IOSR Journal Of Humanities And Social Science (IOSR-JHSS)
Volume 20, Issue 12, Ver. I (Dec. 2015) PP 01-07
e-ISSN: 2279-0837, p-ISSN: 2279-0845.
www.iosrjournals.org

Scientometric Nuclear Research: A Global Perspective

Dr.K.Vinitha[1], Mr.V.Srinivasan[2]
Librarian, St. Mary's College, (Autonomous) Tuticorin, Tamil Nadu,India
Research Scholar, M.S. University, Tirunelveli, Tamil Nadu,India

Abstract: *Since Vassily V. Nalimov coined the term 'scientometrics' in the 1960s, this term has grown in popularity and is used to describe the study of science: growth, structure, interrelationships and productivity. Scientometrics is related to and has overlapping interests with bibliometrics and informetrics. The terms bibliometrics, scientometrics, and informetrics refer to component fields related to the study of the dynamics of disciplines as reflected in the production of their literature. Areas of study range from charting changes in the output of a scholarly field through time and across countries, to the library collection problem of maintaining control of the output, and to the low publication productivity of most researchers. This article narrates the nuclear research at global level.*

Keyword: *Bhaba, Bradford's Law, Informeterics, Nuclear, and Scientometrics,*

I. Introduction:

In 1969, Vassily V. Nalimov & Z. M. Mulchenko coined the Russian equivalent of the term 'scientometrics' ('naukometriya') (Nalimov & Mulchenko, 1969b). As the name would imply, this term is mainly used for the study of all aspects of the literature of science and technology. The term had gained wide recognition by the foundation in 1978 of the journal Scientometrics by Tibor Braun in Hungary. According to its subtitle, Scientometrics includes all quantitative aspects of the science of science, communication in science, and science policy (Wilson, 2001). Soon after its foundation, Nalimov became the (only) Consulting Editor. Some other early papers by Nalimov which helped to nurture the nascent discipline of Scientometrics include: Nalimov (1970), Nalimov & Mulchenko (1969a) and Nalimov et al.(1971).

Much of scientometrics is indistinguishable from bibliometrics, and much bibliometric research is published in the journal, Scientometrics. After all, the immediate and tangible output of science and technology into the public domain is literature (papers, patents, etc).

Research evaluation and assessment has gained momentum as a range of new techniques and tools were devised, particularly to measure the publication productivity and recognition as the technology has enabled new modules of publishing and the increased availability of literature.

II. Methodologies

Research reactors comprise a wide range of civil and commercial nuclear reactors which are generally not used for power generation. The term is used here to include test reactors, which are more powerful than most. The primary purpose of research reactors is to provide a neutron source for research and other purposes. Their output (neutron beams) can have different characteristics depending on use. They are small relative to power reactors whose primary function is to produce heat to make electricity. They are essentially net energy users. Their power is designated in megawatts (or kilowatts) thermal (MWth or MWt), but here we will use simply MW (or kW). Most range up to 100 MW, compared with 3000 MW (i.e. 1000 MWe) for a typical power reactor. In fact the total power of the world's 240 research reactors is little over 3000 MW.

III. Nuclear Research– An Overview

India's three-stage nuclear power programme was formulated by Homi Bhabha in the 1950s to secure the country's long term energy independence, through the use of uranium and thorium reserves found in the monazite sands of coastal regions of South India. The ultimate focus of the programme is on enabling the thorium reserves of India to be utilised in meeting the country's energy requirements.[1][2] Thorium is particularly attractive for India, as it has only around 1–2% of the globaluranium reserves, but one of the largest shares of global thorium reserves at about 25% of the world's known thorium reserves. However, thorium is not economically viable because global uranium prices are much lower.

IV. Bibliometrics Analysis

Bibliometrics is a type of research method used in Library and Information Sciences. It is a quantitative approach of various aspects of literature in specific area and is used to identify the pattern of publication. It helps in getting an insight into the dynamics of growth of knowledge in the area under consideration. In the present day Bibliometrics has attained sophistication and complexity of national, international and interdisciplinary character.

