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Evaluation of Institutional Research Productivity

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ABSTRACT

The quantification of scholarly performance has become an obvious necessity in many academic pursuits. Evaluation of research output is therefore an integral element of R&D institutions worldwide. However the quality-weighted dimensions of quantity are gaining momentum. Consequently, a good number of evaluative studies on publication productivity have been made available in scientometric literature. This paper critically scrutinises the literature on research productivity concerning scientific institutions (include universities and departments) in an informational context. It provides a thorough review to map the quantum of knowledge relating to 'institutional research productivity' correlating the Indian vista. It is, however, indicative to find the gaps and shortcomings in this specialty of research; hence enunciate the issues both attended and unattended. The paper also offers a few recommendations to undertake evaluative studies with caution. Thus it shows a coherent picture of this emerging area in the sociology of science.

Keywords: Scientometrics; Scientific visualisation; Knowledge mapping; Research evaluation; Institutional productivity; Publishing performance; Single-institutional studies

1. INTRODUCTION

Research is the basis of development in any civilised society. The societal progress largely depends upon the human intellectual endeavors. However, the prosperity of a nation depends on how efficiently the researchers are performing to meet the requirements of humankind. Indeed an assessment of research performance is a basic prerequisite for decision-making on possible investments, science governance, and academic administration thereof. So the evaluation of research productivity has become an obvious necessity, and is therefore an integral element of R&D institutions worldwide.

A large number of evaluative studies on publishing productivity concerning an institution or multiple institutions (read as universities or departments) have been made by many scholars. Quantitative measures have been used quite often to analyse the scholarly performance of an individual scholar, aggregated into groups of varying size or scientific institute and long studied by the scientometricians. Nows-a-days evaluative scientometrics has become operative also by the researchers from other domains. This paper presents an in-depth review of literature on 'institutional research productivity' in a globally changing context.

This paper aims to depict the state-of-the-art knowledge relating to the topic. Purposively it describes the evaluative studies emphasizing on Indian vista. It also refers to the developmental activities performed by the researchers

incorporating newer ideas achieved over time. Sincere effort has been made to map the quantum of knowledge relating to this emerging area of scientometric research. It is however indicative to find the gaps and shortcomings in this specialty of research; hence clearly pronouncing the issues both attended and unattended. Thus it presents a coherent picture of this perplexing problem in the measurement of science.

2. SCOPE AND METHODOLOGY

The paper, being the first of its kind, offers a thorough review on the 'institutional research productivity' in two different aspects. Primarily it draws attention to the literature concerning fundamental (conceptual) developments for assessment of research productivity. Subsequently, a detailed review of the institutional evaluations has been provided, where single-institutional studies have received prior importance. Although the scope of this review is highly extensive, but concentrated only on the institutional evaluations inclined to applied scientometrics. Hence it does not cover the literature related to performance indicators (indices) used in research evaluations.

As an earlier impression, Vinkler (2010)¹ systematically presented the literature on scientometric indicators for evaluating research performance. Wildgard *et al.* (2014)² also reviewed on bibliometric indicators for measuring the productivity of individual researchers. Similar other efforts were made by Thelwal and Kousha (2015)³ ; Rijcke *et al.* (2016)⁴ where they reviewed on a few indicators and alternative indicators

used in research evaluations. More recently, Waltman (2016)⁵ conducted an intrinsic review on citation impact indicators focusing the counting methods, normalisation techniques and source databases. We, therefore, felt it worthy to produce an unfold area, which is under study. The chosen topic is hence relevant and quite interesting.

This review should enable the researchers as well as scientometricians to have state-of-the-art knowledge on the area concerned. Its' purpose is to analyse the available literature toward conceptualizing the possible issues of concentration in the future studies. Thus it makes a significance to grasp an idea on the institutional evaluations, thereby aids to formulate the design of new researches with caution.

Pursuant to the identification of literature considered for this review, multiple searches have been conducted to get precise information from authoritative sources; viz. Library and Information Science Abstract (LISA), Indian Library Science Abstracts (ILSA), Library Literature (LibLit), Shodhganga, ProQuest, Scopus, Web of Science, Google Scholar and Indian Citation Index. So it covered almost all possible sources of information relevant to this study. Itemised list of published literature has been scrutinised thoroughly based on our prior understanding. Further information relevant to the topic has been identified systematically via cross-references. A special drive for locating information related to other activities on the issue (say workshop, seminar, conferences, etc.) has been initiated. The review ultimately considered more than 120 items that are found to be most relevant.

