape research during 1901-1981 and weed research during 1950-1982. In both the cases, collaborative research was found to be predominant, and journals were the principal media of communication. In the case of weed research, conference proceedings have also been found to be important media of communication.

Hemasundar Naidu [66] prepared a ranked list of 31 core periodicals in poultry science analysing about 3000 citations appended to 33 theses and dissertations and 30 research papers.

There is only one study on fisheries. In this study by Ghosh [36], scatter of the literature emanated during 1958-62 has been examined and it has been found that 90% of the documents were published in 60 periodicals.

### Food Science & Technology

There are four studies on the field, in which the role of India in the bibliographic organization of food literature in commonwealth countries has been studied by Sangameswaran & Gopinath [140], taking into account the literature output and its varieties, secondary services operating in the field etc. Indian literature pertaining to nuclear science & technology, agriculture etc is being inputted to international secondary service by various agencies. Ranganath et al [120] described the experience of food information input to international abstracting services & highlighted the usefulness of such activity.

A great deal of economy can be achieved in periodical acquisition provided periodicals are procured on the basis of their optimal use. Keeping this in view, a study was conducted by Raghavan & Shalini [110] with the periodical holding of CFTRI library & a ranked list was compiled. The scatter of literature in the field was found to obey Bradford’s law.

Maheswarapappa and Rao [82] conducted a study with the citations appended to three representative journals on the subject, one each from India, U.K. & U.S.A. and prepared a list of core journals. Obsolescence factor was also studied.

### Other Technologies

There is one paper each on glass and ceramics, metallurgy, leather technology, and man-made fibre. Using Bradford’s mathematical model and basing the citations of 346 titles abstracted in *Chemical Abstracts 1970-71*, Bhattacharyya [18] determined the scattering coefficient and core periodicals on the subject.


Four papers are devoted to computer science journals and literature. Subramanyam [178] as well as Radhakrishnan and Kernizan [109] studied Lotka’s law and computer science literature. Subramanyam [173, 176] also conducted bibliometric investigation of computer science literature and prepared a ranked list of core periodicals on computer science.
Linguistics

Analysing 3166 citations appended to 307 articles published in Indian Linguists (Vol. 32-41: 1971-80), Begum and Sharada [12] found that books are used more than journals. References are considerably concentrated on a few journals, and most of the references were from current journals.

PROLIFIC AUTHORS

Taking both singular and joint contributions into account, I N Sengupta is found to be the most prolific author with 15 contributions, followed by B M Gupta and D K Gupta (9 contributions each), K Subramanyam, (8 contributions), S Arunachalam, J S Ghosh and B K Sen (7 contributions each), A Neelameghan, I K R Rao and T S Rajagopalan (6 contributions each).

CORE JOURNALS

Annals of Library Science and Documentation tops the list with 57 contributions followed by IASLIC Bulletin (20 contributions), DRTC Seminar (19 contributions) and Library Science with a slant to Documentation (13 contributions). The score of 14 journals (Indian & foreign) ranges from 2 to 8. 16 Journals (Indian & foreign) have only one article to their credit.

DISCUSSION

Ranking

On an analysis of the studies made in our country, it becomes apparent that the largest number of studies were based on citation count and directed to the ranking of periodicals in various fields, application of Bradford’s law, and determination of obsolescence of literature. Ranking of periodicals has been done in all cases by the total number of citations, a particular periodical has received. This procedure does not lead to correct ranking because a periodical which is publishing more number of articles and coming out for a longer time will obviously be cited more number of times than a periodical of the same standard, but publishing less number of articles and coming out for a less number of years. As a result, new journals will always go down in the order because the total number of articles published in the journal is less, so also the citations. If a library wants to subscribe to journals on the basis of their ranking decided purely on the basis of count, almost always new journals will be axed, for which demands may be more in the library. Application of impact factor and other methods of ranking suggested by Eugene Garfield, as well as Sengupta’s corrective formula for new journals will provide more realistic ranking. Sometimes, it is found that the authors have included titles in the ranked list of periodicals which have been cited just once or twice. It unnecessarily lengthens the table and creates problem for the publication of the article. The authors should judiciously fix the limit of citations for inclusion of periodicals in the list so that all important periodicals are included and the table does not become unwieldy.