V. Informetrics Analysis

The field of informetrics took the place of the originally broader speciality bibliometrics. The term informetrics was adopted by VINITI (Gorkova 1988)18 and stands for a more general subfield of information science dealing with the mathematical statistical analysis of communication processes in science. The term acceptance date since 1987 when B.C. Brooke suggested during the International Conference of Bibliometrics and Theoretical aspects of Information Retrieval in Diepenbak, Belgium that the term informetrics included in the name of the following conference, scheduled for London, Canada in 1989. This meeting was thus named – International Conference on Bibliometrics, Scientometrics and Informetrics. Scientometrics are used to measure scientific activities, mainly by producing statistics on scientific publications indexed in databases. They are flexible tools used to study the sociological phenomena associated with scientific communities, to conduct scientific/strategic, technical, technological or competitive monitoring, to design and manage research programs and to evaluate research. They are extremely valuable methods for evaluating research output, positioning studies and conducting foresight studies in science and technology. Scientometric tools could be used to measure and compare the scientific activities at various levels of aggregation including institutions, sectors, provinces and countries. They could also be used to measure research collaborations, to map scientific networks and to monitor the evolution of scientific fields. Scientometric indicators give policy-makers objective, reproducible and therefore verifiable information that goes beyond the anecdotal.

India continued to import thousands of tonnes of uranium from Russia, Kazakhstan, France, and Uzbekistan. The recent Indo-US Nuclear Deal and the NSG waiver, which ended more than three decades of international isolation of the Indian civil nuclear programme, have created many hitherto unexplored alternatives for the success of the three-stage nuclear power programme.

There is a much wider array of designs in use for research reactors than for power reactors, where 80% of the world's plants are of just two similar types. They also have different operating modes, producing energy which may be steady or pulsed.

VI. Bhabha Atomic Research Cneter

In November 1954, Bhabha presented the three-stage plan for national development, at the conference on "Development of Atomic Energy for Peaceful Purposes" which was also attended by India's first Prime Minister Jawaharlal Nehru. Four years later in 1958, the Indian government formally adopted the three-stage plan. Indian energy resource base was estimated to be capable of yielding a total electric power output of the order shown in the table below. Indian government recognised that thorium was a source that could provide power to the Indian people for the long term.

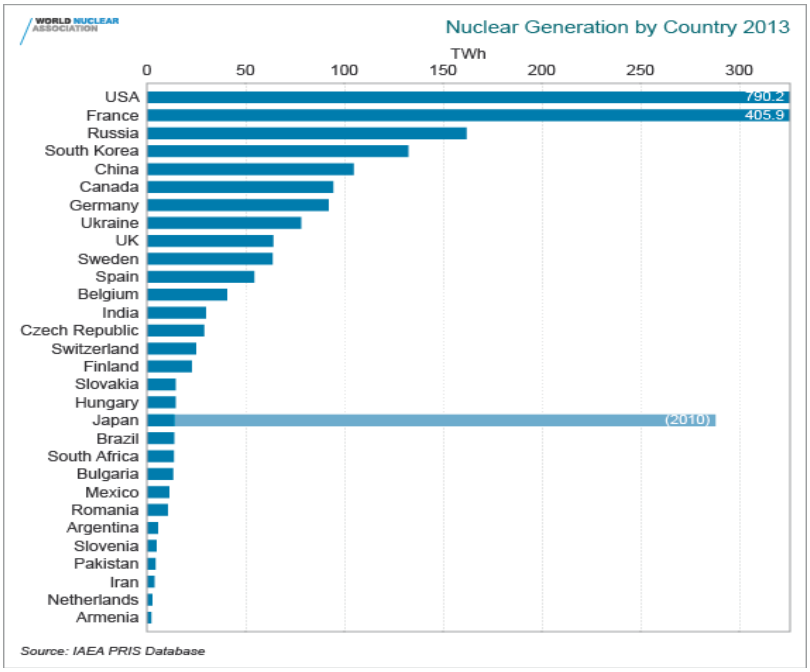
Energy resource type	Amount (tonnes)	Power potential (TWe-year)
Coal	54 billion	11
Hydrocarbons	12 billion	6
Uranium (in PHWR)	61,000	0.3–0.42
Uranium (in FBR)	61,000	16–54
Thorium	~300,000	155–168 or 358[23][25]

A common design (67 units) is the pool type reactor, where the core is a cluster of fuel elements sitting in a large pool of water. Tank type research reactors (32 units) are similar, except that cooling is more active.