To make it more convenient to use and realizing the standard practice, collected references have been organised in the Zotero reference management tool. However to understand the clusters of knowledge; appropriate items are categorised in different sections (single-institutional, multi-institutional) and oriented them chronologically under each section. Finally, it revealed a lot of information to observe them for critical review.

3. CONCEPTUAL DEVELOPMENTS

One of the first writers to suggest scientific publications as a measure of research productivity was William Shockley, a Nobel laureate in Physics; who was interested in measuring research performance among individuals within a group by analyzing their publications. Shockley (1957)⁶ viewed that in scientific enterprises, a few researchers considerably be creative than others in producing scientific output. Later on, Price (1963)⁷ in his breakthrough work provided the basis of publication productivity that typically differs among the scientists and highly skewed. He found that about 6 per cent of the scientists produce almost 50 per cent of the publications in an academia.

Such a difference in productivity among scientists has been explained by Cole and Cole (1973)⁸ in two different ways. Scientists enormously differ in their cognizance, ability and motivation to do creative works. Otherwise, "the success and recognition of productive scientists used to make them more productive" – they opined. The concept of 'sacred spark' and 'accumulative advantage' in the assessment of scientific productivity created ample interest among sociologists and

scientific enterprises world over (Allison & Stewhart, 1974)⁹. Gradually it has become a prominent issue in the sociology of science.

So a good number of researchers have evaluated scientific publications for assessing research productivity in much the same way as viewed by Andrews (1979)¹⁰, Lindsey (1980)¹¹, Rao (1980)¹², Fincher (1983)¹³, Koenig (1983)¹⁴, King (1987)¹⁵, Garfield & Welljams-Dorof (1992)¹⁶, van-Raan (1993,1999)¹⁷⁻¹⁸, Russell & Rousseau (2002)¹⁹, Coccia (2004, 2005)²⁰⁻²¹, Vinkler (2006)²², Abramo *et al.* (2008)²³, and many others. Most of the studies are conducted for measuring either countrywide or domain-specific else organisational research performance, often combining with citation analyses. Such evaluations have been made increasingly by quantifiable characteristics correlating quality-weighted values of scientific publications.

Lawani (1977)²⁴ viewed the citations as a quality measure of publications duly illustrated the scientific papers of Nobel laureates and entomologists. Andrews (1979)¹⁰ gave a theoretical foundation on the organisation of research and studied R&D performance of different research groups of volunteer countries in Europe. Wilson (1979)²⁵ summarily identified numerous other factors can be effective for measuring research performance. Lindsey (1980)¹¹ formed the basis of measuring productivity taking into account of sharing credit for multiple authorships in publications and corresponding citations. Rao (1980)¹² examined that the negative-binomial (over many other distributions) typically entails a pattern of scientific productivity under the condition "success breeds success" in a variety of social circumstances.

Fincher (1983)¹³ brought some theoretical insights and practical indices for assessing the productivity of higher learning institutions. Koenig (1983)¹⁴ correlated bibliometric indicators to generate a composite score in the assessment of research performance. He also compared the results with expert judgment and developed a method of producing score (normalised by institutional budget, i.e. input/output ratio), as an indicator of research productivity. King (1987)¹⁵ outlined the portfolio of science indicators and its methodological developments used to evaluate the research activities. Sen and Gan (1990)²⁶ conceptualised on bibliometric methods for applying them in the productivity measure of scientists.

Garfield and Welljams-Dorof (1992)¹⁶ revealed the 'citation' as an influential indicator of measuring science and technology. Sen (1992)²⁷ devised the idea and method of determining 'normalised impact factor' and can be more indicative to judge comparative performance. van-Raan (1993, 1999)¹⁷⁻¹⁸ introduced some advanced quantitative methods in assessing research performance and to map the developments of scientific endeavors. He stated that "science would not exist, if scientific results were not communicated; so communication is the driving force of science – thus publications are essential and formed the basis of all scientific endeavors". Geisler (1994)²⁸ suggested an improvised technique of measuring the performance of R&D organisations employing 'key output indicators' combining quality and quantity, thus compared two research laboratories. Budd (1995)²⁹ addressed on institutional productivity of research and scholarship at various levels.