In certain cases, where the scattering of articles on a subject are shown there it may be necessary to include periodical in the table even with one citation. Cases like this should be considered exceptional.

Sample

The sample taken for some of the studies is too small for any decisive conclusion. It is suggested that a sample of minimum 1,000 citations should be taken with exceptions in the following cases:

i) the citations study of a single article.
   In this case, citations to the article for a minimum period of five years should be taken in case their total number does not exceed 1000.

ii) the citation study of a single author.

iii) the citation study of a nascent subject. A minimum of 5 years of literature should be studied.

iv) the citation study of a single journal.
   Here also, the citation for a minimum period of five years should be studied. In this case the citation connotes the citable items published in a journal, and not the citation appended to the articles of the journal.

Abstract

In the Soviet Union, the state-of-the-art publication coming out under the title of Itogi Nauki and Itogi Nauki i Tekhniki are completely based on the abstracts published in the Re-
Indian Contributions in Bibliometrics

A review has to take into account all contributions published in various languages in the world. The reviewer, not in a position to handle literature in more than a few languages, has to depend on abstracts to ride over the language barrier. This is true for any reviewer in the world. Therefore, the abstracts should be informative enough for the purpose.

While writing this review, it was found that most of the abstracts were not providing the required information.

It is suggested that in the abstract of bibliometric studies based on various counts, the source document consulted should positively be mentioned along with volume nos/issues, the corresponding years, the total number of citations as well as the important findings.

From a bibliometric study, the ranking list of periodicals, the obsolescence of literature, the pattern of use of documents, authorship pattern, the countrywise, languagewise or yearwise distribution of articles can be determined, as well as Bradford’s law can be applied and verified. As such these studies provide ample scope for spinning out several articles basing a single study. This tendency is quite prevalent in some Indian authors. We feel this is unethical and suggest that all the results of a single study should be published in a single paper.

Reporting of Indian Contributions in Foreign Secondary Services

To what extent and with which speed Indian scientific literature is being covered by the international abstracting and indexing services have been studied in several papers, and all the major services have been covered. However, most of the studies were conducted about two decades ago and more fresh studies can be undertaken to see whether there is any change.

Scattering of Indian contributions in Indian and Foreign Journals

The extent of Indian contributions published in foreign journals vis-a-vis Indian journals has also been studied in a few articles. The earliest study by Guha et al is now old and the recent studies are not sufficient enough to derive any decisive conclusion. More such studies should be undertaken to find out to what extent Indian contributions are being published abroad, and in which journals so that those journals can be scanned, to notice those articles in Indian abstracting and indexing services.

Use of Literature by Scientists

There are several studies devoted to this aspect. However, the number of such studies are really less and more of such studies will be welcome.

Studies according to Subjects

There is not much to tell in this regard, because the main text of the article has been written subjectwise, wherefrom fallow areas can be easily seen. However, it may be pointed out that studies on social sciences are rather scant. Apart from all these, there are one, two or a few papers on single author study, single article study, single periodical study, nascent subject study, publication activity study of a single institute, time lag study between the submission of a paper and its publication, information content study of a citation and so on. More such studies will be welcome.

Limitations

1. The study does not cover the unpublished literature.
2. It has failed to cover some articles which have been published in non-library and non-information science journals. It is possible that some studies published in library & information science journals might have escaped our notice.
3. The study has been mainly based on the abstracts given with the articles or found in abstracting journals. Where the abstracts could not be found, matter has been drawn from the title only.
4. It is not claimed that the study is comprehensive but efforts have been made to cover as many articles as possible.

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