The TRIGA reactor is another common design (40 units). This kind of reactor can safely be pulsed to very high power levels (e.g. 25,000 MW) for fractions of a second. Its fuel gives the TRIGA a very strong negative temperature coefficient, and the rapid increase in power is quickly cut short by a negative reactivity effect of the hydride moderator.

Other designs are moderated by heavy water (12 units) or graphite. A few are fast reactors, which require no moderator and can use a mixture of uranium and plutonium as fuel. Homogenous type reactors have a core comprising a solution of uranium salts as a liquid, contained in a tank about 300 mm diameter. The simple design made them popular early on, but only a few are now operating, and all except two of those (20 kW) are very low power.

Nuclear Power Plant At Global Level:



In 2014, India and Australia signed a civil nuclear agreement which allows the export of uranium to India. This was signed in New Delhi during Australian Prime Minister Tony Abbott's meeting with the Indian Prime Minister Narendra Modi on 4 September 2014. Australia is the third largest producer of uranium in the world. The agreement allows supply of uranium for peaceful generation of power for civil use in India.

Research reactors have a wide range of uses, including analysis and testing of materials, and production of radioisotopes. Their capabilities are applied in many fields, within the nuclear industry as well as in fusion research, environmental science, advanced materials development, drug design and nuclear medicine.

VII. Nuclear Power Growth In India

India now envisages to increase the contribution of nuclear power to overall electricity generation capacity from 2.8% to 9% within 25 years. By 2020, India's installed nuclear power generation capacity will increase to 20 GW. As of 2009, India stands 9th in the world in terms of number of operational nuclear power reactors. Indigenous atomic reactors include TAPS-3, and -4, both of which are 540 MW reactors. India's US$717 million fast breeder reactor.

VIII. Analysis of the Scientometric Study and its View

The investigation is a Scientometric analysis of research productivity in Nuclear Research and a sum total of 14573 records were obtained from the Web of Science for 11 calendar years spanning from 2004 to 2014. The study gives an analytical view of the research literature output in Nuclear Research from the global scenario by area, language and forms of publications, core journals and prolific authors.

- ✓ To know the general growth pattern of research literature in Nuclear Research.
- ✓ To know the thrust areas of research in Nuclear Research at a global level.
- ✓ To identify countries / geographical regions participating and contributing to research in the area of Nuclear Research.
- ✓ To know the author pattern and publishing pattern of research.
- ✓ To assess the existing collaboration level.
- ✓ To assess the institution-wise research in Nuclear Research at global levels.
- ✓ To identify the journal-wise distribution of Nuclear Research output.
- ✓ To examine the relevance of Bibliometric Laws.
- ✓ To suggest a rational strategy for Nuclear Research development in the basis of findings of the study.

IX. Year Wise Distribution of Nuclear Research Productivity During 2004 to 2014

S. No	Year	Records	%	TLCS	%	TGCS	%
1	2004	791	5.43	476	8.98	25741	10.70
2	2005	916	6.29	682	12.86	31703	13.18
3	2006	963	6.61	658	12.41	25808	10.73
4	2007	1042	7.15	642	12.11	30621	12.73
5	2008	1165	7.99	706	13.32	29486	12.26
6	2009	1321	9.06	606	11.43	19063	7.93
7	2010	1433	9.83	541	10.20	25419	10.57
8	2011	1653	11.34	473	8.92	22506	9.36
9	2012	1623	11.14	272	5.13	15117	6.28
10	2013	1754	12.04	193	3.64	10884	4.52
11	2014	1912	13.12	53	1.00	4194	1.74
	Total	**14573**	**100.00**	**5302**	**100.00**	**240542**	**100.00**

Year wise distribution of the nuclear research at global level found gradual growth over the years. It could revealed that the growth particularly from 2007 have got more than 1000 publications covered by the source database. The year 2014 registered highest number of publications as 1912, which is followed by 2013 (1754 publications). It is also interesting to note that the numbers of increase of publications are related as to the reverse chronological order during the period.