Russell and Rousseau (2002)¹⁹ suspiciously argued on

the availability of reliable data that has to be used extensively for evaluating the performance of research institutions. Coccia (2004, 2005)²⁰⁻²¹ proposed a few scientometric models in view of determining the R&D performance of public-funded research institutes. Vinkler (2006)²² identified a new composite indicator (using both quantitative and qualitative techniques) for measuring research performance of scientific institutions. Abramo *et al.* (2008)²³ presented a methodology of assessing research productivity of the academic institutes through a number of input/output variables; like number of researchers, funding amount, special grants, areas of scientific specialty, quantity of publications, level (quality) of contributions, resource allocations, etc.

Garcia *et al.* (2012) evaluated on the research performance of academic institutions having multi-dimensional prestige in a scientific specialty (influential field of research) to produce an aggregated summary of prestige score through a number of scientometric indicators. Besides conventional indicators, Kim *et al.* (2014) explored the possibilities of using research collaboration (in different levels) as a measure of institutional performance. Huang *et al.* (2015) viewed on research collaborations through a systematic comparison of co-authorship in the pre-web and post-web era. They found a steady relationship between the interdisciplinarity, multi-authorship and citation impact during the Internet age. Pal (2015) highlighted on the lateral relationship among co-authors of collaborative publications to determine the density (intensity) in collaborations.

More recently, numerous socio-academic cultural indicators have also been suggested by national statutory bodies for evaluating the performance of scientific institutions (NIRF, 2015). Certainly one has to use appropriate indicator/s and relevant counting technique for utilizing quality-weighted values of quantity in assessing institutional research productivity, as suggested by Li *et al.* (2017).

4. MULTI-INSTITUTIONAL STUDIES

A number of evaluative studies concerning two or more institutions (departments) have been reported in published literature. Those studies were aimed at measuring research contributions across the departments and/or institutions in various dimensions.

4.1 Global Panorama

A pioneering work has been done by Glenn and Villemez (1970)³⁶ for evaluating the productivity of the sociologists of a few American universities. Endler (1977)³⁷ also evaluated research productivity and scholarly impact of Canadian psychology departments. In a similar way, Rushton and Meltzer (1979)³⁸ examined on research productivity (impact) of 31 Canadian Universities. Thereafter Schubert and Barun (1981)³⁹ visualised on publishing performance of 85 Hungarian institutes by approaching scientometrics. Yankevich (1982)⁴⁰ analysed on publication productivity of selected academic institutions in Soviet Republics. McCallum (1984)⁴¹ initiated for assessing the productivity of US speech communication departments. Irvine (1989)⁴² systematically described the progression of evaluating scientific institutions through a

bibliometric analysis of technical universities of UK. Rushton (1989)⁴³ revisited the British psychology departments to assess them scientometrically for a decade long period.

Zachos (1991)⁴⁴ compared the research performance of two university departments in Greece employing bibliometric indicators. Royle (1994)⁴⁵ examined the appropriateness of using the Institute of Scientific Information (ISI) databases for measuring research productivity. He eventually analysed the publication output of three Australian universities using the Science Citation Index (SCI) and Social Science Citation Index (SSCI). Haiqi (1996)⁴⁶ analysed on research productivity of key medical universities in China using quantitative methods and techniques. Vinkler (1998)⁴⁷ calculated the performance indices among the institutions of the Hungarian Academy of Sciences based on a few scientometric indicators. National Research Council (1999)⁴⁸ reported on mathematical sciences research institutes in the United States through a stringent process of accreditation.