Major Findings

It is found that the year wise distribution of the nuclear research at global level found gradual growth over the years of study. It could revealed that the growth particularly from 2007 have got more than 1000 publications covered by the source database. The year 2014 registered highest number of publications as 1912, which is followed by 2013 (1754 publications). It is also interesting to note that the numbers of increase of publications are related as to the reverse chronological order during the study period. The citation scores achieved by the nuclear research publication is noteworthy as an evidence to the significant importance of nuclear research as years 2004 to 2008, 2010 and 2011 have got more than 20000 global citation scores. The year 2005 has got maximum number of global citation score as 31703.

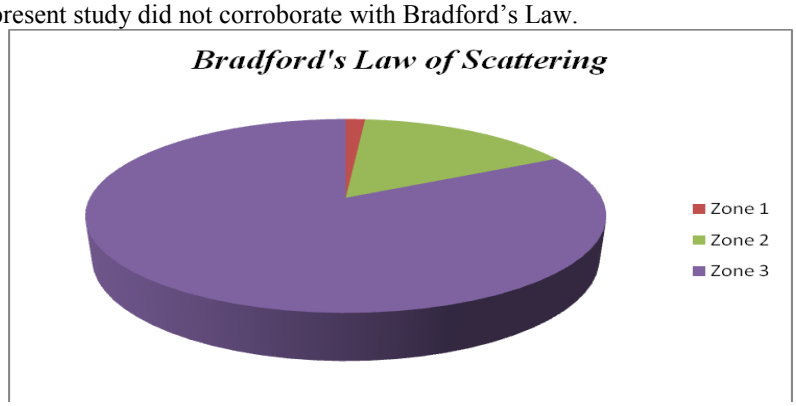
X. Bradford's Law of Scattering

S. No	Zone	No. of Journals
1.	Zone 1	56
2.	Zone 2	628
3.	Zone 3	3217

Bradford's formula is applied to the publication counts in nuclear research, sorting them out in a Journals based productivity zones. The total number of journals figured in the present study was 3901, which were ranked in a descending order of their publication counts (productivity).

The set of 56 journals in the first zone had produced 4902 records. Based on the strength of the first zone, the second and third zones were arrived at by counting the number of journals that had produced nearly 4862 and 4809 records. Here the categorization of three zones resulted in a ratio 56:628:3217 which is not

equal to 1:5:25. The resulting factor is not in conformity to the Bradford's formula i.e., $1:n:n^2$. Hence the inference is that the present study did not corroborate with Bradford's Law.



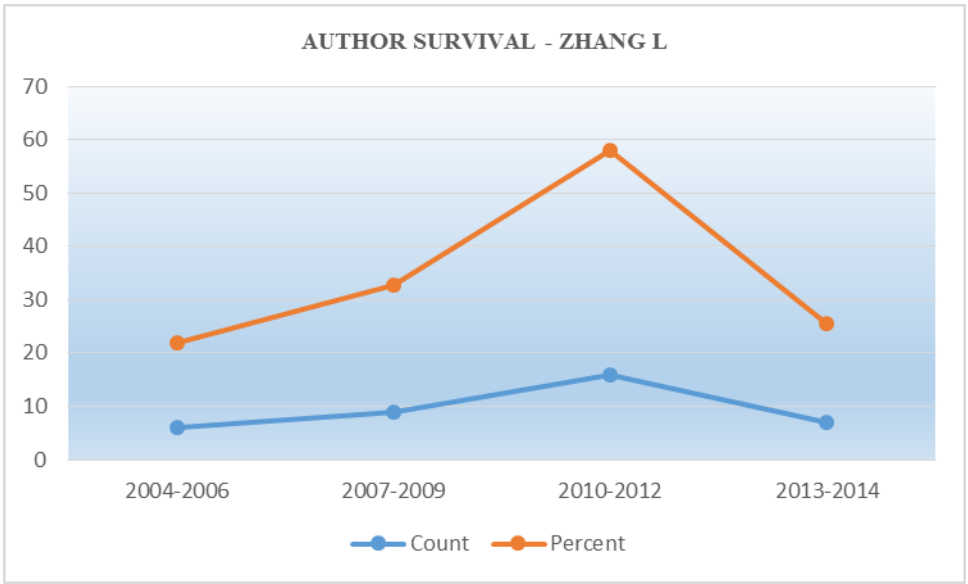
XI. Single Authorship Vs. Co-Authorship

The category of single authors has not become extinct though predictions have been there long since for its peril. But it remains a fact that, between single authored and co-authored publication counts, the performance of the latter supersedes the former in quality and quantity as expressed in many scientometric and bibliometric analysis.

XII. Author Survival – ZHANG L

The top ranking authors (53925) with higher productivity were ranked each according to their publication count. From the above table, it is found that Zhang L and Zhang Y is found to be the most prolific author among the contributors. Second in the rank was Li J (37), followed by Wang Y (37) and Chen J (34). The author, that Zhang L and Zhang Y had higher frequency of incidence of both his name in the author field of records numbering 38 with the Zhang L total local citation score was 7 and the total global citation score was 590 followed by the Zhang Y total local citation score was 12 and the total global citation score was 492.

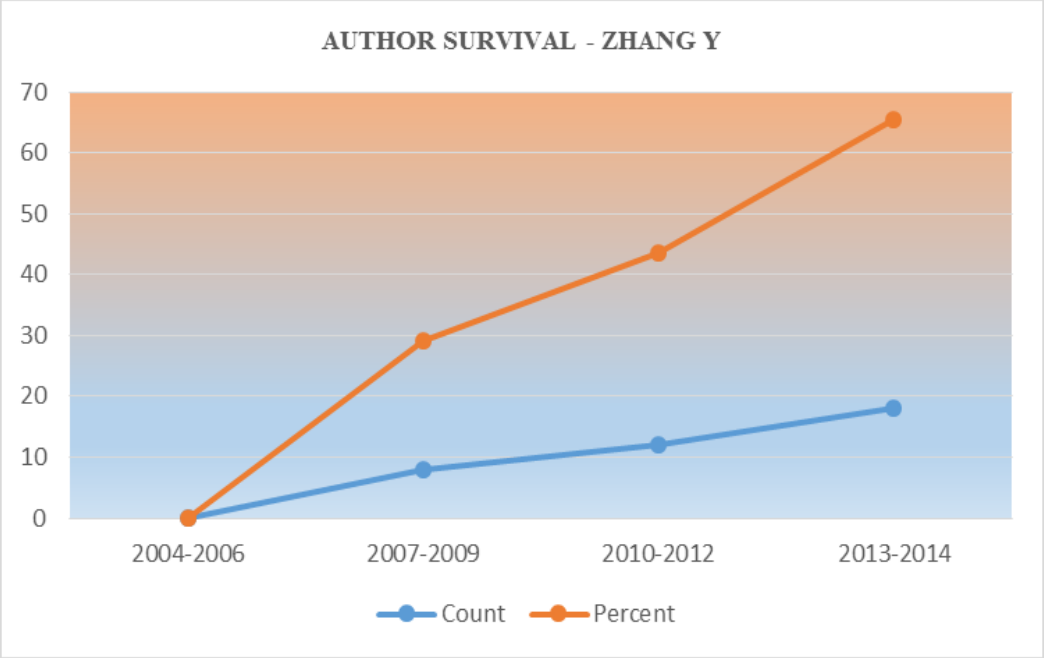
S.No	Year	Count	Percent
1.	2004-2006	6	15.79
2.	2007-2009	9	23.68
3.	2010-2012	16	42.11
4.	2013-2014	7	18.42
	Total	**38**	**100.00**



From the graph displaying the productivity of Zhang L, the maximum (16) output 42.11 percent was found in 2010-2012 while the author disappeared after 2013. It may be concluded that the author Zhang L, as per the present study was a 'terminator.'