Schloegl *et al.* (2003)⁴⁹ demonstrated on various problems (especially data sources) commonly occurs in research evaluations, thereby evaluated two university departments of Austria. A different approach has been devised by Bonaccorsi and Daraio (2003)⁵⁰ for analyzing scientific productivity of French (INSERM) and Italian (CNR) institutes of biomedical research. Jokić *et al.* (2006)⁵¹ assessed on publication output of hard-sciences researchers of six Croatian Universities, as reflected in Web of Science. Albert *et al.* (2007)⁵² aimed at evaluating the performance of the Spanish Council for Scientific Research (CSIC) in Biotechnology, focusing on technology transfer. Valles-valenzuela *et al.* (2009)⁵³ quantified the international exposure of Spanish Universities in the area of legal and forensic medicine by analyzing their research publication data available in Medline database.

Lee *et al.* (2012)⁵⁴ studied the impact of collaboration on publication output of publicly funded research institutions in Korea (via network analysis of Scopus data). Ketzler and Zimmermann (2013)⁵⁵ conducted a citation-based study exploiting Social Science Citation Index and critically measured the influence of research publications of the German economic research institutes for a decade long period. Smyth and Mishra (2014)⁵⁶ compared the research productivity and citation impact of in-bred and out-bred faculties employed at 21 law schools in Australia. Anyaogu and Iyabo (2014)⁵⁷ examined some demographic variables as correlates of research productivity taking into account of Law faculties in the Nigerian Universities. They found a positive relationship between ages (experience) with publication output.

Pastor *et al.* (2015)⁵⁸ pointed out the difficulties of measuring research output of higher education institutions, summarily proposed a simple indicator permitting both qualitative and quantitative aspects of their influence in teaching and research activities. Guskov *et al.* (2018)⁵⁹ initiated a project for enhancing the capability of reinforcing publication-output through a study on measuring the research productivity of top twenty-one Russian universities.

4.2 Indian Vista

Scientometric evaluations focusing research output of two

or more Indian institutions are also evident. First of its type of study was conducted by Sen (1992)²⁷ in the Indian scenario. He analysed on research publications of the CSIR Laboratories by introducing a technique of normalised impact factor. Munshi (1994)⁶⁰ initiated a study for assessing the publication output of Indian agricultural universities. Nagpaul (1995)⁶¹ examined on the research performance of the Indian universities employing interrelated factors of quantity and quality. He measured the quantity by counting articles published in SCI covered journals (only), and assessed the quality via impact factor (normalised) of the source journals. Subsequently, he compared the institutes using related indices; viz. activity index, citability index, relative quality index. Kumar (1999) demonstrated on the idea of determining scientific performance based on the publications of CSIR Laboratories in India.

Dhawan and Gupta (2007) took a serious interest in of measuring the performance of physics-research institutes in India, using INSPEC as their primary source of data. Sevukan and Sharma (2008) evaluated the performance of biotechnology researchers of a few Central Universities in India through PubMed, Web of Science, and National Centre for Biotechnology Information (NCBI) data. Prathap and Gupta (2009) devised a new performance index for ranking Indian universities through a complex procedure of quantity and quality measures on research publications. They conducted another study (Prathap & Gupta, 2011) to rank the Indian medical colleges based on research performance using robust indicators of quantity and quality. Kumar (2010) analysed on scientific publications of the oilseed-crops research institutes under the Indian Council of Agricultural Research (ICAR).

More recently Husian and Muzamil (2011) performed a scientometric assessment of Central Universities of India by analyzing their publications available in Scopus. Abilash (2012) put an effort to evaluate on the research output of selected higher learning institutions located in Kerala. Kaur and Mahajan (2012, 2015), compared the research performance among two premier medical institutes, and also ranked the Indian medical institutes based on their publication output. Bala and Kumari (2013) mapped on research publications produced by the National Institute of Technologies (NITs) over a decade. Gupta *et al.* (2013) compared the research output of Karnataka University with three other universities in the state. Pandita *et al.* (2014) undertook an analysis of publications produced by four medical research institutions in India using Web of Science. Satpathy and Sa (2015) measured the research productivity of a few universities of Odisha through a bibliometric analysis of their publications reflected in Scopus.

Sangeeta (2016) pursued her effort on in measuring the publication productivity of the academic universities in Punjab. Rosalin (2016) gave a clear picture on of the research productivity of the academic universities in Tamil Nadu. Solanki *et al.* (2016) viewed on research competitiveness amongst the IISERs (Indian Institute of Science, Education and Research). Mukherjee (2017) reviewed on research performance of the CSIR Laboratories in India. He presented more current state-of-the-art of publications using Web of Science database. Batcha (2018) analysed the research publications produced by top six universities of Tamil Nadu. Pradhan and Ramesh (2018)

presented a scientometric map of the research publications of six IITs, as indexed in Scopus.

5. SINGLE-INSTITUTIONAL STUDIES

Other interesting efforts on measuring research-performance targeted to an institute have been made by many scholars in the national and international scenario.

5.1 International Efforts

As an earlier impression, Bindon (1981) analysed the scientific output of the Pulp and Paper Research Institute (Canada) using various quantitative techniques. Irvine and Martin (1985) described the reasons of for the growing need for research evaluations. Subsequently, they measured the research performance of the CERN (European Laboratory for Particle Physics at Geneva, Switzerland). Simeon *et al.* (1986) evaluated publication output of the Institute for Medical Research and Occupational Health in Zagreb (Croatia) to understand relevant policies for academia.

Le-Minor and Dostatni (1991) studied on research-performance of the French National Institute for Health and Medical Research in order to develop a tool for scientific decision-makers. Beck and Gaspar (1991) assessed the performance of the five natural science departments of Kossuth Lajos University (Hungary) considering the journal impact factor as a quality indicator. Bradley *et al.* (1992) analysed the publications and corresponding citations of the Department of Information Studies at the University of Sheffield. Noyons *et al.* (1999) demonstrated on how to set a benchmark for productivity assessment of a particular research institute with cognitive orientation and impact. They have used a combined method for evaluating research performance of Inter-University Centre for Micro Electronics (IMEC) in Belgium.

In the present century, similar studies have also been made by many others with improved indicators to obtain better insights. Frohlich and Resler (2001) analysed on publications of the Institute for Geophysics at the University of Texas to understand certain discrepancies in publication-counting methods. Lee (2003) examined on research productivity of the Institute of Molecular and Cell Biology (Singapore) correlating basic inputs (recurrent budget and manpower) of research. Alibeygi (2008) explained some determining factors (rank, age and family profile) of measuring research productivity of Razi University (Iran).

Stvilia *et al.* (2011) evaluated on publication productivity in the light of collaborative efforts of scientific teams at the National High Magnetic Field Laboratory (NHMFL), USA. Pudovkin *et al.* (2012) made an assessment of research productivity at the Deutsche Rheuma-Forschungszentrum (DRFZ), a German medical institution. They also compared the citedness among scientists using citation indexes. Kim (2014) studied on the research performance of the School of Biological Sciences at Seoul National University (South Korea).

Haq and Fouzan (2017) evaluated the research outcome of the King Abdullah International Medical Research Centre (KAIMRC) at King Saud bin Abdul Aziz University for Health Sciences (KSAU-HS), Saudi Arabia. They retrieved the

dataset from the Web of Science and typically employed some bibliometric indicators.

5.2 Endeavors Made in India

A large number of studies on assessing scholarly productivity concerning an institute of India has been reported. An earlier effort was made by Garg and Rao (1988) for evaluating scientific productivity of the National Physical Laboratory (NPL) of India correlating some input-output indicators viz. manpower, annual budget and research publications. Seetharam (1997) carried out an exercise on science indicators for analyzing the publications of the Central Food Technological Research Institute (CFTRI), Mysore. Jeevan and Gupta (2001, 2002), analysed the performance and impact of research papers produced by the Indian Institute of Technology (Kharagpur) and compared R&D performance amongst the departments.

Consequently, Mehta (2005) put her efforts on measuring organisational productivity keeping in view of research publications of the National Chemical Laboratory (NCL), Pune. Kademani *et al.* (2005) also analysed the research performance of chemical scientists at the Bhabha Atomic Research Centre (BARC). Singh *et al.* (2005) studied on impacts of research contributions made by the Indian Institute of Technology (Roorkee) for a decade long period. Angadi *et al.* (2006) analysed the productivity and trends in research of social scientists at the Tata Institute of Social Sciences (TISS), Mumbai. Kumbar *et al.* (2008) assessed on the growth and citation impact of research publications of the University of Mysore. Wadhwa *et al.* (2008) reinitiated a study on comparing research outputs of the NPL produced in two distinct periods. Bala and Gupta (2009) visualised the influence of research publications of Chandigarh Medical College and Hospital, Punjab.