XIII. Author Survival – ZHANG Y

S. No	Year	Count	Percent
1.	2004-2006	00	00.00
2.	2007-2009	08	21.05
3.	2010-2012	12	31.58
4.	2013-2014	18	47.37
	Total	**38**	**100.00**



The inference drawn from the graph depicting the research productivity of Newton, Zhang Y is that the author was a continuant. He maintained a continuation of publications throughout the period of 2007-2009. The maximum output was found in the year 2014. It may be concluded that the author survival is continuous and positive despite fluctuations in the distribution frequency of publications.

XIV. Conclusion

This article narrates the present trend in Nuclear Research all over the world. The developed nations are guiding the still developing nations. The year wise analysis of nuclear research shows the present position of Nuclear Research. By producing the article related to the nuclear research, India is in 9 positions. The single authors are dominating the respective over see the double authors in this article. In the past ten years from 2004 to 2014 the nuclear research articles was recorded as 14573. The main theme of the article shows and encourages the authors to contribute more research papers in the nuclear research.

Reference:

[1]. Bucher, R.G. (January 2009), India's Baseline Plan for Nuclear Energy self-sufficiency stage (pdf), Argonne National Laboratory, retrieved 26 March 2012, p. 1.
[2]. Jayaram, K.M.V., An Overview of World Thorium Resources, Incentives for Further Exploration and Forecasts for Thorium Requirements in the Near Future (pdf), Hyderabad: IAEA, retrieved 26 March 2012, pp. 1, 16–17.
[3]. Ferguson, Charles D. (1 March 2007), "Assessing the Vulnerability of the Indian Civil Nuclear Programme to Military and Terrorist Attack", in Henry D. Sokolski, Gauging U.S.-India Strategic Cooperation, Army War College (U.S.). Strategic Studies Institute, ISBN 1-58487-284-5, p. 135.
[4]. Tellis, Ashley J. (2006), Atoms for War? U.S.-Indian Civil Nuclear Cooperation and India's Nuclear Arsenal (pdf), Carnegie Endowment for International Peace, retrieved 7 April 2012, pp. 41–42.
[5]. "India widens N-fuel base, signs up Uzbek firm for uranium supplies". Indian Express. 27 August 2014. Retrieved 1 September 2014.
[6]. Tellis, Ashley J. (2006), Atoms for War? U.S.-Indian Civil Nuclear Cooperation and India's Nuclear Arsenal (pdf), Carnegie Endowment for International Peace, retrieved 7 April 2012, pp. 50-51.
[7]. Venkataraman, Ganesan (1994), Bhabha and His Magnificent Obsessions, Universities Press (India) Ltd., ISBN 81-7371-007-4, p. 157.
[8]. Ramana, M.V. (1 March 2007), "Nuclear Power in India: Failed Past, Dubious Future", in Henry D. Sokolski, Gauging U.S.-India Strategic Cooperation, Army War College (U.S.). Strategic Studies Institute, ISBN 1-58487-284-5, p.77.
[9]. Tongia, Rahul; Arunachalam, V.S. (15 December 1997), "India's Nuclear Breeders: Technology, Viability and Options" (pdf), 75(6), pp. 549-558 (Pittsburgh: Current).
[10]. Jain, S.K., Nuclear Power – An alternative (pdf), NPCIL, retrieved 4 March 2012, p. 2.
[11]. Woddi, Taraknath V.K.; Charlton, William S.; Nelson, Paul (September 2009), India's nuclear fuel cycle: Unraveling the impact of the US-India nuclear accord, Synthesis Lectures on Nuclear Technology and Society, Morgan & Claypool Publishers, ISBN 978-1-59829-984-7, isbn#2:9781598299854, pp. 8.
[12]. IAEA, Research Reactors database.
[13]. IAEA, Nuclear Research Reactors in the World, reference data series #3, Sept 2000.
[14]. Research Reactors: an overview, by Colin West, ANS Nuclear News, Oct 1997.
[15]. IAEA, Research Reactor Facility Characteristics, 1985.
[16]. Research reactors under threat, by W.Krull, Nucl.Eng.Intl. Oct 2000.