Gradually such evaluations have received momentum with the online access to bibliographic databases. Sarkhel and Raychoudhury (2010) made a quantitative evaluation of agricultural research contributions of the Bidhan Chandra Krishi Viswavidyalaya (BCKV), West Bengal. Kumar and Naqvi (2010) mapped natural sciences publications of the Jamia Millia Islamia University (New Delhi) in different dimensions. Nandi (2010) analytically studied on pure sciences research contributions of the Burdwan University, West Bengal. Mishra (2010) pursued his effort to analyse the research publications of the National Metallurgical Laboratory, Jamshedpur.

It is also evident that in recent past single-institutional studies have been made quite often. Most of the studies are focusing mainly on public-funded academic institutions to realise the accountability and to justify possible returns on investment. Jeyshankar *et al.* (2011) analysed the research publications of Central Electro Chemical Research Institute (CECRI), Tamil Nadu for a period of ten years. Vasistha (2011) investigated on research output of the PEC University of Technology, Chandigarh based on the data available in Scopus. Kaur *et al.* (2011) evaluated the publications of a government medical college at Chandigarh downloading data from Scopus.

Baby and Kumaravel (2012) pursued a bibliometric study

on research productivity of the Periyar University, Tamil Nadu using publication data from Scopus. Savanur and Konnur (2012) studied on quantitative growth of publications of the Bangalore University in terms of Web of Science. Kumar and Dora (2012) analysed the research performance of Indian Institute of Management (Ahmedabad) based on the publications indexed in Scopus and Web of Science.

Sudhier and Priyalakshmi (2013) evaluated on publication trends of the Central Tuber Crops Research Institute (CTCRI), Kerala. Maharana and Sethi (2013) conducted a bibliometric analysis of the publications of Sambalpur University, Odisha as covered in Web of Science. Maharana (2013) further analysed the publications carried out by researchers of the Orissa University of Agricultural Technology, Bhubaneswar as indexed in Scopus. Rautaray *et al.* (2013) quantified the research contributions of the KIIT University, Odisha based on the data available in Scopus. Kumbar and Gupta (2013) assessed on publication output and citation impact of the Karnataka University in the field of Science and Technology. Baskaran (2013) studied on the research performance of the Alagappa University, Tamil Nadu. Visakhi and Gupta (2013) analysed the research publications of IISER, Mohali as reflected in Scopus focusing on publication growth and citation impact. Wani *et al.* (2013) examined the publication productivity of the Indian Institute of Technology, New Delhi using Scopus database.

Another attempt was made by Chaurasia and Chavan (2014) to analyse the publishing productivity of the Indian Institute of Technology, New Delhi based on the Web of Science database. Anilkumar (2011, 2014), conducted studies on productivity of the Physical Research Laboratory, Ahmedabad to understand the research trends duly used to allocate the funds and resources. Gopikuttan and Aswathy (2014) viewed on scientific performance of the Kerala University. Pathak and Bharati (2014) quantified the publications of the Botanical Survey of India over a period of thirty years. Leema Helen (2014) understood publication productivity of the Madurai Kamaraj University through a scientometric study. Ghosh (2014) made his intrinsic efforts on research publications of the Indian Institute of Chemical Biology, Kolkata. He summerly realised the growth and orientation of research focus over the decades of the CSIR-IICB.

Gautam and Mishra (2015) evaluated on scholarly performance of the Banaras Hindu University, Uttar Pradesh based on the Indian Citation Index. Jeyshankar (2015) examined the research productivity of Indira Gandhi Centre for Atomic Research (IGCAR), Chennai using publication data from Scopus. Duraipandi (2015) pursued his dissertation work to map the research contributions of the Jawaharlal Nehru University (JNU), New Delhi. Siwach and Kumar (2015) investigated on publishing performance of the Maharshi Dayanand University, Haryana retrieving dataset from Scopus. Tripathi and Kumar (2015) put their intrinsic effort on identifying decadal changes in the research output of the Jawaharlal Nehru University, New Delhi based on the publications as available in Web of Science. Khan and Ahangar (2015) thoroughly studied on research profile of the Government Medical College Jammu through Scopus data using some bibliometric indicators.

Over the last few years, the assessment of research productivity has begun to flourish by Indian scholars. Nongrang and Laloo (2016) analysed the research contributions of the North-Eastern Hill University (NEHU), Shillong in the field of Biochemistry combining publications from institutional repository and Web of Science for a period of ten years. Mandhirasalam (2016) exercised both quantitative and qualitative indicators to analyse the research contributions of PSG College of Technology, Coimbatore as reflected in Scopus.

Naika (2017) put her efforts on measuring the research performance of the Indian Institute of Technology (Bombay) based on publication output reflected in Scopus. Nongrang (2017) initiated a bibliometric inquiry on published contributions of the NEHU, Shillong for a decade long period. Khanna *et al.* (2017) analysed on Physics and Astronomy publications of the Guru Nanak Dev University (Amritsar), Punjab as appeared in Scopus database.

Built upon previous studies repeated efforts are extended the frontiers of knowledge in applied scientometrics. Kumar (2018a) evaluated on the research performance of the Aryabhatta Research Institute of Observational Sciences (ARIES), Nainital for a period of fifteen-years using Web of Science. Subsequently, he revealed on publication productivity of the Tata Institute of Fundamental Research, Mumbai through Web of Science database (Kumar, 2018b).

Mondal and Raychoudhury (2018) carried out a performance evaluation of the Saha Institute of Nuclear Physics, Kolkata based on Web of Science dataset. Nishavathi and Jeyshankar (2018) analysed the publication records of All India Institute of Medical Sciences (AIIMS), New Delhi as appeared in Scopus. Mulimani and Hadagali (2018) scientometrically analysed the contributions of the Indian Institute of Toxicology Research (IITR) for a period of 25 years. Bhakta and Bhui (2018) visualized the research performance of the University of Petroleum and Energy Studies (Dehradun) in terms of the publications reflected in Scopus during a decade. Similar other studies may also be available in due course of time.

Keeping in mind the huge amount of literature, the authors have considered a few studies with their hierarchy of relevance. Further conceptualisation on the reviewed literature has been made in a three-dimensional way (data–documents–duration). It has been found that, evaluative studies varied with the data source, documents considered, and durations covered. Most of the evaluations have used the publication data from any of the readily available databases (like Scopus or WoS, seldom done by others viz. INSPEC, MathSciNet, PubMed, and Indian Citation Index) without scrutinizing and validating the dataset.

6. OTHER SCHOLARLY ACTIVITIES

Besides the considerable volume of literature, a good deal of scholarly activities on the issue is also evident. As such the conferences and workshops have been initiated regularly. For instance, the ‘International Conference on Scientometrics and Informetrics’ and ‘International Workshop on Webometrics, Informetrics and Scientometrics’ are being held regularly. In this regard, the National and international forums are

also prominent. International Society for Scientometrics and Informetrics (ISSI); and Institute of Scientometrics (in India) has come into being. Plenty of journals in LIS field cover scientometric studies in their scope. Newer journals are also coming up (viz. Journal of Scientometric Research). Study circles, round table meetings and online web-forums are actively discussing on evaluative scientometrics to realise the composite indicators and scholarly metrics for research evaluation.

In India, an earliest attempt in this regard was undertaken by Documentation Research & Training Centre (DRTC) of the Indian Statistical Institute (ISI) through a Seminar on Bibliometrics, held at Bangalore in 1969. The next one also organised by DRTC at Bangalore in the year 1981, and the third event was again held at Bangalore as Fifteenth Conference of the IASLIC in 1985. However the first workshop on “Scientific Communication and Bibliometry” was held at Calcutta in 1988. A landmark event, namely ‘Third International Conference on Informetrics’ was held at DRTC (Bangalore, 9-12 August 1991) organised by IK Ravichandra Rao under the Chairmanship of Jayanta Kumar Ghosh (then Director, ISI). Another important workshop (regional) on ‘Informetrics and Scientometrics’ was organised by DRTC in coordination with the National Information System for Science and Technology (NISSAT), New Delhi scheduled at DRTC, Bangalore during 16-19 March 1998. The workshop suitably selected the theme as ‘scientific productivity’ for blending research and practices.

In 2004, the Central Library of IIT (Roorkee) organised the “First International Workshop on Webometrics, Informetrics and Scientometrics (WIS)” as a part of the Fifth COLLNET Meeting held during 2-5 March. Nowadays, there are many conferences, workshops and hands-on training programs. Such as Third-WIS held at New Delhi (in 2007); Sixth-WIS at Mysore (2010); Eleventh-WIS at New Delhi (2015); and National Conferences of the Institute of Scientometrics are being held annually since 2013. More recently, an effort was mooted by ISI for a “National Workshop on Using Different Metrics for Assessing Research Productivity” held at New Delhi in 2012. UGC sponsored “National Seminar on Advancement of Science through Scientometrics” was held at the Department of LIS, Annamalai University in March 2015. UGC-INFLIBNET Centre regularly organises advanced level trainings on “Bibliometrics and Research Output Analysis”. Almost all the LIS schools are covering research evaluation metrics in their course contents. Nonetheless, scientific evaluation of the institutions has become a national agenda today (NIRF, 2015)34).

7. CRITICAL APPRAISAL

Aforesaid discussion entails that many scholars (scientometricians as well) have put forth their striving efforts on assessing research performance. However the evaluative studies on institutional productivity have been made quite often worldwide. Such (single-institutional) studies are more prevalent in India, immensely organised focusing public-funded institutions (include universities) of the country. Most of the studies have considered either readily accessible bibliographic databases or citation indexes (Scopus and/or

Web of Science) as their source of primary data for evaluations. In reverse, institutional studies are rarely done by exploiting comprehensive dataset, instead of relying only on readymade databases; which needs intrinsic efforts for gathering and validating publication data combining all possible sources. Moreover, the vast majority of evaluative studies were focused primarily on natural and applied sciences research with a very few on social sciences.

In most of the studies, quantitative measures have been taken into account for analyzing the publications; seldom done with quality indicators. While some other studies have been made in a crude and rudimentary manner paying very minimum attention to the requisites of evaluative scientometrics; neither validated the dataset, nor used appropriate tools and techniques – rather overlooked or distorted the scientometric arguments. Sometimes they are far beyond the formalities of scientific writings and reported in questionable journals. Such a practice is more prevalent in India during last few years, perhaps due to superfluity of predatory journals, prompted by policymakers.

It has also been observed that in many studies, bibliometric methods are used repetitively without having the proper context. In moral, no single method can be sufficient for all cases and no single indicator can work well (equally) in many situations of evaluating R&D performance. Careful attention is indeed essential to employ the most appropriate indicator using objective metrics. However the quality weighted dimensions of quantity always be effective in evaluating institutional productivity.

This review has permitted to map the knowledge of institutional research productivity with broad generality, and in particular to single-institutional studies made worldwide. In this juncture, the role of scientometricians is worth mentioning; when Indian scholars have played a crucial role in extending the frontiers of knowledge in bibliometrics and scientometrics. This work could be useful to track many other relevant issues by conceptualizing the ideas expressed herein. Thus it paves the way for improved organisation of research in this area and could be a driving force in producing better research.

8. CONCLUSIONS

The most fundamental idea in the socialisation of science is the publication of research results, which allows researchers to exchange thoughts and reliably receive critical responses on their work. However a researcher acquires recognition, subsequently achieves reputation, thereby fulfills esteem value through publishing. Promotions and positions in the academic world are usually determined by scholarly behavior and research outputs. Quantification of research is therefore an obvious necessity in many academic pursuits.

Scientometric measurements have been recognised as an indispensable tool for intelligent judgment of research activities and scientific behavior of the institutes. None-the-less, research publications found always the best available basis for evaluating research productivity, often combining with influence factors via citation counts. Certainly, the intellectual development in this specialty of research is extensive, but there is an obvious need for cognizance in exercising appropriate metrics. Further, this review observed no such indicator is sensitive enough for

assessment of publications in the interdisciplinary research areas. Although metrics-based evaluations never can replace the peer-review process, but can be a complement to human judgments; yet scientometric evaluations will continue for the institutions to formulate strategies and evidence-based management policies.

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